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A Report on the Governor's Conference on Local Renewable Energy

June 7, 2012

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A Report on the Governor's Conference on Local Renewable Energy

By Jeffrey Russell[1] and Steven Weissman[2]

June 7, 2012

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Photos are courtesy of: UCLA Luskin Center, Troy McClure, etgeek, Doug Caribb, SolarCity, Syntonic Corp, Andrey Manullang, Debbie Mous, Fritz Liess, Chelmsford Public Library, CA Heckler, Pestpruf, RunRunRun, Mirco Wilhelm, Will Lee, The Russians are Here, Let Ideas Compete, Michael Daines, Pete Jordan, Leonardo Bonanni, Adrian Cotter, mad jalapeno, B. Romain, Rob Baxter, Inhabitat, Rossco and Joey Rozier.

"I'd put my money on the sun and solar energy. What a source of power! I hope we don't have to wait til oil and coal run out before we tackle that. I wish I had more years left!"

- Thomas Edison

From James Newton, Uncommon Friends: Life with Thomas Edison, Henry Ford, Harvey Firestone, Alexis Carrel, and Charles Lindbergh, p. 31. Harcourt, Inc. (1987).

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Executive Summary

Background

California has one of the most ambitious renewable energy programs in the country, with a target of procuring 33 percent of its electric energy from renewable sources by 2020. Governor Jerry Brown has raised the bar even higher, calling for California to reach and surpass the 33 percent target by developing 12,000 megawatts of *local* renewable energy: renewable energy electric generation located near the homes, businesses and communities that it serves. 12,000 megawatts represents an extraordinary amount of energy; for perspective, the state's two nuclear generating facilities are each capable of generating approximately 2,200 megawatts of electricity.[1]

By accelerating the development of local renewable generation, Californians will get more of their power from neighborhood sources. Indeed, the state is already well on its way: Californians from Chula Vista to Crescent City are installing solar panels on their roofs, wind turbines on their farms, and bioenergy generators at their landfills and sewage treatment plants, harvesting the state's abundant wind, solar, geothermal and bioenergy resources to generate local electricity.

In order to meet its ambitious goals for renewable energy deployment, California must rely on projects both large and small. Along with the 12,000 megawatt goal for local renewables, the Governor has called for development of 8,000 megawatts of larger "utility-scale" renewable energy projects. Those projects – such as the wind farms in the Tehachapi Pass and the solar fields in the desert – have the benefit of adding substantial amounts of clean, renewable energy to the grid through a relatively small number of installations. However, those projects entail their own special planning, permitting, and construction challenges that relate both to the generation facilities and the transmission lines necessary to convey the power from their remote locations to California's metropolitan areas. Local renewable power can complement the larger-scale projects by enabling a more widely-distributed system of installations situated within or nearer to the built environment.

In addition to clean power, 12,000 megawatts of local renewables will yield other benefits for the state, including new jobs and economic development in communities affected by the recession, ratepayer savings by avoiding costs for new power generators in remote locations and requisite transmission lines, and additional

The two-day event was attended by over 250 key figures from state and local government, utilities, energy developers, public agencies, environmental organizations, ratepayer advocates, and labor and trade groups.

consumer autonomy to influence both power sources and power rates.

Achieving the 12,000 megawatt goal and maximizing its benefits will not be easy. Development of local renewables at that scale will require a coordinated statewide effort to address a host of financial, regulatory and technical barriers. It will require collaboration, creativity and strong leadership to develop comprehensive and cost-effective solutions.

To address those challenges, Governor Brown convened a conference in July 2011 at UCLA with representatives of agencies, businesses and organizations from across the state that will be involved in or affected by the 12,000 megawatt goal.[2] The two-day event , co-hosted by UCLA's Luskin Center for Innovation, was attended by over 250 key figures from state and local government, utilities, energy developers, public agencies, environmental organizations, ratepayer advocates, and labor and trade groups. Attendees participated in a series of expert-led panels dedicated to different parts of the planning and development pipeline for local renewables. Each panel identified the most critical barriers to achieving the 12,000 megawatt goal and discussed solutions that the public and private sectors can adopt to address those barriers.

The Conference was a pivotal event: over the months since it occurred, several of the key figures and organizations in attendance have already taken steps to implement solutions discussed at the Conference, including the following:

- **Renewables on State Buildings:** In April 2012, Governor Brown signed Executive Order B-18-12, which sets a target of achieving zero net energy consumption for 50% of the square footage of existing state-owned buildings by 2025, and zero net energy consumption for all new or renovated state buildings designed after 2025.
- **Faster interconnection:** In March 2012, the Rule 21 Working Group released its proposed revisions for the Rule 21 interconnection rules that address most of the critical interconnection barriers identified by Conference participants. The Public Utilities Commission will review and rule on the revisions.
- **Streamlined permitting:** The Governor's Office is working with local governments, industry representatives and other stakeholders to streamline local permitting for solar photovoltaic installations and to standardize requirements for these installations across jurisdictions.
- **Robust net metering:** In May 2012, the Public Utilities Commission issued a decision clarifying how utilities should calculate the cap on net metering projects.The decision requires utilities to set the denominator for the statutory 5% cap equal to non-coincident aggregate peak customer demand, an interpretation that would support the continued growth of the program and is consistent with the legislature's intent.
- **Better siting:** Under the auspices of its 2012 Integrated Energy Policy Report, the Energy Commission is examining different metrics for siting of local renewables and strategies to identify areas with preferred characteristics.
- **Regional strategies:** Ongoing efforts by stakeholders, local governments and not-for-profits are making advances toward the 12,000 megawatt goal in cities and counties throughout California. In March 2012, Pacific Environment released "Bay Area Smart Energy 2020," a comprehensive roadmap to convert 25 percent of existing Bay Area homes and businesses to net zero energy buildings by 2020. In December 2011, the federal Department of Energy awarded a $700,000 grant to a coalition from Southern California comprising Los Angeles County, ten cities and two energy not-for-profits for the purpose of developing model permitting rules and interconnection processes that can bring a streamlined approach to 21% of California's population.
- **R&D funding:** In December 2011, the Public Utilities Commission established the Electric Program Investment Charge, a funding mechanism intended to fill the void left by the recent expiration of the Public Goods Charge.

If California's markets for local renewable generation continue to flourish, Governor Brown's 12,000 megawatt goal will become just a milestone – rather than a finish line – on the state's path to a clean energy future.

Purpose of this Report

This report summarizes the concerns, observations and suggestions of Conference participants and other stakeholders for clearing a path toward the 12,000 megawatt goal. The report also proposes solutions and immediate and longer-term "next steps": actions that government leaders, private industry and public agencies can take to implement those solutions. The proposed solutions reflect a combination of input from the conference, post-conference investigation, and extensive research and analysis by the authors. *The proposed solutions are presented in this report to inform local, state and national policies that affect efforts to meet the 12,000 megawatt goal, and do not represent the views of the Governor's Office or any of the other sponsors of the July 2011 Conference.*

Summary of Recommendations

If California's markets for local renewable generation continue to flourish, Governor Brown's 12,000 megawatt goal will become just a milestone – rather than a finish line – on the state's path to a clean energy future. The purpose of the goal, then, is to provoke a conversation about what California needs to do to move beyond the admirable successes it has already achieved to expand local renewable energy deployment in a dramatic way. The solutions lie not with a single body, but with each and every agency, business and organization that will affect our ability to reach the goal. The following is a summary of recommended actions discussed in this report that each sector should take in order to clear the path forward and accelerate California's transition to local renewable energy.

1. STATE GOVERNMENT

The state is both a source of stimulus and support, and a major consumer of goods and services.

The Governor should:

- **Establish a definition for "local renewable energy"** within the context of the 12,000 megawatt goal that includes locational attributes – at a minimum, connection to the distribution grid in areas where energy can serve load without flowing into the transmission system – so that procurement programs and other state policies can capture the manifold economic, environmental and other benefits of 12,000 megawatts of localized energy resources.
- **Articulate the policy objectives** underlying the 12,000 megawatt goal to guide the development of statewide programs and policies that affect local renewable development.
- Identify each state-level agency or office that can affect renewable energy markets by creating rules, allocating funds, or accommodating installations, and ensure that each such body **designates a Local Renewables Action Officer,** who would be accountable for identifying and implementing

actions that the agency or office can take to advance the Governor's goal and to site more systems.

- **Adopt an aggressive plan to develop renewables on state property** and identify a high-level local renewable energy liaison in the governor's office to work with state agencies to execute that plan.

Regulators must:

- **Strengthen the net metering program**:[3] Regulators should consider raising the program cap so that net metering can continue its current trajectory and achieve a significant percentage of the 12,000 megawatt goal. As with previous expansions, the level should be founded on a sound basis that does not result in significant adverse rate impacts, including an update of the Public Utilities Commission's 2010 study on the cost effectiveness of the program. Short of raising the program cap, the legislature could modify the net metering statute so that the relevant standard used to measure progress towards the program cap is the *expected amount of energy that will be exported to the grid* rather than the *total rated generating capacity* of enrolled systems.
- Work with local governments, state agencies and utilities to **set and implement regional targets** for development of local renewables that encourage siting near load centers and facilitate establishment of coordinated local targets by cities and counties within each region.
- Continue to **improve programs utilities use to buy power from local renewable projects**, such as the Renewable Auction Mechanism and the feed-in tariff programs, and ensure that they are successfully meeting state goals and capturing the benefits of local generation. For example, procurement programs can be used to promote development of local renewables in urban locations by limiting program eligibility to projects meeting specific location criteria (e.g., connection to the distribution grid in areas where energy can supply load without backflowing into the transmission system).
- **Require greater transparency:** the public availability of information necessary for reasoned business decisions and accountability on the part of agencies, utilities and businesses.
- **Adopt faster, less expensive and more transparent utility interconnection processes**, including those proposed by the Rule 21 Working Group, that include the following features:

    - pre-application project review meetings with utility staff;
    - mandatory and enforceable review timelines;
    - an expanded fast track review process;
    - clear and consistent study methodologies;
    - a queue management system;
    - a fair allocation method for upgrade costs; and
    - a standardized interconnection agreement.

- Lead a **transition from the utilities' traditional top-down, service territory-wide planning approach to a geographically-based plan** as discussed below.

2. ELECTRIC UTILITIES

Utility actions drive the market for local renewables and can create the kind of grid stability necessary to support thousands of distributed systems. Toward that end, the utilities must:

- **Provide the quantity and quality of data about the capacity and constraints of the distribution**

grid necessary to support project planning at the local level by project developers and local governments.

- **Embark on a geographically-based planning process** that balances energy supply with demand and addresses other reliability challenges at the local level, engages local governments to incorporate community objectives for energy supply and local land use, and anticipates potential local renewable energy development.
- **Develop local integration strategies** that ensure grid reliability during integration of intermittent local renewables through use of energy storage technologies, demand response programs and strategic project siting.
- **Retain and deploy more electrical engineers and other "grid experts"** to accurately assess the constraints of existing grid infrastructure and ensure that new local renewables connect to the grid quickly and smoothly while keeping costs for distribution infrastructure upgrades to a minimum.

3. LOCAL GOVERNMENTS

California's expanded reliance on local energy will require the cooperation and active support of each of the state's 58 counties and 482 cities, which hold a range of review and permitting responsibilities for local renewables. To ensure success, local governments should:

- **Amend general plans to incorporate energy elements or otherwise include policies and specific objectives for local renewable energy**, including targets for development of local renewables on public property and overlay maps and/or siting criteria for local renewables.
- Coordinate with neighboring jurisdictions to **utilize collaborative procurement and project aggregation**.
- **Create efficient and regionally-consistent permitting processes** to reduce cost and project delays related to local government approvals.
- Coordinate with utilities to **ensure that their local renewable targets and land use plans are consistent with energy resource and grid constraints**.
- **Establish Community Choice Aggregations** that could prioritize the deployment of renewable energy in general and local renewables in particular.

4. RENEWABLE ENERGY INDUSTRY

One of the benefits of well-designed state and local policies is that businesses can invest in opportunities to achieve state goals and create jobs in a streamlined regulatory environment. To create the best environment for business growth, industry participants should:

- **Ensure that public agencies and utilities have the most current technical information about renewable energy equipment**, which affects everything from a utility's ability to accurately forecast energy generation to a firefighter's safety when encountering the equipment in a fire or other emergency.
- **Embrace health and safety and local environmental requirements** to improve the quality of projects and encourage the type of collaboration that can enable local officials to speed the approval of good projects.
- **Develop ongoing training and certificate programs for installers** to promote consistency and ensure the safety of both installers and the public.

Overview

This report is organized into six chapters: the first five chapters roughly reflect the chronology of the planning and development process for local renewables, from the early stages of grid planning to the final stages of building permits; the sixth chapter focuses on development of local renewable energy on public buildings and lands, where California has the opportunity to make rapid advances toward the 12,000 megawatt goal. The following is a summary of each of the chapters.

1. Grid Planning

Grid planning refers to the process where utilities, federal and state grid managers (such as the California Independent System Operator and the California Public Utilities Commission) and other stakeholders consider a range of long-term energy planning issues with the primary goal of ensuring that an adequate, reliable supply of energy is available to meet load, or energy demand. The 12,000 megawatt goal will be implemented, in large part, by long-term energy procurement plans that consider various energy sources and determine the appropriate array necessary to maintain grid reliability and an adequate supply of energy resources.

Conference participants stated that the current planning framework is reactive and disjointed, and fails to adequately consider or plan for either the potential grid impacts or benefits of local renewables. According to participants, it also does not acknowledge local land use planning considerations that are critical for siting diffuse local renewables. Participants also indicated a desire for state leaders to establish and prioritize the policy objectives associated with the 12,000 megawatt target (e.g., job development, cost containment, grid reliability), so that subsequent decisions implicit in grid planning could support those objectives.

POTENTIAL SOLUTIONS:

- ***Establish Policy Objectives*:** The Governor's Office should convene the Energy Principals group (which represents state agencies and organizations affecting energy policy) to formulate a clear expression and prioritization of objectives related to the local renewables goal.
- ***Develop an Integrated Mosaic Resource Plan*:** The Energy Commission should develop a research agenda to support an Integrated Mosaic Resource Plan (defined in Chapter 1). The Public Utilities Commission should undertake rulemaking to incorporate the plan into the Long Term Procurement proceedings.

2. Integration And Reliability

Local renewables generate energy in proportion to the availability of highly variable natural resources such as sunlight and wind. While that energy is often used on-site, it is also sent back onto the grid, through power lines and equipment that were primarily designed to transport energy in the opposite direction. If managed poorly, the integration of 12,000 megawatts of local renewable energy sources can impact the safe and reliable operation of California's distribution grids. Managed correctly, the integration of local renewables should result in an even stronger and more reliable grid.

Conference participants stated that integration is hindered by a significant information gap, both about the capacities and constraints of existing distribution grids as well as the ability of sophisticated grid planning, emerging technologies and demand-side policies to address integration challenges.

POTENTIAL SOLUTIONS:

- ***Require Local Integration Strategies:*** The Public Utilities Commission should direct utilities to develop localized integration strategies (defined in Chapter 2) that, to the extent possible,

entail minimal reliance on fossil-fuel generators by incorporating resources to support grid reliability such as strategic siting of local renewables, highly accurate forecasting tools and models, energy storage devices, demand response programs and bioenergy generators.

- ***Initiate Regulatory and Market Reforms:*** The Public Utilities Commission should work with the California Independent System Operator as appropriate to develop energy market and regulatory reforms (described in Chapter 2) to stimulate development of technologies and policies that provide grid reliability services to support integration of 12,000 megawatts of local renewable generation into California's electricity system.

3. Financing And Procurement

The credit crisis has impacted all sizes of local renewables, from small customer-side systems (renewable energy generators that are sized to meet on-site energy demand) to larger utility-side systems (renewable energy generators that send power back onto the grid for sale to the local utility). California's net energy metering program and the California Solar Initiative have achieved significant success in promoting widespread development of customer-side systems, yet a large percentage of the state's residents and business are still unable to buy or lease equipment or purchase renewable energy from elsewhere due to a range of challenges, from financial (e.g., inability to access credit) to logistical (e.g., lack of adequate rooftop solar access due to shading, or space/access issues of a multi-tenant building). Similarly, federal tax incentives and state procurement programs have stimulated rapid development of utility-side renewable energy systems, but the expiration of those incentives threatens to stall forward momentum. Several Conference participants also voiced concern that incentive and procurement programs neglect key technologies, project sizes and project locations that require public support to move forward.

POTENTIAL SOLUTIONS:

- ***Restore Residential PACE Financing:*** California's elected leaders should lead a coordinated nationwide effort to support federal legislation such as HR 2599 that would ease restrictions on PACE-assessed mortgages.
- ***Expand On-Bill Financing:*** The Public Utilities Commission should undertake a rulemaking to create on-bill financing or on-bill repayment programs for purchase and installation of renewable energy systems.
- ***Raise Net Metering Cap and Allow Meter Aggregation:*** The Public Utilities Commission should undertake a rulemaking to consider raising the generator size cap and expand eligibility for meter aggregation to enable participation by entities with larger loads and entities with dispersed facilities. The rulemaking could be informed by a full cost accounting of the net energy metering program that considers the long-term benefits of deferred or obviated generation and transmission systems upgrades.
- ***Enable Creation of Community Renewable Energy Systems***: State legislators should support creation of community-based programs such as that detailed in SB 843 (Wolk) that allow individual ratepayers to participate in ownership or use of offsite renewable energy systems through a bill credit system similar to that used for virtual net metering.
- ***Provide Start-up Financing for Community Choice Aggregation:*** Federal and/or state legislation should stimulate establishment of Community Choice Aggregation programs by providing loan guarantees, low-interest loan programs and tax credits for grid-tied renewable energy systems.
- ***Allow Renewable Energy Developers to Form Master Limited Partnerships:*** California's elected leaders should advocate federal legislation that would allow renewable energy developers to form Master Limited Partnerships, a structure currently limited primarily to

fossil fuel companies that receives favorable federal tax treatment and facilitates access to equity markets in a manner similar to corporations.

- ***Extend Federal Tax Incentives for Local Renewables***: California's elected leaders should advocate federal legislation that would extend or reauthorize tax incentives for development of renewable energy systems, including the investment tax credit cash grant and accelerated depreciation.
- ***Promote Stability in the Tradable Renewable Energy Credit Market****:* The Energy Commission and/or a not-for-profit organization should prepare an analysis of California's tradable renewable energy credit market that includes a survey and assessment of markets in other states, and solutions to ensure market stability and efficiency once the credit price and quantity caps expire. The study should also assess the opportunities and constraints for local renewable carve-outs in California's RPS requirements, including a feasibility analysis of a market for local renewable energy credits.
- ***Clarify Policies for Local Energy Procurement Programs:*** The Public Utilities Commission should work with investor-owned utilities and the California Energy Commission to prepare analyses of the results of the Renewable Auction Mechanism and Feed-in Tariff programs as they become available, including the size, location and technology attributes of qualifying bids. Based on that analysis, state legislation should amend or expand the procurement programs to focus on projects that support the policy objectives of the 12,000 megawatt goal. The Public Utilities Commission should also articulate a clear procurement policy consistent with the policy objectives that addresses the role of each procurement program as well as of bilateral PPAs and competitive solicitations.

4. Interconnection

Interconnection is a process where a developer of a proposed energy generator applies for approval from the relevant utility to connect the generator to the power grid. Utilities process interconnection applications under either state or federal rules, depending on a number of factors. If the generator meets certain criteria, it can take advantage of a "fast track" approval process. If it does not, the utility conducts a series of studies to determine the proposed generator's impacts to the grid and whether upgrades to nearby grid infrastructure are necessary to support the new project.

Conference participants described the interconnection process as a "black box" that is a source of significant uncertainty and inefficiency in the development process. It is an especially critical problem for local renewables, due to the sheer volume of interconnection requests that will result from integration of 12,000 megawatts of projects. Participants cited the lack of alignment between the interconnection and procurement processes, lack of transparent data or requirements, protracted review periods, and high costs as some of the major challenges. Significant changes to Rule 21, the interconnection process that controls projects falling under state jurisdiction, have been proposed by a working group that includes state regulators, utilities and stakeholders. Those changes, if approved by the Public Utilities Commission, would address many of the challenges described herein.

POTENTIAL SOLUTIONS:

- ***Clarify State Jurisdiction Over Interconnection:*** A not-for-profit organization should prepare a study of the state's jurisdiction over interconnection of local renewables, including solutions to address jurisdictional ambiguity and the challenges posed by divergent state and federal interconnection processes.
- ***Increase Transparency of Interconnection Data, Requirements and Costs***: The Public Utilities Commission and Energy Commission should work with the Federal Energy Regulatory

Commission and the investor-owned utilities to develop tools and forums to increase the transparency of the interconnection process, including 1) an interconnection study clearinghouse, 2) regional interconnection clinics, 3) periodic interconnection stakeholder forums, and 4) online and software tools to assist with the interconnection process.

- ***Rectify Uneven Interconnection Cost Allocations:*** The Public Utilities Commission and Energy Commission should prepare a study of alternative interconnection cost allocation frameworks that address both the discrepancy between interconnection to the transmission grid versus the distribution grid, as well as cost allocation and containment among projects connecting to the distribution grid. The study should explore expansion of the interconnection cost waiver currently limited to net metered projects.

5. Permitting

Nearly every new construction project in California must be reviewed and approved by the city or county where it is located for consistency with local zoning and building regulations and state environmental laws. Planning, building and environmental regulations serve to promote orderly development, protect human health and safety, and minimize harmful impacts to the environment.

While many of California's cities and counties have aggressively pursued development of renewable energy systems, several others are not even prepared to review and approve local renewables. Representatives of renewable energy developers at the Conference voiced frustration with the state of planning and building codes in many cities and counties, which they indicated do not contemplate or address development of local renewable energy systems. The result is that projects are oftentimes "shoehorned" into another category that is the closest fit or subjected to substantial delay while city or county staff gather information necessary to review the project. Developers also said that the requirements, permit fees and local government expertise in local renewables vary widely from jurisdiction to jurisdiction, increasing inefficiency and costs for development of local renewables.

Representatives of cities and counties, while expressing their desire to support development of local renewables, said that a lack of financial and staff resources prevents them from making necessary updates to their planning and building codes and processing applications in a more timely manner. Local government staff also indicated that it is difficult to update planning and building codes to keep pace with the rapid development of local renewable technologies.

Representatives of emergency responders, including firefighters, have achieved a great deal of success in proactively developing model safety codes and training programs to address fire and safety issues associated with local renewables. However, emergency responders also expressed the challenges of understanding local renewables and keeping tabs on new and emerging technologies. For them, this knowledge is especially critical since they encounter these technologies under extreme conditions and require a thorough working knowledge of the hazards related to local renewables in order to protect property and the public, and also avoid unnecessarily jeopardizing their own safety.

POTENTIAL SOLUTIONS:

- ***Stage a Statewide Permitting Summit for Local Renewables***: A relevant state agency or not-for-profit organization should stage a statewide permitting summit focused on planning and permitting issues for local renewables in the context of the 12,000 megawatt goal. The summit should address ongoing efforts and challenges to developing statewide model planning, building and safety codes and regionally-standardized municipal codes, funding sources for local governments to update codes and provide timely review of projects, and establishment of expedited permit review processes.

- ***Encourage Energy Elements in General Plans:*** State legislation should encourage Californian cities and counties to update their general plans to include policies, objectives and maps for local renewable energy generators – accompanied by program environmental impact reports.
- ***Facilitate Coordinated Planning Between Utilities and Local Governments*****:** The Public Utilities Commission should direct utilities to work with local governments within their service territories to plan for strategic development of local renewable energy systems and localized integration strategies (described in Chapter 2).
- ***Promote Community Choice Aggregation Programs***: The Public Utilities Commission sets rules for the creation of Community Choice Aggregations, pursuant to which local governments can procure power for their constituents who remain free to opt out and continue receiving power as provided by the utility. Normally, the Commission remains neutral as to the merits of creating such an arrangement. The Public Utilities Commission and Energy Commission should encourage the creation of Community Choice Aggregations where there is a reasonable plan to accelerate the use of renewable energy in general and local renewables in particular.
- ***Ensure Widespread Adoption of Most Current Safety Standards and Training Programs for Emergency Responders***: The Governor's Office should work with the Office of the State Fire Marshall to reconvene a Local Renewable Energy Task Force to address new and emerging renewable technologies that warrant additional or modified safety standards and training for emergency responders.
- ***Identify State Agencies and Processes that Affect Development of Local Renewables:*** A not-for-profit organization or relevant state agency should identify and map all state agencies and processes that affect development of local renewables in order to ensure that those agencies have sufficient renewables expertise and to streamline processes that are unnecessarily encumbering achievement of the 12,000 megawatt goal.

6. Public Buildings and Lands

California can make huge strides toward the 12,000 megawatt goal by developing local renewables on its own property. A recent study by the Energy Commission indicates that development on state property could yield as much as 23,000 megawatts of renewable energy, and an initial inventory and assessment of state property set a target of 2,500 megawatts by 2020. Various branches of federal government as well as regional and local governments and public agencies are also actively pursuing development of renewables on their property.

Public agencies face many of the same challenges that encumber private sector development of local renewables, including an inhospitable credit market and interconnection challenges. Public budgets are already stretched thin, and agencies are unable to take advantage of the federal tax incentives that have spurred development in the private sector since they are tax exempt. Public agencies also face institutional resistance stemming from perceived conflicts, real or not, between development of local renewables and the agency's core mission.

The inability of public agencies to secure financing has resulted in public/private partnerships to build renewables on public buildings and lands. Partnerships take the form of power purchase agreements, wherein a private developer agrees to finance and construct a renewable energy system in exchange for an agency's agreement to buy the power generated by it for a specified period of time. Private developers also lease land from public agencies in order to build larger, utility-side renewable systems that sell power back to the grid through a power purchase agreement with a utility. Developers at the Conference said that gaining contract and project approval from a public agency can be a slow and often unpredictable process.

POTENTIAL SOLUTIONS:

- ***Improve State Agency Coordination and Expertise:*** The Governor's Office should convene a meeting of state agency leaders to design a framework and timelines for development of local renewables on state property based on the Memorandum of Understanding spearheaded by the Energy Commission. More generally, all state agencies that are directly or peripherally involved in the permitting or development process for local renewables should be directed to designate liaisons that are familiar with renewable energy issues and can facilitate the permitting or development process.
- ***Develop State Building and Lands Inventory***: The Energy Commission should continue its effort to refine the state building and lands inventory and augment it with data points such as roof life, energy consumption and status of energy efficiency upgrades. The Commission should also develop a methodology or criteria to prioritize development opportunities, and expand the inventory to include property owned by federal, regional and local governments and agencies.
- ***Streamline Agency Procurement and Approval Processes:*** The Governor's Office or Energy Commission should convene a task force consisting of representatives from other state agencies, utilities and private developers to develop tools to streamline the procurement and approval processes for renewables projects on state property. The task force should develop model/standardized PPAs and leases, explore ways to cut costs through project aggregation and collaborative procurement, and create project siting and design criteria.
- ***Research Solutions to Financing Challenges:*** A not-for-profit organization should prepare an analysis of the financial challenges unique to local renewable projects on public property. In addition to proposing solutions, the analysis should develop a model to assess life cycle costs and benefits of local renewable to inform public agency project decisions.

Conclusion

The complexity of the current political and financial environment poses especially difficult challenges to development of local renewables and California's transition to clean energy. Overcoming those challenges demands a level of cooperation, tenacity and creative thinking that California has repeatedly demonstrated in spite of challenging odds and naysayer skepticism. Thanks to the ongoing work of the state's visionary private sector, not-for-profit organizations and public servants, California already leads the nation in the development of local renewable energy sources. By setting ambitious targets and working through the development challenges, California will firmly establish itself as a role model for achievement of aggressive renewable energy targets for communities across the country and around the world.

ENDNOTES

1 State Nuclear Profiles, http://www.eia.gov/nuclear/state/california/ (last visited June 5, 2012).
2 The Governor's Conference on Local and Renewable Energy Resources, http://gov.ca.gov/s_energyconference.php (last visited June 5, 2012).
3 See Ca. Pub. Util. Code § 2827(c)(1).
4 Net Energy Metering (NEM) Cost Effectiveness Evaluation, http://www.cpuc.ca.gov/PUC/energy/DistGen/nem_eval.htm (last visited June 5, 2012)

Introduction

A critical piece of California's effort to reduce greenhouse emissions is the transition from reliance on carbon-rich fossil fuels to clean, renewable energy sources. California law requires that, by 2020, the state's utilities must procure at least 33 percent of electricity from eligible renewable energy resources. This policy is known as the Renewables Portfolio Standard.[1] California is especially well positioned to achieve this goal, with its ample solar and wind resources, illustrious science and technology sectors, as well as its forward-thinking residents, research institutions and elected officials.

Development of large, central-station renewable energy projects (20 to 1,000 megawatts) such as the wind farms in the Tehachapi Pass and the solar panel arrays in the desert is enabling California to make large strides toward the 33 percent Renewables Portfolio Standard. However, just as important to that effort are the thousands of smaller, local renewable energy systems (1 kilowatt to 20 megawatts) that Californians are building in their communities. These projects – also referred to as distributed generation – come in many different shapes and sizes, from rooftop solar panels to biogas generators at sewage treatment plants. While an increasing number of Californians have deployed these types of systems over the past decade, Governor Brown has raised the bar higher by calling on the state to develop 12,000 megawatts of local renewable energy by 2020.

In addition to clean energy, local energy offers many additional benefits to California. Because they are for the most part installed in the built environment, either directly with or close to energy consumers, they do not impact sensitive habitats and species like many of the larger, remotely located projects do. For the same reason, they do not require construction of expensive and often contentious transmission lines. An increase in demand for local renewable energy systems generates construction, installation and maintenance jobs and economic development in Californian communities. Finally, local renewables enable energy consumers to maintain control over both their power source and the rate they pay for that power, enabling energy independence and stability. These benefits are not lost on the nation's military forces, which have embarked on an especially ambitious push to develop local renewable energy systems.

California is making rapid gains toward achievement of the 12,000 megawatt goal. At the same time, local renewable energy systems face institutional, technological, regulatory and economic barriers that hinder more rapid development. Those barriers are only complicated by the especially challenging financial and political climate that is affecting California and the rest of the country.

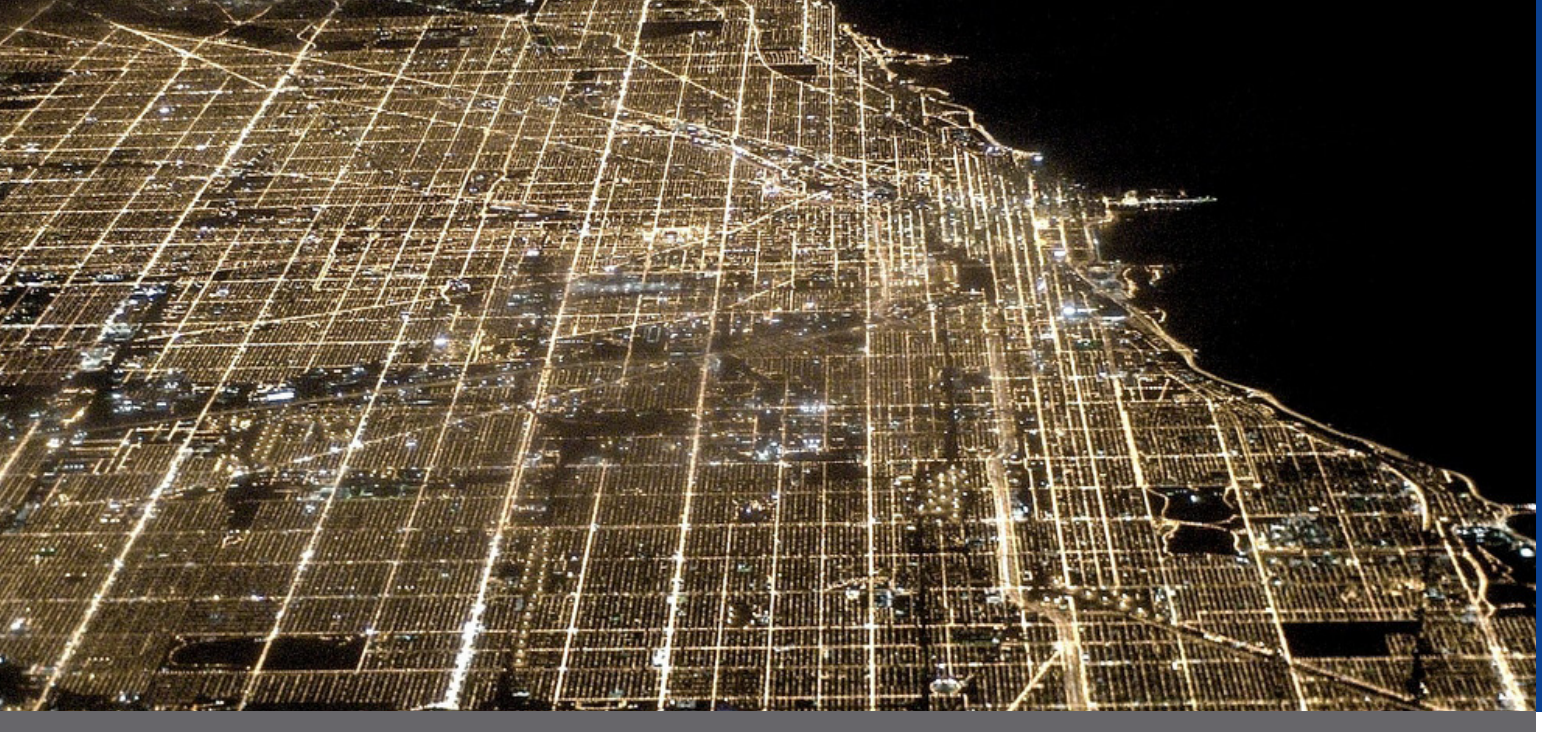
To work through those challenges, Governor Brown convened a conference in July 2011 at UCLA that included over 250 representatives from all of the different sectors – public, private and not-for-profit – that are involved or affected by the 12,000 megawatt goal.[2] The two-day conference included 11 panels, focusing on issues ranging from grid planning and job creation to fire safety and building permits. Whether discussing abstract policies or technical hurdles, each panel was designed to bring divergent perspectives and professions together in one room to discuss how California can achieve the 12,000 megawatt goal.

This report catalogs the challenges facing local renewables and the 12,000 megawatt goal and proposes solutions. It is built on the input from panel leaders and feedback from conference participants in addition to several post-conference interviews and review of pertinent studies and independent research. The report is organized into five general phases of energy development, from the early stages of grid planning and energy procurement to the final stages of permit review and issuance. The sixth chapter addresses development of local renewables on public property, an area where state, federal and local government leaders have the opportunity to establish their commitment to local renewable energy by developing successful models.

ENDNOTES

1 Cal. Pub. Util. Code § 399.11(a).

2 See The Governor's Conference on Local and Renewable Energy Resources, http://gov.ca.gov/s_energyconference.php (last visited June 5, 2012).



1 Grid Planning

Summary

The umbrella concept of "grid planning" entails consideration of myriad issues with the primary goal of ensuring that an adequate, reliable supply of energy is available to meet demand. Those issues include:

- The *generating capacity and profile* of energy sources (i.e., how much electricity can be generated, how that generation varies throughout the day and whether it is capable of being dispatched to meet fluctuations in demand);
- *Peak load forecasting* and *profiles* (i.e., when energy demand peaks and how it varies throughout the day);
- The *locations* of generators and load and their proximity to one another;
- The *technologies* used to generate electricity (e.g., nuclear, coal, natural gas, solar photovoltaic, wind turbine);
- The *demand-side policies* available to moderate load, such as energy efficiency improvements and demand response strategies; and
- The *grid infrastructure* in place to transmit energy from generators to consumers.

Conference participants generally agreed that grid planning is currently a reactive process that accommodates fluctuations in energy supply and demand, rather than a proactive process that coordinates supply and demand to ensure maximum efficiency and lowest costs. They observed that the highly decentralized nature of local renewable energy generators, and the ambitious goal of achieving 12,000 megawatts of localized energy by 2020, will require significant changes to the status quo, including much more cooperation and information exchange between utilities, local governments and renewable energy developers.

Not surprisingly, participants advocated different visions for how, where and when renewable energy systems should be developed, according to the stakeholder group they represented. While achieving the 12,000 megawatt goal will significantly reduce California's greenhouse gas emissions, it could also provide a significant boost for the state's economy, create thousands of new jobs, enhance the reliability of the power grid and ultimately reduce the amount of money that Californians pay for electricity. Conference participants, regardless of whether they represented utilities, environmental not-for-profits, ratepayer advocacy groups or energy developers, agreed that a clear articulation and prioritization of the state's objectives for the 12,000 megawatt goal should guide future policies and decisions.

Introduction

12,000 megawatts of localized renewable energy will provide a multitude of benefits for California, including economic growth, job creation, energy independence and greenhouse gas reductions. Maximization of those benefits,

however, is highly contingent on preliminary decisions Californians will make to reach that goal - namely, decisions about siting of new localized renewable generators, and the array of resources and project sizes that will compose the 12,000 megawatts of localized renewable energy.

A thorough and comprehensive planning process is essential for informing and implementing those decisions. It is also critical for maintaining the reliability of the grid during the integration of 12,000 megawatts of local renewable energy sources. California's transition to local renewable generation will radically decentralize the power grid, which was designed to accommodate large, centralized generators that send power across transmission lines in one direction to substations located near load centers, in most cases hundreds of miles away (see Figure 1a). Substations route the power through smaller distribution lines (the "distribution grid") to consumers (see Figure 1b).

Local renewable energy systems – from solar panels on residential rooftops to biogas plants at landfills – are sited in close proximity to the consumers they serve. Usually, the power they produce is either entirely used on-site or exported to the local distribution grid; rarely does it enter the transmission grid.

While decentralization can provide significant benefits for ratepayers, it also may contribute to reliability challenges. First, most distribution grids were designed to transport power in one direction, which causes problems for wholesale localized renewable generators that will put power back on to the grid in the opposite direction. Utility engineers have expressed concern that reverse power flows can damage obsolete transformers and other high-priced electrical equipment designed to receive electricity at one end and discharge it at the other.[1] Second, solar and wind generators provide intermittent power that is contingent upon availability of a natural resource. When those resources are not available in sufficient quantities, energy production falls and load must be met through other sources. Both of these issues affect the reliability of the grid. Extensive planning is imperative to ensure not only that new localized renewable generation sources can be integrated with minimal disruption to service, but that the integration is coordinated in a manner that actually improves reliability and maximizes potential benefits. Reliability issues are discussed in more detail in Chapter 2.

In addition to reliability, resource planning implicates other policy objectives associated with the 12,000 megawatt goal. For example, a policy that prioritizes optimal capture

FIGURE 1a | California's Major Electric Transmission Lines

Courtesy of the California Energy Commission

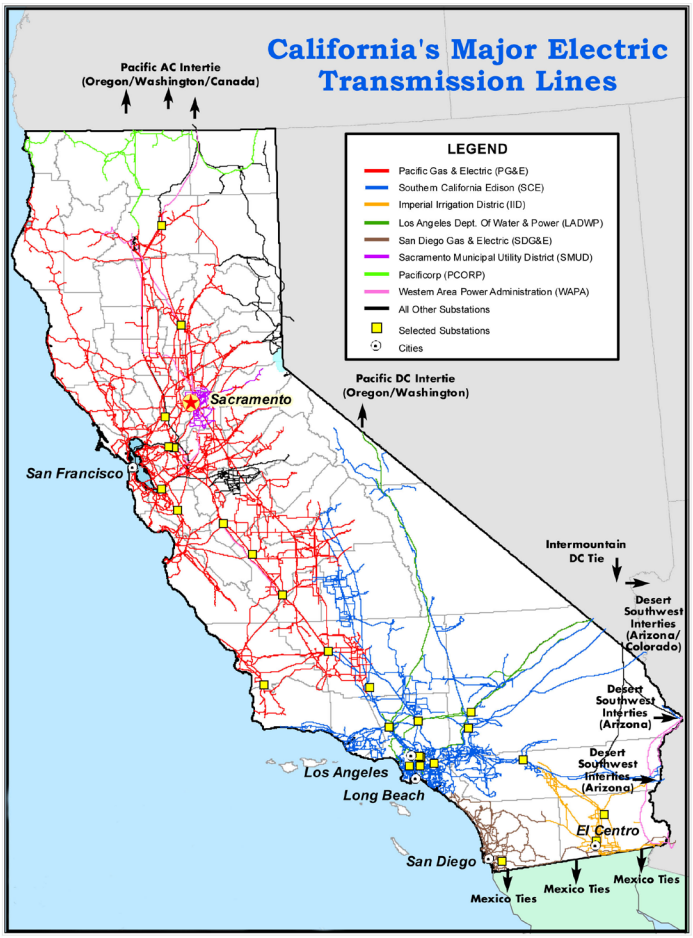
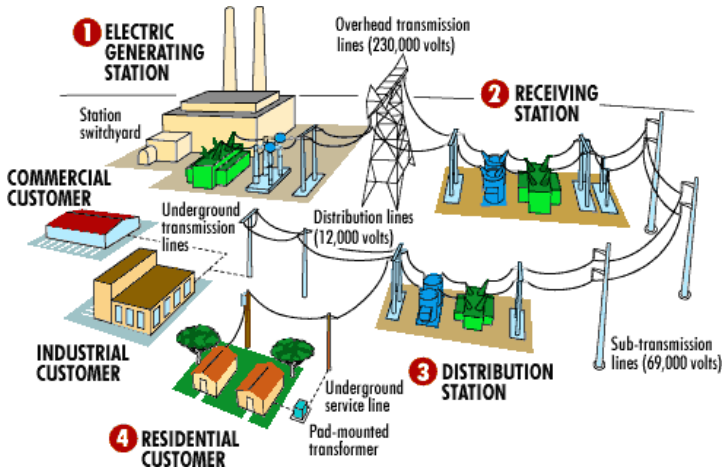


FIGURE 1b | Electricity Distribution



of renewable resources would result in placement of solar panels in the sunniest parts of the state, entailing construction of expensive new transmission lines and more complicated and expensive permitting processes. A policy that prioritizes cost containment, meanwhile, might result in an array of renewable generators located near the existing grid where interconnection can be completed at minimal expense, developed on sites that are more easily permitted and developed. While policy goals such as optimal resource capture and cost containment are not mutually exclusive, reviewing them in isolation illustrates the likely effects of each and the tradeoffs of emphasizing one policy over another.

Since 2004, the Public Utilities Commission has required investor-owned utilities to file long-term energy procurement plans.[2] These plans include information about how the utility intends to purchase energy for the following ten years in order to meet existing and forecasted load, and provide reserves to allow for contingencies. The Public Utilities Commission reviews these plans and determines whether or not to approve them. The resulting proceeding also serves as the main forum for the Commission to consider how the utilities are meeting requirements of resource policies, such as the Energy Action Plan's goals to increase energy efficiency, demand response, distributed generation, combined heat and power, and renewable resources. [3]

Goals

A well-executed integrated resource plan should both support and encourage local renewable energy development. Planning for the integration of 12,000 megawatts of such projects into California's power grid requires policy makers to:

1) Establish and prioritize a suite of policy objectives;
2) Undertake a process, consistent with those objectives, that defines and identifies a) the best places for developers to locate new localized renewable generators, and b) optimal renewable energy resource portfolios;[4]
3) Develop a coordinated land use plan and tools to direct development toward best locations;
4) Develop incentives and procurement targets to achieve the desired resource portfolios;
5) Establish feedback mechanisms that will provide policy makers with the data needed to adjust planning frameworks to respond to changing conditions.

Barriers

1. BARRIER: Unclear Policy Objectives and Definition of "Localized Generation"

Conference participants and other stakeholders indicated a desire for state leaders to both clearly define "localized generation" and articulate the policy objectives associated with the 12,000 megawatt target, so that subsequent decisions implicit in integrated planning - including siting, generator size and technology arrays - can support those objectives.

Governor Brown announced the 12,000 megawatt target as a key component of his Clean Energy Jobs Plan,[5] and a majority of participants at the Governor's Conference said that job creation should be one of the primary objectives of the localized renewable energy goal. However, conference participants and other stakeholders advocated a number of other competing and sometimes conflicting policy objectives, including cost containment, fast deployment speed and grid resilience.

Conference participants described the issue as follows:

- "What are the governor's objectives for the 12,000 megawatt goal?"
- "When we think about [local energy] policies, we should think about cost holistically. We need a full cost accounting of planned transmission and distribution upgrades, permitting, construction, congestion, line losses, and site availability and appropriateness."
- "Our long term goal should be to get off fossil fuels and nuclear."
- "Development of local renewables should focus on economic development such as local job creation, business creation and tax revenues."
- "[Local renewable energy] projects should be developed where they will mitigate or minimize environmental impacts, and serve environmental justice and public health goals."

1. POTENTIAL SOLUTION

Definition of "Localized Generation" and Articulation of Policy Objectives

Working with state agencies including the Energy Commission and the Public Utilities Commission, the Governor's Office could articulate a clearer definition – including size and locational attributes – of localized generation within the context of the 12,000 megawatt goal. According to Energy

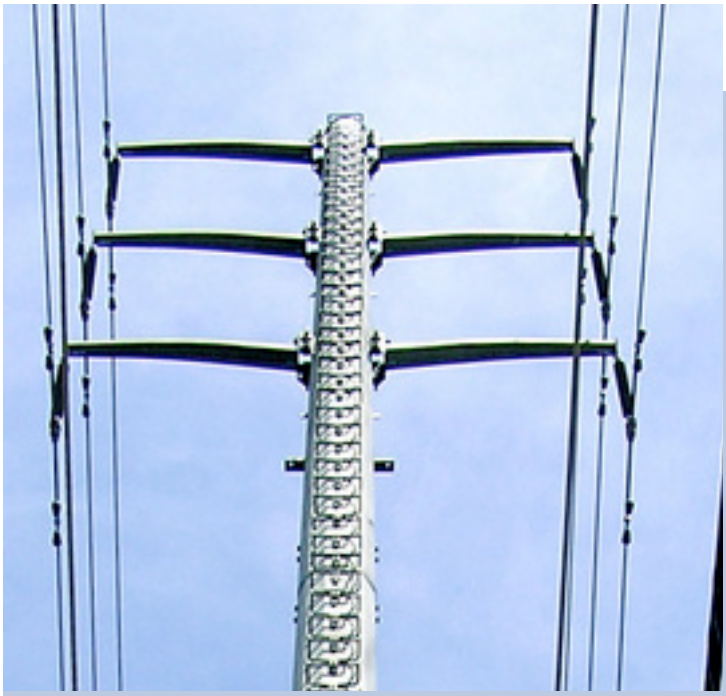
Commission staff, the 12,000 megawatt goal currently is a "location and technology neutral policy that promotes the development of renewable energy projects sized up to 20 MW in California."[6] It does not, according to Energy Commission staff, other agencies and stakeholders, entail any locational attributes, which renders the term "localized energy" an empty misnomer.

Indeed, as discussed in greater detail in Chapter 3, new procurement programs designed to spur development of local renewables – including the Renewable Auction Mechanism and the Feed-in Tariff – have failed to yield projects that are sited "locally" with respect to existing load due largely to the absence of locational restrictions in the programs. The first round of the Renewable Auction Mechanism resulted in projects that are sited in remote parts of the state, almost exclusively in the sparsely-populated high desert region east of Los Angeles.[7] Similarly, new projects subscribing to feed-in tariff programs are located in outlying rural parts of the state. According to comments received from Southern California Edison,

> *"[T]he biggest barrier to the interconnection of [local energy resources] is that projects tend to locate in remote areas. In fact, over 90% of the projects in SCE's current [feed-in tariff program] queue are in outlying regions that may require transmission upgrades to deliver the energy to customers."*[8]

The many economic, environmental and societal benefits of localized energy resources are not captured or supported by existing energy policies due to the absence of critical locational criteria in the definition of "localized generation." A definition that includes locational attributes – including, at a minimum, connection to the distribution grid in areas where energy can supply load without backflowing into the transmission system – is critical to development of procurement programs and other state policies to capture the manifold benefits of 12,000 megawatts of localized energy resources.

The Governor's Office could also establish the set of policy objectives underlying the localized renewable energy goal**.** The first step toward that end could be to assemble a comprehensive list of potential objectives along with the variables that each objective entails consideration of. For example, in order to promote development of renewable generators in the locations with the highest production



Current grid planning is primarily reactive.

potential, a policy that prioritizes optimum use of renewable resources would require data about statewide renewable resources. Next, those objectives could be ranked so that grid planners can incorporate them into models and forecast scenarios. If policy objectives included both optimum use of renewable resources and lowest cost energy, grid planners could develop a range of alternative siting scenarios with varying levels of emphasis on each objective, allowing decision makers to more easily gauge the relationship and trade-offs between those goals.

Prioritization of policy objectives may not be possible until data and modeling tools are available to support a thorough analysis of how the objectives are interrelated and the effects of each on integrated planning. However, an initial list of potential objectives is necessary in order to begin assembling the requisite data and forecast models.

Figure 1c contains policy objectives for the 12,000 megawatt goal articulated by participants at the Conference. Each objective is accompanied by the variables that would affect achievement of the objective. The list should be further developed through additional input from stakeholders, utilities, and relevant state agencies.

FIGURE 1c | Potential Policy Objectives for the 12,000 Megawatt Local Renewable Energy Target

1. Optimum use of renewable resources	Resource quality (production potential, intermittency)
2. Cost containment	Transmission and distribution upgrade costs Congestion Line losses Site availability / appropriateness Permitting costs Construction costs
3. Speed of deployment	Ease of interconnection Environmental impacts Community support Expiration of federal incentive programs
4. Grid reliability and resilience	Resource adequacy Reliance on gas-fired plants Islanding impacts Inverter functions
5. Matching demand growth and other changes in demand profiles	Generation and demand profiles
6. Economic development and job creation	Rate of job creation Quality of jobs created Business generation effects Tax revenues
7. Environmental justice	Local pollution impacts Access to clean energy and self-generation
8. Environmental conservation	Land demands Environmental impacts Transmission needs Greenhouse gas impacts

2. BARRIER: Disjointed Resource and Integration Planning

When asked to describe their views of grid planning, most stakeholders at the Conference responded that they perceived it as primarily a reactive and disjointed process: one that responds to predicted demand changes and new generation projects by proposing new transmission lines and other upgrades, rather than providing a roadmap for siting of new development, considering land use and environmental issues, or integrating either supply-side renewable energy sources or behind-the-meter tools such as energy efficiency improvements.

Conference participants described the issues as follows:

- "Current grid planning is primarily reactive, with planners responding to predicted demand changes and new generation projects, large and small, in the context of certain principles."
- "There are no incentives to locate local projects where they can help avoid network modifications, improve grid resilience or provide energy close to load. In addition, the prices paid for output from such projects do not fully consider the location-based value of the local renewables, such as the

Integrated planning enables the utility to compare a broad range of options for meeting load.

additional Resource Adequacy value in load centers or the reduction in energy loss by avoiding long-distance transmission lines."

- "Projects that electrically affect each other may be handled by different entities or processes."
- "Currently, there is not an effective mechanism to guide the siting and development of new interconnection infrastructure. To achieve more optimal reliability planning and reliably integrate [local energy resources], interconnection planning must be further integrated into the reliability and resource planning process."[9]

Perhaps the biggest challenge for properly incorporating local renewables in the utility planning process is that the existing plans are still not truly integrated. Integrated planning enables the utility to compare a broad range of options for meeting load: new generation large or small, enhanced efficiency, transmission or distribution additions, and demand response.

The current utility plans do not allow for this type of integrated assessment. In the plans, the utilities offer overall load forecasts, identify all existing and expected generating resources, and then determine a residual amount of generating capacity that they must pursue through contract or acquisition. Without a sufficient emphasis on the geographic realities of their service territories, the utilities cannot compare generation options (which can vary by location) with transmission options (the need for which depends on transmission constraints in specific places on the grid). Nor can they determine the merits of targeted energy efficiency efforts that might help meet local load or overcome local transmission constraints.

More to the point in the context of this report, the utilities do not include in their forecasts the potential for developing local renewables in certain places, the need to improve the distribution grid in specific locations, or the overall system benefits that it could achieve by encouraging local renewable generation projects in particular promising or helpful places. One result is that local renewables are not offered an equal place at the table as the utilities develop their plans. Another is that the utility resource plans fail to acknowledge and work with local land use planning considerations.

In 2006, the Public Utilities Commission found that the utilities' long term procurement plans were "deficient in planning for a [greenhouse gas]-constrained world," "insufficient in planning for aggressive renewables goals," and "so inconsistent in their structures and assumptions that they could not be compared to one another."[10] To address those issues, in 2010 the PUC launched a long term procurement plan process based on an "integrated resource portfolio approach."[11]

In doing so, the Commission recognized:

> *"there is still a need, at least periodically, to bring all of the resources and policies together to be considered in a comprehensive way. This is particularly important as it becomes more obvious that the interactions among various policy priorities have the potential to create duplication and potential for excess consumer costs if policies are not closely planned and coordinated."*[12]

As part of the long term procurement planning process, the Commission requires the utilities to run models for four potential scenarios for development of renewable energy

to meet the state's 33% Renewable Portfolio Standard by 2020. The scenarios are as follows:

- A *cost-constrained* scenario: Assumes achievement of the 33% Renewable Portfolio Standard while minimizing ratepayer costs.
- A *time-constrained* scenario: Assumes achievement of the 33% Renewable Portfolio Standard as quickly as possible.
- An *environmentally-constrained* scenario: Assumes achievement of the 33% Renewable Portfolio Standard while minimizing environmental impacts.
- A *trajectory* scenario: Assumes achievement of the 33% Renewable Portfolio Standard based heavily on contracts signed by utilities through 2010 (i.e., continuation of the status quo).

Even if rigorously implemented, it is unclear how much the integrated resource planning approach will facilitate planning efforts for localized renewable energy sources. While the four scenarios assume varying levels of localized renewable energy generation, they only assessed potential development within existing Competitive Renewable Energy Zones, most of which are located in remote and rural areas of the state without access to distribution grids.[13] The vast majority of potential sites for new localized renewable generators were not included in the analysis. Furthermore, only one of the scenarios – the environmentally-constrained scenario – assumes a high proportion of localized generation in the resources portfolio. Based on the limited modeling, it will be difficult, if not impossible, to determine the relationship between varying sizes and locations of localized generation and critical metrics such as cost and greenhouse gas impacts. Finally, many of the benefits unique to development of localized renewable energy generation, such as local job creation and economic development, are omitted from consideration in the current integrated resource planning process.

At the time of this writing, CPUC staff is working on a report that analyzes the opportunities and constraints for high penetration of localized solar photovoltaic panel generators on the distribution grid, potentially filling some the information gaps for localized generation discussed above. Commission staff indicated that the report will describe the constraints posed by interconnection to the distribution gird, as well as the necessity of developing smaller sites – including commercial and industrial rooftops – in order to achieve the 12,000 megawatt goal. CPUC staff also indicated that the long term procurement planning process for 2012, which began last March, will continue to examine the intersection of local renewables with procurement planning, with a particular emphasis on local area reliability and procurement rule changes. They indicated that the 2012 process will explore ways to incorporate a "true" distributed generation scenario alternative into future analyses.[14]

2. POTENTIAL SOLUTION

Integrated Mosaic Resource Planning

A properly integrated resource plan would provide policy makers, utilities and stakeholders with the tools necessary to determine how the different policy objectives associated with the 12,000 megawatt goal – grid reliability, cost containment, speed of deployment, job creation, social justice – are interrelated, and what the potential tradeoffs are in different rankings of those objectives. It would also allow for a fine-grained consideration of different portfolios of generator technologies and demand-side policies, including potential smart grid tools and energy efficiency policies. The current utility plans, even with the recent changes, lack the *geographic component* necessary to make this happen. A bottom-up, location-based approach, resulting in a planning mosaic, could effectively incorporate the critical geographic component necessary for strategic and successful deployment of local renewables.

The Public Utilities Commission has recognized the need for a location-based, bottom-up style of planning. In a decision issued in January of 2004[15], the Commission stated:

"The integrated resource planning we seek to achieve would provide a comprehensive context for all of a utility's resource decisions and would include the following features:

1. Rather than considering projected load and resource needs only on a statewide or service territory scale, each utility would assess the different characteristics of the many planning areas within its service area – taking into account the nature of local customer load (such as specific industries, the residential mix, and related load profiles), transmission and distribution constraints, existing generation resources, land use concerns and community values.
2. Each utility would develop a base plan that would take into account least-cost resources, reliability needs, fuel diversity, and other risk management concerns. On the local level, the utility would determine the optimal way to meet demand (whether it would be through energy efficiency, demand reduction, transmission or distribution additions, distributed generation, renewables, or fossil generation).

3. On a service territory-wide basis, the utility would then determine whether the optimal local solution adequately supports total resource needs and the achievement of the state's policy preference for energy efficiency and renewables, and adjust the plan as needed to serve those broader needs.

"By relying on such a bottom-up approach, the utility would be able to understand the implications of its planning decisions. The Commission and utilities would be able ensure that state policies are implemented in a manner designed to contain cost while achieving other goals. Such a process is not merely consistent with the state's broader policy goals – it will help sustain them."

This type of plan forms a mosaic – the specific local elements of the plan combine to form a picture of resources and opportunities across the utility service territory. Each utility's integrated mosaic resource plan could then be used to guide and inform resource planning, reliability planning and interconnection planning. For example, areas that are identified as requiring additional generation for any number of reasons – projected load increases, transmission constraints or existing generators that are going offline – can be targeted as local energy procurement "hot spots." Costs that utilities would otherwise expend to supply energy to those locations, including new centralized generation and transmission grid upgrades, could be applied to those incentives.

Although the Commission has recognized the importance of geographically-based planning, the utilities have yet to embrace it, and the Commission has not taken steps to make it happen. Eight years after issuance of the decision calling for such planning, it is evident that the Commission must work more directly with the utilities to modify their planning processes, and enforce the requirement that utility plans address the local characteristics of the areas within their service territories.

Regional Targets

Participants at the Conference discussed regional local renewable targets as a means to break down the 12,000 megawatt goal into manageable increments and achieve many of the policy objectives associated with it. Indeed, regional targets could be established to encourage development of renewables near urbanized areas with the largest load centers. Regional targets could also direct development to areas in the state where the existing distribution grid can incorporate additional generation without expensive upgrades, and to communities with high unemployment that would most benefit from job creation and economic development. Regional targets could also enable cities and counties within each region to set localized goals and develop strategies to reach those goals through community planning, planning and zoning code updates, development of programs such as Community Choice Aggregations and PACE financing, and workforce training.

Some stakeholders, including the CPUC's Division of Ratepayer Advocates, recommended that the Energy Commission allocate the 12,000 megawatt goal among the state's utilities, and that the PUC require the investor-owned utilities to adopt those goals as part of their standard planning assumptions for use in the long-term procurement planning process.[16]

3. BARRIER: Inadequate Land Use Planning

As described above, one result of the disjointed and top-down nature of current resource planning is that utility resource plans fail to acknowledge and work with local and regional land use planning considerations. While cities and counties make the majority of land use decisions (see Chapter 5), the transmission and distribution grids generally do not respect political boundaries, serving "load" or demand centers, which usually encompass multiple jurisdictions. Resource planning, therefore, involves local and regional land use decisions. Integration of resource-sensitive renewable energy generators into the grid, combined with the decentralized nature of those generators, will only intensify the need for local and regional land use planning in order to maintain the reliability of the grid while minimizing costs.

The minimal level of land use planning for the siting of new renewable energy generators, combined with the array of federal, state and local government agencies that hold often overlapping land use and environmental oversight duties, creates an especially difficult climate for renewable energy developers. At a workshop hosted by the Energy Commission in May, 2011 to assess transmission demands for meeting the state's renewable energy goals, participants discussed planning needs, including the following:

- "The state needs to better coordinate planning across the various entities.'"
- "The assumptions and processes used by transmission planning organizations are not always transparent or consistent."
- "There is a need to ensure that streamlining or accelerating the process does not hamper effective environmental consideration."

Many participants identified coordinated land use and utility resource planning, transparency in the planning process, and consistency among relevant planning agencies as top needs for utility-scale renewable energy development.

In order to address those challenges in the context of utility-scale renewable energy projects, state agencies and utilities joined efforts to implement the Renewable Energy Transmission Initiative, a statewide land use planning effort to facilitate transmission and generation siting and permitting.[17] The initiative identified approximately 30 zones throughout California with the potential to provide the most cost effective renewable generation development and connection to the grid, with the least impact on the environment. The Desert Renewable Energy Conservation Plan represents a subsequent effort involving the same state agencies as well as federal agencies, several stakeholder groups and non-governmental organizations.[18] It builds upon the work of the Renewable Energy Transmission Initiative to develop a fine-grained land use map for the Mojave and Colorado Desert regions of Southern California that identifies prime locations for development of utility-scale renewable energy projects.

Conference participants identified the same general needs for localized renewable generation as those identified by utility-scale stakeholders: coordinated land use and utility resource planning, transparency in the planning process, and consistency among relevant planning agencies. While the Renewable Energy Transmission Initiative has focused on land use decisions for utility-scale renewable generators, it does not address land use planning for localized generation projects, which are necessarily sited in or near urbanized areas much closer to load. There are a few isolated examples of single agency land use initiatives that facilitate planning for localized renewable projects (described further in Chapter 5), such as the Environmental Protection Agency's RE-Power programs that encourages development of renewable energy generation on contaminated land and mine sites.[19] However, there is no similar comprehensive planning process for local renewable energy generators.

3. POTENTIAL SOLUTION

Development of Planning and Siting Criteria for Localized Renewable Energy Projects

Planning and siting criteria for localized renewable energy projects could mitigate many of the challenges currently faced by project developers, local governments and utilities. Development of the criteria would be a collaborative effort by utilities and local governments at a minimum, and may also include stakeholders such as developers, non-governmental organizations and labor and trade unions. The goal of the criteria would be to integrate local and regional land use concerns with utility resource planning and statewide goals for the 12,000 megawatt goal, consistent with the integrated mosaic resource planning approach described above.

Siting criteria could address interconnection constraints, for example by limiting development of local renewables to sites where either a) interconnection requests could be processed quickly, or b) upgrades would be needed, and costs for the upgrades could be easily allocated among projects proposed for the same distribution line. A number of other criteria could feed into the planning process, such as resource quality (i.e., strength and consistency of sunlight or wind), load profiles and forecasts, site availability, habitat and environmental constraints, and job creation benefits. The relative values accorded to those criteria could be determined by prioritization of the policy objectives for the 12,000 megawatt goal.

Like the zones created by the Renewable Energy Transmission Initiative, local renewable planning and siting criteria would not obviate required land use approvals or environmental reviews, but it could expedite those processes since the criteria could be configured to avoid siting of new projects in areas with sensitive habitat or other complex environmental issues. Land use authorities could also establish streamlined approval processes for projects that satisfy certain criteria.

Some Conference participants and stakeholders suggested creation of the local renewable energy zones similar to those developed under the Renewable Energy Transmission Initiative. While such zones could, like planning and siting criteria, direct development of local renewables in a manner consistent with certain values or policies, they would almost certainly engender much more complexity and controversy, due to the exponentially higher number of jurisdictions, land-owners and stakeholders that would need to be involved. In addition, renewable energy developers have warned that zones that are overly specific and fine-grained are more likely to cause market imbalances by removing due diligence barriers and encouraging developers to flood the zones with new projects.

4. BARRIER: Limited Data Availability

Planning for the integration of 12,000 megawatts of localized renewable generation is a substantial undertaking requiring a tremendous amount of data. The ultimate configuration of policy objectives and planning tools discussed above will shape specific data requirements, and topical data needs are discussed under the relevant subject headings later in this

Neither the private nor the public sector currently invests the resources required to accelerate clean energy innovation and drive down the cost of clean energy.

paper. Regardless of specific data needs or types, though, funding for data collection and data accessibility remain a fundamental challenge for local renewables. Conference participants described the problem as follows:

- "Some information about the distribution grid is currently not collected or available for central analysis, such as minimum load statistics."
- "Utilities need to publish grid information so that wholesale renewables developers can be aware of the preferred locations as early as possible."

4. POTENTIAL SOLUTIONS

Creation of a Statewide Data Clearinghouse for Localized Renewable Energy Generation Planning

A library or web portal that consolidates data relevant to development of localized renewable energy generation could address situations where useful data is available but difficult to access or inaccessible. It could include items such as detailed information about the existing distribution grids and planned upgrades, natural resource values, land use constraints, and availability of local and state incentive programs. It could also facilitate data standardization and highlight true data gaps. Information could be organized into a statewide database but would be most useful if users were able to access data relevant to specific cities or regions.

Consolidation of existing data would be a time, money and labor-intensive effort, and may also engender resistance from current data custodians. Privacy, competition, and safety are some of the issues that have been raised as potential obstacles to increased data availability and transparency. In most cases, those challenges can be addressed through fixes such as data consolidation, or registration requirements to gain access to data.

Increase Support for Research Programs

Investment in energy research is critical to ensuring the success of California's transition to clean energy, and sufficient funding for grid planning is a critical part of that transition. A recent report by the California Council on Science and Technology concluded that "significant levels of research, development, invention, and innovation" will be necessary to reach California's 2050 greenhouse gas emission target, and that the challenge is "as much a technology problem as it is a policy problem."[20]

Unfortunately, the current investment level falls far short of what is necessary. A joint study by the American Enterprise Institute and the Brookings Institute concluded that, despite a clear innovation imperative, "neither the private nor the public sector currently invests the resources required to accelerate clean energy innovation and drive down the cost of clean energy."[21]

In December 2011, the PUC established the Electric Program Investment Charge, a public funding mechanism intended to "provide public interest investments in applied research and development, technology demonstration and deployment, market support, and market facilitation, of clean energy technologies and approaches."[22] The program is intended to fill the void left by the recent expiration of the Public Goods Charge. The Energy Commission will be in charge of administering the funds, and could direct a significant portion of those funds to research that supports planning and integration efforts for local renewables.

Next Steps

BARRIER: Unclear Policy Objectives

- **Definition of Local Energy Resources:** Working with the Energy Commission and the Public Utilities Commission, the Governor's Office could articulate a clearer definition of localized generation within the context of the 12,000 megawatt goal. The definition should include, at a minimum, connection to the distribution grid in areas where energy can supply load without backflowing onto the transmission system.
- **Policy Objectives:** The Governor's Office could work with the Energy Principles group, representing the state agencies and organizations affecting energy policy, to formulate a clear expression of the importance of various objectives related to the deployment of local renewable energy sources.
- **Regional Targets:** The Governor's Office and the Energy Commission could establish regional targets toward achievement of the 12,000 megawatt goal.

BARRIER: Inadequate Planning Processes

- **Integrated Mosaic Resource Planning:** Effective implementation of a new resource planning model will require a combination of research and pilot studies, new organizational and strategic approaches within the utilities, and a clear expression of policy and intent from regulators. Toward that end, the Energy Commission could create a research agenda to support Integrated Mosaic Resource Plan and development and the California Public Utilities Commission could undertake rulemaking and incorporate into the Long Term Procurement Proceedings a clear expression of guidance and expectation for the utilities to implement.
- **Land Use Planning and Siting Criteria:** As part of the Integrated Mosaic Resource Plan process, the Energy Commission and the Governor's Office of Planning and Research could develop and implement a plan to create local renewable energy planning and siting criteria.

BARRIER: Limited Data Availability

- **Research Support:** The Energy Commission could report on research needs to develop a detailed plan for funding necessary research to support local renewable energy systems.

ENDNOTES

1 *See, e.g.,* National Renewable Energy Laboratory, *Distribution System Voltage Performance Analysis for High-Penetration Photovoltaics,* vi (February 2008), www1.eere.energy.gov/solar/pdfs/42298.pdf.

2 California Public Utilities Commission, *Long Term Procurement Plan,* http://www.cpuc.ca.gov/PUC/energy/Procurement/LTPP/ (last visted June 5, 2012)

3 *See* California Public Utilities Commission and California Energy Commission, *Energy Action Plan II: Roadmap for Energy Policies* (September 2005), http://www.energy.ca.gov/energy_action_plan/2005-09-21_EAP2_FINAL.PDF.

4 A resource portfolio is a mix of existing and proposed resources that would be constructed to serve a particular group of electricity consumers. For the purpose of integrated planning, a resource portfolio serves all customers in an Investor-Owned Utility area.

5 Governor Jerry Brown, *Clean Energy Jobs Plan*, http://gov.ca.gov/docs/Clean_Energy_Plan.pdf.

6 Letter from Heather Raitt, Assistant Executive Director, California Energy Commission, to Jeff Russell and Steve Weissman, Center for Law, Energy & the Environment (Mar. 23, 2012) (on file with the Center for Law, Energy & the Environment).

7 *See* Southern California Edison, *Advice Letter 2712-E* (Mar. 29, 2012), http://www.sce.com/NR/sc3/tm2/pdf/2712-E.pdf, and Pacific Gas and Electric, *Advice Letters 4020-E and 4020-E-A*, (Mar. 30,2012), http://www.pge.com/nots/rates/tariffs/tm2/pdf/ELEC_4020-E.pdf.

8 Letter from Kelly Boyd, Director, Legislative Affairs, Southern California Edison, to the Center for Law, Energy & the Environment (March 23, 2012) (on file with the Center for Law, Energy & the Environment).

9 *Id.*

10 California Public Utilities Commission, Decision 07-12-052, pp. 3, 116-117, 255-256 (Dec. 20, 2007),http://docs.cpuc.ca.gov/word_pdf/FINAL_DECISION/76979.pdf.

11 California Public Utilities Commission. *Energy Division Straw Proposal on LTPP Planning Standards*, p. vii (July 1, 2009), http://docs.cpuc.ca.gov/published/Graphics/103215.PDF.

12 *Id.* at 14.

13 California Public Utilities Commission, Pacific Gas & Electric Company, Southern California Edison and San Diego Gas & Electric Company, *2010 Long-Term Procurement Plan System Analysis Preliminary Results* (May 9, 2011), http://www.cpuc.ca.gov/NR/rdonlyres/DC4E126B-B8D0-41C5-9CB5-081CCF98689E/0/LTPP_Apr29_Filing_E3_final_5911.pdf

14 RETI Phase 2 Updates, (Mar. 9, 2012), http://www.energy.ca.gov/reti/documents/phase2B/RETI-CREZ_Map_10_0309.pdf.

15 California Public Utilities Commission, Decision 04-01-050 (Jan. 22, 2004), http://docs.cpuc.ca.gov/word_pdf/FINAL_DECISION/33625.pdf.

16 California Energy Commission, *Staff Draft Report on Renewable Power in California: Status and Issues*, , 81, 84(August 2011),http://www.energy.ca.gov/2011publications/CEC-150-2011-002/CEC-150-2011-002.pdf.

17 *Renewable Energy Transmission Initiative,* http://www.energy.ca.gov/reti/ (last visited June 5. 2012).

18 *Desert Renewable Energy Conservation Plan,* http://www.drecp.org/index.html (last visited June 5, 2012)

19 RE-Powering America's Land, http://www.epa.gov/oswercpa/ (last visited June 5, 2012)

20 California Council on Science and Technology, *California's Energy Future – The View to 2050*, 45 (May 2011), http://www.ccst.us/publications/2011/2011energy.pdf.

21 American Enterprise Institute, *Post-Partisan Power: How a Limited and Direct Approach to Energy Innovation can Deliver Clean, Cheap Economic Productivity and National Prosperity*, 13 (October 2010), http://thebreakthrough.org/blog/Post-Partisan%20Power.pdf.

22 California Public Utilities Commission, Decision 11-12-035, (Dec. 15, 2011), http://docs.cpuc.ca.gov/word_pdf/FINAL_DECISION/156050.pdf.

2 Integration and Reliability

Summary

Conference participants highlighted the challenges to grid reliability posed by integration of 12,000 megawatts of local renewables, which include both 1) intermittent power generation that depends on availability of a natural resource (i.e., sun or wind), and 2) power that is oftentimes sent back into the grid from local generators through lines and equipment designed to route power in the opposite direction. Nearly all participants said that further research on the reliability needs of the grid during integration are necessary, especially as the technologies of local renewables evolve and the array of technologies that will make up the 12,000 megawatts becomes more apparent. Participants also agreed that maintaining "grid flexibility" – the ability of the grid to quickly and adequately respond to changes in generation or demand – should be a key goal during integration.

However, participants and other stakeholders advocated several different responses to the challenges posed by local renewable energy systems, including better planning, more accurate forecasting, and investment in new technologies and strategies such as energy storage and demand response. This chapter explores the barriers and potential solutions for maintaining a safe and reliable energy grid during the state's integration of 12,000 megawatts of local renewable energy.

Introduction

Regulating electricity supply to meet demand is the paramount – and arguably the most complex – responsibility of grid managers and utilities. Utilities must accurately forecast energy demand, or "load," and then ensure that the system remain balanced with adequate power available to match the load.

Load profiles vary from community to community and load forecasters must consider an array of geographical constituents. Forecasters also consider multiple timeframes. Indeed, utilities and grid managers need to anticipate energy demand on a daily, hourly and even minute-by-minute basis. They must also project energy demand in the 10-20 year range so that they have sufficient time to develop new energy generators or plan for procurement of that energy from elsewhere.

While load forecasting can be a labyrinthine endeavor, energy supply forecasting and regulation has historically been much more straightforward. Conventional generators, such as coal-fired and nuclear power plants, provide a steady and reliable base flow of power into the grid. During the hours of peak demand, utilities can activate peaking power plants – generally gas turbines – that provide on-demand, or "dispatchable," energy generation.

California's grid managers and utilities procure and supply power under the principle known as economic dispatch, which is defined as "the operation of generation facilities to produce energy at the lowest cost to reliably serve consumers, recognizing any operational limits of generation and transmission facilities."[1] In other words, grid operators

select power sources based on their capabilities (such as ramp rate) to meet a particular type of demand, at the lowest cost, while maintaining reliability. Below is a condensed overview of California's existing fleet of conventional generators:

- *Baseload*: Large, conventional generators such as nuclear and coal-fired plants provide large quantities of inexpensive power. Since they are difficult to start up or shut down, and can take at least a few days to do so, they run continuously and serve what is known as base load, a minimum level of demand for power that rarely fluctuates.
- *Ramping*: Ramping (or "load following") generators adjust power output as demand for electricity fluctuates throughout the day, and ensure that average demand is met from one 5-minute dispatch interval to the next. Ramping up and ramping down are separate products that can be used as necessary to balance overall load. Load-following plants are typically less efficient and more expensive than base load plants, but able to start and stop production more quickly and easily.
- *Peakers*: Peaking power plants (or "peakers") operate for the half hour to hour of peak energy demand. These plants, which generally use gas-fired turbines, can fire up quickly but are among the most expensive power generators and are also associated with air quality impacts.
- *Reserves:* Spinning and non-spinning reserves can accommodate unexpected deviations in load or generation. They must be capable of being ramped to capacity and synchronized to the grid within 10 minutes of a dispatch instruction from the grid manager, and of maintaining that output for at least 30 minutes up to several hours at a time.
- *Regulation*: Real-time (second-to-second) adjustments to energy output from multiple generators are used to maintain an ongoing balance between load and generation and also control system voltage and frequency. Adjustment signals are dispatched by a centralized Automatic Generation Control system.

Renewable energy generation, while conferring many other important benefits, does not fit neatly into the traditional energy supply and demand framework. Renewable energy generators often rely on intermittent natural resources such as sun and wind, and therefore do not produce a consistent level of power around the clock. When integrated into the grid on a large scale, the intermittent nature of such renewable energy adds additional layers of complexity to grid management. It will require that utilities and grid managers accurately forecast energy supply in addition to demand, provide continuous energy when those intermittent resources are not available, and also accommodate situations where energy supply may exceed demand.

FIGURE 2a | California Average Wind And Solar Output & Net Demand

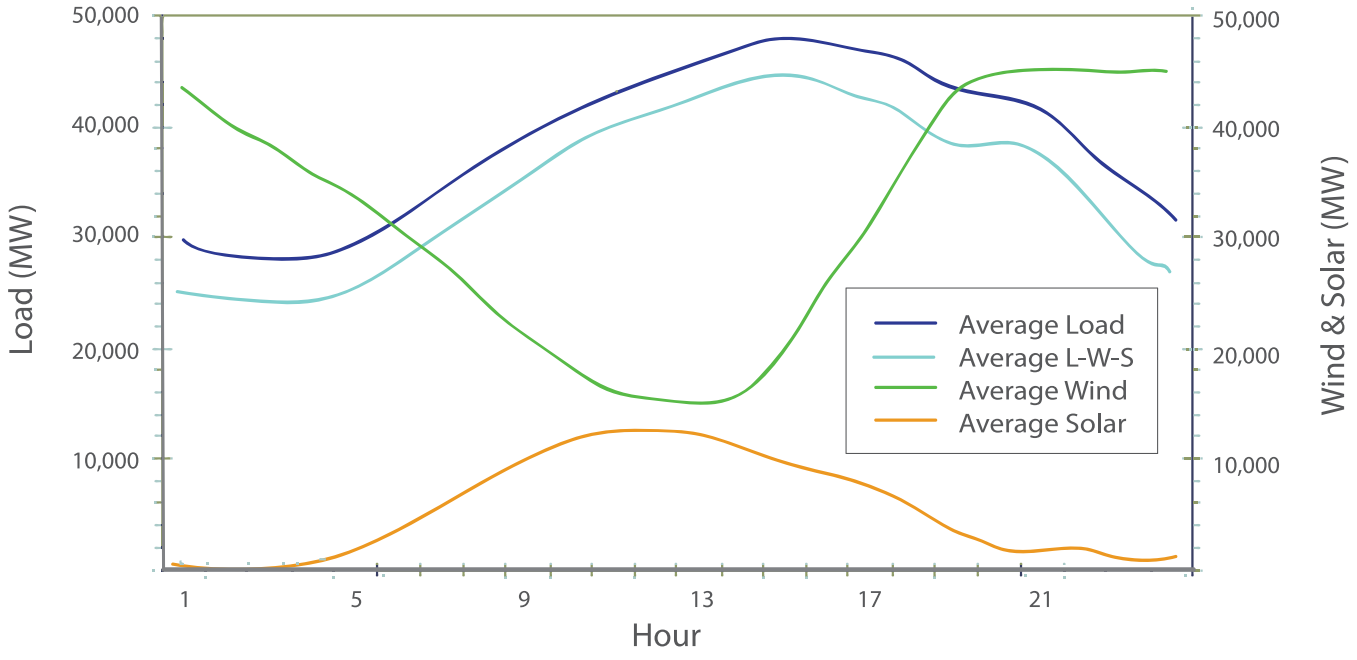
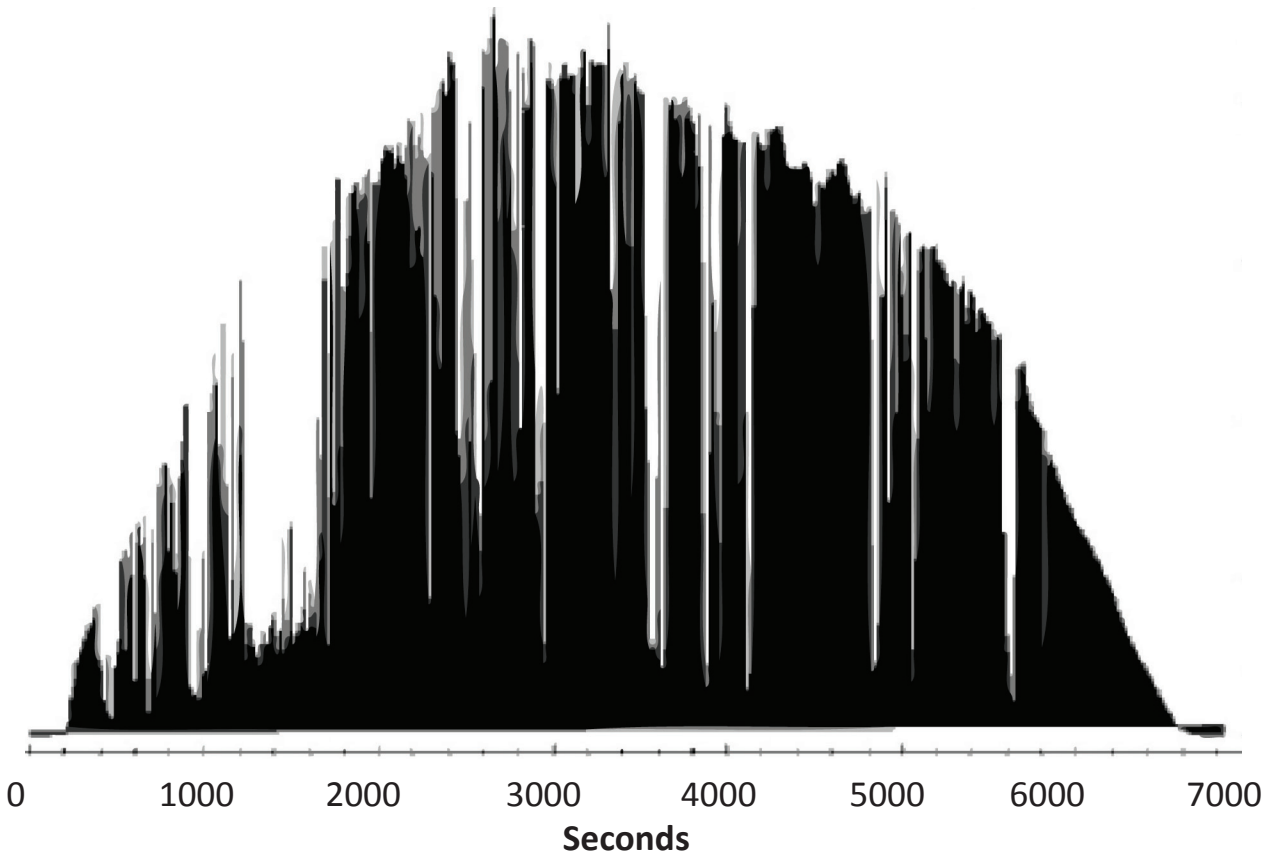


FIGURE 2b | Photovoltaic Facility Daily Output *Courtesy of EPRI*



In most of California, solar and wind energy exhibit generation profiles that complement one another. Solar energy is highest in the early afternoon, while wind energy is highest during the night (see Figure 2a). However, while those forecasts are reliable on a seasonal basis, they are much more volatile from day to day (due to dynamic weather patterns such as storm systems) and from hour to hour (due to transient effects from passing clouds or gusts of wind) (see Figure 2b).

Grid managers have identified the following operational challenges to integrating intermittent renewable energy sources into the grid:

- The magnitude of hourly overall ramping requirements;
- Intra-hour variability;
- Over-generation issues (particularly wind); and
- Large, near-instantaneous production ramps (particularly solar).[2]

Further complicating matters is the fact that the grid was not designed with these types of resources in mind. Ideally, the grid would be able to transport excess power to areas with existing demand. For example, if a layer of fog along the coast prevents the operation of solar panels in some neighborhoods, excess power from sunny inland communities could be tapped to compensate for the shortfall. In many locations, however, that conveyance would be prevented by existing distribution equipment, such as transformers that are not capable of routing power in two directions.

In addition, safety equipment on the grid may be deficient in handling hazards related to localized renewable generation. One situation where this arises is when a general blackout occurs, whether due to a transmission failure or a problem at a conventional generator. Localized energy generators, meanwhile, will continue to produce power and send it into the grid, an effect known as "islanding." Utilities have expressed concern that islanding can jeopardize the safety of utility workers, who may not be aware that they are working with live wires when responding to a power outage.

While anti-islanding equipment – built into the power generator and designed to detect power failures – can alleviate islanding problems, that equipment is still evolving. Utilities have noted that anti-islanding equipment can be susceptible to false positives and other miscues, shutting off power in response to a large draw on local energy such as that required to start a large engine.[3] Similarly, tripping of large amounts of localized renewable energy caused by a transmission-level outage or fault could result in serious problems for the grid.

Maintaining the reliability and safety of the grid while integrating 12,000 megawatts of localized renewable energy will entail a complex choreography between two dynamic actors – intermittent supply and fluctuating demand – on a stage that was built with only the latter in mind. Higher concentrations of renewable energy sources may entail greater reliance on ramping, reserves and regulation to maintain a steady voltage that meets demand. Use of those tools could come at a cost, both in terms of environmental and energy rate impacts. Until better solutions are available, improvements in forecasting, existing technologies and energy market regulations can mitigate and possibly negate some of those impacts. Ultimately, smart grid technologies (including energy storage and demand response, discussed below) may on their own provide adequate buffers for variability.

As described below, maintaining a balanced and reliable energy grid during integration will require making gradual changes to the tools, processes, and equipment used to manage the grid. Ultimately, California should aim to develop a fully integrated grid that allows for the nimble, efficient and automated regulation of clean energy.

Goals

Achieving smooth integration of 12,000 megawatts of localized renewable energy to the grid while maintaining energy reliability, quality and grid safety will require major changes to management of power supply, end-user demand, and the grid infrastructure that connects them. Utilities could, consistent with an Integrated Mosaic Resource Planning strategy (See Chapter 1), begin by assessing the different characteristics of the many planning areas within each service area. They could develop integration studies, and near and long-term plans for distribution equipment upgrades and procurement of supply and demand resources at the planning level, and use that data to inform similar integration studies and plans at the service area level.

Maintaining the reliability and safety of the grid while integrating 12,000 megawatts of localized renewable energy will entail a complex choreography between two dynamic actors – intermittent supply and fluctuating demand – on a stage that was built with only the latter in mind.

Throughout those processes, utilities could be guided by the following goals for grid reliability:

- *Mitigating system variability* through improvements such as more accurate forecasting technologies;
- *Maximizing system flexibility* through development of multiple tools to accommodate variability, such as demand response programs and energy storage.
- *Development of self-healing distribution grids* that will automatically correct for voltage or frequency irregularities.

Barriers

The discussion of barriers toward grid integration and reliability begins with barriers related to grid planning. As described in Chapter 1, the bottom-up approach of an

integrated mosaic planning approach would enable utilities and grid managers to better understand the implications of their planning decisions. That certainly holds true for decisions related to grid reliability, which cannot be made solely at a service-area level without a detailed understanding of how those decisions impact energy reliability and quality in myriad planning areas and distribution feeders.

1. BARRIER: Lack of Localized Integration Planning

According to the Los Angeles Department of Water & Power, "[distributed generation] will have to be truly distributed throughout our system in a studied fashion. Saturation in any area can result in voltage instability and/or circuit loading issues."[4] Southern California Edison notes that "impacts to the distribution system typically are confined to the localized circuit or nearby circuits, but not to circuits located hundreds of miles away. In other words, what is impacting the distribution system in the Los Angeles metro area typically does not have a cascading impact on a distribution system in the Palm Springs area."[5]

According to Southern California Edison, many integration problems are engendered by the remote siting of local renewables:

> "In SCE's experience most [local renewables] are sited in rural areas because land costs are lower, permitting may be simpler, and generator output may be maximized. Infrastructure upgrades to mitigate the resulting impacts on rural circuits are expected to be more significant than the circuits in urban load centers."[6]

In addition to inefficient siting, many of the hazards posed by poor integration of intermittent renewable energy resources result from distribution grids and equipment that are not designed to accommodate energy generation from local sources. Those hazards include:

- *Voltage Regulation*: Power generation from intermittent renewable energy resources such as solar photovoltaics is subject to significant variability. On a sunny day, passing clouds that shadow solar panels can cause voltage to rapidly plunge and surge. The graph in Figure 2b shows output of a large solar photovoltaic facility over the course of one day, with rapid voltage excursions due to clouds. Transformers can smooth out variability, but were not designed to manage the sustained variability of renewable energy generators. According to the Sacramento Municipal Utility District, voltage regulation is likely to be the greatest challenge to distribution grid stability.[7]
- *Islanding*: Islanding occurs when there is no power from a utility due to a generator blackout, transmission failure or other fault, but a localized generator continues to provide energy to a distribution circuit. The continued energy generation from the local source can causes safety hazards for utility workers, among other problems. Utilities have expressed concern that utility workers, responding to an outage, will unknowingly handle "live" power lines powered by local renewables and could be electrocuted. One study found that islanding can also damage renewable energy equipment and make it more difficult for a utility to restore power to the area affected by the blackout.[8] According to Southern California Edison, "[i]slanding also creates a safety concern for the general public and it can cause damage to customer equipment."[9]

  While renewable generation equipment is often equipped with "anti-islanding" devices that are supposed to trip the generator when they detect low voltage on the distribution line, utilities have expressed concern that problems with anti-islanding devices can lead to even larger problems on the grid. For example, the variability resulting from high localized penetrations of solar photovoltaics may cause the anti-islanding algorithms to fail, unnecessarily tripping large amounts of generation. A transmission-level fault or outage could lead so similar large-scale tripping events and resulting sustained power outages.
- *Reverse flows*: Localized energy generators send power back onto distribution feeder lines in the opposite direction than those lines were designed to convey power. According to Southern California Edison, "Transformers are designed to send power in two directions, but SCE's current system was not designed to perform this function. Further study of bi-directional flow from increased penetrations of [local renewables] is required."[10] Other utilities, however, have been able to manage increased levels of reverse power flows without problems. Los Angeles Department of Water & Power noted that, with roughly 4,000 localized energy generators – ranging from 1 kilowatt to more than 30 megawatts – connected to its distribution and/or subtransmission system, "there have been virtually no significant, pervasive problems or instances of...reverse power flow causing voltage regulation or power quality issues."[11]

- *Fault protection*: A fault is an abnormal flow of electrical current and can be caused by a number of factors, such as when a tree touches an electrical line and causes a momentary fault, or when equipment fails and causes a permanent fault. Due to its intermittent nature, some utilities have expressed concern that local renewables could contribute to system faults and impact reliability.

Many conference participants echoed the warnings issued by utilities about the need for a fine-grained, bottom-up approach to integration planning at the risk of jeopardizing reliability. However, some stakeholders framed the issue of integration planning as one not just of risks, but also of opportunities. According to comments from Vote Solar and the Interstate Renewable Energy Council:

> "A number of studies have confirmed the ability of solar photovoltaic (PV) systems to have positive grid impacts, including the ability to reduce system loading at the distribution level during periods of high electricity demand. Depending on the precise timing and duration of solar energy production, installation of solar PV offers an alternative to the traditional utility practice of building additional distribution assets to meet load growth and maintain system reliability. However, solar PV can only offer this benefit if deployment of solar PV is integrated into utility distribution planning in a sustained fashion."[12]

While it is clear that a lack of integration planning will result in a less reliable grid, many stakeholders contend that sophisticated integration planning can make the grid stronger, more reliable and more efficient than it is today.

1. POTENTIAL SOLUTIONS

Localized Integration Research and Planning

Whether it will result in grid improvements, or just maintain status quo reliability, utilities should deploy a forward-looking strategy to address integration of localized renewable generators. The existing approach to integration, which occurs through the interconnection review process (see Chapter 4), results in piecemeal, reactive planning decisions that lead to inefficiencies and do not maximize the benefits offered by localized renewable generation.

The Energy Commission and Public Utilities Commission could work with utilities to produce research in the following areas, the results of which can inform the integrated mosaic resource planning process:

- *Siting:* Studies could assess which siting arrangements for localized renewable energy generators will result in optimal reliability. A recent study indicates that geographic diversity of localized renewable generators can have a "smoothing" effect on variability; further research could focus on ways to incorporate that data into regional and sub-regional planning.[13] Research could focus on the optimal proximities of integration support facilities – such as energy storage or voltage regulation equipment -- to load or generation sources. Studies could review the impacts of different arrays of technologies, including solar photovoltaics, wind turbines, biogas generation and energy storage. Studies could also review different planning scales, from local to regional, including:
  - within a neighborhood block or renewable energy plant;
  - within distribution feeder lines or planning areas;
  - within service territories; and
  - within balancing authority regions.

- *Equipment upgrades:* Utilities could work together with manufacturers and developers to develop strategies for upgrading equipment on distribution lines to allow for high penetrations of renewable energy generators. A coordinated approach would ensure that utilities are using the best and most cost-effective practices and equipment. It would also enable utilities to incorporate equipment upgrade strategies into their integration planning processes, giving renewable energy developers a more accurate picture of the upgrade costs associated with interconnection at various locations on the distribution grid (see Chapter 4), and ensuring that expensive upgrades would not become obsolete at higher penetrations of localized energy generation.

Investor-owned utilities have expressed support for a coordinated approach to integration R&D. Pacific Gas & Electric cited a successful collaboration with manufactures and national laboratories on inverter certification methodology for small units at low penetration. According to PG&E,

> "The certification methodology...provided uniformity in design and simplified the interconnection process which led to the interconnection of thousands of [solar photovoltaic] inverters in a short period of time. Such a collaboration model

> could be repeated for high-penetration scenarios to meet California's 12,000 megawatt [local renewables] goal by 2020."[14]

Conference participants and other stakeholders articulated the need for coordinated research on the following equipment issues:

- *Low voltage ride through* requirements for generators beyond a minimum size to avoid widespread tripping and outages;
- *Better anti-islanding equipment* that would not be affected by high localized penetration of intermittent renewable energy or other causes of ephemeral variability;
- *Remote tripping signals and system monitoring* for generators beyond a minimum size that would allow utilities and grid managers to retain control of critical generation sources during faults or outages;
- *Over current or fault protection* from momentary faults (e.g., a tree touching a line) or permanent faults (e.g., equipment failures), including configuration of circuit breakers, relays, and fuses.
- *Voltage control systems* also known as voltage/volt-ampere reactive optimization tools; and
- *Transformers* than can handle high levels of power and fast switching, with built-in processors and communications hardware to communicate with utility operators, other smart transformers and consumers.

- *Data needs*: Utilities could identify the distribution grid data that they need to develop comprehensive integration plans, share information about distribution circuit performance under a range of localized energy penetrations, and collaborate to develop models that accurately project impacts of localized energy generation on the distribution grid.

Smart Grid Planning

Conference participants also suggested that integration planning efforts should be coordinated with the state's smart grid plans, and that the effects of the smart grid on localized renewable energy generators (and vice-versa) need to be fully explored and accounted for in the planning process. Indeed, a fully developed and mature smart grid could, in principle, enable automatic responses to variability and ensure the smooth operation and reliability of the grid. Many of the components of the smart grid, such as energy storage and demand response, are discussed in other sections of this chapter, and could be implemented as soon as practicable.

Significant research and development efforts are ongoing at universities and research centers throughout California to design the technologies that will be employed in the smart grid. It will be important to develop uniform standards for distribution equipment, such as meters and transformers, so that such equipment will be compatible with smart grid communication and management technologies when they are implemented.

2. BARRIER: Inadequate Forecasting

Forecasting is one of the most important tools available for maintaining grid reliability while containing costs. Accurate day-ahead and hour-ahead load forecasts enable utilities to procure energy and necessary transmission ahead of time at lower costs since they can avoid using more expensive reserve resources to meet demand. Of course, surprise weather events or other conditions sometimes result in disparities between forecasted and actual load. The larger those disparities are, the more utilities are required to rely on use of reserve energy sources.

Because the output of some renewable energy generators is determined by availability of intermittent natural resources such as sun and wind, integration of renewable energy will add variability to the grid. Utilities and grid managers can begin to address that variability through accurate energy generation forecasts, which like load forecasts, enable planners to prepare for variability by ensuring in advance that other energy resources (or loads) are available and capable of maintaining system balance. Errors in forecasted variable energy generation, when coupled with errors in forecasted load, can result in major disparities that necessitate last-minute reliance on expensive and resource-intense reserves.

Conference participants also advocated development of more sophisticated models, which they indicated could provide grid stability without the need for expensive real-time monitoring.

2. POTENTIAL SOLUTIONS

Coordinated R&D to improve forecasting tools, methods and data

Utilities and grid managers need more accurate forecast data both in the day-ahead (weather events) and real-time (transient clouds or wind gusts) time frames. They also need accurate and detailed information about renewable generation equipment and energy output fluctuations in response to changing conditions.

Some studies have shown that integration of renewable energy, if poorly executed, could negate a significant proportion of the greenhouse gas and conventional air pollution reductions.

Grid managers in California have already taken steps to improve forecasting data and techniques. New high-resolution forecast tools show promise in detecting timing and depth of variability.[15] California's Independent System Operator is evaluating forecasting tools that recognize correlated meteorological and system events, such as storms that decrease solar energy production but can also impact demand. They are also evaluating tools that can be used to estimate upward and downward regulation requirements (capacity, ramp rate, ramp duration) and similar load-following requirements. Researchers at the University of California, through the Energy Commission-funded Solar Power Forecasting Initiative, are developing a network of solar instruments to monitor, map and forecast solar resources.[16]

Continued research in day-ahead and real-time forecasting is necessary both to provide higher-quality data and to determine how forecasting tools, especially those that track highly localized events such as passing clouds, can be implemented in a cost-effective and efficient manner. Research efforts could also focus on better modeling of the performance of renewable energy generators, especially given the dynamic nature of the solar panel market.

3. BARRIER: Adverse Impacts from Gas-Fired Plants

California's goal of achieving 20,000 megawatts from renewable energy sources by 2020 is a core component of the state's strategy to reduce its greenhouse gas emissions. Still, some studies have shown that integration of renewable energy, if poorly executed, could negate a significant proportion of the greenhouse gas and conventional air pollution reductions.[17] That is because, as described above, integration of intermittent renewable energy sources could force greater reliance on fossil generators, such as gas-fired plants, to maintain energy balance on the grid. While preliminary results from integration models indicate that new gas-fired plants may not be necessary for integration of the renewable energy resources developed under the 33% Renewable Portfolio Standard,[18] existing plants would likely be cycled more frequently. Some conference participants expressed concern that increased cycling of existing gas-fired plants could result in disproportionate air quality impacts on low-income and minority communities, raising environmental justice issues.

3. POTENTIAL SOLUTIONS

Develop Strategies to Mitigate Variability and Reduce Reliance on Gas-Fired Plants

While reliance on existing conventional generation infrastructure will be essential in the near-term for integration of new renewable energy sources, that reliance could be minimized through a statewide strategy that both mitigates the impacts of variability and promotes development of alternative technologies to balance the grid and maintain reliability.

As described above, more accurate forecasting tools are currently being developed and could lower forecast error ratios. Utilities could incorporate these efforts, along with ongoing research and policy developments related to load balancing tools such as energy storage, demand response, and smart grid technologies, into their resource planning and procurement strategies to minimize use of gas-fired generators to the extent possible while maintaining grid reliability.

Bioenergy generation facilities

Some conference participants advocated regulatory and financial incentives for development of the bioenergy industry. Biogas, which typically comprises methane

and carbon dioxide, is produced through the biological breakdown of organic matter. Landfills, sewage treatment plants and dairy farms are among the facilities that process sufficient quantities of organic waste necessary to efficiently trap and process biogas, and either send it offsite or use it to generate electricity and thermal power onsite. According to a recent report from the Energy Commission, "[b]iopower has the potential to provide between 2,000 and 5,000 MW of the localized renewable capacity needed to achieve the Governor's goals."[19]

Biogas can serve as a dispatchable power plant fuel and presents many environmental benefits over natural gas. Foremost among those is that its use, compared with natural gas, would result in a net reduction in greenhouse gas emissions. Processing organic waste to create biogas would, by itself, significantly reduce the greenhouse gas emissions that would otherwise occur if that waste were allowed to decompose naturally. While combustion of biogas would nonetheless result in some greenhouse gas emissions, the net emissions would still be lower than those from fossil-based natural gases.[20]

Biogas is also more accessible than natural gas. Harvesting of biogas requires specialized processing equipment collocated with municipal and industrial facilities that process organic waste. If the biogas is used to generate electricity onsite, the facility only needs to interconnect to the electric grid.[21]

Natural gas, like any fossil fuel, must be extracted from the earth using drilling and pumping equipment. It then must be transported through pipelines, trains, or in the case of liquefied natural gas, specially-designed seagoing vessels that deliver it from remote plants to shore-side terminals. The transportation demands of natural gas add both expense and additional carbon emission impacts.

Despite the potential benefits, widespread use of biogas still faces many hurdles. In order to be connected to municipal natural gas lines, biogas must be processed to meet exacting safety standards.[22] Citing safety and purity concerns, all three of the investor-owned utilities currently prohibit injection of landfill gas into natural gas pipelines. An ongoing study by the National Renewable Energy Laboratory indicates that a constant supply of biogas from landfills may not, in any case, be sustainable, and that the economic and environmental impacts of processing biogas and sequestering waste streams need to be examined further.[23]

Biogas-fired plants could offer an attractive alternative to conventional gas-fired plants, and the results of pilot projects are promising. Assembly Bill 118[24] created the California Energy Commission's Alternative and Renewable Fuel and Vehicle Technology Program. A biogas-fueled combined heat and power plant at a sewage treatment facility in Sacramento, funded by that program, recently won an innovation award from a national R&D publication.[25] The Energy Commission's *2011 Bioenergy Action Plan* identifies legislative and regulatory actions necessary to streamline permitting, facilitate bioenergy development, support research and development of new technologies, increase use of organic material from waste streams, and preserve and create jobs in rural communities.[26]

Carbon Capture and Sequestration

In order to minimize air quality impacts and greenhouse gas emissions resulting from increased cycling of conventional gas-fired plants, some stakeholders have advocated retrofitting existing plants with carbon capture equipment so that the carbon could be sequestered. While carbon capture and storage may hold promise when integrated with new fossil-burning plants, it is more challenging to retrofit existing plants. According to a report by the Intergovernmental Panel on Climate Change, "[r]etrofitting existing plants with CO2 capture is expected to lead to higher costs and significantly reduced overall efficiencies than for newly built power plants."[27] As carbon capture technologies mature, they may prove to be a feasible and cost-effective tool to enable higher penetrations of intermittent renewable energy generation without risk of adverse air quality or greenhouse gas impacts.

4. BARRIER: Loss of Frequency Control

Frequency refers to the oscillations of alternating current (AC) in an electric power line transmitted from a power plant to the end-user. Major changes in frequency impact grid reliability, so grid managers (such as the California Independent System Operator) regulate frequency levels to stay within a certain range. Frequency deviation is caused by changes in energy supply and load, and is aggravated by major swings in either. One tool used by utilities to regulate frequency is inertia. Inertia is "the ability . . . to use the properties of synchronous generators to slow frequency deviation."[28] Utilities are able to slow down digressions in frequency from mandated levels through the continuous operation and modulation of synchronous generators – primarily turbines.

Intermittent renewable energy generators provide little to no inertia.[29] Grid managers have voiced concerns that as intermittent renewable energy sources displace

conventional generation, the system may have insufficient inertia to maintain system frequency or stabilize frequency following a grid disturbance.[30] However, the threshold at which inertia impacts become manifest is not entirely clear.[31] A recent study on the frequency response by the Lawrence Berkeley National Laboratory found that increased variable renewable generation would have four impacts on the efficacy of primary frequency control actions:

- Lower system inertia;
- Displace primary frequency control reserves;
- Affect the location of primary frequency control reserves; and
- Place increased requirements on the adequacy of secondary frequency control reserves.[32]

4. POTENTIAL SOLUTIONS

Expanded research, planning and use of alternative frequency control technologies

While intermittent renewable energy generators with little frequency control may eventually displace primary frequency control reserves such as large rotating masses, emerging technologies and market reforms could at least partially fill that gap. As recommended in the Lawrence Berkeley National Laboratory frequency study, grid managers and utilities could actively pursue greater use of the frequency control capabilities of demand response, fly wheels, energy storage and electric vehicles.[33] These technologies could be promoted through incentives and market reforms, as further described below. Grid managers could also, as recommended in the frequency study, develop comprehensive planning and operating procedures that consider interaction between primary and secondary frequency control reserves and address new sources of variability.[34]

5. BARRIER: Feasibility of Demand Response Programs

Demand response is defined as "changes in electrical usage by demand-side resources from their normal consumption patterns in response to changes in the price of electricity over time, or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized."[35] It is a market-based tool that works by aggregating smaller loads whose combined demand can be regulated by the utility to balance the grid. The load pools can be compensated and regulated through one of two programs:

- *Economic/price response* programs involve a voluntary response to a price signal.[36] When prices for load reach a level acceptable to a demand response pool, its load can be scheduled and dispatched by a utility, and during the schedule time the demand response pool forgoes the "sold" allocation of its energy demand.
- *Emergency/reliability* programs are similar to economic/price response programs except for that response is not voluntary. Instead, demand response pools receive a capacity payment in exchange for providing load availability, which utilities can access as necessary within certain limits.

The positive public reaction to demand response programs developed by California's utilities is promising, and early research indicates its strong potential as a tool to integrate localized renewable energy.

Several conference participants highlighted the important role that demand response programs will play in maintaining grid reliability during integration of localized renewable energy sources. When energy generation drops unexpectedly, demand resource pools can be called upon to curtail demand.

Because of new capabilities and demands placed upon it, demand response is in a transitional period. Historically,

demand response was largely employed to maintain grid reliability during system emergencies, in the form of targeted blackouts for large industrial customers. However, the deployment of advanced metering technology and development of new energy markets is enabling greater use and flexibility of demand response by all types of customers. Increasingly, customers are able to provide different levels of load reduction in response to price signals or other incentives.

In 2006, the Public Utilities called upon utilities to expand and augment their demand response programs.[37] An ad-hoc "Demand Response Measurement and Evaluation Committee," comprising representatives from the Energy Commission, Public Utilities Commission and three investor-owned utilities, is currently developing a Request for Proposals to assess the ability of demand response programs to provide renewable integration services.[38]

California utilities lead the country in investment in demand response programs.[39] Pacific Gas & Electric has implemented an automatic demand response program that is fully subscribed,[40] and is working with California's grid managers and the Lawrence Berkeley National Laboratory on a demand response pilot project focused on integration of large-scale intermittent resources.[41] Los Angeles Department of Water & Power is also preparing a demand response pilot project, and evaluating various residential load aggregation technologies that can provide demand response options for participating residential customers.[42] Southern California Edison is currently implementing a Demand Management System focused on deploying automatic demand response equipment in commercial office buildings, light industrial and similar larger energy consumers.[43]

The positive public reaction to demand response programs developed by California's utilities is promising, and early research indicates its strong potential as a tool to integrate localized renewable energy. Still, conference participants and stakeholders have voiced a number of questions relating to the fundamental relationship between demand response programs and increased localized energy resource penetration, including the following:

- How much demand response needs to be available to integrate 12,000 megawatts of localized generation?
- Traditional demand response programs curtail load during limited "stress conditions" such as seasonal peak demands, while integration of intermittent renewable energy sources may require much more frequent use of demand response. How will greater reliance on demand response affect program participation or cost?
- Can demand response programs provide a range of response times (i.e., day-ahead, ten minutes-ahead, and less than five minutes)
- Can demand response provide load reductions for long periods of time, such as four to six hours?
- Can demand response accommodate needs for increased load to balance over-generation?
- What are the frequency control capabilities of demand response programs?

5. POTENTIAL SOLUTIONS

Coordinated demand response program R&D and integration of demand response products into utility resource plans and policies

Current research into the capabilities of demand response programs is encouraging, but additional resources could be dedicated to resolving the questions listed above and determining whether there are geographical, technical, cost or market-based constraints that might limit the deployment or effectiveness of demand response programs. For example, grid managers have voiced concern that the telemetry and communication equipment used for large demand response resources may be cost-prohibitive for small and geographically dispersed demand resources.[44] It is also unclear how existing grid constraints, such as localized pockets of poorly connected load, will impact the widespread deployment of demand response programs and their ability to balance intermittent renewable energy sources.

Results from existing demand response programs as well as pilot projects funded by the Energy Commission through its demand response resource center[45] could be consolidated and used to inform policies and programs to deploy additional demand response programs in a manner that will support integration of localized renewable energy source. Ultimately, the Public Utilities Commission could require utilities, in their resource planning processes, to include procurement targets for demand response resources that support integration of localized renewable resources.

6. BARRIER: Feasibility of Energy Storage Technologies

The umbrella term "energy storage" refers to any process whereby energy is removed from the grid, stored, and dispatched at a later time. Many conference participants and stakeholders advocated deployment of energy storage (along with demand response, discussed above)

FIGURE 2c | Energy Storage Characteristics by Application (megawatt-scale) *Courtesy of EPRI*

Technology Option	Maturity	Capacity (MWh)	Power (MW)	Duration (hrs)	% Efficiency (total cycles)	Total Cost ($/kW)	Cost ($/kW-h)
Bulk Energy Storage to Support System and Renewables Integration							
Pumped Hydro	Mature	1680-5300	280-530	6-10	80-82 (>13,000)	2500-4300	420-430
		5400-14,000	900-1400	6-10		1500-2700	250-270
CT-CAES (underground)	Demo	1440-3600	180	8	See note 1 (>13,000)	960	120
				20		1150	60
CAES (underground)	Commercial	1080	135	8	See note 1 (>13000)	1000	125
		2700		20		1250	60
Sodium-Sulfur	Commercial	300	50	6	75 (4500)	3100-3300	520-550
Advanced Lead-Acid	Commercial	200	50	4	85-90 (2200)	1700-1900	425-475
	Commercial	250	20-50	5	85-90 (4500)	4600-4900	920-980
	Demo	400	100	4	85-90 (4500)	2700	675
Vanadium Redox	Demo	250	50	5	65-75 (>10000)	3100-3700	620-740
Zn/Br Redox	Demo	250	50	5	60 (>10000)	1450-1750	290-350
Fe/Cr Redox	R&D	250	50	5	75 (>10000)	1800-1900	360-380
Zn/air Redox	R&D	250	50	5	75 (>10000)	1440-1700	290-340
Energy Storage for ISO Fast Frequency Regulation and Renewables Integration							
Flywheel	Demo	5	20	0.25	85-87 (>100,000)	1950-2200	7800-8800
Li-ion	Demo	0.25-25	1-100	0.25-1	87-92 (>100,000)	1085-1550	4340-6200
Advanced Lead-Acid	Demo	0.25-50	1-100	0.25-1	75-90 (>100,000)	950-1590	2770-3800
Energy Storage for Utility T&D Grid Support Applications							
CAES (aboveground)	Demo	250	50	5	See note 1 (>10,000)	1950-2150	390-430
Advanced Lead-Acid	Demo	3.2-48	1-12	3.2-4	75-90 (4500)	2000-4600	625-1150
Sodium-Sulfur	Commercial	7.2	1	7.2	75 (4500)	3200-4000	445-555
Zn/Br Flow	Demo	5-50	1-10	5	60-65 (>10,000)	1670-2015	340-1350
Vanadium Redox	Demo	4-40	1-10	4	65-70 (>10,000)	3000-3310	750-830
Fe/Cr Flow	R&D	4	1	4	75 (>10000)	1200-1600	300-400
Zn/air	R&D	5.4	1	5.4	75 (4500)	1750-1900	325-350
Li-ion	Demo	4-24	1-10	2-4	90-94 (4500)	1800-4100	900-1700
Energy Storage for Commercial and Industrial Applications							
Advanced Lead-Acid	Demo-Commercial	100-10000	200-1000	4-10	75-90 (4500)	2800-4600	700-460
Sodium-Sulfur	Commercial	7200	1000	7.2	75 (4500)	3200-4000	445-555
Zn/Br Flow	Demo	625	125	5	60-63 (>10000)	2200	440-1040
		500	250	2		2300	
Vanadium Flow	Demo	600-4000	200-1200	3.3-3.5	65-70 (>10000)	4380-3020	1250-915
Li-ion	Demo	100-800	50-200	2-4	80-93 (4500)	3000-4400	950-1900

FIGURE 2d | Energy Storage Characteristics by Application (kilowatt-scale)[55] *Courtesy of EPRI*

Technology Option	Maturity	Capacity (kWh)	Power (kW)	Duration (hrs)	% Efficiency (total cycles)	Total Cost ($/kW)	Cost ($/kW-h)
Energy Storage for Distributed (DESS) Applications							
Advanced Lead-Acid	Demo-Commercial	100-250	25-50	2-5	85-90 (4500)	1600- 3725	400- 950
Zn/Br Flow	Demo	100	50	2	60 (>10000)	1450-3900	725-1950
Li-ion	Demo	25-50	25-50	1-4	80-93 (5000)	2800-5600	950-3600
Energy Storage for Residential Energy Management Applications*							
Lead-Acid	Demo-Commercial	10	5	2	85-90 (1500-5000)	4520-5600	2260
		20		4			1400
Zn/Br Flow	Demo	9-30	3-15	2-4	60-64 (>5000)	2000-6300	785- 1575
Li-ion	Demo	7-40	1-10	1-7	75-92 (5000)	1250-11,000	800-2250

as a potential solution to the variability challenges posed by integration of intermittent renewable energy sources. According to California's Independent System Operator:

> "One strategy for mitigating the challenges of intermittent and variable generation impact on grid operations is to utilize storage technologies. Energy Storage has the potential to change the current "just in time" paradigm by absorbing energy during one period and delivering it within another period based on system conditions. Storage can address the dilemma of continuously matching supply and demand."[46]

Following is a brief description of the current range of storage technologies. The tables in Figures 2c and 2d contain information about storage and applications, maturity status, capacity and costs.

- *Pumped hydro*: In a pumped hydroelectricity storage system, water from higher-elevation reservoirs is released through turbines to generate electricity, typically during periods of peak demand. Water is pumped uphill from a low-lying reservoir during periods of lower electricity demand, typically at night, when rates are less expensive. Pumped hydro is a net consumer of electricity because the energy it generates provides between 70 to 85 percent of the energy required to pump the water.[47]
- *Compressed air*: Compressed air energy storage uses off-peak electricity to compress air and store it in a reservoir, either an underground cavern or aboveground pipes or containers. When electricity is needed, the compressed air is heated, expanded, and directed through a conventional turbine-generator to produce electricity.
- *Rechargeable batteries*: Batteries use a reversible chemical reaction to store energy. Several different types of large-scale rechargeable batteries exist, including lead acid, sodium sulfur, lithium ion, and flow batteries.
- *Thermal energy storage*: Thermal energy storage plants use passive or active energy to store thermal energy for later use. Examples include solar thermal storage, which uses molten salts to retain a high temperature solar thermal energy that can later be used to generate electricity. At the other end of the thermometer, ice-based technologies use off-peak power to create ice that can be used as a thermal coolant during peak demand periods.
- *Flywheels*: A flywheel stores kinetic energy in a spinning rotor made of advanced high-strength materials that is charged and discharged through a generator. Flywheels have a high cycle life, long operating life of about 20 years, rapid response time of 4 milliseconds or less, and fast charging and discharging times of a few seconds to 15 minutes.[48]

In 2010, the California legislature enacted AB 2514, which

directed the Public Utilities Commission to evaluate the costs and benefits of energy storage and, if necessary, determine energy storage procurement targets for investor-owned utilities.[49] Commission proceedings on energy storage are ongoing.[50] Two recent reports are assisting with that effort: *The Power of Energy Storage*, a white paper from the UC Berkeley and UCLA Law Schools released in July, 2010;[51] and *2020 Strategic Analysis of Energy Storage in California*, a comprehensive analysis of current energy storage technologies and policies released by the Energy Commission in October, 2011.[52] In November 2011, Southern California Edison signed an agreement for development of molten salt storage technology at planned solar facilities, which will allow those facilities to operate into the night and also reduce their footprints.[53]

Energy storage holds the promise of providing a counterbalance to the variability that 12,000 megawatts of intermittent renewable energy sources will engender, without the greenhouse gas and air pollution impacts of gas-fired generators. The wide range of storage technologies may someday be capable of maintaining grid reliability and power quality, both on a system-wide scale (such as over a utility's entire service area) and on a much more localized scale (such as on an individual distribution feeder). Energy storage may also provide critical frequency-control services through automatic injection of energy into the grid.

Before they can serve in those roles, energy storage technologies must overcome a number of barriers. Chief among those is cost, according to a majority of conference participants. According to the California Council on Science and Technology, "[t]he cost barrier [of storage] is quite high, with natural gas turbines currently providing load following services for about $0.10/kWh and commercial batteries being from 4 to 10 times that value. Pumped hydro and [compressed air energy storage] are more competitive, but are more limited to specialized geography."[54] Other energy storage barriers imparted by conference participants and other stakeholders include:

- Lack of location-specific data about costs and benefits of energy storage integration;
- Lack of data about how energy storage could operate in conjunction with demand response and gas-fired plants; and
- Regulatory and market frameworks that are unfavorable to integration of energy storage and do not efficiently capture the multiple value streams it offers.

6. POTENTIAL SOLUTIONS

Integrated analysis of opportunities and constraints for energy storage

Consistent with an integrated mosaic resource planning strategy (see Chapter 1), analyses of the opportunities for energy storage integration could begin at the local level, accounting for the different characteristics of the many planning areas within each service area. The Public Utilities Commission could require utilities to define applications of localized energy storage facilities, focusing on substation grid support and maintenance of power reliability and quality for end users in urban and rural load pockets.[55] Utilities could research how storage could meet the needs of both end-users and utilities, and run application-driven storage demonstrations and field trials.[56] Examples of such work are already in progress: PG&E is installing a two megawatt battery system in conjunction with a solar photovoltaic installation at its VacaDixon substation to test the use of energy storage in combination with solar photovoltaic to mitigate distribution system impacts.

Localized studies would complement larger, service-area wide studies: integrated assessments that address the value of storage in enabling higher penetrations of localized renewable generation resources. These studies, conducted by utilities in conjunction with grid mangers, could incorporate multiple regional integration scenarios, as well as data from case studies and demonstration projects, to determine the best types and locations of bulk storage facilities. For example, the Public Utilities Commission recently approved a 300 megawatt compressed air energy storage demonstration project in Kern County, which will be constructed by PG&E using federal funds.[57]

Additional state or federally-funded research could focus on topics including:

- *Inertia*: How can storage address needs for system inertia caused by high penetration of intermittent renewable resources?
- *Relationship with demand response:* How can energy storage operate in conjunction with demand response technologies? How can utilities and grid managers maximize the unique benefits of each?
- *Relationship with gas-fired plants:* What are the costs and benefits of utilizing energy storage technologies over existing natural gas-fired plants? What are the costs and benefits of utilizing energy storage technologies over building new, more efficient gas-fired plants?

- *Siting*: What are the implications of different siting strategies for energy storage devices? What is the relationship between the costs and benefits of an energy storage facility and its proximity to energy generation or load?

Regulatory and market reforms

Existing regulations related to long-term energy procurement and near-term energy markets are neither designed to incentivize development of energy storage facilities nor capture the multiple value streams that storage offers. The California Independent System Operator and the Federal Energy Regulatory Commission are instituting changes to energy markets to address some of those barriers, including:

- Development of a *regulation energy management market* in that will allow demand response and storage resources to place bids on regulation services; and
- *Frequency regulation compensation* to compensate storage systems and other new technologies that can provide faster ramping up and down of generation than previously available.

Below are additional policy initiatives and regulatory changes that could address some of the barriers posed by the existing energy market framework:

- *Valuation*: The Public Utilities Commission could establish a valuation methodology for storage technologies that assesses their value based on integration and grid support needs (e.g., frequency regulation).
- *Resource Adequacy*: The Public Utilities Commission could analyze how energy storage could affect utilities' resource adequacy requirements, including both the ability for storage to be used to meet resource adequacy requirements, as well as its potential to enable higher penetrations of intermittent renewable resources.
- *Tariff changes*: The Energy Commission could fund a study of changes to tariff structures at different grid operators around the country (such as tariffs that incentivize speed and accuracy) and assess how those changes impacted the energy storage market. According to *2020 Strategic Analysis Of Energy Storage In California*:

  "Shorter scheduling may be necessary to justify tariff changes that would compensate providers for speed and accuracy. Some comments received on this report indicate that compensation for faster or more accurate regulation will not assist energy storage manufacturers unless California ISO implements shorter scheduling, noting the multiple initiatives at the Western Electricity Coordinating Council (WECC) related to intra-hour scheduling and a within-hour energy market."[58]

The Power of Energy Storage contains additional recommended regulatory changes that could allow for the efficient capture and maximization of energy storage's multiple value streams.[59]

Financial incentives for development of energy storage facilities

Financial incentives could spur deployment of energy storage technologies just as they have spurred deployment of renewable energy resources. Below are potential financial incentives from *The Power of Energy Storage*:[60]

- *Tax incentives*: The federal government could provide tax incentives for energy storage projects, including an investment tax credit and accelerated depreciation for energy storage technologies.
- *Loan guarantees:* The federal government could offer loan guarantees for energy storage developers by having the United States Department of Energy extend its Loan Guarantee Program to energy storage technologies.
- *Carbon market*: The federal government and the California Air Resources Board could set an appropriate price on carbon that reflects the environmental costs of energy to make renewable energy and energy storage more competitive in comparison to fossil fuel-based energy.
- *Standardized contracts*: The Public Utilities Commission could develop standardized contracts that account for avoided and capacity costs.

Next Steps

BARRIER : Lack of Localized Integration Planning

- **Proactive Localized Integration Research and Planning:** The Public Utilities Commission could direct utilities to develop localized integration strategies that incorporate the most current data regarding optimal arrays and siting of energy generators and ancillary equipment, and established models of distribution line impacts from a range of renewable energy penetration levels. Integration strategies, while useful in the near term for interconnection planning, will ultimately inform and be affected by an integrated mosaic resource planning process (see Chapter 1).
- **Smart Grid Planning:** As part of its smart grid planning process, the Public Utilities Commission could establish standards for smart grid equipment and ensure that distribution equipment upgrades deployed for integration purposes meet those standards.

BARRIER : Inadequate forecasting

- **Coordinated research and development to improve forecasting tools, methods and data:** The California Independent System Operator, Public Utilities Commission and the Energy Commission could continue to provide resources for research to improve day-ahead and real-time forecasting. Utilities could work with manufacturers of renewable energy generation equipment to develop stronger models to predict how the equipment will perform under various meteorological conditions. Modeling could be conducted in tandem with development of performance standards for renewable energy generation equipment.

BARRIER : Adverse Impacts from Gas-Fired Plants

- **Development of strategies to mitigate variability and minimize reliance on gas-fired plants:** The Public Utilities Commission could direct utilities to develop strategies that minimize reliance on gas-fired plants by both mitigating sources of variability and utilizing alternative technologies such as energy storage and demand response.
- **Feasibility analysis of biogas generation facilities:** The Energy Commission could include in its Bioenergy Action Plan steps to assess the feasibility of biogas generation facilities as an alternative to natural gas-fired plants for the purpose of integrating high penetrations of variable renewable energy resources. The analysis could include various biogas sources such as dairy farms, landfills and sewage treatment plants and the associated cost, technical, regulatory and political constraints.

BARRIER : Loss of Frequency Control

- **Expanded research, planning and use of alternative frequency control technologies:** The California Independent System Operator and Public Utilities Commission could direct utilities to explore and increase use of the frequency control capabilities of demand response, fly wheels, energy storage and electric vehicles. The agencies could promote deployment of those policies and technologies through targeted incentive programs and market reforms. Utilities could also be required to address new sources of variability and their strategies to address that variability during the resource planning and procurement process.

BARRIER : Demand Response Programs

- **Coordinated demand response program R&D and integration of demand response products into utility resource plans and policies:** The Energy Commission could continue to fund research into the ways that demand response programs can be structured and deployed to address grid reliability issues. The Public Utilities Commission could require utilities, in their resource planning processes, to include procurement targets for demand response resources that support integration of localized renewable resources.

Next Steps (continued)

BARRIER : Energy Storage Technologies

- **Integrated analysis of opportunities and constraints for energy storage:** The Public Utilities Commission could require utilities to define applications of localized energy storage facilities, focusing on substation grid support and maintenance of power reliability and quality for end users in urban and rural load pockets. Utilities could research how storage could meet the needs of both end-users and utilities, and run application-driven storage demonstrations and field trials. Research could also assess the relationship between energy storage and inertia, including how storage deployment could be coordinated with demand response to maximize frequency control capabilities.
- **Regulatory and market reforms:** The Public Utilities Commission could work with the California Independent System Operator to develop appropriate energy market and regulatory reforms that will stimulate development of storage by capturing its multiple value streams.

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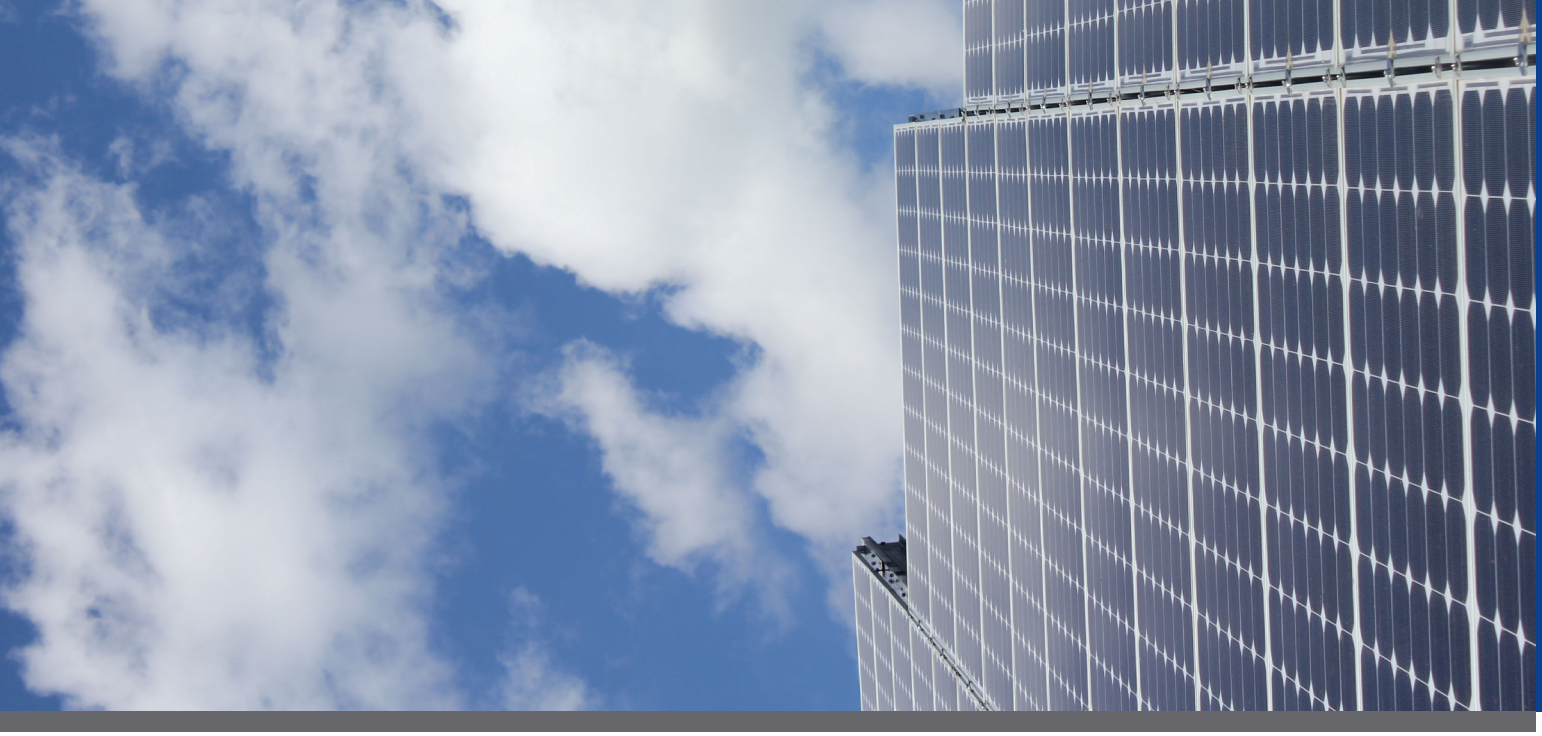
57 Refer to the full EPRI report for important key assumptions and explanations behind these estimates. All systems are modular and can be configured in both smaller and larger sized not represented. Figures are estimated ranges for the total capital installed cost estimates of "current" systems based on 2010 inputs from vendors and system integrators. Included are the costs of power electronics if applicable, all costs for installation, step-up transformer, and grid interconnection to utility standards. Smart-grid communication and controls are also assumed to be included. For batteries, values are reported at rated conditions based on reported depth of discharge. Costs include process and project contingency depending on technical maturity. The cost in $/kW-h is calculated by dividing the total cost by the hours of storage duration. For CAES and Pumped Hydro, larger and smaller systems are possible. For belowground CAES the heat rate may range from ~3845-3860 Btu/kWh and the energy ratio is 0.68-0.78; for aboveground CAES the heat rate is ~4000 Btu/ kWh and the energy ratio is ~1.0. For C&I and Residential applications lower CapEx costs may be possible if the battery system is integrated and installed with a photovoltaic system. First-of-a-kind system costs will be higher than shown. Future system costs may be lower than shown after early demonstrations are proven and products become standardized.

58 Abele, et. al, *supra* note 49, at 139.

59 Elkind, *supra* note 48, at 3-4.

60 *See id*.



3 Financing and Procurement

Summary

Conference participants observed that the ongoing credit crisis has impacted all sectors and sizes of renewable energy generators, and that development has depended upon government support and intervention, whether through supply-side programs such as rebates, incentives or loan guarantees, or through demand-side mandates such as the state's Renewable Portfolio Standard and energy procurement programs. While participants agreed that the guiding principle for financing and procurement programs should be the creation of a long-term, self-sustaining market, they disagreed about the level of government support and intervention necessary to get there.

Both financial incentives and energy procurement programs will be shaped largely by the objectives and priorities underlying the 12,000 megawatt goal. In the near-term, however, Conference participants generally agreed that the range of existing programs would support the development and growth of the renewable energy market during the economic crisis. At the time of this writing, significant demand-side programs and markets for local renewable energy generators – including the Feed-in Tariff, Renewable Auction Mechanism and Tradable Renewable Energy Credits – are in the early stages of development and implementation. The initial results of those programs will be important in guiding the state's policies to reach the 12,000 megawatt goal.

Introduction

Financing and procurement mechanisms for local renewable energy systems vary depending on how the energy generated by the system is used, and to that end there are two general classifications.

> "California's net metering program enables participants to get credits on their electricity bills for energy generated on-site, and also receive compensation for any energy generated in excess of what they consume."

Customer-side generators typically consume all of the power they generate onsite and therefore generally do not send a significant amount of excess energy back through the meter and onto the grid. Because energy demand for a single meter is relatively low, customer-side renewable energy facilities tend to be smaller, ranging from 1-2 kilowatts for a single-family residence to 1 megawatt for a large office building. California's net metering program, administered by the state's utilities and described further below, enables participants to get credits on their electricity bills for energy generated on-site, and also receive compensation for any energy generated in excess of what they consume.

Utility-side generators (also called *system-side* generators) send nearly all of the energy they produce through the meter and onto the grid. A utility purchases the excess power at predetermined wholesale rates and then sells it to its customers at retail rates.

Construction of a local renewable energy facility requires significant up-front capital, which is usually provided through public and private financial products or incentive programs. Financial products and incentives are often predicated on long-term agreements about the use or sale of the electricity generated by the new facility. Therefore, a discussion of financial products to finance construction of local renewable energy facilities necessarily entails a review of the energy procurement programs in place to determine how renewable energy is valued, purchased and sold. The following is a brief overview of existing financial products, incentives and procurement programs for both customer-side and utility-side local renewable energy facilities. Figure 3c contains an overview of the Public Utilities Commission's procurement and incentive programs.[1]

Customer-Side Projects

Financing

While traditional financial products such as home equity loans were once widely available to finance construction of customer-side renewable energy facilities, the collapse of the real estate market and the credit shutdown that followed spelled an end to the days of low-interest loans. Now, traditional financing is much more difficult and expensive to secure. Conference participants and stakeholders indicated that banks are generally unwilling to make loans when the only recourse available to them for a default is foreclosure on renewable energy equipment.

Public financing in the form of property tax assessments showed early promise as a viable tool to fill the gap left by the disappearance of private financing. In 2008, California amended its state law to enable cities and counties to offer property assessment clean energy (PACE) financing programs to property owners. PACE financing is provided by cities and counties, which establish assessment districts and issue bonds to provide upfront financing for the purchase and installation of local renewable energy generation equipment. Property owners who participate in the program and receive the funding pay it back over an extended period of time (15-20 years) through an additional assessment on the their property tax bill. Since the debt is attached to the property, PACE financing eliminates the penalty inflicted on property owners who purchase and install renewable energy equipment but who, upon selling the property, sacrifice the ability to realize a full return on their investment through energy rate savings. Because it is, like any assessment, attached to a property tax bill, (which in case of a default takes priority over other debts, including the mortgage), PACE provides cities and counties with sufficient means of recourse.

However, the primacy of PACE liens has proven to be a double-edged sword: in 2010, the Federal Housing Finance Agency told lenders that it would not buy mortgages with PACE assessments on them, characterizing them as "loans" that "disrupt . . . long-standing lending priorities."[2] Since then, most residential PACE programs have been suspended.[3] The State of California and other groups subsequently filed a lawsuit against the Federal Housing Financing Agency, asserting in part that the Agency inaccurately characterized the PACE liens as loans rather than assessments, consequently making them incompatible with Fannie Mae and Freddie Mac's standard loan provisions.[4] The lawsuit is scheduled to proceed to trial in 2012,[5] and a recent court ruling required the Federal Housing Finance Agency to open a public comment period on its decision.[6] Commercial PACE programs, which were not affected by the

The California Solar Initiative has been largely hailed as a success and has enabled the state's rapid deployment of residential solar photovoltaic panels.

announcement, continue to move forward in cities across the state, and have successfully expanded customer-side renewable energy in regions including Sonoma County and the City of Palm Desert.[7]

On-bill financing, another early-stage lending mechanism, resembles PACE financing and provides similar benefits. In a typical on-bill financing program, the utility lends the upfront capital necessary to purchase and install renewable energy generation equipment. The debt is tied to the electricity meter and paid back through utility bills over an extended term (though unlike PACE, that debt is not associated with a primary lien on the property). On-bill financing is intended to structure payments so that monthly energy savings exceed monthly debt payments. San Diego Gas & Electric and Southern California Edison both currently offer on-bill financing programs to non-residential customers for energy efficiency upgrades. Southern California Edison's program, opened in August, 2010, quickly reached its funding limit and currently has $6.3 million in projects on its wait list.[8]

Third-party ownership models, including leases and power purchase agreements, are also gaining traction as a means of developing customer-side renewable energy facilities. In exchange for monthly payments, a third-party developer installs and maintains the renewable energy equipment (typically solar panels) and is able to take advantage of state and federal renewable energy incentives (including the expiring federal investment tax credit cash grant and accelerated depreciation, discussed below). While leases take many forms, the general concept is simple: a home or business owner enters into a lease contract with the owner of the renewable energy equipment. Like leases, small-scale power purchase agreements use a third-party ownership structure, enabling individuals to reap the benefits of onsite renewable energy facilities with little to no upfront costs. Under a typical power purchase agreement, the host residence or business agrees to purchase the power generated by the equipment at a rate set forth in the terms of the agreement.

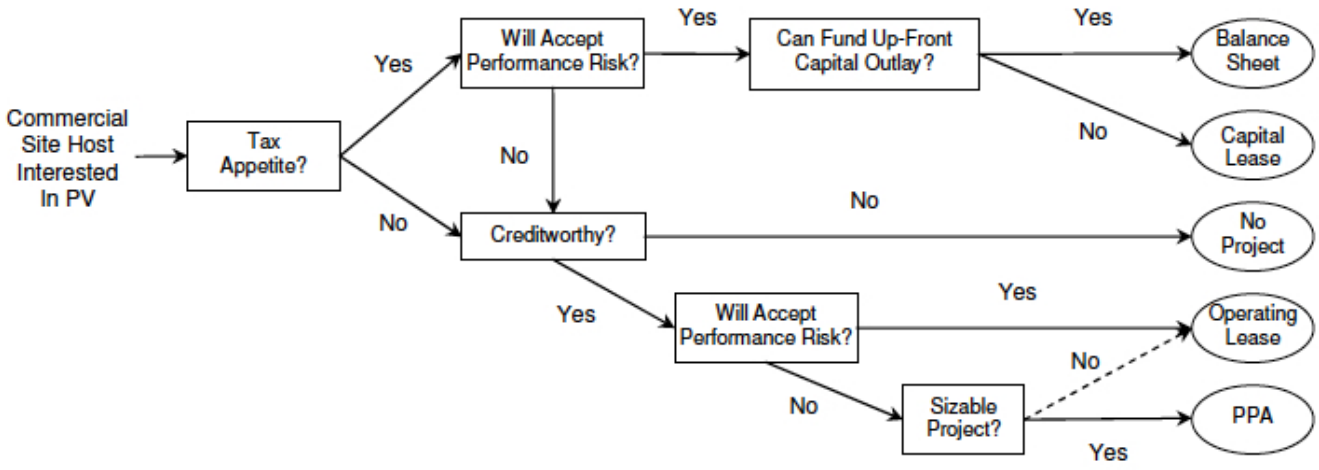
Incentives

Incentive programs generally take one of two forms: rebates, where a capacity-based rebate is awarded after meeting program conditions, and performance-based incentives, where awards are paid over an extended period of time based on actual performance of the equipment. Incentive programs typically contain specific maximum capacity limits for the projects they will cover, with the general restriction that projects cannot be sized any larger than necessary to serve a structure's existing energy demand. A number of different incentives are available through state and local government agencies and utilities, depending on a renewable energy facility's size, location and type of technology. The major state incentive programs available to customer-side facilities are described below:

- *California Solar Initiative:* Started in 2007 under the auspices of the Public Utilities Commission, the California Solar Initiative provides rebates to customers who install solar photovoltaic projects on their homes or businesses, with a goal of installing 1,940 megawatts of capacity in the investor-owned utility territories by 2016.[9] The program is limited to nonresidential structures and retrofits of existing residential structures (new residential structures are covered by the New Solar Homes Program, described below). Renewable energy projects under 30 kilowatts may receive a one-time rebate based on expected performance, while projects over 30 kilowatts are limited to an actual performance-based incentive paid over a period of five years. The initiative also includes targeted programs for low-income households.[10,11] The California Solar Initiative has been largely hailed as a success and has enabled the state's rapid deployment of residential solar photovoltaic panels.[12]
- *New Solar Homes Partnership:* Managed by the Energy Commission, the New Solar Homes Partnership provides rebates to solar photovoltaic projects on newly constructed single-family homes and is intended to complement the California Solar Initiative.[13]
- *Self Generation Incentive Program:* Administered by the Public Utilities Commission, the Self Generation Incentive program provides rebates and performance-based incentives to renewable energy projects (excluding solar photovoltaic panels) over 30 kilowatts in size. The minimum project size is much larger than what is feasible on a single family residence, so program participation is limited to non-residential structures. The Public Utilities Commission revised the program so that it now provides higher incentives for emerging technologies, including energy storage and fuel cells. The program also provides a $2 adder for technologies that utilize biogas. Although participating customer-side generators must be sized to meet existing on-site load, there are no other system size limitations.[14] Technologies eligible for the program under the new requirements include wind turbines, fuel cells, organic rankine cycle/waste heat capture, micro

FIGURE 3a | Finance Structures for System-Side Renewables

Courtesy of NREL's "Financing Non-Residential Photovoltaic Projects- Options and Implications"



turbines, and advanced energy storage.[15]

- *Emerging Renewables Program:* The California Energy Commission established the Emerging Renewables Program in 1998 to "stimulate market demand for renewable energy systems by offering rebates to reduce . . . the initial cost of the system to the customer. The goal of the [Emerging Renewables Program] was to help develop a self-sustaining market for "emerging" renewable energy technologies in distributed generation applications."[16] After the establishment of the California Solar Initiative, the Commission repurposed the program to focus solely on wind and renewable fuel cells less than 30 kilowatts in capacity.
- *Net Metering Program:* California's Net Metering program in many ways resembles a procurement mechanism, as it enables energy generators to receive credits for energy that is generated and not used onsite, and also compensates generators for energy produced in excess of onsite load over a 12-month period.[17] Because renewable energy generation is highly variable, subject to quickly changing weather conditions, it rarely corresponds perfectly with onsite load. Solar panels, for example, provide maximum energy output slightly earlier in the afternoon than the occurrence of peak demand. Over the course of a few seconds, passing clouds can severely diminish energy production and cause it to surge back up. Due to this natural variability, a generator can be putting excess power onto the grid one minute, and then taking power off the grid the next minute. Net Metering is critical for smoothing out these undulations in energy production and ensuring that customer-side renewable energy generators receive adequate credit for the energy they produce.

Utility-Side Projects

Financing

Utility-side local renewables face a financing landscape just as challenging, if not more so, as customer-side projects. Conference participants, whether affiliated with lending institutions or development firms, agreed that financing for utility-side projects has been extremely difficult to secure in the wake of the financial market meltdown. Nearly all projects depend heavily on federal incentives, described below.

Utility-side projects utilize many of the same financing models described above for customer-side projects, including leases and PPAs. Figure 3a contains a simplified decision tree that illustrates the basic criteria underlying each of the major financing models for utility-side projects.

Incentives

The federal government provides incentives in the form of tax credits and loan guarantees to qualified utility-side renewable energy projects. The most significant of those has been the cash grant available in lieu of an investment tax credit pursuant to Section 1603 of the American Recovery and Reinvestment Act of 2009.[18] Identified by many as "the single most important piece of legislation for solar in recent history,"[19] the program allows participants to apply for a cash grant covering up to 30% of the system cost, regardless

of tax liability. Grants are allocated according to technology type and project size.[20]

The program was precipitated by the sudden dearth of tax equity investors resulting from the financial market meltdown. Tax equity investors are "companies with large balance sheets, traditionally banks and more recently larger corporations, which purchase tax credits to shelter otherwise taxable income, while also providing an essential financing tool for large renewable projects."[21]

The cash grant program expired at the end of 2011. Most conference participants said that the expiration of the cash grant program would restrict development of new renewable energy generators for at least the coming year or two since the tax equity market has yet to fully recover, leaving developers with no means to monetize the tax credit. In addition, a report by the National Renewable Energy Laboratory concluded that transaction costs to monetize tax credits are significantly higher than transaction costs to process a cash grant.[22] Expiration of the cash grant creates a two-fold problem: most projects will be unable to secure tax equity financing, and those that do would be more expensive and time-consuming to complete.
Other federal incentive programs include the following:

- *Accelerated depreciation:* Federal tax law enables businesses to recover investments in certain property through annual depreciation deductions according to codified schedules ranging from 3 to 50 years.[23] Owners of renewable energy equipment may typically deduct depreciation for the equipment over a 5-year span.[24] Legislation enacted in December, 2010 allowed businesses that placed qualifying renewable energy equipment into service after September 8, 2010 and before January 1, 2012 to qualify for a 100% first-year bonus depreciation.[25] Equipment placed into service in 2012 is eligible for 50 percent first-year bonus depreciation.[26] A study by the National Renewable Energy Laboratory concluded that even the 5-year schedule reduced solar photovoltaic system costs by as much as 26 percent.[27] The more rapid schedules currently in place likely result in even greater cost savings.
- *Loan guarantees:* The federal government offers loan guarantee programs intended to ease the burden of securing private financing. The most prominent of those is the Department of Energy's Loan Guarantee Program, which targets larger projects with a minimum cost of $75 million.[28] The Department of Agriculture's Rural Energy for America Program provides loan guarantees with a maximum guarantee of the lower of 25% of a project's costs or $25 million. The loan guarantees are directed at smaller renewable energy projects located in rural areas.[29]

Procurement
Utility-side local renewable energy generators are developed specifically to feed electricity back into the grid at a rate that makes them profitable for project developers. The terms of

FIGURE 3b | Utility Solar Photovoltaic Programs

Utility	Eligible Technology	Project size limits	Program size limit*
Southern California Edison	PV (primarily rooftop)	500 kw - 10 mw (aimed at 1-2 mw)	500 mw
Pacific Gas & Electric	PV (primarily ground mount)	1 – 20 mw	500 mw
San Diego Gas & Electric	PV (primarily ground mount)	1 -5 mw	100 mw

** Utilities must procure roughly half the power under the program target from independent power producers and the other half from utility owned and operated generators.*

energy purchase are typically laid out in a power purchase agreement, wherein a utility or other load-serving entity agrees to buy power from a renewable energy facility for a certain period of time at a predetermined rate. Utilities and load-serving entities "select" renewable energy generators according to criteria unique to the procurement program that the generator chooses to participate in. Following is an overview of the main procurement programs used in California for utility-side projects.

- *Utility solar photovoltaic programs:* Operated by California's three investor-owned utilities, solar photovoltaic programs are targeted at relatively small project sites that do not have sufficient onsite load to participate in the California Solar Initiative program.[30] The programs are open only to solar photovoltaic facilities and require the administrating utilities to procure roughly half the power under the program target from independent power producers and the other half from utility owned and operated generators. Each program varies in the sizes and types of targeted projects, as seen in Figure 3b.

- *Feed-in tariff:* The feed-in tariff has been called the Swiss army knife of renewable energy policies: it is heralded as an adaptable, proven tool for affecting rapid changes in the growth of renewable energy generation.[31] Although feed-in tariff policies can be extremely varied, the basic premise is that utilities and renewable energy producers sign a long-term (15-20 year) power purchase agreement at a fixed price per kWh, which stimulates industry growth by guaranteeing producers a secure return on their investment.[32]

  There are two main alternatives for setting the price per kWh under a feed-in tariff. First, a "cost-based" approach sets technology-specific prices based on the levelized cost of energy (LCOE)—the price a generator must earn to break even, including initial capital costs and operations and maintenance over the system's lifetime—plus a rate of return for the developer. Alternatively, a "value-based" approach incorporates the avoided costs of the generation, such as utility's avoided cost of procuring other generation.[33]

  California first instituted a feed-in tariff in 2008.[34] To qualify for the feed-in tariff, projects can be up to 1.5 megawatts in size, and the contracted price per kWh is based on the Market Price Referent, an estimated cost of producing electricity at a hypothetical 500 megawatt natural gas-fired plant.[35] The prices vary based on the start date and length of the contract, but, as an example, a 15-year contract signed in 2010 would purchase electricity at about $0.09/kWh.[36]

  Three California Senate bills have authorized changes in the feed-in tariff, most notably by increasing the eligible project size to 3 megawatts, and by expanding the Public Utility Commission's options for setting the standard kWh price.[37] A May 2012 decision by the Commission will link feed-in tariff prices to the "highest priced executed contract" resulting from the Renewable Auction Mechanism auction held in November 2011. Under the Commission's decision, prices would be adjusted based on time of delivery and then adjusted upward or downward every two months based on market response.[38]

- *Renewable Auction Mechanism:* The Public Utilities Commission approved the Renewable Auction Mechanism in December 2010,[39] selecting it to be the primary procurement tool for utility-side local renewable energy.[40] The Renewable Auction Mechanism authorizes the investor-owned utilities to initially procure 1,000 megawatts of local renewable energy (comprising projects that are 20 megawatts or less) through a series of auctions. Each utility holds two auctions per year, and the first auction closed on November 15, 2011.[41] Utilities select bids by lowest-cost prices until the auction capacity is reached.

  The Public Utilities Commission developed the Renewable Auction Mechanism with the intent to streamline the procurement process: utilities develop standardized contracts that winning bids must enter into, enabling those projects to be submitted for approval by the Commission through an expedited regulatory review process.

Goals

Robust financial products, incentives and procurement programs are fundamental to the achievement of the 12,000 megawatt local energy goal, and the qualities of each will play a large role in determining the assortment of technology types, project sizes and locations that compose

the 12,000 megawatts. Conference participants agreed that policies related to financial products, incentives and procurement programs should support the development of a long-term, sustainable market for local renewable energy, though they had widely varying opinions about how to get there. Some participants advocated competition and free-market policies to achieve lower costs and long-term grid parity.[42] Others argued that long-term sustainability entails diverse technologies and project sizes, even if that diversity comes with higher near-term costs.

Ultimately, the principles guiding financial products, incentives and procurement programs should be consistent with the policy objectives for the 12,000 megawatt local energy goal as described in Chapter 1. However, for the purpose of this discussion, this paper assumes that they will be consistent with the below general principles that have implicitly guided the state's renewable energy policy decisions thus far:

- Maximizing system diversity in terms of both technology types as well as project sizes and locations; and
- Promoting grid parity by fostering competitive free markets and minimizing the length of time that projects are supported by government subsidies.

While these principles can often be in conflict, there are many examples of policies that have successfully achieved both. The discussion that follows addresses the financial and procurement-related barriers to achievement of the 12,000 megawatt goal, and demonstrates how existing programs do or do not support the foregoing principles.

Barriers

As development of renewable energy facilities becomes more widespread, costs for those facilities have fallen. That is especially true for the cost of solar photovoltaic modules, which declined 30 percent from 1998 to 2008 according to a study by Lawrence Berkeley National Laboratory.[43] Nonetheless, local renewable energy projects still face significant financing challenges that will likely persist given the continuing tumult in the credit market and significant uncertainty about the future of government incentive programs. Going forward, these challenges will require extremely efficient use of limited government resources and innovative financial products from the private sector.

Customer-Side Barriers

1. BARRIER: Lack of upfront capital for development of customer-side systems

Conference participants noted that the crash of the real estate and credit markets significantly curtailed the ability of most homeowners to draw on their home's equity to finance installation of renewable energy generation equipment. Establishment of PACE financing filled that critical gap, but the Federal Housing Finance Agency's subsequent statement that Fannie Mae and Freddie Mac would not buy mortgages with PACE assessments attached to them halted most residential PACE programs. Participants noted that without PACE financing, there are limited options for homeowners who prefer to own renewable energy equipment. While third-party ownership models such as leases and power purchase agreements have emerged as alternatives, stakeholders commented that even those models are threatened by the expiration of the cash grant in lieu of the federal investment tax credit, which is used by renewable energy developers to finance purchase and installation of customer-side renewable energy systems.

1. POTENTIAL SOLUTIONS

Federal legislation to eliminate prejudicial treatment of PACE assessments

Efforts are underway at the federal level to revive the PACE program by passing legislation that would restrict the Federal Housing Finance Authority's ability to discriminate against mortgages that are associated with PACE assessments.[44] Many Conference participants and stakeholders advocated an organized effort by California's leadership to push for support of federal legislation such as HR 2599 that would ease restrictions on PACE-assessed mortgages.

Effective and expanded on-bill financing programs

Conference participants urged state leadership to push for expanded on-bill financing programs for purchase and installation of renewable energy systems that also address the fiscal liability issues for the utilities and financial institutions. The debt from on-bill financed projects runs with the meter. Unlike PACE, however, on-bill debt does not carry the leverage of a primary lien on the underlying property, making it more difficult to recover in the event of a default.

Securitized debt

Two clean energy groups recently announced the formation of a working group intended to develop solar energy systems into an investment-grade asset class.[45] Securitization, which involves bundling various sources of contractual debt and then reselling it to investors, can open access to a much

larger pool of capital than available through traditional lending can. According to one of the participants,

> "Standardization of key project attributes -- including contracts, proposals and credit metrics -- is vital to ensuring access to broader pools of capital for renewables as an asset class. This Working Group provides a forum to establish a unified voice among industry stakeholders and ultimately yield solutions that will accelerate the growth of the commercial solar market."[46]

Other Conference participants expressed skepticism about the near-term prospects for securitization of rooftop solar energy systems, indicating that the incentive and procurement programs for those systems need time to establish a strong and consistent track record before a market can be built around them.

2. BARRIER: Net Metering System Size Cap

Conference participants also said that the net metering system size cap should be raised. The net metering program currently contains a system size limit of 1 megawatt.[47] While that limit is more than adequate for single family homes, retail outlets and small offices, it precludes participation by large office buildings and industrial, agricultural and institutional facilities that have significantly higher energy demands and could meet those demands through onsite renewable energy facilities but for the lack of net metering options. At the Conference, a representative of the United States Navy commented:

> "Institutions such as [military] bases or universities should play a prominent role in the effort to reach the [12,000 megawatt] goal. The Navy is essentially barred from participating due to the 1 megawatt [net metering] limit and it cannot do deals with third parties under a partnership model."

2. POTENTIAL SOLUTIONS

Increase or remove the net metering cap to allow increased customer-side generation

Raising or eliminating system size limits would allow nonresidential customers with larger loads to install onsite renewable energy systems capable of meeting their entire load, resulting in systems with a lower cost per-kWh that have the added benefit of contributing to the state's RPS goals.

Investor-owned utilities have voiced strong objections to any expansion of the net metering program. Southern California Edison, for example, stated the following in its comments objecting to a bill (ultimately passed) to expand the range of eligible technologies under the net metering program:

> "The net energy program provides an unfair subsidy to net exporting customer-generators by paying for their generation at retail rates, effectively failing to charge for transmission, distribution and other services on all exported power. This creates an ongoing cross-subsidy of other customers to this customer class."[48]

The net metering program currently contains a project capacity limit of 1 megawatt. While that limit is more than adequate for single family homes, retail outlets and small offices, it precludes participation by large office buildings and industrial, agricultural and institutional facilities that have significantly higher energy demands and could meet those demands through onsite renewable energy facilities but for the lack of net metering options.

Virtual net metering solves these problems by enabling multi-unit buildings to distribute the credits from shared renewable energy systems to the meters of every unit in the building that chooses to participate.

In other words, utilities argue that the net metering program allows net metering customers to take advantage of the benefits of a retail rate without any responsibility for the underlying costs that justify the retail rate it the first place.

A report prepared by the Interstate Renewable Energy Council calls for a "full and fair cost accounting to measure societal and utility-side benefits and costs of [net metering]."[49] Such an accounting could determine whether and how much net metering customers benefit from transmission and distribution services, or alternatively if the energy is consumed onsite with nominal usage of the grid.

San Diego Gas & Electric has proposed assessing a "network use" charge to net metering customers that would compensate for their use of transmission and distribution services,[50] a move that engendered strong opposition from many of its customers and was ultimately rejected by the Public Utilities Commission.[51] Utilities and others have also proposed "time-of-use" pricing, which would establish a rate structure where the highest rates coincide with periods of peak demand when energy is more expensive for utilities to procure and transport. One of the additional benefits of time-of-use pricing is that it would encourage consumers to reduce energy use during peak periods.[52] Recommending time-of-use rates, the Interstate Renewable Energy Council report notes:

> "[T]o be effective, rates must contain low demand charges and have a relatively high on-peak to off-peak price ratio. This creates incentive for net-metered customers to lower consumption and increase generation to the maximum extent possible during all on-peak periods."[53]

Aggregate Net Metering

Meter aggregation allows customers who have more than one meter on their property to use net metering credits generated at one meter to offset consumption at multiple meters, allowing for more cost effective renewable energy facilities. California's net metering allows meter aggregation for municipalities,[54] but the state could expand aggregation to other large customers with dispersed operations such as agricultural customers and universities.

3. BARRIER: Lack of options for sites with limited or no ability to install onsite renewable energy systems

Conference participants and stakeholders commented that a significant percentage of the population is unable to take advantage of customer-side renewable energy programs and incentives for a range of reasons: they rent, they live in multi-unit buildings, they own homes with poor solar access, or they simply lack the resources to install a renewable energy system. Community-based renewable energy programs are an emerging ownership vehicle that can potentially provide this segment of the population with access to renewable energy.

3. POTENTIAL SOLUTIONS

Virtual net metering for multi-unit buildings

Under a standard net metering program, renewable energy systems do not make sense for multi-unit buildings. In most cases it is not feasible to install individual renewable energy systems for each unit, and allowing just a few units to benefit from a renewable energy system is not only unfair but also highly inefficient.

Virtual net metering solves these problems by enabling multi-unit buildings to distribute the credits from shared renewable energy systems to the meters of every unit in the

building that chooses to participate. Virtual net metering was initially established for use in conjunction with the Multifamily Affordable Solar Housing program, but the Public Utilities Commission voted in July, 2011 to extend virtual net metering to all multifamily buildings.[55]

Community renewable energy systems

While there are several different models for community solar programs, the general concept involves a group of community members banding together to either purchase, lease or enter into a power purchase agreement with an offsite renewable energy system. The model allows participants to reap the benefits of scale and realize significant cost savings.[56] It also opens up renewable energy sources to those who are unable to install onsite systems, such as renters, residents of multi-unit buildings and homeowners with poor access to renewable resources.

Participants in community renewable energy systems can realize the benefits from them only if they receive corresponding credits on their individual energy bills. Therefore, community systems require the support of utilities to implement accounting tools similar to virtual net metering. The Sacramento Municipal Utilities District has established its own community renewables program, called SolarShares, which is open to all customers in its service territory. SolarShares participants purchase shares of energy in a 1 megawatt solar farm in Sacramento that is owned and operated by a third party entity.[57] In exchange for a fixed monthly fee that corresponds with the size of the share, a participant receives a per-kilowatt hour credit for the electricity that his or her share of the system generates each month.

Under one model for a community renewable energy system, utilities could establish a bill credit system nearly identical to virtual net metering, except that participants would only need to live within the same utility territory as the renewable energy system that they own, lease, or purchase power from. The program could limit community renewable energy systems to no more than 20 megawatts in capacity, and a customer's share of facility credit to no more than 2 megawatts.[58]

Community Choice Aggregation

In a Community Choice Aggregation program, a city or county (or grouping thereof) aggregates the purchasing power of its residents to secure renewable energy supply contracts and/or renewable energy systems. The programs can result in lower costs for installation of renewable energy systems since they enable use of low- or no-interest local government financing options. According to an Energy

"During the first year of operation, the [Community Choice Aggregation program] can produce energy at a cost that is nearly 40% lower than what the [investor-owned utility] would incur if it owned an identical resource."

Commission report on a Community Choice Aggregation pilot project it funded,

> "During the first year of operation, the [Community Choice Aggregation program] can produce energy at a cost that is nearly 40% lower than what the [investor-owned utility] would incur if it owned an identical resource. The [Community Choice Aggregation program's] cost of producing renewable energy would be nearly the same as the market price of system power."[59]

The first operational Community Choice Aggregation program, established in Marin County, has engendered a great deal of controversy.[60] That is in part because the programs entail a high level of coordination and cooperation between local governments and the utility that services its residents. It also reduces the utility's role in serving a large pool of customers in its service area. Participation in Community Choice Aggregation programs is voluntary, though residents must proactively opt out of the program.

Several stakeholders have advocated stronger state support for Community Choice Aggregation programs. On October 8, 2011, Governor Brown signed SB 790 (Leno), which is intended to facilitate creation of Community Choice Aggregation programs by creating a "code of conduct" governing the relationship between investor-owned utilities and Community Choice Aggregation programs. A group of Bay Area renewable energy stakeholders has called for the following specific actions to support development of Community Choice Aggregation programs:

- Start-up financing through provision of matching grants to qualified communities;
- State level tax credits for renewable energy systems that supply only public load;
- Resolution of interconnection issues that hamper the ability of Community Choice Aggregation programs to implement feed-in tariffs.

Tradable RECs show promise as a market-based tool to inject capital into the renewable energy industry. Still, it is unclear how the market will fare once the quantity and price caps expire.

4. BARRIER: Difficulty of securing upfront capital for system-side projects

As described above, the continuing paralysis in the credit market has made utility-side local renewables much more difficult to finance. Almost all new projects have relied heavily on some combination of state and federal incentives, including the federal investment tax credit cash grant and accelerated depreciation. With the cash grant program expiring at the end of 2011, many conference participants warned of a slow-down in new projects in 2012. According to one stakeholder,

> "The result [of the expiration of the cash grant program] will be a bottleneck in 2012-13, where a substantial number of solar developers and other interested parties look to construct or own commercial-sized solar system, but only a select few can secure the requisite tax equity financing."[61]

A recent article in the *New York Times*, however, raised questions about the necessity for state and federal incentives (albeit for large, utility-scale projects), characterizing the incentives as a "windfall for the industry" that "raises questions of whether the Obama administration and state governments went too far in their support of solar and wind power projects, some of which would have been built anyway, according to the companies involved."[62]

Development of local renewable energy systems is arguably more challenging, less lucrative and harder to finance than development of utility-scale systems. Nonetheless, in the current economic and political climate, it is imperative that the federal and state governments are strategic in their design of incentive programs, and that they monitor the programs closely to ensure that they are operating efficiently and achieving predetermined targets. While, at the time of this writing, efforts are ongoing to extend the cash grant in lieu of the federal investment tax credit, many developers whose projects cannot attract tax equity financing or justify the associated high transactional costs are preparing to shift to alternative forms of financing for development of renewable energy systems.

4. POTENTIAL SOLUTIONS

Securitization

Some Conference participants suggested creation of securitized debt as a means to access capital. One proposed method of doing so is by allowing renewable energy entities to form Master Limited Partnerships, a type of

business structure that is taxed as a partnership, but whose ownership interests are traded on financial markets like corporate stock.

According to a recent report by the Congressional Research Service,

> "Being treated as a partnership for tax purposes implies that [Master Limited Partnership] income is generally subject to only one layer of taxation in contrast to publicly traded C corporations, which are subject to two layers of taxation. The ability to access equity markets in a manner similar to corporations allows [Master Limited Partnerships] to obtain greater amounts of capital. Access to a greater pool of capital, when combined with the favorable partnership tax treatment, may allow [Master Limited Partnership] to secure capital at a lower cost than similar businesses operating under a different organizational structure. The lower cost of capital, in turn, could increase investment in the renewable energy sector.[63]

Under rules established by Congress in the 1980s, Master Limited Partnerships must derive at least 90% of their income from activities related to oil and gas extraction, making them an attractive financial tool for fossil fuel companies.[64] In 2010, more than 70% of market capital in Master Limited Partnerships was attributable to midstream oil and gas operations.[65]

In 2010, Congress expanded the income class to include activities related to transportation and storage of renewable fuels.[66] Further Congressional action would be necessary to enable renewable energy firms to create Master Limited Partnerships.

Credit enhancements and loan guarantees

Government-provided credit enhancements and loan guarantees can facilitate private lending and improved loan terms for renewable energy projects. The Department of Energy's Loan Guarantee Program has provided backing for several successful renewable energy projects, and recently announced a loan guarantee for a project to deploy 750 megawatts of solar panels on rooftops across the county.[67] While the high-profile bankruptcy of Solyndra raised questions about public investment in renewable energy firms, the Solyndra case should be viewed in light of the vast majority of highly successful federal loan guarantees. A commentary from the Brookings Institution noted that:

> "The U.S. government runs some 70 loan guarantee programs and 63 lending programs that catalyze the financing of everything from transportation infrastructure and rural housing to science parks. More than $3 trillion of taxpayer money is at risk in these programs—$3 trillion some might deem a scandalous form of government intrusion into markets for education, housing, agriculture, exports, and entrepreneurship. Yet it's hard to find evidence the guarantees waste taxpayer dollars. Indeed, [the White House Office of Management and Budget] estimates that, on balance, these programs will return $46 billion to taxpayers in 2011."[68]

California is also preparing to offer credit enhancements: in August, 2011, Governor Brown signed a bill into law that will use up to $50 million from the funds originally appropriated to the PACE Bond Reserve Program for credit enhancements and other financial assistance directed towards development of local renewable energy systems, although those funds will be targeted toward customer-side systems.[69]

Tradable Renewable Energy Credit market

Renewable Energy Credits (RECs) represent the environmental attributes of renewable energy generation: one REC is equivalent to 1 megawatt-hour of renewable energy.[70] RECs can either be sold "bundled" with the underlying energy or "unbundled" so that the RECs can be freely traded in a market.

In January 2011, the Public Utilities Commission approved the use of tradable RECs, facilitating a California REC market subject to Commission-established temporary price and quantity caps.[71] The decision allows investor-owned utilities to meet up to 25% of their Renewable Portfolio Standard requirement with tradable RECs, with the provision that they cannot pay more than $50 per REC.[72] In April 2011, Senate Bill 2 (SBX2) extended the tradable REC cap with a gradual ramping down to 15% beginning in 2014 and 10% beginning in 2017.

One of the benefits of tradable RECs is that they can facilitate financing for development of renewable energy facilities. The developer of two wind farms in Alberta, Canada recently executed a 20-year contract with Pacific Gas & Electric to sell

them the tradable RECs from project.[73] The developer said that the secured long-term revenue "opened up the project finance markets. The agreement with PG&E is an important element to support the economics of these projects."[74]

Tradable RECs show promise as a market-based tool to inject capital into the renewable energy industry. Still, it is unclear how the market will fare once the quantity and price caps expire. Current sale prices for tradable RECs are confidential, though some have estimated that they are trading for anywhere between $12 per megawatt-hour to $40 per megawatt-hour.[75] Some have argued that the volatility and risk associated with REC markets ultimately results in higher energy prices than those from a fixed-price mechanism such as a feed-in tariff.[76]

5. BARRIER: Fixed price versus market-based procurement

Stakeholders voiced a wide range of opinions regarding the appropriate features of procurement programs developed for small-scale renewables. Many argued that a rigorous fixed-price program, such as the feed-in tariff, should be expanded to projects as large as 20 megawatts to eliminate the barriers of market-based procurement such as uncertainty regarding price and expenses related to bid preparation or contract negotiation. Other stakeholders, though, advocated market-based approaches such as competitive solicitations and auctions such as the Renewable Auction Mechanism. They argued that market-based pricing for energy procurement will ensure that ratepayers are paying the lowest price possible for renewable energy, and that fixed-price programs can result in major inefficiencies and unnecessary expense.

Critics of auctions such as the Renewable Auction Mechanism said that underbidding could threaten project viability. One said that "projects built on very narrow margins are more likely to be abandoned after tax credits are used up." Local renewables, in many cases, do not benefit from the economies of scale enjoyed by utility-scale projects and could therefore be built on "narrow margins" when compared to larger projects. Costs, from materials to labor, are higher on a per kilowatt hour basis for local renewables, due to their smaller size and location in more expensive real estate markets. Site or structural constraints discovered after execution of a PPA can jeopardize project viability.

Stakeholders have warned that these issues can result in underbidding. If any of the foregoing contingencies occur, they can render projects financially infeasible due to PPA rates that are too low to absorb any additional expenses.

In response, other stakeholders pointed to the safeguards included in the Renewable Auction Mechanism program to ensure project viability. For example, the program contains basic eligibility requirements such as demonstration of developer experience, tracking of project milestones and demonstration of site control that will ensure that only more viable projects are considered. It also requires that successful bids submit security and performance deposits. According to the Commission decision approving the program:

> "To the extent putting capital at risk in the form of a security [or 'development'] deposit will screen more speculative projects out of the solicitation, it is to ratepayers' benefit to require such deposits. … Further, a reasonable deposit will help filter out projects that investors believe have no chance of success."[77]

> "We [also] adopt a performance deposit for all projects electing subscription under the RAM. We do this because … the deposit is a form of collateral that helps compensate the IOU and ratepayers for damages from performance failure [and] a relatively small performance deposit will help filter out projects that investors believe have no chance of success…"[78]

Some smaller developers have expressed concerns about auction gaming. Developers also voiced frustration with the costs and risks associated with auctions, which one stakeholder described as "too resource-intensive and roulette-ish for smaller developers."

Other stakeholders responded that required deposits and viability criteria would prevent gaming and ensure that only viable projects are considered. They added that the program was designed to respond to resource concerns of smaller developers by eliminating time-intensive contract negotiations and the uncertainty that any preliminary agreements with utilities would ultimately be approved by the Commission. According to the Commission,

> "We have established certain contract provisions for small sellers because we have found it is difficult for them to bid into a utility request for proposal, and they generally do not have the resources or expertise to negotiate and enter into a bilateral contract."[79]

Finally, auction critics argued that the auction could also result in projects that, to achieve the lowest costs, are sited in locations that do not serve other policy objectives of the 12,000 megawatt goal and could ultimately result in higher costs to ratepayers. For example, the sites that present the least expense and level of complexity to develop resemble, in many respects, sites for utility-scale projects. They are located in similarly remote parts of the state where there is plenty of inexpensive and undeveloped land. Those projects would do little to generate jobs within cities or balance existing pockets of load on the grid, though they would meet the articulated auction goals or developing renewables as quickly as possible at the lowest cost possible. Remotely-located projects could require expensive transmission upgrades and contribute to existing transmission line congestion during the hours of peak load. They also, as described in the preceding chapter, are less efficient that projects located closer to load due to line losses.

5. POTENTIAL SOLUTIONS

The first auction closed in November 2011, and the results of the auction were released in March. For the most part, projects with successful bids are located in the high desert region east of Los Angeles, remote and far from load. The Publc Utilities Commission could conduct an analysis of the results in the context of the overarching policy objectives for the 12,000 megawatt goal in addition to a more thorough analysis of the potential unaccounted costs associated with the successful bids resulting from externalities including transmission upgrades, line losses and congestion. Conference participants also suggested the following changes to procurement programs.

Raise size limit of feed-in tariff program

Some participants said that the state's feed-in tariff program should be expanded to include projects larger than the current 3 megawatt size limit. The stregths of a feed-in tariff are that it offers transparency and certainty to developers: PPA prices are public and set by the Public Utilities Commission, and participation is on a first-come, first-served basis. The feed-in tariff could also, as described below, be tailored to encourage development of projects in specific locations or of certain technologies.

Critics of expanding the feed-in tariff have countered that the program shifts risks and inefficiency from developers to ratepayers through its failure to contain any competitive features or incentives to reduce costs. Stakeholders have also argued that rates could even result in developer windfalls, citing examples of flaws in Spain's feed-in tariff program. A representative of a larger solar photovoltaic developer, reflecting a commonly-held viewpoint, said that the feed-in tariff is only necessary for small (1-3 megawatt) projects because projects any larger than that are undertaken (and should be undertaken) by experienced developers with market saavy, experience preparing bids, and the ability to adequately assess and accommodate the risks of an auction. In any case, one stakeholder asserted that "it's politically impossible to expand the [feed-in tariff] beyond 3 megawatts."

Several other states, including Colorado, have incorporated local renewable energy set-asides into their Renewable Portfolio Standards.

Bilateral PPAs

Several developers said that the state should continue to use bilaterally negotiated PPAs to procure local renewables, arguing that they engender a higher rate of project success and can be used to provide a "safety net" of projects in the event that underbidding results in a higher than expected number of failed projects. Indeed, one of the strengths of a bilateral PPA is that it offers increased project flexibility to both the developer and the utility:

> "Whereas the [competitive solicitation] process creates a portfolio of possible projects against which a particular proposal can be compared, bilateral contracts may enter into

> the procurement process at any time, effectively allowing [utilities] to choose the portfolio against which to compare such contracts. As a result, the timing and use of bilateral contracts is increasingly strategic. Additionally, contracts that fail to proceed through the [competitive solicitation] process can be resubmitted as a bilateral contract offer."[80]

Indeed, utilities can "strategically" use bilateral contract to accomplish a number of objectives, from testing the market for a certain type of energy product to providing backstop projects as a buffer for potential failures from new and untested procurement programs. However, bilateral PPAs – like any other PPA – must be approved by the Public Utilities Commission, which can be a lengthy process that entails its own level of uncertainty. One stakeholder noted that bilateral PPAs are "risky for [utilities] given the [Public Utilities Commission's] preference for competitive bidding, and are likely to be caught for years in Commission/staff case-by-case approval tensions. Few [utilities] currently will risk threading that needle." Indeed, the Public Utilities Commission's decision approving the Renewable Auction Mechanism appears to preclude bilateral PPAs, noting that utilities "may no longer use bilateral negotiations" to procure system-side local renewable projects up to 20 megawatts.[81] The Public Utilities Commission's position regarding bilateral contracts is, at best, unclear and in need of clarification.

To address the lengthy approval process for bilateral contracts, one stakeholder advocates use of generic approval criteria that enables developers and utilities to execute PPAs and submit them to the Public Utilities Commission for ministerial, non-discretionary approval, or a limited certiorari-type process. Such criteria could, according to its proponent, "balance real world rates with rateyaper concerns...mitigate the current tilt towards very large developers...[and] could also comport with the [auction's] 'uniformity' aspect."

6. BARRIER: Lack of adequate financial products or incentives for large rooftop renewable energy projects

Conference participants discussed the challenges of developing local renewable energy facilities on commercial and industrial rooftops, which several stakeholders agreed should be targeted in the state's effort to achieve 12,000 megawatt goal. The large, flat rooftops of structures such as warehouses that have limited onsite load and are located near urban centers are, at least in theory, ideal sites for development of utility-side renewable systems such as solar photovoltaic panels. One participant noted "[there is a] higher value in rooftop projects since they offset need for distribution system upgrades, reduce peak demand, result in lower line losses and potentially avoid need for transmission upgrades. Development on rooftops also has value given that it allows undeveloped land to be used for other economic, social or environmental purposes." Stakeholders also suggested that development of urban roof-mounted sites would meet job creation goals of the 12,000 megawatt goal better than development of ground-mounted sites on the periphery of the state's urban areas.

Nonetheless, development of large rooftops has been limited by several obstacles, including difficulty in assessing roof condition, and addressing structural support issues, overcoming disincentives engendered by triple-net leases, and paying for expensive interconnection and distribution upgrades.

Conference participants described the challenges as follows:

- "Most U.S. commercial buildings are leased, not owner-occupied. Under the typical triple-net lease structure, owners don't have an incentive to install solar because they don't pay electricity bills; tenants don't have an incentive to install solar on a building they don't own, particularly if their lease term is shorter than the length of the solar payback period."
- "CSI, SGIP and NEM do not work well for commercial real estate companies that lease large facilities like warehouses. Leases are in 3-5 year range but tenants renew options on [an] annual basis. Frequent turnover does not incent[ivize] participation and industry does not want to spend up front capital for endeavor[s] outside of its core business."
- "Net metering doesn't work for my company's [real estate] investments because we do not interact with the utility under a triple net lease. We need to consider the business models that large rooftop owners operate under."
- "Rooftop penetration (i.e., leaks) is a nightmare. There is not much extra capacity for more weight on a roof. We are operating on thin margins and need a premium to compensate for those risks."
- "Rooftops have very clear limits to development. The reality is that yield for development on roofs is very low. Limits are threefold: 1) structural (won't

FIGURE 3c | California's Distributed Generation Programs

Courtesy of the California Public Utilities Commission

	Program	Program Size (MW)	Intalled and Contracted Capacity (MW)	Participating Buyers	Eligible Technologies	Capacity Size Limit (MW)	Price	Implementation Status	Market Opportunity
System-Side Generation	**Feed-In Tariff (FIT)**	750	12.6 online 30 under contract	All IOUs (inc. SMJUs) and municipal utilities	All RPS-eligible technologies	Up to 1.5 (expanded to 3 MW under SB 32)	MPR ~$100-120/MWh; (changed to MPR plus adders per SB 32)	Program available up to 1.5 MW CPUC will begin implementing changes per SB 32 in 2011	Contracts accepted until cap reached
	Renewables Auction Mechanism (RAM)	1,000	New Program	3 large IOUs	All RPS-eligible technologies	Up to 20	IPP competitive bid	Adopted in D.10-12-048. Requires staff implementation.	2 auctions per year First auction to occur Q3/Q4 2011
	IOU Solar PV Programs Utility-owned generation (UOG) Independent Power Producer (IPP)	1,100	SCE: 5.6 UOG online 35 UOG under construction 50 IPP under contract PG&E: 50 UOG under construction	3 large IOUs 526 UOG 574 IPP	Solar PV	SCE: 1 - 2 PG&E: 1 - 20 SDG&E: 1 - 5	IPP competitive bid, contract price cap: SCE - $260/MWh PG&E - $246/MWh SDGE -$235/MWh	SCE and PG&E's programs are fully implemented SDG&E's program requires staff implementation	At least 1 auction per year Approx 50 MW per year for SCE and PG&E 20 MW per year for SDG&E
	SCE Renewables Standard Contract Program (no longer offered)	259	7.5 online 462.5 under contract	3 large IOUs	All RPS-eligible technologies	Up to 20	IPP competitive bid	Utility designed and implemented	1 auction was held Program terminated now that RAM is effective
	Qualifying Facilities (QFs)	No limit	About 1,200 MW of DG	3 large IOUs	All RPS-eligible technologies and CHP Separate contracts and pricing for projects up to 20 MW	None	Fixed and variable components	First implemented in the 1980s Most recent changes adopted in D.10-12-035	Contracts accepted on an ongoing basis
	Combined Heat and Power (CHP) **Feed-in Tariff**	No limit	New program	3 large IOUs	CHP facilities certified as eligible by AB 1613 guidelines (62% efficient topping cycle and 60% bottoming cycle)	Up to 20 MW	Avoided Cost as determined by the price of natural gas	D.10-12-055 approved in December 2010 Tariff available in 1st half of 2011	Continuously available but updated annually
	CHP Competitive Procurement	No limit but minimum targets in both MW and GHG reductions	New Program	3 large IOUs	CHP facilities meeting PU Code 216.6 definition of cogeneration	> 5	IPP competitive bid	Pro-forma contract approved	First solicitation anticipated to be held in April/June 2011
	CHP As-Available Facilities	PG&E and SCE: 75 SDG&E: 15	New Program	3 large IOUs	CHP facilities who are 60% efficient	Large in nameplate but energy delivery ≤ 131,400 MWh/y	Short Run Avoided Cost (SRAC)	Contract approved and available pending effective settlement date	Continuously available beginning March/April 2011
Customer-Side Generation	**California Solar Initiative (CSI)**	1,940	745 (includes solar PV installed prior to CSI)	Customers	Solar Photovoltaic and Solar Thermal	Up to 5 (incentives only up to 1 MW)	Declining incentives Net energy metering (NEM)	Adopted in 2006	Applications accepted until incentive budget are exhausted Statute caps spending
	Self-Generation Incentive Program (SGIP)	Based on budget availability	355	Customers	Small wind, fuel cells, storage (with wind or fuel cells). Considering adding CHP and others	< 5 (incentives only up to 3 MW)	Incentives Some receive net energy metering (NEM)	Adopted in 2001 Under Revision in 2010	Applications accepted until incentive payments are exhausted Statute caps spending

hold weight), 2) ownership (REITs with complicated capital structure and too many consents required—legal fees get out of control), and 3) interconnection. Solar roofs are not the panacea."

Thus, while large commercial and industrial rooftops possess many of the values desirable for development of local renewable sources, they also are encumbered with a number of legal, financial and structural challenges that often make them more costly to develop. Acknowledging those challenges, several Conference participants posited that existing financial and incentive programs do not support rooftop development.

As discussed below, either changes to existing incentive programs and financial products, or development of entirely new ones, will likely be necessary to promote development of rooftop local renewable energy resources in the near term. Also, while this discussion focuses on rooftop development, stakeholders mentioned other potential general development locations that would, at least ostensibly, advance many of the objectives of the 12,000 megawatt goal but were similarly difficult to develop in the absence of targeted incentive programs or financial products. The solutions discussed below are therefore not limited to rooftop development, but could be adjusted to promote development in any locations that support the policy objectives of the 12,000 megawatt goal.

6. POTENTIAL SOLUTIONS

Changes to feed-in tariff program

The feed-in tariff can be used to promote development in targeted urban locations such as rooftops by restricting eligibility to projects meeting location criteria and then providing the adequate level of compensation necessary to enable development in those locations, which are generally more costly to develop than ground-mounted projects in the exurban or rural periphery. State Senator Gloria Negrete McLeod, the author of SB 32 (the 2009 bill that substantially revised California's feed-in tariff program), wrote that "[t]he goal for SB 32 is simple: to establish a feed-in tariff to spur the development of rooftop solar power in our state."[82] Further clarifying the bill's goals, she added that "[l]ocal rooftop solar is best for the environment - requiring no new transmission lines, and little loss of power along the way, requiring few, if any, ecological sacrifices. It is also best for the economy, providing good clean-energy jobs in manufacturing, installation, and maintenance."

A May 2012 decision by the Commission will link feed-in tariff prices to the highest priced executed contract resulting from the Renewable Auction Mechanism auction held in November 2011. Under the Commission's decision, prices would be adjusted based on time of delivery and then adjusted upward or downward every two months based on market response. The feed-in tariff will not include any incentives to site local renewables in "hot spots" or other specific locations.

A feed-in tariff program that seeks to achieve more aggressive objectives, such as rooftop development and job creation, may require additional state legislation to clarify the intent of the feed-in tariff, as well as federal legislation to amend or remove the "avoided costs" requirement of the Public Utility Regulatory Policies Act. As one stakeholder noted, "many renewable energy advocates...criticize [the Public Utility Regulatory Policies Act] as providing a price that is not designed to accomplish the myriad environmental and fuel diversity goals that have been put in place since [the Public Utility Regulatory Policies Act's] enactment in 1978."

Changes to Renewable Auction Mechanism program

The current framework for the Renewable Auction Mechanism places very few restrictions on the types, sizes and locations of projects that are eligible for the auction.[83] One of the benefits of such an unfettered, market-based approach is that it can result in less expensive projects and lower costs for ratepayers. However, it is also a less potent tool for achieving other objectives of the 12,000 megawatt goal, such as rooftop development, land preservation or job creation. To accomplish those objectives, the state could establish separate, smaller auctions with criteria for location, size and other attributes that direct development to preferred sites such as rooftops.

Expand PACE and on-bill financing programs

As described above, PACE and on-bill financing programs attach the initial debt for purchase and installation renewable energy systems to the underlying property (via a property assessment and utility bill, respectively). The occupant of the property, whether a residential or commercial owner or tenant, only makes payments on the debt for as long as it occupies the property. When ownership or tenancy changes hands, the newly-arrived party assumes payments on the debt while also reaping the financial benefits of the system.

One Conference participant said that PACE financing "turns a triple net lease into a green lease...Tax assessments qualify as an eligible pass thru expense under most triple net leases, allowing landlords to pass through retrofit costs to tenants who also benefit from savings." The landlord benefits by increasing the rental value of the property for tenant who will realize energy savings. On-bill financing could work in a similar manner since the initial cost would

be born by the property owner, but subsequent electricity bills (and savings) would be passed through to the tenant.

Commercial PACE programs (which were not affected by the Federal Housing Finance Agency's recent announcement) are taking hold in cities and counties across the state, including San Francisco[84], Palm Desert[85] and Sonoma County[86]. Creation of additional PACE programs is initiated at the local level by cities and counties, which create assessment districts and issue bonds.

Local Renewable Energy Credits

As described above, RECs are "created" by a renewable generator simultaneous to the production of electricity and can subsequently be sold separately from the underlying energy. Allowing utilities to meet Renewable Portfolio Standard requirements through the purchase of separate, tradable RECs shows promise as a way to inject capital into the renewable energy development industry. Several states include specific set-asides in their Renewable Portfolio Standards to encourage development of certain technology types or sizes (e.g., solar set asides), and allow utilities to purchase specialized RECS to meet those set-asides.[87]

California could establish a local renewable energy set-aside in its Renewable Portfolio Standard with specific criteria for the qualifying generators, or allow utilities a credit multiplier for RECS from systems that meet certain requirements, such as customer-sited or rooftop generators. Several other states, including Colorado[88], have incorporated local renewable energy set-asides into their Renewable Portfolio Standards.

7. BARRIER: Lack of adequate financial products or incentives for emerging or underrepresented renewable technologies

Just as Conference participants noted that existing incentives and financial products do not support development of local renewable energy systems in certain locations, several participants also noted a lack of incentives or financing for development of local renewable energy systems of emerging and underrepresented technologies. They asserted that incentive programs tend to focus on solar energy systems at the expense of other technologies. While the conversation at Conference focused on biogas, other technologies including emerging energy storage devices face similar financing challenges. However, other participants responded that incentives should only be directed to technologies that show a realistic chance of one day standing on their own without subsidies, and that price parity should be the ultimate goal of government and utilities.

Conference participants described the challenges as follows:

- "Bioenergy representatives believe existing customer-side DG procurement mechanisms and incentives are too narrowly focused and do not support development of a broad and diverse array of DG technologies, especially generators smaller than 5 megawatts."
- "There is value in having a diverse set of resources and technologies for utilities to procure from. Values should be assigned based on ability to provide baseload or peak power, as well as environmental benefits."
- "The [Small Generator Incentive Program] and the [Emerging Renewable Program] are limited to customer-side facilities and should be expanded to include system-side facilities."
- "The German market has developed biogas, financed 100% by banks because its [feed-in tariff] is set at an appropriate price and finances hundreds of projects. California dairy owners run very large operations, so the issue is an appropriate [feed-in tariff]."
- "Biogas has been commercialized in other states, but not California."
- "The bulk of incentives should go to technologies that have a viable shot at being able to stand on their own with reduced or no subsidies. Example: if you put a bunch of resources behind a [Renewable Auction Mechanism] PV program, you can get gigawatts of power, which drives PV to parity."
- "One nice thing about solar and wind is that the energy source is easily predictable (i.e. the wind will blow and the sun will shine). Biomass and biofuels are a place that lenders should be focused on due to availability of technology. But providers of feedstock are not of credit quality that lenders are used to dealing with. First question of a lender is "do we have a feedstock agreement for 20 years and what is the credit behind that provider?" Is there a way for the state to stand behind the availability of certain types of feedstocks, such as dairy-related or garbage?"
- "Feedstock availability in dairy industry is stable in California. The biggest barrier to financing biogas is lack of pricing signal. [California's feed-in tariff] program is great, but it has the wrong price."
- "If a project lender is going to provide 5-6% debt for a biogas deal versus a wind/solar deal, who knows what the dairy's financials are? The bank is not interested in taking that risk."

In addition to the solutions proposed above for rooftop and other locational development barriers, the following solutions could address the financing challenges faced by emerging renewable energy technologies.

7. POTENTIAL SOLUTIONS

Carve-outs in existing procurement programs

Existing procurement programs such as the feed-in tariff could incorporate special rates for emerging technologies based on the costs to develop those technologies. Conference participants stated that current feed-in tariff prices are set too low to enable development of renewable energy generators using that use more expensive technologies such as biogas generation, and argued that incentives are necessary to promote price parity for those technologies. However, others warned that the state should be careful about unintended consequences of the feed-in tariff in "distorting the value chain."

Scale existing incentive programs

Both the Emerging Renewable Program and the Self-Generation Incentive Program only provide incentives for customer-side generators sized to meet existing onsite load (with rebate caps of 30 kilowatts and of 3 megawatts, respectively).[89] Legislation could expand one or both of those incentive programs.

Next Steps

BARRIER : Lack of upfront capital for development of customer-side local renewable energy systems

- California's elected officials should lead a coordinated effort to push for support of federal legislation such as HR 2599 that would ease restrictions on PACE-assessed residential mortgages.
- Legislation and/or the Public Utilities Commission could initiate a rulemaking to expand existing on-bill financing programs to include residential customers and promote development of renewable energy systems.
- The Energy Commission, coordinating with the ongoing work of clean energy groups, could host workshops and prepare a study on the barriers to securitizing renewable energy systems as an asset class.

BARRIER : Lack on net metering options for sites with loads larger than 1 megawatt

- Working with the investor-owned utilities, the Public Utilities Commission could initiate a cost accounting of the state's net metering program, and assess alternative pricing models such as SDG&E's network usage charge and time-of-use pricing. The accounting could also assess the costs of increasing or removing the existing generator size cap on net-metering eligibility.
- Legislation and/or the Public Utilities Commission could initiate a rulemaking to expand net meter aggregation to large customers with dispersed operations (though this solution would also require changes to the existing generator size cap.)

BARRIER : Lack of options for sites with limited or no ability to install onsite renewable energy systems

- The Energy Commission could prepare a study on the regulatory and financial barriers to community renewable energy systems along with potential solutions. State leaders could support legislation such as SB 843 (Wolk) to facilitate creation of community renewable energy systems.
- Legislation could support start-up financing for Community Choice Aggregation programs through provision of matching grants to qualified communities, and state tax credits for renewable energy systems that supply only public load.

BARRIER : Difficulty of securing upfront capital for system-side local renewable energy projects

- California's elected officials could lead a coordinated effort to push for support of federal legislation to 1) extend the availability of the cash grant in lieu of the investment tax credit, 2) extend 100% accelerated depreciation for renewable energy systems, and 3) enable renewable energy firms to create Master Limited Partnerships.
- The Energy Commission could prepare a study on the status of California's tradable REC market, including assessments of markets in other states, and proposed solutions to ensure market stability and efficiency once the REC price and quantity caps expire.

BARRIER : Fixed-price versus market-based procurement

- The Public Utilities Commission could conduct an analysis of the results of the first round of the Renewable Auction Mechanism to assess consistency with the state's policy objectives for the 12,000 megawatt goal and to analyze the potential cost impacts of externalities such an transmission line congestion and line losses.
- Based on the results of the Renewable Auction Mechanism and the policy objectives of the 12,000 megawatt goal, the Public Utilities Commission could analyze the opportunities and constraints of modifying the Renewable Auction Mechanism program or expanding the feed-in tariff program to larger-sized projects or projects with certain locational or technological attributes.
- The Public Utilities Commission could sponsor a workshop focusing on the role of and need for bilateral PPAs in the state's renewable energy strategy. Based on the outcome, the Public Utilties Commission could articulate its policy for bilateral PPAs.

Next Steps (continued)

BARRIER : Lack of adequate financial products or incentives for large rooftop renewable energy systems

- The Public Utilities Commission could prepare periodic reports on the status and results of the feed-in tariff program, clarifying the size, locational and technological attributes of participating generators. If development of rooftops or other objectives such as job creation emerge as top objectives for the state's 12,000 megawatt goal (and the existing feed-in tariff does not achieve those objectives), elected officials could enact state legislation clarifying the intent of the feed-in tariff program, and if necessary, push for federal legislation amending the "avoided costs" requirement of the Public Utility Regulatory Policies Act.

BARRIER : Lack of adequate financial products or incentives for large rooftop renewable energy systems

- Legislation and/or the Public Utilities Commission could initiate a rulemaking to establish Renewable Auction Mechanisms with regional or locational restrictions.
- The Energy Commission could work with the Local Government Commission and other non-governmental organizations to organize regional workshops and panels on commercial PACE programs throughout the state.
- Legislation and/or the Public Utilities Commission could initiate a rulemaking to expand on-bill financing to renewable energy systems for large commercial and industrial uses.
- The Energy Commission could prepare a study of the opportunities and constraints for set-asides in the state's Renewable Portfolio Standards, including a review of existing set-asides in other states, with the goal of assessing the feasibility and impacts of establishing a Local Renewable Energy Credit market.

BARRIER : Lack of adequate financial products or incentives for emerging or underrepresented renewable energy technologies

- If development of emerging or underrepresented technologies (such as biogas or energy storage) emerge as top objectives for the state's 12,000 megawatt goal or as components of the utilities' Long Term Procurement Plans, elected officials could enact state legislation to create carve-outs in the feed-in tariff program for those technologies, and if necessary, push for federal legislation amending or clarifying the "avoided costs" requirement of the Public Utility Regulatory Policies Act.
- The Public Utilities Commission could initiate a rulemaking to expand the Self-Generation Incentive Program to include system-side technologies.

ENDNOTES

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4 Interconnection

Summary

California's current process for approval and completion of interconnections is slow, lacks transparency and is not structured to maximize opportunity for small-scale renewable energy generation. Conference participants described the interconnection process as a "black box" that acts as a source of significant uncertainty and inefficiency in the development process for local renewable energy generators. Many stakeholders cite interconnection challenges as the primary barrier to achieving the 12,000 megawatt goal as well as the state's 33 percent Renewable Portfolio Standard.

A Conference participant summarized the interconnection problem as follows:

> "Interconnection procedures were not designed for large quantities of small projects seeking interconnection in the same time period. The queues are backlogged and studies are significantly delayed, with the end result that fewer projects can interconnect in the short-term, decreasing program competition."

While one of the state's interconnection processes is undergoing review and revision at the time of this writing, and resulting changes could address some of the concerns discussed in this chapter, there are several other near- and long-term interconnection challenges that will likely require action in addition to updating the regulatory process and requirements. Jurisdictional ambiguity, overwhelmed interconnection queues and lack of data transparency also insert significant expense and uncertainty into the process and contribute to a protracted interconnection review process.

Introduction

Interconnection is the process whereby new local renewable generators connect to the distribution grid. The goals of interconnection procedures are two-fold: 1) to ensure that integration of new energy sources does not negatively affect the safety, reliability or service quality of the grid, and 2) to provide consistent requirements and timelines for new generators in order to minimize the time and expense of the interconnection process.

In light of these dual and often conflicting goals, interconnection requirements are tiered depending on generator size and type, so that the generators with a higher likelihood of impacting the grid undergo a more thorough review process. Smaller renewable facilities, such as those generating power for onsite load, can generally take advantage of an expedited interconnection process and fee waivers. California's Net Energy Metering program requires utilities to waive interconnection application fees for net metered projects and to review completed applications within 30 days of receiving them.[1] The review process for larger utility-side facilities, on the other hand, can be substantially longer and more expensive, taking anywhere between a few months and well over a year to complete.

There are two different procedures for utility-side systems to interconnect to the distribution grid in California: the so-called "Rule 21" process and the Wholesale Distribution Access Tariff, or WDAT (see Figure 4a). While both processes are administered by utilities, they emanate from different government regulatory agencies. Rule 21 applies to projects that fall within state jurisdiction and are regulated by the California Public Utilities Commission, while WDAT applies to projects that fall within federal jurisdiction and are regulated by the Federal Energy Regulatory Commission.

The boundaries of federal versus state jurisdiction over local renewable energy generators are somewhat ambiguous. The federal government has exclusive jurisdiction over rate-setting and interconnection requirements for wholesale generators. However, federal law grants state jurisdiction over exporting generators that meet certain criteria. In 1978, Congress passed the Public Utility Regulatory Policies Act[2] which, among other things, established a class of so-called "Qualifying Facilities," generators that receive special regulatory and rate treatment.[3] Qualifying facilities are either combined heat and power providers, or generators of 80 megawatts or less whose primary energy source is renewable (hydro, wind or solar), biomass, waste, or geothermal resources.[4] The Public Utility Regulatory Policies Act requires utilities to purchase power from Qualifying Facilities at state-approved "avoided cost" rates.[5] A recent ruling by the Federal Energy Regulatory Commission confirmed that California may establish a feed-in tariff program for Qualifying Facilities.[6] As described below, however, it is not entirely clear how far the state's jurisdiction extends under the Qualifying Facility provision. Some stakeholders have argued that California should require all generators meeting federal eligibility requirements for Qualifying Facilities to interconnect under Rule 21, while others have maintained that doing so would be overstepping the state's regulatory authority.

Rule 21

Rule 21 utilizes a one-size-fits-all approach, applying the same review process regardless of generator size and containing no overall size limit. Interconnections begin with an initial review, which applies eight "screens" to the project to determine whether it qualifies for simplified interconnection, an expedited process requiring no additional studies (see Figure 4b). The screens are designed to weed out projects that would export power onto the grid, precluding expedited review under Rule 21 for utility-side projects of any size, no matter how small.

If the project passes the screens, it qualifies for simplified interconnection and no additional studies are required. If it fails one of the screens, it moves into a supplemental review wherein the utility determines whether the issue related to the failed screen can be addressed with minor alterations to the interconnection. If it cannot, the utility provides a timetable and cost estimate for a full interconnection

FIGURE 4a | Procedures currently used for interconnection to the distribution grid

	Rule 21	Wholesale Distribution Access Tariff
Jurisdiction	California Public Utilities Commission Publicly-Owned Utilities in California	Federal Energy Regulatory Commission
Utilization	– Customer-side projects (<1 megawatt) – Feed-in Tariff (SCE and SDG&E)[6] – Publicly-Owned Utility programs – Qualifying facilities with PURPA contracts	– Feed-in tariff (PG&E)[7] – Solar PV programs – Renewable Auction Mechanism[8]
Expedited Review	"Simplified Interconnection"	"Fast Track"
– Size Limit	None (though projects that export power cannot qualify)	SDG&E and SCE: 2 megawatts PG&E: 5 megawatts
– Screens	8	10
– Timing	< 1 month[9]	1 month[10]
Standard Review	– Supplemental Review – Interconnection Study	– Supplemental Review – Study Process (Cluster or Independent)

FIGURE 4b | Role 21 Initial Review Flow Chart *Courtesy of the California Energy Commission*

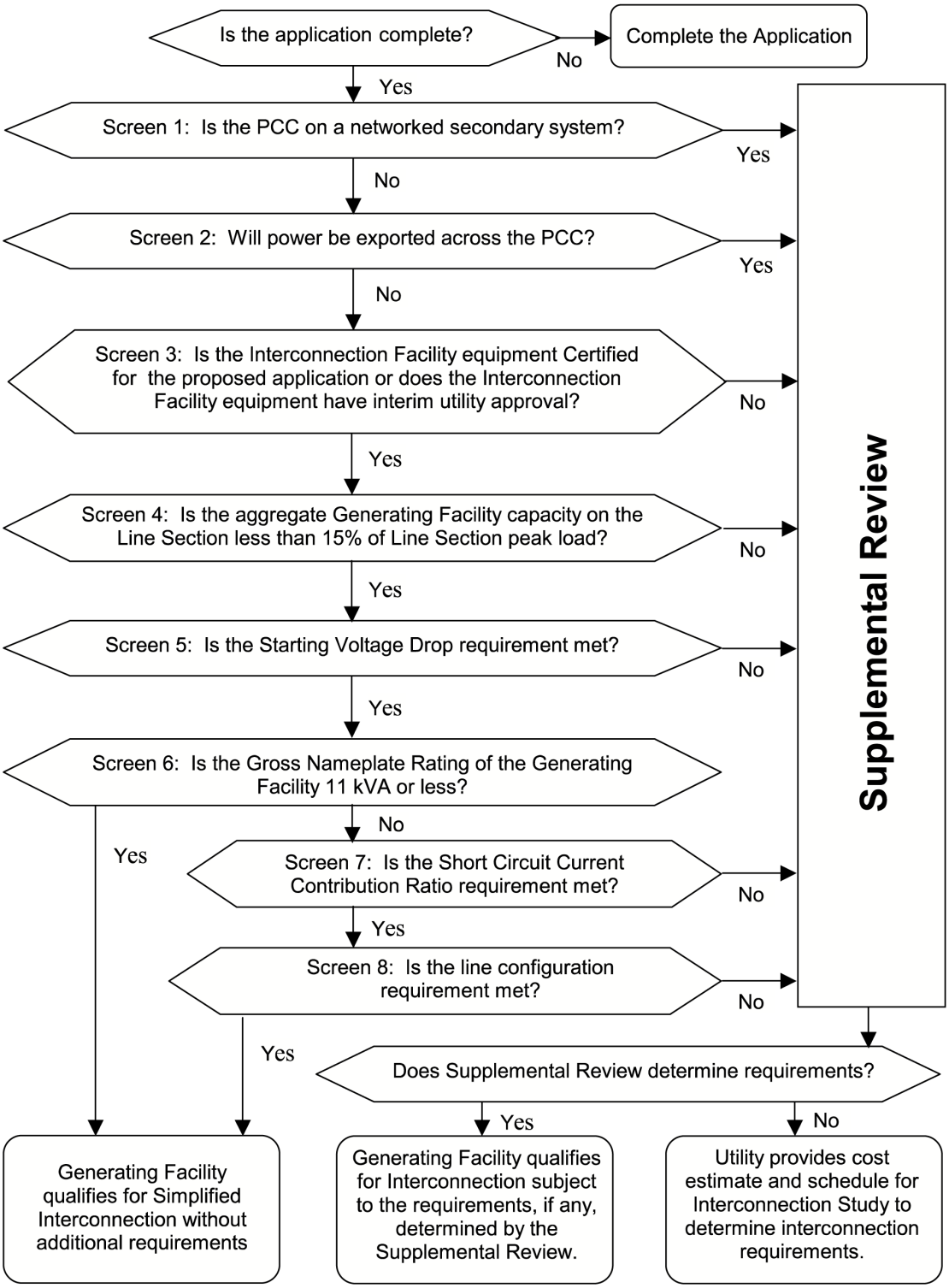
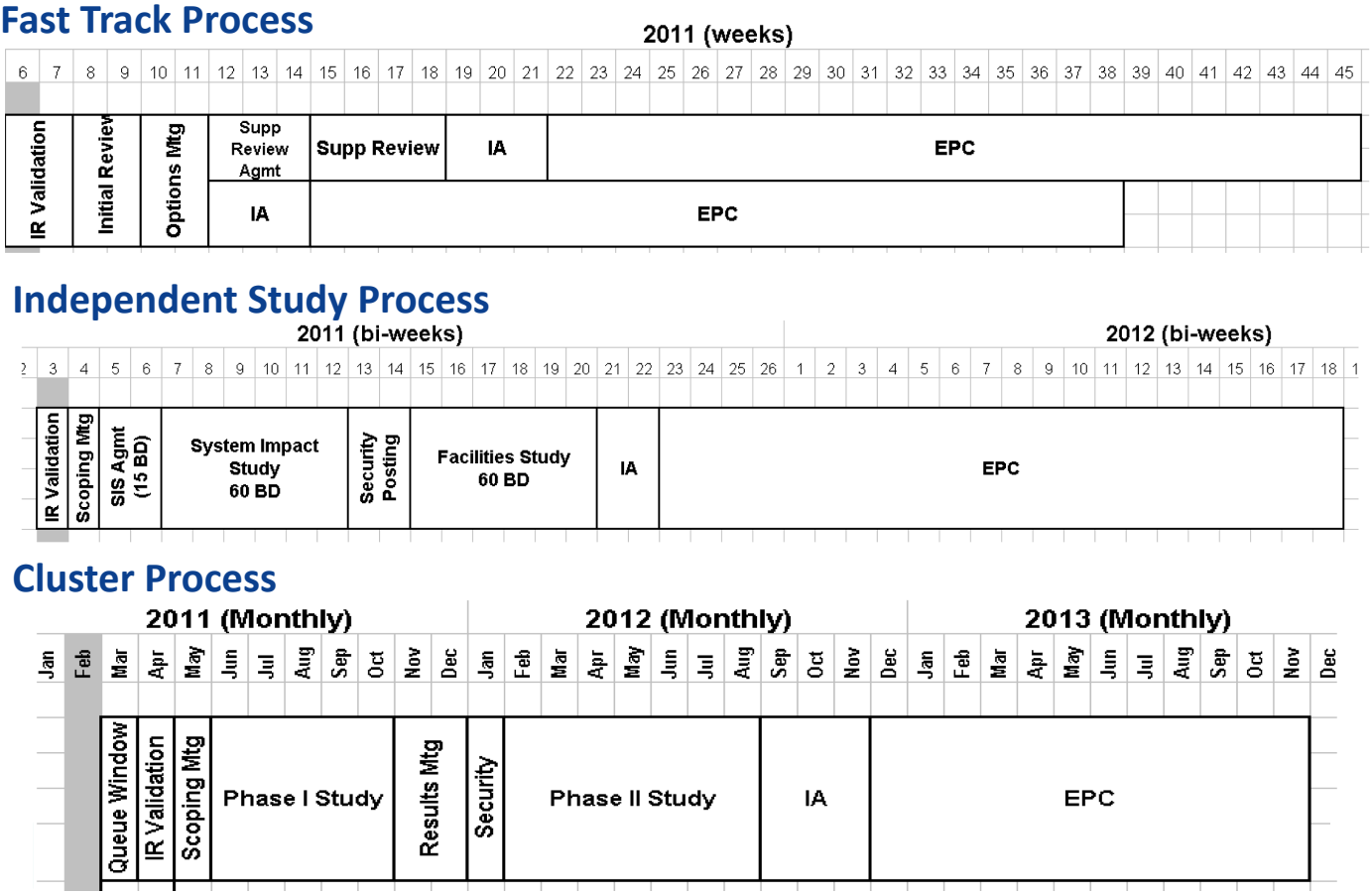


FIGURE 4c | WDAT Schedule Overview *Courtesy of PG&E*



study. At that point, an applicant may choose to cancel the application.

In April 2011, the Public Utilities Commission convened a working group to begin the process of reforming Rule 21. In August 2011, the Commission announced that the working group was converting into a confidential settlement discussion. In March 2012, the Working Group submitted its proposed revisions to the Public Utilities Commission. The revisions, if adopted by the Commission, would address many of the interconnection barriers raised by Conference participants and discussed in this chapter. Proposed changes include the following:

- A preapplication report that developers can purchase from utilities containing critical data about grid capacity and constraints for proposed project sites;
- Expanded fast track eligibility through creation of a new "supplemental review" process;
- Mandatory and enforceable timelines for interconnection application review along with a dispute resolution process;
- A queue management system that is transparent and publicized; and
- A standardized interconnection agreement.

The Public Utilities Commission must review and approve the proposed revisions. Additional changes to Rule 21 that address issues of cost allocation and information sharing will be addressed in the forthcoming second phase of the Commission's rulemaking.

Wholesale Distribution Access Tariff (WDAT)

The investor-owned utilities designed the WDAT to facilitate interconnection for utility-side generators sized up to 20 megawatts. Under the WDAT process, an applicant must select (and qualify for) one of three study processes at the

outset: Fast Track, Cluster Study or Independent Study. The timelines for each process are in Figure 4c.

The WDAT's interconnection Fast Track is available for local renewable generators that are up to 5 megawatts in PG&E's service territory, and up to 2 megawatts in SCE's and SDG&E's service territories. It applies ten screens to determine eligibility, including screens to disqualify projects from the fast track that would require construction of network or distribution upgrades, or those that would, when aggregated with other projects on the same distribution line, exceed 15% of peak load on the line (see Figure 4d). These screens act as de facto size limits on most utility-side generators that would otherwise participate in the WDAT's Fast Track interconnection process.

If the proposed generator passes the screens, the utility must provide the interconnection application with an executable interconnection agreement within five business days of the determination.[11] If it fails one of the screens, the project moves to a supplementary review similar to that under Rule 21, wherein the utility determines whether the issue related to the failed screen can be addressed with minor alterations to the interconnection application or whether the application must be advanced to a full study process.

The majority of new applicants for WDAT interconnection participate in the Cluster Study process. In that process, all proposed generators within the same distribution circuit are studied together so that the costs of necessary upgrades to the distribution can be allocated fairly among them. The Cluster process has two windows per year during which utilities receive interconnection applications and schedule scoping meetings with applicants. At the scoping meeting, the utility provides the applicant with technical information about and limitations of the distribution system, as well as information about projects that are ahead of it in the queue.[12] If the applicant chooses to move forward, the proposed generator joins others in embarking on an 18-month long review process that includes completion of two detailed studies. Upon successful completion of the second "Phase II" study, the utility and the applicant can execute an interconnection agreement.

The Independent Study process is the third interconnection process available for WDAT applicants. The Independent process allows proposed generators to apply at any time of

FIGURE 4d | WDAT Track Screens *Courtesy of PG&E*

Screen	Summary
1	Generating Facility (GF) must interconnect to applicable Jurisdiction, e.g. distribution if under WDT
2	GF, in aggregate with other generation, shall not exceed 15% of Peak Load
3	Requirements to interconnect to Spot Network
4	GF, in aggregate with other generation, shall not contribute more than 10% to the circuit's maximum fault current
5	GF, in aggregate with other generation, shall not exceed 87.5% of the short circuit interrupting capability
6	Line configuration and transformer connection required to prevent over-voltage due to a loss of ground during the operating time of any anti-island function
7	GF, interconnecting to single-phase shared secondary, shall not exceed 20kW
8	GF that is single-phase and is to interconnect on a central tap neutral of a 240 volt service, shall not create an imbalance between the two sides of the 240 volt service of more than 20% of the nameplate rating of the service transformer
9	GF, in aggregate with other generation interconnected to the transmission side of a substation transformer feeding the circuit the GF is connecting to shall not exceed 10MW in an area where there are known transient stability limitations
10	No construction of facilities by PG&E (distribution or network upgrades)

the year and takes roughly ten months to complete. However, in order to utilize the Independent Study process, applicants must successfully pass an "electrical independence" test. In short, the test requires that the proposed generator, when considered with other proposed generators that are in the study phase and on the same distribution circuit or substation, would not cause or exacerbate power back-feeding to the affected substation.[13]

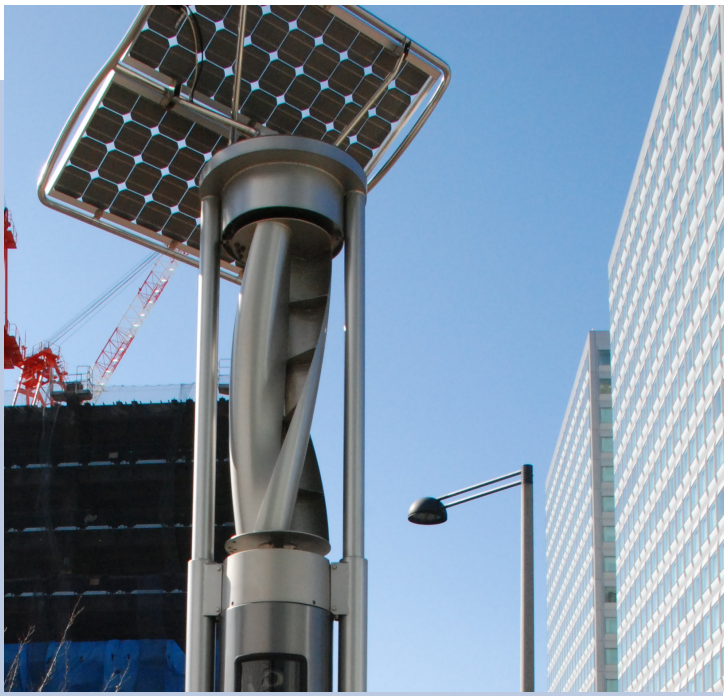
The Federal Energy Regulatory Commission approved changes to the WDATs in the first half of 2011; the changes were modeled largely after earlier modifications of the Generator Interconnection Procedures, the regulations governing interconnection to the transmission grid. The biggest change for the WDATs was the replacement of the serial study process with the Cluster Study process. While the Cluster process provides planning benefits for the utilities and cuts down the review time for larger generators, many Conference participants said that the change has prolonged the interconnection review time for smaller generators that are not eligible for Fast Track review.

Rule 21 versus the WDAT

At the time of this writing, there are a number of major distinctions between Rule 21 and the WDAT which add to the confusion and complexity of the interconnection process, including the following:

- *Timelines:* Rule 21 does not include any mandatory review timelines for either the applicant or the reviewing utility. WDAT, on the other hand, contains specific timelines for each stage of the interconnection review process.
- *Fast Track:* Rule 21's fast track process ("Initial Review") is not available for utility-side generators. The Initial Review screens out utility-side generators regardless of size or the ability of the grid to accommodate them. The WDAT's fast track process allows for utility-side generators up to a certain size, as long as the generator would not, aggregated with other generators on the same distribution line, exceed 15% of peak load on the line.
- *Standardized Review:* Rule 21 has one default review process ("Interconnection Study"), and that process has no defined study methodology.[15] The WDAT has two review processes ("Independent Study" and the default "Cluster Study"), both of which have defined study methodologies.
- *Queue Management:* Rule 21 does not contain a queue management system, meaning that applications for interconnection are not necessarily studied in the order that they are submitted, and projects do not have to submit periodic deposits to show good faith and ensure viability. Interconnection applications under the WDAT are assigned a queue position based on the date and time they are submitted, and must submit period security postings to ensure project viability.
- *Upgrade Cost Allocation:* Rule 21 does not contain a cost allocation method for situations where the interconnection of two or more generators will trigger upgrades, so the first generator to trigger an upgrade often must cover the entire cost for it. The WDAT allocates costs proportionately to all projects in the queue during the Cluster Study process.
- *Interconnection Agreement:* Under Rule 21, each utility uses one of an array of different interconnection agreements according to how much energy the applicant generator will export. Under the WDAT,

There is currently no concerted effort to align the interconnection process with procurement, land use permitting or any other so-called "viability screens" for local renewable energy generators. The result is massive inefficiency that serves to only further impede the development process.



"Interconnection procedures were not designed for large quantities of small projects seeking interconnection in the same time period. The queues are backlogged and studies are significantly delayed, with the end result that fewer projects can interconnect in the short-term, decreasing program competition."

each utility has one standard interconnection agreement for all generators under 20 megawatts.

- *Resource Adequacy:* The Public Utilities Commission requires utilities to demonstrate that they have adequate resource capacity to meet peak demand needs. Under Rule 21, there is no clear pathway for a generator seeking to secure resource adequacy value; the WDAT provides access to a "Deliverability Assessment" used to secure resource adequacy value.

Goals

The interconnection process should continue to ensure that connections to the distribution grid are safe and that that reliability of grid is maintained during integration of local renewable energy generators. While ensuring safety and reliability, Conference participants suggested that reforms should achieve the following goals:

- *Speed:* Expedite review and approval of interconnection process
- *Cost:* Make interconnection as inexpensive as possible and allocate costs fairly
- *Transparency:* Create more transparency in interconnection process (requirements, procedures, timelines and agreements)
- *Uniformity:* Create uniformity across different types of utilities (investor-owned and publically-owned), interconnection processes, and between state and federal processes.
- *Fairness:* Ensure fair and equitable treatment of all applicants; make rules technology neutral except when differences are fully justified.

Barriers

1. BARRIER: Lack of Alignment between Interconnection and Procurement

There is currently no concerted effort to align the interconnection process with procurement, land use permitting or any other so-called "viability screens" for local renewable energy generators. The result is massive inefficiency that serves to only further impede the development process. For example, issues related to permitting or procurement may force a developer to change the size, location or applicable interconnection procedure of a proposed generator. Rather than file a new interconnection application and return to the end of the queue, developers have flooded the interconnection queues with speculative applications as a safeguard. The result is not only a slower review process, but also analyses that are fundamentally flawed by inaccurate assumptions about the number and type of projects that are actually in the pipeline.

Conference participants and stakeholders have described the problems as follows:

- "Interconnection procedures were not designed for large quantities of small projects seeking interconnection in the same time period. The queues are backlogged and studies are significantly delayed, with the end result that fewer projects can interconnect in the short-term, decreasing program competition."
- "Interconnection procedures need to match market procedures."
- "The Cluster Study takes 18 months, but most

wholesale (local generation) programs require 18 months (from contract execution) to commercial operation."

- "The current interconnection queue is bogged down with projects that are expected to be identified as unviable at some time in the future. However, due to open access rules, if such projects are willing to put up the required security deposits then they can remain in the queue, producing unrealistic study results. Such study results may include upgrades to the distribution and transmission system that might not be needed if only the truly viable projects remained in the queue."
- "Many developers do not understand the end-to-end requirements and may make business decisions without fully understanding the implications ...Developers that are experienced and know what to look for will retrieve information to make educated decisions to proceed."

1. POTENTIAL SOLUTIONS

Conference participants were in accord that alignment of the interconnection procedures with procurement and other viability screens is critical toward mitigating the high level of existing uncertainty and inefficiency associated with interconnection. However, they posited a range of opinions as to precisely what that alignment should look like. Suggested potential solutions include:

Require satisfaction of screens or interconnection Phase 1 study before filing a procurement application (Renewable Auction Mechanism or Feed-in Tariff)

By requiring a higher level of project investment and due diligence before applicants can participate in a procurement process, utilities may be able to more quickly weed out speculative applications and weaker projects from the queue. Currently, bars to participation are lower; placing a bid in the Renewable Auction Mechanism, for example, only requires projects to have an interconnection application filed. Another benefit of this approach is that it could provide developers with interconnection pricing information that is critical for consideration during the procurement process.

Require an executed power purchase agreement prior to filing an interconnection application

Other participants suggested requiring applicants to have successfully completed the procurement process before beginning the interconnection process. This approach would certainly eliminate the queue. However, it would also make it very difficult for developers to determine either a) the locations where projects could be interconnected to the grid more easily, or b) how interconnection costs such as distribution upgrades would impact the price of the project. Such a solution would only be feasible if utilities developed a platform that clearly and accurately conveyed the existing capacities and constraints of the distribution network along with the necessary upgrades and costs associated with varying sizes and types on new generation sources. Otherwise, unforeseen interconnection constraints could jeopardize the viability of projects already under contract with utilities.

Create a single queue for Rule 21 and WDAT

Developers often must adjust the size of a proposed generator in response to interconnection restraints, local land use requirements or failure to secure procurement at the originally planned size. To ensure that those adjustments do not force them to restart the interconnection process, many developers file applications for the same project in both Rule 21 and WDAT interconnection queues. Stakeholders suggested combining the queues into a single queue. Of course, the review process and requirements differ between Rule 21 and WDAT, so at some point the applicant would be forced to choose one process or the other. However, up until that point, utilities would have a much more realistic picture of the actual number of projects in the pipeline, and developers would be able to adjust their projects without jeopardizing their standing in the queue.

2. BARRIER: Jurisdictional Ambiguity

Several Conference participants highlighted the ambiguity related to federal versus state jurisdiction over interconnection requirements as a barrier to more efficient interconnection. As described above, the federal government has primary jurisdiction over wholesale rates and interconnection, which is one reason why most utility-side generators apply for interconnection under the WDAT. However, the federal Public Utility Regulatory Policies Act allows the state to regulate generators that are deemed Qualifying Facilities. What the state may deem Qualifying Facilities, and how far it may go it regulating those facilities, is not entirely clear.

Conference participants and stakeholders have described the problems as follows:

- "There is a present lack of clarity in California regarding the correct interconnection procedures that should apply to any particular generator interconnection."

"More uniformity equals more efficiency in installation processes. That will allow us to hit our 12 gigawatt goal at a lower cost."

- "Above 5 megawatts we start getting into bigger issues, and different organizations claim jurisdiction. [Jurisdiction] is clear for less than 5 megawatts, but unclear for 5 megawatts and above on the distribution grid."
- "[The Public Utilities Commission] has not clarified this question. It's under consideration. What is clear is that the state does have jurisdiction over qualifying projects under a [Public Utility Regulatory Policies Act] contract. What makes the most sense in terms of aligning procurement and interconnection? What gains would there be if the state oversees the entire process for larger project sizes?"
- "WDAT follows [Federal Energy Regulatory Commission] interconnection procedures and takes control away from the State of California . . . WDAT injects significant [Renewable Portfolio Standard] fulfillment risk by removing California's ability to control critical interconnection rules."

2. POTENTIAL SOLUTIONS

Several Conference participants advocated broader state authority over interconnection procedures for local renewable energy generators. Some posited that the only way for California to meet its aggressive Renewable Portfolio Standard goal is to assert control over the interconnection process that will bring the necessary power sources online. Others commented that the state should work much more closely with the Federal Energy Regulatory Commission on developing coordinated, efficient interconnection procedures. The following are a few potential solutions:

Assert state jurisdiction over interconnection for local renewable energy generators

One Conference participant commented that if the state is serious about achieving its Renewable Portfolio Standard of 33% by 2020, it needs to be in control of the means to get there, including interconnection procedures. Another participant urged the Public Utilities Commission to take greater control over distribution system interconnections "to provide greater uniformity to the interconnection process and to facilitate successful integration of higher penetrations of distributed generation." That participant said that the state should require all renewable generators meeting federal eligibility requirements for Qualifying Facilities to apply for interconnection under Rule 21, which would represent an expansion of the Commission's current practices.

Participants noted that Rule 21 is not currently designed to address utility-side generators and that the Commission would need to update Rule 21 before expanding its purview. At the time of this writing, changes to Rule 21 are being developed through an ongoing confidential settlement process and it is not yet clear what changes that process will yield.

Develop a clear policy directive with federal grid managers

Conference participants highlighted planning conflicts between the WDAT and Rule 21 interconnection processes as evidence that state and federal grid managers should coordinate much more closely than they currently do. A representative from the California Independent System Operator noted the difficulty in assessing proposed transmission system projects when they would be located near a substation that would serve a number of proposed distribution system projects. The representative added that the California Independent System Operator needs to know what to plan for and how they can optimize the interconnection process to help the state achieve its

goals. State and federal regulators could work together to develop a clear policy regarding interconnection jurisdiction and establish a system to better coordinate planning and approval processes.

3. BARRIER: Lack of Regulatory Uniformity

Conference participants cited a lack of regulatory consistency as a major barrier to market efficiency. Examples of inconsistency include both the fundamental differences between the requirements of Rule 21 and the WDAT, as well as differences in how those requirements are implemented by each utility. The inconsistencies create compliance challenges for developers that have projects in several jurisdictions. As described above, they also create problems for regulatory agencies and utilities.

One utility representative provided an example of a planning conflict created by the differing timelines of the WDAT and Rule 21. In a Rule 21 interconnection study for a feed-in tariff project, the utility is required to establish a "base case" that includes all other projects for the same distribution line with applications submitted by March 31, 2011. However, many of those base case projects were submitted during the March window of the WDAT's Cluster Study process and will not have final studies completed until July, 2012. Until that time, the utility has no way to study the following implications of its feed-in tariff projects:

- short circuit duty /breaker replacement
- power flow
- thermal overload
- voltage control
- cost responsibility

Conference participants and stakeholders described the issues as follows:

- "When putting in place policies to promote growth in distributed generation we want to create consistency across state processes to develop strong markets. Cost per install watt in Germany is half what it is in the US. One factor is efficiency. Installers know the process – they have done it before. Uniformity facilitates efficiency. They do business across the country and the world."
- "More uniformity equals more efficiency in installation processes. That will allow us to hit our 12 gigawatt goal at a lower cost."

3. POTENTIAL SOLUTIONS

Conference participants called for creation of consistent, statewide interconnection requirements. While regulatory differences will persist as long as interconnection responsibility for local renewable energy generators is split between state and federal grid managers, those agencies could modify the processes they use (Rule 21 and WDAT) so that they are much more compatible and consistent with one another. The Rule 21 working group, prior to entering confidential settlement discussions, flagged this issue as one that it would address.[15] State and federal grid managers could also initiate processes to review utilities' individual tariffs, both for consistency with the applicable interconnection regulation and for consistency with one another.

4. BARRIER: Speed of Interconnection Approval

Several Conference participants expressed frustration with the slow speed of the Rule 21 and WDAT interconnection processes. They acknowledged that a large part of the problem is due to an overwhelming number of interconnection applications, but commented that utilities were not meeting the increased demand through matching staff increases and more streamlined, transparent and responsive interconnection programs. Participants also highlighted flawed fast track programs and obsolete standards as issues hindering faster interconnection approvals. Some noted that the WDAT's recent incorporation of the Cluster Study process, intended to expedite interconnection review, actually resulted in a longer review process for smaller projects that do not qualify for Fast Track review. Smaller projects are generally hit harder than larger projects by delays and the costs to maintain site control during those delays, so stakeholders have indicated that the interconnection backlog discourages small generators from continuing with interconnection studies.

Conference participants and stakeholders described the challenges as follows:

- "The interconnection study process takes years, and the cluster process may be delayed. Existing uncertainty in the serial queue may create lingering uncertainty in the clustering process. We need to process the serial queue to eliminate uncertainty. Many developers are frustrated by utility studies."
- "There are so many interconnection requests – many times more renewable power than is needed in the state."

- "Some utilities are understaffed even though they should have sufficient resources to conduct the interconnection studies, since the developer pays the study fees."

- "Rule 21 doesn't contain a timeline or process for how the utilities should conduct studies within the Supplemental Review or Interconnection Study phases."

- "There aren't any screens in Supplemental Review to identify exporting generators that don't require an engineering study."

4. POTENTIAL SOLUTIONS

Many of the solutions already discussed in this Chapter – such as alignment of the interconnection and procurement processes, standardized regulations, and vesting of jurisdiction in a single agency – would eliminate some of the major causes of protracted interconnection approvals. To address the volume of interconnection applications in the queues, utilities could develop a process to weed out duplicative or speculative applications. Going forward, the utilities could work with regulatory agencies to develop higher bars for participating in the interconnection process, develop a single queue, provide better access to grid and cost data and increase the size of staffing dedicated to processing interconnection applications.

Conference participants' suggestions to speed up the interconnection process include the following solutions:

Mandatory review timelines

The WDAT contains mandated review time periods associated with each review phase, though participants advocated shorter time periods for the Cluster Study process. The Public Utilities Commission could develop clear timelines for utility review of Rule 21 interconnection requests that include enforcement mechanisms.

Updated fast track processes

Participants advocated updating the technical review screens that qualify projects for fast track interconnection approval in a manner that expands eligibility without compromising grid stability. Currently, Rule 21's Simplified Interconnection process disallows generators that would export any power to the grid. The WDAT's Fast Track contains a screen that disallows generators that would contribute to an aggregate capacity of more than 15% of peak load on a distribution circuit.

5. BARRIER: Transparency of Interconnection Data, Requirements and Costs

Conference participants used the phrase "black box" to describe the interconnection process. Several stakeholders cited lack of transparency as one of the major interconnection barriers. The main data need voiced by participants was for detailed information about the distribution grid, including locations where generators could interconnect without triggering expensive upgrades as well as what costs would be associated with upgrades, if necessary. Additional needs articulated at the Conference included information about the status of queues, customer applications and accurate processing time estimates.

Stakeholders also noted that a major contributing factor to the lack of data transparency is a disagreement about data confidentiality. One stated the problems as follows: "While respecting the confidentiality of both the project developer and the utility, it's arguable that innocuous data exists that isn't confidential, or shouldn't be, and could be useful to regulators and the public."

In response, utility representatives noted that they have posted interconnection maps to their websites. One acknowledged the information gap while also advocating better stakeholder education about the interconnection review process:

> "[Utilities] are open to suggestions. Things are moving quickly. The importance of having information is critical. It does have significant impacts to project viability. We want to stress that education is critical piece to interconnection. If you have folks that fully understand the process, then the costs of the overall process will decrease."

5. POTENTIAL SOLUTIONS

While stakeholders acknowledged that the utilities' interconnection maps were a step in the right direction, some also commented that the maps still lack critical information that developers need to site and plan local renewable energy facilities, such as size and siting details for other projects in the queue, information about distribution upgrades in the pipeline that might open up new areas for easy interconnection, or estimates of equipment and associated costs that generators of different sizes might trigger on distribution lines.

Conference participants also suggested the following solutions to address transparency barriers:

Pre-application project review meetings
Utilities should host pre-application project review meetings with project proponents wherein utilities could discuss opportunities and constraints of the local distribution grid, other renewable energy projects in the pipeline and planned grid infrastructure upgrades.

Interconnection study clearinghouse
One participant suggested that the utilities should make public the interconnection study results from higher queued projects.

Interconnection clinic/technical mastery group
A utility representative suggested formation of education interconnection clinics that would meet regularly to provide project updates, new technical information, and guidance to applicants.

Interconnection stakeholder forums
Similar to the Rule 21 Working Group but with a wider scope, stakeholder forums would comprise people intimately familiar with the interconnection process such as utility staff, select project developers, and government experts. The forums would review recurrent issues slowing interconnection across the state and attempt to craft solutions. The forums could also be used to determine existing data needs and work through potential confidentiality issues.

Online and software tools
The Energy Commission could work with the Public Utilities Commission to develop software, online and informational tools to assist with interconnection.

6. BARRIER: Interconnection costs and cost allocation

Renewable energy developers attending the Conference shared their frustration with both the high costs often required to connect to the distribution grid and the sometimes unfair allocation of costs.

Several participants highlighted the contrasting cost apportionment rules between transmission and distribution grid interconnection: a developer with a project that connects to the transmission grid and triggers the need for system upgrades pays for those upgrades but is reimbursed, but if the very same project connects to the distribution grid, the costs are borne by the developer.

Other participants commented on cost discrepancies within the distribution grid, placing blame on a dearth of information about which parts of the grid infrastructure

Participants advocated development of a forum for developers to strategize and collaborate so that upgrades that may otherwise be necessary could be avoided through voluntary project adjustments.

can accommodate additional generators without upgrades. While interconnection maps recently released by the investor-owned utilities represent a first step toward addressing that information gap, some stakeholders said that the maps were of limited benefit since they lack critical information such as locational information for other projects that are in the queue.

Finally, participants were critical of the "first-to-trigger" method of allocating financial responsibility for costly upgrades under Rule 21, and said that costs should be allocated proportionate to system impacts for all projects in the queue.

Conference participants described the problems as follows:

- "We need a process that creates incentives to locate projects in areas where existing infrastructure can support them without expensive upgrades."
- "According to the [Energy Commission's 2007 Integrated Energy Policy Report], the investor-owned

utilities are spending 75 percent of capital expenditures on the distribution grid. All of those costs are passed on to ratepayers. We have a huge number of dollars that we can direct to make sure that the distribution grid accommodates a lot of projects."

- "A [renewable energy] project that connects to the transmission grid and triggers upgrades gets reimbursed for those costs. If that same project connects to a distribution system, they don't get reimbursed for the distribution upgrades. This classification dictates what the 12 gigawatts in California will look like. Developers are going to look opportunities in the lowest cost areas. Is that what we want for 12 gigawatts in California? Do we get local job benefits and transmission with efficiency loss minimization with this?"
- "A lot of people just compare the [power purchase agreement] prices. Transmission costs are a hidden cost that isn't being accounted for between transmission and distribution grid connection costs. Wholesale distributed generation is a far better value for ratepayer."

6. POTENTIAL SOLUTIONS

Conference participants and stakeholders suggested the following solutions to high interconnection costs and uneven allocation of upgrade costs.

Encourage development in specific locations by directing development or using financial incentives

Participants proposed that the Public Utilities Commission could encourage or require developers of new local renewable energy generation projects to locate at places along the distribution grid where existing grid infrastructure could accommodate the additional energy without requiring expensive upgrades. Suggested methods for doing so ranged from prescriptive to market-based, including: 1) restricting new energy procurement to generators sited in areas where existing infrastructure could be most efficiently utilized, 2) requiring utilities to provide more detailed technical information about the distribution grid in advance so that developers could avoid distribution lines with limited capacity, and 3) amending procurement programs to provide financial incentives to developers for siting projects in optimal locations.

At the time of this writing, efforts to implement some of these solutions are already under way:

- As part of the Renewable Auction Mechanism (discussed in Chapter 3), the Public Utilities Commission required each investor-owned utility to release an interconnection map detailing information about existing capacity and constraints of the distribution grid.
- Commission staff is working on a distributed solar photovoltaic comparison tool that will compare the net costs (net of location-specific avoided cost benefits) of solar photovoltaics up to 20 megawatts. The study will also assess the potential, in megawatts, of solar photovoltaics that can be readily interconnected to the utilities' distribution grid.

Alignment of cost apportionment between transmission and distribution systems

Several Conference participants advocated a consistent approach to cost apportionment to avoid inadvertently encouraging development of renewable energy generators in areas where connection to the transmission grid would lower costs for developers but require more expensive (and socialized) transmission upgrades. Most participants supported extending the interconnection cost waiver currently in place for net-metered systems to any generator whose contribution would not cause the local grid to exceed a predetermined ratio of aggregate capacity to minimum load on a distribution line. Other participants supported passing transmission upgrade costs through to the developer and placing stricter limits on cost waivers for net-metered systems.

Promotion of cost-sharing among developers

Renewable energy developers noted that, under the Cluster Study system, there is no opportunity for developers to collaborate and reduce costs by adjusting project sizes. Rather, projects within the cluster are studied as proposed for impacts on the distribution grid, and necessary upgrades are calculated accordingly. Participants advocated for development of a forum for developers to strategize and collaborate so that upgrades that may otherwise be necessary could be avoided through voluntary project adjustments.

Next Steps

BARRIER : Lack of Alignment between Interconnection and Procurement

- **Single queue:** If necessary, the Commission could require the working group to consider a range of options to align procurement with interconnection and develop a single queue for projects whether they are interconnecting through Rule 21 or the WDAT. The Commission could also establish a coordinated effort with the Federal Energy Regulatory Commission to align Rule 21 and the WDAT.

BARRIER : Jurisdictional Ambiguity

- **State Jurisdiction over Qualifying Facilities:** State leaders could organize a coordinated effort to enact federal legislation amending or clarifying the state's jurisdiction over Qualifying Facilities under the Public Utility Regulatory Policies Act. Alternatively, the Public Utilities Commission could initiate a rulemaking requiring any generator that meets the eligibility requirements for a Qualifying Facility to interconnect to the distribution grid under Rule 21.
- **State/federal policy directive:** The Public Utilities Commission could work with the California Independent System Operator and the Federal Energy Regulatory Commission to develop a clear policy regarding interconnection jurisdiction and establish a system to better coordinate planning and approval processes.

BARRIER : Lack of Regulatory Uniformity

- **Consistent tariffs:** The Public Utilities Commission and the Federal Energy Regulatory Commission could also initiate processes to review utilities' individual tariffs, both for consistency with the applicable interconnection regulation and for consistency with one another.

BARRIER : Transparency of Interconnection Data, Requirements and Costs

- **Informational workshops and clinics:** The Public Utilities Commission, Energy Commission, Federal Regulatory Commission and utilities could collaborate to develop tools for increasing the transparency of the interconnection process, including 1) an interconnection study clearinghouse that allows developers to access interconnection studies for previous projects; 2) regional interconnection clinics that would meet regularly to provide project updates, new technical information, and guidance to applicants; 3) interconnection stakeholder forums where utility staff, select project developers, and government experts would review recurrent issues slowing interconnection across the state and attempt to craft solutions; and 4) online and software tools to assist with the interconnection process.

BARRIER : Interconnection Costs and Cost Allocation

- **Locational requirements/incentives:** Legislation and/or the Public Utilities Commission could initiate a rulemaking to include enhanced locational requirements and/or incentives in the energy procurement processes (See Chapter 3).
- **Cost allocation study:** The Energy Commission could prepare a study of alternative interconnection cost allocation frameworks and the effects of each.
- **Developer collaboration:** The investor-owned utilities could develop a forum during the interconnection process where developers with projects proposed for the same distribution lines could collaborate in order to avoid unnecessary upgrades.

ENDNOTES

1 Ca. Pub. Util. Code § 2827.

2 Public Utilities Regulatory Policies Act of 1978, 16 U.S.C. §§ 2601-2645 (2012)

3 *Id.*

4 *Id.*

5 18 C.F.R. § 292.303 (2012).

6 *FERC Provides Clarification on Feed-in Tariff Options for States*, Interstate Renewable Energy Council, http://irecusa.org/2010/10/ferc-provides-clarification-on-feed-in-tariff-options-for-states (last visited June 5, 2012)

7 D.07-07-027 established the FIT program rules and allowed the utilities to select the state regulated Rule 21 or the federal regulated Small Generator Interconnection Procedures (SGIP) for interconnecting FIT generators. At the time of this writing, the Commission Staff Proposal for the revised feed-in tariff rulemaking recommends that all generators participating in the feed-in tariff program interconnect through Rule 21 once the new Rule 21 procedures are in place. *Renewable FIT Staff Proposal – Revised Draft*, Cal. Pub. Util. Comm'n, 19 (Oct. 13, 2011), http://docs.cpuc.ca.gov/efile/RULINGS/145433.pdf.

8 The CPUC declined to impose a Qualifying Facility requirement on RAM participants. As a result, RAM participants must apply for interconnection under the relevant utility's Wholesale Distribution Access Tariff., *Decision adopting the Renewable Auction Mechanism, Rulemaking 08-08-009*, Cal. Pub. Util. Comm'n, 73 (Dec. 17, 2010), http://docs.cpuc.ca.gov/word_pdf/FINAL_DECISION/128432.pdf.

9 *Renewable Power in California: Status and Issues*, Cal. Energy Comm'n, 160 (Dec. 2011), http://www.energy.ca.gov/2011publications/CEC-150-2011-002/CEC-150-2011-002-LCF-REV1.pdf.

10 *Id.*

11 Southern California Edison, *FERC Electric Tariff, Attachment G: Small Generator Interconnection Procedures,* 8 (May 2010), http://www.sce.com/NR/sc3/tm2/RPA/Reg_Info_Ctr/OpenAccess/WDAT/attachment_g.pdf.

12 Pacific Gas & Electric, *Cluster Study Process,* 6 (Oct. 2011), http://www.pge.com/includes/docs/pdfs/b2b/newgenerator/wholesalegeneratorinterconnection/Cluster_Study_Roadmap.pdf.

13 Pacific Gas & Electric, *Independent Study Process,* 8-13 (Oct. 2011), http://www.pge.com/includes/docs/pdfs/b2b/newgenerator/wholesalegeneratorinterconnection/Independent_Study_Roadmap.pdf

14 "An Interconnection Study is simply defined as an engineering review of specific aspects of the proposed Generating Facility and the Distribution System to which it will be connected to establish the requirements for interconnection of the Generating Facility. The issues to be evaluated in the Study, as well as the cost and timeline for completion of the study, are determined in the Supplemental Review process." *California Interconnection Guidebook: A Guide to Interconnecting Customer-owned Electric Generation Equipment to the Electric Utility Distribution System Using California's Electric Rule 21*, Cal. Energy Comm'n, 47 (Sept. 2003), http://www.energy.ca.gov/reports/2003-11-13_500-03-083F.PDF.

15 *Rule 21*, Cal. Pub. Util. Comm'n, http://www.cpuc.ca.gov/PUC/energy/Procurement/LTPP/rule21.htm (last visited June 5, 2012)

5 Permitting

Summary

Conference participants, whether they represented solar energy developers or city planners, agreed that land use regulations, environmental laws and municipal codes fail to address the development of local renewable energy generators. Developers voiced frustration with the high costs and delays associated with the permitting process, as well as with the differing requirements from jurisdiction to jurisdiction. Representatives of city and county planning departments said that they have neither the tools nor the funding to update their planning codes to enable faster planning, project processing and building permit issuance. All stakeholders agreed that the environmental review process for development of local renewable energy generators needs to be standardized and streamlined.

Introduction

CIn California, land use is regulated by local jurisdictions: cities and counties. There are two general steps for the development of any project, including renewable energy projects:

- **Step 1 – Planning Department:** During the first phase, city or county planning department staff determine whether a proposed land use is consistent with the jurisdiction's General Plan and Zoning regulations. This land use evaluation process is also known as the planning phase. If staff determines that the land is zoned for the proposed use, the environmental review process begins, wherein planning staff assess potentially significant impacts of the proposed project and determine whether those impacts be mitigated. Finally, the project and its accompanying environmental review document must be approved by the local jurisdiction. Depending on the jurisdiction and the nature of the proposed project, the project is either approved by staff, an appointed body such as a planning commission, or the elected city council or county board of supervisors.

- **Step 2 – Building Department:** Once the project has been approved, it proceeds through the building permit phase. This process is split into three parts: application submittal, plan check and inspection.

  a. Application Submittal: Every jurisdiction requires submittal of an application which includes a site plan, structural plans that comply with the building code and payment of applicable fees.

  b. Plan Check: This stage includes review of the application for consistency with the jurisdiction's building code and compliance with public safety standards. During this phase, the building department coordinates the review and approval of all other impacted departments, including Fire, Planning, Agriculture, Public Works and state and

federal agencies as appropriate.

c. Inspection: After approving the project's construction plans, the jurisdiction issues a building permit and the project moves to construction. During this phase, the building inspector assures that construction complies with the approved plans. If there are deviations, they must be pre-approved and documented before the inspector can approve them. Prior to receiving a final building permit, all agencies and departments that issued plan check approvals must sign off on the project as constructed.

While cities and counties possess a great deal of autonomy in the land use realm, local jurisdictions still must comply with state laws to ensure orderly land development and minimize adverse environmental impacts. For example, state law requires each city and county to adopt a General Plan. A General Plan is a planning document used "for the physical development of the county or city, and any land outside its boundaries which … bears relation to its planning."[1] Referred to as the "constitution for future development" by the California Supreme Court,[2] the General Plan "expresses the community's development goals and embodies public policy relative to the distribution of future land uses, both public and private."[3] Land use designations and policies in a General Plan are implemented through planning and zoning codes. All subsequent land use decisions must be reviewed for consistency with the jurisdiction's adopted General Plan.

State law also requires local jurisdictions to review proposed projects for potential environmental impacts and consistency with environmental laws. Pursuant to the California Environmental Quality Act, state and local agencies must identify the significant environmental impacts of their actions – including land use approvals – and avoid or mitigate those impacts as much as possible.[4] Environmental review encompasses studies of impacts over a range of issues, including air and water quality, sensitive habitats and endangered or threatened species, loss of agricultural lands, noise, traffic and aesthetics.

Like any other development project, local renewable energy facilities – whether a 300 kilowatt rooftop solar panel or a 5 megawatt wind turbine farm – are subject to land use regulations, environmental review, and building codes. Unlike typical development projects, though, renewable energy projects are especially susceptible to becoming ensnarled in the planning and building permit processes. In several cities, land use regulations and building codes are designed to address traditional construction projects but are ill-equipped to consider the new and rapidly changing technologies of renewable energy generators, and the often unknown or misunderstood safety, aesthetic and environmental impacts posed by them. Those potential impacts, and the lack of information about them, often result in protracted and expensive planning and building Permit processes.

One study on installation costs of residential solar generators found that local permitting and inspection processes add an average of $2,516 per installation, or $0.50 per watt.

Inefficiency and delay at the local permitting stage has impacts of its own, serving as a major impediment to development of local renewable energy generators by significantly increasing project costs. A recent study by SunRun on installation costs of residential solar generators asserts that, "local permitting and inspection processes add an average of $2,516 per installation, or $0.50 per watt."[5] Similarly, a study by the Sierra Club found that permit fees in Bay Area cities for a small commercial solar panel system ranged from no cost to over $25,000.[6]

However, several jurisdictions have developed streamlined permit processes for small scale projects (e.g., roof-mounted solar photovoltaic systems). In Butte County, for example, the entire submittal and permit issuance process for roof-mounted solar photovoltaic projects can be accomplished online via the County's website. Also, several jurisdictions waive permit fees for small scale solar photovoltaic projects.

In most cases, however, variations and inconsistencies in application and permit requirements, fees, and review times explain the real and perceived frustrations and high costs often associated with the permitting and inspection processes for local renewable energy projects.[7] For solar photovoltaic systems, these costs will play an increasingly important role in determining the total system cost as the cost of solar equipment continues to decrease.[8]

It is also important to highlight the relationship of project location with the degree and type of planning and building permit challenges. Many utility-scale projects have encountered significant barriers because of their proposed location in sensitive habitat, most notably in the Mojave Desert region of California. Because local renewable energy systems are, by most definitions, sited close to load (either within or close to urbanized areas), they are widely assumed to avoid many of the problems associated with development in outlying areas. However, that assumption fails if local renewable energy systems are defined simply as those that possess a generating capacity at or below 20 megawatts and are interconnected to the distribution grid. Large swaths of the utilities' distribution grids extend into rural and agricultural areas, such as the farmland and foothills along the Interstate 5 corridor in the Central Valley, and the high desert regions east and northeast of Los Angeles. Developers that have proposed renewable energy projects such as large wind farms or ground-mounted solar energy arrays in those locations have encountered habitat and species issues similar to those faced by developers of utility-scale systems. Projects proposed for agricultural lands that receive tax breaks under the Land Conservation Act, a state law enacted to preserve agricultural areas and protect them from development,[9] must address the use restrictions of those underlying contracts either through a solar use easement or termination of the contract. The potential loss of significant amounts of California's agricultural lands is a critical issue that must be addressed during each large scale project review.

Local renewable energy facilities developed within urban or suburban areas generally do not confront sensitive habitat or agricultural issues. However, they do face challenges shared by projects of all types proposed for development in an existing neighborhood: localized community opposition based on aesthetic objections, safety concerns, or simply different ideas about what the proposed site should be used for.

No matter where they are sited, local renewable energy projects can face planning and permitting challenges. Because the proposed definition of local renewable energy currently encompasses both urban and rural sites, this chapter discusses the very different land use challenges to development of each.

Goals

Conference participants, whether they represented renewable energy developers or city/county planning departments agreed that state and local governments need to mount a coordinated effort to update, standardize and streamline the land use permitting and environmental review process for development of local renewable energy generators, with the below general goals:

- *Speed:* Expedite review and approval of land use approvals and environmental review.
- *Cost:* Make permitting as inexpensive as possible. Cities and counties should not charge building permit fees based on the value of the project. Rather, they should calculate these fees based on the actual cost of providing plan check and inspection services for the building permit. This will serve to reduce the fees to the lowest level as appropriate for each permit.
- *Transparency:* Create more transparency in land use and environmental review process (requirements, procedures, timelines).
- *Uniformity:* Create uniformity across different jurisdictions.
- *Incentives:* Maximize opportunities for small scale renewable energy generation.
- *Safety/Reliability:* Ensure that new generators are safe and that the reliability of the grid is maintained.
- *Environmental Impacts:* Minimize adverse impacts on sensitive habitats and agricultural lands.

Barriers

1. BARRIER: Protracted Environmental Review

California's environmental review process, while intended

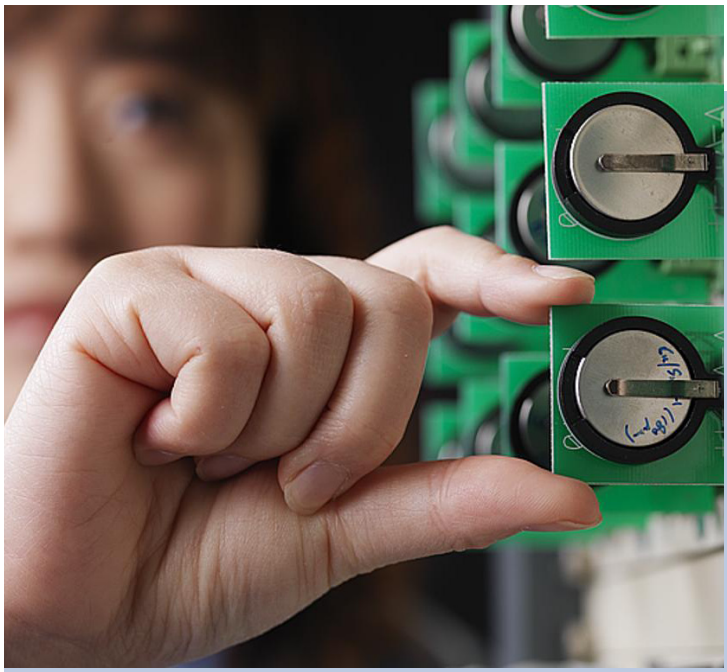
to safeguard the state's resources and the health and safety of its citizens, can also add significant time and expense to the development of any new construction project. Lengthy environmental studies, contentious public hearings and the potential of litigation can thwart even the best projects. Advanced planning measures such as general plans enable cities and counties to prevent certain project-specific disputes by establishing land use policies and planning maps at the outset that avoid development in environmentally sensitive areas and prevent development of conflicting uses (such as heavy industry and residential) on contiguous parcels. Advanced planning also provides a vehicle to conduct comprehensive environmental studies and a forum for the public to provide input and reach a consensus on appropriate land use policies.

Local renewable energy generators, which only recently achieved widespread penetration and comprise a range of new and highly dynamic technologies, have received little if any consideration in the planning process of many cities and counties in California. For that reason, it is rare to find land that is designated as appropriate for the location of renewable energy systems. there is a shortage of designated zones or local code planning requirements for them: new projects must be fit into existing and often ill-suited zones and planning criteria, with the result that environmental and land use disputes and appropriate planning requirements are hashed out through the environmental review process. While many of those disputes relate to legitimate concerns about sensitive habitat impacts, potential loss of farmland or safety issues, in some cases they may serve as a pretense for purely aesthetic objections.

Beyond concerns related to cost and timing, some Conference participants noted that a long environmental review process could cause a project to run afoul of timing provisions required by the Public Utilities Commission in energy procurement contracts. For example, projects participating in the Renewable Auction Mechanism must be online within 18 months of contract execution, with one allowable 6-month extension for regulatory delays.[10] The Commission Staff proposal for the feed-in tariff program includes an identical requirement.[11]

Conference participants described the problems as follows:

- "[Public Utilities Commission]-imposed deadlines for electricity delivery under procurement contracts conflict with protracted [California Environmental Quality Act] review."
- "Multiple small projects present cumulative environmental impact issues."
- "Resource impacts cause delay and expense."
- "If a project needs [California Department of Fish & Game] sign-off because of endangered or threatened species issues, the developer has to go back to county for additional [environmental review] even if the county had already exempted them from it initially. The state needs to consider creating special [renewable energy project] exemptions for endangered species."



When establishing local policies and standards, it is important to recognize job creation, goods and service purchases, and tax revenues that can result from energy facility development.

1. POTENTIAL SOLUTIONS

A robust and comprehensive local planning and environmental review process at the outset, such as in a general plan, can obviate many of the environmental review issues that hinder development of local renewable energy generators during the planning and building permit processes. Changes to the state laws that govern land use decisions and environmental review could also facilitate better and faster approvals for renewable energy projects. The following are potential solutions to the challenges

posed by the environmental review process:

Require Energy Elements in General Plans

State law requires general plans to contain seven "elements" covering broad subjects ranging from land use to safety. Each element identifies issue-specific problems or goals and corresponding policies. While an energy element is not required, the Governor's Office of Planning and Research, as part of its *General Plan Guidelines*, encourages local governments to consider including it in general plans:

> "Communities may...consolidate energy policies in an optional energy element. An energy element can help integrate the economic and environmental effects of energy costs and benefits into a city's or county's long-term growth planning. In this way, an energy element can be a useful component of a sustainable development strategy.."[12]

The *Guidelines* contain several examples of policies applicable to local renewable energy that an energy element could contain, including location and design standards for various local renewable technologies.[13] Over 80 cities and counties in California already have incorporated an energy element into their general plans.[14] Echoing comments made by several Conference participants, the *Guidelines* also suggest that cities and counties address environmental justice concerns when planning sites for new energy facilities by avoiding concentration of fossil fuel generators near residential areas or schools, and by encouraging development of clean local renewable energy sources as an alternative to conventional power plants.[15]

In addition to environmental impacts, energy elements could also address the economic benefits resulting from development of local renewable energy generators. According to the Energy Commission's *Energy Aware Facility Siting and Permitting Guide*:

> "When establishing local policies and standards, it is important to recognize job creation, goods and service purchases, and tax revenues that can result from energy facility development. For example, a jurisdiction whose goal is energy supply diversification could give preference to local renewable resource development for both its diversity benefits and local employment created by facility construction and renewable energy production."[16]

Determining the employment benefits of local renewable energy generators in planning documents could bolster support for their development at the local level. It could also enable local jurisdictions to assess labor needs and develop training and education programs as needed (see Chapter 7 for further discussion of employment issues). To track those benefits, energy elements could require preparation of annual reports on the impacts of local renewable energy development, including "the amount of clean electric provide locally, reduction in carbon dioxide emissions, and net economic impacts."[17]

Encourage incorporation of local renewable energy maps into general plans

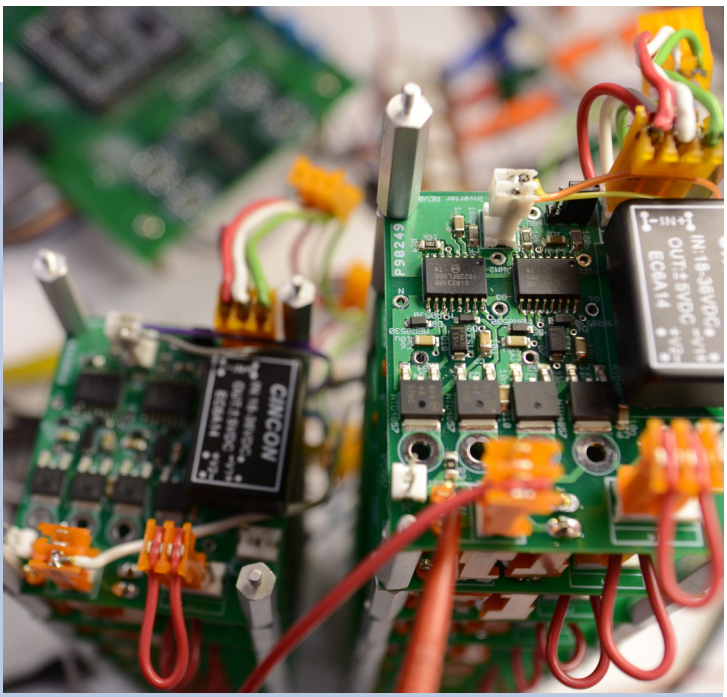
Complementary to a general plan energy element are overlay maps – either in the general plan, supplementary community plans or specific plans – that direct development of local renewable energy generators to locations that minimize or eliminate impacts to sensitive habitats or threatened species, avoid conflicts with neighboring uses, and enable maximal use of natural resources (e.g., sun, wind, biogas, geothermal).

As described in the Energy Commission's *Energy Aware Guide*:

> "State and federal agencies with energy facility siting responsibilities [should] encourage local planning as a means of identifying local needs and preferences, reducing jurisdictional conflicts, and expediting the timely and orderly permitting and development of energy facilities when and where they are ultimately needed . . . utilities and local jurisdictional agencies should jointly consult on proposed energy facility projects and system planning as early as possible so that new developments can be consistent with existing local planning requirements and planning objectives can be incorporated into local land use plans and ordinances, as much as possible."[18]

Local renewable energy overlay maps could be developed in tandem with utilities so that they encourage siting in areas where interconnection to the distribution grid can be secured with minimal upgrades, avoiding impacted distribution lines. The maps and policies could also support the goals and policies of the Public Utilities Commission's procurement and incentive programs.

While most Conference participants supported development of general plan overlay maps for local renewable energy



"Keeping up with new product categories is tough; in LA we are waiting for approval of micro-inverters. We need some way to offload evaluation of these technologies from municipalities."

generators, some voiced concerns that such maps would encourage developers to flood areas mapped for development with projects. They encouraged planners to provide developers with guidelines or siting criteria and then allow developers to do the work necessary to find appropriate sites.

Encourage streamlined environmental review processes

Cities and counties could incorporate streamlined environmental review processes for development of local renewable energy generators. The California Environmental Quality Act, the legal authority underlying environmental review, empowers cities and counties to prepare what is called a program level environmental impact report (PEIR) for a class of related projects (such as local renewable energy generators) when those projects are 1) geographically related, 2) parts of a chain of contemplated actions, or 3) subject to the same permitting authority with similar environmental effects and mitigation requirements.[19] A PEIR can ensure consideration of the cumulative impacts resulting from development of several projects in a way that may not be possible through piecemeal review of individual projects, and allow a city or county to "consider broad policy alternatives and program-wide mitigation measures early in the process when the [city or county] has greater flexibility."[20] A PEIR could be part of and complementary to jurisdiction-wide planning processes, such as the preparation of an energy element or other general plan amendment.

A bill in the California legislature would have provided that a PEIR prepared for a renewable energy project would not be subject to judicial review under the California Environmental Quality Act, but language relating to that exemption was subsequently deleted.[21] In October, 2011, Governor Brown signed SB 226, which creates a new statutory exemption from environmental review for solar energy systems installed on the roof of an existing building or parking lot.[22] While it is too early to evaluate the efficacy of SB 226 at the time of this writing, future legislation could expand the exemption to larger, ground-mounted infill renewable energy projects and other technologies in addition to solar panels.

2. BARRIER: Obsolete and Inconsistent Permitting Requirements

Conference participants representing renewable energy developers voiced frustration with the obstacles often presented by municipal planning codes. In many cases, the regulations – like the general plans on which they are based – are obsolete and do not contemplate or accommodate development of local renewable energy sources, requiring planners to shoehorn those projects into categories that are the closest fit. Even when jurisdictions have adopted codes to accommodate the development of renewable energy systems, those codes can be quickly rendered obsolete by the emergence of new technologies and rapid evolution of existing technologies. In some cases, cities have adopted development regulations – usually for aesthetic concerns, but sometimes for fire and public safety issues – that make development of local renewable energy systems unduly difficult. California's Solar Rights Act prohibits adoption of ordinances that "create unreasonable barriers to the installation of solar energy systems, including, but not limited to, design review for aesthetic purposes."[23] However, participants and other stakeholders noted that the law is unevenly applied among California's cities and counties.

Developers also noted, not surprisingly, that there is a high degree of variability in development requirements from jurisdiction to jurisdiction, adding additional complexity and opportunity for delay to the development

process. For projects that require approvals from multiple agencies, such as those proposed for environmentally sensitive or contaminated sites, developers voiced frustration with a lack of coordination and conflicting requirements among the various permitting agencies.

City and county representatives, meanwhile, said that they often do not have the financial resources or informational tools necessary to update and maintain land use and building code regulations for renewable energy facilities. They also defended variances among jurisdictional codes, noting that differences in geography, weather and existing building stocks often underlie unique code requirements.

Conference participants described the problems as follows:

Obsolete municipal codes

- "The problem is that the [municipal] code doesn't list [solar photovoltaics], so the city has to figure out what else it looks like. Is it a roof? Is it a carport? It depends on how each city employee reads the code."
- "Projects are being shoehorned into odd land use categories and are also subject to special inspections, which can get into serious money."
- "We've been permitting solar for a while; it's other types of [local renewable energy generators] that shock everyone. Frontline staff doesn't know what to do next."
- "Keeping up with new product categories is tough; in LA we are waiting for approval of micro-inverters. We need some way to offload evaluation of these technologies from municipalities. Some counties, like San Bernardino, have a standardized plan for all renewable energy generators. Others start fresh for each new technology, establishing new fees and new reviews."
- "Why would cities be motivated to [adopt standardize renewable energy codes]? They like local control. I think there's an emotional context that isn't being discussed. We need to show cities the consequences of good and bad solar policies in terms of jobs, dollars, etc."

Adverse code requirements

- "In our city, [renewable energy] systems are required to be in the least visible location. The city was unwilling to leave all aesthetic considerations alone, resulting in an unnecessarily complicated calculation for developers. Cities are unwilling to give up local control."
- "The scope of Solar Rights Act needs to be broadened to explicitly include ground-mounted solar that supports onsite load, or large rooftop generators that sell power to the grid."
- "Some cities do not have experience with the Solar Rights Act and this leaves them unprepared and unwilling to address concerns raised by developers under the Solar Rights Act."

Regional efforts can serve as incubators for development of strong and comprehensive model codes and inspection guidelines for local renewable energy generators.

Inconsistency within codes and among jurisdictions

- "Inconsistent ordinances are a problem. There are jurisdictional differences and there are also conflicting ordinances and rule interpretations in a single jurisdiction."
- "There are six different codes that apply to [new rooftop solar panel projects] in LA."
- "Building code requirements vary from jurisdiction to jurisdiction, which drives up project costs"
- "I can be on a house that looks like the same as

the last house I was on: for the first one I need a structural engineering permit but for the second I don't."

- "Some conditions such as snow load, wind or building construction and age of housing stock that differ by location may require different standards."
- "The permit process is where it [development] can spiral out of control and take many months, as the planning department adds additional requirements for site upgrades, infrastructure improvements and landscape concerns."
- "The checklist for inspectors varies wildly: there is a lack of standardized training."

Lack of coordination among local, state and federal permitting agencies

- "Dealing with multiple agencies with different processes is challenging."
- "[The Public Utilities Commission] and [the renewable energy] industry worked on [the renewable auction mechanism], but they never contacted local permitting offices to discuss how to make it happen. Cities will not step over the rules, but we need more tools."

2. POTENTIAL SOLUTIONS

To address obsolete or inconsistent codes, the state and local governments could mount a coordinated effort to update, standardize and streamline land use permitting requirements for local renewable energy generators. Conference participants discussed ongoing efforts to develop statewide model planning codes and standardize regional planning codes. Participants also advocated development of educational and training tools for local governments to use or participate in to better understand local renewable energy generators. Potential solutions for obsolete or inconstant planning codes include the following:

Encourage development and adoption of model planning codes

An effort led by the California County Planning Directors' Association (CCPDA) to develop a Model Solar Energy Facility Ordinance for use by California counties was completed in February, 2012.[24] The Model Code was developed with input from a variety of stakeholders and includes four tiers for solar photovoltaic projects. They are as follows:

- ***Tier 1:*** Roof Mounted Solar or Ground Mounted Solar < ½ acre
- ***Tier 2:*** Ground Mounted Solar < 15% of a parcel up to 5 acres
- ***Tier 3:*** Ground Mounted Solar located on non farm land < 30 acres
- ***Tier 4:*** Ground Mounted Solar > 30 acres

The goal of this effort was to create and recommend streamlined processes for Tiers 1-3. Tier 4 would require discretionary approval and full environmental review, which may include an Environmental Impact Report.

As an example of how this could work if adopted by a city or county, Tier 1 projects are exempt from CEQA/discretionary review and can thus proceed directly to the building permit phase. For large scale photovoltaic ground- mounted projects (>30 acres), CEQA review is required. If potentially significant impacts are identified (loss of agricultural lands, conflicts with Williamson Act contracts, sensitive environmental resources, etc.), an EIR may be required. Large scale projects typically require a conditional use permit, an Environmental Impact Report and often involve controversial public hearings before Planning Commissions and Boards of Supervisors or City Councils.

The model serves as a baseline for counties to use to write their own ordinances but would provide the basic tools and standardized requirements necessary to do so. A similar statewide effort could be initiated for California cities. Conference participants suggested that cities adopt standards and processes developed by the Department of Energy-funded Solar America Board for Codes and Standards.[25] Several Conference participants suggested that local renewable energy codes should be standardized across the state. Stakeholders also advocated passage of state legislation that mandates local adoption of model codes, as well as expansion of the benefits provided by the Solar Rights Act to non-solar renewable energy technologies. Future work on model codes and related legislation could include renewable energy technologies in addition to solar. The State could encourage cities and counties to adopt new regulations to streamline the planning and building permit process by tying it to eligibility for grant programs to fund Energy Elements, Energy Overlay or other tools that would help to achieve the state's renewable energy goals.

Promote development and adoption of regional standardized planning codes

Several local governments have teamed up with neighboring jurisdictions to develop and standardize permit requirements and processes for local renewable energy generators. Those

efforts are underway in cities and counties across the state. In December, 2011, the Department of Energy's SunShot Initiative awarded $12 million to 22 municipalities and non-governmental organizations to fund projects that "spur solar power deployment by cutting red tape — streamlining and standardizing permitting, zoning, metering, and connection processes — and [improve] finance options to reduce barriers and lower costs for residential and small commercial rooftop solar systems."[26] Four of the awardees are located in California.[27]

Conference participants also advocated standardization of building inspections and renewable energy training for building inspectors. One participant discussed an example of a city in Southern California that sent its building inspectors to "solar school" and as a result realized improvements in inspection speed and efficiency.

Regional efforts too can serve as incubators for development of strong and comprehensive model codes and inspection guidelines for local renewable energy generators. A state or non-governmental organization-led effort could promote regional standardization in other parts of the state through development of model codes, educational tools, informational bulletins and workshops that consolidate and review the successes and failures of new and ongoing regional efforts across the state.

Develop educational and training resources for cities and counties

Representatives of city and county planning and permitting departments indicated a desire for educational tools and materials to both develop sophisticated planning requirements for local renewable energy facilities and to train their employees to use them. At the time of this writing, the Energy Commission is developing a "Renewable Planning and Permitting Program" that would provide local governments with planning and permitting assistance to help them evaluate and expedite renewable energy development in their jurisdictions.[28] The Commission has also developed a website that contains planning resources for local governments.[29] The Energy Commission also took part in an effort to develop an internet-based land use modeling tool designed for use by local and regional government planners.[30] The Department of Energy has funded a number of programs to promote information exchange and development tools for local governments, including a recent $3 million award to Clean Power Finance for creation of a national database of solar photovoltaic permitting requirements by jurisdiction.[31]

Future efforts by the Energy Commission and non-governmental organizations could focus on connecting newly developed tools with the cities and counties they are intended for. Education and outreach efforts to jurisdictions could also include guidance about state laws related to development of local renewable energy generators, such as the Solar Rights Act and SB 226.

Promote interagency coordination

Federal and state permitting agencies could develop platforms to standardize requirements for local renewable energy generators and streamline application approvals. The Energy Commission's *Energy Aware Facility Siting and Permitting Guide* recommends development of consistent policies among agencies with overlapping jurisdictions, creation of joint application review panels, and elimination of duplicative approvals.[32]

Similarly, utilities could collaborate with the jurisdictions in their service territories to plan for strategic development of local renewable energy generators. Such collaboration could target development for points on the grid that are forecasted for load increases and/or population growth.[33] Such an evaluation could also identify locations where development of local renewable energy generators would provide demand response benefits, as currently called for in the state's Energy Action Plan.[34]

3. BARRIER: Development of Fire and Safety Standards

Among land use and building permit requirements, those that serve to protect public health and safety in the event of an emergency are arguably the most critical. That is certainly the case for local renewable energy generators, which produce significant amounts of electricity, often in close proximity to places where people live or work. Hazards associated with local renewable energy generators vary depending on the type, size and the location of the energy system. Large wind turbine farms in rural areas present much different risks than those of small rooftop solar installations.

By setting strict installation, siting and maintenance standards, fire and safety codes aim to protect both people and property from hazards associated with renewable energy equipment. They also protect emergency responders such as firefighters by ensuring that responders know what they are getting into when they encounter the equipment under emergency conditions: emergency responders need to understand how the equipment works, how it responds to fires and other extreme conditions, and how to properly

"It is imperative for firefighters to be taught to recognize and understand the hazards [of renewable energy systems] and increase awareness for firefighter safety."

mitigate any of the hazards associated with it. For example, according to *Fire Operations for Photovoltaic Emergencies,* a training manual for local firefighting agencies, hazards posed to emergency responders by solar photovoltaic panels include:

- *Electrical shock:* "[Photovoltaic] systems typically have the capacity to generate electricity in the range of 600 volts. This voltage, even at low amperages, is extremely dangerous to fire- fighters who may come in contact with it."[35]
- *Electrical burns:* "An arc-flash can occur when there is sufficient amperage and voltage and a path to ground or to a lower voltage. Arc-flashing is most common in AC circuits due to the presence of high amperage. Temperatures generated by arcing electricity can reach 15,000 to 35,000 degrees and can melt or vaporize metal in close vicinity. It can also burn flesh and ignite clothing at distances of up to 10 feet."[36]
- *Trip, slip and fall hazards:* "[Photovoltaic] systems are comprised of metal, glass, conduit and cable, all of which are slippery when wet. Some of these components protrude above the roof line or crisscross the space between rows of modules and may not be visible to firefighters in dark or smoky conditions creating a trip and fall hazard. Building integrated components, such as roof tile or shingle shaped PV modules may not be visible at all to a firefighter walking across a roof at night."[37]
- *Increased dead load roof loads:* "A [photovoltaic] system installed during new construction or retro-fitted onto an existing building adds weight to the roof assembly. Light-weight constructed roofs are engineered to carry the building's design load under normal conditions. They are not designed to continue to support a load under fire conditions. The additional weight of a PV system, whether part of the original design load, or added as a retrofit, is likely to cause a roof to fail sooner."[38]
- *Hazardous material inhalation:* "Many hazardous materials used in the semi-conductor industry are also used in the construction of PV modules. These include: silicon, boron, phosphorus, cadmium, tellurium, arsenic, and gallium...During a fire involving [photovoltaic] modules the aluminum frame can easily deform or melt, exposing these materials to direct flame. The hazardous materials then become dissipated in the smoke plume and may be inhaled by firefighters not wearing breathing apparatus."[39]
- *Battery hazards:* "In some [photovoltaic] systems, batteries are used to store solar-generated electricity...Lead acid batteries contain sulfuric acid that can cause harmful and explosive fumes ...Lithium ion batteries may burn rapidly with flare-burning effect and may ignite other batteries or combustibles in close proximity. Contact with the electrolyte in the lithium ion battery may be irritating to skin, eyes and mucous membranes. Fire will produce irritating, corrosive and/or toxic gases including hydrogen fluoride gas."[40]

Representatives of emergency responders, including municipal and state firefighting organizations, stressed the need for cities and counties to adopt uniform fire and safety codes for local renewable energy generators, and for widespread training of emergency responders. Others, while agreeing with the need for comprehensive codes, warned against adoption of overly stringent requirements

that could unnecessarily impede development of renewable energy systems and stifle progress towards the state's 12,000 megawatt goal.
Conference participants described the barriers as follows:

- "For technologies such as wind turbines, knowing when and where to enter a firefighting situation is contingent on understanding the equipment, the hazards it can present and the expectations for fire control."
- "Emergency responders will need to understand how to access all sizes of solar facilities and turbines; what type of containment and resources apply (e.g., water, property boundaries); and the security, prevention and operational measures associated with electrical, chemical or other hazards."
- "We're finding new challenges as [renewable energy] technology diversifies."
- "Water and access is the biggest concern for ground-mounted solar, especially out in rural areas. Access can be problematic. Our [firefighting] apparatuses are very heavy. We need good roads, and lots of times new access roads are expensive for developers."
- "Rooftop solar also has issues. How do we account for getting around the physical structures? Cabling is often hidden under the roof. Electrical conduit is very dangerous for firefighters. The integrated systems can be hidden in the smoke and very slippery. Panels also divert smoke, which can create confusion about where to approach fire on roof and where the fire actually is."
- "The fiberglass in wind turbines burns easily and can send burning fiberglass up to half a mile. Is there enough water at the array to help put the fire out? There is a lot of pressure on the fire department to protect these million dollar assets, but little data to help us understand how fire behaves around clean energy projects."
- "It is imperative for firefighters to be taught to recognize and understand the hazards [of renewable energy systems] and increase awareness for firefighter safety."
- "It is not feasible that every conceivable situation is placed within the code; therefore, the fire service must provide the required information to address safety issues. This process may be perceived as slowing down the deployment of the renewable energy systems."

Regional or statewide standardization of planning codes for local renewable energy systems could result in signifcant upfront savings for cities and counties that adopt them into their codes.

3. POTENTIAL SOLUTIONS

At the time of this writing, efforts are well underway to implement comprehensive, standardized fire and safety standards for local renewable energy generators. In 2008, the Office of the State Fire Marshall released the *Solar Photovoltaic Installation Guide*, a set of fire and safety guidelines for installation of solar photovoltaics that can be adopted by jurisdictions throughout the state.[41] Two years later, it released *Fire Operations for Photovoltaic Emergencies,* a training manual for local firefighting agencies.[42] Both documents are products of collaboration between members of the Photovoltaic Solar System Task Force, a committee brought together by the Governor's Office to address concerns from the solar industry and the fire service surrounding the installation of solar photovoltaic systems. The Task Force included representatives from the Office of the State Fire Marshall, several local fire departments, building departments and the solar industry.

Both guides represent significant achievements and are successful examples of collaboration between stakeholders with sometimes divergent viewpoints. Future efforts to further develop and implement fire and safety codes could include the following:

Promote expansion of and regular updates to model code guidelines and training manuals

The *Solar Photovoltaic Installation Guide* does not include code guidelines for renewable technologies other than solar. In fact, it does not even include guidelines for the complete array of solar photovoltaic technologies on the market. As stated in the cover letter to the document,

> "The Task Force's guideline document does not address all types of PV solar systems. This technology continues to evolve and manufacturers continue to update and provide innovative methods of addressing the use of solar for energy consumption. With changing technology, it may be necessary to make adjustments to address new technology."[43]

The Governor's Office could convene a Local Renewable Energy Task Force to address new and emerging renewable energy technologies that warrant additional or modified safety standards and training for emergency responders. Working with relevant state agencies or non-governmental organizations, the Task Force could also establish standing meetings or workshops to discuss and develop updates to the model guidelines and training manuals.

Expedite adoption and implementation of model codes

Several local jurisdictions have already adopted or are in the process of adopting fire and safety standards for local renewable energy generators, most based on guidelines from the *Solar Photovoltaic Installation Guide.* However, the majority of cities and counties in California have not done so. Model guidelines for fire and safety standards could be incorporated into statewide or regional efforts to develop standardized permitting requirements (discussed above). Similarly, legislation could require local jurisdictions to adopt model fire and safety guidelines.

Facilitate statewide training programs

Working with local fire and building departments, firefighting organizations, and representatives from the renewable energy industry, the Office of the State Fire Marshall could develop training classes for emergency responders based on the technology types and sizes that are most common in each region.

Encourage third-party research partnerships

Third-party organizations such as Underwriters Laboratories that are active in technology testing and development of standards have provided data and information to state fire groups to improve model codes and training frameworks. Those types of partnerships could be encouraged and formalized by including relevant third-party research laboratories and organizations in a Local Renewable Energy Task Force or similar statewide effort to develop and maintain model code guidelines and training manuals.

4. BARRIER: Permitting Fees and Funding

Discussion at the conference about fees for permit applications versus jurisdictional resources for code updates and permit reviews presented a unique conundrum: representative of renewable energy developers voiced frustration with high costs and arbitrary pricing frameworks for planning and building permit applications and inspections, while representatives from cities and counties said that they lacked the financial resources to make necessary updates to their municipal codes and process permit applications in a more expeditious manner. Participants described the challenges as follows:

- "The state shouldn't cram policies down local government throats; it has to provide resources for local governments to revise ordinances, zoning codes, etc."
- "Local governments need grants to support ordinance development and priority mapping for renewables."
- "Jurisdictions maintain high fees based on complex review requirements or have developed a permit fee calculation methodology based on the estimated value of a project rather than the time or resources necessary to review and approve it."
- "By law, the costs charged by local jurisdictions for permitting cannot exceed the amount required to cover the cost of that activity. But costs nonetheless vary widely depending on the process used by the local agency or jurisdiction."
- "I've seen permit fees ranging from five dollars to one thousand dollars. Now the average is probably around four hundred dollars. I don't think valuation fees are fair for solar."
- "We see a range of fees on the building permit side, mostly because of valuation fees, even though

there is often little if any correlation between project value and the cost for a city to check and review plans and finished projects. We prefer a time and materials approach, with a base fee for utility scale."

4. POTENTIAL SOLUTIONS

Regional or statewide standardization of planning codes for local renewable energy systems could result in significant upfront savings for cities and counties that adopt them into their codes by relieving them of the often time and labor-intensive process of code development. It may also result in savings through more efficient and faster permit review processes. Other federal and state programs, such as the Department of Energy's SunShot Initiative and the Energy Commission's Renewable Planning and Permitting Program, are advancing development of comprehensive and streamlined codes for local renewable energy projects.

Counties are encouraged to utilize the CCPDA Model Solar Energy Facilities Permit Streamlining Ordinance to assist them in modifying their General Plans and Zoning Ordinances to provide a clear delineation of processes for various tiers of Solar PV projects.

In addition, Conference participants and stakeholders advocated the below solutions to address costs associated with permitting of local renewable energy systems:

State funding for local development of renewable energy ordinances

Some participants suggested that the state should fund the costs borne by cities and counties to update their codes. One stakeholder advocated designating a portion of funds from the Public Goods charge if it is reauthorized.

Outsourced permit review

To save costs and staff time, local jurisdictions could outsource review of applications for local renewable energy system permits to third parties with technological and regulatory expertise. Outsourcing would likely be even more cost-effective if planning ordinances are standardized. One Conference participant recommended development of a standardized memorandum of understanding that would enable project applicants to pay for costs associated with outsourcing (and potentially an expedited review process) while ensuring that the third-party reviewer is still answerable to the permitting jurisdiction. Outsourcing could raise accountability issues if not executed carefully.

Permit fee waivers for local renewable energy projects

Some conference participants noted that certain jurisdictions, in order to foster development of local renewable energy systems, have waived permitting fees entirely for projects meeting certain size or location criteria. However, most participants agreed that adoption of fee waivers is unlikely to be an option for most local governments given the current budget challenges.

Fees based on time and materials

As described above, several jurisdictions establish permitting fees according to the estimated value of the developed project under review. When some element of a renewable energy project drives up project costs but does not contribute to permitting complexity or review time, resulting variations in permit fees can appear arbitrary and baseless. As one participant mentioned, state law only allows jurisdictions to assess fees that are no higher than the costs they bear in return. Representatives of developers and several jurisdictions agreed that permitting fees should be based on a time and materials approach rather than a valuation method.

Expedited permit system

An expedited permitting process could result in savings for both project applicants and jurisdictions by reducing the amount of time that permitting staff spends on project review. Even if applicants could only participate in an expedited review process by agreeing to outsourced review and the potentially higher rates of a third-party reviewer, it would still make financial sense for many renewable energy developers who are liable for other costs associated with permitting delays. Some of the suggested methods for expediting permit review and approval processes are discussed in the next section.

5. BARRIER: Protracted Permit Review Periods

As described above, protracted permit application review periods are the chief consequence of permitting barriers, whether resulting from inadequate planning codes and environmental review processes or simply from insufficient staffing. Delays are also among the chief complaints of renewable energy developers due to potentially significant cost implications.

The following are additional factors that contribute to application review delays, in addition to those described above. Most of these relate to problems with application submittal and complexity, and primarily affect applicants for smaller, customer-side projects who, unlike larger renewable energy developers, do not have the development experience or savvy necessary to navigate the sometimes

labyrinthine forms and processes of city and county planning departments.
Participants described the challenges as follows:

- "Many jurisdictions are dealing with obsolete application technologies and require multiple hard copies to be submitted for review."
- "[Planning departments] have inadequate staff to complete timely review of permits requests due to a backlog of other work."
- "Some jurisdictions report that delays sometimes result from poor preparation by installers, including inconsistencies between the plans submitted and actual field conditions."

5. POTENTIAL SOLUTIONS

The following are solutions suggested by stakeholders and others to expedite the permit application process:

One-stop permitting

The *Energy Aware Planning Guide* recommends that jurisdictions designate a permit "ombudsman," a single point of contact at the planning department for all local renewable energy permits (including electrical, plumbing and building), that application materials are compiled into one easy-to-use packet and that jurisdictions establish a clear timeline for application review and approval.[44]

Electronic application submittal process

Conference participants advocated use of electronic application processes to speed up the submittal and review process. While they suggested both email and web-based formats, web-based applications would provide the added benefit of ensuring that applications are filled out completely in order to be submitted. Acknowledging that development of the necessary software could be cost-prohibitive and infeasible for a jurisdiction to execute on its own, participants suggested that the state or federal government or a non-governmental organization could develop a shared infrastructure platform for application software, such as a statewide web portal. Another participant mentioned that companies such as Google have developed online tools that may be used to develop an application submittal process. In any case, standardization of planning codes and applications could significantly reduce costs and make statewide or regional applications much more feasible. Participants mentioned Santa Clara County, Butte County and the City of Sacramento as jurisdictions that have successfully implemented electronic application systems.

6. BARRIER: Williamson Act Challenges

As discussed in Chapter 5, utilities' distribution grids extend into rural areas of the state, and renewable energy developers have targeted those areas to take advantage of lower land costs, and build less expensive ground-mounted projects at significantly larger scales than possible in urbanized areas. Since they interconnect to the distribution grid, they can take advantage of programs intended to promote growth of local renewable energy sources.

Many of the rural areas targeted for development of renewable energy facilities are dormant agricultural and farmlands that are subject to Williamson Act contracts. The Williamson Act, a voluntary program enacted to preserve the state's agricultural lands, grants tax breaks to owners of agricultural land in exchange for agreement to contractual development restrictions on those lands.[45] As described by the California Department of Conservation:

> "Under the Act, cities and counties may establish agricultural preserves which are designated areas consisting of one or more parcels totaling at least 100 acres, and devoted to agricultural, open space or recreational use. Once a preserve is established, a city or county may enter into contracts with landowners within the preserve to restrict the use of the land. Some Williamson Act-based restrictions apply to all parcels in an agricultural preserve, so even if a specific parcel is not under contract, its location within an agricultural preserve can have an effect on the siting of a solar project."[46]

The Williamson Act grants jurisdictions with a wide degree of latitude to develop use restrictions for parcels located in Williamson Act preserves, as well as to determine the requirements of individual Williamson Act contracts. Since nearly all preserves and contracts were established prior to the widespread development of renewable energy generators, use restrictions and contracts are generally silent or ambiguous on whether renewable energy generators are permitted as uses.

There are currently five general options to develop renewable energy systems on Williamson Act lands:

1. Renewable energy facilities may be allowed on lands under contract as a compatible use, depending on local rules and satisfaction of statutory criteria governing compatibility. The use must be listed in

the locally adopted Rules for Agricultural Preserves, must be allowed by the type of contract (prime or non-prime), and must meet the principles of compatibility in state law. The use cannot impair the productive agricultural capability of the land, nor impair agricultural operations on the site or on adjacent sites.

2. A Williamson Act contract may be converted to a Solar Use Easement under legislation effective in January 2012 (SB618). If the farm land is determined to be marginally productive or physically impaired, the Williamson Act contract may be rescinded and replaced with a new Solar Use Easement with a rolling 10-year term.
3. A landowner may provide notice of non-renewal to the city or county administering the Williamson Act contract on the land, and after a 9-year phase out period, eventually remove the Williamson Act's restrictions over use of the land.
4. The contract may be "cancelled" pursuant to required statutory processes under appropriate circumstances. Cancellation requires a finding that there is no other non-contracted land for the use and that the cancellation is in the public interest. In almost all cases, the landowner would be responsible for paying a significant cancellation fee of 12.5 percent of the unrestricted value of the property.
5. A public agency with the power of eminent domain may acquire land subject to a Williamson Act contract through eminent domain or in-lieu of eminent domain, thereby "nullifying" the contract and rendering the land free from the contract's restrictions.[47]

Representatives of renewable energy developers at the Conference said that ambiguities and challenges posed by restrictions related to the Williamson Act result in significant additional costs and time to develop renewable energy facilities on otherwise appealing sites.

6. POTENTIAL SOLUTIONS

Conference participants suggested the following solutions toward addressing development barriers created by Williamson Act restrictions:

Renewables easements on Williamson Act lands

In October, 2011, Governor Brown signed SB 618 (Wolk), which provides a mechanism for rescinding Williamson Act contracts for non-prime agricultural land for half the normal cancellation penalty, provided that the landowner simultaneously enters into a newly defined "solar easement" for a term of no less than 20 years. SB 618 also requires that when the solar easement ends or is terminated, the land must be restored to its pre-solar easement condition. At the time of this writing it is too early to determine whether SB 618 will facilitate renewable energy project development on Williamson Act lands.

Amend Williamson Act designations

Conference participants advocated updating the state's Farmland Monitoring and Mapping Program designation of "prime" agricultural land to reflect those that have access to water, and removing "prime" designations from lands that have lost their water rights. Doing so could open up non-prime lands to development of renewable energy facilities.

Renewable ordinances

Participants cited examples of ordinance revisions in Tulare, Kern, Fresno, San Bernardino and San Diego counties that contain Williamson Act work-arounds and other provisions that facilitate permitting for renewable energy systems in Williamson Act lands. Such ordinances could be incorporated into statewide or regional efforts to standardize planning codes.

Next Steps

BARRIER : Protracted Environmental Review

- **Energy elements:** Legislation could require general plans to incorporate energy elements, including policies, objectives and maps for development of local renewable energy generators, accompanied by program environmental impact reports.

BARRIER : Obsolete and Inconsistent Permitting Requirements

- **Model ordinances:** The Energy Commission, the Governor's Office of Planning & Research, CSAC, the League of Cities and/or the California County Planning Directors Association could work together to host public workshops on the practical use of the CCPDA approved Model Solar Energy Facility Permit Streamlining Ordinance. The Energy Commission could invite the California County Planning Director's Association to report on the use of its Model Solar Energy Facility Permit Streamlining Ordinance, as well as organizations such as the East Bay Green Corridor that are leading efforts to adopt regionally standardized planning codes.
- **Model building codes:** The Governor's Office of Planning and Research could work with the Building Standards Commission and the local building officials to strategize on future Green Building Code amendments to successfully facilitate the construction of renewable energy facilities in cities and counties.
- **Regional standardization:** A state agency or non-governmental organization could promote regional standardization of planning codes and standards applicable to local renewable energy systems in areas of the state where no such effort is yet underway. The initiative could draw upon model codes (e.g., the Solar Photovoltaic Installation Guide, Solar ABCs, and the work of the California County Planning Directors' Association). It could also draw from the lessons learned by regions currently developing standardized codes, such as the Bay Area's East Bay Green Corridor[48] and Southern California's Center for Sustainable Energy[49].
- **Local government outreach:** The Energy Commission and/or non-governmental organizations could develop an initiative to connect newly developed planning tools and strategies for local renewable energy system permitting with the cities and counties that can use them. Education and outreach efforts to jurisdictions could also include guidance about state laws related to development of local renewable energy generators, such as the Solar Rights Act and SB 226.
- **Coordinated planning with utilities:** Legislation or the Public Utilities Commission could direct utilities to work with jurisdictions within their service territories to plan for strategic development of local renewable energy systems by targeting development for sections of the grid that have existing capacity or are forecasted for load increases. The evaluation could also identify locations where development of local renewable energy generators would provide demand response benefits.
- **Mandatory code updates:** Legislation could require jurisdictions to adopt planning codes for local renewable energy generators.
- **Elimination of prejudicial code requirements:** Legislation could expand the benefits provided by the Solar Rights Act to non-solar renewable energy technologies.
- **Agency coordination:** Federal and state agencies with land use permitting authority, such as the U.S. Fish & Wildlife Service and the California Department of Fish & Game, could collaborate to standardize requirements and application review processes for local renewable energy systems and establish joint application review panels.

Next Steps (continued)

BARRIER : Development of Fire and Safety Standards

- **Updated safety standards:** The Governor's Office could convene a Local Renewable Energy Task Force to address new and emerging renewable energy technologies that warrant additional or modified safety standards and training for emergency responders.
- **Emergency training programs:** The Office of the State Fire Marshall could develop training classes for emergency responders that vary according to the technology types and sizes that are most common in each region or jurisdiction.

BARRIER : Permitting Fees and Funding

- **State support for code updates:** Legislation could allocate state funding for use by cities and counties to update their planning codes and standards.
- **Permit cost reduction:** As part of the broader discussion of standardized permitting requirements, the Energy Commission and/or nongovernmental organizations could host a workshop on methods for reducing permit fees, including exploration of outsources permit review and fees based on time and materials.

BARRIER : Protracted Permit Review Periods

- **Expedited permit review:** As part of the broader discussion of standardized permitting requirements, the Energy Commission and/or nongovernmental organizations could host a workshop on methods for expediting permit review periods, including designation of permit ombudsmen and development of electronic application submission capabilities.

BARRIER : Williamson Act Challenges

- **Williamson Act workarounds:** As part of the broader discussion of standardized permitting requirements, the Energy Commission could invite the Department of Conservation to report on the utilization of the renewable energy easements tool created by SB 618. The workshop could also explore other methods to ease Williamson Act restrictions, such as redesignation of lands without access to water from "prime" to "non-prime," and development of local ordinances that are compatible with Williamson Act requirements while also facilitating development of renewable energy systems on encumbered lands.

ENDNOTES

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6 Public Buildings and Lands

Summary

California can make great strides toward the 12,000 megawatt goal by developing local renewables on its own property. A recent Energy Commission study indicates that state property could yield as much as 23,000 megawatts of renewable energy (including utility-scale systems).[1] Based on an initial inventory of state property, Energy Commission staff recommended a target of 2,500 megawatts of renewable energy on state property by 2020. The State of California is not the only governmental body aggressively pursuing renewable energy development on its property: renewables initiatives are well underway in various branches of the federal government as well as several regional and local governments and agencies.

Conference participants, representing both public agencies and private sector developers, acknowledged the significant progress that public agencies have made in developing renewable energy systems to both offset their own energy demand and also sell power back to the grid. They also described a variety of challenges that encumber faster and more widespread development of renewables on public property, including the need for a full and detailed inventory of potential development sites, support for financing or better development of public/private partnership models, standardization of contracts and development standards, better training and staffing for renewables projects within agencies, and statewide leadership to drive development efforts at all levels of government and coordinate information exchange and collaboration.

Introduction

The property assets of federal, state and local government agencies in California present tremendous opportunities for development of local renewable energy systems, and will play a significant role in achieving the state's 12,000 megawatt goal. Representatives of public entities, from military services to public schools, attended the Conference and described the efforts already underway to develop both customer- and system-side renewables on public buildings and lands.

> In December 2010, the Energy Commission approved a Memorandum of Understanding with eight other state agencies to "work together to study, plan and develop localized renewable electricity generation on state property."

At the state level, an effort spearheaded by the Energy Commission aims to promote development of renewable energy systems on state-owned properties. In December 2010, the Energy Commission approved a Memorandum of Understanding with eight other state agencies[2] to "work together to study, plan and develop localized renewable electricity generation on state property."[3] The Governor's

FIGURE 6a | State Property Inventory Categories *Courtesy of the California Energy Commission*

	State buildings in load centers	State property with potential for wholesale generation	Land lease for wholesale generation
Location	One of seven load centers	Statewide	Not in a load center
Amount of land	Only rooftop and parking lots	Rooftop, parking lots and surplus land	All surplus land.
Size of system	< 1 megawatt	< 1 megawatt; additional system up to 4 megawatts	> 1 megawatt
Energy product	Partially offset onsite load	Partially offset onsite load with potential for larger system for wholesale market	Wholesale local energy generation

FIGURE 6b | Potential for Renewable Development by Type of State Property
Courtesy of the California Energy Commission

State Property Category	Potential Renewable Generation Capacity (megawatts)
State buildings in load centers	15 – 28
State property with potential for wholesale generation	55 – 195
Land lease for wholesale generation	12,800 – 23,050
Total potential state properties renewables	***12,870 – 23,270***

Office also convened an interagency working group to share resources and experience among state agencies.

In January 2011, the Energy Commission released *Developing Renewable Generation on State Property*, a report that contains a discussion of development barriers and solutions as well as an initial inventory of state buildings and lands that may be suited to development of renewable generators.[4] The inventory divided state properties into three general categories: state buildings in load centers, state property with potential for wholesale generation, and state lands available for lease for wholesale generation. The criteria for each category are in Figure 6a and the estimated potential for renewable generation capacity for each category is in Figure 6b.

In *Developing Renewable Generation on State Property,* Energy Commission staff proposes a target of 2,500 megawatts of renewable energy generation on state property by 2020. The goal incorporates the state's 33 percent RPS standard by setting a base target that is equivalent to 33 percent of state buildings' total electricity usage (200 megawatts), and adds an additional 2,300 megawatts in recognition that "state government should set an example, and because opportunities exist to install renewable generation on state lands with no current building load."[5]

Indeed, several state agencies have already embarked on ambitious campaigns to develop renewables on their properties, including (but not limited to) the following:

- The *Department of General Services* has released three Requests for Proposals to develop solar photovoltaic systems on state buildings ranging from California State University facilities to state prisons, using third-party financing and 20-year Purchase Power Agreements. Once fully developed, the projects could generate as much as 65 megawatts of electricity.[6]
- The *Department of Water Resources* is working with the University of California on a solar photovoltaic demonstration project along the California aqueduct, is establishing a program to lease some of its properties for development of renewables, and has released a Request for Proposals for re-

"[I]f every school district in California installed 1 megawatt of solar capacity, the resulting clean energy produced would conservatively represent 2% of the state's 33% RPS goal.

newable energy systems of at least 5 megawatts.[7]

- The *University of California* has committed to installing 10 megawatts of onsite renewable energy by 2014. It currently has 8.4 megawatts of onsite solar photovoltaic systems and 6.2 megawatts of biogas-powered generation installed or under construction.[8]
- *Caltrans*, consistent with Governor Brown's advocacy for a California Solar Highway, is evaluating potential for development of renewables along state highways. A pilot project conceived in partnership with a private developer would install up to 15 megawatts of solar photovoltaic panels along a 20-mile stretch of Highway 101 in Santa Clara County.[9]
- The *Department of Corrections and Rehabilitation* has installed four 1-megawatt ground-mounted solar arrays and has a contract for another 3 megawatt ground-mounted system. It also expects to install 9 additional ground-mounted systems that will be completed in 2013 and will add about another 20 megawatts. It has identified additional potential locations for ground-mounted systems and is evaluating potential for rooftop and parking lot renewables.[10]
- In September 2011, the *Department of Education* released *Schools of the Future*, a report that addresses various strategies for modernization of the state's public school facilities, including development of renewable energy sources.[11] Among other findings, the report estimates that "[i]f every school district in California installed 1 megawatt of solar capacity, the resulting clean energy produced would conservatively represent 2% of the state's 33% RPS goal."[12] The report identifies a number of benefits to be gained by schools through development of renewable energy systems, not the least of which is significant cost savings, which "can be put back into the classroom to support student learning."[13]

The federal government is also actively facilitating development of renewable energy resources on federal properties. The Energy Policy Act of 2005 set the primary renewable energy requirements for federal agencies, mandating that the federal government procure at least 7.5 percent of its electricity from renewable sources in Fiscal Year 2013 and thereafter.[14] Executive Order 13423, executed in 2007 by President Bush, strengthened the requirements of the Energy Policy Act by requiring federal agencies to ensure that at least half of all renewable energy required pursuant to the Energy Policy Act comes from new renewable sources (developed after January 1, 1999).[15] Spurring local renewables, it also requires that, "[t]o the maximum extent possible, renewable energy generation projects should be implemented on agency property for agency use."[16] Executive Order 13154, signed in 2009 by President Obama, requires that new federal buildings entering the design phase in 2020 or later are designed to achieve zero net energy by 2030, and also requires federal agencies to align their policies to increase the effectiveness of local planning for energy choices such as locally-generated renewable energy.[17]

While several federal agencies have developed initiatives to promote development of renewable energy systems, the Department of Defense is among those with the potential to develop the largest amount of renewable energy in California. Military representatives at the Conference described their ongoing efforts to actively develop renewable energy systems, which is detailed in a January

2012 report that discusses potential for solar development at select military installations in Southern California.[18] The report, which considered both ground-mounted and rooftop solar development, determined that over 7,000 megawatts of solar energy development is technically feasible and financially viable at several military installations in the Mojave and Colorado Deserts.[19]

Several local governments and agencies have actively pursued development of local renewable energy systems. Cities such as Murrieta have either installed or executed contracts to install solar panels on their city halls.[20] Sewage plants and landfills across the state have discovered the potential of transforming climate-harming methane gas into clean power.[21]

While public agencies are making rapid inroads toward development of local renewables, they still face major barriers. Many of those barriers, such as interconnection challenges, are shared by the private sector, and solutions will equally benefit public agencies. Others, such as the inability to take advantage of tax incentives, are unique to public agencies. It is the latter class of barriers that is the focus of the remainder of this chapter.

Goals

- *Speed:* Expedite review and approval of local renewable energy projects on public buildings and lands.
- *Cost:* Keep costs as low as possible and ensure that public agencies realize a fair rate of return from PPAs and leases.
- *Transparency:* Increase transparency at all levels of the solicitation and procurement process.
- *Uniformity:* To the extent possible, promote standardized solicitation and procurement documents across different agencies and jurisdictions.
- *Consistency:* Ensure that policies related to development of local renewable energy systems on public property are secure and consistent through election cycles and staff changes.

Barriers

1. BARRIER: Lack of Site Inventory and Information about Potential Sites

According to one Conference participant, "we do not currently have a full inventory of public property in California, necessary basic information about those sites, or any way to prioritize sites." While the state has made a great deal of progress toward creating an inventory of its properties and the suitability of those properties for renewable energy development, the inventory still lacks several critical data, such as more detailed information about the condition and life of roofs, onsite energy consumption for each facility, or environment issues.

The inventory also lacks data about energy efficiency upgrades necessary to prioritize renewables development at state facilities. According to *Developing Renewable Generation on State Property,* "[i]mplementation of the [2,500 megawatt] 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."[22]

With the exception of certain federal agencies such as the Department of Defense, most federal agencies do not currently provide or have plans to develop detailed site inventories for the purpose of renewable energy development. Neither is there a comprehensive inventory for local governments and agencies.

1. POTENTIAL SOLUTIONS

Continue efforts to identify, prioritize and assess state properties for renewable development

Working with the state agencies that are signatories to the Memorandum of Understanding as well as utilities and developers, Energy Commission staff could continue to refine the inventory and augment it with critical data points such as roof life, energy consumption and status of energy efficiency upgrades. Commission staff could also develop a method to prioritize properties that meet the criteria for renewables development under the loading order, perhaps by folding in external data or objectives such as regional job creation targets or avoidance of distribution upgrades.

Representatives of renewable energy developers have suggested that the inventory should also:

1. Indicate (and not prioritize) the facilities that are fully in use, since occupancy can often increase construction duration and developer costs (e.g., high-traffic parking lots);
2. Include only parcels of land that are within 5 miles of a 115-kilovolt or smaller line; and

3. Prioritize larger brownfields to smaller highway right-of-ways, which are less electrically efficient due to shape (i.e., square or rectangular parcels allow more solar panels) and orientation (depending on whether highway runs north/south or east/west, project could require more capacitators, increasing project cost and likelihood of electrical losses).

Finally, the Energy Commission, perhaps with support or leadership from the Governor's Office and elected officials, could encourage additional state agencies to participate in the Memorandum of Understanding (described above) and add their properties to the statewide inventory. They could also encourage state agencies to include on-site renewable energy systems in all plans for new state buildings.

Encourage federal and local government agencies to join the statewide inventory effort

The statewide inventory could be expanded to include federal agencies and well as local and regional governments and public agencies. *Schools of the Future* recommends that the state prepare a statewide inventory of school facilities that includes, among other data, "[e]xisting energy efficiency and renewable energy systems, capabilities, and potentials."[23] Using the experience that state agencies have had in preparing renewable energy inventories, the Energy Commission could develop a toolkit or guidelines for other public agencies that have yet to begin the process.

Public/private partnerships have been successfully used by public agencies across the state to develop local renewable energy systems.

2. BARRIER: Project Costs and Financing

Project financing, as discussed in Chapter 3, is a barrier for all local renewable energy projects whether they are developed by a public agency or a private sector developer. However, there are additional financing barriers unique to public agencies, including the inability to take advantage of tax equity financing (since government bodies have no tax liability) and the difficulty of procuring traditional public financing such as bonds given the current negativity in the financial market.

Conference participants described the challenges as follows:

- "Public agencies may not be appropriately staffed or funded to maintain equipment on their own. The current state of public budgets limits new hiring in most agencies, including those dedicated to maintenance and construction."
- "A general obligation bond offers the lowest interest rate, but it requires popular vote and the cost may be high due to state's low credit ratings. Plus, solar would have to compete with other infrastructure needs."
- "Bond financing does not help address hurdles to renewable energy on public buildings. Projects tend to be small, which requires aggregation for bond financing unless for a particularly large campus. State agencies and local governments are constitutionally required to go to the public vote to incur debt. Lease revenue bond or rent payment for a bond do not require a public vote, but a lot of state government buildings already have a lease revenue bond, and it is very complicated to put another one on top of it. Most state agencies and local governments operate under an annual appropriations model, which complicates financing – future revenue streams can be withdrawn."
- "Huntington Beach found that there was no appetite for bonds for the city to own renewable energy systems, like a CREBs issuance. This led the city to utilize a PPA."
- "In Oakland, we found it difficult to convince the local government to go forward with incurring debt."
- "In San Francisco, municipal power is so cheap it

makes it difficult to issue a bond, and there has been negative experience with energy services contracts."

- "We can't get an institutional investor to invest in a small municipality with poor credit on a rated deal."

2. POTENTIAL SOLUTIONS

Conference participants and other stakeholders have advocated the solutions below to address the project finance challenges that encumber development of local renewables on public buildings and lands.

Public/private partnerships

Public/private partnerships have been successfully used by public agencies across the state to develop local renewable energy systems. As described by a Conference participant, "[p]artially because of the inability to hire new kinds of experts or simply add workers to plan, procure and maintain new energy resources, public/private partnerships will remain an important factor in state renewables development."

There are two general models for these types of partnerships:

1. Under a **power purchase agreement** (PPA), a private developer agrees to finance, construct and maintain a renewable energy system on property owned by the public agency in exchange for the agency's agreement to purchase the power generated by the system at a rate and term laid out in the PPA.

2. **Leases** can be used in one of two situations: either a developer can develop and lease a renewable energy system to a public agency so that the agency can use the energy generated by it, or a public agency can lease land to a private developer for development of a system-side renewable energy system that sells power to a utility or other end user.

Under any of these public/private partnership models, financing barriers are reduced by the private developer's ability to access federal incentives for renewable energy such as tax equity credits and accelerated depreciation (discussed further in Chapter 3). According to a representative of the Department of Corrections and Rehabilitation,

> "The PPA model has worked well for us. At the end of a 20-year term, it results in a $55 million savings in energy costs. Given the longevity of the prison system, 20 years is not that big a deal. Prisons are uniquely placed to do these projects because they have consistent and heavy loads, and lots of available, flat and sunny land. "

However, PPAs and other public/private partnerships are not a panacea. Both developers and public employees said that the regulatory confines that most public agencies operate within reduces flexibility and can conflict with the contractual needs of private lenders. Representatives of public agencies also highlighted the high transactional costs and sometimes negligible savings of PPAs, which can vary depending on the size and location of the project. According to *Schools of the Future,* "PPAs generally only offer very modest General Fund savings, while projects funded through bond measures offer the greatest savings."[24] These challenges are discussed further below.

State financing for regional and local public agencies

Several conference participants representing local governments and regional public agencies advocated state financing mechanisms – including expansion of existing programs and development of new ones – to facilitate development of smaller, customer-side local renewable energy systems. State financing could be delivered either as low-interest loans or grants. For example, SB 128 (Lowenthal), signed by Governor Brown in October 2011, will allow school modernization grants available from the state to be used for renewable energy technology.

Suggestions from stakeholders include the following:

- "Expand the Energy Commission's Energy Conservation Act Assistance program (which makes loans to local governments to assist with energy efficiency upgrades)."
- "[The state should] reauthorize the Energy Commission's Bright Schools program to assist districts in upfront baseline assessment financing."[25]
- "Encourage the Department of Education, through its representative on the State Allocation Board, to lead a regulatory change that would provide matching grants (60-40) for renewable energy components."[26]

Combine renewable energy installation with energy efficiency upgrades

Conference participants discussed the benefits of combining development of renewable energy systems with energy efficiency upgrades, noting that doing so can result in significant additional cost savings. As described above, California's loading order policy already requires that state

facilities implement energy efficiency upgrades before investing in renewable energy systems. Local and regional governments could adopt similar policies. One participant suggested mounting a coordinated effort with Energy Upgrade California, a portal developed by the Energy Commission along with a coalition of utilities, counties, cities, and non-profit organizations to provide information, guidance and training related to energy efficiency measures.

According to participants:

- "Bundling solar with energy efficiency can make a project pencil out, as it did on [San Francisco's] Moscone Center."
- "We think we're going to get more solar if we focus on energy efficiency retrofits."

Project collaboration/aggregation

Both agency and developer representatives emphasized the cost savings attainable through aggregation of projects or project sites. Developers recommended that local governments package buildings or sites into groups under one solicitation to realize savings from economies of scale. In 2011, the World Resources Institute and the Joint Venture Silicon Valley Network published *Purchasing Power: Best Practices Guide to Collaborative Solar Procurement.*[27] According to the guide, collaborative procurement "can yield 10 to 15 percent lower costs and save 75 percent of administrative time and fees, while helping participants negotiate better contract terms to save money in the long run." [28]

Expansion of state incentive programs

Conference participants and stakeholders pushed for expansion or modification of state incentive programs to allow for greater participation by public agencies. For example, *Schools of the Future* calls for virtual net metering for schools so that districts can benefit from the cumulative savings of local renewables at district-wide school facilities and "can net meter across all of their electrical accounts."[29] Virtual net metering for schools could also help avoid the barriers of onsite renewables, such as seismic retrofit upgrades required by the Division of the State Architect as a condition for construction of rooftop solar photovoltaic panels. AB 512 (Gordon), signed by Governor Brown in October 2011, enables local governments, school districts and college campuses to do just that by designating a "benefitting account" that can receive credits for energy generated by offsite "generating accounts" located anywhere within the government or district's jurisdiction, with a per-account cap of 5 megawatts.[30] SB 585 (Kehoe), signed in September 2011, expanded the California Solar Initiative incentive by authorizing an additional $200 million in rebates for non-residential projects.[31]

3. BARRIER: Project and Contract Approval Challenges

Conference participants described the difficulty of gaining project approvals and executing contracts with public agencies. While federal and state agencies act as the permitting authorities for their own properties and are generally exempt from local land use requirements or review, new projects still must comply with state and federal environmental review laws. In addition, each agency typically has its own set of specific design standards for new projects developed on its property. Similarly, each agency also develops its own set of procurement, contract and approval processes.

According to representatives of developers at the Conference, bureaucratic inefficiency can affect the development process as early as the solicitation phase, when public agencies prepare requests for proposals or requests for offers. Developers said that solicitations are often not widely circulated or otherwise difficult to find, and that many agencies have unique and often arcane requirements related to the format and content of responding bids. These challenges become more critical during the PPA negotiation phase, which according to developers can take an inordinate amount of time due to inflexible regulations and multi-layered agency approval processes required for any changes to those regulations. The challenges, when added to standard permitting requirements such as environmental review that all projects must comply with regardless of location, threaten the viability of local renewables on public property.

Even when developers are only leasing public land and planning to sell energy back to the grid through a PPA with a utility, exacting regulations and protracted review and approval periods can negatively impact a project. A private developer that entered into a contract with Caltrans to develop solar panels along a portion of Highway 101 described the difficulty of meeting the often strict regulatory requirements associated with development on public property while still controlling overall project costs. The developer, which entered a failing bid in PG&E's reverse auction and has not yet secured a PPA, described the problem as follows:

> "We believe the reverse auction process to be inadequate for future [public/private partnerships] on state owned properties. In

> short, [public/private partnerships] cannot compete with "private" developments that do not have the same processing conditions and overall design hurdles that are associated with projects that are partnered with state agencies like Caltrans. For example, our project cannot compete, on costs, with a 15 MW solar project being developed in Dixon, CA, on a single parcel by a private solar developer . . . The [public/private partnership] renewable project will always cost more than the private project, and therefore cannot compete within the current IOU reverse auction programs and this will be a major obstacle when the State attempts to develop commercial solar projects on state owned property."[32]

Similarly, the Sacramento Municipal Utility District recently announced that it was dropping its "solar highways" project due to lack of developer interest: the agency only received one bid for the project, and that bid was "extremely high."[33] The project faced lengthy state and federal environmental reviews, in addition to prolonged lease negotiations with Caltrans, according to an agency representative, who added:

> "[T]he lack of competition and the highly priced bid reflects the complex nature of locating this type of project on highway right-of-ways . . . We believe the effort that was undertaken provides input for consideration of how to proceed with these types of projects in the future. We hope that this experience will allow the state of California to determine how to better align its goals for the development of renewable energy with processes that support implementation."[34]

Both of the preceding comments highlight fundamental conflicts between state policies that aim to promote development of local renewables at specific locations (e.g., highway right-of-ways and rooftops) and programs such as auctions that incentivize lowest cost developments, a problem that is addressed in Chapter 3. Relevant to this chapter, they also highlight the cost impacts of agency regulations and rules.

Conference participants described the challenges as follows:

Rigid agency regulations

- "Standard language required by many public agencies does not allow the flexibility that private companies need."
- "Typical commercial terms in a PPA conflict with federal acquisition regulations for military applications and will force financiers to conform to government regulations."
- "Navy has more regulations on procurement. Navy does not normally buy energy financed by someone else on their land, so they are having to shoehorn PPAs into their existing procurement rules. Eight offices of counsel have reviewed their PPAs. Navy must have a "termination for convenience" clause. This is not normal in a PPA, but we required it."
- "Any modification of public schools is covered by design standards in the Field Act of 1933, which is enforced by Division of State Architect. [The State Architect] has not given clear and consistent messages through their approval processes."

Aversion to long-term contracts

- "Agencies have trouble locking up assets under long-term contracts. For example, Caltrans' infrastructure "needs assessments" only look forward ten years so they have trouble with commitments extending beyond that time frame. Most renewable projects need longer term agreements, often in a 20-year time frame."

Lengthy review processes

- "The length of time to complete a contract can be burdensome, as even immaterial changes of the contract trigger lengthy review and processing by state entities."
- "The military needs sign-off from the Secretary of Defense's office."

High transaction costs

- "Huntington Beach looked only at the largest potential sites [for renewables development]. Large scale is required for a PPA since transaction costs are very high."

3. POTENTIAL SOLUTIONS

Many of the challenges underlying the contract and permitting barriers are the result of an agency's dedication to its core mission, which in most cases is not the development of local renewable energy systems. Caltrans, for example, must ensure that highways are safe and reliable and that roadways can be repaired or modified

without major difficulty in the future. Military bases must maintain their ability to conduct training exercises. Schools must guarantee the safety of their students and the integrity of their facilities. Many times, the rules and processes in place to protect those core missions either conflict with or prolong the development process for local renewable energy or other projects.

Public agencies that have already begun the process of developing renewables on their properties have, in almost all cases, recognized that renewable energy systems can be developed in harmony with existing uses, and can actually support those agencies' core missions. The military, for example, has recognized the energy independence benefits of local renewables.[35] Educators have praised the instructional values of onsite local renewables as well as the potential money from energy savings that can be redirected to classrooms.

The solutions proposed below are based in large part on models developed by public agencies that have actively pursued local renewables. Any solution must endeavor to make development of local renewables as easy as possible, with minimal impacts on the budget, staffing or core mission of public agencies.

Standardized procurement procedures and contracts

Contracts and procedures for procurement and development of local renewables could be standardized as much as possible across public agencies, so that the only variations between contracts would be those necessary to either avoid conflicts with an agency's core mission or to address an issue unique to the project site or type.

Standardization could begin as early as the solicitation phase. Stakeholders have suggested development of solicitation clearinghouses where public agencies could collectively post requests for proposals, requests for offers, and other renewables solicitations (currently, state agencies post requests for proposals at http://www.bidsync.com/, a website for Government Bids, RFPs, and Government Contracts). A solar industry representative advocated creation of "a clearinghouse on the [Department of General Services] website listing competitive solicitations for DG projects issued by all state agencies."[36] The *Schools of the Future* report says that a centralized resource library or clearinghouse would be a "quick and seamless method for allowing school districts to post RFPs for energy projects."[37] Stakeholders have also called for standardized procurement processes and response templates, such as a "statewide template/best practices for energy project procurement steps."[38] One stakeholder has suggested that agencies should "[s]tandardize proposal formats so that companies can easily respond to multiple solicitations. For example, use common templates for statements of work, budgets, schedules of deliverables, and reporting requirements."[39] Another advocated development of "model RFQs and RFPs for use by different agencies (including local governments and school districts."

Many of the challenges underlying the contract and permitting barriers are the result of an agency's dedication to its core mission, which in most cases is not the development of local renewable energy systems.

Several conference participants highlighted the strengths of a standardized PPA. One participant said that "a well-constructed PPA can direct energy savings from third-party owned projects; those savings could be returned to the agency to create an incentive for the agency to invest time and staff resources in such efforts. The PPA could also filter money from leases back to responsible agency." A standardized PPA could establish boilerplate language based on successful PPAs while still "dealing with peculiarities of particular agencies." Similarly, one participant advocated greater information sharing among agencies: "Make PPAs public. Agencies that have experience can help the inexperienced agencies."

Standardization could also be applied to land leases for development of system-side local renewables. Caltrans has developed a "lease template" that "protects the travelling public and Caltrans' obligation to operate and maintain the highway while striving to provide sufficient incentive to attract solar highway development."[40]

As with PPAs, interagency coordination will play a critical role in development of standardized leases. One benefit of collaboration is assuring that lease rates accurately reflect market value. According to the report on renewable energy development prepared for the Department of Defense,

> The [Department of Defense] should consider working with [Bureau of Land Management] to evaluate whether federal compensation could be re-calibrated under the [Bureau's] solar rental formula to continue to capture fair market value for the Federal Government against the backdrop of rapidly-changing and regionally-variable solar economics. The [Department of Defense] and [Bureau of Land Management] should maintain a cooperative approach so that private solar developers won't have an incentive to work with one agency over the other because of more attractive land rental rates."[41]

Interagency coordination

In addition to standardizing contract terms and processes, public agencies can collaborate and coordinate to address several other challenges in the permitting and approval process for local renewables. Agencies can develop best practices on a range of issues through collaboration. For example, *Schools of the Future* recommends that the Department of Education "[i]mplement a partnership with the [State Architect] to independently review formulas and standards for renewable project life-cycle costs and projected savings."[42] Coordination can also be used to expedite agency approvals. Caltrans developed a memorandum of understanding with the Federal Highway Administration that allows Caltrans to grant federal environmental approvals for renewable energy projects in highway right-of-ways.[43] Other state agencies could develop similar agreements where federal environmental review is required. Conference participants advocated this type of "localized approval," which they said can save both time and money. Even though state and federal properties are not subject to local land use and zoning regulations, stakeholders also advocated agency coordination with local governments.

Siting and design criteria

Public agencies such as Caltrans have developed siting and design criteria for local renewables that allow for their development in a manner that mitigates or avoids conflicts with the agency's core mission.[44] A developer that has partnered with Caltrans to develop renewable energy systems along highway right-of-ways said that the partnership "has been very productive [through] the development of project design criteria, including the suitable location and siting of solar arrays to ensure driver safety and overall operation of systems."[45] Similarly, the military is considering "developing a mission compatibility assessment methodology that can be applied within [military bases] to address the full range of renewable energy technologies and the full range of mission activities."[46]

Some participants also advocated agency prescreening and environmental review of sites where local renewables could be developed. The "unbundling" of permitting from procurement could increase costs for agencies, but it would also expedite the development process by ensuring that sites are shovel-ready. Costs for prescreening and environmental review - since they benefit developers by lowering their costs, shortening review times and eliminating a major source of uncertainty - could be reimbursed to the agency through negotiated lower PPA rates or higher lease rates.

Expedited approval processes

Public agencies could develop expedited approval processes available for renewable energy projects that are under a certain size threshold or meet other design or siting criteria. Agencies could also enable developers to expedite review through payment of additional fees to cover necessary staff time. One conference participant noted the inability to expedite approval processes for renewable energy systems on public school facilities: "In most agencies, you can pay for expedited services. But you cannot do that with [the State Architect].

4. BARRIER: Limited Public Agency Experience in Energy Development

In an era of tightened budgets and limited staff, most public agencies are reluctant to dedicate resources – staff or budget – to any tasks that do not support their core missions, including development of local renewables. For many of those agencies, their first exposure to the technological, siting and safety issues of local renewables occurs when they review a proposal for a renewable energy project. "The resulting steep learning curve and concerns about unknown challenges create many inefficiencies,"

according to a Conference participant. Indeed, just as with the barriers already discussed, the combination of limited expertise in renewables and an agency mission that may seem at odds with development of renewables results in challenges for all parties involved. Conference participants said that "ongoing staffing [for renewables development] requires technical and legal expertise," and that "agency staff needs education on PPAs because only lawyers seem to be familiar with them."

4. POTENTIAL SOLUTIONS

Public agency staff dedicated to development of local renewable energy systems

Several stakeholders and Conference participants pushed for the hiring of renewable energy teams or point persons within agencies that currently lack that expertise. *Schools of the Future* recommends creation of an energy liaison position within the Department of Education that would "[r]epresent school districts at legislative and CPUC hearings" and "[u]pdate school districts of regulatory/legislative changes and funding opportunities related to energy conservation."[47] A representative from the Department of Corrections and Rehabilitation said:

> "We need a specialized [renewables] team within the agency. It has been a struggle to make renewable energy a part of the core mission of the Department of Corrections. Having an executive team that supports is imperative. It has been very difficult to convince the institutional structure of the importance of renewable energy."

Similarly, a representative of a renewable energy trade group recommended that the Governor's Office identify each state agency that could have a role in promoting local renewables (either through policy and regulation or by actually installing them on their facilities) and require that agency to designate a person to lead/coordinate the agency's efforts to promote local renewables.

Funding for additional agency staff could be generated through revenue from land leases and energy savings resulting from onsite renewable energy systems.

Stakeholders also supported designation of a "lead agency" or point person at the local, state and federal levels to coordinate planning, policy-making and information-sharing for renewable energy development, as well as to serve as an advocate for agencies to key state and federal leaders. According to one participant, "it would be extremely useful if there was a dedicated office or department offering advice to agencies and leading the charge. A high-level political appointee could bring people and agencies together." A school system representative suggested that "the state can provide roving expertise so that each school does not have to figure out [renewable energy development issues] on their own dime every time."

Agency collaboration and coordination spearheaded by third-party lead agency or not-for-profit organization

In addition to hiring staff with renewables expertise, Conference participants said that an effort to exchange information and develop best practices for public agencies should be initiated by a lead agency or not-for-profit organization. One stakeholder said that various levels of government should convene forums to discuss local renewable energy issues and "have a lead agency . . . or even a nonprofit in the middle in case the agencies don't trust one another . . . The Public Sector Climate Task Force in Silicon Valley brings together various agencies to share best practices and build a framework to start projects."

Training and educational resources

Representatives of public agencies promoted targeted outreach, training seminars and accessible educational materials to develop renewable energy expertise within public agencies. According to one participant, "staff from the Department of Corrections has addressed lack of knowledge by going to workshops and conferences and by building a network with staff from other agencies with similar renewable energy experiences." In order to "better navigate the evolving renewable energy marketplace," *Schools of the Future* recommends that the Department of Education develop or sponsor an energy schools academy.[48] It also identifies a need for resources and training in the following subject areas:

- Understanding various renewable energy options, including their costs and applicability;
- Accessing external resources including federal, state, local case studies, and examples;
- Site evaluation and renewable project planning;
- Vendor and technology procurement and selection;
- Project financing and contracting; and
- System commissioning and operations.[49]

Agencies driving development of local renewable energy resources, such as the Energy Commission, could also

develop a centralized clearinghouse or web portal for other agencies to access training and educational materials, best practices manuals, and model contracts and agreements. As noted in *Developing Renewable Generation on State Property*,

> "Standardizing PPAs can reduce [project staffing] costs and help reduce developer uncertainty about what to expect when dealing with a public agency. Further, lessons learned both at the state and local levels can be shard to form a more cohesive process."[50]

One conference participant opined that "a well-constructed PPA can help solve government's lack of energy knowledge." An agency clearinghouse could also house model RFQs and RFPs.

5. Barrier: Uncertainty about Public Agency Commitment to Local Renewables Development

Conference participants discussed the challenges engendered by the turnover in elected officials and their staff that occurs at all levels of government every two to four years. Turnover, and its potential ramifications for local renewables in the development pipeline, can aggravate the already high level of uncertainty in the market. Those effects can be especially pernicious for projects that rely on significant levels of private investment or are viewed as "high risk." Short-term political expediency and bureaucratic inertia can also threaten agency support for renewables.

Participants described the challenges as follows:

- "Funds to pay utility bills are routinely approved through a public agency's annual budget process. It is simply much easier and less risky for a government agency to seek budget approval for a utility bill than to seek approval for the development of a new energy source with unknown technology and performance risks as well as increased maintenance costs."
- "Government leadership changes every few years and, many times, the turnover comes with a change in policy. For projects that are still considered to have a high degree of risk, it is important to send the right signal of stability."
- "[The Sacramento Utilities District] has fewer problems with cities and counties than with the State of California because there is less turnover in these smaller governments. We get a call once every two years saying that need to put solar on the Capitol, and it never happens. There is a problem with follow through. It is very important to get politics out of environmental planning so that business can move forward. Uncertainty creates issues for utilities and private sector."
- "The every two year change in direction is a big problem. We need to make longer term plans, build better business models. This uncertainty creates a whole series of issues for utilities and private entities."

5. POTENTIAL SOLUTIONS

While the political and economic environment are fraught with certainly, several public agencies have already taken steps to mitigate that uncertainty by developing and investing in long-term policies related to renewable energy procurement, and mounting aggressive outreach and educational efforts to promote the myriad benefits of renewable energy systems to key decision-makers, agency heads and the public.

Highlight the benefits of local renewables to elected officials and agency heads

Conference participants said that renewable energy advocates, during interactions with high-level political figures and decision-makers, should stress the manifold benefits possible through development of local renewables on public property. "High-level political leadership needs to understand how their involvement would result in job creation," according to one stakeholder. A representative of a state agency said that advocates need to "emphasize the monetary savings."

Agencies also should understand that development of renewable energy systems is compatible with or supportive of their core missions, and be able to reconcile any potential conflicts. A representative of the Navy said that the military viewed development of renewable energy systems, and the resulting energy independence of military installations, as a "national security issue."

Ensure that host facilities or agencies realize economic benefits of local renewables

Public agency representatives advocated policies that would direct revenues from energy savings and/or leases to the facilities or agencies that host the renewable energy systems. Ensuring that savings or revenue stays with the systems would provide public facilities with much more incentive to development renewables. *Schools of the Future* recommends:

> "Legislation that will encourage greater interest and investment for renewable energy projects at the local level. Local educational agency energy savings programs and initiatives should be protected by excluding their savings from revenue limit calculations . . . [The Department of Education should] encourage school districts to allow individual school sites to share in any savings achieved through better energy and resource conservation behaviors."[51]

Similarly, a study commissioned by the Department of Defense recommends "[development of] a consistent and incentive-focused formula to allocate project benefits and costs between the host installation and parent organizations. Providing clear incentives for military installations to invest the considerable time and effort required to host renewable energy projects will likely generate increased interest and support from military installation staff."[52]

Promote adoption of renewable energy policies and dedicated staff

Public agencies could formalize their commitment to developing a renewable energy policy that lays out what the agency's renewable energy goals are and how the agency plans to achieve them. One benefit of a formal policy is that changes to or elimination of it would need to be just as formal: rather than a simple "executive initiative," a renewable energy policy could be folded into an agency or local government's core mission or governing rules and regulations.

Participants also suggested that agencies could hire permanent staff to handle renewable energy development issues. Such a position could provide continuity through election cycles and also serve as an advocate for renewable energy development within an agency.

Next Steps

BARRIER : Lack of Site Inventory or Site Information

- **Refined state building inventory:** The Energy Commission could continue its effort to refine the state building inventory and augment it with critical data points such as roof life, energy consumption and status of energy efficiency upgrades. It could also hold a workshop to discuss additional potential data points and develop a prioritization methodology or criteria.
- **Expanded participation in MOU:** The Governor's Office could encourage or direct other state agencies as appropriate to participate in the Memorandum of Understanding with the Energy Commission and to install onsite renewable energy systems at all new state buildings.
- **Coordination with federal, regional and local agencies:** Elected officials and/or a not-for-profit organization could spearhead an effort to expand the state building inventory for renewables development (and the policies laid out in the Memorandum of Understanding) to properties owned by federal, regional and local governments and agencies. The effort could include development of an inventory toolkit or guidelines for use by public agencies that have yet to begin the inventory process.

BARRIER : Project Costs and Financing

- **Financial support and incentives:** Legislation and/or the Governor's Office could extend low-interest loans or grants to local and regional governments, school districts and other public agencies for development of customer-side renewable energy systems. Legislation could also modify state incentive programs, as necessary, to encourage participation by local and regional governments and agencies.
- **Incorporation of energy efficiency:** Outreach efforts to local and regional governments could include promotion of policies to develop renewables simultaneously with energy efficiency upgrades, possibly by coordination with and/or expansion of the Energy Commission's "Energy Upgrade California" initiative.

BARRIER : Project and Contract Approval Challenges

- **Model PPAs and leases:** The Energy Commission or a not-for-profit organization could work with state agencies, developers and other stakeholders to create standardized solicitations, PPAs and leases for public agency renewable energy systems. Agency collaboration could include development and promotion of best practices guidelines for issues ranging from collaborative procurement to formulas and standards for renewable systems life-cycle costs and savings.
- **Model siting and design criteria:** The Energy Commission, working with other state agencies, could develop model siting and design criteria for renewable energy systems. The effort could explore the costs and benefits of conducting pre-procurement site screening and environmental review and folding those costs into related PPAs or leases. It could also develop standardized expedited review tracks for projects that are prescreened and meet certain size, siting or other criteria. Outreach efforts to federal, regional and local agencies could promote development of similar siting criteria and prescreening processes.
- **Single RFP:** The Governor's Office could direct the Department of General Services to develop an RFP for state buildings included in the inventory. Agencies with land holdings could conduct preliminary screening of potential lease sites (including resource availability, ease and cost of interconnection and environmental review).

Next Steps (continued)

BARRIER : Limited Public Agency Experience in Energy Development

- **Renewable energy liason:** The Governor's Office could direct all state agencies to designate renewable energy liasons and appoint a local energy czar within the Governor's Office to lead efforts by state agencies to develop local renewables.
- **Training and education:** The Energy Commission or a not-for-profit organization could develop training and education resources and programs related to renewables development for relevant public agency staff.

BARRIER : Uncertainty about Public Agency Commitment to Local Renewables Development

- **Life-cycle impact model:** Working with other public agencies, the Energy Commission or a not-for-profit organization could develop standardized methodologies to quantify the life-cycle impacts of customer-side and system-side local renewables for public agencies, including impacts relative to agency revenue, local employment, local economic development, and environmental concerns such as air quality and greenhouse gas emissions.
- **Revenue benefits:** Legislation or the Governor's Office could enact rules to ensure that facilities that install renewable energy systems directly benefit from the monetary savings they generate.
- **Renewable energy policies:** Outreach efforts to local and regional governments and agencies could include development of renewable energy policies that are incorporated into relevant regulations or governing documents and include specific goals and milestones.

ENDNOTES

1 *Developing Renewable Generation on State Property*, Appendix A, Cal. Energy Comm'n, (April 2011),http://www.energy.ca.gov/2011publications/CEC-150-2011-001/CEC-150-2011-001.pdf

2 The agencies that are party to the MOU are: the California Energy Commission, the Department of General Services, the Department of Corrections and Rehabilitation, the Department of Transportation (Caltrans), the Department of Water Resources, the Department of Fish and Game, the California State Lands Commission, and the University of California.

3 *Developing Renewable Generation on State Property*, *supra* note 1.

4 *Id.*

5 *Id.* at 67.

6 *See id.* at pp. 18-19.

7 *See id.* at pp. 21-22.

8 *See id.* at pp. 24-25.

9 Cal. Dept of Transp., *Solar Highways Pilot Project, (*July 2011), http://www.cloverleafsolarhighways.com/wp-content/uploads/SolarHighways_Draft_IS-MND_7-6-11_circulation.pdf

10 *Developing Renewable Generation on State Property*, *supra* note 1 at 23-24.

11 *Schools of the Future Report*, Cal. Dept. of Educ., (September 2011), http://www.cde.ca.gov/ls/fa/sf/documents/sotfreport.pdf.

12 *Id.* at 65.

13 *Id.*

14 *Requirements for Renewable Energy on Federal Sites*, Dept. of Energy, http://www1.eere.energy.gov/solar/federal_guide/requirements.html (last visited June 6, 2012).

15 *Increasing Use of Renewable Energy,* Dept. of Energy, http://www1.eere.energy.gov/femp/regulations/eo13423.html#re (last visited June 6, 2012).

16 *Id.*

17 *Sustainable Buildings and Communities,* Dept. of Energy, http://www1.eere.energy.gov/femp/regulations/eo13514.html#sbc (last visited June 6, 2012).

18 ICF International, *Solar Energy Development on Department of Defense Installations in the Mojave & Colorado Deserts*, (January 2012), http://serdp-estcp.org/content/download/12728/151119/version/3/file/Solar+Energy+Development+on+DoD+Installations+in+the+Mojave+and+Colorado+Deserts.pdf.

19 *Id.*

20 Maggie Avants, *City Hall to Run on Solar Power,* Murietta Patch, (Oct. 19, 2011), http://murrieta.patch.com/articles/city-hall-to-run-on-solar-power.

21 Pramod Kulkarni, Combined Heat and Power Potential at California's Wastewater Treatment Plants, Cal. Energy Comm'n, (July 23, 2009), www.energy.ca.gov/2009publications/CEC-200-2009-014/CEC-200-2009-014-SD.PDF.

22 *Developing Renewable Generation on State Property*, *supra* note 1 2.

23 *Schools of the Future Report*, *supra* note 11 at 37.

24 *Id.* at 65.

25 *Id.* at 68.

26 *Id.*

27 Jenna Goodward et. al, *Purchasing Power: Best Practices Guide to Collaborative Solar Procurement,* World Resources Institute, (2011), www.jointventure.org/images/stories/pdf/purchasing.power_best.practices.guide.to.collaborative.solar.procurement.pdf

28 *Id.* at 13.

29 *Schools of the Future Report*, *supra* note 11 at 67.

30 Cal. Assembly 512, 2010-2011 Reg. Sess. (2011). Available at: http://www.leginfo.ca.gov/pub/11-12/bill/asm/ab_0501-0550/ab_512_bill_20111006_chaptered.html.

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33 Melanie Turner, *SMUD drops solar highways project*, Sacramento Business Journal, (Oct. 21, 2011), http://www.bizjournals.com/sacramento/news/2011/10/21/smud-drops-solar-highways-project.html.

34 *Id.*

35 *See* ICF International, supra note 18.

36 Gary Gerber, *Comment re Docket No. 11-IEP-1G, Renewables. From Gary Gerber of Cal. Solar Energy Industries Ass'n*, Cal. Energy Comm'n, (May 23, 2011), http://www.energy.ca.gov/2011_energypolicy/documents/2011-05-09_workshop/comments/CALSEIA_Comments_on_May_09_IEPR_Workshop_TN-60786.pdf

37 *Schools of the Future Report*, *supra* note 11 at 70.

38 *Id.*

39 Gerber, *supra* note 36.

40 *Developing Renewable Generation on State Property*, *supra* note 1 *at* 20.

41 *See* ICF International, *supra* note 18.

42 *Schools of the Future Report*, *supra* note 11 at 68.

43 *Developing Renewable Generation on State Property*, *supra* note 1 at 21.

44 *See id.* at 20.

45 Van Every, *supra* note 32.

46 *See* ICF International, *supra* note 18.

47 *Schools of the Future Report*, supra note 11 at 69-70.

48 *Id.* at 69.

49 *Id.*

50 *Developing Renewable Generation on State Property*, *supra* note 1 at 34.

51 *Schools of the Future Report*, supra note 11 at 67.

52 *See* ICF International, *supra* note 18.

Conclusion

The barriers and solutions discussed in this report are sundry and several. They are, nonetheless, united by a common theme: local energy requires local action. 12,000 megawatts will not be a top-down effort by the state government or utilities. Rather, it will require a renewed focus on communities across the state along with the unique geographical, political, social, environmental and economic factors that distinguish them. Utilities will need to become reengaged with the neighborhoods that they serve by opening up local offices where residents and businesses can go to learn more about the distribution grid, the types of renewable energy systems that the grid can handle and the process for connecting new systems to the grid. Local governments will need to work with utilities to develop land use plans and policies that encourage development of local renewables and that are congruous with the distribution grid and natural resource availability. The state government will need to ensure that state regulations and processes do not unduly hinder development of local renewables, and that incentives and procurement programs will promote the development of a stabile grid network and self-sustaining markets. The renewable energy industry will need to continue to develop creative solutions to financing and technological challenges while working with both regulators and consumers to ensure that renewable energy equipment is safe, reliable and cost-efficient. Californians, who will ultimately pay for and benefit from the state's transition to a clean energy future, will also drive that process by installing local renewables on their homes and businesses, and demanding that their utilities and elected officials clear the path to get there.