This document is a preliminary draft of the Regional Energy Strategy (RES) Update. The final draft will incorporate comments received in the public review process and include an Executive Summary.

Comments on this document should be provided to Susan Freedman, staff, at sfr@sandag.org by August 21, 2009.

SAN DIEGO ASSOCIATION OF GOVERNMENTS

July 31, 2009
PRELIMINARY DRAFT REGIONAL ENERGY STRATEGY UPDATE

INTRODUCTION

San Diego has a long history of regional energy planning. SANDAG adopted its first regional energy strategy in 1979, with subsequent strategies adopted in 1984, 1994, and 2003. Concurrent with adoption of Regional Energy Strategy 2030 in 2003, the SANDAG Board of Directors established the Regional Energy Working Group to provide input to the SANDAG Regional Planning Committee and Board on coordination and implementation of the 2003 RES.

The 2003 RES focused primarily on electricity and natural gas supply and demand issues, including resource choices and energy efficiency. Serving as the energy policy blueprint for the region, similar to the state’s Integrated Energy Policy Report, the 2003 RES has 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 (SDG&E), obtain funding, and implement SANDAG’s Sustainable Region Program.

THE NEED FOR AN UPDATE

Since adoption of the 2003 RES, significant energy policy changes have occurred from the state to the international level. SANDAG’s decision to prepare the RES Update is based on the major policy changes related to global climate change and California’s preferred loading order.

Global Climate Change

Global climate change has emerged as the defining challenge of the 21st century, with the Intergovernmental Panel on Climate Change (IPCC) reporting that greenhouse gas (GHG) emissions from human activities have begun to destabilize the Earth’s climate. The Intergovernmental Panel on Climate Change is the leading international scientific body for the assessment of climate change, established by the United Nations Environment Program (UNEP) and the World Meteorological Organization (WMO) to provide the world with a clear scientific view on the current state of climate change and its potential environmental and socio-economic consequences. The changing climate threatens the public health, economy, and environment of the San Diego region, California, and the entire world. Projected adverse climate change impacts to the San Diego region include hotter temperatures, sea level rise, water shortages, more frequent and intense wildfires, increased risks to public health, loss of native plant and animal species, and increased demand for electricity.

California has responded to the challenge of climate change in many ways, including passage of the California Global Warming Solutions Act of 2006 (Assembly Bill 32, Statutes of 2006). Among other things, this legislation establishes the 1990 emissions level as the statewide limit for 2020; an approximately 15 percent reduction from the current level. Moreover, Executive Order S-3-05 establishes a long-term climate goal for the state of reducing emissions an additional 80 percent below the 1990 level by 2050. The types of energy sources, and how much they are used, are the primary contributors to climate change in the San Diego region. As shown in Table 1, 91 percent of all GHG emissions are related to energy.

<table>
<thead>
<tr>
<th>Intergovernmental Panel on Climate Change Category</th>
<th>Percentage of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>91%</td>
</tr>
<tr>
<td>Industrial (non-fuel)</td>
<td>5%</td>
</tr>
<tr>
<td>Waste</td>
<td>2%</td>
</tr>
<tr>
<td>Agriculture, Forestry, Land Use</td>
<td>2%</td>
</tr>
</tbody>
</table>

Source: Energy Policy Initiatives Center, University of San Diego, 2008.

Although many activities consume energy, most of the region’s energy consumption and related GHG emissions is due to 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. As shown in Figure 1, nearly half of the region’s 34.5 million metric tons of carbon dioxide equivalent (MMTCO₂e) emissions (47 percent) are the result of transportation fuel consumption (i.e., passenger cars, light-duty trucks, heavy-duty
vehicles), with the vast majority of transportation fuel-related emissions (89 percent) generated by personal transportation in automobiles (i.e., passenger cars and light-duty trucks).

Figure 1: Summary of Greenhouse Gas Emissions by End-Use Category

The level of GHG emissions from on-road transportation is due to the region’s near total 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 calling for petroleum reduction, development of low-carbon and alternative fuels, increased vehicle efficiency, and improved land use and transportation planning. Due to concern for climate protection and in line with the state’s policy framework, the RES Update focuses on reducing GHG emissions from transportation fuel consumption by transitioning the region away from petroleum-based fuels and reducing automobile dependence through improved land use and transportation planning.

Table 2: Electricity Resource Mix

<table>
<thead>
<tr>
<th>Resource</th>
<th>CA</th>
<th>SDG&amp;E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>16%</td>
<td>18%</td>
</tr>
<tr>
<td>Large Hydro (&gt;30 MW)</td>
<td>19%</td>
<td>10%</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>41%</td>
<td>49%</td>
</tr>
<tr>
<td>Nuclear</td>
<td>13%</td>
<td>15%</td>
</tr>
<tr>
<td>Renewables</td>
<td>11%</td>
<td>8%</td>
</tr>
<tr>
<td>Total Mix:</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Sources of Renewables

<table>
<thead>
<tr>
<th>Resource</th>
<th>CA</th>
<th>SDG&amp;E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomass</td>
<td>19%</td>
<td>38%</td>
</tr>
<tr>
<td>Geothermal</td>
<td>43%</td>
<td>25%</td>
</tr>
<tr>
<td>Small Hydro (&lt;30 MW)</td>
<td>19%</td>
<td>6%</td>
</tr>
<tr>
<td>Solar</td>
<td>2%</td>
<td>6%</td>
</tr>
<tr>
<td>Wind</td>
<td>17%</td>
<td>25%</td>
</tr>
<tr>
<td>Total Renewables</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>


Electricity and natural gas-end uses account for about one-third (33 percent) of GHG emissions in the region. The level of GHG emissions from electricity generation and natural gas end-uses is explained by the region’s reliance on natural gas and out-of-state coal for about two-thirds (67 percent) of the electricity mix, and total amount of energy demand, including peak demand. Older and relatively inefficient natural gas power plants, buildings, and end-use equipment also contribute to the level of emissions from electricity and natural gas. Resources comprising the electricity mix for the State of California and SDG&E are provided in Table 2.

Although many of the goals and actions identified in the RES Update will have beneficial impacts on the region’s GHG emissions, energy and climate change are not synonymous issues. As a result, SANDAG is also preparing a Regional Climate Action Plan to accompany the RES Update. These highly related plans will complement each other, with cross references provided where applicable.

The Preferred Loading Order

After adoption of the 2003 RES, California adopted a preferred loading order to meet increasing demand for electricity. The loading order consists of decreasing electricity demand by increasing energy efficiency and demand response, and meeting new generation needs first with renewable and distributed generation resources, and
second with clean fossil-fueled generation. Regional implementation of the loading order is a major focus of the RES Update.

Figure 2: The Preferred Loading Order

Among the loading order preferred resources, “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. “Demand response” includes new rate designs, which provide customers lower electricity prices during most hours in exchange for higher prices during the peak hours when supply reserves are small and electricity typically costs more, and programs that provide incentives for on-peak load reductions. “Renewable resources” include forms of electricity generation that naturally replenish themselves, including energy from wind, solar, small hydroelectric, geothermal, and biomass. “Distributed generation” is electricity that is produced by the customer or utility who will use some or all of it locally. Examples include small fuel cells, rooftop photovoltaic solar systems, or cogeneration systems that simultaneously produce electricity and heat or steam for on-site use.

**BENEFITS OF A REGIONAL ENERGY STRATEGY**

The Regional Energy Strategy establishes a framework to guide a long-term energy strategy for the region. Benefits of developing a regional energy plan 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 the co-benefits of energy policies such as improved air quality, public health, job creation, and financial savings.

**THE REGIONAL ENERGY STRATEGY UPDATE**

The RES Update is a policy document written for regional and local decision-makers – an audience that can influence and implement changes in the region that impact our energy use. The RES Update does not make recommendations on specific energy projects (e.g. power plants or transmission lines); it does assess regional need for various kinds of energy resources and infrastructure. The RES Update also does not replace San Diego Gas and Electric’s long term procurement plan, which the utility is required to develop for the California Public Utilities Commission. SDG&E’s plan is written within constraints regulated by the CPUC and focuses on providing adequate supply for the next ten years. The RES Update provides a vision out to 2030 that can inform decisions made by SDG&E and the CPUC for the procurement plan.
2030 Vision

By formulating a regional energy vision, establishing goals and policies to manifest that vision, and representing the vision in legislative, regulatory, and market-based planning activities, a regional energy plan can guide energy supply and demand choices influenced by regional and local governments. A regional energy plan not only can influence local choices but also provide a regional perspective to state and federal efforts. Stakeholder and public involvement have been integral to development of the Regional Energy Strategy vision for 2030:

REGIONAL ENERGY STRATEGY VISION FOR 2030:

- Energy Needs Are Met Sustainably
- Lower Greenhouse Gas Emissions
- High Levels of Education and Consensus
- A Robust Clean Energy Sector
- Improved Social Equity and Environmental Justice
- Electricity Resources are Cost-Effective and Sustainable
- A Modernized Electricity Grid
- Existing Buildings are Highly Efficient
- Energy Efficiency Promotes Lower Renewable Energy System Costs
- New Buildings Achieve Zero Net Energy Status
- Communities are Designed to Lower Energy Consumption
- Infrastructure is Widely Deployed to Support Alternative Fuels and Vehicles

Connection to the Regional Comprehensive Plan

SANDAG’s Regional Comprehensive Plan (RCP) integrates the array of local and regional plans in land use, transportation and supporting infrastructure that maintain 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.

Regional Comprehensive Plan Vision:

To preserve and enhance the San Diego region’s unique features – its vibrant and culturally-diverse communities, its beaches, deserts, mountains, 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 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 Regional Energy Strategy, its vision, guiding principles and goals, all fit within the larger regional vision adopted in the Regional Comprehensive Plan.
Goals and Recommended Actions

The following sections of the RES Update put forth goals and recommended actions in twelve topics areas to implement the regional vision. Online technical chapters will provide further detail for each topic area and be available on the SANDAG website.

<table>
<thead>
<tr>
<th>REGIONAL ENERGY STRATEGY UPDATE TOPIC AREAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Energy Efficiency and Conservation</td>
</tr>
<tr>
<td>2. Renewable Energy</td>
</tr>
<tr>
<td>3. Distributed Generation</td>
</tr>
<tr>
<td>4. Energy and Water</td>
</tr>
<tr>
<td>5. Peak Demand</td>
</tr>
<tr>
<td>6. The Smart Grid</td>
</tr>
<tr>
<td>7. Natural Gas</td>
</tr>
<tr>
<td>8. Transportation Fuels</td>
</tr>
<tr>
<td>9. Land Use and Transportation Planning</td>
</tr>
<tr>
<td>10. Border Energy</td>
</tr>
<tr>
<td>11. Clean Energy Economy</td>
</tr>
<tr>
<td>12. Energy and Climate Change</td>
</tr>
</tbody>
</table>
1 - ENERGY EFFICIENCY AND CONSERVATION

Goal: Through conservation and energy efficiency, achieve a 20% reduction in per capita electricity consumption by 2030 in order to keep total regional electricity consumption flat.

<table>
<thead>
<tr>
<th>Measures</th>
<th>2030 Reductions (2007 baseline)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased utility energy efficiency program funding</td>
<td>675 GWh</td>
</tr>
<tr>
<td>Comprehensive residential building retrofit program</td>
<td>1482 GWh</td>
</tr>
<tr>
<td>Comprehensive commercial building retrofit program</td>
<td>572 GWh</td>
</tr>
<tr>
<td>New construction building standards (post-2009 updates)</td>
<td>260 GWh</td>
</tr>
<tr>
<td>Appliance standards (post-2009 updates)</td>
<td>447 GWh</td>
</tr>
<tr>
<td>Total electricity reduction from above Energy Efficiency Measures</td>
<td>3438 GWh</td>
</tr>
<tr>
<td>Reduction in total electricity consumption due to energy efficiency</td>
<td>22 GWh</td>
</tr>
<tr>
<td>Reduction in per capita electricity consumption due to energy efficiency</td>
<td>n/a</td>
</tr>
</tbody>
</table>

Table 3: Regional Electricity Savings Targets for Energy Efficiency

Source: California Center for Sustainable Energy, 2009.

The Regional Energy Strategy uses the California Energy Commission’s June 2009 electricity consumption forecast for its targets and analysis. SDG&E also relies on the Energy Commission’s forecast for its resource planning. The chart below depicts regional consumption if current trends continue. The region’s total electricity consumption from 2007 (18,648 GWh) is expected to increase by about 10% in 2020 (to 20,555 GWh) and 21% in 2030 (to 22,647 GWh). This increase is after accounting for an existing level of funding continuing for energy efficiency programs, and reductions from existing efficiency standards for buildings and appliances. The 2009 forecast is actually about 10% lower than what was forecast two years earlier and is attributed primarily to the worsening statewide economy. Even though the forecast is lower, it does not change the region’s need take additional actions to slow and flatten expected growth in total electricity consumption.

Figure 3: San Diego County Business as Usual Electricity Forecast 2010-2030 (with measures and impacts shown)

Source: California Center for Sustainable Energy, 2009.

As the current trend of total regional electricity consumption continues to grow, per capita consumption is projected to remain flat through 2030. 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 reason for overall growth is that San Diego County’s population is expected to grow by one million people between now and 2030. Therefore, the region will need to have sufficient energy to accommodate its future growth. The cheapest and most effective way to provide for increased population growth is through energy efficiency and conservation. If efficiency measures above and beyond what already exist today
do not occur, the region’s total electricity consumption will continue to grow and additional electricity sources will need to be financed and built.

California requires utilities to follow a “preferred loading order” when seeking additional electricity supplies. Under this law, utilities must seek new electricity resources first through conservation and energy efficiency, and then demand response programs, followed by renewable energy and clean distributed generation, and finally conventional fossil-fuel based generation. This is depicted in the graphic on the right, which identifies the highest priority and most-used resources at the base of the pyramid and the last choice resources at the top of the pyramid.

Keeping total electricity consumption flat will require increased energy conservation and efficiency efforts. Energy conservation is associated with changes in behavior, such as turning off lights and changing thermostat settings, that decrease the quantity of energy used. Energy efficiency refers to structural changes, such as replacing appliances with more efficient versions, changing incandescent lamps for 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.

![Figure 4: San Diego County Projected Impacts of Energy Efficiency Measures 2010-2030 (above and beyond business as usual)](image)

Source: California Center for Sustainable Energy, 2009.

Existing residential and commercial buildings use the most electricity in the San Diego region, as depicted in the chart below. Conservation and efficiency targeting existing buildings will provide the greatest electricity savings for the San Diego region. In addition to reducing utility bills, demand on the electricity grid, and associated greenhouse gases; energy efficiency is known to increase comfort and durability of structures and reduce waste and pollution. California energy codes (Title 24) were established in 1982 and are regularly updated as relevant cost-effective improvements become available. Energy codes are enforced by local governments at the time of construction. In general, efficiency upgrades are not required afterward; therefore the improvements included in subsequent energy codes are not captured by existing buildings. Continuing training and education for building officials and building industry workers on Title 24 updates will increase understanding and enforcement of the building energy codes.
Numerous energy efficiency programs exist for homes and businesses, but they generally address singular components of a building. Longer-term and larger energy savings can be achieved through more comprehensive or holistic programs that take an integrated approach to each building, evaluating its specific condition and prioritizing the most attractive measures together in a package. Types of measures can include lighting, insulation, space and water heating, space cooling, ductwork, weatherization, electronics, appliances, swimming pools and spas. Such a performance-based approach enables the building owner to make a well-informed decision. Program efforts will have the greatest impact, and will achieve greater benefits for the customer and region, when efficiency options are presented to the consumer in a coherent and integrated form, and combined with the proper education.

San Diego regional natural gas consumption is expected to grow to 660 MMTh in 2020 and 730 MMTh in 2030 as shown below. As demand for natural gas continues to grow in the region, coupled with volatile prices, priority must be made to utilizing natural gas in the most energy efficient manner and where applicable and cost-effective, replacing it with a renewable fuel.

Within buildings, lighting usually comprises the largest portion of electricity usage, roughly 20-25% of the total. In homes located in hot climates such as inland San Diego, air conditioning is likely to be the largest single energy user. Central, wall-unit, and so-called “split” air-conditioning systems sold today can use significantly less energy than older systems. “Plug loads” collectively account for around 25% of overall household energy use in California—and 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 largely unaware that they are paying higher electricity bills to cover this “phantom” usage, also called “standby” power. Some estimates show standby power to be as much as 10% of a newer home’s electric consumption.

State and federal governments work with manufacturers 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. State and regional per-capita consumption have been able to remain relatively flat, while many more electronic devices are in homes and buildings, due to technological improvements through standards and consumer action to purchase more energy-efficient products.
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. There is a significant lack of trained HERS raters in the San Diego region and this void will need to be filled.

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

Once an energy audit is completed and conservation opportunities identified, additional help is needed for building and home owners to cover associated 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 bill financing, property-assessed financing, energy-efficient mortgages, 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 the building retrofits necessary to reduce per capita electricity consumption and keep the region’s total electricity consumption flat.

Recommended Actions:

- Promote energy efficiency and conservation as the easiest and cheapest methods to reduce energy use and associated greenhouse gas emissions.
- Promote energy conservation within local governments and to the region’s residents, businesses, and schools.
- Support a comprehensive energy efficiency program that targets existing residential and commercial buildings.
- Identify and support financing mechanisms that can enable more building owners to undertake energy audits and retrofits.
- Develop and provide regionally-consistent consumer information on plug loads, air-conditioner replacement, energy audits, and finance measures that all local governments can use online, at events, permit desks, and other outreach mechanisms.
- Prioritize comprehensive energy efficiency measures that use electricity and natural gas more efficiently and target sectors with largest energy-saving potential.
- Support and promote targeted air-conditioning tune up and replacement program.
- Support local workforce training and education on HERS rating and whole-building improvements.
- Support state building and appliance standard improvements that reduce energy consumption.
- Support training and education to building officials and associated building trades on energy codes.
2 - RENEWABLE ENERGY

**Goal:** Increase renewable energy supply that provides cleaner fuel options big and small.

<table>
<thead>
<tr>
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<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>San Diego Regional Peak Demand in megawatts</td>
<td>2,695</td>
<td>3,159</td>
<td>4,244</td>
<td>4,205</td>
<td>4,677</td>
<td>5,203</td>
</tr>
<tr>
<td>RES 2030 targets from 2003</td>
<td>&lt;1%</td>
<td>&lt;1%</td>
<td>5.2%</td>
<td>15%</td>
<td>25%</td>
<td>40%</td>
</tr>
<tr>
<td>(actual)</td>
<td>(actual)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RES Update Targets</td>
<td>20%</td>
<td>33%</td>
<td>45%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Megawatt equivalents for RES Update Targets</td>
<td>841 MW</td>
<td>1,543 MW</td>
<td>2,341 MW</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The renewable energy targets developed for the 2003 strategy were considered very aggressive at the time. Since then, state laws and policies have called for even more aggressive targets. The RES Update reflects these changes. State law requires each investor owned utility to obtain 20 percent of its electricity supply from renewable resources. California’s adopted Climate Change Scoping Plan (December 2008) calls for California to obtain 33 percent of its electricity from renewable resources by 2020. In November 2008, Governor Schwarzenegger signed Executive Order S-14-08 directing all state agencies to work toward achieving 33 percent by 2020. San Diego Gas and Electric and the lead state energy agencies, the California Energy Commission and California Public Utilities Commission (CPUC) have made commitments to meet the 33 percent target. The RES Update’s 2030 target is increased to 45% to reflect a little more than one percent supply increase each year between 2020 and 2030.

**Statewide Renewables Mix 2006***

- Wind 17%
- Biomass 19%
- Solar 2%
- Small Hydro 19%
- Geothermal 43%

**SDG&E Renewables Mix 2006***

- Wind 25%
- Biomass 38%
- Solar 6%
- Small Hydro 6%
- Geothermal 25%

*2006 is the most recent year for which data is available.

The more that renewable energy resources become part of our electricity supply, the less greenhouse gas emissions are produced from electricity consumption. A greater renewable energy supply also will have a positive impact on the transportation sector as more “plug-in” electric vehicles are utilized in the region. Electricity as a transportation fuel provides an alternative to petroleum and creates zero emissions at the tailpipe.

Renewable energy resources are energy resources that are naturally replenishing but flow-limited. They are virtually inexhaustible in duration but limited in the amount of energy that is available per unit of time, e.g. rooftop solar panels that generate power when the sun is out but not at night and wind farms that generate power depending on when the wind is blowing. Since this “intermittent” supply cannot be produced all day every day, “dispatchable” power supplies, e.g. natural gas, nuclear and geothermal, are relied upon in the San Diego region. These supplies can be called on to operate at full capacity at virtually any time they are needed.

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 photovoltaic, concentrated solar power, and solar thermal)
- Geothermal (systems using heat from 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)
- Onshore wave power (built along shorelines, systems extract energy in breaking waves)

In order to reach regional and state 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 megawatts 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 seek permits from a federal agency since many of the best solar, wind, and geothermal sites are on federal land. In recent years, permitting entities have been inundated with applications for new renewable facilities, causing project delays. In November 2008, Governor Schwarzenegger issued Executive Order S-14-08 to remove red tape surrounding permitting for renewable projects. To streamline the application process, the Energy Commission and Department of Fish and Game have created a “one-stop” permitting process in order to reduce application process times by half.

The CPUC requirement for utilities to acquire renewable energy supply is called the “renewable portfolio standard” (RPS). Not all of the region’s renewable energy resources are counted in the RPS. For example, residential and most commercial rooftop solar PV cannot be counted toward the state RPS requirement. The RES Update promotes renewable energy regardless of its purpose or size; therefore, the Renewable Energy Goal recognizes and accounts for all renewable resources providing electricity for the San Diego region.

Some smaller renewable energy systems (up to 1.5 megawatts) are able to be counted toward the RPS due to a “feed-in-tariff” that the CPUC adopted in February 2008 in response to Assembly Bill 1969. The law was enacted to support deployment of renewable resources specifically on publicly owned water and wastewater treatment facilities. The CPUC established the feed-in tariffs but expanded them to non-water and non-wastewater facilities for only Southern California Edison and PG&E territories. The expansion of this type of tariff to the San Diego region could be another mechanism to incentivize greater deployment of renewable resources. This topic is further addressed in the RES Update Distributed Generation Goal.

 Tradable renewable energy credits (RECs) are an emerging benefit to renewable energy resources. The state currently is establishing a trading program in which owners of the environmental attributes, or REC, can sell this attribute to entities that must reduce their greenhouse gas emissions. In California, a REC represents one megawatt-hour of renewable energy that was generated and delivered by an eligible renewable energy resource.

The CPUC, Energy Commission and other agencies are conducting financial analyses to learn the cost and benefit impacts of meeting the state’s needed 33 percent renewable energy target by 2020. Initial CPUC analysis shows that electricity costs will increase in 2020, regardless of renewable resource requirements. For the analysis, they assessed the cost of procuring all natural gas between now and 2020, which was comparable to the cost of procuring 20 percent renewable resources. The electricity cost to achieve a 33 percent renewable mix is estimated at about 7 percent higher as of June 2009. See Table below. At the printing of this document, analysis was in its preliminary stages.
### Electricity Costs to Increase in 2020, Regardless of Renewable Resource Requirements

<table>
<thead>
<tr>
<th></th>
<th>2008</th>
<th>All-Gas Scenario in 2020</th>
<th>20% RPS Reference Case in 2020</th>
<th>33% RPS Reference Case in 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Statewide Electricity Expenditures</td>
<td>$36.8 billion</td>
<td>$49.2 billion</td>
<td>$50.6 billion</td>
<td>$54.2 billion</td>
</tr>
<tr>
<td>Average Statewide Electricity Cost</td>
<td>$0.132 per kWh</td>
<td>$0.154 per kWh</td>
<td>$0.158 per kWh</td>
<td>$0.169 per kWh</td>
</tr>
</tbody>
</table>

Source: CPUC/E3

The all-gas scenario may grow more costly with passage of federal climate change laws. A greater demand for natural gas will occur from states that have been chiefly reliant on coal. The added competition could raise prices (San Diego natural gas prices are impacted by price spikes in the East) and reduce available supply. If this scenario occurs, increasing renewable energy supply may insulate the region from higher-priced finite natural gas resources.

### Historical Average Electricity Prices by Customer Class (in cents per kilowatt-hour)

<table>
<thead>
<tr>
<th>Year</th>
<th>Residential SDG&amp;E</th>
<th>Commercial SDG&amp;E</th>
<th>Residential CA</th>
<th>Commercial CA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>10.7</td>
<td>9.6</td>
<td>10.4</td>
<td>10.6</td>
</tr>
<tr>
<td>2000</td>
<td>14.1</td>
<td>14.5</td>
<td>11.5</td>
<td>11.0</td>
</tr>
<tr>
<td>2007</td>
<td>15.7</td>
<td>17.4</td>
<td>12.5</td>
<td>13.5</td>
</tr>
<tr>
<td>2008</td>
<td>15.5</td>
<td>16.9</td>
<td>12.7</td>
<td>12.7</td>
</tr>
</tbody>
</table>

Source: Energy Almanac, CEC, 2009

The magnitude infrastructure that is necessary for California to meet the needed renewable energy target for 2020 has never 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 renewable resource supply by 2020 is to be a top priority, including:

- Planning for more transmission and generation than needed to reach just 33 percent;
- Pursuing procurement which is not dependent on new transmission such as distributed solar photovoltaics (PV); and
- Concentrating renewable development in pre-permitted land that would be set aside for a renewable energy park.

The **Renewable Energy Transmission Initiative (RETI)** is a statewide initiative to help identify the transmission projects needed to accommodate state renewable energy goals, support future energy policy, and facilitate transmission corridor designation and transmission and generation siting and permitting. RETI process is open and collaborative so any interested parties can participate. In addition to identifying transmission corridors to reach renewable resources, RETI assesses all **competitive renewable energy zones (CREZ)** in California, and possibly zones in neighboring states, that can provide significant electricity to California by 2020.

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, the California Independent System Operator (CAISO) is developing a framework for multiple projects within a transmission constrained renewable resource area to share the costs of connecting to the grid.
**Recommended Actions:**

- Monitor feed-in-tariff level of participation here and other regions to see if we want to ask the state to open up more in our region.
- In a regionally-consistent manner, assist local governments in the identification and removal of barriers to siting renewable energy installations in San Diego County.
- Assist local governments in identification of potential sites for renewable energy projects that will help the region meet renewable energy targets.
- Promote quality jobs for workers employed in the energy sector through training programs related to local renewable energy industries.
- Support cost-effective transmission access from areas rich in renewable resources to the San Diego region.
- Monitor the Renewable Energy Transmission Initiative (RETI) and consider its recommendations in future regional planning.
3 - DISTRIBUTED GENERATION

Goal: Increase clean distributed generation that provides homes and businesses with reliable options to offset their electricity and natural gas needs with onsite power systems.

<table>
<thead>
<tr>
<th>Technology</th>
<th>2008 Level</th>
<th>2030 Base Targets</th>
<th>2030 Stretch Targets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biofuels</td>
<td>26 MW</td>
<td>27 MW</td>
<td>31 MW</td>
</tr>
<tr>
<td>Solar photovoltaics</td>
<td>49 MW</td>
<td>844 MW</td>
<td>970 MW</td>
</tr>
<tr>
<td>Combined heat and power</td>
<td>341 MW</td>
<td>398 MW</td>
<td>458 MW</td>
</tr>
<tr>
<td>Other (hydro &amp; steam)</td>
<td>11 MW</td>
<td>11 MW</td>
<td>11 MW</td>
</tr>
<tr>
<td>Total Distributed Generation in the Region</td>
<td>427 MW</td>
<td>1278 MW</td>
<td>1590 MW</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Proportion of Regional Peak Demand</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>RES 2030 targets from 2003</td>
<td>12% (2010)</td>
<td>30%</td>
<td>30%</td>
</tr>
<tr>
<td>RES Update targets</td>
<td>9% (actual)</td>
<td>21%</td>
<td>24%</td>
</tr>
</tbody>
</table>

Source: California Center for Sustainable Energy, 2009

For the RES Update, clean distributed generation is defined as small-scale power generation technologies located close to the load being served, capable of lowering costs, improving reliability, reducing emissions and expanding energy options. Figure 1 depicts various distributed generation systems integrated with the electricity grid. In California, clean power designates a system that is more energy efficient than the most efficient conventional power plant built today, a natural gas combined-cycle gas turbine plant. Combining energy efficiency measures with distributed generation is the best way to reduce a customer’s energy demand, thereby properly sizing the distributed system and generally saving the customer costs of a larger system.

Figure 1.

Small-scale is defined as less than 20 megawatts in capacity. In the San Diego region, the primary sources of clean distributed generation are identified in Table 1 above and the pie chart below. The Renewable Energy Goal and to an extent the Distributed Generation Goal address renewable energy systems. Distributed generation, renewable or not, installed primarily for a customer’s use onsite has many similar benefits and barriers regardless of fuel source. Ongoing performance monitoring will distinctly identify all technologies cross-listed in both goals.

Source: California Energy Commission

In the San Diego region, solar photovoltaic (PV) systems have the greatest growth potential. Several regional resources are available that help enable residents to install solar. The City of San Diego partnered with the California Center for Sustainable Energy (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 California Solar Initiative 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.
In addition to solar options, combined heat and power (CHP) and other clean heat and power technologies, such as those that use waste energy recovery or biofuels, have a variety of commercial and societal benefits for the region. CHP systems provide efficient use of natural gas by recycling otherwise wasted heat and reusing it for additional electricity or heating and cooling. They also can operate on renewable fuels. Technologies include microturbines, internal combustion engines and fuel cells. Fuel cells are most efficient in CHP mode, but do not have to operate this way.

End users that need greater reliability and power quality onsite than what the electric grid can supply, tend to use CHP systems. Biotech firms, data centers, telecommunications, and industrial processes are some of the business types that cannot afford power to be interrupted. CHP can provide premium power onsite, offering end users a higher level of reliability than the electric grid. Additional distributed generation resources include hydro power, steam and wind but they are not anticipated to play a larger role through 2030. The former two have reached their market potential and the latter one plays a role in larger sizes included in the RES Update renewable energy goal. These resources will be monitored and if options for increased use materialize, targets for those resources will be added.

Although the lifecycle costs of distributed generation 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 California Solar Initiative, 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.

Net-metering is an additional financial incentive set up to expand California’s renewable energy markets. Net-metering allows entities with onsite renewable generating potential in excess of what they can use onsite to be compensated for that generation. “Feed-in tariffs” are available for some renewable energy systems and combined heat and power systems. Feed-in tariffs are for distributed generation systems that are used for export to the electric grid rather than offsetting the customer’s load.

Interconnection policies have been another barrier to increased use of distributed generation. California applies a standard practice for interconnecting distributed generation 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 DER generators.

Since there are a variety of distributed generation systems, customers are able to choose the technology that best serves their needs. Distributed generation 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, distributed generation 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. Storage is beneficial to providing more usable electricity from intermittent resources such as solar and wind. AES also can reduce peak demand and save money by storing electricity for use during periods when grid-based electricity is most expensive.

**Recommended Actions:**

- Explore development of a regional incentive program to further reduce cost to homes and businesses of energy efficiency and distributed generation installations
  - Identify the cost, benefits, and funding sources for a regional program
  - Encourage and support the implementation of financing and loan guarantee programs in addition to the partial rebates and incentives available.
  - Explore opportunities to use energy bonds to increase installations in the region
  - Support bill financing programs
- Lead by example by exploring opportunities to generate electricity at municipal sites, schools, and water pumping stations.
- Identify local barriers and solutions that could be supported throughout the region and applied across jurisdictions to reduce the confusion for builders, contractors, officials, about various distributed generation technologies, applications and financing.
- Support smart grid policy implementation
- Explore opportunities and applications for local governments to demonstrate advanced energy storage with distributed generation technologies.
4 - ENERGY AND WATER

Goal: Reduce the embedded energy of water supply and uses.

There is a close relationship between water and energy resources in the San Diego region. 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 for the region, while pumped storage facilities provide commercially viable electricity storage on a large scale.

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) burns 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 and energy intensive sources; about 18 percent is supplied from local sources.

Table 1: Energy Intensities in the Water Cycle

<table>
<thead>
<tr>
<th>Water Cycle Segments</th>
<th>Range of Energy Intensity (kilowatt hours/million gallons)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>Supply and Conveyance</td>
<td>0</td>
</tr>
<tr>
<td>Treatment</td>
<td>100</td>
</tr>
<tr>
<td>Distribution</td>
<td>700</td>
</tr>
<tr>
<td>Wastewater Collection and Treatment</td>
<td>1,100</td>
</tr>
<tr>
<td>Wastewater Discharge</td>
<td>0</td>
</tr>
<tr>
<td>Recycled Water Treatment and Distribution</td>
<td>400</td>
</tr>
</tbody>
</table>

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

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. Water demand and associated energy costs will continue to grow if current trends continue. Water and energy demands are growing at roughly the same rate. Water-related electric use is expected to grow at a faster rate because of increasing and more energy-intensive water treatment requirements, conversion of diesel agricultural pumps to electric, increasing long-distance water transfers, and changes in crop patterns that require more energy intensive irrigation methods.

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.

Energy and Water in the San Diego Region

San Diego County Water Authority (CWA) currently supplies about 600,000 acre-feet\(^1\) of water per year (af/year) to water agencies in the region. Supply sources include 470,000 af/year from the Metropolitan Water District (MWD), 83,000 af/year from the SWP, 30,000 af/year from local groundwater supplies, and 18,000 af/year from

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\(^1\) 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.
recycled wastewater. 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 water demand is estimated at 4,140,000 megawatt-hours (mWh) per year.

The energy intensities for the five stages of the water life cycle in San Diego region are 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. Despite the energy-intensive process of conveying water over long distances to the region, end uses like landscape irrigation and showering are the most energy-intensive stages of the water life cycle, accounting for over half (57 percent) of water-related energy use.

As shown in the table below, the residential sector is responsible for 58 percent of energy consumption related to water end uses. The commercial, industrial and institutional sectors are responsible for an additional 32 percent, while agriculture accounts for 10 percent. The five largest end use consumers of energy are residential landscape irrigation (23 percent), residential toilets and leaks (14 percent), commercial/industrial landscape irrigation (12.1 percent) residential showers, faucets and bathtubs (12 percent), and clothes washers (8 percent). Targeting conservation measures in these largest end use subsectors can reduce the energy intensity of water end uses.

Table 2: Estimated Embedded Energy of Water End Uses in the San Diego Region

<table>
<thead>
<tr>
<th>Water Use Category</th>
<th>Estimated Percent of Total Use in 2010 (8)</th>
<th>Estimated Energy Intensity kWh/af (6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>58%</td>
<td>0</td>
</tr>
<tr>
<td>Toilets and leaks</td>
<td>1%</td>
<td>27,200</td>
</tr>
<tr>
<td>Dishwashers</td>
<td>1%</td>
<td>11,650</td>
</tr>
<tr>
<td>Clothes washers</td>
<td>8%</td>
<td>6,790</td>
</tr>
<tr>
<td>Showers, faucets, and bathtubs (1)</td>
<td>12%</td>
<td>0</td>
</tr>
<tr>
<td>Landscape irrigation</td>
<td>2.2%</td>
<td>0</td>
</tr>
<tr>
<td>Commercial, industrial, and institutional</td>
<td>32%</td>
<td>27,200</td>
</tr>
<tr>
<td>Kitchen dishwashers</td>
<td>0.5%</td>
<td>6,790</td>
</tr>
<tr>
<td>Pre Rinse nozzles</td>
<td>0.2%</td>
<td>0</td>
</tr>
<tr>
<td>Other kitchen use</td>
<td>1.2%</td>
<td>Not Estimated</td>
</tr>
<tr>
<td>Laundries</td>
<td>0.6%</td>
<td>800</td>
</tr>
<tr>
<td>On-site wastewater treatment (2)</td>
<td>8.8%</td>
<td>800</td>
</tr>
<tr>
<td>Watercooled chillers (3)</td>
<td>2.4%</td>
<td>67,700</td>
</tr>
<tr>
<td>Single pass cooling (3)</td>
<td>2.4%</td>
<td>0</td>
</tr>
<tr>
<td>Landscape irrigation</td>
<td>22.1%</td>
<td>0</td>
</tr>
<tr>
<td>Other heated water (4)</td>
<td>0.3%</td>
<td>6,790</td>
</tr>
<tr>
<td>Other unheated water (5)</td>
<td>6.5%</td>
<td>Not Estimated</td>
</tr>
<tr>
<td>Agricultural (6)</td>
<td>10%</td>
<td>Not Estimated</td>
</tr>
<tr>
<td>Totals and weighted average (7)</td>
<td>100%</td>
<td>3,000</td>
</tr>
</tbody>
</table>


Energy Considerations for Meeting Future Water Demand

The population of the San Diego region will grow by approximately one million residents by 2030, increasing the region’s demand for water. 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 acre-feet (af) by 2010, 94,000 af by 2020 and 108,000 af by 2030 to meet the region’s water needs. 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. Energy intensity varies by strategy, as shown in Table 3.

Conservation

The Energy Commission identifies water conservation as the far superior water “source” from an energy perspective. Investment in conservation 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 annual electricity for 118,000 households.
### Table 3: Energy Intensity for Satisfying Additional Water Demand

<table>
<thead>
<tr>
<th>Status quo plus scenario</th>
<th>Source and Conveyance (kWh/af)</th>
<th>Water Treatment (kWh/af)</th>
<th>Distribution (kWh/af)</th>
<th>End Use (kWh/af)</th>
<th>Wastewater Treatment (kWh/af)</th>
<th>Total (kWh/af)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status quo</td>
<td>2,040</td>
<td>60</td>
<td>330</td>
<td>3,900</td>
<td>570</td>
<td>6,900</td>
</tr>
<tr>
<td>Conservation</td>
<td>1,780</td>
<td>50</td>
<td>290</td>
<td>3,400</td>
<td>500</td>
<td>6,020</td>
</tr>
<tr>
<td>Recycling</td>
<td>1,830</td>
<td>50</td>
<td>330</td>
<td>3,900</td>
<td>500</td>
<td>6,610</td>
</tr>
<tr>
<td>Water bag transfer</td>
<td>1,950</td>
<td>60</td>
<td>330</td>
<td>3,900</td>
<td>570</td>
<td>6,810</td>
</tr>
<tr>
<td>Imperial Irrigation District transfer</td>
<td>60</td>
<td>60</td>
<td>330</td>
<td>3,900</td>
<td>570</td>
<td>6,940</td>
</tr>
<tr>
<td>Additional State Water Project</td>
<td>60</td>
<td>60</td>
<td>330</td>
<td>3,900</td>
<td>570</td>
<td>7,100</td>
</tr>
<tr>
<td>Seawater desalination</td>
<td>50</td>
<td>50</td>
<td>330</td>
<td>3,900</td>
<td>570</td>
<td>7,250</td>
</tr>
</tbody>
</table>

Source: California Energy Commission.

Notes: (1) The conservation, recycling, and desalination scenarios assume the additional 100,000 acre-feet of water do not require treatment, reducing the average energy intensity of treatment from 60 to 50 kWh/af delivered to customers. (2) Conserved water does not need to be distributed, reducing the embedded energy of distribution from 330 to 290 kWh/af delivered. (3) Conservation assumes no energy is conserved when water is conserved, but no energy is expended to conserve water either. (4) 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. (5) The scenarios are presented for purposes of comparing energy consumption only. They do not necessarily represent feasible or likely scenarios for satisfying future water demand in the San Diego region.

### 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 can displace use of fresh water for power plant cooling, industrial processes, landscape irrigation, and groundwater replenishment.

The San Diego region has already 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 (SBWRP). NCWRP has capacity to produce up to 24 million gallons per day (MGD) of recycled water, but existing beneficial reuse, consisting mostly of irrigation and some industrial purposes, total only about 6 MGD (City of San Diego, Water Reuse Study [2006]). The SBWRP produces five to six MGD of recycled water that is then disposed through the ocean outfall, without application for domestic or industrial reuse. Thus, although the region has substantial capacity to produce recycled water with adequate quality, actual demand for recycled water has not matched that capacity. However, none of the recycled water is currently used as potable water.

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.

### Desalination

Desalination is another option to meet future water demand. The process removes salt from brackish 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 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 consideration, are relevant to the selection of water sources to meet future demand in the region. Energy is just one of the considerations. Reliability, cost, and regional control may be other important considerations.
Producing Energy from Water

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 or 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. Although this technology is widely deployed, additional in-conduit projects could help offset the embedded energy of the water system or be sold back to the grid. In-conduit projects could also 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 percent 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 megawatt (MW) generator, which saves the City millions of dollars in energy costs and produces power for the electrical 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 impact on the electricity grid. Wind and solar photovoltaic 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 requires little to no water for operations. Many water agencies have potential for installation of solar panels on rooftops and structures and other unused or underutilized land within their control. Water agencies can take advantage of renewable energy opportunities to offset their own electricity load and even send power to the grid and contribute to regional goals for the generation of renewable power (e.g., Renewable Portfolio Standard goals). However, existing tariffs and rules constrain full development of self-generation by water and wastewater utilities.

Recommended Actions:

- Regional and local governments should collaborate with the San Diego County Water Authority, local water districts and SDG&E on cooperative programs that achieve energy and water savings.
- Support programs and efforts to increase energy conservation and efficiency of water end-uses in the residential and commercial sectors, with priority on the most energy-intensive water end-uses.
- Identify financing mechanisms that end users can utilize to reduce water-related energy consumption, such as those available for energy measures (e.g., on-bill financing [property tax or utility] and low interest loans).
- Consider integration of water-related energy considerations into regional program to incorporate energy efficiency and distributed generation into the existing residential and commercial building stock.
- Promote energy efficiency, demand response and self generation efforts to local governments that own or operate water pumping stations and treatment facilities.
- Assist local governments and other regional agencies in public education and promotion of the water, energy, climate change and environmental benefits of reclaimed water in order to gain public acceptance for domestic uses that help the region meet its goals of water source diversification.
- Promote or identify uses for existing, unused reclaimed water, such as landscape irrigation or power plant cooling.
5 - PEAK DEMAND

Goal: Close the gap between peak and average demand to improve operating efficiency of the electric system.

The RES Update uses the California Energy Commission’s June 2009 peak demand forecast for its targets. SDG&E also relies on the Energy Commission’s forecast for its resource planning. “Peak Demand” is the electric load that corresponds to a maximum level of electric demand, measured in kilowatts (kW), in a specified time period. In contrast, average demand measures the total annual demand averaged over all the hours in the year (8760). The relationship between average and peak demand is called the load factor. This is a measure of how effectively the total capacity of the electrical system is used on average. The higher the load factor, the more effective the electric system is. A load factor of 100%, which is nearly unattainable, would mean the average and peak demand were equal. The current regional load factor is approximately 53%.

Weather and behavior play a role in determining peak demand. On an annual basis, the region generally experiences high peak demand periods on the hottest days of the year and during continuous heat waves, usually in summer. High demand periods are typically driven by air conditioning use. 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. Demand response programs and other demand-side management measures are another option to alleviate peak demand conditions and potentially postpone the need for additional power plants. Demand response programs shift end-user demand from peak times to lower demand periods of the day, when electricity is cheaper and more abundant. California’s preferred loading order to meet our resource needs places demand response second in priority, only behind conservation and energy-efficiency.

A demand response program provides customers with incentives for reducing load in response to a call for load reduction by the utility. Incentives can be a credit on the utility bill, a dynamic rate or exemption from rolling blackouts. SDG&E manages several types of demand response programs that local governments and SANDAG can take part in or provide education to our employees, businesses and residents about.
In addition to demand response programs, distributed generation systems can reduce peak demand. Rooftop solar, fuel cells and combined heat and power systems all provide end-users with power generated on or near its point of use. Distributed generation technologies can produce electricity during peak times, thus reducing system wide electrical demand. Energy savings from these technologies are included in the RES Update Distributed Generation Goal so they are not included in the peak demand reduction targets here. Development of smart grid technologies, in particular smart meters and advanced metering infrastructure, can help to reduce regional peak demand. The RES Update Smart Grid Goal provides further detail on the attributes and benefits of a smart grid.

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 collect data on the amount and time of day of electricity consumption. Providing customers with detailed information about their consumption patterns can result in energy and demand reductions. Pilot smart metering projects in the San Diego region and across the state have shown that consumers that were provided 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 to smart meters, smart end-use devices 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.

Smart grid technology also will enable the convergence of the electricity and transportation sectors. Electric vehicles that plug-in to the electric grid for recharging may also be able to provide electricity back to the grid in the near future, once smart grid components are in place. To prevent a fleet of electric vehicles from increasing peak demand, smart charging features could help to even out the increase in electric demand caused by electric vehicles.

**Recommended Actions:**

- In coordination with SDG&E, provide education and outreach on demand response programs available to residents, businesses and institutions
- Support fair and reasonable rate designs and incentives that encourage reductions in peak demand
- Support the rollout of advanced metering infrastructure and communication technologies that enable electric vehicles, distributed generation, and electricity consumption to be accurately monitored by consumers and the utility
- Support the modernization of communications across the electricity grid through implementation of the smart grid for the San Diego region
- Since air-conditioning units are a large proportion of electric load during peak demand times, local governments and SANDAG should support and promote aggressive air conditioning cycling, tune-up and other load reduction programs
6 - THE SMART GRID

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

The U.S. Department of Energy has found that if the electric grid were just 5 percent more efficient, the energy savings would equate to permanently eliminating the fuel and greenhouse gas emissions from 53 million cars. A smart grid can help the region achieve many of the RES Update Goals. It can better provide reliable power to end users while saving money for both the utility and end user. Smarter communications will improve reliability and reduce outages, as well as enable electric vehicles and distributed generation technologies to be accurately integrated into the electricity grid.

Figure 1

Source: U.S. Department of Energy

In 2006, the Energy Policy Initiatives Center of the University of San Diego released the San Diego Smart Grid Study. The regional study included extensive analysis of the technologies, utility and societal costs and benefits as depicted in Tables 1 and 2, as well as scenarios for implementing a smart grid in the San Diego region.

<table>
<thead>
<tr>
<th>Table 1. Summary of San Diego Smart Grid Study Cost-Benefit Analysis Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Annual Benefits</td>
</tr>
<tr>
<td>System Benefits (20 years)</td>
</tr>
<tr>
<td>Societal (Consumer-side) Benefits (20 years)</td>
</tr>
<tr>
<td>Total Capital Cost</td>
</tr>
<tr>
<td>Annual Operating and Maintenance Cost</td>
</tr>
</tbody>
</table>


The integration of smart grid technologies, e.g. smart meters, advanced metering infrastructure, and interactive communications, will help the region to achieve multiple RES Update energy goals. 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 that were 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.
The smart-grid will reduce the number and duration of power outages. When the power goes out at a home, the smart grid can communicate that outage to the utility when it happens. With the grid in place today, the utility does not know that the power is out at a house or business until the end-user calls the utility to let them know.

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

Source: EPIC, 2006

Smart grid’s can be region-wide and at a micro level (micro-grid). For instance, the University of California, San Diego was awarded a Department of Energy grant to create a campus micro-grid combining fuel cells and advanced energy-storage technologies. The project will demonstrate smart grid benefits at a campus scale.

**Recommended Actions:**

- Support education on the regional deployment of the smart grid and smart meters.
- Support regional entities in acquiring state and federal funds to implement components of the smart grid in the San Diego region.
7 - NATURAL GAS

GOAL: Reduce total natural gas supply in the electricity sector by replacing inefficient power plants with energy-efficient plants that run on natural gas, biogas, or other reliable, renewable alternative.

Natural gas is the least polluting fossil fuel and the only fossil fuel that California allows to fuel in-state power plants. The majority of natural gas supply in the region is used to generate electricity. Natural gas also is used for space conditioning and water heating for homes and buildings, industrial processes, and increasingly as a transportation fuel. With the exception of electricity supply, how to best utilize natural gas is addressed throughout the RES Update, in particular in the following topic areas: energy efficiency and conservation; renewable energy; distributed generation; peak demand; and transportation fuels.

The San Diego region currently consumes approximately 581 million metric therms (MMTh) of natural gas annually. At present, California imports 87 percent of its natural gas needs from out state, and at the same time in-state production is decreasing. Natural gas markets have proven to be very volatile over the last decade, which has made most forecasts less- or un-reliable. The RES Update looks to historical data, as shown in Figure 1, and several other factors to identify appropriate regional policies.

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 greenhouse gas emissions will likely cause many states that rely heavily on coal for electricity generation to switch to natural gas to fuel 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 impacted by supply and demand imbalances, infrastructure (storage and pipeline) issues, the weather, regional and global economic conditions, speculative trading, market manipulation, and unreliable data.

The San Diego region should utilize natural gas as efficiently as possible to help mitigate volatility issues. As power plants are the largest user of natural gas, and the region is home to aging, inefficient plants, there are opportunities to make improvements in this area. Energy efficient natural gas plants currently are combined-cycle gas turbine plants. Biogas (generally at landfills and wastewater treatment plants) offers another way to diversify from natural gas use. 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. There are aging, inefficient plants in the region. New plants would provide more energy for less fuel. Chart 1 shows the state and regional fuel sources for electricity.
Statewide Electricity Mix 2006

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Gas</td>
<td>41%</td>
</tr>
<tr>
<td>Coal</td>
<td>16%</td>
</tr>
<tr>
<td>Nuclear</td>
<td>13%</td>
</tr>
<tr>
<td>Large Hydro</td>
<td>19%</td>
</tr>
<tr>
<td>Renewables</td>
<td>11%</td>
</tr>
</tbody>
</table>

SDG&E Electricity Mix 2006

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Gas</td>
<td>49%</td>
</tr>
<tr>
<td>Coal</td>
<td>18%</td>
</tr>
<tr>
<td>Nuclear</td>
<td>15%</td>
</tr>
<tr>
<td>Large Hydro</td>
<td>10%</td>
</tr>
<tr>
<td>Renewables</td>
<td>8%</td>
</tr>
</tbody>
</table>

*2006 was latest year for which data was available

**Recommended Actions:**

- Monitor the availability and cost of natural gas supplies in light of increased regulatory and environmental restrictions on fossil fuels.
- Establish or support energy efficiency programs that reduce natural gas usage in existing homes and businesses.
- Support policies that will provide more stable natural gas prices and reduce consumer exposure to market volatility.
- Support increased use of solar water heating in residential, pool and commercial uses to offset natural gas demand.
- Promote the use of high efficiency distributed generation technologies like combined heat and power.
- Promote the weatherization and insulation of un-insulated homes built before the development of building energy codes (1983).
- Increase and promote demand-side energy efficiency programs to reduce residential, commercial and industrial gas usage.
- Facilitate the re-powering, replacement, or removal of older power plants in the county based on the RES loading order with high efficiency combined cycle gas turbines or renewables where possible.
8 - TRANSPORTATION FUELS

Goal: Substantially increase efficiency and the deployment of alternative fuel vehicles.

The region can improve air quality, promote public health, protect against petroleum price volatility and supply uncertainty, reduce GHG emissions, and the benefit the economy by substantially increasing efficiency and transitioning to alternative fuel sources in the transportation sector. Passenger vehicles, heavy-duty trucks and buses, aircraft, watercraft, off-road engines, 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 these petroleum-based fuels include biofuels (ethanol and biomass-based diesels), electricity, hydrogen, natural gas, and liquefied petroleum gas (LPG or propane). Electricity can displace the most petroleum and GHG emissions. Electric drives are inherently more efficient than internal combustion engines, and existing electric infrastructure would facilitate the deployment of this alternative fuel faster than others. Hydrogen and renewable biofuels 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. Natural gas and propane can also achieve economic and environmental benefits for the region, but of a more modest nature. Please consult the 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, it is important to note that 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 extraction of raw materials, industrial assembly, and typically long-distance distribution to customers. A careful, holistic approach to alternative transportation fuels will help the region minimize 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.

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 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 lower travel demand are discussed in the Land Use and Transportation Planning section of the Regional Energy Strategy.
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 1, 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 or 85 percent of total consumption by on-road vehicles. Light-duty trucks represent only about 35 percent of total miles traveled, 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. In total, on-road vehicles account for about 46 percent of GHG emissions in the region. While heavy-duty trucks mostly use diesel fuel, the region’s transit agencies operate a substantial number of CNG buses, including CNG-electric hybrids. Passenger vehicles are the largest contributors, generating about 89 percent of emissions from on-road vehicles, while heavy-duty vehicles account for the remainder.

Without changes in policy or behavior, on-road consumption of petroleum-based fuels is expected to increase sizably by 2020, with the trend continuing to 2030.

![Figure 1. Fuel Consumption by On-Road Transportation Vehicles in San Diego County](source: Energy Policy Initiatives Center, University of San Diego, 2008)

Passenger Cars and Light-Duty Trucks

The State has developed a 2050 vision for alternative fuels and vehicles based on a fair-share of 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. By 2030, the horizon year of the RES, substantial progress toward this vision must be achieved. Major attributes of the 2050 vision include:

- Average vehicle fuel economy of 60 miles per gallon (mpg); 80 mpg 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 vehicle miles traveled (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).

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. At least for the near-term, 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. Electric vehicles will likely first become available to the region in 2010, with additional automaker vehicle rollouts over the next 2-5 years. 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 be overcome before they are 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.

Importantly, government coordination of public access electric charging and alternative fueling infrastructure is required to support private sector rollout and purchase of vehicle and fuels in the San Diego region.

Heavy-Duty Trucks and Buses

Although 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, CNG, and LNG. The state 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 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.

It should be noted that, after air transport, heavy-duty trucks are the least efficient form of goods movement. As discussed in the next section, Other Transportation, rail and ocean-based goods movement are more energy efficient modes than heavy-duty trucks.

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 10 percent of GHG emissions in the San Diego region and is primarily petroleum-based.

As of 2007, the civil aviation sector (primarily comprised of 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 are not included in this analysis. Fuel use in this sector combined to account for about five percent of total GHG emissions in the region. The off-road category is the next largest consumer of fuel in this sector (primarily gasoline and diesel), and accounted for about four 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 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 one 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 at Port of San Diego marine terminals. It should be noted that in addition to rail, OGVs are 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, which primarily consume heavy fuel oil, but also use diesel fuel. The majority of harbor craft fuel use is due to commercial and charter fishing boats. Water-borne navigation accounts for less than one percent of total GHG emissions. Without change in policy or behavior, fuel consumption from these sources is expected to increase to 2030 and continue to rely primarily on petroleum-based fuels. However, the trend of decreasing aviation fuel consumption is projected to continue.

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 (TSE) and anti-idling (AI) 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 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. Please see SANDAG’s Draft Regional Alternative Fuels, Vehicles, and Infrastructure Report for a detailed assessment of alternative fuels, vehicles, and infrastructure and recommended actions for the San Diego region (the final report is anticipated in Fall 2009).

Recommended Actions:

General

- Create an action plan that incorporates alternative fuel vehicles and increased efficiency into the SANDAG vehicle fleet, and the vehicle and equipment fleets of contractors and funding recipients, such as the vehicle fleet for the vanpool program.
- Use the Regional Alternative Fuels, Vehicles, and Infrastructure Report and the Regional Energy Strategy Update as tools to support the integration of alternative transportation options into local government fleets, planned regional transportation projects, and future updates of the Regional Transportation Plan and the Regional Comprehensive Plan.
- Develop a regional approach to infrastructure planning for alternative fuels by facilitating continued development of a public-private strategic alliance.
- Support regional efforts to educate the general public about the benefits of alternative fuels.
- Help local governments develop streamlined permitting requirements and standardized design for electric charging stations.
- Support regional production of alternative fuels, vehicles, and infrastructure.
- Help the region pursue and secure funding for increased deployment of alternative fuel vehicles and infrastructure.
- Support electricity and natural gas tariffs that encourage their use as transportation fuels.
Support state and federal legislation that can help the region increase availability of alternative fuels, vehicles, and infrastructure.

**Passenger Cars and Light-Duty Trucks**
- Make plug-in hybrids and electric vehicles the top priority for alternative fuel vehicle purchases. Where plug-in hybrids or electric vehicles are not an option, purchase new CNG vehicles.
- Monitor the status of E85, propane, biodiesel, and hydrogen fuels and vehicle technologies and periodically re-evaluate opportunities for regional deployment.
- Accelerate the transition to plug-in hybrids and 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*.
- Analyze the potential impacts of plug-in hybrid and electric vehicle deployment on the electricity grid.

**Heavy-Duty Trucks and Buses**
- Make natural gas, biodiesel blends up to B20, and hybrid technologies the top priority for heavy-duty trucks.
- Improve efficiency and conserve energy in the heavy-duty truck sector through measures like truck stop electrification and anti-idling.
- Monitor the status of electric vehicles, hydrogen, and biodiesel blends greater than B20 and periodically re-evaluate opportunities for regional deployment.
- Coordinate with regional transit agencies and school districts to incorporate alternative fuels, vehicles, and infrastructure considerations into their bus fleets.
- Facilitate the transition to natural gas, B20, and electrification by developing a regional plan for public access infrastructure.
- In addition to improved efficiency and alternative fuels, support energy efficient alternatives to moving goods by heavy-duty truck.

**Other Transportation**
- Support strategies to reduce jet fuel and natural gas consumption, including but not limited to lower-carbon alternatives to jet fuel, provision of landside electric power to aircraft, more efficient movement of aircraft, electrification of airport ground support equipment, and shifting people and goods movement to more efficient travel modes like rail transportation.
- Support efficiency, electrification or use of alternative fuels to power off-road vehicles and equipment.
- Support ocean going vessels as an efficient means of people and goods movement.
- Reduce fuel oil and diesel consumption in ocean going vessels through electrification and strategies to increase efficiency.
- Support rail transportation as an efficient mover of people and goods relative to on-road transportation and aviation.
- Reduce diesel consumption from rail transportation through use of the most efficient diesel locomotive technology or electrification.
9 - LAND USE AND TRANSPORTATION PLANNING

Goal: Reduce the energy demand of the built environment through land use and transportation planning.

Energy consumption is strongly related to urban form, the physical features and composition of the built environment in a region. 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. The energy demand of the built environment is strongly related to the design and orientation of buildings, distribution and density of development, types of transportation infrastructure, 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 urban design that favor the automobile over biking, walking, and public transit. To a large degree, these factors influence the amount of energy residents of the San Diego region consume in their daily lives. 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% of total GHG emissions in the region.

Figure 1: The Urban Heat Island Effect

![Urban Heat Island Effect Graph]

In addition, exposed urban surfaces like roofs and pavement absorb heat and cause surface and air temperature in developed areas to become warmer than undeveloped areas through a process known as the urban heat island effect (Figure 1). There are several negative impacts associated with urban heat islands, including increased energy demand for cooling during summer months, particularly during periods of peak electricity demand.

Local governments and SANDAG have the ability to influence the built environment, including the amount of energy consumed, through regulation, incentives, and infrastructure investments. In addition, local governments can contribute to regional energy goals for increased distributed generation and large scale renewable power by considering the spatial requirements of energy infrastructure in local land use plans, ranging from on-site and distributed generation systems to utility-scale renewables, power plants, substations and transmission lines. A local government’s approach to these issues may influence its character, energy demand, carbon footprint, and type of available energy sources.

A major objective of local land use and regional transportation planning is to identify the land and infrastructure needed to accommodate projected population, housing, and job growth while maintaining and enhancing quality of life. The San Diego region is forecast to grow by another million residents by 2030, about 30 percent more people than today. In the past, population growth has been associated with increased total electricity consumption, gasoline consumption, and vehicle miles traveled. The relationship among population growth, energy consumption and travel behavior will continue to follow past trends unless the region develops a new strategy for population growth and the built environment that addresses energy savings.
Existing Planning Efforts

Fortunately, SANDAG and the local jurisdictions, through a collaborative process, have already developed a strategy to accommodate projected growth based on the concept of smart growth. Under SANDAG’s adopted smart growth principles, smart growth opportunity areas are places that could accommodate higher residential and employment densities within pedestrian-friendly activity centers connected to other activity centers by public transit. Essentially, smart growth seeks to reduce the amount of vehicle use. The Smart Growth Concept Map (Figure 2) illustrates the nearly 200 locations of existing, planned, and potential smart growth opportunity areas in seven place types reflecting the notion that smart growth is not a “one-size-fits-all” concept. SANDAG provides funding for transportation and transportation-related infrastructure improvements and planning efforts that support smart growth development through the TransNet Smart Growth Incentive Program.

The Regional Comprehensive Plan – the blueprint for the region’s growth – describes the importance of better integrating smart growth development with transportation planning. SANDAG develops the Regional Transportation Plan (RTP) and allocates funding to implement the long-range vision for the regional transportation network. The adopted 2007 RTP is founded on four main components: (1) better integration of smart growth land use with the transportation system, (2) systems development including improvements to the highway, road, and public transportation systems, (3) systems management to make more efficient use of existing facilities and investments, and (4) demand management to encourage alternatives to driving alone and minimize demand during peak travel periods.

Broadening Planning Efforts to Address Energy

Energy savings is not an explicit objective of regional land use and transportation planning. However, the region’s adopted smart growth strategy and existing transportation investments in areas like public transportation and demand management promote a less energy-intensive built environment. These energy implications of the smart growth strategy and transportation plan should be acknowledged, as should land use and transportation strategies that do not save energy. Moreover, the region could more broadly address energy demand, supply, and infrastructure issues by broadening the definition of smart growth to include all energy strategies. Increasing onsite production of renewable energy, using distributed electricity generation, orienting residences in relation to the sun, increasing shading, incorporating roofs and pavements that reflect heat, producing food locally, and installing energy-efficient appliances are some of the non-transportation related strategies that would fall under a broader definition of smart growth and produce significant energy savings. Smart community strategies – deployment of information technology to change how a community uses its physical space – may also reduce the energy demand of the built environment by reducing the amount of vehicle travel, for example.

A review of the region’s existing 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 smart growth land use and transportation planning:

1. Building stock featuring energy efficiency, distributed generation, and solar orientation;
2. Compact land use pattern with convenient access to a mixture of land uses and a person’s daily needs;
3. Infrastructure supporting 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); and
6. Consideration of spatial requirements of small- and large-scale energy infrastructure.
Figure 2: Smart Growth Concept Map
Since the existing built environment is the result of several decades of land use development and transportation investments, reducing its energy demand will likely be incremental in the near-term. However, by 2030, land use and transportation planning decisions made to accommodate future growth can have a large impact on the amount of energy consumed, the distribution of land uses, 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 distributed generation, improved urban design, and transportation planning and investments that reduce energy consumption.

Finally, it is important to note that the increased support for walking, bicycling, and public transit as well as shorter vehicle trips associated with a low-energy demand built environment will help lower greenhouse gas (GHG) emissions from passenger cars and light-duty trucks. SANDAG’s requirement under state law to achieve GHG emission reduction targets from passenger cars and light-duty trucks in the next update of the RTP through integrated land use and transportation planning will be discussed in greater detail in the Regional Climate Action Plan.

**Recommended Actions:**

- Local governments should participate in SANDAG’s Sustainable Region Program and Energy Roadmap Initiative that identify ways to integrate energy considerations into local planning tools, codes, and ordinances such as the General Plan, zoning ordinance, and building code.
- Support adoption of local building energy codes beyond the current Title 24 and other measures that help meet a goal of zero net energy homes by 2020 and zero net energy commercial buildings by 2030.
- Continue to encourage and help local governments incorporate Potential Smart Growth Opportunity Areas into adopted land use plans.
- Support a low-energy demand built environment, energy efficient transportation choices, and alternative fuel vehicles in future updates of the Regional Transportation Plan, including, to the extent applicable, the Sustainable Communities Strategy required by Senate Bill 375.
- Support further integration of energy considerations for the built environment in future updates of the Regional Comprehensive Plan.
- Explore opportunities to support one or more demonstration projects in the region that exemplify adopted smart growth principles along with comprehensive energy saving strategies.
- Include comprehensive estimates of energy consumption and GHG emissions for land use and transportation planning scenarios at the regional and local level.
10 - 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 governments² (the most in any county of the US). 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 our neighbors. Through its Borders Committee, SANDAG addresses policy issues related to transboundary planning from three perspectives—tribal, interregional, and binational.

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.

Interregional Coordination

During the 1990s, the San Diego region's average annual population growth rate paralleled the national average. However, the rates in Orange, Riverside, and Imperial Counties 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 that 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 jobs-rich areas. SANDAG and its member agencies can foster the integration of energy considerations into existing interregional efforts, like the voluntary partnership between Western Riverside and San Diego region centered on the two-county commute corridor along the Interstate 15.

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. This year’s binational event was held in June 2009 and focused solely on climate change initiatives on both sides of the border, as well as exploring opportunities to share information and work together to reduce greenhouse gas emissions. 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.

Recommended Actions:

- Encourage regional coordination on energy and climate related issues in the border region that come within the purview of SANDAG, the Borders Committee, the Committee on Binational Regional Opportunities (COBRO), and the Regional Energy Working Group.
- Collaborate with entities seeking funding opportunities that promote binational, tribal and interregional energy efficiency programs for buildings, planning, infrastructure and transportation.
- Support the integration of energy-saving measures for buildings, transportation and overall project design for the development of the new Port of Entry at Otay Mesa East.
- Support measures including greater transit, pedestrian, and bicycle access that can reduce congestion and vehicle idling at the Ports of Entry between San Diego, California and Baja California, Mexico.
- Support measures that reduce the petroleum use and greenhouse gas emissions from heavy duty vehicles associated with goods movement across our borders.
- Explore energy saving measures on both sides of the international border that relieve stress on the shared regional electricity system.
- Monitor and evaluate regional natural gas storage and pipeline capacity to accommodate future demand.
11- 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 and investment based primarily on tracking business and employment growth by industry is difficult to quantify. The following types of industries and jobs comprise the Clean Energy Sector:

<table>
<thead>
<tr>
<th>GREEN INVESTMENTS AND JOBS</th>
<th>REPRESENTATIVE JOBS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Retrofitting</td>
<td>Electricians, Heating/Air Conditioning Installers, Carpenters, Construction Equipment Operators, Roofers, Insulation Workers, Carpenter Helpers, Industrial Truck Drivers, Construction Managers, Building Inspectors</td>
</tr>
<tr>
<td>Mass Transit/Freight Rail</td>
<td>Civil Engineers, Rail Track Layers, Electricians, Welders, Metal Fabricators, Engine Assemblers, Bus Drivers, Dispatchers, Locomotive Engineers, Railroad Conductors</td>
</tr>
<tr>
<td>Smart Grid</td>
<td>Computer Software Engineers, Electrical Engineers, Electrical Equipment Assemblers, Electrical Equipment Technicians, Machinists, Team Assemblers, Construction Laborers, Operating Engineers, Electrical Power Line Installers and Repairers</td>
</tr>
<tr>
<td>Wind Power</td>
<td>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</td>
</tr>
<tr>
<td>Advanced Biofuels</td>
<td>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</td>
</tr>
</tbody>
</table>

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

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; and
- 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; and
- Mitigating climate change by cutting greenhouse gas emissions.

Through 2019, significant investment will be injected into the Clean Energy Sector through the American Recovery and Reinvestment Act (ARRA) of 2009. Nationally, ARRA will provide $787 billion of stimulus funding, with most made available in 2009-2011. As of June 2009, energy-related allocations to California are listed in the table below.
Investment in the Clean Energy Sector Growing
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 photovoltaics, 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 US-based companies from 2007 (9.1 percent) to 2008 (11.8 percent). In 2000, clean energy venture capital comprised only 0.6 percent of the total.

Job Creation by Clean Energy Sector
The influx of federal stimulus funding creates the potential for significant growth in Clean Energy Sector. Various levels of job creation are identified in economic studies from the US Environmental Protection Agency, American Council for an Energy-Efficient Economy (ACEEE), American Solar Energy Society (ASES), US 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.

Building Retrofit and Green 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 fall under the classifications of the traditional 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>
<thead>
<tr>
<th>Manufacturing Investment</th>
<th>Job Creation</th>
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<tbody>
<tr>
<td>$1 million in renewable energy systems</td>
<td>5 full time employment component manufacturing jobs</td>
</tr>
<tr>
<td>$1 million in energy efficiency programs</td>
<td>3-4 building material manufacturing jobs</td>
</tr>
<tr>
<td>1 direct manufacturing job</td>
<td>2.9 indirect jobs (finance, transportation, supply chains, installers, and other related businesses) (EPI 2003)</td>
</tr>
</tbody>
</table>

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

Clean Transportation (including transit and biofuels)
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 have also 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, a good working knowledge of chemistry. Training and retraining of existing workers is critical to reducing petroleum use and limiting adverse environmental emissions.

Regional Clean Energy Job Development Opportunities
Leverage state and federal resources such as California’s Green Collar Jobs Council (formed by passage of Assembly Bill (AB) 3018) 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 2008-2009. Links to apprenticeship programs and job placement programs are included.

Recommended Actions:
- Promote the integration of Clean Energy Sector initiatives into existing workforce systems.
- Foster the development and implementation of clean energy workforce training programs amongst the region’s private and governmental organizations and labor unions.
- Collaborate with universities, community and technical colleges, high schools, Workforce Investment Boards (WIBs), community-based organizations, and economic development agencies to bring funds to the region and support pathways to provide technical training, and integrate students and newly trained workers into the local workforce.
  - Support apprenticeships, internships, and/or job shadowing with labor unions, government organizations, and private companies
  - Support continual technical (re)training of existing workforce to maintain jobs as new technologies and methods change
- Collaborate with regional economists to develop mechanism to start tracking level of clean energy investment and jobs in the San Diego region.
12 - ENERGY AND CLIMATE CHANGE

Goal: Transition to energy sources and consumption levels that will put the region on a path to achieve the 2050 emissions level for climate stabilization.

The type and amount of energy used in the San Diego region is the overwhelming source of greenhouse gas (GHG) emissions that cause climate change. Table 1 shows emissions in the four principal categories established by the United Nations Intergovernmental Panel on Climate Change (IPCC).

Table 1: San Diego County GHG Emissions by IPCC Category

<table>
<thead>
<tr>
<th>Intergovernmental Panel on Climate Change Category</th>
<th>Percentage of Total Greenhouse Gas Emissions</th>
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<tbody>
<tr>
<td>Energy</td>
<td>91%</td>
</tr>
<tr>
<td>Industrial (non-fuel)</td>
<td>5%</td>
</tr>
<tr>
<td>Waste</td>
<td>2%</td>
</tr>
<tr>
<td>Agriculture, Forestry, Land Use</td>
<td>2%</td>
</tr>
</tbody>
</table>

Source: Energy Policy Initiatives Center, University of San Diego, 2008.

Although a myriad of energy-consuming activities are responsible for GHG emissions in the region, about 80 percent of emissions are caused by three categories: on-road transportation (i.e., passenger cars, light-duty trucks, electricity generation, and heavy-duty vehicles); electricity generation; and natural gas end uses (Figure 1). The largest emissions category is on-road transportation, which accounts for nearly half of emissions (47 percent). Moreover, energy consumed by passenger cars and light-duty vehicles (pick-up trucks, sport utility vehicles), primarily gasoline for personal transportation, accounts for about 89 percent of on-road transportation emissions, and about 41 percent of total emissions in the region.

Figure 1: Summary of Greenhouse Gas Emissions by End-Use Category

GHG emissions can also be analyzed by economic sector. As shown in Figure 2, the residential sector (i.e., passengers cars, light-duty trucks, electricity and natural gas consumption) accounts for more than half (56 percent) of all regional emissions. This indicates that energy used by residents move around the region and how they consume energy at home are significant contributors to regional GHG emissions.
Regional Greenhouse Gas Emissions Projections

Under a business-as-usual scenario in which current energy use trends and policies do not change, GHG emissions in the region will be approximately 43 MMT CO₂E in 2020, approximately 26% greater than the 2006 level and 48% higher than the 1990 level. Emissions would be even greater in 2030 under a business-as-usual scenario. The projected increases in energy consumption and GHG emissions for on-road transportation, natural gas and electricity are provided below in Figures 3-8.

Figure 3: Projected On-road Fuel Consumption, 2007-2020

Source: Energy Policy Initiatives Center, University of San Diego, 2008.
**Figure 4: Projected Greenhouse Gas Emissions from On-road Consumption, 1990-2020**

Source: Energy Policy Initiatives Center, University of San Diego, 2008.

**Figure 5: Projected Natural Gas Consumption, 2007-2030**

Source: Energy Policy Initiatives Center, University of San Diego, 2008.

**Figure 6: Projected Greenhouse Gas Emissions from Natural Gas Consumption, 1990-2030**

Source: Energy Policy Initiatives Center, University of San Diego, 2008.
Greenhouse Gas Reduction Targets

The California Global Warming Solutions Act of 2005 (Assembly Bill 32, Statutes of 2006) requires GHG emissions to be reduced to the 1990 level by 2020; about 15 percent below current levels. In addition, Executive Order S-3-05 establishes a long-term goal for GHG emissions equal to 80 percent below the 1990 level by 2050. Although not required by statute, the 2050 target is based on the level of emissions reduction required for climate stabilization and used as the long-term driver for state policy development.

Although the state does not set reduction targets for specific geographic region of the state, the theoretical emissions reductions necessary to reduce emissions to the 2020 and 2050 targets illustrates the magnitude of change the region needs to make over the next four decades (Figure 9). It should be noted that deep cuts in GHG emissions must occur during a period of projected growth in population and economic output.
The Regional Energy Strategy Approach to Climate Change

Achieving the 2020 target will likely focus efforts to use energy more efficiently, while the 2050 target for GHG emission reductions will require fundamental change in how we use energy. Fortunately, we have already started on a path to a cleaner and more energy efficient future. The Regional Energy Strategy identifies recommended actions that build on existing efforts to start the region on a long-term path to do its part for climate stabilization.

Strategies for On-Road Transportation

The three primary strategies for reducing GHG emissions from fuel use in the on-road transportation sector are to: (1) improve vehicle fuel efficiency, (2) reduce the carbon content of transportation fuels, and (3) better integrate land use patterns and transportation infrastructure through improved planning.

The State has adopted the Light-Duty Vehicle Greenhouse Gas Standards and Low Carbon Fuel Standard (LCFS) to improve vehicle fuel efficiency and increase the availability and diversity of low-carbon fuels, respectively. Section 8, Transportation Fuels, identifies how the region can contribute to the deployment of low-carbon alternative fuels, vehicles, and infrastructure to local governments and the general public. Senate Bill 375 (Statutes of 2008) requires metropolitan planning organizations (MPOs) such as SANDAG to achieve GHG emissions reduction targets from passenger cars and light-duty trucks through improved land use and transportation planning. Section 9, Land Use and Transportation Planning, describes how the region can reduce energy consumption from passenger cars and light-duty trucks through improved land use and transportation planning. A major focus is on the need for land use planning and transportation investments to support energy efficient transportation choices like walking, bicycling, and public transit as well as shorter vehicle trips.

Strategies for Electricity Generation and Natural Gas End Uses

The primary strategies for reducing GHG emissions from electricity generation and natural gas end use are increasing energy efficiency and reducing the carbon intensity of electricity supplies.

Energy Efficiency

Energy efficiency measures for both electricity and natural gas can significantly reduce GHG emissions. The primary focus is on improving energy efficiency for both existing building stock and new construction. In particular, the existing building stock presents a significant opportunity to achieve major improvements in energy efficiency. Much of the region’s building stock is already on the ground, and substantial new building stock will be added between now and 2030. Buildings typically have a lifespan of several decades. As a result, it is important to reduce emissions from both the existing building stock and new construction.

The strategies to improve building energy efficiency include Zero Net Energy (ZNE) buildings, voluntary and mandatory measures to achieve energy efficiency beyond minimum requirements for new construction, voluntary and mandatory energy-saving retrofits for existing buildings, and improved compliance and enforcement of energy efficiency standards. Increased installation of high efficiency technologies like solar hot water heaters and cogeneration systems are additional strategies to offset natural gas use and meet energy needs more efficiently. And finally, funding and financing strategies are essential to successfully increasing energy efficiency and reducing GHG emissions from the region’s building stock. For more on Energy Efficiency, please refer to Section 1.

Carbon Intensity of Energy Supplies

In addition to improved energy efficiency, reducing GHG emissions from electricity and natural gas requires the increased installation of renewable energy sources, including renewable onsite power systems such as photovoltaic solar panels and utility-scale electricity projects taking advantage of solar and wind resources. Clean, nonrenewable onsite power systems and the most efficient, state-of-the-art utility-scale natural gas plants also are needed to reduce the GHG intensity of the region’s energy supply. Please see Section 2 for more discussion of regional goals and actions related to renewable energy. Natural gas is discussed in Section 7.
Although resources like biomass, geothermal, and small-scale hydroelectric generation can provide baseload power, other renewable resources are intermittent (wind) or variable over time (solar). As a result, integration of intermittent generation into the electricity system will require grid improvements to accommodate the variation in power availability and improve grid reliability such as improved communications technology, automated demand response, and other modern technologies. Recommended actions to improve demand response and implement the smart grid are discussed in sections 5, Peak Demand, and 6, The Smart Grid, respectively.

Energy-Water-Climate Change Connection

In the San Diego region, water and energy resources – and therefore climate change – are closely connected. 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 also is used to dispose of wastewater and power the large pumps that move water throughout the state. GHG-emitting fossil fuels are the primary source of the embedded energy in water. As of 2005, water-related energy use consumes 19 percent of the state’s electricity, 30 percent of its non-electricity generation natural gas consumption, and 88 million gallons of diesel fuel every year. Moreover, water demand continues to grow. End-uses, like landscape irrigation and clothes washing, are the highest amount of water-related energy use. On the other hand, water providers have the opportunity to offset their energy consumption and even contribute to regional goals for renewable electricity by generating hydroelectric power through pumped storage projects, or onsite generation of renewable electricity.

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 off 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. Recommended actions are provided in Section 4, Energy and Water.

The Effect of Climate Change on Energy Consumption

Environmental changes caused by climate change also will impact energy production. 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 and increase risk of flooding. As a result, 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. Lost hydropower generation would have to be replaced with electricity generated from renewable sources, or else GHG emissions from electricity generation would increase.

In addition, increased average temperatures and longer and more extreme heat events associated with climate change are expected to increase peak demand for electricity. In many cases, relatively inefficient and high GHG-emitting “peaker plants” are utilized to meet peak demand. 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.

Conclusion

The goals and recommended actions of the Regional Energy Strategy described above will help the region meet its energy needs while beginning and making substantial progress on a path to clean, low carbon energy future. Please refer to SANDAG’s Regional Climate Action Plan for more details on the region’s response to global climate change.