California Energy Commission

STAFF REPORT

DEVELOPING RENEWABLE GENERATION ON STATE PROPERTY

Installing Renewable Energy on State Buildings and Other State-Owned Property

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ABSTRACT

California has a long history of developing renewable energy resources to help meet its energy needs. This report focuses on the potential for developing renewable distributed generation – onsite or small energy systems located close to where energy is consumed – on state-owned properties to contribute toward the goal of installing 20,000 megawatts of renewable generation by 2020. In addition to distributed generation, the report explores the potential for developing utility-scale renewables on state properties as well. Making state properties available to renewable developers could reduce energy costs in state buildings, create new sources of revenue by leasing vacant or unused lands and rights-of-way, and provide cost savings to the state through reduced land maintenance costs that would be assumed by renewable developers who use those lands. The report outlines the current amount of renewable energy development on state properties, challenges and opportunities for further development, and next steps. Through its leadership, California has the opportunity to demonstrate the benefits of renewable distributed generation and encourage increased deployment of these resources throughout the state and across the country.

KEY WORDS:

Renewable, state buildings, state properties, photovoltaic, wind, biomass, geothermal, small hydro, storage, distributed generation, interconnection, integration, economics, permitting, inventory, rights-of-way.

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EXECUTIVE SUMMARY

California has the potential to develop renewable energy systems on state owned buildings, properties, and rights-of-way to help meet the state's renewable energy goals, create green jobs, and reduce greenhouse gas emissions and other harmful air pollutants. Making state properties available to renewable developers could reduce existing energy costs in state buildings, create new revenue streams by leasing vacant or unused lands and rights-of-way, and realize cost savings by eliminating the obligation to maintain lands leased to developers. Further, state leadership will demonstrate the benefits of distributed generation (DG), potentially reduce the need for new or upgraded transmission lines, and help spur larger-scale deployment throughout the state and across the country.

There are about 907 megawatts of renewable self-generation capacity installed in California and another 400 megawatts of capacity pending approval. The Schwarzenegger administration set a goal of 5,000 megawatts of renewable DG by 2020, and Governor Brown's *Clean Energy Jobs Plan* calls for a more aggressive goal of 12,000 megawatts of localized electricity generation and 8,000 megawatts of large-scale renewables by 2020, for a total of 20,000 megawatts of additional renewable capacity.

Energy Commission staff recommends that California state government should target installing 2,500 megawatts of renewables on state properties to help meet the overall 20,000 megawatt statewide goal. Although this report focuses on distributed resources – defined here as localized energy up to 20 megawatts in size – it also includes utility-scale renewable opportunities that will help to achieve the 2,500 megawatt target for state properties. The report discusses development of renewable energy on state properties to date, barriers and solutions to deployment, opportunities for further development on state property, and next steps.

On December 15, 2010, the Energy Commission adopted a memorandum of understanding between the Energy Commission and the Departments of General Services, Corrections and Rehabilitation, Transportation (Caltrans), Water Resources, and Fish and Game to facilitate the development of renewable energy projects on state buildings, properties, and rights-of-way. The California State Lands Commission and the University of California have since joined the effort. The memorandum of understanding calls on the signatories to collaboratively study, plan, and develop energy generating infrastructure, coordinate consistent procurement strategies and contract language in requests for proposals, and develop one or more statewide solicitations to make such properties available to interested developers in the future. These agencies have the experience and resources necessary to perform the additional evaluations and environmental screening needed to determine which state-owned buildings, lands, and rights-of-way are most appropriate for renewable development going forward. The aim is to develop renewable resources on state property through existing programs and at no net increase in cost to the state.

The memorandum of understanding includes an option for additional agencies to join in the future. Extending this effort to include local and federal agencies throughout the state should also be considered.

Target for Renewables on State Property

A renewable energy target of 2,500 megawatts installed on state properties by 2020 reflects a 33 percent renewable energy target for state buildings by 2020 and Governor Brown's goal of 20,000 megawatts of new renewable capacity by 2020. It also builds on staff's inventory of the potential for renewable development on state buildings and properties. Table 1 shows the goal allocated across the property types identified in staff's inventory. As shown in Table 1, 14 to 26 megawatts could be developed on state buildings in load centers, 54 to 195 megawatts developed on properties with potential for wholesale generation, and 14,460 to 26,030 megawatts developed on land leased for wholesale generation.

Table 1: Target for Renewable Development Allocated by Type of State Property

State Property Category	Potential Renewable Generation Capacity (megawatts)*
State Buildings in Load Centers	14 – 26
State Property With Potential for Wholesale Generation	54.5 – 195
Land Lease for Wholesale Generation	14,460 – 26,030
Total State Properties Renewables Target	2,500

* The megawatt ranges reflect staff's assumption that 1 megawatt of photovoltaics can be developed on 5 to 9 acres.

Source: California Energy Commission

Implementation of the target should be consistent with the California's "loading order," which defines energy efficiency as the top priority for meeting the state's energy needs and renewables as the highest ranking supply-side resource. Consequently, when developing renewables on state buildings, priority should be given to buildings that have already received energy efficiency upgrades.

To help meet the 2020 target of 2,500 installed megawatts, it will be useful to set interim targets that can be used to monitor progress toward the goal. Although there are near-term opportunities to develop renewables on state buildings, the majority of the target would likely be met with projects developed on land leased for wholesale generation, including large-scale projects that take longer to deploy. Staff therefore proposes the following interim targets consistent with deployment expectations: one-third by 2015 (833 megawatts); one-third by 2018 (1,666 megawatts, cumulative); and one-third by 2020 (2,500 megawatts, cumulative).

Existing State Programs

Several California state agencies have already begun efforts to advance the deployment of renewable resources:

- The Department of General Services is tracking energy use at state buildings to measure progress toward reducing energy consumption 20 percent by 2020 as called for by Executive Order S-20-04. This database serves as a valuable tool for identifying buildings that have undergone low-cost efficiency improvements and are best suited for DG. The Department of General Services also has entered into contracts to install 12.25 megawatts at California State University campuses and several state agencies.
- Caltrans is pursuing the installation of solar photovoltaics along the California highway system consistent with Governor Brown's support of the California Solar Highway. Projects are under development in Santa Clara and the Sacramento/Rancho Cordova areas.
- The Department of Water Resources is working with the University of California on a photovoltaic demonstration project along the California aqueduct and next to one of its pumping plants. Water Resources also recently released a request for proposals for a wind energy system with at least 5 megawatts of capacity. As a result of Assembly Bill 515 (Richman, Chapter 368, Statutes of 2005) Water Code 141, which took effect January 1, 2006, the Department of Water Resources established a program to review requests to lease their properties which are free-owned, non-operating rights-of-way above or adjacent to State Water Project conveyance facilities, for the purpose of installing and operating solar photovoltaic systems. Parties interested in leasing Department of Water Resources' properties for installing photovoltaic panels and systems are required to submit a proposal to the department that includes an engineering study.
- The Department of Forestry and Fire Protection is investigating using wood wastes culled for fire management as a feedstock for electricity generation.
- The Department of Corrections and Rehabilitation has two operational 1 megawatt photovoltaic ground-mounted solar arrays at state prisons and has executed contracts to expand these systems to a capacity of nearly 9 megawatts, which would offset nearly all of the power requirements of both facilities. The department has also identified 20 additional locations for ground-mounted systems from 1 to 20 megawatts in size, is exploring roof-mounted photovoltaics and wind resource opportunities, and could develop wholesale distributed generation at some locations.
- The State Lands Commission manages thousands of acres of "school lands" as a revenue source for the State Teachers' Retirement Fund. Unlike the other agencies, the State Lands Commission is focusing on utility-scale development rather than DG. It has approved leases for renewable energy projects on these lands and is considering applications for new projects.

- The University of California has embraced the goal of sustainability and is transforming its business practices to reduce its impact on the environment. In addition to setting energy efficiency targets, the University of California has committed to installing 10 megawatts of onsite renewable energy by 2014. The University of California currently has 6.3 megawatts of onsite solar photovoltaics installed or under construction, and will have an additional 6.2 megawatts of biogas-powered generation installed by the fall of 2011.

Barriers and Solutions

This report looks at four broad barriers to the increased development of renewable resources: economics, integrating renewable energy into the grid, interconnecting small-scale renewables into the grid, and environmental permitting. Some potential solutions presented in this report will require long-term efforts that are outside the time frame envisioned for installing renewables on state property, but are discussed here to help provide information on how to move forward to install 12,000 megawatts of localized energy by 2020.

Economics

Economic barriers to the development of renewables include high upfront costs and the transaction costs associated with the installation of small-scale DG. Costs can be reduced through technology advancements – one of the goals of the Energy Commission's Public Interest Energy Research Program – and through incentives aimed at lowering cost, increasing demand, and improving economies of scale.

One strategy to address high upfront costs is "net energy metering," which can improve the economics of a DG project by providing a credit at the fully bundled retail rate for energy exported to the grid, up to the amount of energy consumed in a year. Other strategies include rebate incentives offered by the state for government projects ranging from $1.10 to $1.40 per watt for solar projects in investor-owned utility service areas. Incentives are also available for projects located in publicly owned utility service areas. For small wind projects, the Energy Commission offers incentives at $3.00 per watt for the first 10 kilowatts and $1.50 per watt for any incremental capacity installed up to 30 kilowatts. The rebate for fuel cells using renewable fuel is $3.00 per watt for systems sized up to 50 kilowatts, but the incentive applies only to the first 30 kilowatts.

Federal incentives also help reduce upfront costs. A federal tax credit is available for up to 30 percent of system cost, and owners may be eligible for cash grants in lieu of the tax credit. Also, federal tax depreciation incentives are available for renewables, including allowing a developer to potentially expense the entire capitalized cost of the property in 2011 if it is placed in service before the end of the year.

Feed-in tariffs can reduce high transaction costs for installing renewable DG by establishing a predetermined price with must-take provisions within a standard offer contract. The California Public Utilities Commission is required to set a feed-in tariff for up to 750 megawatts of distributed generation that is sized 3 megawatts or smaller, installed in investor-owned utility

service territories, and is eligible for the Renewables Portfolio Standard. Another strategy is the California Public Utilities Commission's Renewable Auction Mechanism, a streamlined contracting mechanism adopted in December 2010 in an effort to allow small renewable projects to better participate in the Renewables Portfolio Standard.

The sale of Renewable Energy Credits, which represent the renewable and environmental attributes of renewable energy generated, can also offset capital costs. While this report does not go into specifics of how to structure a request for proposals, it does suggest that the state should carefully consider whether to retain the Renewable Energy Credits for renewable energy generated on state property.

Finally, in addition to project and power purchase costs, costs associated with project development and management can affect the economic feasibility of a project. For example, costs associated with site identification and state contracting processes can affect project feasibility. The inventory developed by Energy Commission staff to identify potential locations for energy generation infrastructure on state-owned facilities and surplus property is a first step to reducing these costs by identifying areas with good resource potential. Providing advance information about potential sites, including sites that are environmentally sensitive, will help minimize developer risk. The state also plans to evaluate buildings to provide developers with detailed information about a building's roof, shading, and electrical systems.

Integrating Renewable Energy

Renewables such as solar and wind are considered intermittent resources since energy production increases and declines with variations in sunshine and wind. Maintaining a reliable electricity system while integrating increasing levels of intermittent resources requires backup generation that can be turned up or down as needed. Technologies such as smart grid, "microgrids," energy storage, and demand response, as well as improved forecasting of renewable resources, can help integrate renewables into the grid and reduce the need for backup generation.

The smart grid will link electricity with communications and computer control to create a highly automated, responsive, and resilient power delivery system that will both optimize service and empower customers to make informed energy decisions. Related to the smart grid is the microgrid, an integrated energy system of interconnected loads and distributed energy resources that can operate in parallel with the grid or independently from the grid. Storage technologies can be applied on the transmission and distribution system to regulate fluctuations from renewable output and maintain system voltages at required levels. Demand response can ease the integration of renewables by curtailing consumers' energy use to match the intermittency of renewable generation. With improved forecasting tools, the grid operators will have better information about resource variability and can make more informed dispatch decisions to maintain system reliability. The Energy Commission's Public Interest Energy Research Program conducts research, development, and demonstration to advance each of these emerging technologies to help improve efficiency, reduce costs, reduce environmental impacts of the electricity system, maintain grid reliability, and foster consumer choice.

Interconnection

Interconnecting large quantities of renewable distributed generation projects presents additional challenges, but on balance these are expected to be easier to overcome than the challenges associated with developing large transmission lines for utility-scale remote renewables. Although DG does not interconnect to transmission-level voltage systems, interconnection studies are required to assure that project additions will not adversely affect the operation and safety of distribution or transmission systems.

If a DG project developer decides to build a project that connects to a part of the distribution system of a load serving entity within the California Independent System Operator's balancing authority area and sells all its energy to another party, then the interconnection request is under the jurisdiction of the Federal Energy Regulatory Commission and subject to the load serving entity's Wholesale Distribution Access Tariff. Each investor-owned utility has such a tariff, and Pacific Gas and Electric Company and Southern California Edison are engaged in separate stakeholder processes to amend their tariffs. Many of the proposed changes are intended to respond to the dramatic increase in interconnection requests over the past few years.

Rule 21 is a process that describes the interconnection, operating, and metering requirements for eligible projects to connect to the investor-owned utilities' distribution grid. If a project is a qualifying facility under the Public Utilities Regulatory Policies Act and has a qualifying facility standard offer contract, the developer may then apply for interconnection under Rule 21. Although there is no system size limit, it is difficult for a project larger than 2 megawatts to qualify for a simple interconnection. Adopted by the California Public Utilities Commission in 2000, Rule 21 had been a streamlined, standardized process but has since become outdated and needs to be modified to support California's growing DG market. In April, 2011, the California Public Utilities Commission announced that it is resurrecting its Rule 21 Working Group to build consensus on reforms needed to meet the technical requirements and policy goals of interconnecting DG.

For projects that need to interconnect to the transmission system controlled by the California Independent System Operator, developers must apply to the California Independent System Operator using the Generator Interconnection Procedures. Developers can request interconnection through one of four processes depending on the size and location of the project. The processes vary in scope and complexity, and each requires developers to provide technical information and demonstrate site exclusivity or pay a site deposit. Projects that require studies are required to pay a study deposit and participate in a two-phase study process. Cost estimates for equipment, engineering, procurement, and/or construction work needed for interconnection is provided after the first study phase.

The increased ability for small, non-DG projects, such as photovoltaics and other renewable energy projects, to compete in wholesale electric markets has resulted in an unprecedented increase in the number of interconnection requests to the California Independent System Operator. The large volume of smaller interconnection requests has necessitated revisions in the study process to assure that the large numbers of projects are studied in a timely manner. To

accomplish the needed study process revisions, the California Independent System Operator and the Participating Transmission Owners revised their respective interconnection tariffs during 2010 and 2011.

Permitting

State agencies regulate the private use of state land and resources and activities of statewide significance through permitting authority established by statute. Multiple agencies can be involved in the approval of renewable projects and in many cases individual agencies develop additional administrative rules and permitting requirements. All discretionary actions taken in California are subject to compliance with California Environmental Quality Act, although categorical exemptions may be appropriate for renewable projects located on state buildings. A negative declaration or mitigated negative declaration may also be appropriate for projects located on a state building, but an environmental impact report could also be required, depending on the nature and severity of potential impacts. The location and type of project will play a key role in determining the type of document that needs to be prepared.

Small-scale photovoltaic projects located on state-owned buildings would be permitted through the Department of General Services or those agencies with separate permitting authority that evaluate potential environmental issues, approve project plans, and perform inspections during and after project construction. Larger renewable projects located on state-owned rights-of-way, aqueducts, or lands would be subject to review and approval, including California Environmental Quality Act evaluation, by the state agency with appropriate jurisdiction. Larger projects will also involve upgrades to the distribution or transmission system and will require evaluation by utilities or the California Independent System Operator, as well as greater coordination with local governments and affected stakeholders. These larger projects could not be developed as quickly as those on state buildings because they will require more in-depth environmental evaluation and have the potential for greater environmental impacts.

While local governments do not have permitting authority over renewable energy projects on government-owned (state, federal) buildings, rights-of-way, or properties, state agencies are often required to ensure that projects are consistent with local laws, ordinances, regulations, and standards. In addition, appurtenant facilities related to the project, but not located on state property, may require review and approval from the local jurisdiction (for example, a city or county planning agency). Further, local governments, the public, and other stakeholders will be encouraged to participate in the licensing and review of projects proposed on state properties.

The Energy Commission and the state understand that local decision-makers and planners are often confronted with public concerns about the potential impacts and benefits of energy generation projects and that informed local governments, citizens, and stakeholders have a role in helping California meet its renewable energy and climate change goals. In an effort to provide assistance to local governments, the Energy Commission published the *Energy Aware Planning Guide*, a comprehensive resource for local governments seeking to reduce energy use, improve energy efficiency and increase usage of renewable energy across all sectors. The Energy Commission is also proposing a new program, the Renewable Planning and Permitting

Program (RP3) that will provide local governments with planning and permitting assistance to help them evaluate and expedite renewable energy development in their jurisdictions. The first phase is a proposed grants program targeted to cities, counties, and other local jurisdictions.

Inventory of Opportunities

In October 2010, Energy Commission staff began to identify and inventory state properties to understand the potential opportunities available for the rapid deployment of renewable distributed generation systems. To identify the best opportunities, staff focused on clusters of state buildings within seven load centers near existing distribution lines, but also looked at buildings not in load centers that have high onsite load such as correctional facilities, state hospitals, and developmental centers. Staff also collected annual and monthly metered load and utility billing data on many of these buildings and estimated the square feet of available roof and parking lot space. Table 2 shows the estimated amount of the rooftop and parking lot space available to develop on these properties, the estimated potential photovoltaic capacity that could be developed based on available space, and the estimated capacity sized to the space available and the load of the building. From these data, staff estimated rapid deployment opportunities for about 16.2 megawatts that could be developed on rooftops and parking spaces.

Table 2: State Buildings in Load Centers

Load Center	Estimate of Usable Rooftop (sq. ft.)	Estimate of Useable Parking Lot (sq. ft.)	Estimate of Capacity Potential (megawatts)	Estimated Capacity Sized for Space and Load (MW) (megawatts)
Sacramento	1,020,000	330,000	4 – 7	4.8
San Francisco	260,000	540,000	2 – 4	2.2
Stockton/Modesto/ Turlock/Merced	150,000	280,000	2 – 4	1.6
Fresno	50,000	120,000	0.3 – 0.6	0.3
LA Basin	520,000	1,290,000	3 – 5	3
Inland Empire	180,000	600,000	1.5 – 2.5	1.4
San Diego	320,000	800,000	2.5 – 4.5	2.9
Total	**2,500,000**	**3,960,000**	**15.5 – 28**	**16.2**

Note: The area available for renewable energy development on rooftops and in parking lots is an estimate and actual site visits of each property are needed to better characterize available space. The megawatt ranges reflect staff's assumption that 1 megawatt of photovoltaics can be developed on 5 to 9 acres.

Source: California Energy Commission

Staff separately inventoried Department of Corrections and Rehabilitation buildings and Department of Mental Health facilities with high onsite loads and surplus land (Table 3). Staff carved out this grouping because these buildings would likely have different issues than the buildings with only smaller rooftop systems and because many of them are located outside of the state's load centers. Any renewables developed on these sites would likely serve onsite load and could produce excess generation for sale. Staff estimated that there are about 16.7 million square feet of usable rooftop space and about 9 million square feet of usable parking lot space available. The Department of Corrections and Rehabilitation assessed land outside the fenced areas of their facilities and excluded areas with insufficient interconnection opportunities, poor topography, or environmental sensitivity concerns. As shown in Table 3, the potential ground-mounted photovoltaic capacity at corrections and mental health facilities is approximately 50 megawatts to 200 megawatts.

Table 3: State Property With Potential for Wholesale Generation

Facility	Estimate of Usable Rooftop (square feet)	Estimate of Usable Parking Lot (square feet)	Estimate of Potential Capacity (MW)
California Correctional Institution	100,000	481,000	4.6
California Institution for Men	160,000	13,000	5 – 40
Calapatria State Prison	860,000	140,000	5 – 40
Centinela State Prison	840,000	110,000	5 – 40
California State Prison, Corcoran	2,700,000	570,000	3 – 5
Valley State Prison for Women	780,000	395,000	1 – 5
Chuckwalla Valley State Prison	775,000	430,000	4.6
Ironwood State Prison	965,000	280,000	4.6
Avenal State Prison	920,000	380,000	1 – 5
Central California Women's Facility	780,000	420,000	1 – 5
Folsom State Prison	No Info	No Info	0.25
Mule Creek State Prison	830,000	275,000	0.50
North Kern State Prison	940,000	405,000	4.6
R.J. Donovan Correctional Facility	950,000	430,000	1 – 5
Wasco State Prison	645,000	405,000	1 – 5
Mule Creek	Unknown	Unknown	0.50
CSP, Los Angeles County	Unknown	Unknown	2.9
High Desert State Prison	Unknown	Unknown	1 – 5
Pleasant Valley State Prison	Unknown	Unknown	1 – 5
Coalinga State Hospital	655,000	588,000	3 – 6
Metropolitan State Hospital	195,000	90,000	0.7 – 1.3
Napa State Hospital	215,000	200,000	1 – 2
Patton State Hospital	45,000	55,000	0.3 – 0.5
Atascadero State Hospital	438,000	284,000	2 – 3
Total	**13,793,000**	**5,951,000**	**54.5 – 195**

*The estimates reflect California Department of Corrections and Rehabilitation staff assessments of its property and the capacity potential. The estimated capacity potential for the state hospitals reflects only the roof-top and parking lot space and does not reflect any potential of projects located on surplus lands around the facilities.

Source: California Energy Commission

Staff also developed an initial, broad-brush inventory of state-owned properties that could be made available to developers for wholesale distribution and central station projects (Table 4). These properties included aqueduct siphons and pumping plants, excess lands, other state lands, and highway intersections. These and other areas require additional screening to determine their suitability for potential development. For example, further investigation may reveal that many of the properties are unsuitable for development due to environmental issues, the presence of sensitive species, health and safety concerns, or parcel access issues. In addition, many State Lands Commission parcels are not contiguous and could potentially benefit from parcel aggregation that would provide greater opportunities for renewable development while minimizing environmental impacts. To that end, the California State Lands Commission, the Department of Interior, the Bureau of Land Management, and the Renewable Energy Action Team agencies have informally discussed land swaps as way to further promote renewable energy development and enhance environmental conservation in the Desert Renewable Energy Conservation Plan area.

Table 4: State Property for Wholesale Generation

Type of Property	Acreage for parcels smaller than 200 acres	Acreage for parcels greater than 200 acres	Estimate of Capacity Potential (megawatts)*
Caltrans highway intersections within load centers	2,000	0	220 – 400
Caltrans and Department of Water Resources excess lands	520	19,640	2,240 – 4,030
Department of Water Resources aqueduct siphon and pumping station areas	1,1810	7,170	1,000 – 1,800
California State Lands Commission managed lands	15,700	83,600	11,000 – 19,900
Total	**20,030**	**110,410**	**14,460 – 26,030**

* The megawatt ranges reflect staff's assumption that 1 megawatt of photovoltaics can be developed on 5 to 9 acres. The estimate does not include using any of the land for wind capacity. Staff identified more than 100 parcels in areas of good wind resource that could potentially be enough land to support more than 2,000 MW of wind capacity.

Source: California Energy Commission

To estimate the renewable development potential for wholesale distribution and central station projects, staff first divided parcels into two size categories. Staff made the simplifying assumption that projects on parcels that are 200 acres and smaller would be wholesale distributed generators, while projects on parcels larger than 200 acres would be utility-scale

projects. The majority of land available for lease for wholesale generation is on large parcels that may support utility-scale generation. Staff assumed that wind would be developed on Department of Water Resources and California State Lands Commission properties located in areas with annual averages of 12 miles per hour or greater wind speeds at 100 meters. Staff identified roughly 100 parcels of land that could support wind development and estimated 1,900 megawatts of potential, although additional work is required to determine environmental suitability and access to distribution or transmission. Additionally, more than ten siphons and pumping stations are located in wind resource areas that could support approximately 120 megawatts of wind capacity.

Next Steps

Next steps include continued efforts by the Energy Commission to work with other state agencies to refine the inventory of opportunities to develop renewables on state property. Staff will continue to add data to the inventories, such as information about energy consumption, roof age, and environmental sensitivity of parcels, to reduce developer costs and uncertainty and position the state to pursue projects that offer the best value. In 2012, the inventory could be expanded, on a voluntary basis, to include opportunities for local governments and, in 2013, it could be expanded to address opportunities for development on federal facilities and joint procurement with other states.

In the second quarter of 2011, the Department of General Services, with support from the Energy Commission, should develop a request for proposals to develop renewables on state buildings identified as offering the best opportunities for renewable distributed generation development. In the fourth quarter of 2011, the Energy Commission, Caltrans, the Department of Water Resources, and the Department of General Services should work cooperatively to issue a request for proposals to develop renewables on state-owned excess lands.

To expedite development on state property leased for wholesale generation, staff recommends:

- Preliminary screening and environmental analysis to determine which state properties may be suitable and appropriate for renewable development, including analysis to determine the presence of threatened or endangered species and habitats.
- Coordination between the Department of General Services, the Department of Transportation, the California State Lands Commission, the Department of Water Resources, the Department of Education, the judicial branch, and other state and federal agencies as necessary, to collect data and evaluate appropriate sites for renewable development.
- Evaluation of electrical interconnections to transmission or distribution facilities.
- Coordination with the University of California and California State University systems to expand the inventory.

The Energy Commission intends to hold a workshop on May 9, 2011 to solicit public input on efforts needed to meet the Governor's 12,000 megawatt goal. Further, as part of its 2011

Integrated Energy Policy Report Proceeding, the Energy Commission will develop a report by November 30, 2011, that addresses specific barriers to the development of renewable generation and transmission projects and makes recommendations for how to address those barriers and expedite permitting of the highest priority projects.

CHAPTER 1: Introduction

California has vast potential to develop renewable energy facilities, including local resources, to meet its energy needs. This report focuses on localized energy, or distributed generation (DG), which is onsite or small energy systems located close to where energy is consumed that can be constructed quickly (without new transmission lines) and typically with little to no environmental impact. In addition to DG, the report also examines the potential for developing utility-scale renewable facilities on state-owned properties.

Currently, California has approximately 907 megawatts (MW) of installed renewable self-generation capacity and another 500 MW of capacity awaiting approval.[1] California's Clean Energy Future, a joint energy agency document describing key elements needed to achieve 2020 electricity and natural gas policy goals, set a goal to install 5,000 MW by 2020. Governor Brown's *Clean Energy Jobs Plan*[2] more than doubles that target by calling for 12,000 MW of installed DG by 2020. Further, the Governor calls for 8,000 MW of utility-scale renewables for a total of 20,000 MW by 2020.

On December 15, 2010, the California Energy Commission adopted a memorandum of understanding (MOU) among the Energy Commission and the Department of General Services (DGS), Department of Corrections and Rehabilitation (CDCR), Department of Transportation (Caltrans), Department of Water Resources (DWR), and Department of Fish and Game to promote the development of renewable energy projects on state buildings, properties, and rights-of-way (ROW). The State Lands Commission (CSLC) and University of California (UC) have since joined the MOU. The MOU includes an option for additional agencies to join in the future and calls on the signatories to collaboratively study, plan, and develop energy generating infrastructure, coordinate consistent procurement strategies and contract language in requests for proposals (RFPs), and develop one or more statewide RFP solicitations to make such properties available to interested developers. The MOU, a copy of which is provided in Appendix A, is effective through June 30, 2014.

This report is designed to be a first step to jump start the implementation of the MOU. The technologies considered in this report include solar, wind, biomass, fuel cells, geothermal, and hydropower, but the focus of the report is on the potential to develop solar photovoltaics (PV). The report is organized as follows:

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1 As of March 28, 2011, 126.8 MW were funded from the Emerging Renewables Program, 206.3 from the Self Generation Incentive Program, 11.6 from the New Solar Homes Partnership, 502 from the California Solar Initiative. Data on the publicly owned utilities was only available through 2009 and shows 60.1 MW installed. See http://www.energy.ca.gov/renewables/emerging_renewables/index.html, https://energycenter.org/index.php/incentive-programs/self-generation-incentive-program/sgip-documents/sgip-documents, and www.californiasolarstatistics.ca.gov.

2 http://www.jerrybrown.org/sites/default/files/6-15%20Clean_Energy%20Plan.pdf.

- Chapter 1: Rationale and policy context for deploying renewable energy on state buildings and properties, with a focus on DG.
- Chapter 2: Identification of existing state programs to deploy DG on state buildings and on state properties that do not have electricity load. Various state agencies, including signatories to the MOU and those who have not yet signed on, are taking steps to deploy renewables.
- Chapter 3: Assessment of barriers and potential solutions to broader adoption of small-scale, locally available renewable generation on state buildings and properties. The barriers fall into four broad categories: economics, integrating intermittent renewable generation into the grid, interconnecting DG into the distribution grid, and environmental permitting issues.
- Chapter 4: Initial inventory of the opportunities to deploy renewable generation on state buildings and on properties without electricity load. Also, discussion of setting a target for state government renewable development.
- Chapter 5: Suggested next steps for expanding the inventory, issuing RFPs, conducting a broader analysis toward meeting the Governor's goals for localized energy, and supporting continued funding for state research, development, and demonstration of renewable DG through the Energy Commission's Public Interest Energy Research (PIER) Program.

Additional information available in appendices includes:

- Appendix A: Copy of the MOU between the Energy Commission and DGS, CDCR, Caltrans, CDWR, and the Department of Fish and Game.
- Appendix B: Overview of research supported by the Energy Commission's PIER Program to advance renewable DG.
- Appendix C: Maps showing opportunities for development on state lands.
- Appendix D: Supplemental information about the process to interconnect DG into the electricity distribution system.

Assessing opportunities to develop small-scale renewables on state properties is a first step toward achieving Governor Brown's ambitious renewable goals. The Energy Commission plans to develop a more comprehensive analysis by November 30, 2011.

Program Rationale

DG is a central element in meeting the state's renewable energy goals, creating jobs, and reducing greenhouse gas emissions. The state will also need to continue to pursue development of utility-scale renewables. California state government can lead by example, demonstrating the successful operation and tangible benefits of DG and utility-scale renewables and spurring larger scale deployment. Further, by pursuing renewable development on state buildings and

lands, the state will gain valuable experience and become better informed to address market barriers in the future, including any regulatory barriers to market expansion.

In this time of fiscal austerity, the financial benefits of deploying DG on state property are especially attractive. DG installations can create new revenue streams for the state through land lease arrangements with developers and/or can reduce state energy and other costs. For instance, the state would not need to pay maintenance costs for land it leased for renewable development. The aim is to install renewables on state properties through existing programs and at no net increase in cost to the state. Project rollout can occur swiftly by leveraging existing programs and partnering with other state agencies and with utilities. For example, state agencies are working cooperatively to compile information on building characteristics to help developers identify the best opportunities for installing DG. Further, the project can create green jobs, tap the pool of graduates from American Recovery and Reinvestment Act (ARRA) funded training programs, and use ARRA-funded PV manufacturers in California.

Meeting California's aggressive goals necessitates pursuing renewable energy on all fronts – both remote renewables that require new transmission lines and small-scale, locally available resources. Deploying DG at the magnitude envisioned by Governor Brown's *Clean Energy Jobs Plan* will require upgrades to the distribution system but will not depend on large-scale transmission development. While interconnecting to the distribution system has some issues as discussed in Chapter 3, upgrading distribution lines can occur in small, relatively quick steps. For utility-scale renewables, staff is conducting further research to identify where projects can be developed on state land without the need for major new transmission lines.

Current Policy

Installing renewables on state properties supports California's greenhouse gas reduction and renewable energy goals. The driving force for the state's energy policies continues to be maintaining a reliable, efficient, and affordable energy system that minimizes the environmental impacts of energy production and use.[3] Reducing greenhouse gas emissions is a major goal of state energy policies and of the Global Warming Solutions Act of 2006 (Assembly Bill 32, Núñez, Chapter 488, Statutes of 2006), which requires the state to reduce greenhouse gas emissions to 1990 levels by 2020 and sets a comprehensive framework for reducing emissions.

A related policy is the Renewables Portfolio Standard (RPS), which requires 20 percent of the state's electricity consumption to be served by renewable resources by 2010, although California Public Utility Commission (CPUC) implementation requirements allow flexibility to meet the mandate in 2013. On April 12, 2011, Governor Brown signed Senate Bill X1 2 (SB X1 2 Simitian, Chapter 1, Statutes of 2011) codifying that the 20 percent requirement must be met by December 31, 2013 and a 33 percent target by 2020.

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3 California Energy Commission, *2009 Integrated Energy Policy Report*, Final Commission Report, December 2009, CEC -100-2009-003-CMF.

Another key policy is the state's "loading order" for electricity resources, which calls for meeting new electricity needs first with energy efficiency and demand response; second, with new generation from renewable energy and DG resources; and third, with clean fossil-fueled generation and transmission infrastructure improvements.

The *California Clean Energy Future*, developed during the Schwarzenegger administration, sets a goal for renewable DG of 5,000 MW by 2020.[4] The *California Clean Energy Future* also calls for "adaptive management practices"[5] in recognition of the need to address new developments and make any needed course corrections.

The 5,000 MW goal will be met or exceeded through a combination of the following programs, and apply to renewable DG installations on state-owned buildings and properties without electricity load onsite throughout the state:

- 3,000 MW of self-generation DG PV through the programs associated with Senate Bill (SB) 1 (Murray, Chapter 132, Statutes of 2006). Each system is sized to meet onsite electricity load or smaller with a rebate cap of 1 MW and a system cap of 5 MW. Assembly Bill 2724 (Blumenfield, Chapter 474, Statutes of 2010) sets aside 26 MW of this goal for projects on government buildings.
- 500 MW of wholesale DG PV in the Pacific Gas and Electric (PG&E) service territory. Half of the MW will be utility-owned, and half will be provided by independent energy producers. PG&E is pursuing projects between 5 and 20 MW.
- 500 MW of wholesale DG PV in the Southern California Edison (SCE) service territory (half of the MW will be utility-owned; half will be provided by independent energy producers). SCE is interested in projects between 500 kW and 5 MW.
- 100 MW of proposed wholesale DG PV in the San Diego Gas & Electric (SDG&E) service territory (26 MW will be utility-owned, and 74 MW will be provided by independent energy producers). SDG&E is interested in ground-mount single-axis systems between 2 MW and 10 MW.
- 750 MW of wholesale generation, including non-PV DG (Senate Bill 32, McLeod, Chapter 328, Statutes of 2009), through existing feed-in tariffs.[6] Applicable investor-owned utilities (IOUs) and publicly owned utilities (POUs) must meet a portion of the 750 MW requirement according to the proportion of their peak capacity to the entire state's peak capacity. Eligible projects must be RPS-certified and no greater than 3 MW.

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4 *California's Clean Energy Future, An Overview on Meeting California's Energy and Environmental Goals in the Electric Power Sector in 2020 and Beyond*, http://www.cacleanenergyfuture.org/2821/282190a82f940.pdf, page 4.

5 Ibid, page 2.

6 As discussed in more detail in Chapter 3, a feed-in tariff can provide an incentive structure that establishes a predetermined price with must-take provisions within a standard offer contract.

The Sacramento Municipal Utility District (SMUD) created a feed-in tariff for RPS-eligible projects 5 MW and below with a program cap of 100 MW. Of the total 100 MW, SMUD set aside 33.5 MW to be dedicated to projects under 3 MW and in compliance with SB 32. All 100 MW of SMUD's feed-in tariff is fully subscribed with an extensive waiting list of projects in case any fall off. Also, all projects are PV.

- 1,000 MW of wholesale generation, including non-PV DG systems located in PG&E, SCE, or SDG&E service territories and sized 20 MW or smaller, as recently adopted by the California Public Utilities Commission through its Renewable Auction Mechanism.

Governor Brown's *Clean Energy Jobs Plan* suggests the following strategies to achieve the goal of 12,000 MW of localized generation by 2020:

- Solar systems up to 2 MW should be installed on the roofs of warehouses, parking lot structures, schools, and other commercial buildings throughout the state.
- Solar energy projects up to 20 MW in size should be built on public and private property throughout the state. For example, the state should create the California Solar Highway by placing solar panels along the banks of state highways.
- The CPUC or Legislature should implement a system of carefully calibrated renewable power payments (feed-in tariffs) for DG projects up to 20 MW in size. Holding down overall rates must be part of the design.

Renewables on State Property Target

Staff recommends a state properties renewable energy target of 2,500 MW by 2020. The target is consistent with a 33 percent renewable energy target for state buildings by 2020, Governor Brown's *Clean Energy Jobs Plan*, and the potential for utility-scale renewable development on state lands. Implementation of the target should also be consistent with the state's loading order and prioritize buildings that have already received energy efficiency upgrades. Staff's development of the target for state property is discussed in more detail in Chapter 4.

CHAPTER 2:
Existing State Programs

Several state agencies are already working to advance deployment of localized renewable resources and small-scale pilot programs are underway on state properties. This experience positions the state to expand deployment on its own facilities – as called for in the memorandum of understanding described in Chapter 1 between the Energy Commission, the DGS, CDCR, Caltrans, the DWR, the Department of Fish and Game, the CSLC, and UC – to promote the development of renewable energy projects on state buildings, properties, and ROW. To further this effort, the Governor's Office has organized an interagency working group to share resources and experience across state agencies.

Below is a preliminary assessment of state activities to deploy and otherwise advance renewable technologies. Energy Commission staff assembled this information from other state agencies to determine what renewable energy projects are underway or have already been installed on state buildings or properties. Appendix B provides additional information about the Energy Commission's Public Interest Energy Research (PIER) Program projects that cover a wide range of localized generation technologies, multiple technology combinations, and systems integration including smart grid.

Department of General Services

Executive Order S-20-04,[7] signed by Governor Schwarzenegger in 2004, supports the Green Buildings Action Plan[8] and calls on state agencies "to reduce grid-based energy purchases for state-owned buildings by 20 percent by 2015, through cost-effective efficiency measures and distributed generation technologies." Under this order, the state developed a benchmarking database to track the progress of each building in meeting this goal. This database provides a valuable resource for staff to target buildings that have already undergone low-cost efficiency improvements and to help meet this energy purchase reduction goal through the installation of renewable distributed generation. DGS is a cosigner of the MOU for the state lands project and has provided the Energy Commission with a database of state property, acreage, and utility information based on annual and monthly usage.

Consistent with Executive Order S-20-04, DGS also released two RFPs to develop PV generation on several state buildings using third-party financing and power purchase agreements (PPAs). DGS is working on releasing a third RFP in the second quarter of 2011. The first solicitation resulted in eight installed projects for a total of 4.25 MW of capacity with PPAs between the PV developers and the sites where the projects are located: California State Universities (CSUs), state prisons, mental hospitals, and a Caltrans facility.

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7 http://www.dot.ca.gov/hq/energy/ExecOrderS-20-04.htm.

8 http://www.documents.dgs.ca.gov/green/GreenBuildingActionPlan.pdf.

The second solicitation awarded PPAs at 16 CSU campuses for a total of 8 MW and another 8 MW at nine state agency projects. Installation has begun on the CSU campuses and is expected to begin at the state agencies in 2011. DGS initially sized the systems not to exceed either minimum demand or 1 MW rebate limit through the California Solar Initiative (CSI), whichever was less. With the passage of AB 2724, DGS is evaluating installing larger systems on sites where minimum demand is greater than the 1 MW that were originally limited by CSI rebate. Under these contracts, the state purchases the power of the PV system at a discount from the previous electricity rate structure. From this program, DGS has developed standard master agreements for some business arrangements when the project output will be used on-site.[9]

Caltrans

Caltrans is leading the way to promote the installation of solar power facilities in its ROW in a safe and reasonable manner. For example, Caltrans is placing solar facilities on Maintenance and Safety Roadside Rest Area buildings and is evaluating renewable DG development along state highways, consistent with Governor Brown's support of the California Solar Highway. Experience in Germany and Oregon illustrates the feasibility of deploying renewables along highway systems.[10]

Caltrans is in discussions with Republic Cloverleaf Solar regarding a potential long-term lease to develop a 15 MW PV system on seven intersections along Highway 101 in Santa Clara County that is anticipated to cost about $75 million. Cloverleaf Solar needs to negotiate a long term PPA with PG&E. The project is expected to provide new revenue streams as a result of leasing the

Solar Highways in Oregon and Germany

In 2008, the Oregon Department of Transportation completed the nation's first solar PV project in a highway ROW. The 104 kW project uses the utility grid as a battery, supplying energy during the day to light the highway interchange at night. Oregon completed the project just 135 days after agreements were signed.

In Germany, a 500-kW solar PV system manufactured by ISOFOTON acts as a sound barrier along the highway embankment to the Munich airport. The goal of the pilot project is to promote innovative multiple-function solar PV systems.

Also in Germany, Evergreen Solar Inc. is developing a 2.8 MW solar project by installing solar panels on the roof of the A3 highway tunnel. German-based installer Ralos is overseeing construction and Goldbach-Hoesbach, which purchased the land from the German government, will oversee the interconnection to the power grid. The 11 million euro project investment is expected to be paid back through cost savings over 16 years.

9 For more information, see: http://www.green.ca.gov/EnergyPrograms/solar.htm.

10 For more information about projects in Oregon, see: http://www.oregon.gov/ODOT/HWY/OIPP/docs/OregonInspiration.pdf?ga=t . For more information about projects in Germany, see: http://www.asilin.org/2009/11/pv-soundless-world-record-along-highway.html and http://www.renewableenergyworld.com/rea/news/article/2009/02/2-8-mw-a3-highway-solar-system-nears-completion.

land for development, reduce ROW maintenance costs (the state would not pay to maintain lands leased to developers), help the state achieve its environmental and renewable energy policy goals, and create some private sector installation and maintenance jobs.

One issue going forward for placing PV projects on highway ROWs is the necessity for approval by the Federal Highway Administration (FHWA). Since federal funds were used to purchase state and interstate highways, land use programs on these properties must be approved by FHWA. Caltrans has been working with FHWA on implementing a statewide plan for PV on highway ROWs and intersections.

Caltrans also received approval for federal funding to install PV panels at 93 facilities. Upon further review, Caltrans adjusted the scope of the project, reducing the number of facilities to 70. Funding was made available through the Clean Renewable Energy Bonds (CREBs) Program, which is administered by the U.S. Internal Revenue Service and was created under the National Energy Act of 2005 to encourage energy conservation, develop energy infrastructure, and increase domestic energy production and the use of alternative energy sources. The department has budget authority to spend $20 million from the sale of the CREBs that will fund the 70 PV installation projects at various Caltrans facilities for a total installed capacity of more than 2 MW. The savings from potential energy generated from the PV systems will repay the 1.45 percent interest rate bonds over 15 years. It is anticipated that 70 PV installation projects will be generating electricity by the end of fiscal year 2010-11.

At the end of the 2006-07 fiscal year, California became the only state to participate in a pilot program allowing Caltrans to take responsibility for federal environmental approvals on transportation projects. The FHWA delegated that authority to Caltrans under the federal transportation bill. This delegation allows the department to assume FHWA responsibilities for federal approvals under the National Environmental Protection Act (NEPA) and other environmental laws for most highway projects in the state that are processed with an environmental impact statement or environmental assessment. Allowing Caltrans to grant federal environmental approval saves time by accelerating project production and is an important piece of streamlining permitting. Although the NEPA Delegation pilot program ends in August 2011, Caltrans is working to extend the program.

Caltrans/Sacramento Municipal Utility District

Caltrans' partnership with SMUD is called the Sacramento Solar Highway pilot program. SMUD is proposing two locations for solar development along U.S. Highway 50 in the Sacramento and Rancho Cordova areas. In January 2010, the project was awarded $1.5 million by the federal Department of Energy, and the California Transportation Commission approved Caltrans to work with SMUD on the project at its June 2010 meeting. The project was recommended for PIER co-funding through the ARRA cost-share solicitation (PON-08-011); the cost-share funding is expected to begin mid-2011 or once CEQA requirements are completed. Through the collaboration of SMUD and project partners SolFocus and Caltrans, the solar highway project will plan, design, and construct two grid-connected solar photovoltaic systems

on the south-facing embankments (in the Caltrans ROW) with target total system capacity of 1.4 MW.

Similar to the Cloverleaf project described above, this project is expected to provide a new revenue stream from the land lease and reduce ROW maintenance costs, as well as help meet energy and environmental goals. The project also aims to:

- Promote public awareness and support of solar technology and local renewable energy.
- Create a highly visible demonstration of the region's commitment to sustainability and the development of "green" technology.
- Assist SMUD in meeting carbon reduction and renewable energy goals.
- Establish a blueprint for utility-scale solar power installations on Caltrans public ROWs in California.

Environmental work is underway for the SMUD projects and several concerns that were identified are being addressed prior to the project being energized. These include visual concerns, construction access, and distribution losses that will require system upgrades. Caltrans staff suggested that other sites may be more appropriate for solar facilities given safety concerns, construction access, graffiti, and the potential for vehicle accidents.

Department of Water Resources

DWR is taking action to develop renewable energy in an effort to reduce its greenhouse gas emissions and achieve AB 32 goals. In addition to executing power contracts for the output from wind and solar projects constructed by others, DWR is exploring ways it can develop solar on its own property.

DWR has partnered with UC, which has a goal of becoming carbon neutral, to explore the feasibility of putting solar along or over the California Aqueduct. They have had informational discussions with three large global solar energy developers to explore the unique issues and challenges with such a project. Safety is a concern, as any installation would have to be moved quickly to accommodate an emergency response to a canal lining failure, which has occurred in various locations. There are also above-ground pipelines and other utilities crossing the aqueduct that must be considered.

Presently, the UC and DWR are identifying areas of the aqueduct near transmission and clear of critical DWR infrastructure that would be suitable for a demonstration project. Once a location is identified, an RFP will be developed and issued for a solar project. If this demonstration project is successful, it could be applied to other feasible sites along the entire State Water Project.DWR is also working with the UC on the development of a 10 to 20 MW solar project on vacant property owned by DWR next to an existing pumping plant in Southern California. Both the UC and DWR are optimistic about opportunities to develop commercially feasible renewable solar energy adjacent to the aqueduct while preserving the ability of DWR to safely maintain water deliveries.

DWR opened bids in late January 2011 in response to its request for bids for energy output from a wind facility in the 5 MW to 25 MW range. Although DWR had received 12 notices of intent to bid, only one bid was received. However, as it was a non-binding offer, it was deemed a non-responsive bid. DWR followed up with the other 11 entities in an attempt to determine why they did not submit a bid. There are a variety of reasons, but the primary hurdle was the state contracting process and requirements which prohibits direct negotiations and is an inflexible process. DWR is assessing what actions it can take to modify the RFP and the process to attract responsive bidders. Additionally, DWR is exploring the feasibility of adding new small hydropower generation to the existing State Water Project and is assessing the potential for wind development on Sherman Island in the Delta.

DWR also established a program (as authorized by Assembly Bill 515)to evaluate proposals by private entities to lease space above or next to appropriate conveyance facilities of the State Water Project for installing solar photovoltaic panels and related systems for the generation and transfer of electricity.

California Fairgrounds

California's fairgrounds began adding PV systems under an energy conversion program launched by former Governor Gray Davis. By 2004, 12 fairgrounds were involved in the program using a combination of state grants, low interest loans, and the assistance of energy providers. Energy Commission staff contacted the California Construction Authority, which oversees the fairgrounds program, and learned that solar installations are now complete at 26 of the 74 state fairgrounds ranging in size from 41 kW to 1 MW, with a total installed capacity of approximately 6.5 MW. Although the California Construction Authority expressed a desire to move forward with additional projects, doing so under the previous model of purchasing equipment would require significant upfront investments.

California Department of Forestry and Fire Protection

The California Department of Forestry and Fire Protection (CAL FIRE) has many facilities located in remote locations throughout the state, many of which are in isolated areas in the Sierra. One forest fire management strategy is the thinning of dead and dry forest wood waste. Typically, the wood waste is collected and burned under supervision. CAL FIRE is looking into using the forest wood waste to provide local electricity generation for their isolated facilities, which can help the facilities with energy independence. A map showing the locations of CAL FIRE buildings with an overlay of feedstock potential by county is provided in Appendix C, Figure 4.[11] The figure shows that a number of CAL FIRE buildings are in counties with considerable amount of biomass feedstock, greater than 150,000 tonnes per year, namely Butte, Lassen, Riverside, San Bernardino, Tuolumne, and Yuba counties. CAL FIRE buildings located

11 Feedstocks include agricultural residues (crops and animal manure), wood residues (forest, primary mill, secondary mill, and urban wood), municipal discards (methane emissions from landfills and domestic wastewater treatment), and dedicated energy crops (switchgrass on Conservation Reserve Program lands). For additional information please see http://www.nrel.gov/docs/fy06sti/39181.pdf.

in Shasta, Placer, and San Diego counties may potentially have access to greater than 500,000 tonnes of feedstock per year. Energy Commission staff does not have enough information at this time to determine whether these buildings or sites would be good candidates for either biomass or PV projects, and therefore they were not included in the inventory. Staff will evaluate these buildings and sites in coordination with CAL FIRE to determine if they are candidates that can be included in the second round of building inventory.

California Department of Corrections and Rehabilitation

The CDCR manages 33 adult and 5 juvenile correctional facilities occupying several thousand acres of state-owned property. Currently, CDCR has two operational 1 MW PV ground-mounted solar arrays; a fixed-mount system on approximately nine acres of land at Chuckwalla Valley State Prison, and a single-axis tracking array occupying nearly 10 acres of property at neighboring Ironwood State Prison . Both systems were activated in 2006 and 2007, respectively, and were completed through a third-party power purchase business model as part of the DGS' solar initiative program. The systems have allowed each facility to offset a total of nearly 2.6 megawatts (dc) of their annual electrical load and have saved about $150,000 to $300,000 annually for both systems.

Additionally, CDCR has executed contracts for expansions on the existing systems at Chuckwalla Valley State Prison and Ironwood State Prison that will total nearly 9 MW and offset nearly all the power required by both facilities. Construction is tentatively scheduled to begin as early as the fourth quarter of 2011. The department recently signed agreements for two new systems (1 MW each), in the central valley at North Kern State Prison and in the Tehachapi Valley at the California Correctional Institution and taken advantage of the opportunity to expand these systems under AB 2724, which extends the solar incentive cap up to 5 MW, by executing agreements for an additional 4 MW at both facilities as well as a new 3 MW system at its Los Angeles County Prison in Lancaster.

CDCR plans to continue its partnership with DGS as it moves into the Phase III solar effort. At this time, CDCR has identified 14 additional locations suitable for ground-mounted systems and one potential roof top project ranging in generating capacity from 1 to 5 MW. Although CDCR plans to investigate the possibility of roof-mounted solar systems further, opportunities are limited at present due to the security constraints surrounding construction within a prison's secure perimeter fence line. However, possibilities for roof-mounted systems outside the secure perimeter, as well as canopy systems, are being vetted by CDCR staff in terms of cost-effectiveness and practicality. Since some CDCR facilities have many acres of unused land with electrical utility transmission and distribution lines available, CDCR is also a potential candidate for wholesale DG PV at some locations.

CDCR continues to lead in terms of energy efficiency projects with nearly $12 million in projects underway and scheduled to be completed later this year. Approximately $9.3 million of these projects will be accomplished using ARRA funding and will have a "payback" in fewer than five years. CDCR is also accomplishing another $2.6 million in energy efficiency projects through the IOUs (PG&E, SCE, and SDG&E) via their low-interest "On Bill Financing"

programs. Not only do these projects save energy, reduce greenhouse gas emissions, and create green jobs, they also replace antiquated equipment and systems that would otherwise be dependent on the state budget.

California State Lands Commission

Unlike the other agencies, CSLC is focusing on utility-scale development rather than DG. In 1853, the United States Congress granted to California hundreds of thousands of acres of land for the specific purpose of supporting public schools. In 1984, the State Legislature passed the School Land Bank Act, which placed these "school lands" into a trust that is managed by the CSLC for the benefit of the State Teachers' Retirement System. The CSLC, as trustee of this trust, has an obligation to develop school lands into a permanent and productive resource base. Many of these school lands have significant potential as sites for renewable energy projects. To date, the CSLC has leased thousands of acres for renewable energy (geothermal) projects on school lands and is processing new applications for solar, geothermal, and wind energy projects. [12]

University of California

The University of California has embraced the goal of sustainability and is transforming its business practices to reduce its environmental impact. UC has committed to the following: achieving a minimum LEED Silver certification and exceeding Title 24's energy provisions by at least 20 percent on all new construction projects; installing 10 MW of onsite renewable energy by 2014; and reducing greenhouse gas emissions to year 2000 levels by 2014 and 1990 levels by 2020, after which UC will strive to become carbon neutral as soon as possible.[13]

UC currently has 6.3 MW of onsite solar PV installed or under construction. By fall of 2011, UC campuses will generate an additional 6.2 MW of green electricity from biogas. In addition, UC has made a significant investment in energy efficient cogeneration and thermal energy storage capacity. UC's six cogeneration plants have a combined capacity of 130 MWs and there are approximately 26 million gallons of thermal energy storage capacity on seven UC sites. Because of their investments in advanced energy infrastructure, several UC campuses have received grants from the Energy Commission's PIER Program to study the integration of onsite renewable generation, energy storage, and smart grid technologies.

In planning to meet its goals, UC will continue to develop its onsite renewable energy resources[14] and expand its aggressive energy efficiency program, while also pursuing two

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12 For Surface Lease Applications for CSLC property, please see http://www.slc.ca.gov/Online_Forms/Surface_Leasing_Application_Home_Page.html. These agreements are dissimilar to the previously discussed DGS arrangements in which renewable energy systems are sized to meet onsite load. These properties do not have onsite load and would fit a structure where the system sells the electricity on the wholesale market.

[13] More information on UC's sustainability efforts is available at www.universityofcalifornia.edu/sustainability

[14] A 2008 study identified 36 MW of capacity from installation on approximately 4.3 million square feet of rooftops at UC campuses.

additional strategies: procurement of carbon neutral wholesale power and large-scale biogas production. UC plans to develop, or contract for the output of, remotely sited large-scale renewable energy projects. UC plans to accomplish this goal in part by collaborating with other state agencies and is piloting this concept by partnering with the DWR to explore development of a 20 MW solar PV array at DWR's Pearblossom pumping station. UC is also working to substitute biogas for natural gas and has been actively pursuing opportunities to procure large quantities of biogas. Biogas is methane generated from controlled decomposition of organic matter; it is carbon-neutral and available from a variety of sources, including waste water treatment plants, landfills, and dairy farms.

CHAPTER 3:
Barriers and Solutions

Below is a discussion of potential barriers to deploying DG on state properties and some possible near-term and long-term solutions. Although state properties also provide opportunities to develop large-scale renewables, this chapter focusses on issues relevant to small-scale projects since state development is expected to initially focus on small-scale, localized renewables. Barriers and solutions specific to large-scale renewable projects will be addressed in next steps and the *Strategic Plan for Increasing Renewable Generation and Transmission Infrastructure in California* scheduled to be completed by the endo of November, 2011.

The discussion of barriers and solutions to DG covers four broad categories: economics, integration, interconnection, and permitting issues. Despite these issues, statewide deployment of DG has increased dramatically in recent years. Although additional work is needed to make the economics more attractive, ensure that the intermittant nature of solar and wind does not disrupt the electricity grid, and ensure that developers can seamlessly interconnect to the grid, various policies discussed below and advances in research and development can help address these issues.

Economics

Although the renewable DG technologies have relatively low operating costs, the high initial upfront costs are a barrier to widespread use. Net metering, state incentives, and federal tax incentives all make the economics more attractive. Policies such as the feed-in tariff and the Renewable Auction Mechanism help reduce transaction costs and offer additional opportunities to realize long-term payback periods. Although the details of how to structure an RFP for state buildings or properties are not explored here, there is discussion about “renewable energy credits” and the need to consider them when drafting an RFP or other contractual arrangements for renewable development on state property. Also discussed below are incentive programs that improve the cost-competiveness of renewable DG.

Net Metering

California’s net energy metering policy improves the economics of DG by compensating the self-generation DG owner for any additional electricity generated beyond what is simultaneously consumed onsite. Installed solar generation systems with capacity up to 1 MW and wind with capacity up to 50 kW are eligible for "full retail net energy metering” and receive a credit from the interconnecting electric utility at the fully bundled retail rate of electricity supplied to the grid. Wind projects greater than 50 kW, fuel cells, and agricultural biogas generators are eligible for "generation-rate net energy metering” and receive a credit at the generation rate of kWh supplied to the grid. Assembly Bill 510 (Huffman, Chapter 6, Statutes of 2010) set the net energy metering aggregate capacity limit at 5 percent of the utility’s peak

demand. DG deployment has not yet reached the net energy metering cap on any of the IOUs' systems, but PG&E is approaching the cap and is anticipated to reach it by 2012.

In the past, utilities were not required to purchase the electricity for self-generation systems that generate more electricity than is consumed onsite in one calendar year. However, Assembly Bill 920 (Huffman, Chapter 376, Statutes of 2009) requires the utilities to establish a tariff or credit for any excess generation. This must be implemented by the CPUC for the IOUs and the local governing boards for the larger POUs.

California Incentives for Self Generation

A large barrier for small scale renewable energy systems continues to be upfront costs. Although solar panel costs have steadily declined over the past few years, overall costs remain high. The installed cost of PV systems was slightly above $12 per watt in 1998 and has steadily declined to $8.00 per watt in 2009[15]. Despite the decline of installed costs for residential and small commercial-sized PV systems, a simple payback can take up to 20 years without any other incentives.

Senate Bill 1 established three rebate programs − the California Solar Initiative, New Solar Homes Partnership and Publicly Owned Utilities Rebate Program − to provide rebates for solar energy systems installed on different market sectors including existing residential, commercial, and new home construction. Systems up to 5 MW are eligible for incentives, but payments are capped at 1 MW. Under the California Solar Initiative the current rebate level for government projects is $1.10 per watt in Pacific Gas and Electric and San Diego Gas & Electric territories and $1.40 per watt in Southern California Edison territory.[16] To put this in relative terms, a $1.10 per watt incentive provides about a 14 percent savings for an average system installed cost of $8.00 per watt.[17] Rebate levels under the POUs' programs vary by utility. The New Solar Homes Partnership provides rebates only for new residential construction in IOU territories.

Since being established in 1998, the Energy Commission's Emerging Renewables Program has funded more than 585 small wind installations representing 3.74 MW of generating capacity. The Emerging Renewables Program is funded from public goods charge revenues collected from ratepayers. Funding is scheduled to sunset this year unless it is legislatively reauthorized. The program provides rebates for eligible small wind systems and fuel cells using renewable fuel up to 50 kW in size with incentives capped at 30 kW. The current rebate level for small wind is $3.00 per watt for the first 10 kW (this rebate level is scheduled to be reduced to $2.50

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15 Barbose, Galen, Naim Darghouth, Ryan Wiser, *Tracking the Sun III The Installed Cost of Photovoltaics in the U.S. from 1998-2009*, Lawrence National Berkeley Laboratory, LBNL-4121E, December 2010.

16 The government project incentive level began at $3.25 per watt in all IOU territories. Information on current incentive levels is available at: http://www.csi-trigger.com.

17 According to the United States Department of Energy, *2008 Solar Technologies Market Report*, January 2010, the average price of solar PV was $2.51 to $3.83 per watt depending on technology in 2008. A rebate of $1.10 is a significant portion of the price of the panels.

per watt after April 6, 2011) and $1.50 per watt for any incremental kW up to 30 kW. The current rebate level for fuel cells under the Emerging Renewables Program is $3.00 per watt up to 30 kW.

The Energy Commission has temporarily suspended the Emerging Renewables Program (as of 5 p.m. on March 4, 2011) to address deficiencies in the Program's guidelines. During the suspension period, Energy Commission staff will review the current Program guidelines to address these deficiencies and to ensure that the guidelines properly reflect the original intent of the Program. The suspension will be lifted once the Energy Commission completes its review of the Guidebook and adopts any necessary changes. The Energy Commission intends to extend the $3.00 per watt rebate level for approximately 30 days after the suspension is lifted, but applications will be subject to any changes in the Program guidelines.

The CPUC's Self-Generation Incentive Program[18] provides incentives for wind turbines, fuel cells, and advanced energy storage systems between 30 kW and 5 MW, although the incentives are capped at 1 MW. Incentive levels are $1.50 per watt for wind turbines, $4.50 per watt for fuel cells using renewable fuel, $2.50 per watt for fuel cells using non-renewable fuel, and $2.00 per watt for advance energy storage systems.

Feed-in Tariff

A feed-in tariff can provide an incentive structure that establishes a predetermined price with must-take provisions within a standard offer contract. This incentive structure has the potential to reduce upfront transaction and legal costs and may provide the financial certainty needed to overcome the current hurdles wholesale distribution generators are facing. Feed-in tariffs are expected to remove barriers to interconnection by reducing transaction costs, minimizing the usual time and effort required to contract with power generators by standardizing the price and contract terms. As with other policies, feed-in tariffs provide benefits and limitations, depending on the design of the tariff. For example, getting the price right can be challenging. If the price is set too high, the tariff introduces the risk of overpaying the market. On the other hand, if the tariff is set too low to provide adequate returns to eligible projects, it may have little effect on stimulating development of new renewable energy generation.[19]

Senate Bill 32 sets a feed-in tariff for the IOUs for RPS-eligible projects 3 MW and smaller. The price will be set by the CPUC at the market price referent established under the RPS program and must include all current and anticipated environmental compliance costs. CPUC has not yet implemented the provisions of this bill, so it is unknown whether the implemented price of electricity will be enough to attract developers to pursue this option.

In a July 2010 ruling, the Federal Energy Regulatory Commission (FERC) confirmed that the combined heat and power feed-in tariff established by the CPUC and based on cost of

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18 For more information, see: http://www.cpuc.ca.gov/PUC/energy/DistGen/sgip/ .

19 Grace, Robert, W. Rickerson, K. Corfee, K. Porter, and H. Cleijne (KEMA). *California Feed-In Tariff Design and Policy Options*. California Energy Commission. Publication Number: CEC-300-2008-009F.

generation was preempted by the Federal Power Act and the Public Utility Regulatory Policies Act of 1978 (PURPA). Subsequently, FERC clarified, under FERC EL10-64 et. al., that California may establish a multi-tiered feed-in tariff that is determined by the lowest cost of resources (including renewable generation) that are actually avoided to meet the state's legislated resource mix. If the price of the tariff is determined by an avoided cost matrix, then it complies with PURPA. This clarification allows technologies that tend to be more expensive to receive a higher tariff because many of them also avoid more costly production. For example, PV may not be able to compete with wind on solely a kWh-to-kWh basis; however, because it can help avoid more expensive and potentially less efficient (higher heat rate and more greenhouse gas and other air pollution emissions) peaker plants, the tariff could be set higher than the wind tariff.

SMUD approved a feed-in tariff in January, 2010. The feed-in tariff targets systems that are up to 5 megawatts in size and connected to SMUD's local distribution system. The program is capped at 100 MW system wide. The program was extremely popular, and on August 4, 2010, SMUD suspended the acceptance of new feed-in tariff applications because the cap had been reached and the wait list was full. SMUD has not announced any plans to reopen the program; therefore, it is unlikely that state property would be eligible for this tariff.

Renewable Electricity Credits

Renewable energy credits (also termed "renewable energy certificates" or RECs) represent renewable and environmental attributes associated with renewable energy production.[20] RECs are used by utilities and other load-serving entities to track and claim electricity generated from eligible renewable energy resources toward compliance with the RPS[21] and other regulatory and voluntary renewable energy programs. RECs are a separate commodity from the associated electricity and need to be considered when crafting an RFP. For example, the state or a third-party developer may be interested in selling the RECs bundled with the electricity generated on

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20 *Commission Guidebook, Renewables Portfolio Standard Eligibility Guidebook, Fourth Edition.* California Energy Commission, Efficiency and Renewable Energy Division. Publication Number: CEC-300-2010-007-CMF, page 5.

21 Public Utilities Code Section 399.12, Subdivision (g)(1), defines a renewable energy credit for California Renewables Portfolio Standard purposes to mean a certificate of proof, issued through the accounting system established by the Energy Commission under Public Utilities Code Section 399.13, that one unit of electricity was generated and delivered by an eligible renewable energy resource. Public Utilities Code Section 399.12, Subdivision (g)(2), specifies that a REC includes all renewable and environmental attributes associated with the production of electricity from the eligible renewable energy resource, except for an emissions reduction credit issued under Section 40709 of the Health and Safety Code and any credits or payments associated with the reduction of solid waste and treatment benefits created by the use of biomass or biogas fuels. In addition, Public Utilities Code Section 399.12, Subdivision (g)(3), specifies that no electricity generated by an eligible renewable energy resource attributable to the use of nonrenewable fuels, beyond a *de minimis* quantity as determined by the Energy Commission, shall result in the creation of a REC. Source: *Commission Guidebook, Renewables Portfolio Standard Eligibility Guidebook, Fourth Edition.* California Energy Commission, Efficiency and Renewable Energy Division. Publication Number: CEC-300-2010-007-CMF, Page 6

government property to a utility for the RPS or the Renewable Electricity Standard. Or, the state or a third-party developer may be interested in selling RECs that could be counted toward a utility's RPS requirements without selling the underlying electricity. However, there may also be cases in which a state agency is subject to a regulatory obligation and will want to retain the RECs or may want to retain the RECs for other reasons such as to meet agency specific renewable energy goals[22] or to make public claims that a specific state building is powered with renewable energy. In any event, the state should carefully consider whether to retain the RECs from renewable energy generated on state properties.

In January 2011, the CPUC adopted a decision authorizing the use of RECs that will allow facilities to sell eligible RECs for the RPS without also selling the energy. The CPUC set a 25 percent cap on the amount of these REC-only transactions utilities can purchase to meet their annual RPS obligations. Because system-sized facilities already had a market for the RECs provided that they were sold with the energy, it is not clear whether the CPUC decision will affect large-scale development on state property. However, selling RECs for the RPS can provide a new revenue stream for rooftop solar and other renewable self-generation facilities on state property. Before customer-side renewable generation can participate, though, the Energy Commission needs to determine whether it is eligible and, if appropriate, establish eligibility criteria.[23] The demand for REC-only contracts may be small until 2014, however, when the 25 percent cap for REC-only contracts is set to expire.

Renewable Auction Mechanism

To date, small renewable projects have not been able to effectively participate in the IOUs' annual RPS solicitations due to the high transaction costs associated with trying to participate in a procurement process geared toward large-scale projects. To assist developers of smaller, RPS-eligible projects, the CPUC recently adopted the Renewable Auction Mechanism procurement process, which is expected to reduce transaction costs and provide a better procurement opportunity. The Renewable Auction Mechanism is a streamlined contracting mechanism that employs a standard contract but also relies on market-based pricing, uses project viability screens, and selects projects based on least cost rather than on a first-come, first-served basis at an administratively determined price.

In the initial implementation of the Renewable Auction Mechanism, PG&E, SCE, and SDG&E were directed to procure at least 1,000 MW allocated proportionally by retail sales to each IOU over two years. All projects solicited through Renewable Auction Mechanism must be 20 MW or fewer and located within one of the IOU's service territories. Each IOU is required to determine up front the types of products (for example baseload, peaking as-available, non-peaking as-available) they intend to procure under Renewable Auction Mechanism to ensure

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22 The Department of Water Resources has a goal to acquire 360 gigawatt-hours (GWh) of renewable energy by 2020. http://www.water.ca.gov/climatechange/docs/Memo_sustainability-Sept%202010.pdf.

23 See p. 12-16, 36-39 of the CPUC TREC decision, http://docs.cpuc.ca.gov/word_pdf/AGENDA_DECISION/129354.pdf.

their procurement is consistent with their portfolio needs. This is intended to provide developers and investors greater clarity and certainty regarding the market opportunity this program provides.[24]

Federal Tax Incentives

Federal tax incentives and cash grants are available for qualifying renewable systems designed to meet onsite load. Owners of small wind turbines, solar energy systems, and fuel cells are eligible for an investment tax credit for 30 percent of the system if installed before the end of 2016. Projects installed on state property would have to be owned by a for-profit entity to qualify for the credits. The incentive can be taken as a tax credit or, if construction of the project begins by the end of 2011, the owner may be eligible for a cash grant in lieu of tax credits.[25] Although the state does not qualify for the tax credits, it can indirectly benefit from the incentive by entering contracts to purchase renewable-based electricity from a third party who owns the project and collects the tax benefit.

In late 2010, the U.S. Congress passed H.R. 4853, the "Tax Relief, Unemployment Insurance Reauthorization and Job Creation Act of 2010" Section 707 extended the availability of cash grants in lieu of the federal business energy investment tax credit for renewable projects. The program had required construction to begin by the end of 2010. Moreover, Section 401 of the act, among other benefits in terms of depreciation for renewable generation developers, increases the first-year bonus depreciation allowance to 100 percent for property placed in service before the end of 2011. This allows a renewable generation developer to expense the entire capitalized cost of the property in the year it is placed in service.

Other Cost Considerations

In addition to power purchase costs and lease revenues, project management will incur costs or may pose challenges that may not be readily quantified. For example, site identification, feasibility assessment, and transaction costs can add to project cost. Also, there may be contracting and other legal requirements unique to state facilities that do not apply to non-State projects and that can pose challenges. The state will need to address these issues going forward.

The inventory discussed in Chapter 4 is a first step at reducing the costs associated with site identification and feasibility, including identifying areas with good resource potential. The intent is for the state to use its technical expertise to do as much upfront work as possible to help bring down the cost. By reducing the amount of work the developer must do for site identification, and by providing as much information as possible about the site, the developer's

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24 CPUC, Decision Adopting the Renewable Auction Mechanism, Decision 10-12-048, Rulemaking 08-08-009, December 16, 2010, http://docs.cpuc.ca.gov/word_pdf/FINAL_DECISION/128432.pdf

25 Solar, wind, fuel cells, closed-loop biomass facilities, open-loop biomass facilities, geothermal energy facilities, landfill gas facilities, trash facilities, qualified hydropower facilities, and marine and hydrokinetic renewable energy facilities qualify for a grant up to 30 percent of the basis cost of the facility. The maximum incentive for fuel cells is $500 per 500 Watts and for qualified microturbine property the maximum incentive is $200 per kW.

risk is minimized. Accordingly, the state plans to evaluate buildings to provide developers with detailed information about a building's roof, shading, and electrical systems. For state lands, as discussed in Chapter 4, a next step is to identify areas that are not environmentally sensitive and, thus, can be developed at relatively low cost.

Although this report does not explore contractual arrangements, the project ownership structure can play an important role in the project costs. For example, renewable projects can be developed such that a third party owner can take advantage of tax benefits and depreciation that is not available to government-owned facilities. Also, power purchase agreements, can be structured such that a third party bears the upfront costs and amortizes the costs through a long-term contract to sell the electricity generation. The Energy Commission intends to explore financing issues in a workshop and report on the topic in the *Strategic Plan for Increasing Renewable Generation and Transmission Infrastructure in California.*

Integrating Renewables

In addition to the economic challenges, some renewable resources provide variable electricity production, which can pose challenges to operating the electricity system. The output of PV necessarily varies as the position of the sun changes through the day and season, and cloud cover can change solar insolation on a small system by 60 percent in seconds (although for a large 100 MW project, the time it takes to shade a system will be on the order of minutes rather than seconds).[26] Indeed, after sun set the output would be zero. Electricity generated from wind varies as the wind increases or decreases. For example, Figure 1 shows the wind generation of a wind facility over the course of one month in 2005. Notice how the actual generation fluctuates greatly from day to day and fluctuates within the day on an hourly basis. On Day 29 the capacity fell from 500 MW at 7:00 AM to 100 MW at 10:00 AM.

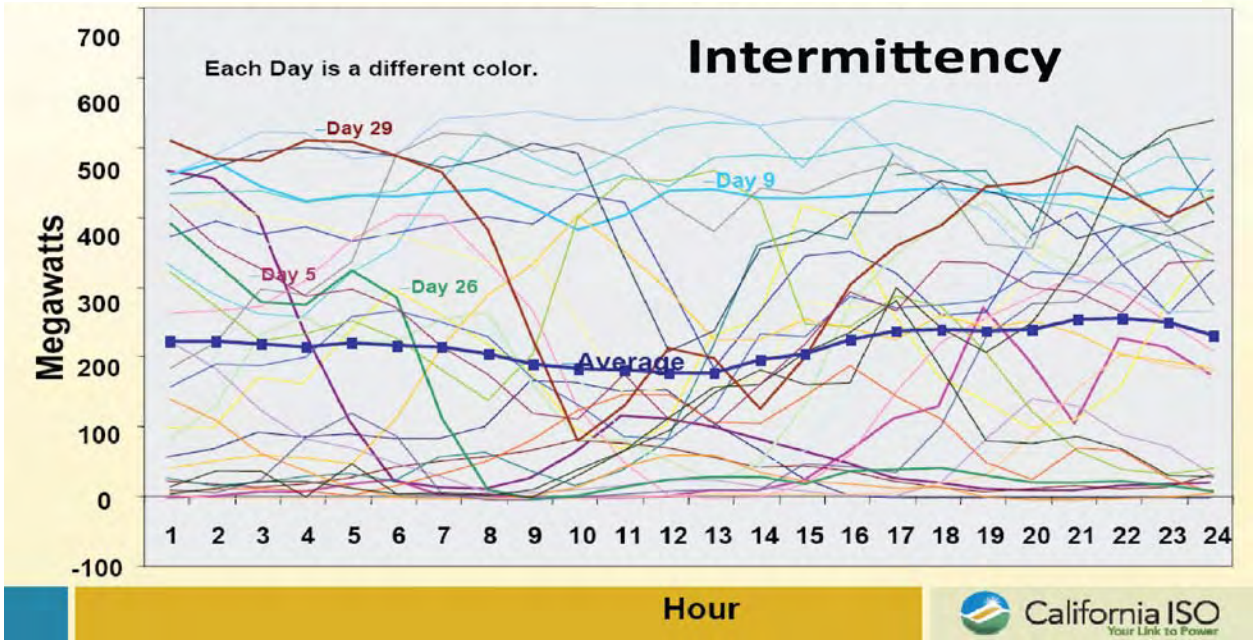
Installing 12,000 MW of DG will require that the transmission and distribution grid be able to integrate this variation in output. Figure 2 represents what the increase of renewable penetration could look like as additional wind capacity is added to the electricity system. To integrate this variation in output, additional baseload generation may need to be backed down, which will enhance the value of load-following generation and certain ancillary services.

Integration of high levels of renewable penetration should be possible with a few modern, enabling technologies as discussed below and significant planning and coordination. A massive amount of PV capacity on the distribution side could create unprecedented integration issues

26 Mills, Ahlstrom, Brower, Ellis, George, Hoff, Kroposki, Lenox, Miller, Stein, and Wan, *Understanding Variability and Uncertainty of Photovoltaics for Integration with the Electric Power System*, Lawrence Berkeley National Laboratory, LBNL-2855E, December 2009.

for the California Independent System Operator (California ISO)[27] attempting to balance load and generation without the visibility of many electricity generating systems. Power flowing from alternate sources such as central generators and imports would have to be used to help maintain system reliability and could create challenges for maintaining voltage, power quality, and safety on the distribution circuits. The California ISO is evaluating the integration requirements of meeting 33 percent renewable mandate, with a report anticipated in the fourth quarter of 2011. The California ISO is studying various scenarios for meeting the RPS, developed in the CPUC's long-term resource planning proceeding, to determine operational requirements such as load following and regulation requirements and a production cost associated with each alternative. One of the RPS scenarios the California ISO is studying is the CPUC's environmentally-constrained RPS scenario, which assumes 9,000 MWs of utility-scale DG.

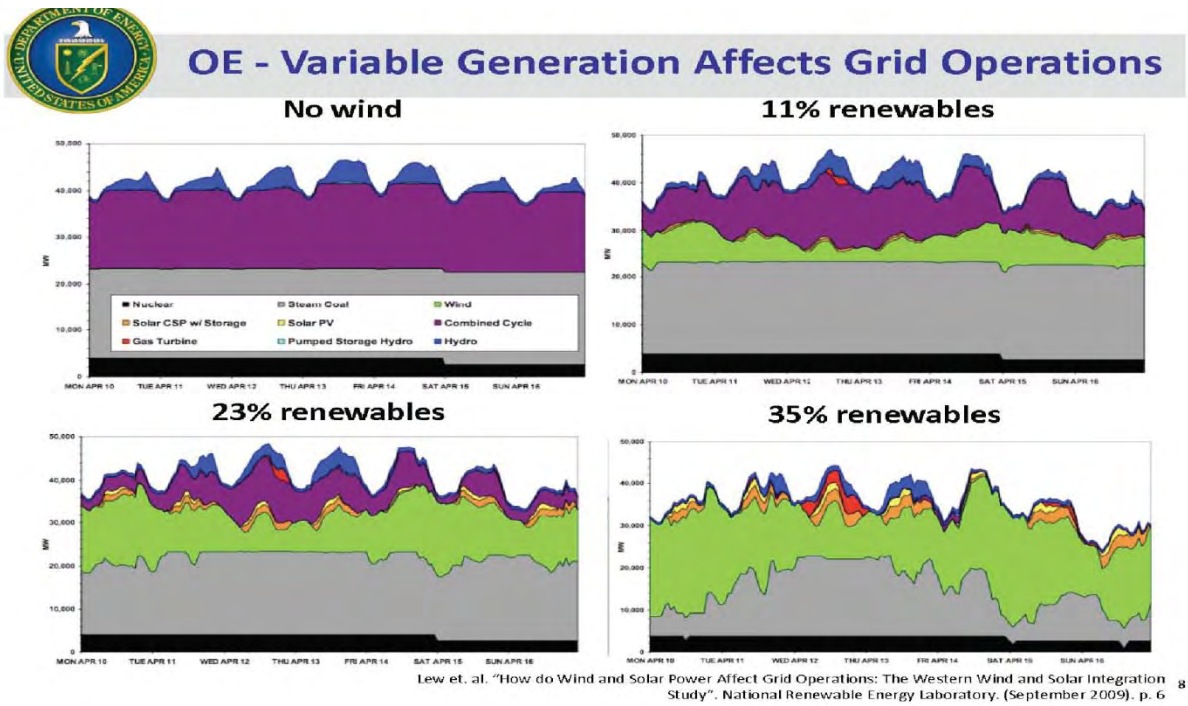
Figure 1: Tehachapi Wind Generation (April 2005)



Source: California ISO

27 The California ISO control areas include the three major investor-owned utilities and all publicly owned utilities except Los Angeles Department of Water and Power, SMUD, Imperial Irrigation District, and Turlock Irrigation District.

Figure 2: OE – Variable Generation Affects Grid Operations



Source: California ISO

The distribution grid was designed and built to accommodate one-way power flow from centralized generation to the customer. Increasing numbers of renewable DG units are being installed at homes and facilities throughout the state, most "passively interacting" with the distribution grid without problem. The existing distribution grid, however, is not currently equipped to realize the full potential of distributed PV and other renewable generation envisioned in this proposal.

Along with using conventional generation to backup variable generation, three emerging enabling technologies will allow the full potential to be realized: smart grid, storage, and demand response, each of which will be discussed in turn. Also, as discussed below, improved forecasting of renewable resources will help resolve integration issues. These solutions offer promise in meeting 2020 goals but may not be ready in the near term.

Smart Grid and Microgrid

The "smart grid" concept can help reduce the effects of integrating large amounts of renewables into the system. The smart grid will link electricity with communications and computer control

to create a highly automated, responsive, and resilient power delivery system that will both optimize service and empower customers to make informed energy decisions.[28]

The PIER Program invests in research that is important to California but is not adequately funded in the market or by the federal government. The program conducts research, development, and demonstration in the areas of energy efficiency and demand response, renewable energy resources, advanced electricity generation, electricity transmission and distribution, transportation, and the environment as it relates to energy. The PIER Program has demonstrated that a smart grid will provide the ability to aggregate customer loads for demand response, automatically locate utility system outages, quickly resolve utility system congestion issues, automatically control building and industrial loads in response to critical network needs, coordinate the use of electric energy storage, and provide customers the ability to have greater options to manage their energy needs.

PIER has funded advanced smart grid sensor technologies, such as synchrophasor, for improving visibility of the grid dynamics to accommodate increased use of renewable resources. At present, the synchrophasor use is limited at the transmission level. However, system operators can observe the real-time and near-term impact of renewables on the distribution grid by using sensors and other communication equipment as advanced distribution automation is implemented.

Related to the smart grid is the "microgrid," an integrated energy system consisting of interconnected loads and distributed energy resources, which can operate in parallel with the grid or independently from the grid. The PIER Program has been researching and developing this technology to allow for the safe operation of microgrids. The potential benefits of microgrid applications include reducing the cost of energy and managing price volatility, improving reliability and power quality, increasing the resiliency and security of the power delivery system, and helping manage the intermittency of renewables. PIER Program research has demonstrated that microgrids can operate safely and that a whole range of new opportunities and benefits like those described above will be available for both customers and utilities. In particular, microgrids offer the opportunity for customers to develop "micro" systems that use clean generation technologies, such as PV and wind turbines, and support California's low-carbon objectives.

Energy Storage Technology

Energy Commission research has determined that electric energy storage can help resolve grid stability and operational issues related to higher penetrations of intermittent renewables.

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28 Chuang (Electric Power Research Institute) Dasso (PG&E), Montoya (SCE), Krevat (SDG&E), *California Utility Vision and Roadmap for the Smart Grid of Year 2020* Joint presentation by Electric Power Research Institute and the investor-owned utilities at the Energy Commission's Integrated Energy Policy Report workshop held on December 17, 2010.
http://***.gosolarcalifornia.org/2011_energypolicy/documents/2010-12-17_workshop/presentations/03_EPRI-Chuang_Dasso_Montoya_Kreva_%20Summary.pdf.

Storage technologies can reduce the need for new fossil fuel-powered peaking generation facilities; eliminate or reduce transmission and distribution losses, including increased losses during periods of grid congestion; reduce the demand for electricity during peak periods; and provide the ancillary services otherwise provided by fossil-fueled generating facilities.

Recognizing the importance of storage, the Legislature passed Assembly Bill 2514 (Skinner, Chapter 469, Statutes of 2010), which requires the CPUC to open a proceeding by March 1, 2012, to determine appropriate targets for investor-owned utilities to procure viable and cost-effective energy storage systems. The CPUC is required to set an initial target to be achieved by December 31, 2015, and a second target to be achieved by December 31, 2020. Publicly owned utilities have comparable requirements and are required to achieve an initial target by December 31, 2016, and the second target by December 31, 2021.

In response to Assembly Bill 2514, PIER is funding a study to determine the current status of energy storage technologies and identify related issues, research gaps, barriers, and opportunities as well as specific targets or milestones and specific actions necessary for development and deployment of energy storage technologies in California. This project will support the CPUC in its proceedings to determine specific energy storage targets for the California utilities. Working in collaboration with utilities, the energy storage industry, and other stakeholders, this project will also develop a strategic analysis of energy storage technology and a 2020 Energy Storage Strategic Vision for California. The 2020 Energy Storage Strategic Vision will identify the research needed and the best applications for energy storage technologies to help achieve greater penetration of intermittent generation from renewable energy resources.

Energy storage can be applied on the transmission and distribution system to regulate fluctuations from renewable output and maintain system voltages at required levels. Smaller energy storage systems can provide significant grid support when connected at the distribution or end-use customer level. A distribution system operator or energy service provider acting on behalf of an energy storage owner could aggregate the energy and capacity of these storage systems and provide voltage support, capacity, or energy to manage intermittency when high levels of renewables are introduced.

Fortunately, electricity energy storage comes in multiple technology types and sizes, and many small-scale storage systems are in the early commercialization stage. Several systems are being demonstrated by utilities on their transmission and distribution systems to facilitate deferral of distribution and substation upgrades, provide power quality, and aggregate PV power in the neighborhoods. Some of the systems being tested are in the range of 25 kW to 500 kW capacity, which could supply both small- and medium-size state buildings.

Listed below are a few critical functions that storage can provide to overcome multiple power quality and stability issues that large-scale penetration of PV might pose. Specifically storage can provide:

- Voltage support (to keep the voltage within the narrow band around 120 volts).

- VAR support (supply reactive power for Power Factor Management).
- Frequency regulation (to maintain electricity at 60 Hertz).
- PV output shifting (since the peak load in California extends a few hours beyond the sunset).
- PV output leveling (sudden increase or decrease in PV output due to clouds).
- Added reliability and availability of electricity during brownouts/unintended outages.
- Community energy storage (storage shared by a cluster of homes) for aggregating PV for dispatch.

If storage is absent on distribution lines, utilities will have to install many more capacitors, tap changers, and transformers to manage a high level of PV penetration on some of the circuits. Instead of deploying more legacy devices to manage frequent voltage fluctuations, a distribution operator could deploy energy storage devices. These devices, in addition to managing voltage, can improve frequency, power factor, and harmonics.

The Energy Commission's PIER program has already undertaken efforts to make the integration of PV and energy storage easier. PIER conceptualized and then funded the development of software released recently by Lawrence Berkeley National Laboratory to determine economic and technical viability of installing energy storage for optimizing PV use.[29] The software is meant for commercial/ industrial customers whose loads would be similar to those of the state buildings for which PV could be installed.

PIER also approved demonstration of an energy storage project for a big-box store that has installed multi-megawatt PV on some stores in California in July 2010. The project could be a good simulation to assess the ability of energy storage to integrate widespread, roof-mounted PV on state buildings.

Demand Response

PIER program research has shown that using demand response for load following can facilitate the integration of renewables. Load following can be provided by demand response by curtailing consumers energy use to match the intermittency of renewable generation.

PIER research has developed technology to automate demand response as well as methods to automate end-use control systems in existing buildings. The automation is known as Open Automated DR (OpenADR) Communications. OpenADR is an open data model that links price, reliability, and event signaling to customer energy control systems and devices. OpenADR provides capability, costs, and values that bridge multiple CPUC proceedings in demand response, dynamic pricing, demand response energy efficiency integration, and smart grid.

29 http://der.lbl.gov/microgrids-lbnl/current-project-storage-viability-website.

Additionally, five years of PIER-sponsored research has demonstrated that it is technologically feasible to provide spinning reserve using demand response, and that relying on demand response may be preferable because it can be targeted geographically and its performance is superior to generation resources. As a result, the research has now successfully transitioned from a demonstration project to pre-commercialization activity that is largely funded by California's IOUs. In addition, the research has provided a technical basis for the development of new market products by the California ISO to take advantage of the unique characteristics of demand response in providing this critical reliability function.

A recent national study for the United States showed that even a 5 percent drop in peak demand would yield substantial savings in generation, transmission, and distribution costs – enough to eliminate the need for installing and running some 625 infrequently used peaking power plants and associated power delivery infrastructure. This would yield an annual savings of $3 billion or more than $300 million per year for California. Reducing peak demand reduces the cost of expensive power, thereby reducing the total costs. California is moving toward dynamic real-time and critical peak pricing as the default price structure, thereby providing a price signal for hot summer days. The energy efficiency agenda associated with the smart grid is critical to obtain the best use of new schemes.

Combining demand response with electric energy storage in a system enhances the value and capabilities of both technologies. With smart grid providing coordination between the renewable generation and storage on the power system and demand response for customer loads, greater use of local renewable electricity generation is practical.

Increased Capability of Forecasting Tools

Higher penetration of localized renewable electricity generation resources requires improved forecasting tools to inform the California ISO for electricity scheduling and dispatch decisions. Accurate forecasts help address intermittency of resources and can increase their value to the system. The PIER Program's ongoing research in this area focuses on increasing the accuracy and reliability of forecasts as discussed further in Appendix B.

Interconnection

Interconnecting large quantities of renewable DG projects presents challenges, but on balance these are expected to be easier to overcome than the challenges associated with developing large transmission lines for utility-scale, remote renewables. Small distributed PV and other renewable energy technology market share has been growing in recent years in response to legislatively mandated and CPUC-directed programs. The outcome is an unprecedented increase in the number of interconnection requests to utilities and the California ISO. The purposes and locations of many of these new DG projects are shifting and add a degree of complexity to the interconnection process. In the past, most DG was installed at an existing customer site to reduce load or provide reliability; it was just a question of connecting the generator to the existing infrastructure. Although these interconnections continue to be the easiest, the quantity, concentration, and effect of these requests have resulted in the need for new studies to assure that additions of DG projects, even if they are small projects, will not

cumulatively affect distribution or transmission system operations and safety. The need and the time necessary to perform these additional impact studies are two of the reasons the backlog of interconnection requests continues to grow.

The Energy Commission has contracted with KEMA to investigate lessons learned in Europe, which has interconnected thousands of MWs of small-scale renewable projects. KEMA will develop a comparative analysis of the physical distribution system infrastructure in California and Europe, with a focus on Germany and Spain. The comparative analysis will evaluate how Europe is able to integrate large amounts of electricity from renewable DG into its electric distribution systems. The evaluation and comparison will include a determination of the tools used by system operators to forecast load and generation, the distribution system configurations, operating controls and dispatch, interconnection requirements, and control performance requirements compared to requirements that govern California IOUs' and POUs' system reliability and operation. The contractor will also assess the integration and interconnection of renewables on government property and the applicability to California state-owned property use.

One of the fastest growing DG markets is small PV projects (2-5 MW) that are built on undeveloped land where there are no existing facilities or demand for electricity. These "greenfield" sites are located near utility infrastructure or substations to reduce interconnection costs. All the power generated from these projects is contracted and sold to third parties to meet state renewable goals. Interconnecting greenfield facilities can be more complicated and expensive than interconnecting at existing customers' sites where electric infrastructure is already in place, but there are system locations where these interconnections can be easily and cost effectively accommodated using expedited "fast track" processes.

The interconnection processes discussed below offer a range of options for developers that depend on the voltage, size, and whether a project will be installed at an existing customer's site or at a greenfield location. Each process also allows projects that pass nearly identical technical screens to move to a fast track that has an accelerated timeline and lower costs. They were developed in early 2000 when only small numbers of DG projects were applying for interconnection, but now with the number and sizes of DG projects changing, the "one-size-fits-all" approach needs to be updated to more accurately assess which projects can be quickly and safely interconnected to the grid. The screens are provided in Appendix D. Needed updates are being discussed in CPUC's Renewable Distributed Energy Collaborative (Re-DEC), which brings together stakeholders including utilities, DG manufacturers, customers, and regulators to address issues related to high penetrations of distributed energy resources.

Developers incur costs for both the interconnection study and for the upgrades associated with their interconnection. These costs can be marginal or hundreds of thousands of dollars. To the extent that developers have good information about the distribution system, they can select sites that minimize interconnection costs.

All DG projects must be interconnected using one of three processes: the new California Independent System Operator Generation Interconnection Procedures, the Wholesale Distribution Access Tariff, and the CPUC's Rule 21 interconnection process.

Small projects (5 MW or smaller) for which all electricity generation is used onsite usually will be interconnected using the Rule 21 process, regardless of whether the project is located in an IOU or POU service territory. State development of solar on building rooftops will likely be eligible to interconnect using the simplified Rule 21 process. Larger projects (6-20 MW) on state lands will have more impact on infrastructure and utility systems, and, consequently, interconnection will be more complicated. If these projects are proposed in locations where there is excess system capacity, developers may use the fast track processes of the California ISO Generation Interconnection Procedures for transmission-level connection or the Wholesale Distribution Access Tariff for distribution-level connection, and these projects may be interconnected in less than a year.

California Independent System Operator Generation Interconnection Procedures

DG project developers wishing to connect at the transmission level controlled by the California ISO must apply for interconnection to the California ISO. Originally, the California ISO established the small generator interconnection procedures (SGIP) requirements for facilities that are 20 MW or smaller and want to connect directly with the California ISO-controlled grid[30]. The California ISO established the large generator interconnection procedures (LGIP) for projects greater than 20 MW.

The California ISO processed all interconnection requests, whether LGIP or SGIP, one at a time as generators applied for interconnection. In 2008, when applications for the LGIP began accelerating, the California ISO determined that studying these applications in clusters, rather than serially, would save time while allowing the California ISO and the participating transmission owners to determine how best to interconnect new generation resources safely and reliably to the grid. In April 2010, when the number of SGIP interconnection requests exceeded the number of large generator requests, the California ISO opened a stakeholder process to discuss a proposal to combine the small generator and the large generator interconnection procedures into a new single set of generator interconnection procedures (GIP). The California ISO's goal was to reduce the time it takes to process the increasing number of large and small generator interconnection requests.

On December 16, 2010, the FERC conditionally accepted the proposal by the California ISO to merge its SGIP and LGIP into one unified set of procedures to help it deal with the increasing

30 The SGIP established the requirements for generators no larger than 20 MW to interconnect to the California ISO-controlled grid. FERC order No. 2006 issued on May 12, 2006, required the ISO to standardize the terms and conditions of open-access interconnection service.

volume of small generator interconnection requests and increasing delays in its assessment of those requests.[31]

Under the new GIP, DG developers that seek to interconnect to the California ISO controlled transmission system can request interconnection through one of the four following processes depending on their size and location of their project.

First, the Independent Study Processing Track is open at any time to any size project providing the developer is requesting to interconnect at a circuit or substation where the project has minimal impact on upgrades required by other projects already in the California ISO queue. Second, the Fast Track Study Process is open at any time to projects that are 5 MW or smaller. Entry into this accelerated process is contingent on meeting all specified technical screening requirements. Third, the 10 kW Inverter Process is available only for inverter-based small generating facilities no larger than 10 kW that meet the codes, standards, and certification requirements of the SGIP.

Fourth, if a project does not qualify for the accelerated interconnection options above, then the developer may request entry into the California ISO's Cluster Study Track. The California ISO only does one cluster study per year, and it takes approximately 420 calendar days to complete. Developers have two opportunities during the year to apply to enter the cluster study. The first window is March 1 to March 31 of each year, and the second is from September 15 to October 15.

Participation in each of these processes requires developers to provide technical information, and demonstrate site exclusivity or pay a deposit in lieu of site exclusivity. The Independent Study Track and the Cluster Study Track processes also include paying a deposit toward study costs and participating in system studies. The studies provide costs and timelines of any required network upgrades and interconnection facilities needed to interconnect the project to the existing transmission grid. Completion timelines range from as little as 78 days in the Fast Track to 420 days in the Cluster Study Track. Even that is 330 days shorter than the previous LGIP process. When a developer decides to connect at the transmission level, costs for the developers can be expected to be higher than if the connection is requested at the distribution level.

Once the window is closed to enter a Cluster Study Track, the California ISO separates projects into groups for study based on a common transmission facility use. If transmission upgrades are required for a particular group, then interconnection customers share the costs. The number of groupings per cluster depends upon how electrically distinct the projects are from each other. Some projects are studied individually if there are no other projects proposing to interconnect in the same area. In those cases, the cost of transmission upgrades would be the responsibility of that single interconnection customer. The cost of transmission upgrades can be significant and should be a key consideration in choosing a project location and interconnection point.

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31 Order Conditionally Accepting Tariff Revisions. http://www.ferc.gov/whats-new/comm-meet/2010/121610/E-3.pdf.

Wholesale Distribution Access Tariff

If a DG project developer decides to build a project, connect to a part of the transmission system controlled by the California ISO, and sell all its energy to another party, then the interconnection request is FERC-jurisdictional and subject to the Wholesale Distribution Access Tariff (WDAT). FERC requires all IOUs to have a WDAT. A project developer meeting these criteria will first have to determine in which utility service territory the project will be interconnected. If the project is in an IOU's service territory, it will be subject to the utility's WDAT.

FERC has limited jurisdiction over POUs; so without a mandated tariff for wholesale generators, POUs are left to determine what contract and interconnection requirements they want to establish for these transactions in their service territories. Energy Commission staff discussion with SMUD suggests that many POUs do not have WDATs, including SMUD, but will need to develop options to accommodate these types of interconnection requests in the near future as developer interest is growing.

Once it is known in which utility service territory the project will be, the project developer must request interconnection and start a process that is in many respects similar to the process described when applying to the California ISO for a Generation Interconnection Agreement. If not eligible for a Fast Track or 10 kW Inverter Process, then the process will start with an application processing and scoping meeting. If the distribution provider (the IOU) and the project developer determine the project is feasible, then, at the developer's expense, the distribution provider performs a series of studies to determine the potential impacts to the distribution and transmission system and the cost of facilities needed to address those impacts. Following the studies, the two parties enter into an interconnection agreement. Engineering and design studies are completed, followed by procurement of materials to construct of facilities necessary for interconnection. The time frame for this process varies; some projects take months, and others take years, depending on the project and the complexity of the interconnection.

Unlike the FERC policy, under which the transmission owner (the IOU) bears the ultimate cost responsibility for transmission network upgrades,[32] the cost for upgrades to the distribution system is the responsibility of the generation developer. FERC rationalizes this policy based on the argument that transmission network facilities benefit all users of the bulk grid, whereas local distribution facilities do not have such wide benefits.

This difference has a pronounced impact on distribution-line developers because of the current serial approach for determining cost responsibility. The rule is if your project triggers the need for an upgrade, then you bear the cost responsibility. A hypothetical example can help illustrate the concerns this practice raises when multiple projects queue up to be interconnected. Assume

32 For transmission network upgrades required for generator interconnections, the generator is required to provide initial financing to the transmission provider. However, the cost of these network facilities are phased into rates over five years starting when the generator and the facility are both on-line, and the generator receives phased refunds with interest.

a utility has a circuit that can handle 10 MW of new generation. A 9 MW project applies to be interconnected on the circuit, and the interconnection study begins. A few days later, a 2 MW project applies to be interconnected to the same circuit. The second project puts the circuit over its limit and is therefore responsible for the full cost of the upgrade on the circuit. In recognition of this possibility, the California ISO GIP and the SCE WDAT have used an approach that clusters the studies of multiple projects that are electrically dependent such that costs can be allocated to projects based on size. One of the goals is to provide cost allocation that more fairly aligns with the sizes of the projects.

Currently, both PG&E and SCE are engaged in separate stakeholder processes that will lead to requests to FERC for amendments to their respective WDATs. Many of the changes being considered deal with the dramatic increase in the volume of interconnection requests these two utilities have been experiencing over the past year. SCE currently has more than 600 active requests (all sizes) with the number continuing to accelerate. Just a year ago, it had approximately 200 active applications. One of the major changes being proposed and discussed by both PG&E and SCE in their draft tariff proposals is the addition of a Cluster Process to their WDAT for any generating facility that does not qualify for the Independent Study Process, the Fast Track Process, or the 10 kV Inverter Process. The Cluster Process also has the benefit of allowing distribution-level generation projects to be studied for deliverability in conjunction with the California ISO process, allowing those generators to qualify for the CPUC's resource adequacy capacity program. Stakeholders, the CPUC, and the Energy Commission have advocated for having the IOUs revise their WDAT so as to complement the California ISO's new GIP and to offer simplified, timely, and increased opportunities for small projects (5 MW or smaller) to apply for interconnection at any time during the year.

SCE had planned to complete its stakeholder process and file proposed amendments to their WDAT by January 31, 2011, with PG&E's scheduled to have been filed by February 28, 2011. FERC is expected to respond in a few months. SDG&E has not begun a process to revise its WDAT. The Energy Commission does not know what final WDAT reforms PG&E and SCE will propose to FERC, but one potential outcome of these individual processes is that each IOU may request different and unique technical requirements and screens for their respective interconnection processes. The Energy Commission is participating in the WDAT stakeholder reform proceedings and had planned to file comments on the final reforms PG&E and SCE propose to FERC.

Rule 21 Interconnection Standard

A Qualifying Facility (under the Public Utilities Regulatory Policies Act (PURPA) with a CPUC jurisdiction Qualifying Facility contract Standard Offer, can apply to be connected under Rule 21.[33] There is no system size limit, but the current screens make it more difficult for a relatively large project (more than 2 MW) to qualify for a simple interconnection.

33 Rule 21 describes the interconnection, operating, and metering requirements for generation facilities to be connected to the distribution system for utilities over which the CPUC has jurisdiction.

Adopted by the CPUC in 2000, the Rule 21 interconnection standard was modified to accommodate interconnection of small distribution generation. The current version of Rule 21 evolved as a result of efforts of the Energy Commission, the CPUC, California's IOUs, municipal public utilities, engineering companies, manufacturers, distributed generation developers, and clean energy advocates to develop a safe, simple, and efficient interconnection process for small DG generators. Even though Rule 21 applies only to IOUs, all POUs in California recognized its simplicity and agreed to adopt the technical aspects of Rule 21 and incorporate these procedures into their interconnection guidelines. Today, if a customer -owned DG project wants to interconnect to a POU's distribution grid, the customer will go through the same Rule 21 process as applies to interconnection in IOU service territories.

All projects applying for interconnection under Rule 21 must determine what utility service territory their project is located in and go through a three-step process that includes:

- An initial review where if the eight technical screens included in the Rule 21 Interconnection Standard are passed, the project is offered a simplified interconnection Agreement. If the project fails any one of the screens, it moves to the Supplemental Review.
- The supplemental review determines if failure to pass the Initial Review can be addressed easily and incorporated into a final interconnection agreement or if the problems identified can only be understood and resolved through a full Interconnection Study.
- If the utility determines that an interconnection study is needed, the applicant must enter into an agreement with the utility to perform the needed studies and facility engineering, including cost estimates for required interconnection facilities. If the project passes all studies, the utility will send an interconnection agreement to the applicant.

One of the key accomplishments resulting from these efforts was the development of eight technical screens that, if passed, allowed a DG project to be offered a simplified interconnection agreement. Currently, those screens are still used for Rule 21 interconnection requests and, over time, various levels of these screens have been adopted and integrated into the Fast Track processes of the California ISO GIP process, as well as the current WDAT processes. As a result of increasing numbers of solar DG installations, it may be beneficial to review these decades'-old screens and explore implementing standard interconnection agreements and defined timelines for the Rule 21 process, to support California's growing renewable DG sector.

In April, 2011, the CPUC announced that it is restarting of the Rule 21 Working Group to build consensus on reforms needed to meet the technical requirements and policy goals of interconnecting distributed generation. Currently, the need to update Rule 21 is affecting implementation of various programs including feed in tariffs and utility PV programs. For example, SCE and SDG&E use Rule 21 for their feed-in tariff programs for projects 1.5 MW and smaller. SCE is not able to study all of the interconnection requests in a timely manner. In the

CPUC's draft resolution approving the PG&E Solar PV Program, the CPUC requires PG&E to use Rule 21 and not WDAT. If the CPUC adopts this in the final resolution, then the CPUC will have to revise Rule 21 so that it meets the needs of these types of programs.

Permitting Issues for Localized Renewable Electricity Generation

State agencies regulate the private use of state land, resources, and activities of statewide significance through permitting authority established by statute. Multiple agencies are or may be involved in the approval of renewable projects, and in many cases agencies develop additional administrative rules and permitting requirements.[34] All discretionary actions taken in California are subject to compliance with California Environmental Quality Act (CEQA), although categorical exemptions from CEQA may be appropriate for renewable projects located on state buildings. A negative declaration or mitigated negative declaration may be appropriate for other types of projects, or the projects may require an environmental impact report The location and type of project will play a role in determining the type of CEQA document that is prepared. Where a state agency is proposing, funding, and/or playing a major role in a project, it is typically the lead agency under CEQA. If it has have authority to do so, it completes the environmental documentation and compliance under CEQA and/or NEPA.

The installation of PV projects on state-owned buildings, ROWs, aqueducts, and other excess or vacant state lands would follow separate permitting paths. DGS typically manages projects and permitting activities for state agencies without its own permitting authority. Small-scale PV projects located on the majority of state-owned buildings would be permitted through DGS, which would review the project in conformance with the CEQA and implementing guidelines, evaluate and approve project plans, and perform inspections during and after project construction.[35] For projects located on buildings owned by Caltrans or DWR, or other agencies with permitting authority, those agencies would conduct these activities. It is assumed that small-scale projects on state buildings in urbanized areas, if appropriately sized to match the load of the building, would use the energy onsite and would not require electrical system upgrades. Staff contacted several cities and counties to understand their permitting processes for adding PV panels to existing (not state-owned) buildings – in many cases, local governments may determine that such projects are exempt under CEQA from environmental review, but they require a design review before issuing building and/or electrical permits. Staff assumed that small-scale PV projects located on state-owned buildings in many cases would have no significant environmental impacts and either would fall within a statutory or categorical exemption under CEQA or, after an initial study, would be the subject of a negative declaration. Even if such a project has the potential for significant impacts that could be mitigated to a less than significant level, a mitigated negative declaration could be prepared.

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34 http://ceres.ca.gov/ceqa/guidelines/intro.html.

35 http://www.dgs.ca.gov/resd/AboutUs/ProfessionalServicesBranch.aspx.

Larger, utility-scale projects located on state-owned ROWs, aqueducts, or other lands would be subject to review and approval, including CEQA evaluation, by the state agency with appropriate jurisdiction. Sites for larger projects will require additional screening to determine their suitability for potential development – environmental issues such as the presence of sensitive wildlife or plant species, health and safety concerns, proximity to the electric system interconnections, and parcel access issues will require further in-depth evaluation. Archaeological sites are common in rural areas and state ROWs. If impacts to archaeological sites cannot be avoided, these issues will need to be resolved with the State Office of Historic Preservation, which has both federal and state authority. Formal consultation with the US Fish and Wildlife Service (USFWS) and/or the California Department of Fish and Game will be needed for impacts to endangered species habitat. For impacts to streams, which may result from construction activities, a streambed alteration permit (Fish and Game Code Section 1600) from the California Department of Fish and Game will be needed. For impacts to wetlands, permits may be required from the Army Corps of Engineers. Furthermore, the vast majority of highways and ROWs in rural areas are located on lands owned by the Bureau of Land Management , and the U.S. Forest Service , and small portions are owned by tribes and other entities. The Bureau of Land Management and U.S. Forest Service have separate evaluation requirements for historic, archeological, and aesthetic impacts and may require mitigation or resolution of impacts to species not listed by U.S. Forest Service or California Department of Fish and Game. Such projects could also involve upgrades to the distribution or transmission system that would require additional study by and coordination with utilities or the California ISO. Therefore, larger solar thermal, PV, biomass, wind, or geothermal projects located on state-owned ROWs, aqueducts, or other lands will require an environmental impact report and cannot be developed as quickly as those on state buildings.

Local Government Coordination

While local governments do not permit renewable energy projects on government-owned (state, federal) buildings, ROW, or properties, state agencies are often required to ensure that projects are consistent with local laws, ordinances, regulations, and standards. In addition, appurtenant facilities related to the project, but not located on state property, may require review and approval from the local jurisdiction (city/county planning agency). However, local governments, the public, and other stakeholders will be encouraged to participate in the licensing and review of projects proposed on state properties in their jurisdictions and provide comments related to compatibility with adopted land use plans, zoning codes, and energy-related ordinances, as well as information about potential environmental, public health and safety, and economic impacts. The Energy Commission and the state understand that local decision-makers and planners are often confronted with public concerns about the potential impacts and benefits of energy generation projects and believe that informed local governments, citizens, and stakeholders have a role in helping California meet its renewable energy and climate change goals.

In December, 2010 the Energy Commission published a draft of the *Energy Aware Planning Guide*[36], which is a comprehensive resource for local governments seeking to reduce energy use, improve energy efficiency, and increase usage of renewable energy across all sectors. Wiser use of energy resources can lead to cost savings for local governments, residents, and businesses; reinvestment in the local economy; improved quality of life and public health; increased compliance with state and federal goals; and more energy security. Additionally, strategies to reduce energy consumption promote progress towards aggressive greenhouse gas reduction goals laid out in Assembly Bill 32, California's Global Warming Solutions Act. The *Energy Aware Planning Guide*, originally published in 1993 and updated in 2009, is intended to help local governments develop strategies and best management practices to improve energy efficiency, reduce energy consumption through transportation and land use, and enhance renewable sources of energy. Strategies explored include: transportation and land use changes, optimizing water use, building improvements, and other strategies. Each strategy section contains general plan language ideas, implementation ideas, case studies, and resources. The *Energy Aware Planning Guide* also contains supporting information and references to help local governments organize strategies into an energy action plan and estimate the likely energy efficiency and greenhouse gas reduction impacts of their strategies.

36 http://www.energy.ca.gov/energy_aware_guide/index.html.

CHAPTER 4: Opportunities on State Buildings and on Other Property

Recognizing the barriers to deploying localized renewable generation, there are also many opportunities for development on state buildings and properties. As part of its commitment to advancing renewable deployment and greenhouse gas emission reductions, the Energy Commission staff has begun identifying potential locations for energy generation infrastructure on state-owned facilities and surplus property, as called for in the MOU discussed in Chapter 1 between the Energy Commission and the DGS, CDCR, Caltrans, DWR, Department of Fish and Game, and CSLC to promote the development of renewable energy projects on state buildings, properties, and ROW. This report provides an initial assessment of potential opportunities, and the Energy Commission staff anticipates developing a more refined analysis as more information becomes available.

The buildings and lands of various agencies have been included in the inventory discussed below, including agencies that have signed the MOU and some who are not currently part of the MOU. The Energy Commission will continue to work with other agencies that have expressed an interest or that may be interested in joining this effort and signing the MOU. For example, the Energy Commission would like to partner with the UC and the CSU to further deploy renewables and renewable integration technologies such as smart grids and energy storage devices. By working collectively, the state can achieve a critical mass for these efforts and ensure that best practices, experience, and expertise are effectively shared among state agencies.

For this analysis, staff assigned all California state properties to one of four groups: state buildings in load centers, state property with potential for wholesale generation, remote state buildings with potential for energy independence, and land available for lease with potential for wholesale generation (Table 5). The groups were determined based on each property's electricity load, interconnection procedure, location, amount of land, size of system, and energy product. Details and examples of all four state property applications are discussed in more detail below.

Inventory of State Buildings in Load Centers

Energy Commission staff conducted an initial mapping exercise using data made available from DGS to identify state property that could accommodate renewable DG and the potential opportunities available. The DGS data file was from 2009 and contained information on 3,274 state-owned properties. Staff removed from consideration sensitive state properties and some facilities with existing renewable projects as follows:

- Properties less than one acre in size.
- Conservancy lands.

- Department of Fish and Game properties.
- Department of Parks and Recreation.
- Demonstration State Forests.
- Reservoirs and weirs.
- CSU and UC facilities (these were not included because DGS does not have authority to conduct an RFP for development on CSU nor UC campuses);
- California State Fairs projects.
- Caltrans buildings with existing CREB-financed PV installations.
- Properties located outside the seven identified load centers (Sacramento, San Francisco Bay Area, Stockton/Modesto/Turlock/Merced, Fresno, Los Angeles Basin, Inland Empire, San Diego).[37]

Table 5: Categorization of State Properties

	State Buildings in Load Centers	State Property With Potential for Wholesale Generation	Remote State Buildings With Potential for Energy Independence	Land Lease for Wholesale Generation
Electricity Load	> 0.5 GWh annually	> 1 GWh annually	< 0.5 GWh annually	Without load or a DWR pumping station
Interconnection	Rule 21	Rule 21 and/or WDAT	Rule 21	WDAT or California ISO GIP
Location	One of seven load centers	Statewide	Not in a load center	Not in a load center
Amount of Land	Only rooftop and parking lots	Rooftop, parking lots, and surplus land	Rooftop, parking lots	All surplus land
Size of System	< 1 MW	< 1 MW; additional system up to 4 MW.	< 1 MW	>1 MW
Energy Product	Partially offset onsite load	Partially offset onsite load; potential for larger system for wholesale market	Fully offset full; 100 percent departing load and energy independence	Wholesale distributed generation or utility-scale generation

Source: California Energy Commission

37 There may be opportunities outside of the load centers that are not captured in this inventory but could be reflected in the RFP.

Because many of the state properties contain multiple structures and the square footage of individual structures/rooftops was not initially available, total site acreage was used to estimate the potential range of opportunity during the first screen.

This inventory includes buildings under the jurisdiction of the DGS or occupied by the following agencies: the Employment Development Department, the California Highway Patrol, the Department of Justice, the Department of Motor Vehicles, the Department of Toxic Substances Control, and the Department of Veterans Affairs.[38] Staff collected data on many of these properties such as annual and monthly energy load, annual and monthly utility billing based on ENERGY STAR's® *Portfolio Manager*. These facilities are likely to go through the Rule 21 interconnection process, since the energy produced will be consumed onsite and not sold back to the grid. All of these systems are expected to net-meter and are eligible for government-rate CSI rebates.

Energy Commission staff used ESRI ArcGIS software to evaluate the available rooftop and parking lot space. Square footage of available space was estimated by calculating the total size of the roof and then subtracting the square feet of any obstructions and areas of pitched roof facing north. Available parking lot space was estimated by aggregating the total space within the perimeter of the lot.

Further study will be needed to determine if the available rooftops and parking lots identified in the inventory are suitable for development or can support PV systems. For example, staff has not determined whether the structure of each roof in the inventory could physically support the weight of a PV system, or identified the age or type of each roof, which are factors that can help determine whether the inventoried properties may be suitable candidates for a PV system.

In Table 6, staff identifies the number of state properties within the seven load centers, the total land area of properties within the load centers, the estimated amount of the rooftop and parking lot space available to develop on these properties[39], the estimated potential PV capacity that could be developed based on the space available, and the estimated capacity sized to the space available and the load of the building. Staff compared the system size that the available space could support with the system size needed to generate 80 percent of the annual load. The smaller of the two system sizes is the estimated capacity sized for the space available and the building load. Staff chose 80 percent as the discounted size of the system to support load because energy efficiency improvements at the buildings could reduce the annual load by 10 to 20 percent and the system should not provide more electricity than is consumed on an annual basis. Table 6 shows 16.2 MW of PV capacity could be developed in the seven load centers on roof-top and parking spaces. .

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38 Since staff conducted the initial screen, the state has taken ownership of over 500 courts buildings which could be good potential sites for renewable energy systems as well as energy efficiency retrofits. Staff is exploring including them to the database.

39 The area available for renewable energy development is just an estimate, and site visits of each property are needed to determine actual space available.

Table 6: State Buildings in Load Centers PV Potential

Load Center	Number of Properties	Total Area of Properties (million sq. ft.)[40]	Available Rooftop (sq. ft.) [41]	Available Parking Lot (sq. ft.)[42]	Estimated PV Potential (MW)[43]	Estimated Capacity Sized for Space and Load (MW)
Sacramento	27	3.9	890,000	783,000	4 – 7	4.8
San Francisco	24	2.4	300,000	610,000	2 – 4	2.2
Stockton/ Modesto/ Turlock/ Merced	11	0.8	182,000	745,000	2 – 4	1.6
Fresno	2	0.4	50,000	90,000	0.3 – 0.6	0.3
LA Basin	29	3	400,000	780,000	3 – 5	3
Inland Empire	13	1	160,000	400,000	1.5 – 2.5	1.4
San Diego	8	3	330,000	680,000	2.5 – 4.5	2.9
Total	111	14.4	2,250,000	3,423,000	14 – 26	**16.2**

Source: California Energy Commission

For illustration purposes, Figure 3 shows the state buildings within the seven load centers as a grey dot. Most of the state buildings are located in moderate annual insolation regions. For a similar map of state buildings with a wind resource overlay, see Appendix C.

Inventory of State Property With Potential for Wholesale Generation

The interagency group identified a clear difference in the types of projects that would be suited to buildings with limited space available for PV and buildings that had surplus lands available for renewable development. The inventory for this subset of state properties used the 2009 DGS file, focusing only on the buildings with high energy consumption. CDCR, Department of Mental Health (DMH), and the Department of Developmental Services (DDS) developmental centers typically have high energy loads and have surplus land. The DDS developmental centers' population has been declining as the community system expands; from a high of over

41 Square feet are rounded to nearest 10,000.

41 Square feet are rounded to nearest 10,000.

42 Square feet are rounded to nearest 10,000.

43 MW ranges are only estimates. Range of PV capacity potential is based on 5 to 9 acres per MW (217,800 to 392,040 sq. ft. per MW).

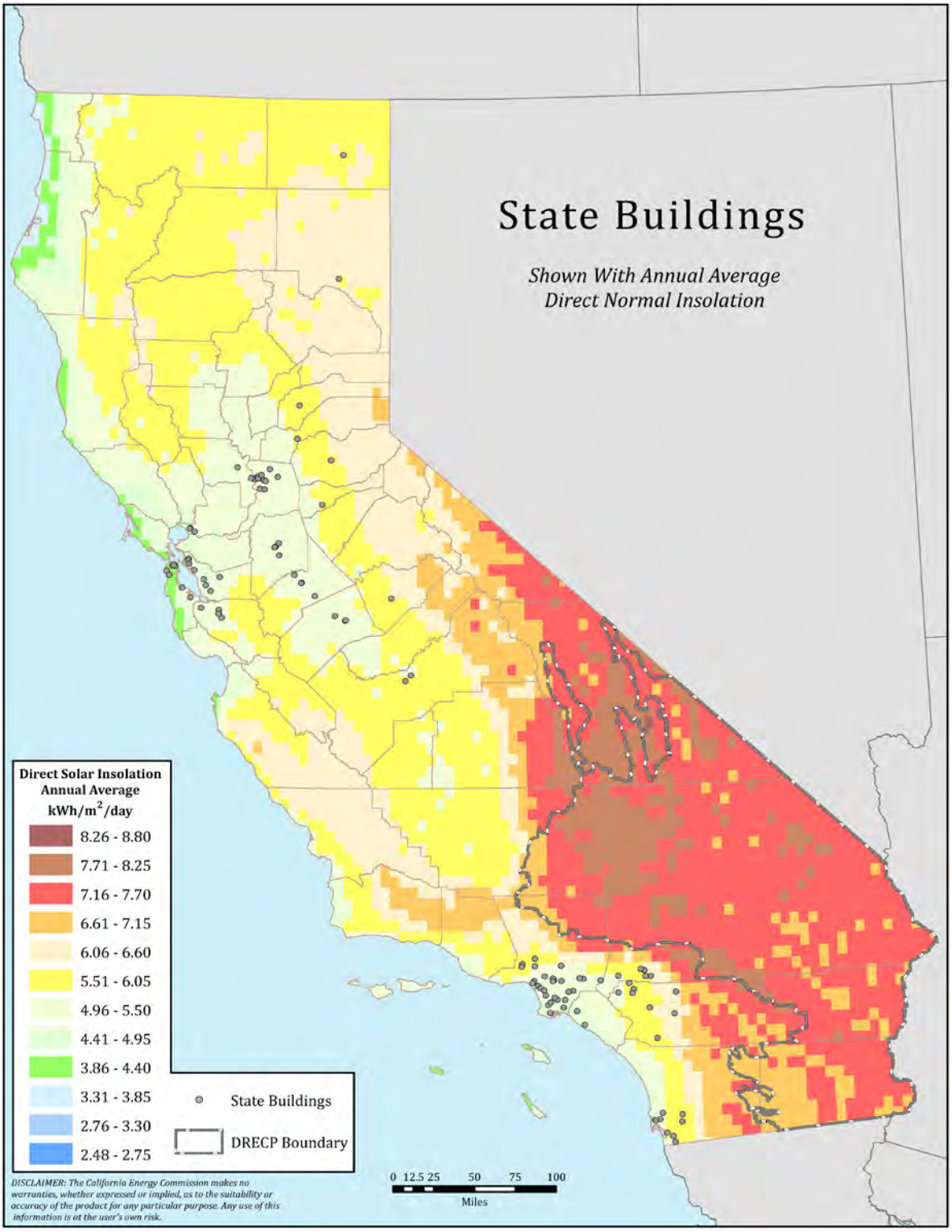
13,300 residents in 1968 to 1,995 residents as of November 2010. During this time, DDS closed five centers and recently received Legislative approval to initiate the closure process of Lanterman DC. At one of the centers that closed 10 years ago, the State is obligated to pay for a 20-year cogeneration contract, but it would be difficult to predict DDS's need for renewable energy power at that site. Consequently, this list only includes CDCR and mental health facilities. However, Energy Commission staff could only assess the parking lots and building rooftops of CDCR and DMH facilities. Further, because security and safety constraints would increase system costs if located within the secure areas of prison or mental health facilities, ground-mounted systems located outside the walls of these facilities offer the best development opportunity. California CDCR assessed the land outside the walls of their locations and estimated that the potential photovoltaic capacity at approximately 50 MW to 200 MW.[44] This estimate reflects initial screening by the CDCR staff to exclude areas with insufficient interconnection opportunities, poor topography, or environmental sensitivity concerns. CDCR plans to release a request for information to identify the amount of additional wind capacity that could be built-out on the properties located in very good wind resource areas (see Appendix C, Figure C-4 for those locations).

These buildings could accommodate systems larger than 1 MW both because of their large demand and available space. Due to the 1 MW net-metering cap, the systems designed for the high-load buildings could have a hybrid approach using one system as self-generation and another larger system for wholesale export to the grid. Under this scenario, the first MW would interconnect via Rule 21, while the additional capacity would have to go through the WDAT interconnection with the utility service area it is located. Another possible approach to take advantage of additional CSI funds available through AB 2724 would be to size one net metered system at 1 MW. The other system would have to be equal or less than 4 MW and would not exceed the minimum load at any daytime interval during the year. Both systems may interconnect through Rule 21. There are several net energy metering bills currently proposed in the Legislature that could help increase the size of the system and the percent of peak demand cap per utility.

Figure 3 shows the 111 state buildings located in the load centers and a number of buildings outside the load centers that have reasonably high loads and relatively large properties. The state buildings tend to be in average solar resource regions. The regions with the best solar resource are the Inland Empire and San Diego areas. Appendix C contains a similar map showing the buildings with a wind resource overlay.

44 California Department of Corrections and Rehabilitation staff assumed 10 acres per megawatt to estimate potential solar PV capacity.

Figure 3: State Buildings Within Load Centers With Solar Insolation



Source: California Energy Commission

CDCR and DMH properties are summarized by load center in Table 7. The column labeled "Estimate of Potential Capacity" reflects two sources. The data for CDCR facilities except state hospitals are for ground mount potential as estimated by CDCR staff; the data do not include estimates of roof-top or parking lot potential even though the useable space has been included in the table. The Energy Commission staff estimated the potential for DMH facilities based on the useable roof-top and parking lot space. **

Table 7: State Property with Potential for Wholesale Generation

Facility	Estimate of Usable Rooftop (sq. ft.)	Estimate of Usable Parking Lot (sq. ft.)	Estimate of Potential Capacity (MW)[45]
California Correctional Institution	100,000	481,000	4.6
California Institution for Men	160,000	13,000	5 – 40
Calapatria State Prison	860,000	140,000	5 – 40
Centinela State Prison	840,000	110,000	5 – 40
California State Prison, Corcoran	2,700,000	570,000	3 – 5
Valley State Prison for Women	780,000	395,000	1 – 5
Chuckwalla Valley State Prison	775,000	430,000	4.6
Ironwood State Prison	965,000	280,000	4.6
Avenal State Prison	920,000	380,000	1 – 5
Central California Women's Facility	780,000	420,000	1 – 5
Folsom State Prison	Unknown	Unknown	0.25
Mule Creek State Prison	830,000	275,000	0.5
North Kern State Prison	940,000	405,000	4.6
R.J. Donovan Correctional Facility	950,000	430,000	1 – 5
Wasco State Prison	645,000	405,000	1 – 5
Mule Creek	Unknown	Unknown	0.5
CSP, Los Angeles County	Unknown	Unknown	2.9
High Desert State Prison	Unknown	Unknown	1 – 5
Pleasant Valley State Prison	Unknown	Unknown	1 – 5
Coalinga State Hospital	655,000	588,000	3 – 6
Metropolitan State Hospital	195,000	90,000	0.7 – 1.3
Napa State Hospital	215,000	200,000	1 – 2
Patton State Hospital	45,000	55,000	0.3 – 0.5
Atascadero State Hospital	438,000	284,000	2 – 3
Total	**13,793,000**	**5,951,000**	**54.5 – 195**

Source: California Energy Commission

[45] The total MW are only estimates for potential PV capacity. Some of the facilities are in good wind resource areas and could be candidates for wind potential.

Figure 4 on the following page shows CDCR and DMH facilities in relation to the state's annual solar insolation underlay. Properties located in the northern and southwestern parts of California are located in moderate insolation areas, properties located in Central California are located in moderate to good insolation, and properties in southeast California are located in areas with high annual insolation. Appendix C has a similar map of the properties with a wind resource underlay.

Remote State Buildings With Potential for Energy Independence

Some state properties located in remote locations may be more susceptible to power outages. These remote facilities often rely on backup generators and could benefit from renewable projects that would allow them to be energy self-sufficient. For example, many remote California Department of Forestry and Fire Protection (CAL FIRE) facilities are located in high biomass and solar resource locations. These facilities could take advantage of a baseload bioenergy generator or an intermittent renewable system with energy storage to meet their energy demands.

Table 8 shows 46 remote CAL FIRE facilities where staff has information on the amount electricity used annually and the estimated amount of renewable capacity needed to reach energy independence. There are 29 CAL FIRE facilities for which staff has no information.

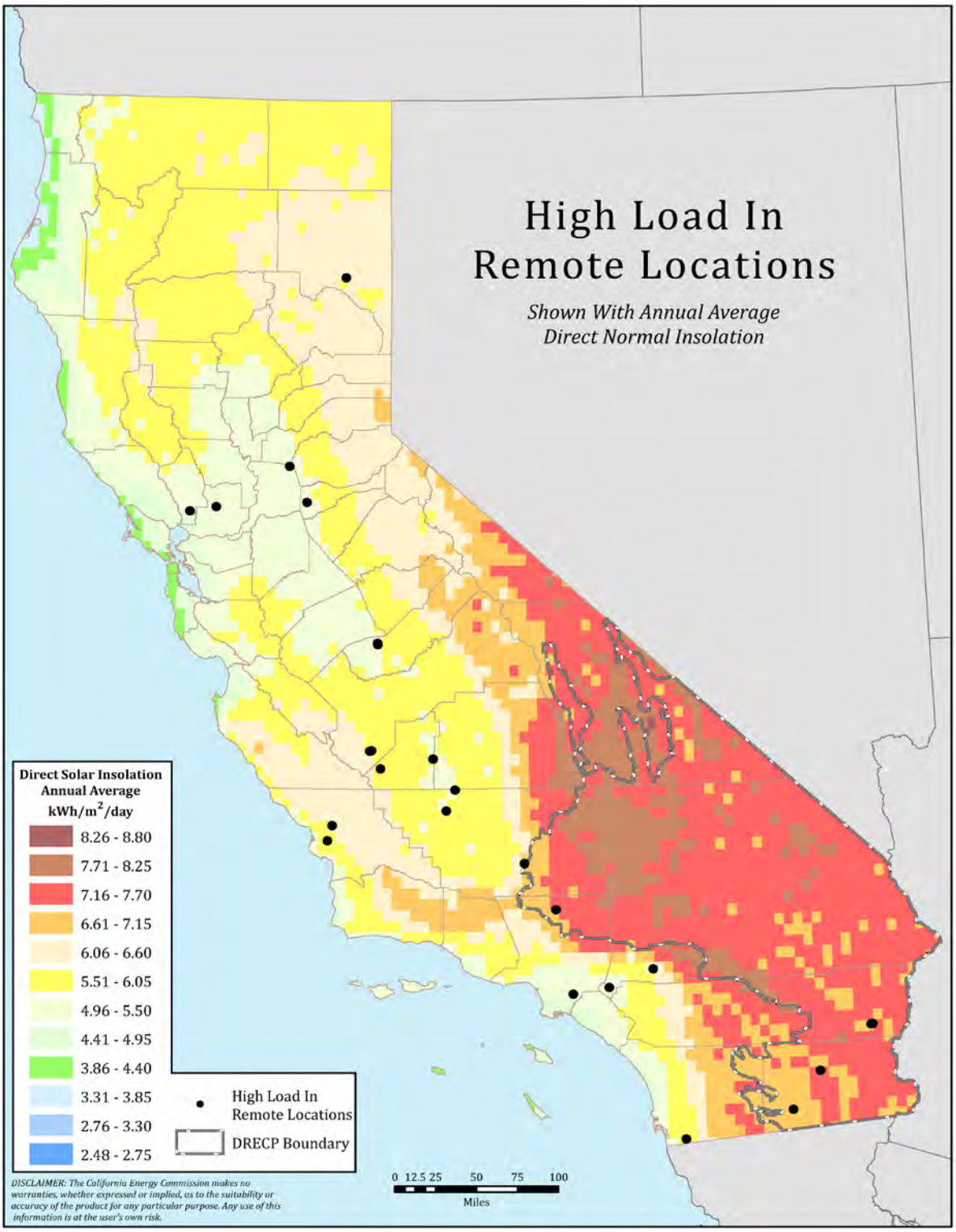
Table 8: Remote Buildings with Potential for Energy Independence

Number of Properties	Total Floor Space (sq. ft.)	Current Site Electric Use (MWh)	Estimated Biomass Capacity(MW)	Estimated PV Capacity (would need additional storage) (kW)
46	470,000	2,450	0.5	1.5
29	No info	No info	No info	No info

Source: California Energy Commission

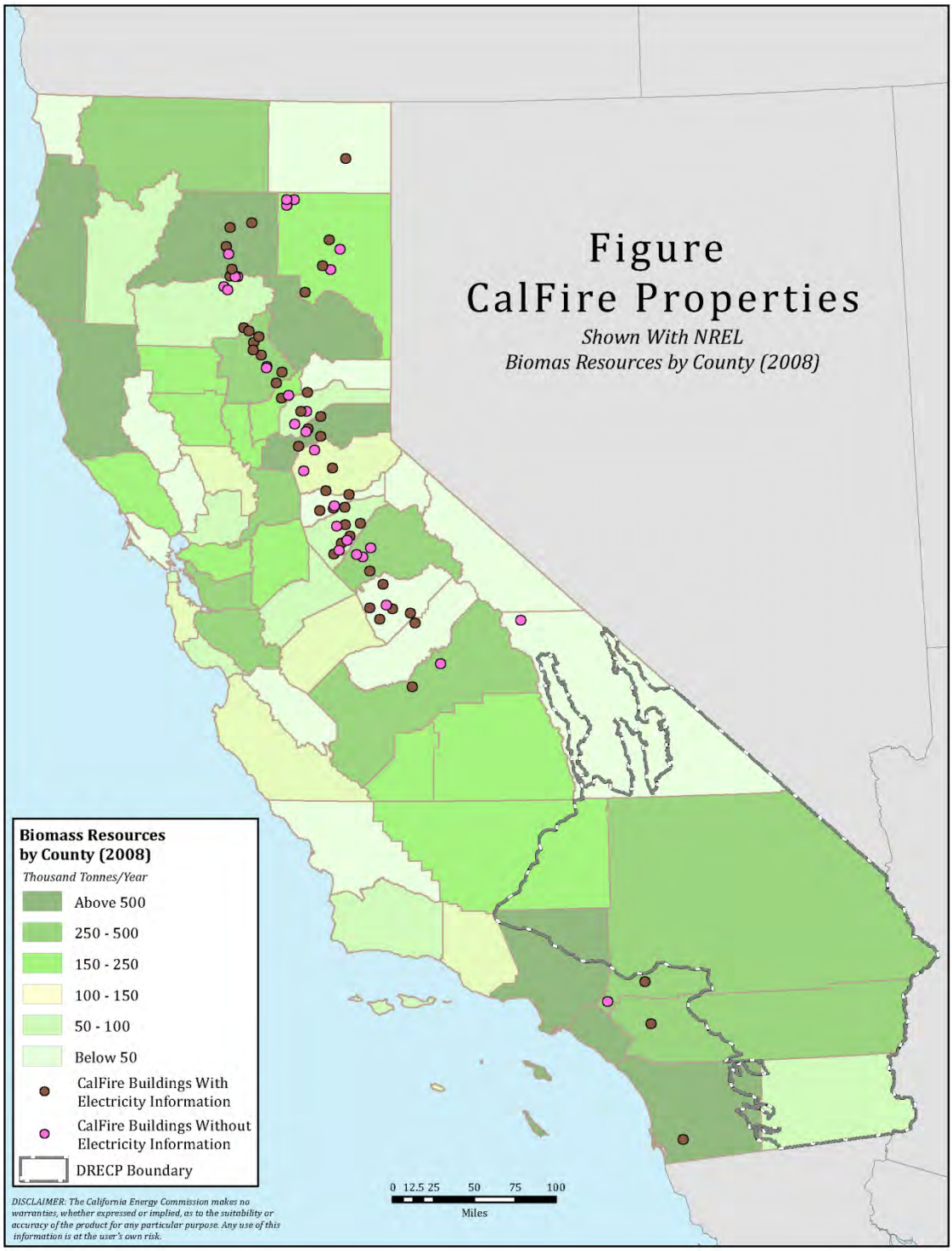
Figure 5 on page 58 shows that a number of CAL FIRE buildings are in counties with considerable amount of biomass feedstock, greater than 150,000 tonnes per year, namely Butte, Lassen, Riverside, San Bernardino, Tuolumne, and Yuba counties. CAL FIRE buildings located in Shasta, Placer, and San Diego counties may potentially have access to greater than 500,000 tonnes of feedstock per year. See Appendix C for a map of these facilities with an annual solar insolation underlay.

Figure 4: DMH and CDCR Facilities With Annual Solar Insolation



Source: California Energy Commission

Figure 5: CAL FIRE Buildings with Available Biomass Feedstock by County



Source: California Energy Commission

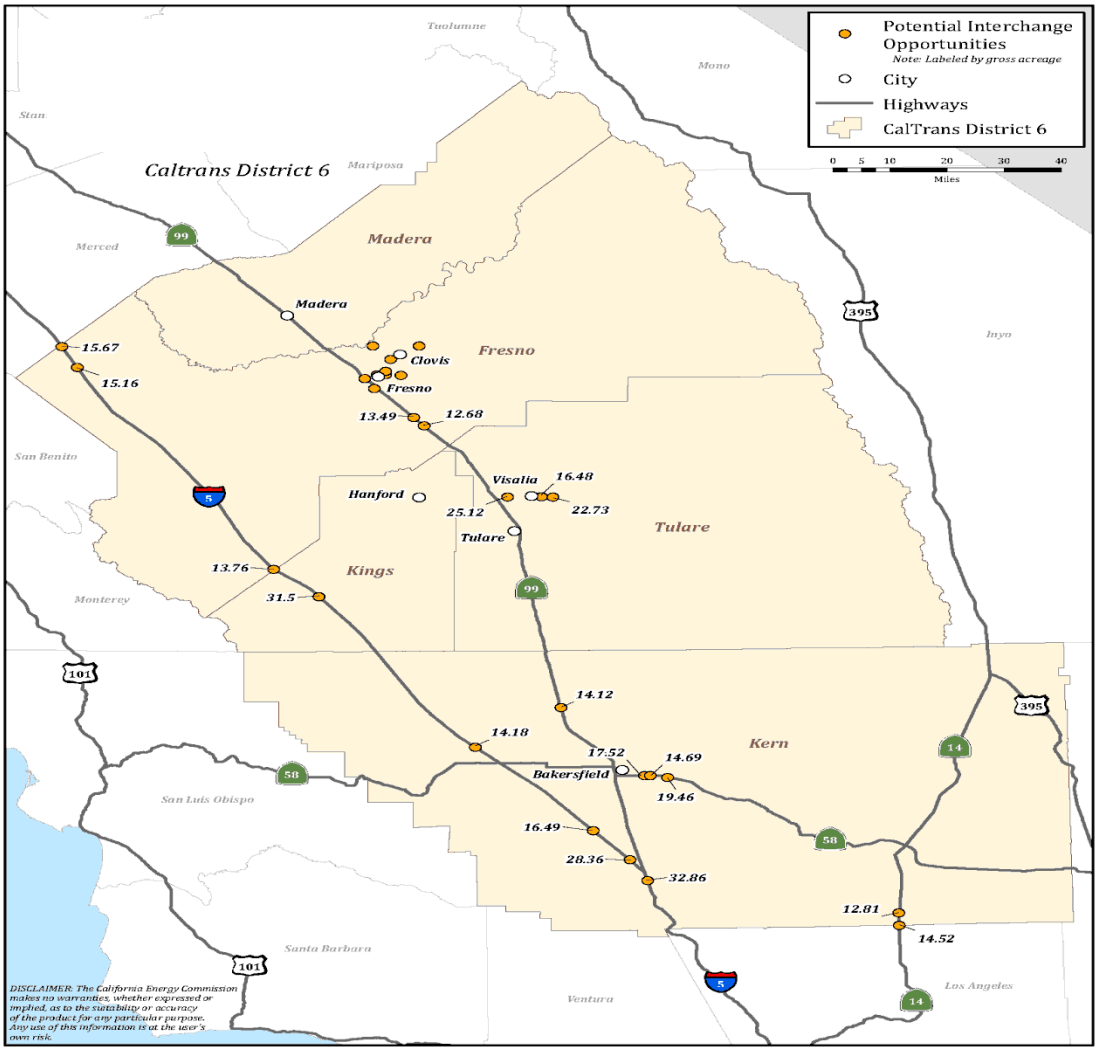
Land Leased for Wholesale Generation

Because no database was available to identify state properties that could accommodate wholesale generation systems for distribution and utility-scale applications, Energy Commission staff coordinated with Caltrans, the DWR, and CSLC to assemble data of surplus and managed lands.

Energy Commission staff initially used Google Earth to identify potential highway interchange opportunities in six of the seven load centers. Staff did not include the Los Angeles Basin because access and space are very limited along the highway system. Staff estimated that as many as 200 intersections on approximately 2,000 acres may be available in six of the seven load centers, which could potentially support between 225 to 400 MW of solar PV. Because Caltrans ROWs are generally smaller parcels of land and have considerable safety, security, and visual concerns, PV is the most suitable renewable technology for ROWs. Caltrans is working to inventory and determine potential ROWs for further evaluation throughout the state, although many factors, including safety, access, and environmental issues, will need to be considered before a renewable project on a ROW is developed. For example, Caltrans has noted that major highway intersections would not make ideal candidates because the only point of access is from the highway. A preliminary evaluation and inventory for District 6, which includes Fresno, Kern, Kings, Madera, and Tulare counties, have been completed. A report on all districts is expected around the June-July time frame in 2011.

Figure 6 identifies potential ROW opportunities in Caltrans District 6 located within 5 miles of electrical interconnections that will require further evaluation and screening. Caltrans also identified two 500 acre parcels in District 6 that were targeted to be sold but are now under consideration for renewable development and hopes to identify additional opportunities as it evaluates ROWs in the other districts. DWR has identified 20 parcels of excess lands for a cumulative total of more than 20,000 acres that may be available for renewable development. DWR staff has also identified 26 aqueduct siphons and 12 pumping stations located on state-owned land. While the aqueduct siphons and pumping stations are underground or consist of very small buildings with limited rooftop space, there are typically large parcels of land around them that are owned by the state. DWR staff has identified approximately 5,000 acres of surplus land surrounding the siphons and 3,900 acres of surplus land surrounding the pumping plants that need further review to determine if they may be potential candidates for renewable energy development. The siphons and pumping stations can be disaggregated into parcels greater than 200 acres and those less than 200 acres as shown in Tables 9. Staff identified 14 siphons and pumping stations are in parcels larger than 200 acres for a total of about 7,200 acres. There are 24 siphons and pumping stations with surplus land less than 200 acres for a total of about 1,800 acres. In addition, CSLC manages more than 88,200 acres of land that may be suitable for renewable energy development but will require further evaluation and screening. All of these properties will require an in-depth environmental evaluation to determine whether all or parts of these properties are suitable for renewable development. Energy Commission staff is compiling information on the presence of sensitive species from the California Natural Diversity Database for these properties where available to facilitate future evaluations.

Figure 6: Caltrans District 6 Interchanges



Source: California Energy Commission

For the most part, solar iridescence in California increases toward the south and east in the state. However, wind resource areas are more site-specific and include Solano County, northeast Alameda County, southeast Ventura County, northwest Los Angeles County, east Kern County, as well as scattered locations throughout San Bernardino, Riverside, San Diego, and Imperial counties. Also, wind is less expensive and may produce more electricity per megawatt installed if targeted in good wind resource locations. Therefore, staff assumed that wind would be developed on DWR and CSLC properties located in areas with annual averages of 12 miles per hour or greater wind speeds at 100 meters. Staff identified roughly 100 parcels of land that could support wind development and estimated 1,900 MW. More work is needed to assess the availability of distribution or transmission and the environmental characteristics and suitability. Further, more than ten siphons and pumping stations are located in good wind resource areas and could support approximately 120 MW of wind capacity.

Table 9 summarizes the potential amount of state-owned land that may be available for lease for wholesale renewable generation development and provides a rough estimate of the potential capacity that could be developed, based on the simplifying assumption that only PV is developed.

Table 9: State Land Leased for Wholesale Generation

Type of Property	Number of Parcels < 200 Acres	Total Acres	Number of Parcels > 200 Acres[46]	Total Acres	Estimated Potential*(MW)[47]
Caltrans highway intersections within load centers	200	2,000	0	0	220 – 400
Caltrans and DWR Excess Lands	10	520	10	19,640	2,240 – 4,030
DWR Aqueduct Siphon areas	24	1,810	14	7,170	1,000 – 1,800
CSLC managed lands	197	15,700	166	83,600	14,460 – 26,030
Total	**431**	**20,030**	**190**	**110,410**	**17,920 – 32,260**

* The megawatt ranges reflect staff's assumption that 1 megawatt of photovoltaics can be developed on 5 to 9 acres.

Source: California Energy Commission

The table includes staff's estimate of 2,000 acres of ROW potential, which will be replaced with Caltrans estimates as they become available. Larger parcels are often located in solar and wind resource areas but may be suitable for geothermal, biomass, small hydro or a combination of resources. For this analysis, however, staff made the simplifying assumption that the land would be used exclusively for solar.[48] Governor Brown's *Clean Energy Jobs Plan* calls for the development of 12,000 MW of new local generation by 2020. Staff assumes these local generation goals would consist of projects smaller than 20 MW, located on parcels of less than 200 acres. The Governor's *Clean Energy Jobs Plan* also calls for 8,000 MW of new utility-scale

46 Parcels of land that are adjacent to others have been aggregated in this column and are represented as one parcel.

47 Staff assumed 5 to 9 acres per MW for solar PV based on presentation from NREL's Ken Zweibel http://solar.gwu.edu/index_files/Resources_files/Solar%20Siting%20Challenges.pdf.

48 Staff did note that some of the lands may be in good geothermal locations, but did not include any estimates in the report. Please refer to Appendix C for a map of those properties and the geothermal resource potential.

generation capacity, which staff assumes would consist of projects greater than 20 MW located on parcels larger than 200 acres. The estimated renewable potential on state lands is approximately 13,260 to 23,870 MW assuming PV capacity and assuming a mix of DG and utility-scale PV. The vast majority of this potential is on parcels greater than 200 acres, with 107,910 acres reflecting parcels greater than 200 acres and 11,430 acres made up of parcels 200 acres and smaller. This suggests that most of the potential for renewable development on leased lands is for utility-scale projects. These estimates are for technical potential and staff believes this is much greater than what can actually be developed due to environmental permitting issues, technical feasibly, and resource supply. Also, staff assumes that actual development would be a mix of technologies, not exclusively PV.

Figure 7 overlays the mean annual wind speeds at 100 meters with DWR and Caltrans District 6 excess lands, DWR siphons and pumping plants, and CSLC-managed lands that are within five miles of either distribution or transmission lines and are not located in state or federal parks or conservation lands areas identified by the *Desert Renewable Energy Conservation Plan* (*DRECP*).[49] CSLC lands in eastern Imperial and Riverside counties and San Bernardino County are located in moderate to good wind resource areas. Figure 7 also shows that DWR siphons and pumping plants in north Los Angeles County, CSLC lands in southeast Kern County, and Caltrans District 6 excess lands are all located in areas of high wind resources, as are DWR excess lands and a pumping station located in Solano County. Appendix C contains additional maps of these properties with solar insolation and geothermal potential underlays.Mapping CSLC lands shows that the lands are incongruous and could potentially benefit from parcel aggregation that would provide greater opportunities for renewable development while minimizing environmental impacts. To that end, the CSLC, the Department of Interior /Bureau of Land Management, and the Renewable Energy Action Team[50] agencies have informally

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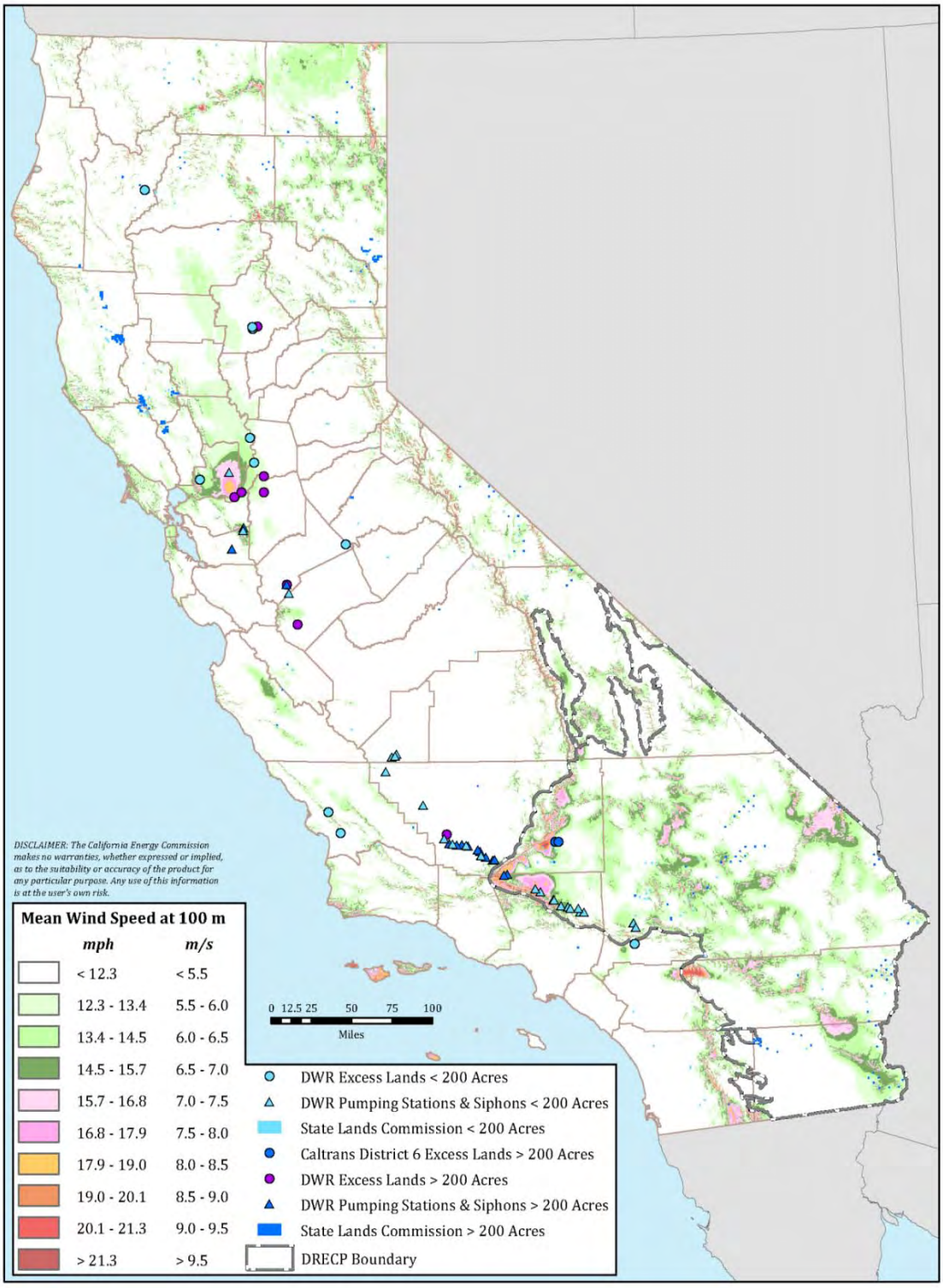
49 Governor Schwarzenegger's Executive Order S-14-08 directs state agencies to work with the federal agencies to prepare a DRECP for the Mojave and Colorado Deserts of California. The science-driven DRECP is intended to become the state road map for renewable energy project development that will advance state and federal conservation goals in these desert regions while also facilitating the timely permitting of renewable energy projects under the state and federal laws which protect these resources.

50 Executive Order S-14-08 that directed development of the DRECP also established a joint state-federal Renewable Energy Action Team ("REAT"), comprised of the Energy Commission, the Department of Fish and Game, the Bureau of Land Management, and the US Fish and Wildlife Service. Federal participation is supported by the Secretary of the Interior's Secretarial Order 3285 (March 2009) directing all Department of the Interior agencies and departments (which include the Bureau of Land Management and the United States Fish and Wildlife Service) to encourage the timely and responsible development of renewable energy, while protecting and enhancing the Nation's water, wildlife and other natural resources

Figure 7: State Property for Wholesale Generation With Wind Resource



Source: California Energy Commission

discussed land swaps as way to further promote renewable energy development, protect sensitive species, and enhance conservation areas. Department of Interior /Bureau of Land Management and CSLC have practiced land swaps in the past and there may be additional opportunities to do so going forward in the DRECP, particularly where CSLC lands are already located in or are surrounded by lands that are not suitable for energy resource development, such as National Parks, National Monuments, or other sensitive lands. The Renewable Energy Action Team agencies will continue to discuss these potential opportunities with the CSLC in the DRECP area

More recently, Assembly Member Skinner introduced AB 982, the Solar Energy Parks Act, on February 18, 2011, to promote concentrating solar energy project development while protecting the environment. The bill would require the following: the Energy Commission to work with the CSLC and other agencies to identify solar parks, capable of producing 10 GW worth of electric power; the Energy Commission to approve "lease applications" (sic) for projects in solar parks within 6 months; projects in the solar parks on state lands to have 10 year power purchase agreements to receive permits; and the Energy Commission to work with the CSLC to identify and negotiate land swaps with the Department of Interior."

Setting a Target for Renewables on State Properties

Staff proposes setting a goal for developing renewable on state properties that shows leadership and, at a minimum, is consistent with the state's 33 percent RPS goal. Thus, the state property goal should be at least equivalent to 33 percent of state buildings' total electricity usage. Excluding electricity consumption at CSU buildings, UC buildings, and DWR infrastructure, state buildings consumed 1,127 GWh in 2009[51]. Staff estimates that the amount of renewable energy generation needed in 2020 to serve 33 percent of state building load is roughly the same since zero or negative growth is expected over the time period.

Serving 33 percent of state building load with renewable energy by 2020 would require generating 372 GWh of renewable electricity on state property annually. This equates to over 200 MW of DG capacity.[52] As such, a minimum capacity target should equal 200 MW. However, since state government should set an example, and because opportunities exist to install renewable generation on state lands with no current building load, the target should be increased beyond 200 MW. Staff proposes increasing the state properties target by 2,300 MW, for a total goal of 2,500 MW.

51 Energy Commission staff calculation based on the ENERGY STAR *Portfolio Manager* database maintained by DGS in compliance with Executive Order S-20-04.

52 Energy Commission staff calculation assuming a 20 percent capacity factor for PV.

Staff's inventory supports this goal. Approximately 15.5 to 28 MW of PV could be developed on state buildings in load centers. Further, 68 to 122 MW of PV could be developed on state properties with the potential to produce excess energy for the wholesale distribution market. Additionally, 1.5 MWs of renewable energy may be feasible on remote buildings that have the potential for energy independence. The total estimated potential, excluding lands available for lease, is 85 MW to 151.5 MW. However, the state has a large amount of land available for lease that could potentially support the development of thousands of megawatts of renewable generation, between 13,260 MW to 23,870 MW (Table 9). Staff recommends that a modest amount of this potential, roughly 10 to 20 percent, be included in the target given the considerable uncertainty about what is feasible to develop. To better estimate the realistic potential for development on leased lands, further evaluation and screening of various environmental constraints are needed, as well as an analysis of access to transmission or distribution systems. In the future, staff recommends increasing the target if further evaluation supports such a change.

Opportunities to Meet State Property Target

Near-term (1-2 years) opportunities:

85 to 151.5 MW
This represents potential development on: state buildings in load centers, state property with potential for wholesale distribution market, and remote state buildings with potential for energy independence.

Medium to long-term opportunities:

13,260 to 23,870 MW
This represents potential development on land leased for wholesale generation.

Another consideration going forward is that the goal does not reflect DWR's replacement of its current procurement of coal-fired generation. In 2009, DWR imported 1,175 GWh from the Reid Gardner Coal-fired power plant.[53] The DWR contract ends in July, 2013 and DWR does not expect to purchase electricity from the facility after the contract expires. If the generation currently procured from Reid Gardner was replaced with renewable energy, DWR would need at least 500 MW of intermittent renewable capacity.[54]

To help meet the 2020 target, it is useful to set interim targets which can be used to both drive and monitor progress. Although there are near-term opportunities to develop rooftop installation of renewables on state buildings, most of the target will be met through development on land leased for wholesale generation which will likely include large-scale projects which require longer term planning and action. Because of this, staff proposes interim targets as follows: one-third by 2015 (833 megawatts); one-third by 2018 (1,666 megawatts, cumulative); and one-third by 2020 (2,500 megawatts, cumulative).

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53 *The California Department of Water Resources Report on Reducing the State Water Project's Dependency on Fossil Fuels and Changes to the state Water Project's Power Contracts Portfolio*. http://www.water.ca.gov/legislation/docs/March-1-2010-AnnualReport.pdf

54 Energy Commission staff calculation assuming a 32 percent capacity factor for wind.

To stay on target, some medium- to long-term opportunities will need to be realized in the first and second time periods.

To expedite development on state property leased for wholesale generation, staff recommends:

- Preliminary screening and environmental analysis to determine which state properties may be suitable and appropriate for renewable development, including analysis to determine the presence of threatened or endangered species and habitats.
- Coordination with the DGS, Caltrans, the CSLC, DWR, Department of Education, the judicial branch, and other state and federal agencies as necessary to collect data and evaluate appropriate sites for renewable development.
- Evaluation of electrical interconnections to transmission or distribution facilities.
- Coordination with the UC and USC systems to expand the inventory.

Developer Input

Representatives from the Governor's Office and Energy Commission, along with staff from the agencies that signed the MOU, met with renewable energy developers to learn how to improve the attractiveness of state properties for renewable projects. The developers provided the following feedback for state building development:

- It is important to match the system size to the energy building's energy load.
- Package multiple buildings into groups under one solicitation to benefit from economies of scale.
- Limit properties that are fully in use because it increases construction duration/developer costs (high-traffic parking lots).

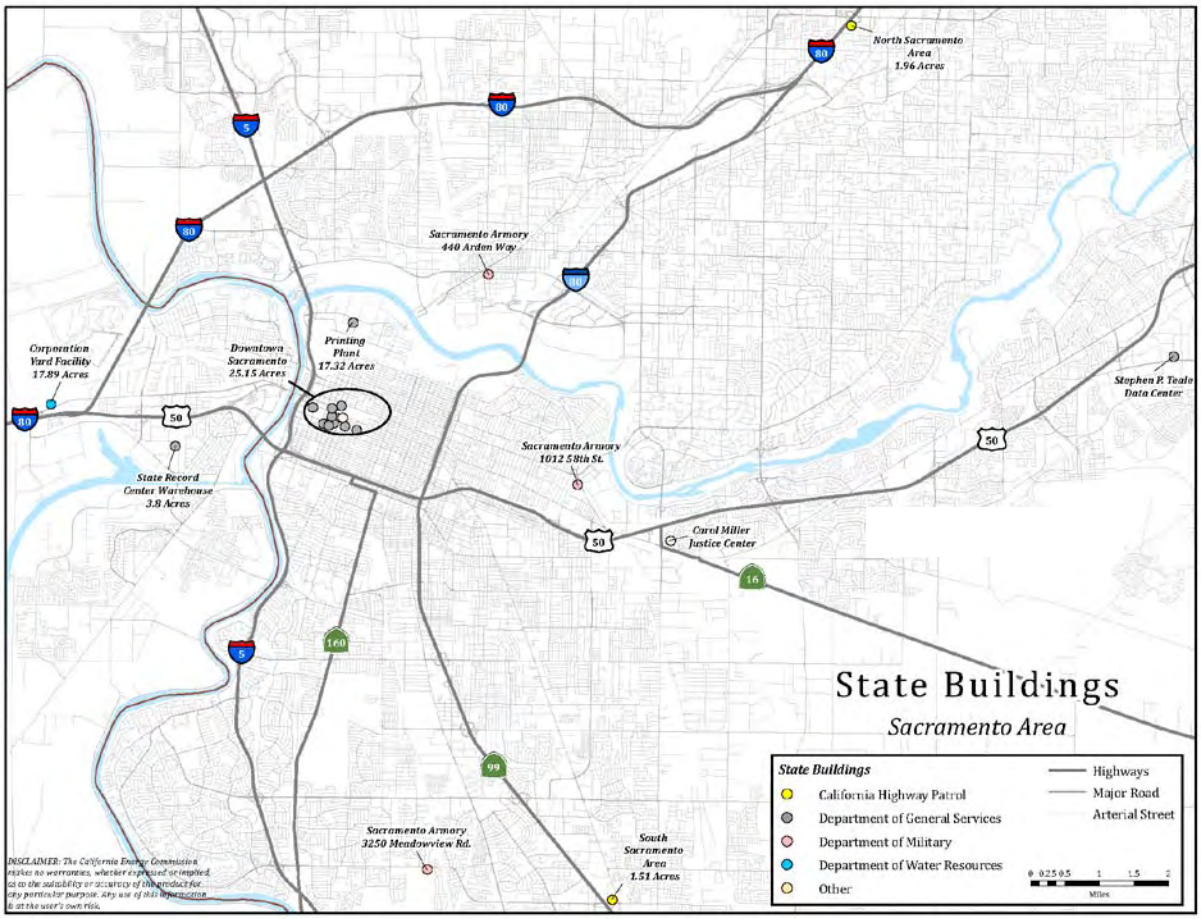
Figure 8 is a regional map of the Sacramento area and depicts the locations of the state buildings and ownership. Toward the left center of Figure 8 is a cluster of buildings in the downtown area. These buildings would be a good example of packaging of multiple buildings into one solicitation for developers to evaluate.

The following feedback was provided by developers regarding state-owned property ideal for renewable wholesale development:

- Include only parcels of land within 5 miles of a 115-kilovolt (kV) line or smaller (for larger land parcels, staff also considered interconnections up to 230-kV lines to account for potential 20 MW or larger projects that could be located on multiple state-owned properties adjacent to each other).
- Prefer larger brown fields (disturbed from previous use) to smaller highway ROWs, which are less electrically efficient due to property shape. That is to say square or rectangular shaped parcels allow more solar panels than other shapes. Also, depending on the orientation of the highway system (north/south or east/west running), ROW

projects could require more capacitors, increasing both the project cost and the likelihood of electricity losses.

Figure 8: Location and Ownership of State Buildings in Sacramento Area



Source: California Energy Commission Developers provided the following guidance for any project on state-owned property:

- Facilitate easements across all state agencies' properties. Coordinate a request for proposal process for all agencies.
- Include only state-owned properties rather than leased properties to increase the long-term project viability.
- Help streamline permitting to reduce transaction costs.

This input helped provide information for the method used to identify potential development property for the inventory and the identification of barriers and solutions. Staff anticipates seeking further input from developers and other interested parties by holding a public workshop in the second quarter of 2011 on how to achieve the 12,000 MW by 2020 goal.

CHAPTER 5:
Next Steps

- In the second quarter of 2011, the Energy Commission plans to hold a workshop to solicit public input on this paper and on broader efforts needed to meet the goal of 12,000 MW of localized renewable generation in California by 2020. The Energy Commission will also seek comments on the development of specific milestones and goals for developing localized renewable energy on state buildings and public lands.
- The Energy Commission will continue to develop an inventory of state buildings and properties without load on which localized renewables could be developed. Staff will continue to work with DGS, Caltrans, CSLC, and other agencies to collect data, populate the database, and assess the best sites for development. The intention is to provide a systematic evaluation of the opportunities to install renewables on state properties and to make that information readily available to developers. Staff will initially vet the database properties and ROW and release an updated version to coincide with the release of RFPs, as discussed below.
- The Energy Commission will encourage additional state agencies to join the MOU as well as the UC and CSU systems.
- By the end of 2011, the inventory should expand across all state agencies, including the university system. By the end of 2012, the inventory could be expanded on a voluntary basis to include local public facilities in California. Finally, by the end of 2013, the program could be expanded to include federal facilities in California and joint renewable procurement programs with other states.
- The Energy Commission will work with DGS to issue an RFP to develop renewable DG on state-owned buildings in the second quarter of 2011.
- Energy Commission will coordinate with Caltrans, DWR, and DGS to issue an RFP to develop renewable DG on state-owned excess lands and ROWs in the fourth quarter of 2011. To expedite development on state property leased for wholesale generation, staff recommends:
    - Preliminary screening and environmental analysis to determine which state properties may be suitable and appropriate for renewable development, including analysis to determine the presence of threatened or endangered species and habitats.
    - Coordination with the Department of General Services, the Department of Transportation, the California State Lands Commission, the Department of Water Resources, Department of Education, the judicial branch, and other state and federal agencies as necessary to collect data, and evaluate appropriate sites for renewable development.
    - Evaluation of electrical interconnections to transmission or distribution facilities.

- Coordination with the university and California State University systems to expand the inventory.

- By November 30, 2011, the Energy Commission will release a report that will expedite permitting of the highest priority renewable generation and transmission projects.
- The Energy Commission's PIER Program continues to provide solutions to expanding the use of distributed energy resources. In 2011, the Energy Commission will seek reauthorization and continued funding for PIER Program research.
- The PIER Program includes a Transmission Research Program Advisory Committee that meets to plan transmission related research needs. This group should focus on DG issues in the early part of 2011.

Glossary

AB	—	Assembly Bill
ARRA	—	American Recovery and Reinvestment Act of 2009
CAL FIRE	—	California Department of Forestry and Fire Protection
California ISO	—	California Independent System Operator
Caltrans	—	California Department of Transportation
CDCR	—	California Department of Corrections
CSLC	—	California State Lands Commission
CSU		California State University
CEQA	—	California Environmental Quality Act
CPUC	—	California Public Utilities Commission
CPV	—	concentrating photovoltaic
CREB	—	Clean Renewable Energy Bond
CSI	—	California Solar Initiative
DDS	—	Department of Developmental Services
DG	—	distributed generation
DGS	—	Department of General Services
DMH	—	Department of Mental Health
DRECP	—	Desert Renewable Energy Conservation Plan
DWR	—	Department of Water Resources
FERC	—	Federal Energy Regulatory Commission
FHWA	—	Federal Highway Administration
GWh	—	gigawatt hour
IOUs	—	investor-owned utilities
kWh	—	kilowatt hour
LGIP	—	large generator interconnection procedures
MOU	—	memorandum of understanding
MW	—	megawatts
NEPA	—	National Environmental Protection Act
OpenADR	—	Open Automated Demand Response
PG&E	—	Pacific Gas and Electric Company
PIER	—	Public Interest Energy Research
POU	—	publicly owned utility
PPA	—	power purchase agreement
PURPA	—	Public Utility Regulatory Policies Act of 1978
PV	—	photovoltaic
RFP	—	request for proposal
REC	—	renewable energy credit
ROW	—	rights-of-way
RPS	—	Renewables Portfolio Standard

SB	—	Senate Bill
SCE	—	Southern California Edison Company
SDG&E	—	San Diego Gas & Electric Company
SGIP	—	small generator interconnection procedures
SMUD	—	Sacramento Municipal Utility District
UC	—	University of California
WDAT	—	Wholesale Distribution Access Tariff

APPENDIX A:
Memorandum of Understanding, Renewable Energy Opportunities

The memorandum of understanding is an agreement among Caltrans, DGS, CDWR, CDCR, Department of Fish and Game, and the Energy Commission to work together to study, plan, and develop localized renewable electricity generation on state property. The group's initial objective is to coordinate consistent procurement strategies and contract language in requests for proposals and develop one or more statewide solicitations to facilitate development and implementation of localized renewable electricity generation on such properties. The MOU identifies the Energy Commission as the lead coordinating agency in the overall effort. The MOU is effective through June 30, 2014, and allows other agencies to join along the way. All agencies have signed the MOU, and it was approved at the December 15, 2010, Energy Commission Business Meeting.

MEMORANDUM OF UNDERSTANDING

RENEWABLE ENERGY OPPORTUNITIES

This Memorandum of Understanding (MOU) is entered into by and among the California Department of General Services (DGS), the California Department of Water Resources (DWR), the California Department of Transportation (CALTRANS), the California Department of Fish and Game (DFG), the California Department of Corrections and Rehabilitation (CDCR) and the California Energy Resources Conservation and Development Commission (ENERGY COMMISSION) (individually as "Agency" and collectively as "Agencies") with respect to the following:

RECITALS

WHEREAS, the State of California is a world leader in efforts to reduce global warming and greenhouse gas emissions, increase renewable energy production, promote energy efficiency, energy conservation, clean air and emission controls, expand the use of low carbon, alternative fuels and promote and commercialize new technologies and industries; and

WHEREAS, California's high standards and ambitious goals have resulted in California leading the nation in renewable energy innovation, receiving more investment funding in clean technology than anywhere else in the United States, and accounting for 44 percent of all U.S. patents in solar technologies and 37 percent of all U.S. patents in wind technologies; and

WHEREAS, producing electricity from renewable resources provides multiple and significant benefits to California's environment and economy, including improving local air quality and reducing global warming pollution, diversifying energy supply, improving energy security, enhancing economic development, and creating jobs; and

WHEREAS, California has some of the best renewable energy resource areas in the world, providing immense potential for clean, valuable electricity generation in the state, and the development of these resources must be accelerated; and

WHEREAS, substantially increased development of renewable electricity sources, energy efficiency and demand response is needed to meet the greenhouse gas reduction goal of 1990 levels by 2020 and 80 percent below 1990 emissions levels by 2050, making the success and expansion of renewables a key priority for California's economic and environmental future; and

WHEREAS, fostering greater and more timely renewable energy development means the Agencies should establish a more cohesive and integrated statewide strategy, including greater coordination and streamlining of the siting, permitting, and procurement processes for renewable generation, improving the manner in which the state develops its transmission infrastructure, and encouraging technically and economically feasible distributed renewable energy opportunities; and

WHEREAS, the Governor's Executive Order S-14-08 established a state policy goal adopted by the California Air Resources Board as the Renewable Electricity Standard, which requires Utilities to meet 33 percent of California's electrical needs with renewable energy sources, hereinafter referred to as "Energy Generating Infrastructure", including wind, solar, and geothermal by 2020; and

WHEREAS, the President and Congress have intensified the need for accelerated development of renewable energy projects in California with the passing of the American Recovery and Reinvestment Act of 2009 (ARRA); and

WHEREAS, due to continuing weak performance in the California economy and other factors, there is a multi-billion dollar General Fund deficit; and

WHEREAS, the State must find alternative ways to reduce expenditures and alternative means of additional revenue streams; and

WHEREAS, the Agencies desire to enter into this MOU voluntarily to: 1) Set forth their intent to further implement the Governor's Executive Order S-14-08 and the 33 percent Renewable Electricity Standard; 2) Cooperate in identifying potential locations for Energy Generation Infrastructure within the State-owned right of way or on State-owned facilities; 3) Establish expectations, roles and responsibilities of the Agencies regarding the development and implementation of Energy Generation Infrastructure.

NOW, THEREFORE, in consideration of the mutual benefits and representations made herein, the Agencies hereby agree as follows:

1. The ENERGY COMMISSION will be the lead coordinating agency in this effort. Each Agency will provide at least one representative to serve as a primary point of contact and to attend meetings.

2. Agencies will seek to meet at regular intervals, or as otherwise requested by the ENERGY COMMISSION.

3. Agencies mutually agree to perform, or cause to perform, all work related to the study, planning, development and implementation of Energy Generating Infrastructure in accordance with federal and state laws.

4. Agencies agree to develop procurement strategies to be utilized, including contractual language and arrangements in order to maintain consistency.

5. Agencies with authority to site Energy Generating Infrastructure on the property or right of ways they own or occupy may develop and issue guidelines regarding the design and placement of such Energy Generating Infrastructure on their property or right of ways to the extent authorized by statute and consistent with the Agency's mission and the Agencies' collective procurement strategies.

6. Agencies with authority to site Energy Generating Infrastructure on the property or right of ways they own or occupy shall coordinate with each other on the development of one or more statewide solicitations to facilitate the development and implementation of such Energy Generation Infrastructure on their property or right of ways.

7. Agencies mutually agree to share, to the extent permissible by law, all public information required to prepare and submit documents required for the study, planning, development and implementation of Energy Generating Infrastructure.

8. Each Agency will acknowledge the contributions of the other Agencies as appropriate in publications and press releases.

9. This MOU may be amended in writing in the same manner the MOU was entered.

10. This MOU in no way restricts the Agencies from participating in any activity with other public or private agencies, organizations, or individuals.

11. All commitments made in this MOU are subject to the availability of appropriated funds and each Agency's budget priorities. This MOU is neither a binding fiscal nor funds obligation document. Nothing in this MOU authorizes or is intended to obligate the Agencies to expend, exchange, or reimburse funds, services, or supplies, or transfer or receive anything of value, or to enter into any contract, interagency agreement, or other financial obligation. Any endeavor involving reimbursement or contribution of funds between the Agencies will be handled in accordance with applicable contracting requirements under separate agreements. All travel expenses by personnel from each Agency shall be the sole responsibility of the Agency.

12. Each of the persons signing below on behalf of an Agency represents and warrants that they are authorized to sign this MOU on behalf of such Agency.

13. This MOU shall take effect on the date that it has been executed by all the Agencies and shall continue in effect until June 30, 2014, unless terminated earlier or extended by agreement of all Agencies by amendment to the MOU.

14. If during the term of this MOU, any new agency desired to participate will be included by adding a new signatory in signature page without further amendment.

CALIFORNIA DEPARTMENT OF TRANSPORTATION

FOR CINDY McKIM

Director of Transportation

By: _____

Date: 12/6/10

MALCOLM DOUGHERTY, Chief Deputy Director

CALIFORNIA ENERGY RESOURCES CONSERVATION AND DEVELOPMENT COMMISSION

MELISSA JONES

Director of Energy Resources Conservation & Development Commission

By: _____

Date: 12/15/10

CALIFORNIA DEPARTMENT OF GENERAL SERVICES

RON DIEDRICH (Acting)

Director of General Services

By: _____

Date: _____

CALIFORNIA DEPARTMENT OF WATER RESOURCES

MARK COWIN

Director of Water Resources

By: _____

Date: 12/4/10

CALIFORNIA DEPARTMENT OF CORRECTIONS AND REHABILITATION

MATTHEW CATE

Secretary of Corrections & Rehabilitation

By: _____

Date: _____

CALIFORNIA DEPARTMENT OF FISH AND GAME

JOHN McCAMMAN

Director of Fish & Game

By: _____

Date: _____

CALIFORNIA DEPARTMENT OF TRANSPORTATION

CINDY McKIM

Director of Transportation

By: _____

Date: _____

CALIFORNIA ENERGY RESOURCES CONSERVATION AND DEVELOPMENT COMMISSION

MELISSA JONES

Director of Energy Resources Conservation & Development Commission

By: _____

Date: _____

CALIFORNIA DEPARTMENT OF GENERAL SERVICES

RON DIEDRICH (Acting)

Director of General Services

By: _____

Date: _____

CALIFORNIA DEPARTMENT OF WATER RESOURCES

MARK COWIN

Director of Water Resources

By: _____

Date: _____

CALIFORNIA DEPARTMENT OF CORRECTIONS AND REHABILITATION

MATTHEW L. CATE

Secretary

By: Matthew L. Cate

Date: 12/6/10

CALIFORNIA DEPARTMENT OF FISH AND GAME

JOHN McCAMMAN

Director of Fish & Game

By: _____

Date: _____

CALIFORNIA DEPARTMENT OF TRANSPORTATION

CINDY McKIM

Director of Transportation

By: _____

Date: _____

CALIFORNIA ENERGY RESOURCES CONSERVATION AND DEVELOPMENT COMMISSION

MELISSA JONES

Director of Energy Resources Conservation & Development Commission

By: _____

Date: _____

CALIFORNIA DEPARTMENT OF GENERAL SERVICES

RON DIEDRICH (Acting)

Director of General Services

By: _____

Date: _____

CALIFORNIA DEPARTMENT OF WATER RESOURCES

MARK COWIN

Director of Water Resources

By: _____

Date: _____

CALIFORNIA DEPARTMENT OF CORRECTIONS AND REHABILITATION

MATTHEW L. CATE

Secretary

By: _____

Date: _____

CALIFORNIA DEPARTMENT OF FISH AND GAME

JOHN McCAMMAN

Director of Fish & Game

By: _____

Date: 12/8/10

CALIFORNIA DEPARTMENT OF TRANSPORTATION

CINDY McKIM

Director of Transportation

By: _____

Date: _____

CALIFORNIA ENERGY RESOURCES CONSERVATION AND DEVELOPMENT COMMISSION

MELISSA JONES

Director of Energy Resources Conservation & Development Commission

By: _____

Date: _____

CALIFORNIA DEPARTMENT OF GENERAL SERVICES

RON DIEDRICH (Acting)

Director of General Services

By: _____

Date: 12-14-2010

CALIFORNIA DEPARTMENT OF WATER RESOURCES

MARK COWIN

Director of Water Resources

By: _____

Date: _____

CALIFORNIA DEPARTMENT OF CORRECTIONS AND REHABILITATION

MATTHEW L. CATE

Secretary

By: _____

Date: _____

CALIFORNIA DEPARTMENT OF FISH AND GAME

JOHN McCAMMAN

Director of Fish & Game

By: _____

Date: _____

CALIFORNIA STATE LANDS
COMMISSION

CURTIS FOSSUM

Executive Officer

By: _____

Date: MARCH 10, 2011

UNIVERSITY OF CALIFORNIA

BERKELEY • DAVIS • IRVINE • LOS ANGELES • MERCED • RIVERSIDE • SAN DIEGO • SAN FRANCISCO

SANTA BARBARA • SANTA CRUZ

EXECUTIVE VICE PRESIDENT—
BUSINESS OPERATIONS

OFFICE OF THE PRESIDENT
1111 Franklin Street, 12th Floor
Oakland, California 94607-5200
510/987-9029

April 20, 2011

Melissa Jones
Executive Director
California Energy Commission
1516 Ninth Street MS-39
Sacramento, CA 95814

Dear Ms. Jones:

On behalf of the University of California (UC), I am pleased to be a signatory to the Memorandum of Understanding (MOU) with the State of California and a variety of State agencies on Renewable Energy Opportunities.

This MOU will advance the interests of all Californians by creating a framework whereby the University and various agencies within State government can work together to develop sustainable and renewable energy alternatives. It not only will ensure that best practices are shared among the various participants, but that opportunities for collaboration are fully explored and carried out.

As we have discussed with your office, we are signing the MOU with the understanding that the University:

- Not be precluded from entering into contracts that may be different than those entered into by State agencies, and
- Not be bound to a particular form or template with regard to such contracts.

We appreciate the value that comes from working together, but also believe that it is important to recognize that each party to the MOU may have different needs when it comes to contracting for energy services. We have appointed Associate Director Dirk van Ulden to be UC's official representative. We look forward to working with you and the other members of the Working Group on this very important public policy issue.

Sincerely,

Nathan Brostrom
Executive Vice President

Attachment

cc: Senior Vice President Dooley
Vice President Lenz
Vice Chancellor Brase
Associate Vice President Juarez
Associate Vice President Obley
Director Getgen
Associate Director van Ulden

UNIVERSITY OF CALIFORNIA

NATHAN BROSTROM
Executive Vice President for Business Operations

By: Nathan Brostrom
Date: 4/20/2011

APPENDIX B:
Renewable Distributed Generation Research Under the Public Interest Energy Research Program

The Public Interest Energy Research (PIER) Program has made significant contributions to advance science and technology in energy research that will help meet California's Clean Energy Future and Governort Brown's *Clean Energy Jobs Plan*. Below is a discussion of PIER projects that will assist in the deployment of DG on state properties.

Solar

Tracking the Sun for High Value Grid Electricity

The research project with Powerlight Corporation (now SunPower) addressed design improvements for an existing single-axis solar tracker that included standardizing parts and reducing the number of required parts. The modified tracker design resulted in increased reliability, lower capital costs, and less required installation and maintenance time compared to previous designs of tracker systems. Depending on site conditions, the tracker can result in 15 to 35 percent more energy production compared with a stationary array using an equivalent number of solar panels. The new design is sold commercially in California.

Next Generation Solar Collectors

This PIER-funded project– in conjunction with the research team at the University of California, Merced, and corporate participants SolFocus and United Technologies Research Center – developed an innovative nontracking system consisting of a series of stationary evacuated solar thermal absorbers paired with external nonimaging reflectors. These stationary reflectors can generate at least 90 percent of the heat of reflectors that do track the sun. Called an external compound parabolic concentrator, this system is able to operate with a solar thermal efficiency of 50 percent at a temperature of 400 °F. The external compound parabolic concentrator can be readily manufactured at a cost of about $15 to $18 per square foot.

Slat-Array Concentrator Development

This project with the SMUD and SVV Techonology Innovations, Inc., promises a unique opportunity to naturally combine the robustness and high efficiency of the reflective optics and design conveniences of the Fresnel lens technology in a single and inexpensive concentrating photovoltaic (CPV) device based on a novel slat-type concentrator concept. The technical performance demonstrated by the slat-array concentrators in this project shows that this technology offers technical advantages in the collection and use of solar energy. The 500 watt prototype module demonstrated the ability of the slat-array concentrator concept to produce highly uniform concentrated fluxes while maintaining high concentration with design and manufacturing simplicity. The 500 watt CPV prototype demonstrates the potential for future commercial systems producing localized renewable electricity generation.

Other Concentrating Photovoltaic

CPV is an emerging technology that appears to be the least expensive and most efficient of all photovoltaic technologies due to substituting a large fraction of expensive flat-plate PV panels with less expensive concentrators supplied by tracking systems. PIER funded research projects that exploit the advantages of CPVs and achieve relatively high concentration ratios. A project with GreenVolts, Inc., is demonstrating the self-ballasting Green Volts' concentrated PV system (PVC), which requires no such concrete or permanent foundations in a 2 MW system while a small grant project with United Innovations, Inc., will produce an operating-scale version of a photovoltaic cavity converter-based concentrating solar-energy system. An upcoming project will demonstrate a concentrating solar power-dish/engine technology on a 1-MW scale at a wastewater treatment plant specifically to offset the plant's electrical usage and costs during peak demand periods. The proposed solar array would occupy about five acres of land and consist of 330 individual CSP dish units. The technology is estimated to reduce energy demand from wastewater facilities by 20 to 35 percent.

Solar Forecasting

UC Merced RESCO Solar Forecasting and Monitoring

In support of UC Merced's Renewable Energy Secure Community Vision, one of the project tasks is to confirm UC Merced's solar generation capability and reliability**.** For this task, accurate solar instrumentation and actual performance data from the campus's 1 MW solar photovoltaic array (to be added under this project) will be used to estimate the quantity and reliability of solar generation capability by season and time of use. Specifically, several measurements of solar irradiance will be collected at UC Merced, and a model will be created that predicts the solar resource at UC Merced based on three years of measured solar irradiance and publicly-available weather variables. This model will be useful for electricity scheduling on the UC Merced campus, and the results and method can be copied in many communities throughout the state to better increase accuracy of solar forecasting.

High Solar PV Penetration Modeling

PIER is cofunding this project with the U.S. Department of Energy under the ARRA program. The project, which is a research collaboration anong UC San Diego , Electrical Design System & Analysis Micro Corporation, and SDG&E, commenced in December 2010 with a goal of modeling the integration of a diverse set of DG, storage, and demand response. The project focuses on forecasting and modeling of the PV penetration. This project will develop advanced modeling tools and electric power control strategies to optimize electric power value and remove or reduce the effect of PV-sourced electricity on existing microgrids and the smart grid. Factors to be modeled and evaluated include monitoring of micro-climate effects and sky imaging systems to enable 1-hour-ahead PV-sourced electric power output forecasting along with a utility's dynamic price signals. The project will also use advanced technology to track cloud cover to better predict solar insolation and to provide better forecasting of rooftop PV.

Wind

California Regional Wind Energy Forecasting System

As wind is an intermittent generation resource and weather changes can cause large and rapid changes in output, system operators will need accurate and robust wind energy forecasting systems in the future. PIER and Electric Power Research Institute initiated the California Regional Wind Energy Forecasting System Development Project in 2003 to develop and test short-and intermediate-term (for example, next-hour and next-day) forecast algorithms with improved forecast accuracy relative to the results of a previous project completed in 2002. Forecasting error reduction targets for these models include a 10 percent reduction relative to the prior study and a bias reduced to less than 0.3 percent. The short-term forecast algorithm used an artificial neural network algorithm trained using five-minute time series data for wind energy deliveries to the grid in each of the five wind resource regions, provided by the California ISO. Testing showed the artificial neural network forecast algorithm reduces forecast error vs. persistence. On the other, development of the intermediate-term forecast algorithm assessed the impacts of several algorithm changes on forecast performance relative to the results of the first California forecasting project completed in 2002. Of the five changes tested, using improved water surface temperature data, segmented wind plant power curves, more sophisticated model operating statistics , and ensemble forecasting gave the greatest improvement. The project also developed the California Wind Generation Research Dataset provides one year of wind speed, direction, power density, and other parameters at multiple elevations over two 5-km grids, one in Northern California and one in Southern California. The database was generated using numerical weather data and a meso-scale weather model for the period July 1, 2004, through June 30, 2005.

Strategic Value Analysis – Economics of Wind Energy in California

This project analyzed economic potential for wind energy generation technologies in California. The analysis considered the technical potential and economic viability of wind turbines in a range of sizes, including small-scale (<100 kilowatts [kW]). Barriers to small-scale wind deployment include:

- Intermittency, reducing overall value of wind-generated electricity on the grid and making scheduling, regulation, and control difficult.
- Heavy imbalance and uninstructed costs levied against wind operators, making the whole system non-cost competitive.
- High capital costs, as compared with base load systems.

PIER is positioned to support projects that aim to address some of the above issues by increasing wind forecasting accuracy, increasing turbine efficiency, and decreasing system cost.

Small Hydro

Statewide Small Hydropower Resource Assessment

This study looked at the potential for development of hydroelectric generation in man-made conduits across the state. For this study, "man-made conduits" included pipelines, aqueducts, irrigation ditches, and canals. The study concluded that approximately 255 MW of small hydropower potential in man-made conduits could be developed with current technologies. While significant potential exists, there are several major barriers to development of small hydropower, including:

- Relatively high capital costs.
- Often remote resource locations, necessitating lengthy transmission or distribution lines to be constructed to interconnect to the grid.
- Excess generation must be sold into the wholesale bulk power market.

PIER is well positioned to support development of the state's small hydropower opportunities through continued research and development of new technologies and applications. In addition to encouraging development of packaged units and low head technologies, accelerate development of California's small hydropower potential in municipal and water irrigation systems. Staff is uncertain as to the opportunities for projects on state property. DWR does have existing conduit hydro facilities within its aqueducts.

Biomass

Production and Conditioning of High-Sulfur Biogas for Fuel Cell Combined Heat and Power Generation

This project is to demonstrate onsite processing and digestion of onion peel waste products to biogas generated power and heat at Gills Onions, which is located in Oxnard, California. The primary technical challenge of this project is to clean and condition the high-sulfur content biogas using technology developed by the Gas Technology Institute, so that it is suitable for high efficiency fuel cell power plants. The process works by digesting the onion waste in a 145,000-gallon anaerobic digester to produce biogas which is cleaned, conditioned, and fed into a reformer that strips hydrogen out of the biogas. The hydrogen in turn is fed into two molten carbonate fuel cells that each generate 300 kW of power. In 2009, the project was awarded the Governor's Environmental and Economic Leadership Award, California's most prestigious environmental honor. The Energy Commission also received an award from the Clean Energy States Alliance in October 2010 for its participation with the project.

Anaerobic Phased Solids Digester

The PIER Program supported the development and demonstration of the anaerobic phased solids digester, a high-rate bioconversion technology developed at the University of California, Davis (UC Davis). The APS system can process a wide variety of organic materials including food processing waste, agricultural crop residues, animal waste, and municipal green and food waste streams and convert 60 to 90 percent of the organic solids to biogas. A pilot anaerobic

phased solids digester system, located in UC Davis wastewater treatment plant, has a total reactor volume of 14,000 gallon. The primary function of this pilot system was the evaluation of a variety of commercially available equipment and components. The demonstration project also validated the economic and technical viability of large-scale commercial anaerobic phased solids digester systems. This technology would be well-suited for facilities like prisons and hospitals that have large volumes of food scraps and wastewater.

Valley Fig Growers Anaerobic Digester

The research conducted by Valley Fig Growers demonstrates the use of an anaerobic digester to convert food processing waste and wastewater into biogas for electricity and heat. The project designed and constructed a digester to pretreat wastewater prior to disposal in the municipal sewer system. The biogas produced by anaerobic digestion of the fig wastes is collected and used to fuel a microturbine equipped with a heat exchanger. The electricity produced by the generator is used at the Valley Fig Growers facility to offset a portion of its electricity purchases. Additionally, the waste heat from the digester is used to heat the digester influent and to heat water used for cleaning the figs. This technology would be well-suited for facilities like prisons and hospitals that have large volumes of food scraps and wastewater.

Multiple Renewable Energy Conversion Technology

To continue working toward the state's energy goals, the PIER Program shifted its focus from individual technologies to accelerating the deployment of multiple renewable energy conversion technologies. A primary initiative is the Renewable-based Energy Secure Communities (RESCO), which will help deploy synergistic demonstration projects in California that provide innovative integration solutions and capabilities for a portfolio of local renewable energy and efficiency measures.

UC Davis West Village Zero Net Energy Community

The West Village RESCO located at UC Davis will provide 3,000 residents with affordable, reliable, and secure energy. A goal of the West Village project is to be a zero net energy community. This means the West Village will satisfy its annual electricity and gas demand by using onsite renewable resources. It will be a model for future communities and help accelerate the adoption and use of scalable renewable energy systems in California.

Renewable Energy Secure Sonoma County

This project will demonstrate a model for the integration of mature renewable resources and conversion technologies coupled with energy efficiency measures and demand response. This model will prepare Sonoma County for constructing a locally owned, cost-effective renewable energy portfolio. The county will develop tools and methods to design a low-carbon portfolio, develop implementation strategies, and implement a pilot project that will demonstrate:

- A geothermal heat pump system using treated wastewater to reduce heating and cooling costs.

- A solar photovoltaic system with a peak output of 500 kW and a 10 kW wind turbine to power both a wastewater treatment plant and electrical vehicle charging stations.
- An anaerobic digester using manure from surrounding dairies to produce biogas that will power a 10 kW output fuel cell.

Smart Grid Research, Development, and Demonstration

Smart Grid is well-positioned to help improve the quality of life in California by bringing environmentally sound, safe, reliable, and affordable energy services and products to the California marketplace. The PIER Program's smart grid research has positioned California to take advantage of the ARRA funds to maintain California's leadership position in smart grid implementation. The smart grid that California is deploying will provide more options to manage and control renewable generation resources connected at the distribution level. It will also enable the use of demand response measures and electric energy storage to help address operational impacts of increased integration of renewables by balancing load and generation.

To fully realize the benefits of a smart grid, the PIER Program has provided funding to three organizations to develop a comprehensive plan that will guide the development and implementation of the smart grid. The Electric Power Research Institute is developing a road map from the IOU perspective. R.W. Beck, Inc., will focus their efforts on the smart grid from the perspective of the publicly owned utilities. Jet Propulsion Laboratory is concentrating on the technology manufacturer and vendor perspective. The three projects will help establish a vision of the 2020 Smart Grid and provide California with a complete and comprehensive road map and implementation plan.

Automated Demand Response

The Demand Response Research Center has developed technology to automate demand response as well as methods to automate end-use control systems in existing buildings. The automation is known as Open Automated DR Communications. OpenADR is an open data model that links price, reliability, and event signaling to customer energy control systems and devices. OpenADR provides capability, costs, and values that bridge multiple CPUC proceedings in demand response, dynamic pricing, demand response-energy efficiency integration, and smart grid.

OpenADR also provides a secure, reliable notification capability to support dynamic pricing that can't be provided by conventional phone and e-mail (PG&E Rate Window Testimony, August 21, 2009, Chapter 6). Linkage of price and event signals with facility energy management systems provides the automation necessary to create the smart grid. OpenADR is an open, nonproprietary, standards-based platform to support the delivery of price, reliability, and demand response event signals. OpenADR is neutral to and can support almost all communication methods. OpenADR is also neutral to customer energy management systems and control hardware. Demand Response Research Center testing and implementation has clearly demonstrated that low-cost options are available that provide OpenADR with capability to address multiple vendors and existing legacy as well as new state-of-the art options for all

customer segments. Each of the California IOUs has already acquired and operate its own OpenADR demand response automation servers.

Demand Response Spinning Reserve Demonstration

Spinning reserve is an electricity grid operator's first strategy for maintaining system reliability following a major contingency, such as the unplanned loss of a large generation facility or critical transmission line. Spinning reserve is traditionally provided by generation resources that are standing by – "spinning" – ready to connect to the grid in case of an emergency.

Five years of PIER-sponsored research has demonstrated that it is technologically feasible to provide spinning reserve using demand response, and that relying on demand response may be preferable because it can be targeted geographically and its performance is superior to generation resources. As a result, the research has now successfully transitioned from a demonstration project to precommercialization activity that is largely funded by the IOUs. In addition, the research has provided a technical basis for the development of new market products by the California ISO to take advantage of the unique characteristics of demand response in providing this critical reliability function.

Real-Time Dynamics Monitoring System

A prototype Real Time Dynamic Measurement System was installed at the California ISO in Folsom, California, and monitored by its engineering group with active feedback to Electric Power Group under a continuous improvement program. In 2009, the California ISO, acknowledging the value of the system, decided to bring the system into its mainstream operation and to place it under Information Technology support, essentially establishing it as a production tool. The Real Time Dynamic Measurement System, like other synchrophasor-based tools, enables enhanced situational awareness of impending contingencies, increased transfer capacity, and improved reliability of the grid.

PG&E Sodium Sulfur Energy Storage Demonstration

Energy storage technologies have the potential to increase the reliability and dispatchability of California's energy supply. California's future "smart grid" will need energy storage to integrate intermittent renewables, provide ancillary services, manage peak demand, and relieve transmission and distribution congestion. Building a portfolio of energy storage options addresses these system challenges and balances the development of newer, distributed storage technologies (batteries, flywheels) with the development of well-established technologies such as pumped storage and compressed air energy storage.

This project is the first utility-scale demonstration of a sodium-sulfur battery energy storage system in California. The sodium-sulfur BESS is one of the most advanced battery storage technologies on the market, with both fast discharge and slow energy release capabilities, a high efficiency of about 80 percent, and a long life span of 15 years. This specific installation will be a 4-MW system with a 28-MWh storage capacity. Once installed and operating, this system will be the largest battery storage system in California and will provide critical data on the use of large-scale battery energy storage technologies to meet California's future renewable energy needs.

Strategic Analysis of Energy Storage Technology Project

This project will develop a strategic analysis of energy storage technology and will a 2020 Energy Storage Vision for California working interactively with utilities, the energy storage industry, and other stakeholders. It will:

- identify and define the necessary research on the energy storage technologies and applications for achieving greater penetration of intermittent generation from renewable energy resources,
- reduce the need for new fossil-fuel powered peaking generation facilities,
- eliminate or reduce transmission and distribution losses, including increased losses during periods of congestion on the grid,
- reduce the demand for electricity during peak periods, and
- use energy storage systems to provide the ancillary services otherwise provided by fossil-fueled generating facilities.

San Diego Gas & Electric Microgrid Project

PIER microgrid research is demonstrating how a microgrid can use multiple advanced and innovative technologies to support the integration and management of utility and customer based energy resources in an interconnected network. Multiple customers interconnect and receive their power from a local portfolio of utility and nonutility interconnected resources. This network relies on a mix of high-efficiency and renewable distributed generation, storage, as well as energy reduction programs and strategies to meet most of the demand of customers on the network. Distribution automation and other smart grid technologies are being used to address operational and stability issues. The research also evaluates everyday operations of the network to assure it can consistently provide reliable and stable power to all customers. Attention is focused on understanding how to optimize system performance in both peak and nonpeak periods.

APPENDIX C:
Maps of Opportunities for DG Development

The figures in Appendix C provide more background than the figures located within the body of the report. Energy Commission staff has all the data behind each point of these figures. The figures are only for illustration and the Energy Commission does not guarantee geographic or resource precision.

Figure C-1 maps annual solar resource with DWR and Caltrans District 6 excess lands, DWR siphons and pumping plants, and CSLC-managed lands that are within five miles of distribution and some transmission lines and are not located in state or federal parks, not located in Desert Renewable Energy Conservation Plan (DRECP) conservation zones. Many CSLC lands and DWR siphons and pumping plants in Southern California are located in great insolation regions. Also, there are a number of CSLC lands in northwest and northeast California that are located in good solar insolation regions.

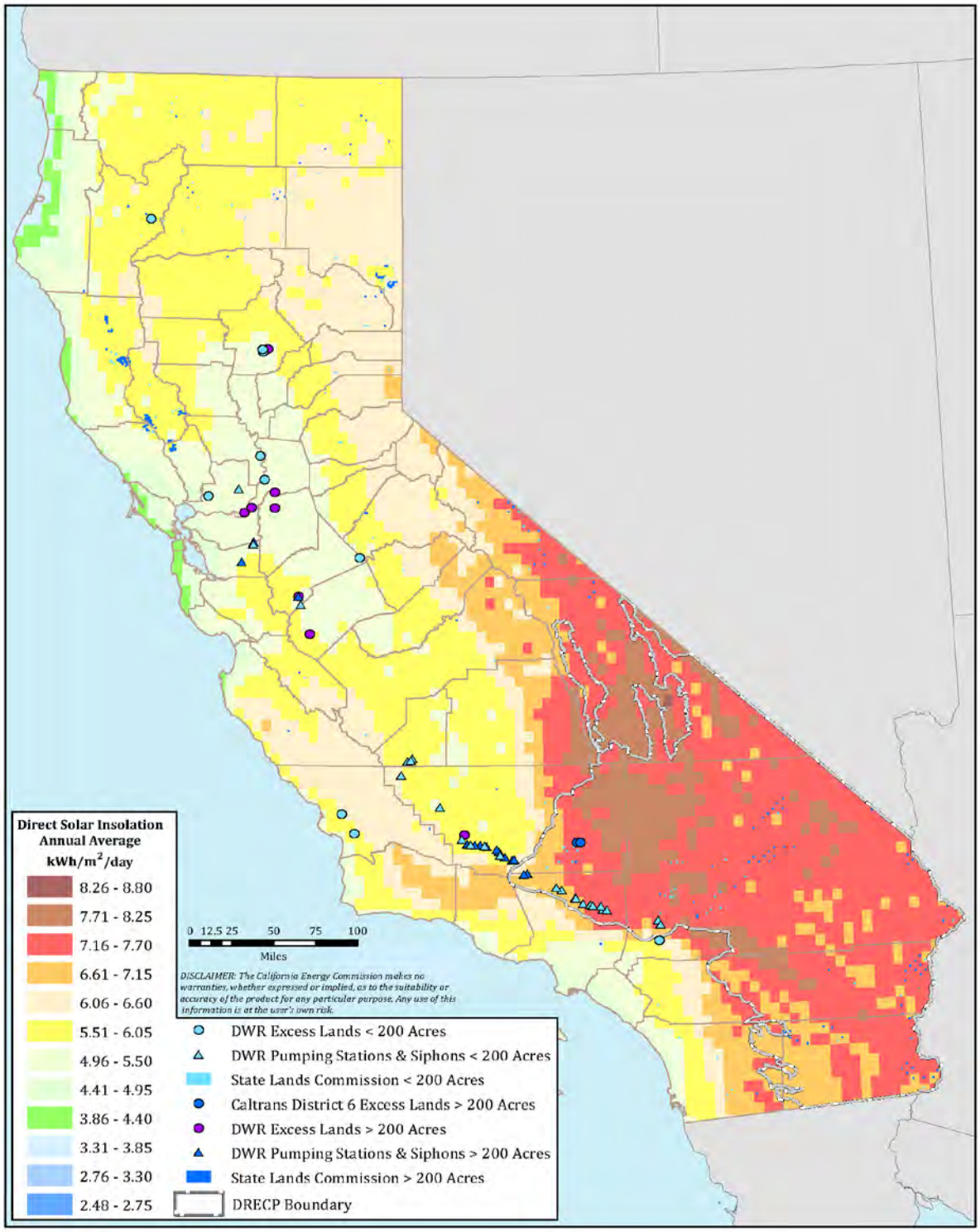
Figure C-2 shows geothermal potential with DWR and Caltrans District 6 excess lands, DWR siphons and pumping plants, and CSLC-managed lands that are within five miles of distribution and some transmission lines. There are three CSLC land parcels in Imperial County that may have potential to use the geothermal energy located within their proximity. Also, there is a large cluster of CSLC land parcels located in Lake County and a parcel on the southeastern tip of Lassen County that have the potential to use the geothermal resource located underneath the land.

Figure C-3 illustrates the mean annual wind speed at 100 meters along with state buildings within load. State buildings may not be ideal candidates for wind projects because many do not have enough land area to support a wind project. However, the high-load buildings in remote locations tend to have much more land area and may be suitable for wind development.

Figure C-4 illustrates the mean annual wind speed at 100 meters along with state buildings with high loads and surplus lands. These properties would tend to be better candidates for wind development because of surplus land that could support the large turbines. Buildings located in Solano, Napa, Monterey, San Luis Obispo, Kern, and Riverside counties are located in good to excellent wind resource areas.

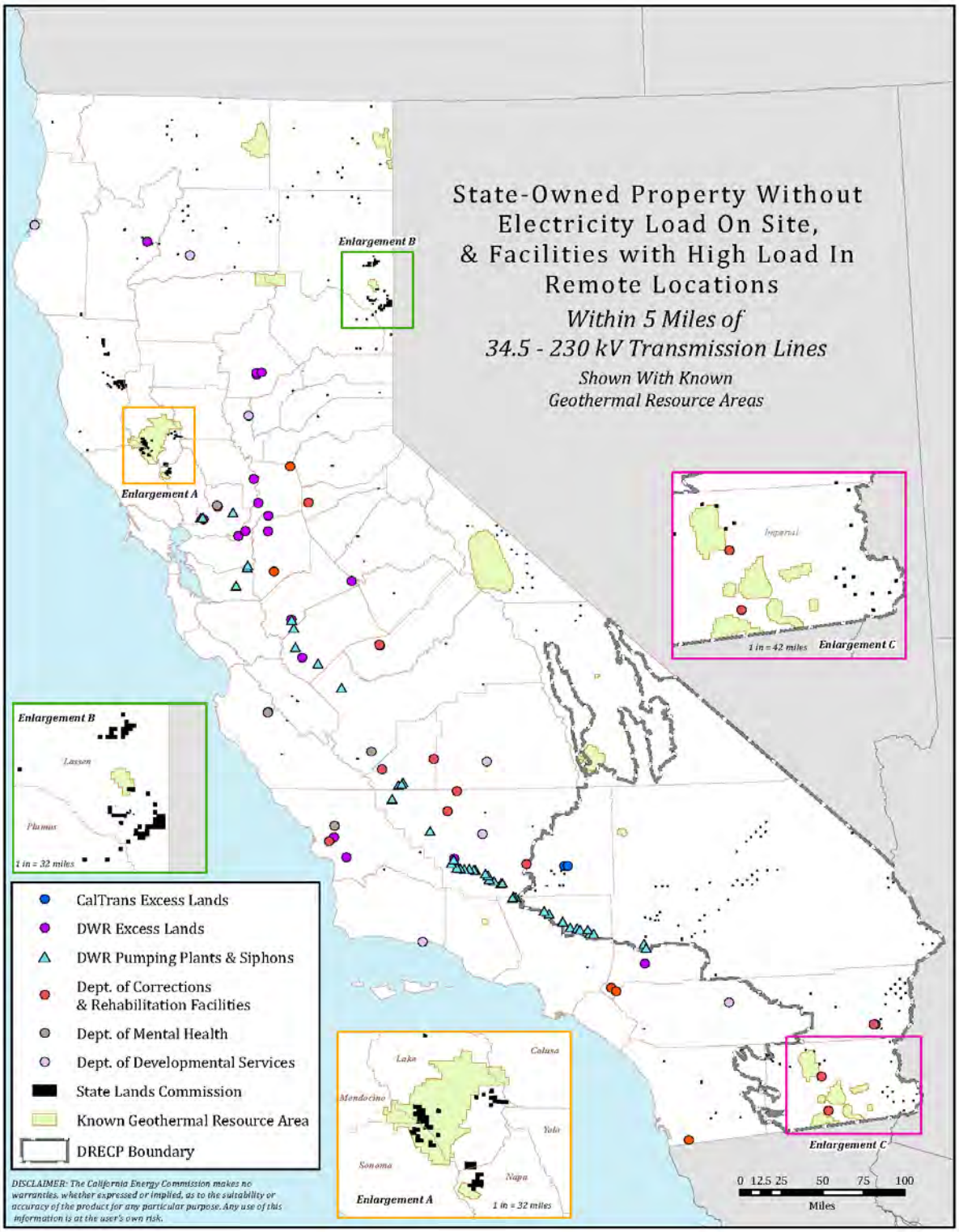
Figure C-5 displays CAL FIRE buildings with a solar insolation underlay. All of the CAL FIRE buildings are located in good solar resource areas in the Sierra Nevada. Many of these buildings will have tree shading issues; however, buildings in open space would be excellent candidates for PV with backup storage.

Figure C-1: State Property for Wholesale Generation With Solar Insolation



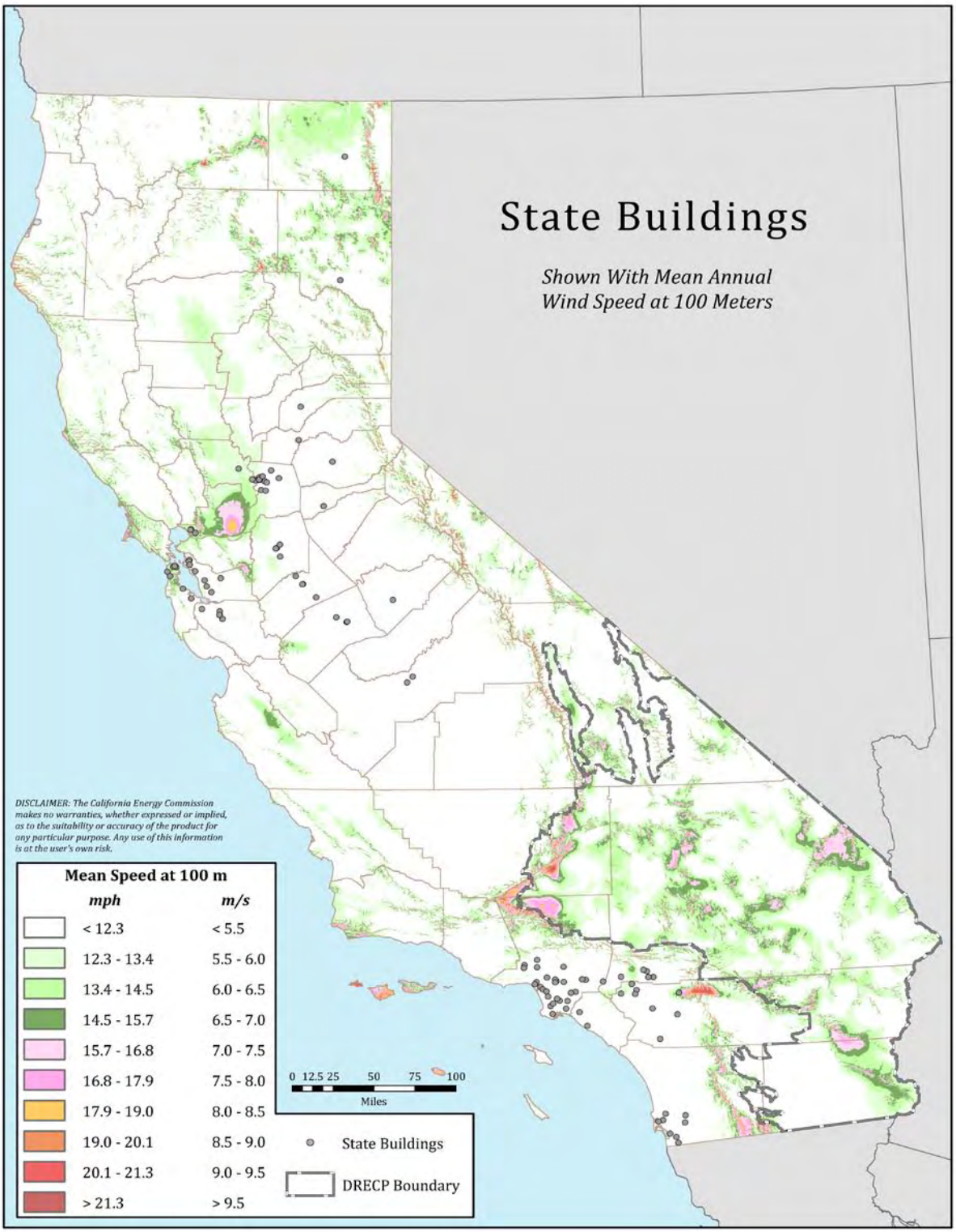
Source: California Energy Commission

Figure C-2: State Property for Wholesale Generation With Geothermal Resource



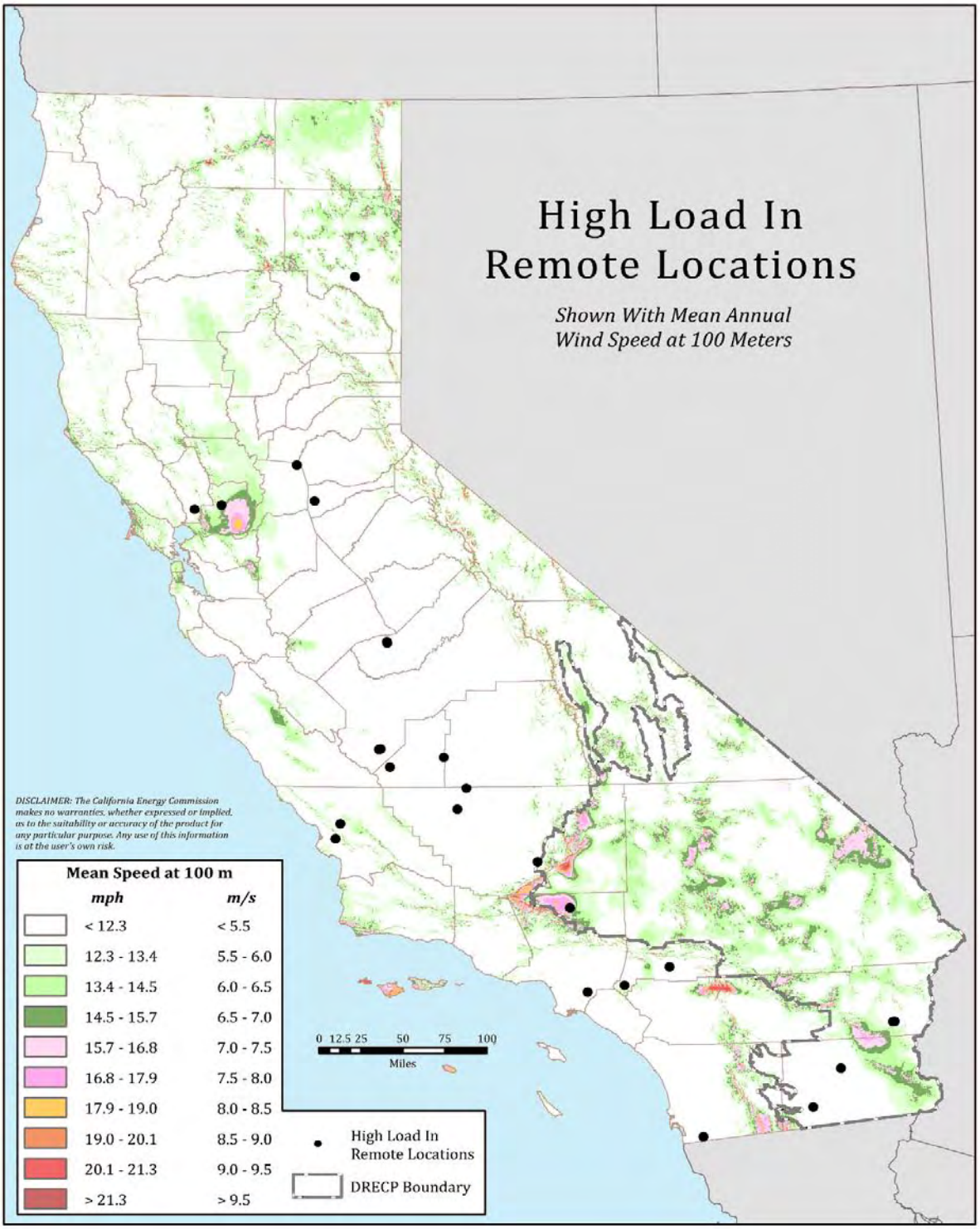
Source: California Energy Commission

Figure C-3: State Buildings in Load Centers With Wind Resource



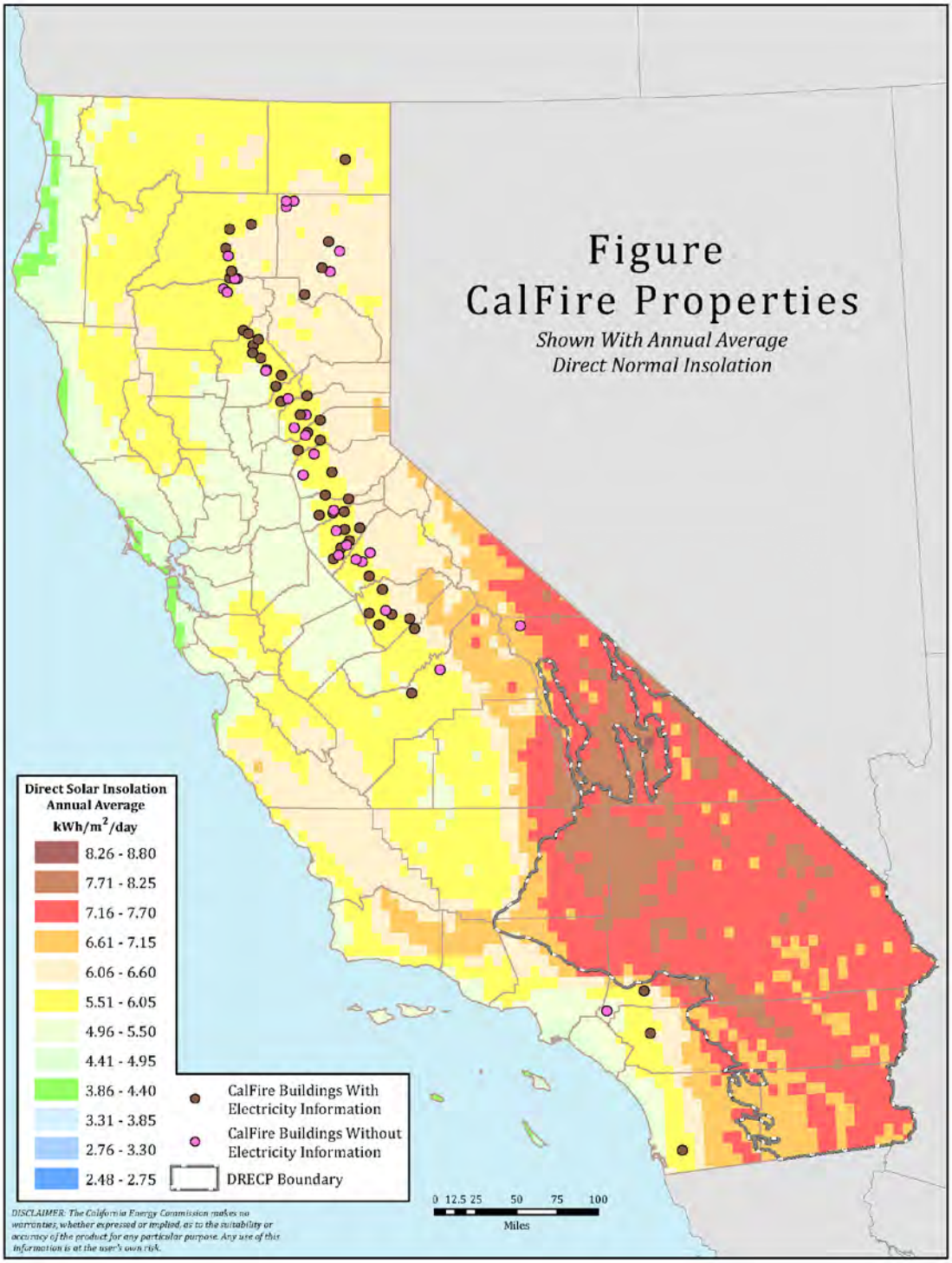
Source: California Energy Commission

Figure C-4: State Property With Potential for Wholesale Distributed Market With Wind Resource



Source: California Energy Commission

Figure C-5: CAL FIRE Buildings With Annual Solar Insolation



Source: California Energy Commission

APPENDIX D:
Interconnection Screens

Rule 21 Screens (applicable for all utilities)

- Is the point of common coupling on a networked secondary system?
- Will the power be exported across the point of common coupling?
- Is the interconnection equipment certified for the proposed application?
- Is the aggregate generating facility capacity on the line section less than 15 percent of the line-section peak load?
- Is the starting-voltage drop screen met?
- Is the gross generating-facility capacity 11 kVA or less?
- Is the "Short Circuit Current Contribution" screen met?
- Is the "Line Configuration" screen met?

SGIP/GIP and WDAT Screens

For the SGIP/GIP and WDAT, the utilities use the first 8 screens shown above for Rule 21 and add two additional screens. The 10 SGIP/GIP screens as described by FERC are shown below.[55]

The last screen has been deleted in the new approved GIP.

- The proposed Small Generating Facility's Point of Interconnection must be on a portion of the Transmission Provider's Distribution System that is subject to the Tariff.
- For interconnection of a proposed Small Generating Facility to a radial distribution circuit, the aggregated generation, including the proposed Small Generating Facility, on the circuit shall not exceed 15% of the line section annual peak load as most recently measured at the substation. A line section is that portion of a Transmission Provider's electric system connected to a customer bounded by automatic sectionalizing devices or the end of the distribution line.
- For interconnection of a proposed small generating facility to the load side of spot network protectors, the proposed small generating facility must use an inverter-based equipment

55 These screens are described in the FERC document titled "SMALL GENERATOR

INTERCONNECTION PROCEDURES (SGIP)", pg. 3, 2.2.1 available at:
http://www.epelectric.com/Site/transmission.nsf/bf25ab0f47ba5dd785256499006b15a4/02c737971797636d8725714b0067e5a5/$FILE/SGIP.pdf

package and, together with the aggregated other inverter-based generation, shall not exceed the smaller of 5 percent of a spot network's maximum load or 50 kW.

- The proposed small generating facility, in aggregation with other generation on the distribution circuit, shall not contribute more than 10 percent to the distribution circuit's maximum fault current at the point on the high voltage (primary) level nearest the proposed point of change of ownership.
- The proposed small generating facility, in aggregate with other generation on the distribution circuit, shall not cause any distribution protective devices and equipment (including, but not limited to, substation breakers, fuse cutouts, and line reclosers), or interconnection customer equipment on the system to exceed 87.5 percent of the short circuit interrupting capability; nor shall the interconnection be proposed for a circuit that already exceeds 87.5 percent of the short circuit interrupting capability.
- Using the table on page 5 of the FERC document (available at http://www.epelectric.com/Site/transmission.nsf/bf25ab0f47ba5dd785256499006b15a4/02c737971797636d8725714b0067e5a5/$FILE/SGIP.pdf), determine the type of interconnection to a primary distribution line. This screen includes a review of the type of electrical service provided to the interconnecting customer, including line configuration and the transformer connection to limit the potential for creating over-voltages on the Transmission Provider's electric power system due to a loss of ground during the operating time of any anti-islanding function.
- If the proposed small generating facility is to be interconnected on single-phase shared secondary, the aggregate generation capacity on the shared secondary, including the proposed small generating facility, shall not exceed 20 kW.
- If the proposed small generating facility is single-phase and is to be interconnected on a center tap neutral of a 240-volt service, its addition shall not create an imbalance between the two sides of the 240-volt service of more than 20 percent of the nameplate rating of the service transformer.
- The small generating facility, in combination with other generation interconnected to the transmission side of a substation transformer feeding the circuit where the small generating facility proposes to interconnect shall not exceed 10 MW in an area where there are known, or posted, transient stability limitations to generating units located in the general electrical vicinity (three or four transmission busses from the point of interconnection).
- No construction of facilities by the transmission provider on its own system shall be required to accommodate the small generating facility.