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1 EXECUTIVE SUMMARY

The San Diego Regional Energy Innovation Network (SDREIN) brings together organizations in San Diego, Imperial, Riverside, and San Bernardino counties to connect entrepreneurs to facilities, training, and resources that will help accelerate market adoption of their energy innovations and transform the region’s energy system.

The SDREIN is composed of academic institutions, business organizations, nonprofits, accelerators, and incubators, including Cleantech San Diego, CONNECT, EvoNexus, San Diego Venture Group, Imperial Valley Economic Development Corporation, Inland Empire Economic Partnership, Center for Sustainable Energy, San Diego State University, University of California San Diego, and University of San Diego.

The SDREIN’s primary goal is to advance commercialization and adoption of energy innovations that will overcome barriers to meeting state energy goals by leveraging and building on the team’s existing programs, resources, and opportunities in entrepreneurship and advanced energy technology.

1.1 Purpose of the Report

As defined in the SDREIN Scope of Work, the goal of Task 2 is to identify priority energy technology needs in the San Diego Region. To achieve this goal, Task 2 required the SDREIN project team to complete the following:

- Assess regional energy needs and opportunities using market analysis and regulatory documentation.
- Establish regional energy technology priorities that will be used to match applicant technologies to state energy targets.
- Conduct a review of state energy goals and create a Report of Regional Energy Technology Priorities and Needs.

This report is intended to present an enduring framework to help the SDREIN select energy companies to participate in the program and to assess the potential impacts of their technologies on state energy and climate policy targets and goals. Given the timeframe for completion, this first report presents the results of preliminary evaluation of regional characteristics and policies to identify and prioritize technology needs and will be updated over time to reflect changes in energy policies, EPIC Investment Plan funding initiatives, and other relevant factors affecting designation of technology priorities and needs. The report also describes a strategy to update the document to include additional research and to accommodate changes in policy and market conditions.

1.2 Framework for Selecting Priority Technologies

Figure 1 provides an overview of the framework used to select priority technology areas for the SDREIN project region. The first step is to identify policies in these categories at the federal, state, and local levels, which create an overall summary of the policy framework that supports or encourages various energy technology types. The next step is to assess unique characteristics of the SDREIN project region. This is done by reviewing demographic and economic data, as well as energy trends and patterns. Based on this assessment, key insights related to energy technology
innovation are identified. These insights are compared with the funding initiatives in the EPIC Investment Plan to determine which match best with regional needs. The final step is to use these high-priority areas to develop technology categories that can be used by the SDREIN project team during the intake and management process.

**Figure 1 Framework for Evaluating Technology Priorities**

![Figure 1 Framework for Evaluating Technology Priorities](image)

1.3 **Policy and Regulatory Framework**
For the purposes of organizing a framework for evaluating and identifying energy technology priorities, we designate greenhouse gas (GHG) emissions reductions as the overall goal, because while most or all of the other policy targets serve to reduce emissions, this is not the primary goal of the other policy targets. Experts generally agree on a three-pronged strategy to meet long-term GHG emissions reduction targets in the energy sector: (1) reduce consumption; (2) decarbonize electricity; and (3) electrify transportation and other traditional natural gas loads (Figure 2).
The EPIC Investment Plan funding areas presented above match well to this structure. Even though the EPIC Investment Plan includes some electric vehicle-related funding areas — given the importance of GHG emissions reduction in the transportation sector — we added a Clean Transportation category to better organize policy and technology priorities.

Figure 2 Greenhouse Gas Reduction Policy Framework

Figure 2 also shows the state and regional policies in each category. Given the relative roles of state and local authority, the vast majority of policies affecting the energy sector are driven by state law and associated regulations. At the local level in our region, most energy-related policies and programs are related to Climate Action Plans or General Plan Updates that address energy or climate in some way.
1.4 Regional Characteristics

An assessment of regional characteristics yielded relevant information for selecting technology priorities. The following provides a summary of the key points from this assessment:

- **Geographic Scope** - The SDREIN project covers San Diego, Imperial, Riverside, and San Bernardino Counties. The broader project region covers most of Southern California, excluding Los Angeles, and represents about 20% of California’s land area. The region is geographically diverse, covering numerous climate zones, including coastal, inland valleys, mountains, and desert. San Bernardino County is the largest County, with over 20,000 square miles of land area, but has a relatively low population density. On the other hand, San Diego County is relatively small in terms of land area (4,207 square miles) but has by far the highest population density.

- **Population** - The total population in the four-county region was nearly 8 million in 2015 and is expected to be about 10.5 million in 2040. Riverside County will experience the most growth with a nearly 50% increase over its 2015 population by 2040. San Diego County will experience a 25% increase in that same timeframe, the least among the four counties.

- **Population by Climate Zone** - A significant majority of the land area is located in climate zones 14 and 15, yet most of the population is located in zones 7 and 10, in which 29% and 54% of the total regional population is located, respectively. Because nearly 70% of the population is located in Climate zones 10, 14, 15, and 16, the region has a higher than average per capita energy consumption and peak demand.

- **Housing** - The total housing stock of the SDREIN project region of 2.9 million will grow to 3.2 million by 2040. Housing in Riverside and Imperial Counties will increase by about 35% by then, with San Bernardino and San Diego housing increasing by 30% and 25%, respectively.

- **Economy** - The projected total gross domestic product (GDP) for the SDREIN project region is approximately $330 billion for 2015. San Diego County has the largest GDP with nearly $200 billion, followed by the Riverside-San Bernardino-Ontario metropolitan area. All areas have experienced growth since 2010. The overall economy in the Riverside-San Bernardino-Ontario area grew by 3.8% over 2010 levels, San Diego County by 2.5%, and El Centro (Imperial County) by 2.2%. There are several significant industry clusters in the region, including military and defense, life sciences, and clean technology.

---

• **Electricity** - San Diego County accounts for about 40% of total electricity consumption within the region.\(^5\) Riverside and San Bernardino each consume about 30% of the total. Total electric consumption in the region has increased steadily from 1990-2014 but has begun to show signs of leveling off. Annual peak demand has grown steadily for the San Diego Gas & Electric (SDG&E) (San Diego County) and the Southern California Edison (Riverside County and San Bernardino County) since 1990. SDG&E peak demand has grown by about 70%, while SCE’s peak has grown by about 35%.\(^6\)

• **Natural Gas** - Over the period from 1990-2010, total natural gas consumption has been relatively steady. This trend also holds for both residential and non-residential consumption.

• **Greenhouse Gas Emissions from Energy** - Energy-related GHG emissions account for a significant majority of emissions in the SDREIN project region. While it is difficult to accurately compare across jurisdictions, given differences in calculation method and the number of emissions categories included, energy-related emissions range between 60%-90% of total GHG emissions.\(^7\) On-road transportation generally represents the highest share of emissions, accounting for between 40%-60% of emissions. Electricity and natural gas, generally used to power buildings, represent between 20%-50% of emissions.

• **Large-Scale Renewable Energy** - Nearly 6,000 MW of large-scale energy generation is located within the SDREIN project region.\(^8\) Table 1 shows the breakdown by technology for each County. Riverside and Imperial Counties each account for about 35% of the total project capacity. San Bernardino accounts for about 26%, while San Diego County has only 3% of projects on a capacity basis. Photovoltaic projects account for 42% of project capacity, followed by solar thermal (22%), wind (18%), and geothermal (13%). Riverside and

---


\(^6\) The SDG&E service territory covers nearly all of San Diego County so the load factor is an accurate representation for the San Diego region. Conversely, SCE’s service territory consists of more than just Riverside and San Bernardino Counties so it is unclear whether the load factor is an accurate representation of those counties.


Imperial Counties each have over 900 MW of photovoltaics installed. San Bernardino County has nearly 1,000 MW of solar thermal capacity.

Table 1 Capacity of Renewable Energy Projects by County (as of June 2016)

<table>
<thead>
<tr>
<th>Technology Type</th>
<th>Riverside County</th>
<th>Imperial County</th>
<th>San Bernardino County</th>
<th>San Diego County</th>
<th>Total</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar thermal</td>
<td>250</td>
<td>-</td>
<td>999</td>
<td></td>
<td>1,249</td>
<td>22%</td>
</tr>
<tr>
<td>Photovoltaic (PV)</td>
<td>984</td>
<td>929</td>
<td>451</td>
<td>65</td>
<td>2,429</td>
<td>42%</td>
</tr>
<tr>
<td>Small hydroelectricity</td>
<td>50</td>
<td>93</td>
<td>38</td>
<td>13</td>
<td>194</td>
<td>3%</td>
</tr>
<tr>
<td>Wind</td>
<td>699</td>
<td>265</td>
<td>7</td>
<td>51</td>
<td>1,022</td>
<td>18%</td>
</tr>
<tr>
<td>Biomass</td>
<td>59</td>
<td>-</td>
<td>3</td>
<td>44</td>
<td>106</td>
<td>2%</td>
</tr>
<tr>
<td>Geothermal</td>
<td>-</td>
<td>718</td>
<td>-</td>
<td>-</td>
<td>718</td>
<td>13%</td>
</tr>
<tr>
<td>Total</td>
<td>2,042</td>
<td>2,005</td>
<td>1,498</td>
<td>173</td>
<td>5,718</td>
<td>100%</td>
</tr>
</tbody>
</table>

% of Total

- 36%
- 35%
- 26%
- 3%

• Penetration of Distributed Energy Resources - The SDREIN project region has a high concentration of distributed generation technologies. Table 2 summarizes the penetration of these technologies for each County.

Table 2 Penetration of Distributed Generation Technologies

<table>
<thead>
<tr>
<th>Technology Type</th>
<th>San Diego</th>
<th>Riverside</th>
<th>Imperial</th>
<th>San Bernardino</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Distributed Solar Photovoltaic Capacity (MW)</td>
<td>570 MW</td>
<td>353 MW</td>
<td>0 MW</td>
<td>239 MW</td>
</tr>
<tr>
<td>Total Distributed Solar Photovoltaic Projects</td>
<td>85,149 projects</td>
<td>48,292 projects</td>
<td>13 projects</td>
<td>32,258 projects</td>
</tr>
<tr>
<td>Advanced Energy Storage Installed and Rebated through SGIP (MW)</td>
<td>8.4 MW</td>
<td>1.4 MW</td>
<td>No information available</td>
<td>2.8 MW</td>
</tr>
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1.5 Key Insights from Regional Analysis

Based on the regional characteristics above, several preliminary insights emerge as criteria to help prioritize the existing CEC EPIC funding initiative areas and to identify possible additional categories. Each key insight includes several factors that are used to screen the EPIC funding areas.

- Growing Population in Climate Zone 10 - The majority (54%) of the SDREIN project region’s population is currently located in climate zone 10 (CZ 10) and much of the growth in population and housing is expected in this same climate zone. In addition, climate scientists expect temperatures to increase over the coming decades, which is likely to

increase electricity consumption in this zone. There likely will be an increased need for energy efficiency in existing buildings, including efficient HVAC and envelope and demand management, and energy management technologies to shift demand like those contemplated in AB 793. Also, a similar need will likely exist for new buildings to be efficient. Key regional priorities and needs arising from this insight include the following:

- Increase use of efficient HVAC and envelope in existing buildings
- Increase use of demand management technologies and strategies
- Increase use of energy project financing
- Enhance software and models to identify and optimize efficiency investments

• **High Penetration of Customer-Sited Photovoltaics** - The SDREIN project region accounts for over 1,100 MW of customer-sited photovoltaics (PV). San Diego County has one of the highest concentrations of PV in the U.S. Innovation is needed to help to integrate PV more effectively into electric distribution networks and to optimize performance on the customer side of the meter. Key regional priorities and needs arising from this insight include the following:

  - Higher efficiency modules to increase production per area of installed capacity
  - Advanced inverters to increase conversion efficiency and address possible power quality issues
  - Energy storage solutions to couple with onsite PV
  - Software and optimization control schemes for managing energy in a home or business.

• **Need for Higher Penetration and Integration of Electric Vehicles** – The transportation sector accounts for over 40% of overall GHG emissions from in the region. There are many solutions to reduce emissions from the transportation sector, but for the purposes of identifying priority technology areas, advancing the use of electric vehicles is a key strategy, particularly as the carbon intensity of grid power declines with the implementation of the Renewable Portfolio Standard. Key regional priorities and needs arising from this insight include the following:

  - Breakthrough energy storage technology to increase driving range
  - Vehicle-Grid Integration (VGI) technology, particularly focused on the cycling issue
  - Smart charging technologies and strategies

• **Need for Efficiency and Decarbonization of the Water Cycle** - Each aspect of the water cycle uses energy. From supply and conveyance to treatment and distribution to waste water treatment, energy is an important aspect of the water cycle in California. Because the SDREIN region is one of the furthest from water sources in the North and East of the state, the embedded energy and carbon in a gallon of water consumed in this region – particularly in San Diego County, the southernmost County in California – is higher than in other areas in the state. Key regional priorities and needs arising from this insight include the following:

  - Reduce energy intensity of water by increasing efficiency of the entire water cycle
  - Reduce energy inputs for desalination
• **Increasing Attention on Climate Action Planning** - There has been significant climate planning within the SDREIN project region. Most of the largest jurisdictions have completed a climate action plan with targets to reduce GHG emissions. The largest emissions category is generally transportation, followed by electricity and natural gas. Key regional priorities and needs arising from this insight include the following:

  - Increase efficiency of existing building stock
  - Electrify the on-road transportation fleet
  - Deploy energy storage to help integrate high penetration of renewable electricity supply
  - Integrate high levels of distributed renewable electricity from photovoltaics

• **Large Military Presence/Military has Significant Efficiency and Renewable Energy Goals** - The SDREIN region has a high concentration of military bases and employment. The federal government has set ambitious energy efficiency and renewable energy targets for the military. Energy technologies relevant to military operations could serve an important role in helping meet federal targets and also could create a significant market for innovative energy technologies. Key regional priorities and needs arising from this insight include the following:

  - Increase building efficiency
  - Increase on-site renewable electricity production
  - Develop microgrids

• **High Concentration of Large-Scale Renewable Energy Projects and Potential for More** - The SDREIN region has significant renewable energy resources. About 30% of the renewable energy capacity installed in California is located in Riverside, Imperial, and San Bernardino Counties. As California increases its supply of renewable electricity, it is likely that more renewables will be installed in this region. Key regional priorities and needs arising from this insight include the following:

  - Reduce the role of water in certain renewable generation technologies
  - Increase efficiency of renewable energy technologies
  - Integrate greater percentage of large-scale renewables into the grid

### 1.6 SDREIN Technology Priority Areas

Based on the key regional insights described above, the SDREIN project technology priorities in each of the four categories are presented in Figure 3. Several technologies provide multiple benefits and serve more than one state policy goal. For example, electric transportation technologies reduce emissions from on-road transportation and with smart charging can also shift load to help integration of renewable energy. Similarly, increasing renewable electricity supplies reduces emissions in the electric sector but also reduces emissions from the on-road transportation sector when vehicles are powered by electricity.
### Figure 3 Technology Priority Areas by Category

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<th>Clean Generation</th>
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<td>Envelope Efficiency</td>
<td>Hydroelectric and Related Technology</td>
</tr>
<tr>
<td>Lighting Efficiency</td>
<td>Wind and Related Technology</td>
</tr>
<tr>
<td>HVAC Efficiency</td>
<td>Solar and Related Technology</td>
</tr>
<tr>
<td>Plug Load Efficiency</td>
<td>Geothermal and Related Technology</td>
</tr>
<tr>
<td>Pump/Other Equipment Efficiency</td>
<td>Wave and Related Technology</td>
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<td>Energy Management Technologies</td>
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<tr>
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<th>Clean Transportation</th>
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<tbody>
<tr>
<td>Mechanical Energy Storage</td>
<td>Battery Electric Vehicle Technologies</td>
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<td>Electrochemical Energy Storage</td>
<td>Hybrid Electric Vehicle Technologies</td>
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<td>Electrical Energy Storage</td>
<td>Electric Vehicle Charging Infrastructure</td>
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<tr>
<td>Thermal Energy Storage</td>
<td>Software Platforms</td>
</tr>
<tr>
<td>Smart Grid/Metering Hardware,</td>
<td></td>
</tr>
<tr>
<td>Software, Data Analytics</td>
<td></td>
</tr>
<tr>
<td>Microgrids</td>
<td></td>
</tr>
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</table>
2 INTRODUCTION

2.1 San Diego Regional Energy Innovation Network Overview
The San Diego Regional Energy Innovation Network (SDREIN) brings together organizations in San Diego, Imperial, Riverside, and San Bernardino counties to connect entrepreneurs to facilities, training, and resources that will help accelerate market adoption of their energy innovations and transform the region’s energy system.

The Cluster is composed of academic institutions, business organizations, nonprofits, accelerators, and incubators, including Cleantech San Diego, CONNECT, EvoNexus, San Diego Venture Group, Imperial Valley Economic Development Corporation, Inland Empire Economic Partnership, Center for Sustainable Energy, San Diego State University, University of California San Diego, and University of San Diego.

The San Diego Regional Energy Innovation Network’s primary goal is to advance commercialization and adoption of energy innovations that will overcome barriers to meeting state energy goals by leveraging and building on the team’s existing programs, resources, and opportunities in entrepreneurship and advanced energy technology. Products and processes generated from this program will also provide benefits to SDG&E and SCE ratepayers by improving grid reliability, increasing safety, lowering consumer costs, reducing greenhouse gas (GHG) emissions, and creating new jobs in the energy sector. In order to achieve this goal, the SDREIN will (1) provide customized entrepreneurial services, including education/training, business development, testing facilities, and advisory support to accelerate the successful deployment and commercialization of energy innovations that address the technological needs of the San Diego region; and (2) organize collaborations and regional planning around energy innovations that will benefit SDG&E and SCE ratepayers. The SDREIN anticipates providing services for 20 to 25 entrepreneurs annually based on the number of participants in existing programs and the ability to support additional innovation.

2.2 Purpose of the Document
As defined in the SDREIN Scope of Work, the goal of Task 2 is to identify priority energy technology needs in the San Diego Region. To achieve this goal, Task 2 required the SDREIN project team to complete the following:

- Assess regional energy needs and opportunities using market analysis and regulatory documentation.
- Establish regional energy technology priorities that will be used to match applicant technologies to state energy targets.
- Conduct a review of state energy goals and create a Report of Regional Energy Technology Priorities and Needs.

This report is intended to present an enduring framework to help the SDREIN select energy companies to participate in the program and to assess their potential impacts of their technologies on state energy and climate policy targets and goals. Given the timeframe for completion, this first report presents the results of preliminary evaluation of regional characteristics and policies to identify and prioritize technology needs and will be updated over time to reflect changes in energy
policies, EPIC Investment Plan funding initiatives, and other relevant factors affecting designation of technology priorities and needs. The report also describes a strategy to update the document to include additional research and to accommodate changes in policy and market conditions.

2.3 Structure of this Report
Section 2 of this report presents the overall process used for evaluating and selecting technology priorities and needs. The results of a detailed review of relevant federal, state, and local energy and climate policies are presented in Section 3. This serves as the policy framework to help link energy technologies to policy priorities and contribute to the eventual assessment of impacts for participating projects. Section 4 presents the results of a detailed review of regional characteristics relevant to the evaluation of technology priorities. Section 5 identifies key insights from the work in Section 4 that are used to identify the most relevant technology areas from the EPIC Investment Plan funding initiatives. Technology categories used for the intake process are presented in this section. Section 6 presents a roadmap for future reports, including areas identified for further market assessment and technology assessment.

3 FRAMEWORK FOR SELECTING TECHNOLOGY PRIORITIES

The overall framework for selecting the technology priorities for the SDREIN is a multi-step process that draws from the EPIC Investment Plan, California’s state policy framework to reduce GHG emissions through energy efficiency, renewable energy, and clean transportation, and an assessment of characteristics within the four-county SDREIN project region.

3.1 EPIC Investment Plan
The framework used here relies on the structure of the EPIC investment plan, which is broken into three funding areas:\(^\text{11}\)

- **Applied Research and Development (Applied R&D)** includes activities to support pre-commercial technologies and approaches at applied lab-level or pilot-level stages.
- **Technology Demonstration and Deployment** involves installation and operation of pre-commercial technologies or strategies at a scale that will reflect actual operating, performance, and financial characteristics and risks.
- **Market Facilitation** focuses on a range of activities, such as commercialization assistance, local government regulatory assistance and streamlining, market analysis, and program evaluation to support deployment and expand access to clean energy technologies and strategies.

For the purposes of selecting technology priority areas for the SDREIN, we focus on the Applied R&D program area. While the Technology Demonstration and Deployment and Market Facilitation funding areas are important to the overall energy innovation ecosystem, they are not as useful to our purpose here to map regional technology priority areas to state policy priorities and goals.


\(^{11}\) Ibid.
In addition to the categories shown in the figure above, the EPIC Investment Plan also includes a category called “cross-cutting.” We did not include this here because the funding initiatives were not directly applicable to determining technology priorities. However, the cross-cutting category is
included in the policy section of this report to capture policies that do not fit into any one category, such as residential rate reform, energy storage, the water-energy nexus, and integrated distributed energy resources.

3.1.1 CEC EPIC Ratepayer Impacts (PRC 25711.5(a))

Pursuant to California Public Resources Code Section 25711.5(a) added by SB 96 (2013), EPIC awards are designed to benefit electricity ratepayers by funding projects that will lead to technological advancement and breakthroughs that overcome barriers to the state’s statutory energy goals. The EPIC program is designed to fund a strategically-focused and sufficiently narrow portfolio of projects that will advance the most significant technological challenges in areas that include energy storage, renewable energy and its integration into the grid, energy efficiency, integration of electric vehicles into the grid, and accurately forecasting the availability of renewable energy on the grid.

The mandatory guiding principle of EPIC is to “invest in clean energy technologies and approaches that provide benefits to electricity ratepayers that promote greater reliability, lower costs, and increase safety.” EPIC also operates with the following complimentary principles:

- Achieving greenhouse gas (GHG) emissions mitigation and adaptation in the electricity sector at the lowest possible costs;
- Supporting the Loading Order;
- Advancing low-emission vehicles and transportation;
- Supporting economic development; and
- Using ratepayer funds efficiently.

The EPIC program also considers principles conveyed in California Public Utilities Code Sections 740.1 and 8360 governing utility research, development, and demonstration (RD&D) and electrical transmission and distribution, respectively.

3.2 Framework for Evaluating Technology Priorities

The EPIC Investment Plan funding areas serve as the starting point for the SDREIN framework for evaluating technology priority areas. In addition to the three funding areas presented in Figure 4, we have separated out clean transportation given its importance in GHG emissions reductions and the penetration levels of electric vehicles in the project region. Also, we modified the name of the first category to be “Energy Efficiency and Demand Management” to indicate a broader need for demand management technologies that are reflected in the regional priorities described in Section 6. These areas serve as the top layer and organizing structure of the framework presented in this report. (Figure 5)

The first step is to identify policies in these categories at the federal, state, and local levels, which create an overall summary of the policy framework that supports or encourages various energy technology types. The next step is to assess unique characteristics of the SDREIN project region. This is done by reviewing demographic and economic data, as well as energy trends and patterns.

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13 Ibid.
Based on this assessment, we identified key insights related to energy technology innovation. These insights are compared with the funding initiatives in the EPIC Investment Plan to determine which match the best with regional needs. The final step is to use these high-priority areas to develop technology that can be used by the SDREIN project team during the intake and management process.

**Figure 5 Framework for Evaluating Technology Priorities**

4 **POLICY AND REGULATORY FRAMEWORK**

For the purposes of organizing a framework for evaluating and identifying energy technology priorities, we designate GHG emissions reductions as the overall goal, because while most or all of the other policy targets serve to reduce emissions, this is not the primary goal of the other policy targets. For example, energy efficiency programs are designed to reduce consumption, which contributes to reducing emissions. Experts generally agree on a three-pronged strategy to meet long-term GHG emissions reduction targets in the energy sector: (1) reduce consumption; (2)
decarbonize electricity; and (3) electrify transportation and other traditionally natural gas loads (Figure 6).

The EPIC Investment Plan funding areas presented above match well to this structure. Even though the EPIC Investment Plan includes some electric vehicle-related funding areas — given the importance of GHG emissions reduction in the transportation sector — we added a Clean Transportation category to better organize policy and technology priorities.

Figure 6 Greenhouse Gas Emissions Reduction Policy Framework

4.1 Role of Federal, State, and Local Policy
For each of the EPIC funding areas presented in Figure 6, this report identifies relevant laws, regulations, policies, and resulting programs. At the federal level, executive orders, statutes, and regulations define priorities and determine procurement directives for technology as well as what types of technologies can participate in electric wholesale markets. State level executive orders, statutes, and regulations set directives for policy implemented by relevant agencies in the form of rulemaking, incentives, and programs. At the local level, land use and planning authority is used to adopt ordinances, general plans, and GHG emissions reductions or Climate Action Plans that define priorities for building and transportation. Together, these serve as a foundational framework to help define the needs and market potential for technology in the EPIC funding areas. This section provides a summary of the relevant policies and regulations that could directly or indirectly encourage energy technology innovation and can serve as the basis for more specialized and specific briefs for participating companies.

4.2 Greenhouse Gas Policy
In many ways, GHG emissions reduction policy has become the overarching policy for other energy-related policies. That is, energy efficiency, clean energy generation, and clean transportation all contribute to overall GHG emissions reduction. A commonly accepted, long-term strategy to reduce GHG emissions is to increase efficiency, decarbonize the electricity supply, and electrify transportation and other loads. In this respect, GHG emissions reduction policy provides a context for the specific policies discussed below. Nonetheless, separate GHG-related policies exists at all levels of government.
4.2.1 Federal Greenhouse Gas Policies

The U.S. does not have an overarching GHG emissions reduction policy in place. One pending regulation, the U.S. EPA’s Clean Power Plan (CPP) is described below.

4.2.1.1 Clean Power Plan

The U.S. EPA’s CPP for existing power plants operates under Section 111(d) of the Clean Air Act (CAA). The CPP sets interim and final CO₂ emission performance rates for both fossil fuel-fired electric steam generating units and natural gas-fired combined cycle units. California has the option to establish standards to achieve the required reductions in:

- A rate-based state goal measured in pounds per megawatt hour (lb/MWh);
- A mass-based state goal measured in total short tons of CO₂;
- A mass-based state goal with a new source complement measured in total short tons of CO₂.

California would then implement a state implementation plan (SIP) to achieve the interim CO₂ emissions performance rates over the period of 2022 to 2029 and the final CO₂ emission performance rates, rate-based goals or mass-based goals by 2030. The U.S. EPA established a best system of emission reduction (BSER) for CPP compliance in the form of three building blocks:

- **Building Block 1** - reducing the carbon intensity of electricity generation by improving the heat rate of existing coal-fired power plants.
- **Building Block 2** - substituting increased electricity generation from lower-emitting existing natural gas plants for reduced generation from higher-emitting coal-fired power plants.
- **Building Block 3** - substituting increased electricity generation from new zero-emitting renewable energy sources (like wind and solar) for reduced generation from existing coal-fired power plants.

On February 9, 2016, the U.S. Supreme Court stayed implementation of the CPP pending judicial en banc review by the U.S. Court of Appeals for the District of Columbia.

4.2.2 State Greenhouse Gas Policies

Unlike at the federal level in the U.S., California has enacted comprehensive GHG emissions reduction policies, including statutory reduction targets and a cap-and-trade program.

4.2.2.1 Statewide Greenhouse Gas Emissions Reduction Laws

The basis for California’s GHG policy stems from AB 32 (California Health and Safety Code Section 38500 et. seq.) which authorized GHG emissions reduction programs that include the Low Carbon Fuel Standard, Advanced Clean Car standards, and Cap-and-Trade (C&T). AB 32 mandated that GHG emissions be reduced to 1990 levels by 2020. AB 32 granted authority to the California Air Resources Board to develop and implement a scoping plan, rulemakings, methodologies, reporting requirements, compliance (e.g., cap-and-trade), and enforcement programs. CARB updated its original Scoping Plan in 2014 and is currently in the process of updating the Scoping Plan to reflect the 40% reduction below 1990 levels by 2030 target found in Executive Order S-3-05. The legislature and governor recently codified the 40% reduction below 1990 levels by December 31,
2030, with the charting of SB 32 (adding Health and Safety Code Section 38566) in the fall of 2016. Statewide emission targets extend to 2050 under Executive Order S-3-05 that requires an 80% reduction below 1990 levels. Additionally, SB 375 authorized the creation of 2020 and 2035 targets for GHG emissions reductions from passenger vehicles and land uses for each region covered by a state metropolitan planning organization (MPO).

4.2.2.2 Cap-and-Trade Regulation
AB 32 (2006) mandated that California reduce GHG emissions to 1990 levels by 2020. C&T represents one piece of the policy to achieve this goal through the authority of the California Air Resources Board (CARB). C&T sets a statewide limit on sources (covered entities) that emit 85% of California’s GHG emissions through the issuing of allowances that cap emissions. Trading, banking, offsets (up to 8% of a facility’s compliance obligation), and multi-year compliance periods form the basis of the C&T allowance market, which serves as a price signal to focus long-term investment in technology and fuels that decrease GHG emissions. The program covers 450 entities with a Phase I for electricity generators emitting 25,000 MTCO2e or more annually that began in 2013 and a Phase II that began in 2015 for distributors of transportation, natural gas, and other fuels. The 2013 cap was set at 2% below the emission levels forecast for 2012, with declines of approximately 2% in 2014 and approximately 3% annually from 2015-2020. C&T allows linkage with other similar programs in other states and regions and is currently linked to the province of Quebec. Covered entities must report emissions and additional data annually with third-party verification. CARB is currently undergoing an adjudication to amend the C&T regulations to deal with GHG accounting and reporting issues resulting from primary and secondary generator dispatches in the California Independent System Operator’s (CAISO) Energy Imbalance Market (EIM).14

California provides funding to multiple relevant programs from the GHG Reduction Fund. Funding for 2016-2017 related to electricity can be found below.

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14 See CARB, Mandatory GHG Reporting and Cap-and-Trade Program Workshop, October 21, 2016.
Table 3 California Climate Investments from the GHG Reduction Fund\textsuperscript{15}

<table>
<thead>
<tr>
<th>Program / Agency</th>
<th>Fiscal Year 2016-2017 Funding ($M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Speed Rail (HSRA)</td>
<td>25% Continuous Appropriation</td>
</tr>
<tr>
<td>Transit and Intercity Rail Capital Program (CalSTA)</td>
<td>$135 + 10% Continuous Appropriation</td>
</tr>
<tr>
<td>Transformative Climate Communities (SGC)</td>
<td>$140</td>
</tr>
<tr>
<td>Affordable Housing and Sustainable Communities</td>
<td>20% Continuous Appropriation</td>
</tr>
<tr>
<td>Program (CSD)</td>
<td></td>
</tr>
<tr>
<td>Clean Vehicle Rebate Project (ARB)</td>
<td>$133</td>
</tr>
<tr>
<td>Low Income Weatherization Program (CSD)</td>
<td>$20</td>
</tr>
<tr>
<td>Dairy Methane Program (CDFA)</td>
<td>$50</td>
</tr>
<tr>
<td>Agricultural Energy and Operational Efficiency</td>
<td>$8</td>
</tr>
<tr>
<td>Program (CDFA)</td>
<td></td>
</tr>
<tr>
<td>Urban Greening Program (NRA)</td>
<td>$80</td>
</tr>
</tbody>
</table>

4.2.3 Local Greenhouse Gas Policies

A number of jurisdictions that encompass the project region have adopted general plan updates in the form of Climate Action Plans (CAPs) or Greenhouse Gas Reduction Plans that guide land use and planning targets for building energy efficiency and renewable energy procurement. The following sections describe adopted policies in the project region.

4.2.3.1 Climate Action Plans

San Diego County

Many of the local governments within San Diego County have conducted significant climate planning activities. All have completed a GHG inventory, 10 have adopted CAPs, and five are currently developing a CAP. Table 4 summarizes this activity.

\textsuperscript{15} California Climate Investments from the GHG Reduction Fund, Transportation and Sustainable Communities, September 2016, accessed October 25, 2016: https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/final_expenditure_table_revised_10-6.pdf
Table 4 Summary of Climate Action Planning Activities in San Diego County

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>GHG Inventory (Latest Year)</th>
<th>Climate Action Plan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carlsbad</td>
<td>2011</td>
<td>2015</td>
</tr>
<tr>
<td>Chula Vista</td>
<td>2012</td>
<td>2000, 2008 Update underway</td>
</tr>
<tr>
<td>Coronado</td>
<td>2005</td>
<td>2012 Update underway</td>
</tr>
<tr>
<td>County of San Diego</td>
<td>2005 (unincorporated)</td>
<td>2012 (rescinded) Update underway</td>
</tr>
<tr>
<td>Del Mar</td>
<td>2012</td>
<td>2016</td>
</tr>
<tr>
<td>El Cajon</td>
<td>2012</td>
<td></td>
</tr>
<tr>
<td>Escondido</td>
<td>2010</td>
<td>2012</td>
</tr>
<tr>
<td>Imperial Beach</td>
<td>2005</td>
<td></td>
</tr>
<tr>
<td>La Mesa</td>
<td>2010</td>
<td>✓ (2017)</td>
</tr>
<tr>
<td>Lemon Grove</td>
<td>2013</td>
<td>✓ (2017)</td>
</tr>
<tr>
<td>National City</td>
<td>2005</td>
<td>2011</td>
</tr>
<tr>
<td>Oceanside</td>
<td>2013</td>
<td>✓ (2017)</td>
</tr>
<tr>
<td>Poway</td>
<td>2005</td>
<td></td>
</tr>
<tr>
<td>San Marcos</td>
<td>2005</td>
<td>2013</td>
</tr>
<tr>
<td>Santee</td>
<td>2013</td>
<td>✓ (2017)</td>
</tr>
<tr>
<td>Solana Beach</td>
<td>2012</td>
<td>✓ (2017)</td>
</tr>
<tr>
<td>Vista</td>
<td>2005</td>
<td>2012</td>
</tr>
</tbody>
</table>

The City of San Diego is the largest jurisdiction in the region by far, representing about 40% of the total population. The City adopted a legally-binding Climate Action Plan (CAP) in December of 2015 with robust policy directives to achieve sustainability goals. The goals in the CAP include 100% clean energy for the city by 2035. The plan is divided into phases to achieve incremental goals and benchmarks every few years with an annual review and report on progress. San Diego aims to reduce GHG emissions and reach 100% carbon-free electricity by 2035.

Some smaller jurisdictions in the San Diego region, such as Solana Beach, La Mesa, and Oceanside, are in planning and implementation phases for their climate action plans. The City of Del Mar adopted a 100% clean energy climate plan in 2016, and some of the north county coastal cities are assessing the feasibility of a community choice aggregation (CCA) method of energy procurement. The County of San Diego is in the process of revising its plan to address litigation challenging the original plan and gathering public input.

Other public agencies have adopted GHG emissions reduction plans. The San Diego Unified Port District adopted a Climate Action Plan in December 2013\(^{16}\) and the San Diego Association of

Governments (SANDAG) has adopted both a Regional Energy Strategy\textsuperscript{17} and Climate Action Strategy,\textsuperscript{18} which serve as regional policy documents.

**Riverside County**

The County of Riverside adopted a Climate Action Plan in December of 2015. The plan provides a list of actions to reduce GHG emissions to levels consistent with AB 32 and establishes a plan for future development to tier and streamline environmental analysis processes. Smaller cities within Riverside County are also developing plans to meet or exceed state-mandated goals. The City of Riverside put forth a “Riverside Restorative Growthprint” (RRG) which combines two plans – Riverside’s Economic Prosperity Action Plan and Climate Action Plan. The RRG-CAP contains GHG emissions reduction measures in the sectors of Energy, Transportation and Land Use, Water, and Solid Waste.

**San Bernardino County**

The San Bernardino Association of Governments (SANBAG) created a Regional Greenhouse Gas Reduction Plan in March 2014. Under this plan, SANBAG compiled an inventory of GHG emissions and reduction measures that can be adopted by the 21 Partnership Cities of San Bernardino to reduce GHG emissions to levels consistent with AB 32 by 2020. The identified reduction measures selected by the cities that compose SANBAG would reduce emissions from the region as a whole by 18% compared to 2008 baseline levels and 28% compared to 2020 business-as-usual (BAU) levels if all state and local measures are implemented effectively.\textsuperscript{19}

CAPs in San Bernardino include:

- Town of Apple Valley (July, 13, 2010): Identifies measures to reduce community-wide GHG emissions to 15% below 2005 levels by 2020;
- City of Hesperia (June 20, 2010): Outlines actions to reduce per capita GHG emissions 29% below projected levels by 2020; and
- Unincorporated San Bernardino County (September 2011): Reduces GHG emissions to 15% below 2007 levels by 2020.\textsuperscript{20}

The San Bernardino County General Plan (GP) supports the County of San Bernardino Greenhouse Gas Emissions Reduction Plan with the following measures:

- Reducing GHG emissions through reduced energy consumption, with implementation supported through the annual budget process.\textsuperscript{21}
- GHG emissions reduction plan that includes:

\textsuperscript{17} http://www.sandag.org/uploads/projectid/projectid_374_18168.pdf.
\textsuperscript{20} Ibid. at p. 2-12 - 2-13.
Measures to reduce GHG emissions attributable to the County’s operational activities, services and facilities, over which the County has direct responsibility and control;

Measures to reduce GHG emissions produced by private industry and development that is located within the area subject to the County’s discretionary land use authority and ministerial building permit authority; and

Implementation and monitoring procedures to provide periodic review of the plan’s progress and allow for adjustments over time to ensure fulfillment of the plan’s objective.22

• Incentives to promote siting and use of clean air technologies (e.g., fuel cell technologies, renewable energy sources, UV coatings, and hydrogen fuel).23

4.3 Energy Efficiency and Demand Management
Reducing energy use is a pillar of the overall strategy to reduce GHG emissions in California. Energy efficiency and demand management is a preferred energy resource in California energy policy. Local governments have also adopted policies and strategies to reduce energy use that leverage their land use and permitting authority.

4.3.1 State Efficiency and Demand Management Policies
In 2015, California officially committed to double statewide energy savings in Senate Bill 350 (2015). This ambitious goal builds on the state’s commitment to energy efficiency as a priority resource and a long history of energy efficiency programs and policies, including building and appliance standards (Title 24 Parts 6 and Title 20), ratepayer-funded energy efficiency programs, local government programs and partnerships, and research and technology development. Each of these areas is outlined in California’s Long Term Energy Efficiency Strategic Plan, most recently updated in January 2011.24

4.3.1.1 Codes and Standards
Building Energy Efficiency Standards (Title 24, Part 6) and Appliance Efficiency Standards (Title 20) continue to drive energy efficiency by setting floors for minimum performance in buildings (primarily new construction and major retrofit) and pushing appliance manufacturers towards greater efficiency and innovation. Title 24, Part 6 and Title 20 development is led by the California Energy Commission (Energy Commission) on a three-year cycle. The 2016 California Buildings Standards Code was published on July 1, 2016 and goes into effect January 1, 2017.

4.3.1.2 Existing Buildings Energy Efficiency Action Plan
Existing buildings are critical to meeting the state’s climate goals and offer the most significant opportunity to realize energy savings through innovative strategies. In 2009, the California legislature passed AB 758 (2009) that required the Energy Commission to develop a strategic plan
to achieve cost-effective energy efficiency in existing buildings. The final *Existing Buildings Energy Efficiency Action Plan* (EBEE) is the result of a comprehensive stakeholder process led by Energy Commission staff and Commissioner Andrew McAllister. As the *California Long Term Energy Efficiency Strategic Plan* is updated, the EBEE Action Plan is intended to fulfill the existing residential and commercial buildings strategy sections.\(^{25}\)

The EBEE Action Plan provides a roadmap for reducing building energy use 20% by 2030 by activating markets for energy efficiency. The plan sets five core goals for ramping up energy efficiency in commercial, multifamily, public, and residential buildings across the state.

1. Increased Government Leadership in Energy Efficiency
2. Data-driven Decision-making
3. Increased Building Industry Innovation and Performance
4. Recognized Value of Energy Efficiency Upgrades
5. Affordable and Accessible Energy Efficiency Solutions

Each of these goals includes strategies for catalyzing energy efficiency markets, reducing barriers to energy-saving measures and technologies, and improving or launching public efforts to facilitate greater energy efficiency across sectors. Within Goal 1 are “policies, initiatives and programs [targeted to] lead a long-term commitment to achieve energy efficiency at large scales”, including Strategy 1.2, Nonresidential Benchmarking and Disclosure, explained further below.

4.3.1.3 Assembly Bill 802

Benchmarking and transparency of monthly building energy use information are foundational steps to improve statewide energy management in large commercial and multifamily buildings and can inform improved policy and program design by local and state agencies, industry stakeholders, and program administrators to better target energy savings.

**AB 802 (2015)** was passed by the California legislature on September 11, 2015, and signed into law by Governor Jerry Brown on October 9, 2015. The bill includes three sections that deal with energy benchmarking.

**Section 1** – Requires the Energy Commission to create a benchmarking program through which building owners of commercial and multifamily buildings above 50,000 square feet will publicly report annualized benchmarking metrics, “which enables understanding of a building’s energy usage for improved building management and investment decisions.” This section aligns with the statewide benchmarking program discussed in the Energy Commission’s EBEE Action Plan, Section 1.2.

**Section 4** – Repeals the section of the Public Resource Code created by AB 1103 that required commercial building energy use disclosure at time of whole-building sale, lease or refinance.

Section 5 – Defines the terms by which utilities must provide whole-building energy use data to owners or their agents by January 1, 2017. This section sets the “aggregation thresholds” above which utilities must make monthly, whole-building energy information available as follows:

- Three or more active utility accounts, commercial only; and
- Five or more active utility accounts, residential or commercial.

For buildings with fewer utility accounts, building owners or agents will still need to request authorization from tenants for access to energy use information. Access to monthly whole-building energy use information is critical to the success of any benchmarking program. AB 802 ensures that building owners and operators will have access to this information to track energy consumption, improve energy management, and comply with state and local benchmarking and transparency policies.

The Energy Commission is currently in the process of finalizing AB 802 regulations. Public workshops, featuring informative presentations by the Energy Commission, were held on November 10, 2015, March 25, 2016, and July 22, 2016. Comments, presentations, and the draft regulations are located at energy.ca.gov/benchmarking.

4.3.1.4 Net Zero Energy
Net Zero Energy has also been a key driver for energy efficiency policy and program efforts. The Long-Term Energy Efficiency Strategic Plans embraces “Zero Net Energy Goals” previously established by the CPUC:

- All new residential construction in California will be zero net energy by 2020; and
- All new commercial construction and 50% of existing buildings in California will be zero net energy by 2030.

Executive Order B-10-12 (2012) also mandated State buildings to undertake water and energy efficiency improvements and requires that all new State buildings and major renovations after 2025 be constructed as Zero Net Energy facilities, with an interim target for 50% of new facilities beginning design after 2020. The state must also achieve Zero Net Energy for 50% of the square footage of existing state-owned building area by 2025.

Combined, these three goals have positioned Zero Net Energy as a vision for significantly improved building efficiency when combined with renewable energy generation. Of additional note, there is no single, official statewide definition for Zero Net Energy but rather a “Zero-Net-Energy Code” definition, a Department of Energy Definition, and a California Department of General Services.
definition that is consistent with the Department of Energy definition. This means that meeting the
goal depends on the specific program or regulation and definition applied.

4.3.1.5 Ratepayer Energy Efficiency Programs
Finally, ratepayer-funded energy efficiency programs represent $1.4 billion in annual energy
efficiency spending each year in investor-owned utility territories alone, with additional funding and
programs offered by public and municipal utilities. These programs, and the complex policies that
underpin them, can be effectively addressed in a future addendum to this report. This update will
be particularly ripe in Q2 2017, once a five-year Business Plans for ratepayer programs under the
auspices of the CPUC are approved.

4.3.1.6 Demand Management and Reduction
Demand response programs are a flexible energy reduction strategy that helps reduce grid peaks in
a cost-effective manner and enables customers to meet their energy needs at a reduced cost.
Demand management prioritizes shifting peak energy consumption and general consumption to
the time of day when there is greater generation.

In April of every year, PG&E, SCE, and SDG&E file reports with the CPUC to highlight demand
response program metrics as well as forecast for the future of these programs. The CPUC requires
the aforementioned California IOUs to integrate their demand response programs as resources
available for dispatch in the CAISO wholesale energy market.26

Per the recent CPUC Decision D.16-09-056, the IOUs are required to individually file applications by
January 16, 2017 to request approval of activities and funding for existing models of demand
response programs. The Decision also establishes a five-year budget cycle, with a mid-cycle review
and oversight by the CPUC.

4.3.2 Local Efficiency and Demand Management Policies
San Bernardino County Building Energy Reduction Measures

The San Bernardino County’s March 2011 General Plan Amendment and Greenhouse Gas
Reduction Plan document includes an environmental impact report (EIR), GHG inventory, and
subsequent plan to reduce GHG emissions. These measures depend on County permitting for
major retrofits or new builds and incentives for voluntary retrofits. Actions and programs specific to
the County of San Bernardino are described below:

• Residential Energy Efficiency Retrofits: Target of improving efficiency by 15% that assumes
  20% of residential dwellings existing in 2007 will be retrofit or renovated by 2020.27
• Commercial Energy Efficiency Retrofits: Assumes that 20% of commercial buildings existing
  in 2007 will be retrofit or renovated by 2020.28

26 Decision Adopting Guidance for Future Demand Response Portfolios and Modifying Decision 14-12-024,
September 29, 2016.
27 County of San Bernardino General Plan Amendment and Greenhouse Gas Reduction Plan, Draft Supplemental
28 Ibid. at p. A-49.
• Warehouse Renewable Energy Incentive Program: This measure would require that solar PV panels offset at least 50% of a warehouse’s electricity use.29
• Residential Energy Efficiency for New Development (Development Review Process (DRP))30: This measure is designed around meeting Zero Net Energy (ZNE) goals for residential buildings by 2020. This primarily depends on new residential buildings meeting more stringent Title 24 Energy Efficiency Standards and assuming that design for new residential construction is equivalent to 15% in excess of the 2008 Title 24 Energy Efficiency Standards.31 Additionally, energy efficiency design is assumed to improve 17% triennially in 2011, 2014, and 2017. The options to achieve this include: energy efficient appliances, efficient lighting, PV solar panels, solar water heaters, site and orientation of buildings, insulation, windows, passive ventilation, heating and cooling, and use of natural shade, skylights, and reflective surfaces in building design.32
• Commercial Energy Efficiency (DRP): This measure is designed around meeting ZNE for residential buildings by 2030. The 2008 Title 26 Energy Efficiency Standards are approximately 7% greater than the 2005 standards. Additionally, this measure assumes that energy efficiency design equivalent to 10% in excess of 2008 Title 24 Energy Efficiency Standards would be implemented for new commercial buildings.33 Non-residential standards are assumed to increase 7% triennially in 2011, 2014, and 2017. This measure assumes the same options available for residential energy efficiency for new development listed above.
• Green Building Development Facilitation and Streamlining: The County seeks to identify and remove regulatory or procedural barriers to implement green building practices in support of the Green County Program. This program provides permit-related (fee-waiver) and other incentives (priority plan review, processing, and field inspection) for energy efficient building projects.34
• Energy Efficiency and Renewable Energy Financing: The County seeks to encourage and utilize financing mechanisms, including PACE or other funding sources.35
• Off-Site Mitigation of GHG Impacts for New Development: Under this measure, the County seeks to develop a policy and/or guidelines for off-site mitigation of GHG impacts from new development projects in accordance with CEQA, including retrofitting off-site buildings to improve energy efficiency.36

30 The County’s Development Review Process (DRP) is composed of specified programs that review and implement requirements for new construction to achieve a 31% GHG emission reduction.
31 15% is the minimum requirement for LEED for Homes, Energy Star, and utility rebate programs.
33 10% is the minimum requirement for LEED new construction based on LEED 2009 for New Construction and Major Renovations.
34 Ibid. at p. A-55 – A-56.
36 Ibid.
San Bernardino has the following general policies related to energy efficiency:

- Promoting residential development with emphasis on energy-efficient design and siting options.37
- Encouraging the use of energy conservation features in new residential construction, remodeling, and existing homes through SCE’s existing conservation efforts.38
- Recognition of unique climatic and geographic opportunities that may create energy conservation and small-scale alternative energy systems:
  - Land use and building controls and incentives to ensure energy-efficient standards in new developments that comply with Title 24;
  - Quantifying local climate variations and required energy conservation system in new construction for each climatic region; and
  - Fully enforcing Title 24 standards.39
- New developments that incorporate energy-efficient technologies through weatherization, insulation, efficient appliances, solar energy systems, reduced energy demand, efficient space cooling and heating, water heating, and electricity generation.40
- All new subdivisions for which a tentative map is required will provide, to the extent feasible, for future natural heating or cooling opportunities in the subdivision. 41
- Promoting energy-efficient design features, including appropriate site orientation, use of lighter color roofing and building materials, and use of deciduous shade trees and windbreak trees to reduce fuel consumption for heating and cooling.42
- Promoting the use of automated time clocks or occupant sensors to control central heating and air conditioning.43

Imperial County

Imperial County operates with the following General Plan policies summarized below:

- Promote sustainable development by encouraging the inclusion of energy conservation features in new and existing housing stock. The following ongoing programs support this policy:
  - Promote the use of energy conservation measures to “weatherize” existing homes as part of the County’s rehabilitation program efforts; and
  - Continue to implement Title 24 Energy Conservation Requirements in housing design and rehabilitation efforts.44

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38 Ibid. at p. IV-8.
39 Ibid. at p. V-37.
40 Ibid.
41 Ibid.
43 Ibid. at p. 38.
44 County of Imperial, 2014-2021 Housing Element, Adopted September 17, 2013, p. 12.
4.4 Clean Generation
Increasing the use of clean and renewable electricity generation is another key pillar in the overall strategy to reduce GHG emissions. It is pivotal because decarbonized electricity will allow the transportation sector to convert to electricity as a fuel and current natural gas-fueled activities (e.g., water heating) to be served by lower emissions electricity.

4.4.1 Federal Clean Generation Policies
Federal tax credits include both the Renewable Electricity Production Tax Credit (PTC) and Business Investment Tax Credit (ITC). These credits provide incentives that form a major part of the value proposition for small to large renewable energy projects. The programs are summarized below.

4.4.1.1 Renewable Electricity Production Tax Credit
The PTC\(^{45}\) operates as an inflation-adjusted per kilowatt hour (kWh) credit for electricity generated by qualified energy resources that is sold at arms-length to an unrelated buyer during the taxable year.\(^{46}\) The credit duration is 10 years after the facility for most eligible\(^{47}\) technologies. The PTC applies the following inflation adjusted credits for the 2016 calendar year:

- Wind, Closed-loop Biomass, and Geothermal energy resources: $0.23/kWh.
- Open-loop Biomass, Landfill Gas, Municipal Solid Waste, Qualified Hydroelectric, and Marin and Hydrokinetic energy resources: $.012/kWh.\(^{48}\)

The tax credit phases down for wind facilities as described below:

- Construction Commencing in 2017: Reduced by 20%
- Construction Commencing in 2018: Reduced by 40%
- Construction Commencing in 2019: Reduced by 60%\(^{49}\)

The tax credit expires for all other technologies commencing construction after December 31, 2016 and for wind commencing construction after 2019. Taxpayers may carry forward unused credits for up to 20 years following the year of generation or carried by one year under an amended return. Additional information can be accessed [here](#).

4.4.1.2 Business Investment Tax Credit
The ITC\(^{50}\) operates as a credit that provides a tax benefit for a specified percentage of the investment in an eligible technology for specific economic sectors.\(^{51}\) The ITC expiration date,


\(^{46}\) See Renewable Energy Production Tax Credit (PTC), DSIRE, NC Clean Energy Technology Center, Updated May 24, 2016: programs.dsireusa.org/system/program/detail/734.

\(^{47}\) Open-loop biomass, geothermal, small irrigation hydro, landfill gas, and municipal solid waste combustion facilities placed in service after October 22, 2004, and before enactment of the August 8, 2005, Energy Policy Act of 2005 were only eligible for a 5-year credit period; Open loop biomass facilities placed in service before October 22, 2004, were eligible for the a 5-year credit period beginning January 1, 2005.

\(^{48}\) See Renewable Energy Production Tax Credit (PTC), DSIRE, NC Clean Energy Technology Center, Updated May 24, 2016: programs.dsireusa.org/system/program/detail/734.

\(^{49}\) Ibid.

\(^{50}\) Ibid.

\(^{51}\) Ibid.
maximum incentive, and equipment requirements vary by technology. Table 5 provides the declining credit by year and technology.

**Table 5 ITC Credit by Technology and Date**

<table>
<thead>
<tr>
<th>Technology</th>
<th>12/31/16</th>
<th>12/31/17</th>
<th>12/31/18</th>
<th>12/31/19</th>
<th>12/31/20</th>
<th>12/31/21</th>
<th>12/31/22</th>
<th>Future Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>PV, Solar Water Heating, Solar Space Heating/Cooling, Solar Process Heat</td>
<td>30%</td>
<td>30%</td>
<td>30%</td>
<td>26%</td>
<td>22%</td>
<td>10%</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>Hybrid Solar Lighting, Fuel Cells, Small Wind</td>
<td>30%</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Geothermal Heat Pumps, Microtubules, Combine Heat and Power Systems</td>
<td>10%</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Geothermal Electric</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>Large Wind</td>
<td>30%</td>
<td>24%</td>
<td>18%</td>
<td>12%</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td></td>
</tr>
</tbody>
</table>

The following list states the maximum incentives and eligible system size by technology:

- Fuel Cells: $1,500 per 0.5 kW
- Microturbines: $200 per kW with system of 2 MW or less
- Small Wind Turbines Placed in Service 10/4/08-12/31/08: $4,000 with a system of 100 kW or less
- Small Wind Turbines Placed in Service after 12/31/08: No limit with a system of 100 kW or less
- All other Technologies: no limit but Combined Heat and Power (CHP) system must be 50 MW or less

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52 Authority includes: 26 USC § 48; Instructions for IRS Form 3468; IRS Form 3468; and H.R. 2029 (Consolidated Appropriations Act, 2016).
51 Sectors include: Commercial, Industrial, Investor-Owned Utility, Cooperatives Utilities, and Agricultural.
52 See Business Energy Investment Tax Credit (PTC), DSIRE, NC Clean Energy Technology Center, Updated December 21, 2015: http://programs.dsireusa.org/system/program/detail/658.
53 CHP receive full credit if electrical capacity is 15 MW or less, and mechanical energy capacity of 20,000 horsepower (hp) or less, or an equivalent combination of electrical and mechanical energy capacities. Large power systems up to 50 MW and 67,000 hp based on the specified ratio.
54 See Business Energy Investment Tax Credit (PTC), DSIRE, NC Clean Energy Technology Center, Updated December 21, 2015: http://programs.dsireusa.org/system/program/detail/658.
For the tax benefit to accrue, the original use of the equipment or the original construction must be by the taxpayer. The energy property must be operational in the year the credit is first taken. Additional information can be found here.

4.4.1.3 Salton Sea Area Federal Initiatives

On August 31, 2016, the Obama Administration announced a package of actions to foster a strong partnership with the State of California and innovation in support of the communities surrounding the Salton Sea in Imperial and Riverside counties. Among other things, the package of actions aims to stimulate economic growth by developing new clean energy resources in the Salton Sea region.

As the press release notes, “the Imperial Valley is home to world-class renewable energy resources, with an existing capacity of over 6000 MW of renewables, and an estimated 1200 MW of additional geothermal resources that are currently untapped.” Accordingly, the U.S. Department of Energy’s (DOE) Federal Energy Management Program (FEMP) issued a Request for Information, the first step to identify pathways for aggregating a power purchase between 100-250 MW of new geothermal energy from around the Imperial Valley’s Salton Sea. In addition, in September 2016, the Department of the Interior finalized the Desert Renewable Energy Conservation Plan, which includes provisions to help facilitate permitting of renewable energy and transmission projects in the Imperial Valley. In October 2016, the DOE, State of California, and Geothermal Resources Council convened a technical forum, including government, industry and research stakeholders to develop solutions for new geothermal development in California and in the Salton Sea region.

In conjunction, the Water Funder Initiative, a collaborative of philanthropic foundations including the S.D Bechtel, Jr. Foundation, the Energy Foundation, the Rockefeller Foundation, and the Walton Family Foundation, announced a goal to provide $10 million over five years to support implementation of a comprehensive plan to, among other things, promote renewable energy and restoration at the Salton Sea. According to the press release, funding opportunities could include loan guarantees, civil society support, private sector engagement, economic diversification programs, and other initiatives that benefit wildlife habitats and local communities.

4.4.2 State Clean Generation Policies

California has been a leader in promoting clean energy both at the customer level and at the utility scale through statutory targets, financial incentives, and regulatory structures.

4.4.2.1 Renewable Energy Portfolio Standard

The Renewable Portfolio Standard (RPS) requires IOUs, electric service providers, and community choice aggregators (CCAs) to increase the procurement of eligible renewable energy resources. California has incrementally expanded its RPS program since its creation under SB 1078 (2002). SB 1078 established the program with a 20% renewable energy requirement by 2017 [later accelerated to 2010 by the 2003 Energy Action Plan codified under SB 107 (2006)]. Executive Order S-14-08 created a target of 33% by 2020 that was later supported by CARB’s adoption of regulations.

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55 Ibid.
56 See: 8/31/2016 Whitehouse press release
57 8/31/2016 Whitehouse press release
increasing the RPS to 33% by 2020 pursuant to Executive Order S-21-09. SB 2(1x) (2011) further defined RPS requirements, setting a 20% target by December 31, 2013, a 25% target by December 31, 2016, and a 33% target by 2020. SB 350 (2015) now mandates that 50% of electricity generated and sold to retail customers per year be from eligible renewable energy resources by December 31, 2030. Interim targets of 40% by December 31, 2024, and 45% by December 31, 2027, are also included under SB 350.

The RPS program is in its second compliance period (2014-2016), with an average procurement target of approximately 23.3% of retail sales. The IOUs procured approximately 26% of retail sales in 2014 and anticipated procuring approximately 29% in 2015 and 31% in 2016.\footnote{CPUC, Renewables Portfolio Standard Quarterly Report, 2\textsuperscript{nd} Quarter 2016, p. 3.}

4.4.2.2 Net Energy Metering
Customers who install eligible systems one MW or less to serve onsite load are eligible for net energy metering (NEM). NEM systems are sized to meet annual load – as opposed to peak demand – to account for seasonal variation in demand and solar production. NEM uses an electricity billing mechanism to provide customers retail-rate billing credits for energy exported to the grid when onsite generation exceeds onsite load. Pursuant to AB 327 (2013), each IOU must offer NEM to customers until either July 1, 2017, or the date that the IOU reaches its NEM program cap. The original NEM program cap was determined as the point in time when installed NEM capacity exceeded 5% of an IOUs aggregate customer peak demand total. The caps are below:

- PG&E: 2,409 MW
- SCE: 2,240 MW
- SDG&E: 607 MW

SDG&E recently reached its NEM cap, forcing new NEM customers to use the recently adopted CPUC NEM successor tariff pursuant to AB 327. CPUC Decision D.16-01-044 continued most of the original NEM tariff measures but now, among other things:

- Requires reasonable interconnection fees;
- Requires Nonbypassable charges on each kWh of electricity obtained from an IOU in each metered interval;
- Requires residential NEM customers interconnecting on or after January 1, 2018 to take service on time-of-use (TOU) rates; and
- Allows system size to be greater than 1 MW where a customer pays for a Rule 21 interconnection study and upgrades costs for interconnection.\footnote{CPUC D.16-01-044, Decision Adopting Successor to Net Energy Metering Tariff, January 28, 2016, pp. 2-5.}

Once caps are reached in the other two IOU service territories, new NEM customers will be subject to the successor tariff.

4.4.2.3 Financial Incentive Programs
California offers several financial incentive programs to support distributed generation technologies:

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\textsuperscript{58} CPUC, Renewables Portfolio Standard Quarterly Report, 2\textsuperscript{nd} Quarter 2016, p. 3.
\textsuperscript{59} CPUC D.16-01-044, Decision Adopting Successor to Net Energy Metering Tariff, January 28, 2016, pp. 2-5.
• Self-Generation Incentive Program (SGIP): SGIP provides incentives for existing, new, and emerging distributed energy resources in the form of rebates for qualifying systems installed on the customer’s side of the utility meter. Qualifying technologies include: wind turbines, waste heat-to-power, pressure reduction turbines, internal combustion engines, microturbines, gas turbines, fuel cells, and advanced energy storage systems.

• California Solar Initiative (CSI)/California Solar Initiative-Thermal (CSI-Thermal): CSI provides rebates for solar PV, and CSI-Thermal provides rebates for solar hot water heating systems and other solar thermal technologies for customers in PG&E, SCE, or SDG&E service territories.

• Single Family Affordable Solar Homes (SASH) Program: Provides fixed, upfront capacity-based incentives for solar energy systems to qualified low-income home owners to offset solar energy system costs.

• Multifamily Affordable Solar Housing (MASH) Program: Provides fixed, upfront capacity-based incentives for solar energy systems to qualified multifamily affordable housing.

• New Solar Homes Partnership (NSHP): NSHP provides financial incentives and other support to home builders to encourage the construction of new, energy efficient solar homes.

4.4.2.4 Community Solar

Senate Bill 43 (2013) directed the CPUC to implement the Green Tariff Shared Renewables (GTSR) program to build upon the success of the CSI and expand customer access to “all eligible renewable energy resources to all ratepayers who are currently unable to access the benefits of onsite generation.” The law sunsets on January 1, 2019 for new subscribers, unless extended. The GTSR applies to all “participating utility[ies]”, defined as all electrical corporations with 100,000 or more customer accounts in California, which includes the three large IOUs, PG&E, SCE, and SDG&E. The law mandates that participating utilities administer the GTSR program in their service territory by adopting both a Green Tariff Option (Green Tariff) and Enhanced Community Renewables (ECR) option. A Green Tariff program allows a customer to pay the difference between their current generation charge and a charge that reflects the cost of procuring 50% to 100% solar generation for their electricity needs. This program is composed of systems ranging from 500 kW to 200 MW. Under the ECR option, a customer agrees to purchase a share of a local solar project directly from a solar developer and, in exchange, will receive a credit from their utility for the customer’s avoided generation procurement and for their share of the benefit of the solar development to the utility. This program is composed of projects ranging in size from 500 kW to 3 MW. A limit of 1 MW was also set for projects located in identified disadvantaged communities (DACs). SB 43 did not mandate how procurement should be divided between the Green Tariff and ECR programs.

SB 43 placed a statewide cap of 600 MW of nameplate generation capacity across all three IOU service territories. The law makes specific allocations of the total 600 MW:

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60 California Public Utilities Code Section 2831(b).
61 California Public Utilities Code Section 2831.5(b)(2).
62 California Public Utilities Code Section 2833(a).
63 See California Public Utilities Code Section 2831-34.
64 California Public Utilities Code Section 2833(d).
• 100 MW for systems of 1 MW or less located in identified impacted and disadvantaged communities by CAL EPA (CPUC EJ Reservations);\textsuperscript{65}
• 100 MW reserved for residential customers;\textsuperscript{66} and
• 20 MW reserved for City of Davis.\textsuperscript{67}

The CPUC issued D.15-01-051 on February 2, 2015, approving the GTSR Programs for SDG&E, PG&E, and SCE. It mandated that each IOU procure projects equal to their portion of the 600 MW cap as determined by each IOU’s percentage of total statewide bundled sales as mandated by California Public Utilities Code Section 2833(d).\textsuperscript{68} The CPUC also mandated that residential participation and the EJ facilities use the same retail sales percentage.\textsuperscript{69} The breakdown of the procurement requirement can be found in Table 6 below:

<table>
<thead>
<tr>
<th>Percentage of Total IOU Bundled Sales</th>
<th>TOTAL (MW)</th>
<th>EJ (MW)</th>
<th>Davis (MW)</th>
<th>Unreserved (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PG&amp;E</strong></td>
<td>45.25%</td>
<td>272</td>
<td>45</td>
<td>20</td>
</tr>
<tr>
<td><strong>SDG&amp;E</strong></td>
<td>9.87%</td>
<td>59</td>
<td>10</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>SCE</strong></td>
<td>44.88%</td>
<td>269</td>
<td>45</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>100%</td>
<td>600</td>
<td>100</td>
<td>20</td>
</tr>
</tbody>
</table>

4.4.3 Local Clean Generation Policies

Local governments in the project region also are adopting policies and pursuing strategies to increase the use of clean energy generation.

San Diego County Clean Energy Policies

San Diego County\textsuperscript{71} and City of Chula Vista\textsuperscript{72} have adopted PV and EV ready policies.

\textsuperscript{65} California Public Utilities Code Section 2833(d)(1)(A).
\textsuperscript{66} California Public Utilities Code Section 2833(d)(1)(B)(2).
\textsuperscript{67} California Public Utilities Code Section 2833(d)(1)(B)(3).
\textsuperscript{68} CPUC D.15-01-051 at 5.
\textsuperscript{69} Ibid.
\textsuperscript{70} Ibid.
\textsuperscript{71} http://www.sandiegocounty.gov/content/dam/sdc/cob/ordinances/ord10380.pdf
San Bernardino Clean Energy Policies

The County of San Bernardino’s General Plan and Greenhouse Gas Reduction plans include the following policies:

• Community Alternative Energy Development Plan: This measure explores developing alternative energy plans with SCE for alternative energy production in the existing built environment. This includes identification of appropriate types of alternative energy facilities and potential sites for location in the County. 73

• Support Utility-Scale Renewable Energy Siting and Transmission Lines: Under this measure, the County will identify possible sites for production of renewable energy using local renewable solar, wind, small hydro, and biogas. 74

• Identify and Resolve Potential Barriers to Renewable Energy Deployment: This measure seeks to identify and remove regulatory or procedural barriers to producing renewable energy in building and development codes, design guidelines, and zoning ordinances. 75

• Solar Ready Buildings Promotion: This measure seeks to encourage the construction of new buildings that allow for solar ready, cost-effective installation. This includes proper orientation, clear access to south sloped roofs, electrical conduit installed for systems, plumbing for solar hot water systems, and space for hot water storage tanks. 76

• Regional Renewable Energy Collaboration: Under this measure, the County will explore developing regional collaborations among local governments, special districts, nonprofits, and other public organizations to share resources, achieve economies of scale, and develop renewable energy policies and programs that are optimized on a regional scale. 77

• Accessory Wind Energy Systems: Under this measure, the County Development Code provides a uniform and comprehensive set of standards for the placement of accessory wind energy systems on parcels in unincorporated areas of the County in order to encourage the generation of electricity for onsite use, thereby reducing the consumption of electrical power supplied by utility companies. These regulations are intended to facilitate use of wind energy systems and to ensure that accessory wind energy systems are designed and located in a manner that minimizes visual and safety impacts on the surrounding community (See Chapter 85.18 of the County Development Code). 78

74 Ibid. at p. A-58.
75 Ibid.
76 Ibid.
77 Ibid. at p. A-59.
78 Ibid.
• Residential Retrofit Renewable Energy Incentives: Assumes that 20% of residential buildings existing in 2007 will be retrofit or renovated with solar PV by 2020.\textsuperscript{79}

• New Home Renewable Energy (DRP): PV panels on 20% of new homes built within the County by 2020 to reduce home electric use by 51%.\textsuperscript{80}

• New Commercial/Industrial Construction Renewable Energy (DRP): Applies to new commercial and industrial projects, excluding warehousing, and assumes that energy use would be reduced by 15%.\textsuperscript{81}

• Commercial and Industrial Rehabilitate/Expansion Renewable Energy (DRP): Installation of renewable energy systems on commercial and industrial projects requiring discretionary permits for major rehabilitations or expansion (addition of 25,000 square feet of office/retail commercial or 100,000 square feet or industrial floor area) of commercial, office, or industrial development greater than or equal to 25,000 square feet in size. Assumes incorporated renewable energy generation will serve 15% or more of the projects energy needs.\textsuperscript{82}

• For all new divisions of land for which a tentative map is required, a condition of approval will be the dedication of easements, for the purpose of assuring solar access, across adjacent parcels or units.\textsuperscript{83}

**Imperial County Clean Energy Policies**

Imperial County operates with the following General Plan policies summarized below:

• Support development of renewable energy resources that will contribute to and enhance the economic vitality and protect the environment of Imperial County.

• Support development of renewable energy resources that will contribute to the restoration efforts of the Salton Sea.

• Encourage development of innovative renewable energy technologies that will diversify Imperial County’s energy portfolio.
  
  o Support the implementation of pilot projects intended to test or demonstrate new and innovative renewable energy production technologies.

  o Encourage development of utility-scale distributed generation projects in the County.


\textsuperscript{80} Ibid.

\textsuperscript{81} Ibid.

\textsuperscript{82} Ibid. at p. A-55

• Support development of renewable energy while providing for the protection of military aviation and operations.

• The County will actively minimize the potential for land subsidence to occur as a result of renewable energy operations.

• The County will develop overlay zones that would facilitate the development of renewable energy resources while preserving and protecting agricultural, natural, and cultural resources. Development of overlay zones shall include coordination with federal, state, County, and Tribal governments, as well as educational entities, the public, and local industries.84

4.5 Clean Transportation
The transportation sector is a significant source of GHG emissions in California. Policies to reduce emissions in this sector are key to reaching overall targets.

4.5.1 State Clean Transportation Policies

4.5.1.1 Zero Emissions Vehicles
The burning of fossil fuels in California accounts for 37% of the state’s GHG emissions.85 To meet our long-term emissions reductions goals per AB/SB 32, de-carbonizing the transportation sector is essential. As such, a diverse array of state agencies and stakeholders are deploying a wide range of policies and regulations targeted at the systematic and (eventual) complete de-carbonization of the sector. The primary focus remains on replacing Internal Combustion Engines (ICEs) with Zero Emissions Vehicles (ZEVs).

For the light duty sector, these policies include California’s Low-Emission Vehicle (LEV) regulations,86 as well as Executive Order B-16-12, which sets the goal of putting one million ZEVs on California’s roads by 2020, and 1.5 million by 2025.87 Methods of achieving these policies are embodied in California’s 2013,88 2015,89 and 2016 ZEV Action Plans,90 which detail agency roles and responsibilities to support the ZEV initiatives. In addition, to accelerate ZEV adoption, the state provides incentives through programs such as the Clean Vehicle Rebate Project, where California residents can receive up to $6,500 for the purchase or lease of new, eligible zero-emission or plug-in hybrid light-duty vehicles.91

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86 Low-Emission Vehicle (LEV)
88 2013 ZEV AP. Website Access: https://www.opr.ca.gov/docs/Governor’s_Office_ZEV_Action_Plan_(02-13).pdf
91 The Clean Vehicle Rebate Project (CVRP) is an initiative of the California Air Resources Board. Since program inception in 2009, CSE has issued over $317 million to fund rebates for individuals, nonprofits, government entities and business owners. The project and incentives are part of California Climate Investments, which uses proceeds
The ZEV Challenge in the San Diego Region

While the state has successfully deployed more than 160,000 light duty ZEVs\(^2\) statewide (with upward trends in adoption), this rate remains only a small portion of the total ZEV goal. Specific to the San Diego region, while adoption trends are in the thousands and showing growth, when examining on a per-capita basis, one can see clear opportunities of expanded ZEV technology penetration. Pairing CVRP statistics with Census population show that San Diego County ranks 11\(^{th}\) in ZEV adoption on a per capita basis with more than 12,000 ZEVs deployed. However, Riverside, San Bernardino, and Imperial Counties have seen average to lower-than-average adoption patterns, ranking 26\(^{th}\), 28\(^{th}\), and 56\(^{th}\) out of California’s 58 counties for ZEV adoption per capita. Hence, there remains an opportunity to promote projects that encourage and complement accelerated ZEV adoption—especially in Imperial County, which ranks the lowest per capita. More generally, projects that target the continued and accelerated adoption of ZEVs in the region should be expected. Table 4 provides data showing adoption trends.

### Table 4 EV Adoption in San Diego Region

<table>
<thead>
<tr>
<th>County</th>
<th>County Rank</th>
<th>County Population</th>
<th># of Electric Vehicles Rebated</th>
<th># of Electric Vehicles Rebated /County Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Diego</td>
<td>11</td>
<td>3,299,521</td>
<td>12,662</td>
<td>0.38%</td>
</tr>
<tr>
<td>Riverside</td>
<td>26</td>
<td>2,361,026</td>
<td>3,795</td>
<td>0.16%</td>
</tr>
<tr>
<td>San Bernardino</td>
<td>28</td>
<td>2,128,133</td>
<td>2,971</td>
<td>0.14%</td>
</tr>
<tr>
<td>Imperial</td>
<td>56</td>
<td>180,191</td>
<td>31</td>
<td>0.02%</td>
</tr>
</tbody>
</table>

ZEV Charging and Fueling Infrastructure

To support one million ZEVs by 2020 and 1.5 million by 2025, the ZEV Action Plan also prioritizes ZEV infrastructure development. As such, the state is rapidly expanding access to Electric Vehicle Supply Equipment (EVSE), as well as the deployment of hydrogen fueling infrastructure.\(^3\) Efforts to expand EVSE infrastructure have been led by the Energy Commission, and have included the California Statewide Plug-In Electric Vehicle Infrastructure Assessment,\(^4\) as well as a variety of regional readiness plans.\(^5\) The Energy Commission’s California Statewide Plug-In Electric Vehicle Infrastructure Assessment analyzes potential ZEV distribution and suggests the needs for EV infrastructure from the state’s cap-and-trade auctions to reduce greenhouse gas emissions and provide other benefits. See more at CVRP Website: https://cleanvehiclerebate.org/eng

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\(^1\) This measure consists of 63,833 Plug-in Hybrid Electrics, 95,321 Battery Electrics, and 309 Fuel Cell Vehicles. This data is available at the CVRP Rebate Statistics website: Center for Sustainable Energy (2016). California Air Resources Board Clean Vehicle Rebate Project, Rebate Statistics. Data last updated October 03, 2016; from https://cleanvehiclerebate.org/rebate-statistics

\(^2\) Currently there are 22 retail and six non-retail hydrogen fuel stations available. Website Access: http://cafcp.org/sites/default/files/h2_station_list.pdf

\(^3\) Website Access: http://www.nrel.gov/docs/fy15osti/60729.pdf

charging across the four counties to be substantial, as follows in Table 5, based on two scenarios (i.e., home charging versus high public access charging).

Table 7 ZEV Infrastructure, Potential Needs in San Diego Region

<table>
<thead>
<tr>
<th></th>
<th>Home</th>
<th>Work</th>
<th>Public</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L1</td>
<td>L2</td>
<td>Total</td>
</tr>
<tr>
<td>Home Dominant</td>
<td>46,000</td>
<td>33,000</td>
<td>79,000</td>
</tr>
<tr>
<td>High Public Access</td>
<td>47,000</td>
<td>26,000</td>
<td>73,000</td>
</tr>
</tbody>
</table>

The ZEV Infrastructure Challenge

When comparing Table 8 EVSE needs to Table 8 EVSE actual deployment, the San Diego region is not ready for one million—let alone 1.5 million ZEVs. While ZEV infrastructure is expanding at a moderate pace, information gathered from the Alternative Fuels Data Center suggests only modest growth in the San Diego Region. Of the four counties, for example, San Diego far surpasses other counties in EVSE adoption, with almost 400 available locations; San Bernardino and Riverside Counties contain 150 and 100, respectively. However, this deployment of EVSE is insufficient to support the regional need. Notably, EV charging locations in Imperial County are almost nonexistent. As such, the counties should anticipate an aggressive effort to expand the EVSE infrastructure necessary to support one million ZEVs.

Table 8 ZEV Infrastructure Locations across the Four Counties

<table>
<thead>
<tr>
<th>County</th>
<th>EV Charging Locations</th>
<th>Hydrogen</th>
<th>Biofuels</th>
<th>Compressed Natural Gas</th>
<th>Ethanol 85</th>
<th>Liquid Natural Gas</th>
<th>Liquid Petroleum Gas</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Diego</td>
<td>387</td>
<td>3</td>
<td>10</td>
<td>26</td>
<td>17</td>
<td>2</td>
<td>20</td>
<td>465</td>
</tr>
<tr>
<td>Riverside</td>
<td>147</td>
<td>2</td>
<td>2</td>
<td>33</td>
<td>9</td>
<td>5</td>
<td>15</td>
<td>213</td>
</tr>
<tr>
<td>San Bernardino</td>
<td>95</td>
<td>2</td>
<td>1</td>
<td>21</td>
<td>6</td>
<td>7</td>
<td>14</td>
<td>146</td>
</tr>
<tr>
<td>Imperial</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>6</td>
</tr>
</tbody>
</table>

It is worth noting additional socioeconomic factors that can act as a barrier to ZEV adoption. Generally, there remain barriers for low- and moderate-income households, residents of disadvantaged communities (DACs), as well as individuals living in multi-unit dwellings that are generally rented. These barriers also persist in affordable housing units. As such, the counties within the program region should reasonably focus on efforts to expand EVSE infrastructure in these and other sectors, which have yet to receive access to EVSE. Such efforts are also codified in legislation, including SB 1275 and SB 535, as well as other laws focusing on equity matters.

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97 Alternative Fuels Data Center, Alternative Fueling Station Locator: Website Access: Further information can be obtained through the plug in electric vehicle data center. See: https://driveclean.arb.ca.gov/pev/Charging/Find_Charging_Stations.php
Utility EVSE Applications

To meet the growing needs for EV charging infrastructure necessary to reach one million ZEVs, each of the three IOUs filed applications with the CPUC to build EVSE. Specific to the region, SDG&E’s Pilot, which will operate from 2016-2021, will target the deployment of EVSE technology coupled with a specialized Vehicle-to-Grid (VGI) rate and will be comprised of 3,500 L1 and L2 chargers. The pilot program will also target 350 MUDs and workplaces, with 10% focusing on DACs. SCE’s Pilot, which will also operate from 2016-2021, will consist of 1,500 L1 and L2 chargers, 150 focused on MUDs, workplaces, and public sites, with 10% targeting DACs. Table 9 provides a cross-comparison between the three applications (Note: PG&E program approval is pending with the CPUC).

Table 9 IOU EV Proposals

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number and Type of Chargers</td>
<td>3,500 L1/L2 chargers.</td>
<td>1,500 L1/L2 chargers.</td>
<td>7,500 L2 chargers.</td>
</tr>
<tr>
<td>Number and Type of Eligible Installation Sites</td>
<td>350 MUDs and workplaces.</td>
<td>150 MUDs, workplaces, and public sites.</td>
<td>Nearly 750 MUDs and workplaces, and 100 DCFC public sites.</td>
</tr>
<tr>
<td>Disadvantaged Communities</td>
<td>10 percent of expenditures, $0 participation payment</td>
<td>10 percent of expenditures, 100 percent EVSE rebates</td>
<td>15 percent of expenditures</td>
</tr>
</tbody>
</table>

Source: California Public Utilities Commission

While both SDG&E and SCE’s pilot programs have high potential to support regional growth in EVs, contributing an additional 5,000 chargers collectively to the ecosystem, this falls short of the wider San Diego regional goal of approximately 88,000 needed to support one million ZEVs in the region, as detailed in Table 2 and anticipated by stakeholders.

A Statewide Focus on Vehicle-To-Grid Integration

In addition to expansive EVSE rollout, the state is rapidly building policy around utilizing ZEVs, specifically plug-in electric vehicles (PEVs), as a preferred grid resource. This is embodied in policy including the VGI Roadmap, as well as a recent CPUC decision, which favors enabling VGI through a communication standard. In this regard, the four counties should anticipate continued policy initiatives focused on actualizing VGI for PEVs and efforts to leverage the energy storage capabilities of PEVs.

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99 http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M167/K099/167099725.PDF
Accelerating Medium and Heavy Duty ZEV Adoption

Due to technology costs and other barriers, it has been more challenging to accelerate adoption in medium and heavy duty fleets. That said, there is a diverse array of policies that seek to accelerate adoption in this sector, for both freight and passenger fleets. In addition, the state also provides incentives via the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP)100 to accelerate adoption.

In the freight sector, consistent with Executive Order B-32-15,101 the Sustainable Freight Action Plan sets a variety of goals, including the integration of 100,000 ZEV freight vehicles and equipment capable of zero emission operation by 2030.102 It also prioritizes US-Mexico pilot projects, which will have impact on the San Diego region as a whole. For the passenger bus transit systems, analysis is underway evaluating the path to integrate ZEV technologies through regulation as well as incentives. Advanced Clean Transit (ACT) Regulation may put in place requirements for Zero Emission Bus Purchases, with a goal of complete transit fleet transition to zero emission technologies by 2040.103 As one of the available incentives, fleet operators are able to accrue Low Carbon Fuel Standard (LCFS) credits for charging their vehicles. It is worth noting that the region pursues compliance with emission policies through the utilization of natural gas bus fleets (rather than electric propulsion), which has been a debated topic in the ACT sphere.

SB 350: An Accelerant to Transportation Electrification Diversity

While the lion’s share of ZEV growth has been in the light duty sector, the ZEV Action Plan is structured to intentionally widen the definition of what constitutes a ZEV, which was codified via legislation. Specifically, broader and wide-scale Transportation Electrification (TE) efforts will be undertaken consistent with provisions as outlined in SB 350. SB 350 (2015) specifically redefines TE,104 places TE as a third stand-alone category on equal footing with energy efficiency and renewables,105 ensures TE as a fundamental tool to achieve our 2030 and 2050 targets, and establishes provisions through which utilities can be evaluated for expanded roles in TE though CPUC rulemaking.106 Most recently, the CPUC has interpreted SB 350 guidance to “[e]ncourage the utilities to target pilots and experiments in diverse market segments to gain experience to inform the eventual design of scaled programs that will be crucial to address substantial reductions in criteria air and GHG pollutants from on-road light, medium and heavy-duty vehicles, off-road vehicles, and maritime, aviation, and rail sectors in the near term”.107 This reinforces the notion of project flexibility and creativity for TE-related projects across the state. As such, the San Diego Region should anticipate a diverse array of TE project options consistent with SB 350 provisions.

100 See HVIP Website: https://www.californiahvip.org/
103 https://www.arb.ca.gov/msprog/bus/actdiscussiondocument.pdf
104 California Public Utilities Code Section 237.5.
105 California Public Utilities Code Section 701.1(a)(1).
106 California Public Utilities Code Section 740.12(b).
107 Assigned Commissioner’s Ruling Regarding the Filing of the Transportation Electrification Applications Pursuant to Senate Bill 350: http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M167/K099/16709640.PDF
A Focus on Fuel Switching

In addition to the technology changes associated with ZEVs, the state prioritizes moving away from fossil fuels through regulations focusing on deep carbon reductions. In this regard, two key programs foster change in the transportation sector.

- **Cap & Trade**: The Cap & Trade system targets GHG emissions reductions from the state’s heavy polluters. Beginning January 1, 2015, the transportation sector (i.e., oil producers) came under the cap. Funds from sold allowances are channeled into the Greenhouse Gas Reduction Fund (GGRF) and from there are distributed out to a variety of state-level initiatives. Notably, transportation and infrastructure is a primary recipient of these funds. Sixty percent of the funds focus on the development of four key projects: 1) high-speed rail project; 2) low carbon transit operations; 3) transit and intercity rail capital projects; and 4) affordable housing and sustainable communities programs. These four programs receive continuously-allocated funding awards. In addition, 40% of funds are allocated annually based on the Governor’s and California State Legislature’s budget, to a diverse array of programs, including low carbon transportation funds for light, medium, and heavy duty programs. The major take-away in this regard is that Cap & Trade is structured to penalize polluters with the intention to fund key projects in the transportation (and other) sectors to reduce GHG emissions.

- **Cap & Trade in the San Diego Region**: There has been a diverse array of resources invested in Cap & Trade program projects, shown as total dollars in Table 10. San Diego, Riverside, and San Bernardino Counties represent the higher end of funding investment across the 58 counties. Imperial County ranks in the bottom 10. Generally, the region can benefit from expanded efforts to integrate Cap & Trade program projects into regional transportation and infrastructure plans and strengthen paths of communication while coordinating collective resources.

<table>
<thead>
<tr>
<th>Rank (1 to 58)</th>
<th>County</th>
<th>Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>San Diego</td>
<td>$108,062,376</td>
</tr>
<tr>
<td>7</td>
<td>Riverside</td>
<td>$54,595,377</td>
</tr>
<tr>
<td>8</td>
<td>San Bernardino</td>
<td>$49,495,396</td>
</tr>
<tr>
<td>51</td>
<td>Imperial</td>
<td>$142,759</td>
</tr>
</tbody>
</table>

- **Low Carbon Fuel Standard (LCFS)**: An additional policy pillar focuses on transitioning away from carbon-intense transportation fuels through Low Carbon Fuel Standard (LCFS) regulation. The LCFS program has been in place for several years, and is one of the initiatives developed under the authority of AB/SB 32. This program is separate from the Cap & Trade program. The goal of the program is to reduce the carbon intensity of fuels by at least 10% by

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108 Data Gathered From California Climate Investments Webpage: https://www.arb.ca.gov/cc/capan dtrade/auctionproceeds/auctionproceeds.htm
2020 from a 2010 baseline. LCFS uses a market-based credit trading system to lower GHG emissions, particularly from petroleum-based fuels. Notably, there are diverse arrays of hydrogen and electricity provisions in LCFS that complement EV charging and generally support TE diversification.¹⁰⁹

- **Natural Gas**: As detailed previously in Table 8, the San Diego region also has a relatively high concentration of investment in biofuels, Compressed Natural Gas, Ethanol 85, Liquid Natural Gas, and Liquid Petroleum Gas. Notably, the direct combustion of these resources in low NOx emission trucks offers great benefits over the diesel alternative. This is especially pertinent with the certification and release of the Cummings ultra-low-NOX engine.¹¹⁰ In addition, many stakeholders in the freight and bus sectors favor the natural gas option. Moreover, natural gas resources can leverage various incentive programs, such as the LCFS. As such, it is likely that the region will need to plan a path to accommodate natural gas in an appropriate manner which is to be determined.

4.5.1.2 **Regional Rail**
The San Diego region has touchpoints on some of the nation’s most prominent passenger rail systems. Metrolink plays a key role in connecting across San Diego, Riverside, and San Bernardino counties. Moreover, San Diego Metropolitan Transit System (MTS) and North County Transit District have operational capacity moving thousands of passengers daily throughout the region. These key systems contribute to direct vehicle miles traveled reductions, leading directly to GHG emissions reductions. Moreover, MTS is electrified.

For systems that have not been electrified (i.e., Metrolink and Coaster—North County Transit District), it is worth noting that electrifying the rail fits within the ZEV Action Plan, the SB 350 TE policy scope, and is consistent with recent CPUC decisions that prioritize TE pilots in diverse market segments — including rail projects in the near term.¹¹¹ As such, there may be value in prioritizing support for rapid TE of these and other rail systems in the short term. Currently, electrified systems can access LCFS for compensation in credits for their system’s propulsion, and the 2016 ZEV Action Plan prioritizes evaluating extending LCFS provisions to the freight sector.

4.5.1.3 **High-Speed Rail**
Long-term strategy favors the development of a high-speed rail (HSR) in the region. Phase 2 of the project will see the construction of the Los Angeles to San Diego Project Section, which will have touchpoints in San Diego, Riverside, and San Bernardino Counties in key areas, such as airports and other hubs.¹¹²

Recent legislation will provide some flexibility in support of regional rail project developments. AB 1889¹¹³ (Mullin et al.) clarifies that Proposition 1A (High-Speed Rail Act of 2008) funds can be used

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¹¹⁰ https://www.arb.ca.gov/msprog/tech/techreport/diesel_tech_report.pdf
¹¹¹ Assigned Commissioner’s Ruling Regarding the Filing of the Transportation Electrification Applications pursuant to Senate Bill 350. Website Access: http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M167/K099/167099725.PDF
¹¹² http://www.hsr.ca.gov/Programs/Statewide_Rail_Modernization/Project_Sections/losangeles_sandiego.html
for early investments in California’s emergent HSR system. While Phase 2 is not part of the Proposition 1A provisions, it is plausible that AB 1889 will provide added flexibility around HSR infrastructure planning and development.

With a 100% RE policy, the goal to work closely with the Energy Commission to develop ZNE infrastructure and the stated intention to integrate ZEVs at station locations, the HSR system presents the opportunity to operate this cutting-edge system as a massive and integrated ZEV, with a diverse array of distributed generation and renewable energy options available to power it by 100% RE. These themes are consistent with the 2015 and most recently the 2016 ZEV Action Plans, which prioritize the actualization of a 100% RE strategy.

4.5.2 Local Clean Transportation Policies

San Diego Vehicle Fleets and Transportation

Emissions from on-road transportation is the largest category of GHG Emissions in San Diego County. Several efforts in the San Diego region seek to reduce dependence on fossil fuel-based transportation and associated emissions. In October 2015, the San Diego Association of Governments (SANDAG) adopted San Diego Forward: The Regional Plan, a comprehensive regional planning document. The plan includes significant investment in alternative transportation infrastructure such as transit, bicycle, and pedestrian facilities. In addition, cities in the region have included similar transportation policies in their CAPs. For example, the City of San Diego’s CAP seeks to provide more efficient transportation options, as well as provide access to affordable and healthy travel transportation options. It also has targets for replacing municipal fleet vehicles, including waste haulers, with clean fuel alternatives.

Riverside Vehicle Fleets and Transportation

Similarly, the Western Riverside County Clean Cities Coalition works with vehicle fleets, fuel providers, community leaders, and other stakeholders to reduce petroleum use in transportation. Also, the Mobile Source Air Pollution Reduction Review Committee (MSRC) was created in 1990 by state Assembly Bill 2766 to authorize a motor vehicle registration fee to help reduce air pollution from motor vehicles. The MSRC is comprised of representatives from the transportation agencies of Riverside, Los Angeles, San Bernardino, and Orange Counties.

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114 Subject: Renewable Energy Feasibility Highlights. Website Access:
119 The Plan is available from the SANDAG website at http://www.sdforward.com/.
120 Information about the WRCOG Clean Cities Coalition is available at http://www.wrcog.cog.ca.us/clean-cities.
121 Information about the MSRC is available at http://www.cleantransportationfunding.org/.
San Bernardino Vehicle Fleets and Transportation

The County of San Bernardino General Plan seeks to replace existing vehicles in the County fleet with the cleanest vehicles commercially available that are cost-effective, meet the vehicle use needs, and support the development of alternative fuel infrastructure that is publicly accessible.

4.6 Smart Grid

A modernized electric grid is key to many of the other crucial strategies discussed above, including increasing demand response and enabling demand flexibility, integration of clean energy both at the utility- and customer-scale, and integration of electric vehicles. This section discusses smart grid policies at the federal and state levels. Given the regulatory structure of the electricity system, there is not much policy activity to support smart grid development at the local level, although there are examples of smart grid projects, such as microgrids, happening on university campuses in the SDREIN project region.

4.6.1 Federal Smart Grid Policies

The Energy Policy Act of 2005 (EPACT) represents the first federal policy directly related to smart grid technologies. It centered around Department of Energy (DOE) and Federal Energy Regulatory Commission (FERC) mandates to assess demand response (DR) in the United States by, among other things, surveying penetration of advanced metering and other technologies as well as encouraging time-of-use pricing and a new standard for DR under the Public Utilities Regulatory Policy Act (PURPA). The Energy Independence and Security Act of 2007 (EISA) built on this by:

- Mandating that FERC create a National Action Plan for DR;
- Encouraging modernization of the electric grid by defining system needs;
- Requiring that the DOE issue a report every two years on the status of and barriers facing smart grid deployments;
- Facilitating research and development, including demonstrations;
- Creating protocols and standards for a Smart Grid Interoperability Framework;
- Creating a 20% matching fund grant program for qualifying smart grid investments; and
- Mandating that DOE conduct a security assessment of smart grid deployment.

The Emergency Economic Stabilization Act of 2008 included an Energy Tax provision that accelerated the depreciation period for smart meters and smart grid technology from 20 to 10 years. An accelerated depreciation period better accommodates advances and deployments of new smart grid technology by mirroring the rate of change and investment in technology. Finally, the American Recovery and Reinvestment Act (ARRA) of 2009 included measures to modernize the nation’s energy and communication infrastructure and enhance energy independence. This legislation provided DOE with $4.5 billion to modernize the electric grid through multiple programs, such as the Smart Grid Investment Grant (SGIG) program.

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123 Ibid.
124 See, for example, UCSD’s microgrid. Available at http://sustain.ucsd.edu/highlights/microgrids.html.
125 See, for example, military microgrids in the San Diego region. Available at https://www.greentechmedia.com/articles/read/connecting-the-military-microgrid-dots.
4.6.2 State Smart Grid Policies

SB 17 (2009) created California’s smart grid policy by requiring the CPUC, in consultation with the Energy Commission, CAISO, and stakeholders, to determine the requirements for smart grid deployment based on improved overall efficiency, reliability, and cost-effectiveness of electrical system operations, planning, and maintenance.126 SB 17 required that by July 1, 2011, each IOU develop and submit a smart grid deployment plan to the CPUC for approval that deploys smart grid products, technologies, and services by entities other than the IOUs. Smart grid technologies were authorized to be deployed in an incremental manner to maximize the benefit to ratepayers and to achieve the benefits of smart grid technology. The CPUC was authorized to modify or adjust SB 17’s requirements for an electrical corporation with fewer than 100,000 service connections as individual circumstances merit.127 The CPUC, in consultation with the Energy Commission, CAISO, and electrical corporations, is required to evaluate the impact of deployment on major initiatives and policies at each step of deployment. SB 17 required that the CPUC issue a report by January 1, 2011, and by January 1 of each year thereafter, to the Governor and the Legislature on the CPUC’s recommendations for a smart grid, the plans and deployment of smart grid technologies by the state’s electrical corporations, and the costs and benefits to ratepayers.128

AB 793 (2015) amended existing law that required electrical corporations to develop and submit smart grid deployment plans to the CPUC for approval. Under AB 793, electrical or gas corporations are required to develop a program to provide incentives to a residential or small or medium business customer to acquire energy management technology for use in the customer’s home or place of business. Electrical or gas corporations must also develop a plan to educate residential customers and small and medium business customers about the incentive program. Electrical or gas corporations are mandated to annually report on actual customer savings resulting from the incentive program to the CPUC. Finally, AB 793 authorizes weatherization for low-income customers to include energy management technology if determined by the CPUC to be feasible, taking into consideration cost-effectiveness and the policy of energy-related hardships facing low-income households.

Smart Grid policy intersects with many technologies, rulemakings, and policies. Recent grid modernization activities include:

- Smart meter deployment
- Cost reductions in digital control and communications technology
- Power electronics
- Advanced automation technologies that improve customer reliability and grid resilience.

With increased deployment of customer-sided distribution energy resources (i.e., batteries and solar PV), the need to facilitate operational changes is driving investment in Smart Grid technology.

126 See SB 17 (Statutes 2009, Chapter 327).
127 Ibid.
128 Ibid.
This is becoming a major focus of the CPUC and IOUs. The following CPUC proceedings and decisions presently deal with Smart Grid technology:

- Distribution Resource Plans (DRPs) (R.14-08-013)
- Integrated Distributed Energy Resources (IDER) (R.14-10-003)
- Interconnection Reform of Rule 21 and Smart Inverter Activities (R.11-09-011)
- Storage Roadmap Activities (AB 2514; D.13-10-040; D.14-10-045)
- Plug-in Electric Vehicle-to-Grid Integration (R.13-11-007)
- Demand Response Policy Advancement (D.14-12-024)
- Enhanced Reliability Reporting (R.14-12-014)
- Customer Data Access, Energy Data Request, and other Data Activity (D.14-05-016)

There are also a number of Smart Grid demonstration projects completed or underway in California, testing technology, deployment, and policy to implement these laws, decisions, and programs.

4.7 Cross-Cutting/Other

Certain policies either cut across more than one of the broad categories presented above or do not fit into any of them. This section presents such cross-cutting policies at the federal, state, and local levels.

4.7.1 Federal Cross-Cutting Policies

4.7.1.1 Federal Agency Energy Efficiency and Renewable Goals: Federal Leadership on Climate Change and Environmental Sustainability

Executive Order (EO) 13693 (March 19, 2015) will cut GHG emissions 40% over the next decade from 2008 levels. EO 13693 directs Federal agencies, starting in 2016 to:

- Ensure 25% of their total energy (electric and thermal) consumption is from clean energy sources by 2025.
- Reduce energy use in Federal buildings by 2.5% per year between 2015 and 2025.
- Reduce per-mile GHG emissions from Federal fleets by 30% from 2014 levels by 2025 and increase the percentage of zero emission and plug in hybrid vehicles in Federal fleets.
- Reduce water intensity in Federal buildings by 2% per year through 2025.

The Office of Management and Budget (OMB) serves as the oversight office that reports on Federal agencies’ and departments’ progress.

4.7.1.2 CAISO Distributed Energy Resources (DERs) Aggregation Tariff Amendment

On June 2, 2016, the Federal Energy Regulatory Commission (FERC) approved CAISO’s proposed revisions to its Open Access Transmission Tariff (OATT) to permit participation of aggregated distribution-connected or distributed energy resources (including non-generator resources such as batteries) in wholesale energy and ancillary services markets. The tariff change allows individual

130 FERC, Order Accepting Proposed Tariff Revisions Subject to Condition, Docket No. ER 16-1085-000, 155 FERC Section 61,229, p. 1.
in-front-of or behind-the-meter DERs to aggregate together to meet CAISO’s minimum market participation requirement of 500 kW or more through a DER provider.

DERs are defined as resources with a first point of interconnection to a utility distribution company or metered subsystem. Each resource is metered pursuant to applicable utility distribution company tariff, aggregated through a DER provider, and bid into the market through a qualified scheduling coordinator. Aggregated DERs are subject to telemetry and metering requirements and pay penalties for not responding to CAISO dispatch orders just like other resources. The CAISO OATT ensures accurate modeling of congestion impacts by analyzing: (1) aggregation consisting of distributed energy resources at one pricing node or multiple pricing nodes; (2) limiting aggregation to 500 kW or greater; and (3) requiring that aggregation that includes DERs located at different pricing nodes be no larger than 20 MW. CAISO used existing participating limits that include: (1) requiring individual generating units that are 1 MW or greater to participate as generators and not as an aggregated resource; (2) preventing current participating resources between 500 kW and 1 MW to participate as aggregated DERs unless the owner/operator terminates its existing participation agreement; (3) preventing current proxy or reliability demand response resources to participate as aggregated DERs; and (4) preventing resources that participate in existing retail programs, such as NEM with storage or virtual net energy metering, from participating in the wholesale market because they are net consumers.

4.7.2 State Cross-Cutting Policies

4.7.2.1 Loading Order

California’s energy policy has defined a loading order of resource additions to meet the state’s growing electricity needs:

1. Energy efficiency and DR;
2. Renewable energy and DG; and
3. Clean fossil-fueled sources and infrastructure improvements.

This policy is designed to reduce GHG emissions and diversify California’s energy.

4.7.2.2 Residential Rate Reform

SB 327 (2013) authorized residential rate reform by repealing the limitations placed on increasing electric service rates of residential customers, establishing new fixed charges, and authorizing the CPUC to require residential time-variant [time-of-use (TOU)] pricing beginning on January 1, 2018. If default TOU rates are authorized, SB 327 requires that each electric corporation offer default rates with at least two usage tiers. The CPUC issued Decision D.15-07-011 directing rate reform that requires default TOU rates by 2019 unless an optional two-tier rate that converges multi-tiered rate structure to two rates over time is chosen by the customer. The following requirements represent the steps under D.15-07-001 for residential rate reform:

131 Ibid. at 2.
132 Ibid. at 5.
133 Ibid. at 4.
134 Ibid. at 3.
• IOUs must evaluate opt-in and pilot TOU rates to prepare for TOU enrollment.
• IOUs must file a residential rate design window (Residential RDW) application no later than January 1, 2018 that proposes default TOU rate structure to begin in 2019, assuming statutory requirements are met.
• IOUs must provide regular updates on progress toward rate reform and the Residential RDW application, including presenting an annual update, regular workshops, and quarterly reporting.
• IOUs may make a new request for a fixed monthly charge, but only after certain conditions have been met.

Additionally, a super-user surcharge that adds an extra $0.20 per kWh will begin in 2017. This surcharge applies to customers who use more than 400% of baseline. The CPUC authorized the collection of a minimum billing fixed charge not to exceed $10 for non-California Alternative Rates for Energy (CARE) customers or $5 for CARE customers. Finally, the CPUC mandated that all residential customers that fall under the NEM successor tariff take service on a TOU rate.

4.7.2.3 Integrated Distributed Energy Resources (IDER)
Under Decision D.07-10-032, the CPUC directed IOUs to integrate demand-side programs. These programs include energy efficiency, self-generation, advanced metering, and demand response that are designed to drive load reductions and grid efficiencies through a combination of integrated technologies, programs, and strategies to facilitate customer behavior changes. The current IDER proceeding, R.14-10-003, is designed to implement lessons identified over the programs’ history to overcome current barriers. Additional efforts focus on cost-effectiveness frameworks and the Distributed Energy Resources Action Plan.

The CPUC’s Integrated Distributed Energy Resources proceeding provides an opportunity to rethink traditional approaches to demand side technologies and programs, which have focused on supporting the growth of markets for individual technology solutions, to encourage integrated technology deployment. This proceeding pairs with the Distribution Resources Plan proceeding (which is supply side) and takes a consumer-focused approach to developing new compensation mechanisms, program strategies, and integration pathways for distributed resources.

4.7.2.4 Distributed Resource Plan
Through the Distribution Resources Plan proceeding (R.14-08-013), the CPUC intends to begin to identify optimal locations for the deployment of distributed energy resources. It defines “distributed energy resources” as “distributed renewable generation resources, energy efficiency, energy storage, electric vehicles, and demand response technologies.” In July 2015, the IOUs submitted plans as to how they will incorporate distributed energy resources into forecasting and grid planning and operation. In 2016, the CPUC accepted proposals for Demonstration Projects.

To encourage consumers to provide distributed resource services where and when they are most valuable, we need better access to data, more reliable load and distributed resources growth projections, and new methods for assessing the locational value of distributed resources sourced through procurement, programs, and pricing. However, the IOUs continue to fight changes to data access rules, have no plans for improving the reliability of load and distributed resources growth.

projections, and assert that the only distributed resources with locational value are those procured to defer specific grid investments identified by the utilities. The Center for Sustainable Energy (CSE) is developing demonstration project concepts and specific policy proposals to provide the CPUC with concrete alternatives to the utilities’ limited proposals.

4.7.2.5 Energy Storage
AB 2514 (2010)\textsuperscript{136} required the CPUC to open a proceeding by March 1, 2012, to determine appropriate targets for each load-serving entity (LSE) to procure viable and cost-effective energy storage systems and to adopt energy storage procurement targets for each LSE by October 1, 2013, if determined appropriate. The Legislature mandated that the storage procurement targets be achieved by December 31, 2015, for the first target (see details below) and by December 31, 2020, for the second target, if deemed appropriate. AB 2514 also required the governing board of a local publicly-owned electric utility to open a proceeding to determine appropriate targets, if any, for the utility to procure viable and cost-effective energy storage systems and to adopt an energy storage system procurement target, if determined to be appropriate. Based on the law, adopted targets would have to be achieved by the utility by December 31, 2016, and a second target achieved by December 31, 2021.

On October 17, 2013, the CPUC adopted Decision D.13-10-040, creating an energy storage procurement framework and program that established a target of 1,325 megawatts (MW) of energy storage to be procured by PG&E, SCE, and SDG&E by 2020 with installment no later than 2024 (Table 11).\textsuperscript{137} The Decision further established targets for CCAs and electric service providers to procure energy storage equal to 1% of their annual 2020 peak load by 2020, with installation no later than 2024.\textsuperscript{138} Importantly, the CPUC determined that AB 2514 was silent as to whether a system needs determination as a basis for storage procurement targets, finding it reasonable to set procurement targets based on precedent, policy, and market need, as defined.\textsuperscript{139} This means that procurement targets are not based on system need—as would be the case for other procurements—but on other factors.

\textsuperscript{136} AB 2514 was codified in California Public Utilities Code Sections 2835-2839.
\textsuperscript{137} CPUC D.13-10-040 (October 17, 2013), p. 2.
\textsuperscript{138} Ibid.
\textsuperscript{139} Ibid. at 19-21.
Additionally, AB 33 (2016) requires the CPUC to evaluate and analyze the potential for all types of long duration bulk energy storage resources as part of its existing storage proceeding(s) to help integrate renewable generation into the electrical grid. AB 2868 (2016) directs the state’s three largest electrical corporations to file applications for programs and investments to accelerate widespread deployment of distributed energy storage systems. AB 2868 authorizes the CPUC to approve, or modify and approve, programs and investments in distributed energy storage systems and requires the CPUC to prioritize those programs and investments that provide distributed energy storage systems to public sector and low-income customers. Finally, AB 2454 (2016) requires the CPUC, prior to approving a contract for any new or repowered gas-fired generation resources, to require the electrical corporation to demonstrate that it has undertaken all feasible efforts to meet identified resources needs through available renewable energy, energy storage, energy efficiency, and demand reduction resources that are cost-effective, reliable, and feasible.

4.7.2.6 Water-Energy Nexus

There is a well-documented relationship between water and energy: energy is associated with nearly every aspect of the water cycle, and it takes water to generate electricity.

Energy in the Water Cycle

Transporting, treating, disposing of, and heating water all require energy. These uses of water account for approximately 20% of total electricity and 30% of non-power plant-related natural gas consumption in California.\(^{140}\) Also, water is required for many electricity generation technologies.

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\(^{140}\) *Ibid.* at 15.
An analysis by the UC Davis Center for Water Energy-Efficiency estimated that the water reductions made in response to Governor Brown’s water reduction mandates from June 2015 to February 2016 also saved over 900,000 MWh of energy, representing an estimated 220,000 metric tons of GHG emissions.142 Between July and September 2015, the energy reduced through typical utility programs was about 460 GWh at a cost of approximately $173 million. During that same period, water reductions lowered energy uses by about the same amount but cost an estimated $45 million.

Water in Electricity Production

Water is also required to produce electricity. Table 12 shows the water requirements for non-renewable electric generation technologies. Medium water consumption for natural gas ranges from about 2-200 gallons per megawatt-hour (gal/MWh), depending on the technology used. By comparison, Table 13 shows the water requirements for renewable electric generation technologies. Much of the incremental capacity installations in California and the SDREIN project region are renewable energy technologies. As discussed in Section 5.5.4 below, the project region is home to 1,249 MW of solar thermal installations and over 718 MW of geothermal – two of the highest water-consuming renewable technologies.

141 Refining Estimates of Water-Related Energy Use In California
Table 12 Water Consumption Factors for Non-renewable Technologies (gal/MWh)\textsuperscript{143}

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>Cooling</th>
<th>Technology</th>
<th>Median</th>
<th>Min</th>
<th>Max</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear</td>
<td>Tower</td>
<td>Generic</td>
<td>672</td>
<td>581</td>
<td>845</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Once-through</td>
<td>Generic</td>
<td>269</td>
<td>100</td>
<td>400</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Pond</td>
<td>Generic</td>
<td>610</td>
<td>560</td>
<td>720</td>
<td>2</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>Tower</td>
<td>Combined Cycle</td>
<td>198</td>
<td>130</td>
<td>300</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Steam</td>
<td>826</td>
<td>662</td>
<td>1,170</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Combined Cycle with CCS</td>
<td>378</td>
<td>378</td>
<td>378</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Once-through</td>
<td>Combined Cycle</td>
<td>100</td>
<td>20</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Steam</td>
<td>240</td>
<td>95</td>
<td>291</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Pond</td>
<td>Combined Cycle</td>
<td>240</td>
<td>240</td>
<td>240</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Dry</td>
<td>Combined Cycle</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Inlet</td>
<td>Steam</td>
<td>340</td>
<td>80</td>
<td>600</td>
<td>1</td>
</tr>
<tr>
<td>Coal</td>
<td>Tower</td>
<td>Generic</td>
<td>687</td>
<td>480</td>
<td>1,100</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Subcritical</td>
<td>471</td>
<td>394</td>
<td>664</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Supercritical</td>
<td>493</td>
<td>458</td>
<td>594</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IGCC</td>
<td>372</td>
<td>318</td>
<td>439</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Subcritical with CCS</td>
<td>942</td>
<td>942</td>
<td>942</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Supercritical with CCS</td>
<td>846</td>
<td>846</td>
<td>846</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IGCC with CCS</td>
<td>540</td>
<td>522</td>
<td>558</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Once-through</td>
<td>Generic</td>
<td>250</td>
<td>100</td>
<td>317</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Subcritical</td>
<td>113</td>
<td>71</td>
<td>138</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Supercritical</td>
<td>103</td>
<td>64</td>
<td>124</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Pond</td>
<td>Generic</td>
<td>545</td>
<td>300</td>
<td>700</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Subcritical</td>
<td>779</td>
<td>737</td>
<td>804</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Supercritical</td>
<td>42</td>
<td>4</td>
<td>64</td>
<td>3</td>
</tr>
</tbody>
</table>

The potentially high water use of electric generation technologies is interconnected with other related issues addressed in this report. For example, one related issue is the goal to increase use of electric vehicles to reduce GHG emissions; the water needs related to replacing gasoline consumption with electricity as a transportation fuel is an important consideration. One study of U.S. transportation trends concluded that displacing gasoline with electric miles would consume three times as much water.\textsuperscript{145}

There are many challenges and uncertainties related to California’s water resources, such as quality, scarcity, drought, population growth, and climate change. Water conservation policy and program

\textsuperscript{144} Ibid.

development, as well as collaborative efforts across government agencies, local governments, and the public and private sectors, are crucial to managing this ongoing resource issue.

4.7.3 Local Cross-Cutting Policies

San Bernardino Energy Facilities, Electricity Demand, and Alternative Energy Systems:

The County of San Bernardino’s General Plan includes the following cross-cutting policies:

- Maximize the beneficial effects and minimize the adverse effects associated with the siting of major energy facilities. The County will site energy facilities equitably in order to minimize net energy use and consumption of natural resources and avoid inappropriately burdening certain communities. Energy planning should conserve energy and reduce peak load demands, reduce natural resource consumption, minimize environmental impacts, and treat local communities fairly in providing energy efficiency programs and locating energy facilities.146

- Conserve energy and minimize peak load demands through the efficient production, distribution, and use of energy.147

- Assist in efforts to develop alternative energy technologies that have a minimum adverse effect on the environment and explore and promote newer opportunities for the use of alternative energy sources. Programs related to electricity supporting this policy include:

  o Encourage and assist in the location of manure recycling and energy conservation efforts;

  o To reduce future demand on energy sources, all new subdivisions for which a tentative map is required will provide, to the extent feasible, for future natural heating or cooling opportunities in the subdivision;

  o For all new subdivisions for which a tentative map is required, a condition of approval will be the dedication of easements, for the purpose of assuring solar access across adjacent parcels or units; and

  o All County facilities, actions, and policies will provide good examples of best available technologies and methods for minimizing energy consumption and waste.148

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147 Ibid. at V-35.
148 Ibid. at V-35 – V-36.
5 REGIONAL CHARACTERISTICS

The framework for identifying regional technology priority areas requires an assessment of key factors, including geographic, demographic, economic, energy, etc. While this section presents information from sources that had data for all counties, in some instances more accurate or detailed data sets may have been available but would not allow for a fair comparison.

5.1 Geographical Scope

The SDREIN project covers San Diego, Imperial, Riverside, and San Bernardino Counties (Figure 7). The broader project region covers most of Southern California, excluding Los Angeles, and represents about 20% of California’s land area. The region is geographically diverse, covering numerous climate zones, including coastal, inland valleys, mountains, and desert. San Bernardino County is the largest County with over 20,000 square miles of land area but has a relatively low population density. On the other hand, San Diego County is relatively small in terms of land area but has by far the highest population density.

Figure 7 Counties Included in the San Diego Regional Energy Innovation Network

5.2 Population

Total population and its distribution among the four counties is particularly important to determining priority technologies for the SDREIN and for understanding the potential ratepayer benefits. Of the total region, there is a large proportion of the population that lives inland where weather patterns lead to higher per capita energy consumption, mainly due to cooling loads.
Changes in weather patterns due to climate change could exacerbate energy use as climate scientists project that all climate zones will experience higher temperatures.

5.2.1 Current and Forecasted Population by County

The total population in the four-county region was nearly eight million in 2015 and is expected to be about 10.5 million in 2040 (Table 14). Riverside County will experience the most growth with a nearly 50% increase over its 2015 population by 2040. San Diego County will experience a 25% increase in that same timeframe, the least among the four counties (Table 15).

Table 14 Population Projection for Counties in the Project Region

<table>
<thead>
<tr>
<th></th>
<th>San Diego County</th>
<th>Riverside County</th>
<th>San Bernardino County</th>
<th>Imperial County</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>3,102,852</td>
<td>2,191,930</td>
<td>2,038,546</td>
<td>175,418</td>
<td>7,508,746</td>
</tr>
<tr>
<td>2015</td>
<td>3,245,170</td>
<td>2,333,140</td>
<td>2,110,557</td>
<td>183,091</td>
<td>7,871,958</td>
</tr>
<tr>
<td>2020</td>
<td>3,413,533</td>
<td>2,545,665</td>
<td>2,233,441</td>
<td>197,617</td>
<td>8,390,256</td>
</tr>
<tr>
<td>2025</td>
<td>3,591,336</td>
<td>2,782,505</td>
<td>2,372,506</td>
<td>214,205</td>
<td>8,960,552</td>
</tr>
<tr>
<td>2030</td>
<td>3,757,931</td>
<td>3,024,425</td>
<td>2,508,343</td>
<td>231,033</td>
<td>9,521,732</td>
</tr>
<tr>
<td>2035</td>
<td>3,918,015</td>
<td>3,239,196</td>
<td>2,633,363</td>
<td>247,457</td>
<td>10,038,031</td>
</tr>
<tr>
<td>2040</td>
<td>4,058,891</td>
<td>3,423,833</td>
<td>2,742,796</td>
<td>263,553</td>
<td>10,489,073</td>
</tr>
</tbody>
</table>

San Diego County is the largest population center of the project region. Its population is mostly urban and suburban. The City of San Diego is by far the largest city in the County, representing nearly half the regional population. There are also significant rural areas in San Diego County.

Riverside County’s population will increase nearly 50% by 2040. San Bernardino County will increase nearly one-third by that same time.

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5.2.2 Climate Zones

The distribution of the regional population among climate zones is particularly relevant for energy planning and technology innovation. The project region spans the following five climate zones.150

- **Zone 7 (Coastal)** – This is the southernmost coastal region of California. The warm ocean water and latitude make this climate very mild. The temperature of the ocean water affects the air temperature over it, and this in turn moderates temperatures over the coastal strip.

- **Zone 10 (Inland Valleys)** – The Southern California interior valleys are hilly and affected by thermal belts. Hilltops and valleys get more cold in the winter (with the possibility of frost) and warmer in the summer than the slopes and hillsides from which cold air drains. This climate is little influenced by the ocean. The days are quite sunny with most of the rain falling in the winter.

- **Zone 14 (Medium/High Desert)** - The climate of this medium to high desert is similar to neighboring cold winter zone 16 and subtropical low desert zone 15. Here, the continental mass influences this interior climate more than the ocean. Climate Zone 14 is characterized by wide swings in temperature, both between summer and winter and between day and night. Hot summer days are followed by cool nights; freezing nights are often followed by 60°F days.

- **Zone 15 (Low Desert)** – This is the low desert and is characterized by extremely hot and dry summers and moderately cold winters. The average temperature in Climate Zone 15 is much higher than any other zone in California, especially in the summer. The humidity is below the comfort range much of the year, which results in a large diurnal temperature range and very cool nights.

- **Zone 16 (Mountain)** – This zone is a high, mountainous and semiarid region above 5,000 feet in elevation. It covers a large area from the Oregon Border to San Bernardino County. The climate is mostly cold, but seasonal changes are well defined and summer temperatures can be mild.

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A significant majority of the land area is located in climate zones 14 and 15 (Figure 8 and Figure 9), yet most of the population is located in zones 7 and 10, in which 29% and 54% of the total regional population is located, respectively (Figure 8 and Figure 9). Because nearly 70% of the population is located in Climate zones 10, 14, 15, and 16, the region has a higher than average per capita energy consumption and peak demand.

Figure 8 Distribution of 2010 Project Region Population by California Climate Zone\textsuperscript{151}

![Figure 8 Distribution of 2010 Project Region Population by California Climate Zone](image)

Figure 9 shows the percentage of population by climate zone for each county.

\begin{figure}
\centering
\includegraphics[width=\textwidth]{figure9}
\caption{Figure 9: Distribution of 2010 Population by Climate Zone}
\end{figure}

5.2.2.1 Projected Temperature Increases

Climate scientists project that average temperatures in the SDREIN project region could increase by 3-4 degrees Fahrenheit in the low emissions scenario (Figure 10) and by 5-7 degrees in the high emissions scenario (Figure 11). Such change could further exacerbate the energy implications of the projected increase in population and housing in Climate Zone 10 described here. Climate Zone 10 could be hotter on average in the future than it has been in the past. These average projections could obscure the potential for more frequent heat waves that are associated with higher temperatures and humidity. Such heatwaves could increase peak demand and further worsen the region’s load factor.

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153 Climate Education Partners. San Diego, 2050 is Calling. How will you answer? http://www.sandiego.edu/2050/
Figure 10 Projected Changes in Annual Average Temperatures for the Low Emissions Scenario\textsuperscript{154}

![Map showing projected changes in annual average temperatures for the low emissions scenario.](image)

Figure 11 Projected Changes in Annual Average Temperatures for the High Emissions Scenario

![Map showing projected changes in annual average temperatures for the high emissions scenario.](image)

\textsuperscript{154} The maps show projected change in annual average temperatures across California under a low and high carbon emissions scenario. The maps show the projected difference in temperature between a baseline time period (1961-1990) and an end of century period (2070-2090). Maps generated with the Cal-Adapt tool on October 30, 2016 from http://cal-adapt.org/.
5.3 Housing
The current and future housing stock of the SDREIN project region is an important factor in overall energy consumption. This section provides an overview of the housing sector for each county.

5.3.1 Current Housing Data
The project region has a total of 2.7 million housing units. San Diego County accounts for about 43% of all housing units in the region, while Riverside and San Bernardino Counties account for 30% and 25%, respectively. Imperial County, the least populated county in the region, accounts for about 2% of housing units. (Table 16).

About 53% of San Diego County housing is owner-occupied, compared with 66% and 61% for Riverside and San Bernardino Counties, respectively. Homeownership is an important factor when considering policies and programs to encourage efficiency upgrades and clean onsite generation. In the case of homeownership, the financial interests of energy improvements generally accrue to the homeowner. In the case of renters, there is a misalignment of interests; the renter would like to pay a lower energy bill but does not own the property, and the landlord does not pay the energy bill and therefore has no incentive to install energy improvements. This dilemma is called the split incentive.

### Table 16 Housing Characteristics of Counties in the Project Region

<table>
<thead>
<tr>
<th>Housing</th>
<th>San Diego County</th>
<th>Riverside County</th>
<th>San Bernardino County</th>
<th>Imperial County</th>
<th>Regional Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housing units, July 1, 2015</td>
<td>1,194,415</td>
<td>826,790</td>
<td>711,660</td>
<td>57,216</td>
<td>2,790,081</td>
</tr>
<tr>
<td>Owner-occupied housing unit rate, 2010-2014</td>
<td>53%</td>
<td>66%</td>
<td>61%</td>
<td>56%</td>
<td>59%</td>
</tr>
<tr>
<td>Median value of owner-occupied housing units, 2010-2014</td>
<td>$412,800</td>
<td>$236,400</td>
<td>$225,400</td>
<td>$145,200</td>
<td></td>
</tr>
<tr>
<td>Median gross rent, 2010-2014</td>
<td>$772</td>
<td>$1,328</td>
<td>$1,182</td>
<td>$1,113</td>
<td></td>
</tr>
</tbody>
</table>

San Diego County also has significantly higher housing values compared to the other counties. Riverside and San Bernardino Counties are comparable to each other, but Imperial County is significantly lower than the other three counties.

5.3.2 Housing Forecast
The total housing stock of the SDREIN project region of 2.7 million will grow to 3.2 million by 2040. Housing in Riverside and Imperial Counties will increase about 35% by then, with San Bernardino and San Diego housing increasing by 30% and 25%, respectively. Table 17 and Figure 14 show this projected growth.

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### Table 17 Projection of Households for Counties in the Project Region\(^{156}\)

<table>
<thead>
<tr>
<th></th>
<th>San Diego County</th>
<th>Riverside County</th>
<th>San Bernardino County</th>
<th>Imperial County</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>1,086,244</td>
<td>686,365</td>
<td>611,618</td>
<td>49,129</td>
<td>2,433,356</td>
</tr>
<tr>
<td>2015</td>
<td>1,111,636</td>
<td>705,968</td>
<td>620,508</td>
<td>49,998</td>
<td>2,488,110</td>
</tr>
<tr>
<td>2020</td>
<td>1,163,412</td>
<td>764,549</td>
<td>650,737</td>
<td>53,343</td>
<td>2,632,041</td>
</tr>
<tr>
<td>2025</td>
<td>1,218,094</td>
<td>829,499</td>
<td>687,642</td>
<td>57,415</td>
<td>2,792,651</td>
</tr>
<tr>
<td>2030</td>
<td>1,277,504</td>
<td>891,397</td>
<td>725,208</td>
<td>61,178</td>
<td>2,955,287</td>
</tr>
<tr>
<td>2035</td>
<td>1,334,908</td>
<td>950,355</td>
<td>764,287</td>
<td>64,424</td>
<td>3,113,974</td>
</tr>
<tr>
<td>2040</td>
<td>1,380,297</td>
<td>1,002,026</td>
<td>802,831</td>
<td>67,333</td>
<td>3,252,486</td>
</tr>
</tbody>
</table>

#### Figure 12 Percentage Change in Projected Population versus 2015

- **San Diego County**: Decreasing trend from 2015 to 2040.
- **Riverside County**: Increasing trend from 2015 to 2040.
- **San Bernardino County**: Steady increase from 2015 to 2040.
- **Imperial County**: Steady increase from 2015 to 2040.

#### 5.3.2.1 San Diego County Housing Forecast

The San Diego Association of Governments (SANDAG) provides detailed housing forecasts for the San Diego region. The total values differ from the data presented above by the California Department of Transportation but provide a breakdown between single-family and multifamily housing units. Single-family housing units will increase less than 10% by 2050, while multifamily units will increase by almost 50% by 2050. Figure 13 and Figure 14 show this trend. It is not clear...  

whether similar trends are occurring in the other counties, but obtaining more detailed data to characterize the housing stock could be useful.

**Figure 13 Housing Forecast for San Diego County**

<table>
<thead>
<tr>
<th>Year</th>
<th>Single-family Housing</th>
<th>Multi-family Housing</th>
<th>Mobile Homes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>703,101</td>
<td>420,147</td>
<td>42,570</td>
</tr>
<tr>
<td>2020</td>
<td>731,693</td>
<td>477,258</td>
<td>40,733</td>
</tr>
<tr>
<td>2035</td>
<td>758,622</td>
<td>597,762</td>
<td>38,399</td>
</tr>
<tr>
<td>2050</td>
<td>763,226</td>
<td>692,709</td>
<td>36,000</td>
</tr>
</tbody>
</table>

**Figure 14 Percentage Change in San Diego County Housing Versus 2012**

<table>
<thead>
<tr>
<th>Year</th>
<th>Percentage Change in Projected Housing Units versus 2012 (San Diego County)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td>-30%</td>
</tr>
<tr>
<td>2035</td>
<td>-20%</td>
</tr>
<tr>
<td>2050</td>
<td>-10%</td>
</tr>
</tbody>
</table>

### 5.4 Economics

The structure of the economy is another important factor to the overall energy consumption of our project region. This section provides an overview of the economy, including gross regional product, income, employment, and summaries of some key economic clusters in the region, including the military, clean technology, life sciences, and Indian gaming industries.
5.4.1 Gross Regional Product

The projected total gross domestic product (GDP) for the SDREIN project region is approximately $330 billion for 2015. San Diego County has the largest GDP with nearly $200 billion, followed by the Riverside-San Bernardino-Ontario metropolitan area. All areas have experienced growth since 2010. The overall economy in the Riverside-San Bernardino-Ontario area grew by 3.8% over 2010 levels, San Diego County by 2.5%, and El Centro (Imperial County) by 2.2% (Figure 15).

Figure 15 Gross Domestic Product by Metropolitan Area 2010-2015

*Projection

5.4.2 Income

Figure 16 Median Household and Per Capita Income by County (2010-2014)\textsuperscript{158}

![Median Household and Per Capita Income by County 2010-2014](image)

Table 18 Projected Per Capita Income\textsuperscript{159}

<table>
<thead>
<tr>
<th>Year</th>
<th>San Diego County</th>
<th>Riverside County</th>
<th>San Bernardino County</th>
<th>Imperial County</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>46,133</td>
<td>30,155</td>
<td>30,464</td>
<td>28,703</td>
</tr>
<tr>
<td>2015</td>
<td>57,398</td>
<td>37,204</td>
<td>37,169</td>
<td>33,598</td>
</tr>
<tr>
<td>2020</td>
<td>71,352</td>
<td>43,877</td>
<td>45,012</td>
<td>40,778</td>
</tr>
<tr>
<td>2025</td>
<td>84,602</td>
<td>50,633</td>
<td>53,351</td>
<td>48,775</td>
</tr>
<tr>
<td>2030</td>
<td>98,779</td>
<td>57,460</td>
<td>62,100</td>
<td>56,453</td>
</tr>
<tr>
<td>2035</td>
<td>114,350</td>
<td>65,030</td>
<td>71,818</td>
<td>64,774</td>
</tr>
<tr>
<td>2040</td>
<td>134,088</td>
<td>74,905</td>
<td>84,009</td>
<td>74,412</td>
</tr>
</tbody>
</table>


\textsuperscript{159} California County-Level Economic Forecast 2015-2040, Economic Analysis Branch, Office of State Planning, California Department of Transportation, 2015. Accessed on 9-16-16 from \url{http://www.dot.ca.gov/hq/tpp/offices/eab/docs/Full%20Report%202015.pdf}
Table 19 Percentage Change in Projected Per Capita Income versus 2015\textsuperscript{160}

<table>
<thead>
<tr>
<th></th>
<th>San Diego County</th>
<th>Riverside County</th>
<th>San Bernardino County</th>
<th>Imperial County</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td>24%</td>
<td>18%</td>
<td>21%</td>
<td>21%</td>
</tr>
<tr>
<td>2025</td>
<td>47%</td>
<td>36%</td>
<td>44%</td>
<td>45%</td>
</tr>
<tr>
<td>2030</td>
<td>72%</td>
<td>54%</td>
<td>67%</td>
<td>68%</td>
</tr>
<tr>
<td>2035</td>
<td>99%</td>
<td>75%</td>
<td>93%</td>
<td>93%</td>
</tr>
<tr>
<td>2040</td>
<td>134%</td>
<td>101%</td>
<td>126%</td>
<td>121%</td>
</tr>
</tbody>
</table>

Figure 17 Percentage Change in Projected Per Capita Income versus 2015

\textsuperscript{160} Ibid.
5.4.3 Employment

Table 20 Projected Total Employment

<table>
<thead>
<tr>
<th></th>
<th>San Diego County</th>
<th>Riverside County</th>
<th>San Bernardino County</th>
<th>Imperial County</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>1,247,620</td>
<td>545,820</td>
<td>613,490</td>
<td>56,730</td>
<td>2,463,660</td>
</tr>
<tr>
<td>2015</td>
<td>1,393,059</td>
<td>648,103</td>
<td>697,203</td>
<td>66,240</td>
<td>2,804,605</td>
</tr>
<tr>
<td>2020</td>
<td>1,497,024</td>
<td>716,741</td>
<td>765,525</td>
<td>72,409</td>
<td>3,051,699</td>
</tr>
<tr>
<td>2025</td>
<td>1,564,879</td>
<td>769,079</td>
<td>817,407</td>
<td>76,605</td>
<td>3,227,970</td>
</tr>
<tr>
<td>2030</td>
<td>1,635,817</td>
<td>830,673</td>
<td>876,418</td>
<td>81,694</td>
<td>3,424,603</td>
</tr>
<tr>
<td>2035</td>
<td>1,701,192</td>
<td>888,514</td>
<td>938,356</td>
<td>88,033</td>
<td>3,616,095</td>
</tr>
<tr>
<td>2040</td>
<td>1,764,865</td>
<td>945,189</td>
<td>995,774</td>
<td>92,617</td>
<td>3,798,444</td>
</tr>
</tbody>
</table>

Table 21 Percentage Change in Projected Employment versus 2015

<table>
<thead>
<tr>
<th></th>
<th>San Diego County</th>
<th>Riverside County</th>
<th>San Bernardino County</th>
<th>Imperial County</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td>7%</td>
<td>11%</td>
<td>10%</td>
<td>9%</td>
<td>9%</td>
</tr>
<tr>
<td>2025</td>
<td>12%</td>
<td>19%</td>
<td>17%</td>
<td>16%</td>
<td>14%</td>
</tr>
<tr>
<td>2030</td>
<td>17%</td>
<td>28%</td>
<td>26%</td>
<td>23%</td>
<td>19%</td>
</tr>
<tr>
<td>2035</td>
<td>22%</td>
<td>37%</td>
<td>35%</td>
<td>33%</td>
<td>24%</td>
</tr>
<tr>
<td>2040</td>
<td>27%</td>
<td>46%</td>
<td>43%</td>
<td>40%</td>
<td>27%</td>
</tr>
</tbody>
</table>

5.4.4 Military Cluster

5.4.4.1 San Diego County

The military plays a significant role in the San Diego region’s economy. It employs over 130,000 active duty and civilian employees.\textsuperscript{161} Figure 18 shows the distribution of military employees by installation and service branch. Accounting for jobs adjacent to and caused by the military, the military in the San Diego region is responsible for a total of approximately 311,000 jobs, representing about approximately 25% of all jobs.\textsuperscript{162}

\textsuperscript{161} San Diego Military Impact Study June 2012. Commissioned by the San Diego Military Advisory Council. Conducted by the Fermanian Business & Economic Institute at Point Loma Nazarene University

\textsuperscript{162} Ibid.
Direct spending related to defense totaled about $20 billion annually from 2010 to 2012 and is expected to continue at about this pace (Figure 19). Defense-related spending contributed about $32 billion to the region’s gross regional product, about 17% of the total.

Figure 19 Total Direct Defense Spending in the San Diego Region.

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163 Ibid.
164 Ibid.
5.4.4.2 Riverside County
The Riverside region is home to two large military installations: March Air Reserve Base (MARB) and the Naval Surface Warfare Center (NSWC), Corona Division. March Air Reserve Base (MARB) employs over 8,500 military personnel and provides more than $500 million in economic impact to the Riverside area.165

5.4.5 Life Sciences Cluster

5.4.5.1 San Diego County
According to the San Diego Economic Development Corporation, life sciences accounts for more than $31.8 billion in total economic impact in the San Diego region.166 In 2014, more than 1,100 San Diego County companies employed more than 34,000 in direct life sciences employment – biomedical devices, biotechnology and pharmaceuticals. That number increases to more than 51,000 employees if related industries like biofuels, alternative energy, education and other related support jobs are included.

5.4.6 Cleantech Cluster

5.4.6.1 San Diego County
San Diego County has a large and growing clean technology sector. According to a recent report by the San Diego Regional Economic Development Council, in 2016 San Diego’s cleantech cluster accounted for about 10,000 jobs in 17 industries, spanning research development and demonstration, manufacturing, energy, and recycling and wastes.167 These positions were associated with about 3,000 payroll business locations, a three-fold increase over the last five years, and account for about $900 million in direct labor income. Cleantech companies contributed over $1 billion directly to the gross regional product.

Solar installation is a large component of San Diego’s Cleantech cluster, accounting for 8,400 direct jobs, with an estimated income of $500 million. This industry contributed about $700 million in value and $1.5 billion in output to the regional economy.

There are more than 800 clean energy companies in the San Diego region supporting research, product development, deployment, and innovation. Clean energy is one of the top five fields of growth in San Diego, and the region has seen positive trends for growth in local business and jobs as well as venture capital investment in clean energy technologies, according to data compiled from the San Diego Regional Economic Development Corporation. In 2015, San Diego was ranked first in the nation for solar jobs and photovoltaic (PV) installations. San Diego County had 59,994 advanced energy jobs in 2015.168 The advanced energy jobs include sectors of advanced grid...
technologies, advanced fuels, advanced generation, advanced transportation, and building energy efficiency.

5.4.6.2 Riverside County
In 2016, the City of Riverside put forth a Riverside Restorative Growthprint (RRG), which combines two plans – Riverside’s Economic Prosperity Action Plan and Climate Action Plan. Per the plan, “[t]he adoption of the RRG will result in actions to reduce GHG emissions that align with the City’s planning priorities and its vision of a future ‘green’ economy based on sustainable businesses.” The RRG-EPAP identifies the measures and strategies in the RRG-CAP with the greatest potential to drive local economic prosperity through cleantech investment, entrepreneurship, and expansion of local green businesses.

Riverside County had 19,993 advanced energy jobs in 2015.\(^{169}\)

5.4.6.3 San Bernardino County
San Bernardino County’s cleantech economic activity is based upon large numbers of installed residential and commercial solar photovoltaics systems as well as high clean vehicle rebates and greentech patents.\(^{170}\) San Bernardino County had 19,242 advanced energy jobs in 2015.\(^{171}\)

5.4.6.4 Imperial County
Imperial County’s cleantech industry serves the predominantly agricultural and biorenewables economy to provide reliable energy sources, decrease water costs, and meet state environmental standards for air and water. Imperial County had 2,441 advanced energy jobs in 2015.\(^{172}\)

5.4.7 Indian Gaming Cluster
The project region is home to a high concentration of Indian reservations, many of which have casino and resort operations. There are 33 tribes in the four-county project region (Table 22).\(^{173}\) San Diego County has 18 Indian reservations, more than any other county in the United States. These reservations are generally very small compared with reservations such as the Navajo in Arizona but account for about 124,000 acres (193 square miles). The total population of Native Americans in San Diego County is approximately 20,000. Riverside County has 10 reservations, San Bernardino has 4, and Imperial County has 4.

---


\(^{173}\) County list of tribal nations accessed from the California’s Clean Air Project (CCAP) on 12-13-16 from http://www.etr.org/ccap/tribal-nations-in-california/county-list-of-tribal-nations/.
Table 22 Indian Reservations in the SDREIN Project Region

<table>
<thead>
<tr>
<th>San Diego County</th>
<th>Riverside County</th>
<th>San Bernardino County</th>
<th>Imperial Valley</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barona</td>
<td>Agua Caliente</td>
<td>Chemehuevi</td>
<td>Quechan</td>
</tr>
<tr>
<td>Campo</td>
<td>Augustine</td>
<td>Fort Mojave</td>
<td></td>
</tr>
<tr>
<td>Capitan Grande</td>
<td>Cabazon</td>
<td>San Manuel</td>
<td></td>
</tr>
<tr>
<td>Cuyapaipie</td>
<td>Cahuilla</td>
<td>Twenty Nine Palms</td>
<td></td>
</tr>
<tr>
<td>Inaja &amp; Cosmit</td>
<td>Morongo</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jamul</td>
<td>Pechanga</td>
<td></td>
<td></td>
</tr>
<tr>
<td>La Jolla</td>
<td>Ramona</td>
<td></td>
<td></td>
</tr>
<tr>
<td>La Posta</td>
<td>Santa Rosa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Los Coyotes</td>
<td>Soboba</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manzanita</td>
<td>Torres-Martinez</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mesa Grande</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pala</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pauma &amp; Yuima</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rincon</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>San Pasqual</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Santa Ysabel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sycuan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viejas</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

There are 22 casinos located in the SDREIN region. Casinos, which are generally large energy consumers, represent a potentially important industry cluster for emerging energy technologies.

Figure 20 Indian Casino Locations in the SDREIN Project Region
5.5 Energy Characteristics

This section summarizes the energy characteristics and trends in the four-county SDREIN project region to help identify potential energy technology opportunities.

5.5.1 Energy Utilities

Energy utilities generally do not match political boundaries. The energy utilities that serve the project region are no exception. There are numerous IOU and publicly-owned utility (POU) service territories that serve the broader four-county project region. None of them adhere to the boundaries of the counties.

5.5.1.1 Electric Utilities

Several electric utilities operate in the four-county project region. The vast majority of load is served by three utilities:

- San Diego Gas & Electric – SDG&E serves most of San Diego County and a small portion of Orange County.
- Southern California Edison – SCE serves most of the load in San Bernardino County and a large portion of Riverside County.
- Imperial Irrigation District – IID serves most of Imperial County, a small area of San Diego County, and a significant area of Riverside County.

In addition, there are numerous smaller publicly-owned utilities:

- Anza Electric Co-op
- City of Banning
- Bear Valley Electric
- City of Corona
- Colton Electric
- Moreno Valley Utility
- City of Needles
- City of Riverside
- Rancho Cucamonga Municipal Utility
- Victorville Municipal Utilities Services

Table 23 compares the number of customers, retail sales, and peak load in 2010. Two Native American Utilities also operate in the project region: Aha Macav Power Service and Morongo.
Table 23 Small Publicly-Owned Utilities Operating in the Project Region

<table>
<thead>
<tr>
<th>Utility</th>
<th>2010 Customers</th>
<th>2010 Retail Sales (GWh)</th>
<th>2010 Peak Load* (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riverside, City of</td>
<td>105,968</td>
<td>1,996</td>
<td>580</td>
</tr>
<tr>
<td>Bear Valley Electric Service</td>
<td>23,660</td>
<td>132</td>
<td>40</td>
</tr>
<tr>
<td>Colton Electric Utility Department</td>
<td>18,206</td>
<td>340</td>
<td>86</td>
</tr>
<tr>
<td>City of Banning</td>
<td>11,784</td>
<td>133</td>
<td>45</td>
</tr>
<tr>
<td>Moreno Valley Electric Utility</td>
<td>5,779</td>
<td>95</td>
<td>29</td>
</tr>
<tr>
<td>City of Banning</td>
<td>2,863</td>
<td>54</td>
<td>16</td>
</tr>
<tr>
<td>City of Corona</td>
<td>771</td>
<td>150</td>
<td>27</td>
</tr>
<tr>
<td>Rancho Cucamonga Municipal Utility</td>
<td>490</td>
<td>65</td>
<td>16</td>
</tr>
<tr>
<td>City of Victorville</td>
<td>22</td>
<td>57</td>
<td>12</td>
</tr>
</tbody>
</table>

*Peak Loads are actual non-coincident peak-hour loads and generally do not include transmission losses.

Figure 21 Electric Utility Service Area Map for Project Region

---

5.5.1.2 Natural Gas Utilities
Several natural gas utilities operate in the four-county project region, including Southern California Gas (SCG), SDG&E, and Southwest Gas. Figure 22 shows these service territories.

Figure 22 Natural Gas Utility Service Area Map for Project Region\textsuperscript{175}

5.5.2 Energy Consumption Trends

5.5.2.1 Electric Consumption
The four-county SDREIN project region consumed over 51,000 GWh in 2014.\textsuperscript{176} San Diego County accounts for about 40% of total electricity consumption within the region. Riverside and San Bernardino each consume about 30% of the total. Total electric consumption in the region has increased steadily from 1990-2014 but has begun to show signs of leveling off (Figure 23). Per capita consumption has also leveled off somewhat over this same period (Figure 23).


While differences occur by utility and by county, the distribution of electricity consumption for the overall project region is dominated by non-residential usage, which accounts for about 65% of all electricity consumption. Residential consumption represents about 35% of the total.
5.5.2.2 Peak Demand

Peak demand is the highest level of demand during a specific time period – an hour, day, week, month, or year. Annual peak demand has grown steadily for the SDG&E (San Diego County) and the SCE (Riverside County and San Bernardino County) service territories since 1990 (Figure 26). SDG&E peak demand has grown by about 70%, while SCE’s peak has grown by about 35%. Peak demand in 2001 was approximately equal to the level in 1990. This seems to be a pivot point for when peak began to increase for both utilities. The effects of the California Energy Crisis were wearing off around that time, and typical consumption and demand patterns resumed.
Load Factor

Load factor is a measure of asset utilization, that is, how much of the time an asset is being used productively. The higher the load factor, the more an asset is being used. In the electric industry, load factor compares average demand to the peak demand as measured in megawatts (MW), which shows the influence of peak demand on the overall utility system. Load factors for the entire service territory of the two IOUs in the SDREIN project region are in the low to mid 50% range. This means that average demand is half of the peak. Put another way, peak demand is twice average demand. The electric system of these IOUs is built to serve a peak demand that is twice the average load served and may only occur for a limited number of hours annually.

Load factor is an important consideration when deliberating technology pathways because reducing peak demand is an important policy priority, and if temperatures increase over time due to climate change, peak demand could rise, thus decreasing load factor.

5.5.2.3 Natural Gas

The following natural gas trend data for the four counties in the project region is from the Energy Commission’s Energy Consumption Data Management System. Figure 28 shows relatively flat natural gas consumption for each of the four project counties over the past 15 years. Residential natural gas consumption (Figure 29) has been flat for San Diego and Imperial Counties, but Riverside and San Bernardino Counties showed slight increases in recent years. Non-residential consumption (Figure 30) has been volatile but relatively flat for San Diego and San Bernardino Counties. Riverside and Imperial Counties had slight increases over the past decade.

177 SDG&E’s service territory covers nearly all of San Diego County, so the load factor is an accurate representation for the San Diego region. SCE’s service territory is much larger than the areas covered in Riverside and San Bernardino Counties, so it is not clear whether the load factor is an accurate representation of those counties.

Figure 28 Total Natural Gas Consumption in the Project Region 1990-2014

Figure 29 Residential Natural Gas Consumption 1990-2014
5.5.3 Greenhouse Gas Emissions from Energy Use

One of the guiding principles of the EPIC program is to encourage technological innovation that can reduce GHG emissions. Energy-related emissions account for a significant majority of emissions in the SDREIN project region. While it is difficult to compare accurately across jurisdictions given differences in calculation method and the number of emissions categories included, Table 24 shows that they range between 60%-90%. On-road transportation generally represents the highest share of emissions. Among the jurisdictional GHG inventories presented in Table 24, transportation accounts for between 40%-60% of emissions. Electricity and natural gas, generally representing energy use in buildings, represents between 20%-50% of emissions. This is consistent with the breakdown of emissions at the state level where transportation accounts for 37% of total emissions, electricity for 20%, and natural gas for about 10%.179

---

Table 24 Contribution of Total Greenhouse Gas Emissions from Energy-Related Activities

<table>
<thead>
<tr>
<th>Category</th>
<th>San Diego County (Region) 2012*</th>
<th>City of Riverside 2007</th>
<th>Unicorp. County of Riverside 2008</th>
<th>Western Riverside Council of Gov’ts 2010</th>
<th>San Bernardino County (Region) 2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-Road Transportation</td>
<td>37%</td>
<td>41%</td>
<td>41%</td>
<td>57%</td>
<td>45%</td>
</tr>
<tr>
<td>Electricity</td>
<td>23%</td>
<td>37%</td>
<td>22%</td>
<td>41%</td>
<td>40%</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>8%</td>
<td>14%</td>
<td>22%</td>
<td>41%</td>
<td>40%</td>
</tr>
<tr>
<td>Total</td>
<td>68%</td>
<td>91%</td>
<td>63%</td>
<td>98%</td>
<td>86%</td>
</tr>
</tbody>
</table>

*On-road transportation value represents percentage after the effects of state and federal policy.

5.5.4 Large-Scale Energy Projects

Nearly 6,000 MW of large-scale energy generation is located within the SDREIN project region. Table 25 shows the distribution of projects for each technology area by county. Riverside and Imperial Counties each account for about 35% of the total project capacity. San Bernardino accounts for about a quarter, while San Diego County has only 3% of projects on a capacity basis.

Solar PV projects account for 42% of project capacity, followed by solar thermal (22%), wind (18%), and geothermal (13%). Riverside and Imperial Counties each have over 900 MW of solar PV installed. San Bernardino County has nearly 1,000 MW of solar thermal capacity.

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Table 25 Capacity of Renewable Energy Projects by County (as of June 2016)\textsuperscript{181}

<table>
<thead>
<tr>
<th></th>
<th>Riverside County</th>
<th>Imperial County</th>
<th>San Bernardino County</th>
<th>San Diego County</th>
<th>Total</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar thermal</td>
<td>250</td>
<td>-</td>
<td>999</td>
<td>1,249</td>
<td>2,429</td>
<td>22%</td>
</tr>
<tr>
<td>Photovoltaic (PV)</td>
<td>984</td>
<td>929</td>
<td>451</td>
<td>65</td>
<td>2,429</td>
<td>42%</td>
</tr>
<tr>
<td>Small hydroelectric</td>
<td>50</td>
<td>93</td>
<td>38</td>
<td>13</td>
<td>194</td>
<td>3%</td>
</tr>
<tr>
<td>Wind</td>
<td>699</td>
<td>265</td>
<td>7</td>
<td>51</td>
<td>1,022</td>
<td>18%</td>
</tr>
<tr>
<td>Biomass</td>
<td>59</td>
<td>-</td>
<td>3</td>
<td>44</td>
<td>106</td>
<td>2%</td>
</tr>
<tr>
<td>Geothermal</td>
<td>-</td>
<td>718</td>
<td>-</td>
<td>-</td>
<td>718</td>
<td>13%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2,042</strong></td>
<td><strong>2,005</strong></td>
<td><strong>1,498</strong></td>
<td><strong>173</strong></td>
<td><strong>5,718</strong></td>
<td>100%</td>
</tr>
<tr>
<td>% of Total</td>
<td>36%</td>
<td>35%</td>
<td>26%</td>
<td>3%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Riverside, Imperial, and San Bernardino rank 2\textsuperscript{nd}, 3\textsuperscript{rd}, and 4\textsuperscript{th}, respectively, among California counties with the most renewable energy capacity in 2016. Combined, these three counties have more installed renewable capacity than Kern County, the county with the highest capacity by far (Figure 31).

Figure 31 Top 10 Counties by Renewable Energy Capacity (2016)

5.5.4.1 Desert Renewable Energy Conservation Plan (DRCEP)\textsuperscript{182}

The Desert Renewable Energy Conservation Plan (DRECP) is a collaborative effort between the Energy Commission, California Department of Fish and Wildlife, the U.S. Bureau of Land Management, and the U.S. Fish and Wildlife Service, collectively known as the Renewable Energy


\textsuperscript{182} http://www.drecp.org/
Action Team, to help protect and conserve the desert ecosystems while allowing for development of renewable energy projects.

The DRECP focuses on 22.5 million acres in the desert regions and adjacent lands of Imperial, Inyo, Kern, Los Angeles, Riverside, San Bernardino, and San Diego Counties. Nearly 17 million acres – about 74% of the total participating land area – is located in three counties of the SDREIN project region. Over 90% of the total acreage of San Bernardino and Imperial Counties is covered by the DRCEP (Table 26)

<table>
<thead>
<tr>
<th>Table 26 Desert Renewable Energy Conservation Plan Acres Covered</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Riverside County</td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td>Total Land Area (Milion Acres)</td>
</tr>
<tr>
<td>Land Area in the DRCEP (Milion Acres)</td>
</tr>
<tr>
<td>Percentage of Land in DRCEP</td>
</tr>
</tbody>
</table>

5.5.5 Penetration of Distributed Energy Resources

The SDREIN project region is home to a high concentration of distributed energy resources, including over 165,000 distributed solar PV projects, representing 1,100 MW of capacity. The region also has a high penetration of electric vehicles. Nearly 20,000 vehicles in the region have received or applied to receive financial rebates. Table 27 summarizes the distributed energy resources located in the project region.

<table>
<thead>
<tr>
<th>Table 27 Penetration of Distributed Generation Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology</td>
</tr>
<tr>
<td>Total Capacity of Distributed Solar Photovoltaics (MW)</td>
</tr>
<tr>
<td>Total Number of Distributed Solar Photovoltaic Projects</td>
</tr>
<tr>
<td>Advanced Energy Storage Installed and Rebated through SGIP (MW)</td>
</tr>
<tr>
<td>Number of Fuel Cell CHP and Fuel Cell Electric Projects</td>
</tr>
<tr>
<td>Electric Vehicles Rebates Issued or Approved to Date (PHEV, BEV, and other)</td>
</tr>
<tr>
<td>Number of Total Wind Turbine Projects</td>
</tr>
</tbody>
</table>

Figure 32 shows the capacity of installed solar PV by County. San Diego County has among the highest concentration of solar PV in California and likely the US.

**Figure 32 Distributed Photovoltaics Capacity by County (2016)**

The San Diego region has experienced significant growth in distributed solar PV in recent years. Figure 33 shows energy production from PV and non-PV self-generation in the SDG&E service territory as a percentage of gross generation. In effect, this shows what percentage of the total electricity load is served by self-generation. Solar PV currently supplies about 4% of gross generation but is projected to contribute nearly 10% by 2025, driving the total percentage from self-generation to nearly 14%.

---

184 Gross generation is defined as the total electrical production needed to serve the entire load of an area, including transmission losses and self-generated electricity.
5.5.5.1 Fossil Fuel Distributed Generation
Data for fossil fuel distributed generation was available only for San Diego County at the time of publication. Figure 34 shows that about 200 MW of capacity are operating in San Diego County, with gas turbines and gas reciprocating engines accounting for the vast majority of these technologies. Since 2011, a small capacity of fuel cells has been installed.

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185 California Energy Commission, California Energy Demand 2015 Revised - Mid Demand Case, December 2015. Form 1.2 - SDGE Planning Area, Net Energy for Load (GWh).
6 MAPPING PRIORITY TECHNOLOGIES TO POLICIES

6.1 Key Regional Insights for Selecting Priority Technology Areas

Based on the regional characteristics above, several preliminary insights emerge as criteria to help prioritize the existing CEC EPIC funding initiative areas and to identify possible additional categories. Each key insight includes several factors that are used to screen the EPIC funding areas. Those key factors may apply to more than one Key Insight topic.

6.1.1 Growing Population in Climate Zone 10

The majority (54%) of the SDREIN project region’s population is located in climate zone 10 (CZ 10). Much of the growth in population and housing is expected in this same climate zone. Expected increases in temperature are likely to increase electricity consumption in this zone. Accordingly, there will likely be an increased need for energy efficiency in existing buildings, including efficient HVAC and envelope and demand management. Also, a similar need will likely exist for new buildings to be efficient.

If not managed, the growing population in CZ 10 also could exacerbate the trend of increasing peak demand in the SDREIN region. As demonstrated above, load factor is declining. This suggests a need for more load management to achieve more dynamic and flexible load.

Both a need for efficiency and load management highlights the role of software and models to help optimize efficiency investments and financing and business models to bring products and services to the market.

Key regional priorities and needs arising from this insight include the following:

- Increase use of efficient HVAC and envelope in existing buildings
• Increase use of demand management strategies
• Increase use of energy project financing
• Enhance software and models to identify and optimize efficiency investments

6.1.2 High Penetration of Customer-Sited Photovoltaics

The SDREIN project region accounts for over 1,000 MW of customer-sited solar PV. San Diego County has one of the highest concentrations of PV in the U.S. High concentrations of solar PV on individual feeders can cause operational challenges. On the other hand, coupled with energy storage, this capacity could contribute significantly to strategic demand reductions. Innovation is needed to help to integrate solar PV more effectively into electric distribution networks and to optimize performance on the customer side of the meter.

Key regional priorities and needs arising from this insight include the following:

• Higher efficiency modules to increase production per area of installed capacity
• Advanced inverters to increase conversion efficiency and address possible power quality issues
• Energy storage solutions to couple with onsite solar PV
• Software and optimization control schemes for managing energy in a home or business

6.1.3 Need for Higher Penetration and Integration of Electric Vehicles

As noted above, the broader transportation sector accounts for about 40% of overall GHG emissions. There are many solutions to reduce emissions from the transportation sector, but for the purposes of identifying priority technology areas, advancing the use of electric vehicles is a key strategy, particularly as the carbon intensity of grid power declines with the implementation of the Renewable Portfolio Standard.

Increasing the penetration of electric vehicles could also contribute to peak demand issues in the broader region. Smart charging technology and strategies can help to mitigate these concerns. Similarly, electric vehicles present an opportunity to contribute to demand management through vehicle-to-grid integration (VGI) strategies.

There are significant challenges to increase use of EVs in the SDREIN project region, including lack of charging infrastructure, low gasoline prices, perceived limited driving range, etc.

Key regional priorities and needs arising from this insight include the following:

• Breakthrough energy storage technology to increase driving range
• Vehicle to grid technology, particularly focused on the cycling issue
• Smart charging technologies and strategies

6.1.4 Need for Efficiency and Decarbonization of the Water Cycle

Each aspect of the water cycle uses energy. From supply and conveyance to treatment and distribution to waste water treatment, energy is an important aspect of the water cycle in California. Because the SDREIN project region is one of the furthest from water sources in the North and East regions of the state, the embedded energy and carbon in a gallon of water consumed in this region
– particularly in San Diego County, the southernmost County in California – is higher than in other areas in the state.

Saving water in the SDREIN project region provides a dual benefit by freeing up supply for other customers and reducing energy consumption and the associated GHG emissions. There is a need to increase the efficiency of and decarbonize the water cycle at every step. San Diego County is home to the only water desalination plant on the west coast of the U.S. Desalination is the most energy intensive supply source. As with energy, a Loading Order concept should apply where marginal demand is served by conservation and efficiency, but if additional supply is needed and provided by desalination, it should be as efficient as possible.

Also, as the electricity supply becomes cleaner, the emissions associated with the water cycle will decline. Therefore, reducing consumption yields a dwindling amount of GHG emissions reductions but continues to reduce the costs related to energy and the water cycle.

The water system itself is an important source of clean energy. Improving efficiency of in-line hydropower can help to offset emissions associated with pumping water.

Key regional priorities and needs arising from this insight include the following:

- Reduce energy intensity of water by increasing efficiency of the entire water cycle
- Reduce energy inputs for desalination
- Improve the efficiency of inline hydropower production
- Improve efficiency of water-associated appliances (e.g., Washing machines, dishwashers, etc.)

### 6.1.5 Increasing Attention on Climate Action Planning

There has been significant climate planning within the SDREIN project region. Most of the largest jurisdictions have completed a climate action plan with targets to reduce GHG emissions. The largest emissions category is generally transportation, followed by electricity and natural gas. Much of the emissions reductions included in local jurisdiction climate plans are in compliance with federal and state policies. Local governments have authority to regulate land use and building and other permits.

One challenge to reducing emissions that aligns with statewide policy goals is to achieve energy reductions in existing homes and businesses. Another challenge is how to reduce emissions from the transportation sector. For the purposes of the SDREIN project, electric vehicles are a significant strategy to do this.

Given the difficulty in reaching longer-term emissions targets, some cities have sought to increase the supply of renewable energy to the communities in their jurisdiction beyond that required by California’s Renewable Portfolio Standard. A commonly considered way to achieve higher levels of renewable electricity supply is to form a Community Choice Aggregation (CCA) program to procure higher levels of clean electricity. The City of San Diego has adopted a legally-binding CAP with an aggressive target of supplying 100% of all electricity supply within its borders from renewable sources by 2035. This target raises challenging questions about the feasibility of achieving a 100%
renewable supply, the contribution of distributed renewables such as solar PV, and the role large-scale and customer-sited energy storage would play.

Key regional priorities and needs arising from this insight include the following:

- Increase efficiency of existing building stock
- Electrify the on-road transportation fleet
- Deploy energy storage to help integrate high penetration of renewable electricity supply
- Integrate high levels of distributed renewable electricity from solar PV

6.1.6 Large Military Presence/Military has Significant Efficiency and Renewable Energy Goals

The SDREIN region has a high concentration of military bases and employment. The federal government has set ambitious energy efficiency and renewable energy targets for the military. Energy technologies relevant to military operations could serve an important role in helping meet federal targets and also could create a significant market for innovative energy technologies.

In addition to policy goals, the military is increasingly interested in the concept of resiliency and has developed microgrid projects on bases in the region.

Key regional priorities and needs arising from this insight include the following:

- Increase building efficiency
- Increase on-site renewable electricity production
- Develop microgrids

6.1.7 High Concentration of Large-Scale Renewable Energy Projects and Potential for More

The SDREIN region has significant renewable energy resources. About 30% of the renewable energy capacity installed in California is located in Riverside, Imperial, and San Bernardino Counties. As California increases it supply of renewable electricity, it is likely that more renewables will be installed in this region.

Key regional priorities and needs arising from this insight include the following:

- The role of water in certain renewable generation technologies
- Efficiency of renewable energy technologies
- Integration of large percentages of large-scale renewables into the grid

6.2 Comparison of EPIC Technology Funding Areas with Key Insights

Table 28 compares the EPIC Investment Plan funding initiatives with the key regional insights described in Section 6.1 above to show which funding initiatives are most aligned with regional priorities and needs. The table shows the funding initiatives in order of how well they match up with regional insights.
### Table 28 Comparison of EPIC Energy Technology Funding Initiatives and Key Regional Insights

<table>
<thead>
<tr>
<th>Funding Initiatives</th>
<th>Key Regional Insights</th>
</tr>
</thead>
<tbody>
<tr>
<td>58:1 Develop Customer Systems to Manage Demand Response, Renewables, and Electric Vehicles, and Integrate these Tools with the Grid.</td>
<td>Growing Population in Zone 10</td>
</tr>
<tr>
<td>53:2 Develop Integrated and Hybrid Photovoltaic Technologies and Strategies to Reduce Costs and Advance Zero-Net Energy Buildings.</td>
<td>X</td>
</tr>
<tr>
<td>51:2 Develop Model Designs and Strategies for Cost-Effective Zero Net Energy Homes and Buildings.</td>
<td>X</td>
</tr>
<tr>
<td>51:5 Develop and Test Advanced Industrial, Agricultural, Water and Demand Response Technologies and Strategies to Reduce Energy Use and Costs.</td>
<td>X</td>
</tr>
<tr>
<td>52:1 Develop and Test Demand Response Technologies to Assess Performance, Increase Reliability and Improve Forecasting Techniques.</td>
<td>X</td>
</tr>
<tr>
<td>53:4 Advance Breakthroughs in Renewable Energy Technologies to Dramatically Increase Efficiency, Reduce Costs, and Enable Additional Renewable Resources.</td>
<td>X</td>
</tr>
<tr>
<td>51:1 Advance Efficient Solutions for Lower Energy Buildings.</td>
<td>X</td>
</tr>
<tr>
<td>51:3 Apply Advanced Social Science Research Methods to Improve Adoption of Next Generation Energy Efficiency Solutions.</td>
<td>X</td>
</tr>
<tr>
<td>57:1 Develop Open-Source Electricity System Modeling Tools to Visualize California's Modern Distribution Systems.</td>
<td>X</td>
</tr>
<tr>
<td>59:1 Advance Electric Vehicle Charging to Increase Renewable Energy Levels and Improve Grid Reliability.</td>
<td>X</td>
</tr>
<tr>
<td>53:3 Generate Electricity While Moving Water: Developing Solutions to Expand California’s Use of In-Conduit Hydrokinetic Power.</td>
<td>X</td>
</tr>
<tr>
<td>54:2 Develop Innovative Tools and Strategies to Increase Predictability and Reliability of Wind and Solar Energy Generation.</td>
<td>X</td>
</tr>
<tr>
<td>54:3 Develop Advanced Technologies and Strategies to Improve the Cost-Effectiveness of Geothermal Energy Production.</td>
<td>X</td>
</tr>
<tr>
<td>55:3 Improve Science for Water Management in Power Generation: Hydropower Forecasting and Alternative Sources of Cooling Water.</td>
<td>X</td>
</tr>
<tr>
<td>55:4 Provide Tools and Information for Regional Climate Change Adaptation Measures for the Electricity Sector.</td>
<td>X</td>
</tr>
<tr>
<td>56:1 Develop Smart Inverter Capabilities to Improve Grid Operations.</td>
<td>X</td>
</tr>
<tr>
<td>59:9 Develop TECHNOLOGIES AND METHODS TO ENABLE SAFE, EFFICIENT, SMART RECYCLING OF ELECTRIC VEHICLE BATTERIES.</td>
<td>X</td>
</tr>
<tr>
<td>53:1 Efficient, Sustainable and Lower-Cost Bioenergy: Innovations to Improve Biomass.</td>
<td>X</td>
</tr>
<tr>
<td>54:4 Upgrade California’s Aging Wind Turbines: Design, Cost, and Development Improvements That Meet Local Needs.</td>
<td>X</td>
</tr>
<tr>
<td>51:4 Develop and Evaluate Strategies to Improve Indoor Air Quality in Energy-Efficient Buildings.</td>
<td>X</td>
</tr>
<tr>
<td>55:1 Implement Roadmap to Address Public Health Effects From Energy Technologies.</td>
<td>X</td>
</tr>
</tbody>
</table>

### 6.3 SDREIN Technology Priority Areas

Based on the analysis described above, the SDREIN project technology priorities are presented in Figure 35. Several technology categories provide multiple benefits and serve more than one state policy goal. For example, electric transportation technologies reduce emissions from on-road transportation and with smart charging can also shift electric load to help integrate renewable electricity. Similarly, increasing renewable electricity supplies reduces emissions in the electric...
sector but also reduces emissions from the on-road transportation sector when vehicles are powered by electricity.

**Figure 35 Technology Priority Areas by Category**

<table>
<thead>
<tr>
<th>Energy Efficiency and Demand Response</th>
<th>Clean Generation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Envelope Efficiency</td>
<td>Hydroelectric and Related Technology</td>
</tr>
<tr>
<td>Lighting Efficiency</td>
<td>Wind and Related Technology</td>
</tr>
<tr>
<td>HVAC Efficiency</td>
<td>Solar and Related Technology</td>
</tr>
<tr>
<td>Plug Load Efficiency</td>
<td>Geothermal and Related Technology</td>
</tr>
<tr>
<td>Pump/Other Equipment Efficiency</td>
<td>Wave and Related Technology</td>
</tr>
<tr>
<td>Energy Management Technologies</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Smart Grid Enabling Clean Energy</th>
<th>Clean Transportation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical Energy Storage</td>
<td>Battery Electric Vehicle Technologies</td>
</tr>
<tr>
<td>Electrochemical Energy Storage</td>
<td>Hybrid Electric Vehicle Technologies</td>
</tr>
<tr>
<td>Electrical Energy Storage</td>
<td>Electric Vehicle Charging Infrastructure</td>
</tr>
<tr>
<td>Thermal Energy Storage</td>
<td>Software Platforms</td>
</tr>
<tr>
<td>Smart Grid/Metering Hardware, Software, Data Analytics Microgrids</td>
<td></td>
</tr>
</tbody>
</table>

To summarize how these technology priority areas are related to and support the policy areas and how the EPIC Investment Plan Funding Initiatives and regional insights are used, we provide a series of figures below – one for each policy category. This framework serves not only to help evaluate and select priority technology areas, it also can serve as an important part of the eventual evaluation process. Technologies that participate in the program will have to demonstrate ratepayer benefit, which will require some quantification of energy and emissions impacts as well as a qualitative review of whether it served the guiding principles of the EPIC program. Further, impacts can be directly linked to the policies represented. For instance, using the illustrative framework in Figure 36, the energy and emissions impacts of a building envelope efficiency company could be connected to state and local policies that support overall GHG emissions reductions.
Figure 36 Summary of Evaluation of Technology Priorities for the Energy Efficiency and Demand Response Category

<table>
<thead>
<tr>
<th>Regional Insights</th>
<th>$1.1</th>
<th>$1.2</th>
<th>$1.3</th>
<th>$1.4</th>
<th>$1.5</th>
<th>$1.6</th>
<th>$2.1</th>
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</thead>
<tbody>
<tr>
<td>Growing Population in Zone 10</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Penetration of Customer-Sited Photovoltaics</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
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<tr>
<td>Need for Higher Penetration of Evs</td>
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<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase Efficiency and Decarbonize the Water Cycle</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increasing Attention on Climate Planning</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>Military has Significant Efficiency and Renewable Goals</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>High Concentration of Large Scale Renewable Capacity</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Technology Priority Areas for SD REIC Intake Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Envelope Efficiency</td>
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<tr>
<td>Lighting Efficiency</td>
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<td>HVAC Efficiency</td>
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<td>Plug Load Efficiency</td>
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<tr>
<td>Pump/Other Equipment Efficiency</td>
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<tr>
<td>Energy Management Technologies</td>
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</table>

Figure 37 shows the connection between state policy, the EPIC investment plan, regional insights, and the technology priorities for the Clean Generation Category.
Figure 38 shows the connection between state policy, the EPIC investment plan, regional insights, and the technology priorities for the Smart Grid Enabling Clean Energy Category.

<table>
<thead>
<tr>
<th>Federal</th>
<th>State</th>
<th>SD-REIC Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean Power Plan, EO 13693</td>
<td>AB 32, SB 32, S-3-05, SB 375, C&amp;T</td>
<td>Climate Action Plans</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Federal</th>
<th>State</th>
<th>SD-REIC Region</th>
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</thead>
<tbody>
<tr>
<td>Production and Investment Tax Credits, Salton Sea Area Federal initiatives, CAISO DER GAT</td>
<td>RPS (SB 1078, SB 107, S-21-09, SB 21(a), SB 350), NEM (AB 327, D.16-01-044), SGIP, CSI (MASH, SASH), NSHP, Community Solar (SB 43), Loading Order</td>
<td>PV Ready Programs in San Diego County, 100% RE under City of San Diego CAP, San Bernardino General Plan Amendment and GHG Reduction Plan, City of Riverside Climate Action Plan, Imperial County General Plan</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Regional Insights</th>
<th>S3.1</th>
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<tbody>
<tr>
<td>Growing Population in Zone 10</td>
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<td>High Penetration of Customer-Sited Photovoltaics</td>
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<td>Need for Higher Penetration of EVs</td>
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<td>Increase Efficiency and Decarbonize the Water Cycle</td>
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<td>Increasing Attention on Climate Planning</td>
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<thead>
<tr>
<th>Technology Priority Areas for SD REIC Intake Process</th>
<th>Hydroelectric and Related Technology</th>
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<tbody>
<tr>
<td></td>
<td>Wind and Related Technology</td>
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<td>Solar and Related Technology</td>
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<td></td>
<td>Geothermal and Related Technology</td>
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<td></td>
<td>Wave and Related Technology</td>
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</tbody>
</table>
Figure 38 Summary of Evaluation of Technology Priorities for the Smart Grid Enabling Clean Energy Category

<table>
<thead>
<tr>
<th></th>
<th>Greenhouse Gas Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal</td>
<td>Clean Power Plan, EO 13693</td>
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<tr>
<td>State</td>
<td>AB 32, SB 32, S-3-05, SB 375, C&amp;T</td>
</tr>
<tr>
<td>SD-REIC Region</td>
<td>Climate Action Plans</td>
</tr>
</tbody>
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<th>Smart Grid Enabling Clean Energy Policy</th>
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<td>SD-REIC Region</td>
<td>San Bernardino General Plan Amendment and GHG Reduction Plan</td>
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<th>Regional Insights</th>
<th>S6.1</th>
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<th>S9.1</th>
<th>S9.2</th>
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<tbody>
<tr>
<td>Growing Population in Zone 10</td>
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<tr>
<td>High Penetration of Customer-Sited Photovoltaics</td>
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<td>Need for Higher Penetration of Evs</td>
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<td>X</td>
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<tr>
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<thead>
<tr>
<th>Technology Priority Areas for SD REIC Intake Process</th>
<th>Mechanical Energy Storage</th>
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<td>Microgrids</td>
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Figure 39 shows the connection between state policy, the EPIC investment plan, regional insights, and the technology priorities for the Clean Transportation Category.
7 ROADMAP FOR FUTURE REPORTS

This Task 2 report represents the initial version in a 5-year project, and we expect that through an iterative process, it will be updated and refined over the project period. Given the time to complete this version, several areas emerged for further work. The following summarizes our preliminary next steps to enhance the 2017 Task 2 Report:

<table>
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<tr>
<th>Regional Insights</th>
<th>Greenhouse Gas Policy</th>
<th>Clean Transportation Policy</th>
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<td>AB 32, SB 32, S-3-05, SB 375, C&amp;T</td>
<td>ZEV (B-16-12), AB 32, SB 32, C&amp;T, LCFS, SB 375, SB 350, SB 12 SB 535, B-32-15</td>
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<td>Need for Higher Penetration of Evs</td>
<td>Climate Action Plans</td>
<td>PV and EV Ready Programs in San Diego County, San Bernardino General Plan Amendment and GHG Reduction Plan, City of Riverside Climate Action Plan, Imperial County General Plan</td>
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<td>Increase Efficiency and Decarbonize the Water Cycle</td>
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<tr>
<td>Increasing Attention on Climate Planning</td>
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<td>Military has Significant Efficiency and Renewable Goals</td>
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<td>High Concentration of Large Scale Renewable Capacity</td>
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<td>Battery Electric Vehicle Technologies Hybrid Electric Vehicle Technologies Electric Vehicle Charging Infrastructure Software Platforms</td>
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<tr>
<th>Technology Priority Areas for SD REIC Intake Process</th>
<th>No Additional Specific Funding Initiatives for Clean Transportation</th>
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• Further regulatory research in specific areas, including FERC developments around DER integration. Also, more detailed research into local government policies in the SDREIN project region.
• Incorporate legislative and regulatory changes that occur after the completion of the 2016 Task 2 Report.
• Incorporate any significant changes to market conditions that may affect the viability of existing technology priority areas.
• Conduct further research with regional stakeholders, including surveys and interviews of IOUs, CPUC, Energy Commission, energy company representatives, etc., to increase awareness and knowledge of regional market conditions. This will enhance the general regional characteristics analysis conducted for this report.
• Conduct targeted market assessment research and analysis. This could include a TOU rate customer impact and opportunity analysis, which could be conducted by Navigant Consulting as part of their support contract to do market analysis.
• Conduct further research on Riverside, San Bernardino, and Imperial Counties to better understand regional characteristics, including commercial/industrial lease costs.
• Understand better the potential to add additional technology priority categories, including alternative financing tools and energy planning and analysis tools.
• Develop a framework for evaluating participating technologies in order to determine if they support state policy goals and provide ratepayer benefits.
• Future-looking assessment of regulations and policies to better inform entrepreneurs about what is adopted but not yet implemented, including trends and future regulatory scenarios.

8 CONCLUSION

The purpose of Task 2 was to assess regional energy needs and opportunities using market analysis and regulatory documentation, establish regional energy technology priorities that will be used to match applicant technologies to state energy targets, and conduct a review of state energy goals and create a Report of Regional Energy Technology Priorities and Needs.

To accomplish these goals, the first step was to identify policies in these categories at the federal, state, and local levels, which create an overall summary of the policy framework that supports or encourages various energy technology types. The next step was to assess unique characteristics of the SDREIN project region. This was done by reviewing demographic and economic data, as well as energy trends and patterns. Based on this assessment, we identified key insights related to energy technology innovation. These insights were compared with the funding initiatives in the EPIC Investment Plan to determine which match best with regional needs. The final step was to use these high-priority areas to develop technology categories that can be used by the SDREIN project team during the intake and management process.