AN ENERGY POLICY ESSAY

California's Electricity Policy Future
Beyond 2020

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task force on energy policy

Preface

California and other states have embarked upon an unprecedented effort to change their electricity systems in order to: reduce greenhouse gas (GHG) emissions, develop the state's renewable resources, support technological innovation, and develop new markets. Many of the goals driving this transformation extend only to 2020 even though the milestones needed to accomplish substantial GHG reductions stretch far beyond that and have not yet been identified. And, despite increased collaboration, most of the goals have been set through the lens of traditionally siloed policies, programs, and agency decision-making. There is, however, increasing recognition: 1) that in the post-2020 electricity world, climate, water, air quality, and transportation are intricately linked to electricity planning; 2) that a far wider range of information and cooperation is needed; and 3) that integration of disparate policies and programs into coordinated plans is essential.

California's leadership recognizes many of these challenges, is making concerted efforts to coordinate, and is calling for better-integrated policymaking. But a more structured effort is needed, with development of stronger analytical tools and new institutional structures that will outlast any individual policymaker. This paper addresses these challenges and presents a twenty-first century framework for strategic electricity planning.

We do not know the specific challenges that may come up between now and 2050 or even 2030. But if the regulatory process and the tools used by policymakers are updated so that issues—whatever they may be—can be addressed rapidly, with adequate analytical tools, consideration within a consistent framework, and an established coordination effort, it is far more likely that California will be able to achieve the future electric system it needs.

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Just as California has provided leadership in technology innovation, it can provide leadership in institutional innovation.

This paper acknowledges California's current efforts but calls for a more focused approach for the planning and policymaking structure of California's electricity future.

- First, it calls for a robust and adequately resourced interagency policymaking structure such as a California energy coordinating council. Such a council would be responsible for developing and implementing, in a transparent and accountable manner, the three matters below. More generally, it would be charged with consolidating cross-agency energy policymaking to streamline existing activities in a publicly transparent manner.

- Second, it recommends a *framework* for electricity strategic planning that explicitly focuses on *reliability, affordability,* and *sustainability*.

- Third, it recognizes the need for new California electricity analytical models, to be investigated by an expert California energy modeling forum,

- Fourth, using the three tools outlined above, it proposes development of a *2030 California electricity plan* to integrate the state's electricity future with its climate, water, air quality, and transportation goals.

While this paper is focused on California, the framework and tools we present are applicable to other states and regions seeking major transformation in the electric sector.

The Challenges We Face

In late 2013, Secretary George P. Shultz and Ambassador Thomas Stephenson, cochairs of the Hoover Institution Task Force on Energy Policy, hosted a meeting of key policymakers and stakeholders with leading Stanford University faculty to discuss the electricity issues facing California. The meeting's discussion was framed by the focus of the task force's 2012 energy policy essay, "Renewable and Distributed Power in California," which stated:

> California has embarked upon an unprecedented effort to change, rapidly and fundamentally, the state's electricity supply and delivery system. Utility-scale, fossil-fired power plants are being phased down. A new system driven by renewable and distributed power of all sizes and technologies, owned by customers, utilities, and third parties alike, is being put in place. An overlay of demand-side resources and new information technology is likewise expanding. These ambitions have been crystallized through

the state's climate change law (AB 32) and net zero energy goals, the law mandating the use of renewable power for 33 percent of California's electricity supply by 2020, and by Governor Brown's goals to develop 12,000 MW of distributed generation by 2020 and 6,500 MW of combined heat and power (CHP) by 2030.[2]

Subsequent to the meeting, discussions have continued and expanded to include other key stakeholders. These conversations have confirmed that progress has been made on the issues we identified, particularly in developing unified planning assumptions. However, our further research has confirmed that problems still exist, extending beyond renewables, and that even greater challenges are looming for the post-2020 effort. The following items are of particular concern:

- the challenges California faces in establishing integrated electricity and energy goals, policies, and programs across its diverse governing energy entities[3]
- lack of consistent assumptions, scenarios, and regulatory planning frameworks across organizations
- increasing dockets across agencies, addressing similar or interrelated issues—each with its own decision-makers and sometimes conflicting planning assumptions or policy goals
- the need for expanded planning tools and policy frameworks to address complex future scenarios and optimize desired policy outcomes
- challenges in addressing the perils of climate change while still ensuring a reliable, secure, and affordable electric system

Institutional change is as challenging as physical change but is seldom acknowledged and often resisted. However, without an update to the institutional policymaking structure, efforts for physical and digital transformation of the electric grid will be slower, more expensive, and in all likelihood less successful than they would be under a more unified and streamlined policymaking structure.[4] While California is making strides towards a more unified approach among agencies, including the California Independent System Operator (CAISO), more can be done. This report explores these institutional issues and presents recommendations to address these ongoing regulatory issues.

Key Issues Identified in Our Previous 2012 Energy Policy Essay

The 2012 Renewable and Distributed Power in California essay identified a number of key stresses and institutional concerns:

1. The regulatory policy maze—No single law, regulatory decision, or document describes all policies and programs seeking to develop renewable power in the states, much less the many linkages (or lack thereof) among them. No plan for the state's long-term renewable industry has been developed to bridge the many gaps between planning, procurement, and permitting at the federal, state, and local levels.

2. Rising utility costs and rates—California utilities face significant costs over the next decade, due to the replacement of aging and non-useful infrastructure, investments for grid modernization, and the costs of renewables and distributed generation. In terms of costs, both rates and bills matter and California's investor-owned utilities' (IOU) rates are among the highest in the United States.

3. Outdated rate design and uneven cost allocation burdens among customers—The cost burdens are of increasing concern due to non-cost-based rate tiers, increasing customer-sited distributed generation, and Net Energy Metering (NEM). Current California rate design means that rising IOU costs in the residential sector will fall on a narrowing base of customers. Higher usage customers are incentivized to install rooftop photovoltaic (PV) panels, thereby decreasing their contribution to utility revenue streams. In 2013 the legislature passed AB 327 (Perea) which allows the CPUC to undertake needed reforms.

4. Cumbersome regulatory framework—Four major state-level entities are all responsible for major aspects of California's electricity structure, as well as a host of other state agencies, local governments, permitting agencies, and federal entities. While this structure has functioned to date, there are major problems:

    - No single government agency is in charge of integrating efforts and no roadmap for achieving California's ambitious goals exists.

    - Multiple agencies with key roles have overlapping responsibilities, differing goals, and no process for addressing interdependent decisions.

    - No single source document describes the programs and their rules for participation.

5. Inadequately incentivized utility business model—The utility institutional model does not support, much less lead, California's electricity system transformation for two simple reasons: 1) the utility's business model is designed to generate financial rewards when utility customers increase their energy usage, and 2) financial rewards are increased when large-scale utility-owned assets (e.g., major power plants and long-distance transmission lines) are added to its rate base. Likewise, the traditional regulatory model penalizes innovation and risk-taking by utilities.

A Strategy to Maintain Forward Progress

Proposal 1: Move from Ad Hoc Collaboration to a Robust Interagency Coordinating Structure

Many studies, including our own 2012 essay, have recognized California's balkanized and unwieldy energy governance structure and have proposed changes. While informal collaboration has increased significantly, little formal change has occurred, due to concern that progress on energy policies will stall during an agency restructuring period, that there are constitutional limits regarding changes in the California Public Utilities Commission's (CPUC) jurisdiction, that the existing system is working at least adequately, or that a new structure would require new resources and state funding. However, when looking at the challenges ahead, California cannot afford a continuation of the status quo. The current structure of dozens of dockets, inconsistent assumptions, and ad hoc cooperation on billion dollar investment decisions is not only inefficient but impedes transformation of California's electricity sector. Thus, our first recommendation is a mechanism for integrated and streamlined policy planning and program development across agencies, starting initially with establishment of a robust and adequately resourced California energy coordinating council, based on the current "principals group."

California's approach on demand response (DR)—whereby customers adjust their electricity usage based upon some price, signal, or other condition—is a telling example of why a new regulatory paradigm is needed. Significant use of demand response is needed as a cost-minimization and reliability tool for the decarbonized electricity sector and for integration of renewable resources. Demand response is at the top of the state's electricity policy loading order, yet the goals set in 2007 remain unmet. Three of the state's energy entities—CPUC, California Energy Commission (CEC), and CAISO—are addressing California's demand response future in several different proceedings.[5] The CEC's 2013 Integrated Energy Policy Report (IEPR) recognizes this duplication and recommends that the energy agencies "begin addressing and resolving timelines (both timing and issue priority) developed in CAISO's Roadmap, IEPR, and CPUC processes."[6] The IEPR recommends that by the second quarter of 2014, the agencies should "develop a joint policy document that articulates the resolution of current differences and presents a unified, clearly executable path forward."[7] However, there is no extant forum for developing a single vision/roadmap based on common assumptions and scenarios that will then be formally adopted and implemented by all three entities. Because demand response operates in both wholesale and retail markets and can be used by both IOUs and municipal utilities, none of the three entities can design California's program in isolation.

Similar challenges exist for numerous other aspects of California's energy future. Almost every planning document for California's energy future now stresses the

need for cooperation, yet few formal structures have been implemented to achieve integration across the state's electricity entities. Collaboration thus continues on a mostly ad hoc basis, with each entity still pursuing its own dockets and issues, often using differing assumptions, and seeking different goals.

San Onofre Nuclear Generating Station (SONGS)

California faces a historic moment in electricity planning with the closure of the San Onofre Nuclear Generating Station (SONGS), the retirement and/or repowering of power plants due to once-through cooling (OTC) rules, and load growth in Southern California.

In June 2013, Governor Brown issued a ninety-day directive to develop options to satisfy reliability needs in Southern California. In response, staff of CPUC, CEC, and CAISO released a Preliminary Reliability Plan for LA Basin and San Diego, describing near and long-term actions to pursue, with a goal of procuring 50 percent of incremental resource need from preferred resources of energy efficiency, demand response, distributed generation, and storage. Comments on the draft plan have suggested both significantly larger and smaller procurement of preferred resources. The CEC's IEPR states that the agencies will revise the draft plan into an action plan, to be implemented by the agencies and closely monitored by the governor's office.[8]

The draft plan acknowledges that its implementation will require a variety of decisions at a number of the key state agencies, including new or existing CPUC proceedings, the CAISO planning process, and/or the CEC siting process.[9] As of now, there is no explanation of how the various agency proceedings will be coordinated, integrated, and streamlined.[10]

This reshaping of Southern California's electric system is both a challenge and opportunity. It brings together the competing goals of climate change, clean air, cost, and reliability. Success requires an integrated approach across multiple state (and federal) agencies and involves coordination among dozens of stakeholders. Rather than relying upon ad hoc coordination and collaboration across disconnected decision-making, the SONGS replacement presents a unique opportunity to adopt the framework presented in this paper—use of common analytical tools, development of a single action plan, and use of a robust and adequately resourced coordinating council. A new, streamlined approach to agency decision-making could likewise be used, with integrated proceedings and final decisions jointly adopted by the necessary policymakers.

Given the substantial challenges to major agency restructuring, at least at this time, other approaches must be explored as a path to improvement. We suggest focusing on two key issues: 1) integration across agencies, policies, and programs, and 2) streamlining agency decision-making. For the former, development of statewide, integrated policies, plans, and programs is essential. For the latter, rather than continued use of multiple forums relying upon ad hoc, generally non-transparent coordination, use of joint proceedings with development of a single public record would be a key step. As an example, we again point to demand response. Because demand response involves both wholesale and retail markets, it makes sense to have a single, fully integrated statewide demand response roadmap and proceeding,

jointly headed by CPUC, CAISO, and CEC. A schedule and list of issues would be agreed upon with joint public hearings held where possible. Of critical importance, there would be agreement by all three entities that they would abide by agreed-upon results and not hold additional, separate proceedings.[11]

Since the 2013 convening of policymakers, improved coordination has been achieved in the area of development and use of common planning assumptions and scenarios. The CPUC conducts a Long-Term Procurement Plan (LTPP) proceeding to establish power procurement needs for the state's major IOUs. Separately, CAISO conducts a Transmission Planning Process (TPP) to identify additional transmission needs for the CAISO control area. The staffs of the two organizations and of CEC developed proposed Joint Planning Assumptions and Scenarios and both CPUC and CAISO (albeit separately) received public comments. In late February 2014, the CPUC assigned commissioner released a ruling specifying the final "joint assumptions and scenarios" that CPUC would use in its LTPP. At the same time, CEC and CPUC sent a joint letter to CAISO calling upon CAISO to use the assumptions and scenarios developed through the CPUC process. Clearly progress is being made. Yet, because these issues are being addressed by the differing entities in siloed proceedings, the process wastes valuable resources of stakeholders and remains non-transparent. And, even the CPUC staff is unclear as to whether the assumptions used by CAISO in its planning process will be consistent with those used in the CPUC's dockets.[12]

One notable future improvement would be to initiate: (a) a single proceeding among the three organizations to develop unified planning assumptions and scenarios (or at least a process so that interested parties can submit a single set of comments rather than duplicative—and possibly inconsistent—proposals), and (b) a more transparent decision-making process among the three entities for deciding common planning assumptions and scenarios.

Practically, there are few options to realize both better integration and streamlined decision-making. One obvious direction would be to combine the functions of today's many different agencies under a single roof. This would offer a single source of strategic direction, a single source of information and communication, and a single source of responsibility. We recognize, however, the failed attempts at similar efforts in the past and that the current situation is no more likely to be politically or legally conducive to this route.

Another concept, then, could be a California Energy Coordinating Council (CECC). The council could be formed by statute, executive order, or interagency agreement, potentially moving it into state law at a later date. A good start for this coordinating council is formalization of the existing "principals group," which is headed by the chair of CARB and consists of the heads of CPUC, CEC, CAISO, SWRCB, and a senior governor's office member. The "principals group" impact remains limited because it has no formal responsibilities, meets in private on an ad hoc basis, and lacks

dedicated staff tasked with ensuring coordinated and streamlined follow-up. As a straw proposal, functions of a more formalized coordinating council could include:

- Establishment of a multi-stakeholder modeling forum and potential development of new California economy-wide electricity planning models;
- Development of white papers on the key interagency electricity policy challenges facing California's 2030 energy future;
- Development of a *2030 electricity plan,* linked to 2030 climate, water, air quality, and transportation goals;
- Oversight for development of an action plan, highlighting the specific responsibilities of each agency, to implement that 2030 electricity plan;
- Development of memorandums of understanding (MOUs) among the energy organizations agreeing to specific processes and timelines to coordinate and streamline agency processes;[13]
- Hosting public multiagency forums, including formal multiagency decision-making dockets with CEC, CPUC, and CAISO on critical subject areas that must be addressed in an integrated fashion, considering the role of both investor and publicly-owned utilities and balancing areas;
- Annual reports to the governor and legislature on California's progress to a 2030 electricity future within the three-pronged framework of reliability, affordability, and sustainability.

Examples of coordinating entities elsewhere include the federal government's National Security Council, the Northwest Power and Conservation Council (NWPCC), and the Oregon Energy Planning Council. These councils bring together diverse governmental entities, in a formal advisory framework, to address cross-agency issues and ensure consistency in agency goals and programs. Observers report, for example, that the strength of NWPCC is its independent analysis, modeling capabilities, staff expertise, and transparent public processes that result in wide implementation of its twenty-year power plans across a four-state region. It has also been a forum for hosting advisory committees in many areas, including wind integration, energy efficiency, and systems analysis.

While we believe that California's coordination efforts need to be more than just advisory, it is premature to endorse a specific approach at this time. Serious work needs to begin immediately on identifying new approaches for streamlining and harmonizing California's regulatory structure that will work within the state's unique political, economic, and legal framework.

California Policymakers Recognize that Change Is Needed

"[I]t is imperative that the state have a robust process for coordinating implementation. Increased collaboration, joint planning, and integration across agencies and goals will be required."

—Office of Planning and Research, "California @ 50 Million—Governor's Environmental Goals and Policy Report," discussion draft, September 2013.

"No single party or agency has complete responsibility for the energy sector . . . a reworked and comprehensive State program will be required that addresses all affected energy entities and is specifically designed to ensure that the proposed emissions are achieved."

—California Air Resources Board, "Proposed First Update to the Climate Change Scoping Plan: Building on the Framework," February 2014.

"Although a strong consensus exists among current Commissioners, Board Members and agency executives to cooperate in pursuing resolution of the Southern California reliability concern, each organization is subject to its own decision-making processes within its own policy framework. Many of these measures in the preliminary staff plan are being pursued in these forums already, but what is adopted may not exactly match the preliminary plan. Assuring reliability while trying to preserve affordability and environmental stewardship for electricity services will require ongoing attention to coordinated planning, procurement, and permitting. The Governor's Office will create a mechanism to track progress against the plan."

—California Energy Commission, "2013 Integrated Energy Policy Report," January 2014.

Proposal 2: Develop California's Electricity Future within an Integrated Framework Focused on Reliability, Affordability, and Sustainability

The transformation of California's electric system requires billions of dollars of investment, partially governmental but mostly private. To attract this investment, California needs to show investors a high probability of a successful outcome. To achieve a successful outcome California will need an integrated planning framework that analyzes policies, programs, and scenarios using consistent and comprehensive criteria focused on the most important features of a viable electric system—*reliability, affordability,* and *sustainability*.

California's current approach to transforming its electric system, while guided by general principles of the "loading order,"[14] is in reality a complex assortment of analyses, policies, and programs that continually grow in number, duration, and overlap. Much of the complexity stems from the nature of California's electricity market, which operates on both the wholesale and retail levels and consists of an interconnected system run by dozens of utilities and other organizations.[15] The unprecedented rate of technology change within the transformation of the electricity sector also contributes significantly to the challenges facing policymakers since many technologies are advancing faster than policy. A fundamental challenge for California is the lack of a consolidated energy law and a single state-level decision-maker.

California policymakers are cooperating at unprecedented levels. However, the collaboration is layered on top of existing institutional structures, rather than changing and streamlining the underlying decision-making structures. As a result, the current approach has large elements of duplicative, inefficient, risky, and incomplete analysis and policymaking.

This paper proposes a new approach—use of an integrated policymaking framework that focuses on optimizing three goals: *reliability, affordability,* and *sustainability*. Placing these three goals at the top of California's electricity policy pyramid, provides a framework to ensure a California future that is both economically and environmentally viable. No one goal is emphasized at the risk of another.

The assessment framework would scrutinize existing policies and programs to identify explicitly where conflicts exist *among* the goals and what combinations optimize *across* the goals. Policymakers (both the existing ad hoc "principals group" and a potential future formal coordinating council) would use this framework not only for programs in specific subject areas—distributed generation, energy efficiency, etc.—but also across entire utility portfolios and statewide. Assessment and mitigation of risk factors—and doing so transparently—would be a central part of implementing this structure. It would not disregard California's foundational policies, but would provide a consistent and transparent big-picture policy framework across agencies and programs.

The Three Elements of the Proposed Electricity Policy Framework

California law already recognizes the importance of the three framework "legs" we propose. Section 25000.1 of the Public Resources Code states that "a principal goal of electric and natural gas utilities' resource planning and investment shall be to *minimize the cost* to society of the *reliability* of energy services that are provided by natural gas and electricity, and to *improve the environment* . . ." (emphasis added). The three elements of the proposed framework are also embedded in the California Energy Action Plan, which establishes the state's loading order policy and asserts that the state's goal is to:

> Ensure that adequate, reliable, and reasonably priced electrical power and natural gas supplies, including prudent reserves, are achieved and provided through policies, strategies, and actions that are cost-effective and environmentally sound for California's consumers and taxpayers.[16]

However, California has not developed a decision-making framework that explicitly optimizes policies and programs in terms of these objectives nor, most importantly, is there a common planning approach that crosses energy agencies. Below we review each of the three elements of the proposed framework.

Reliability and Security California's economy requires dependable electricity. The California Legislature has declared that "*safe, reliable* electric service is of the utmost

importance to the citizens of this state, and its economy."[17] Safe and reliable electric supply and delivery is a shared responsibility between CAISO[18] and the utilities in the state. Failure to meet this responsibility has the potential to create significant harm.[19] California's rolling blackouts thirteen years ago caused billions of dollars of lost productivity and led to a widespread public distrust of both utilities and the government's ability to manage California's electricity infrastructure.[20] The challenge now is that the fundamental operating paradigm is changing. California is moving from a system of centralized, dispatchable power plants to significant dependence upon non-dispatchable variable resources. This change means that electric system operators at CAISO and utilities are increasingly losing their traditional means to control the bulk electricity system. Also, high adoption of distributed energy resources is newly tasking a distribution grid designed to deliver power one way: to customers. This change creates engineering issues for distribution reliability and power quality as well as regional transmission stability. A recent study examined the technical challenges of operating the California system at a 50 percent Renewables Portfolio Standard (RPS) with high penetration of both wind and solar energy. The study determined that maintaining reliable operation of the California grid is feasible but will be challenging and costly unless portfolios of solutions are explored and carefully developed.[21]

There are major technical considerations in running a variable, networked, and highly distributed grid; it is not clear what resources will be used to firm these new resources, at what cost, and under what market structures. Additionally, much of California's existing electric system is old and needs replacing or updating. Do the investments being made today support the variable and distributed future codified in California legislation and regulation?

Moreover, there are legitimate questions of national security and the extent to which grid infrastructure and operational choices affect the risk and potential impact of accidents or attacks, both physical and cyber.[22] This issue today tends to be treated as an after-the-fact hardening expense rather than an integrated element within policy and regulatory planning.

Thus, given the combination of old and new technologies and the necessity of reliable electricity for a healthy California economy, reliability must be a fundamental leg of California's future electricity framework.

Affordability It is critical to control the cost of California's transformation and ensure that electricity remains affordable. Where California's electricity transformation adds costs, the state should explain both what is driving those costs and why they are being undertaken, while optimizing cost-effectiveness.

Our 2012 essay considered both the overall costs of California's energy future and inequities among end-use customers in sharing the cost burden.[23] Lack of current

and transparent cost and rate data prevents a true understanding of the costs of the current transformation, but there are certainly signposts of concern. A 2013 Edison Electric Institute (EEI) study references industry projections that 33 percent of the market will be "in the money" (e.g., cost-competitive) for distributed energy resources by 2017, assuming current tax and regulatory policies.[24] The EEI study concluded that if loads decline 10 percent due to distributed energy production (with full subsidization of those participants), then average rates for other electricity users will grow 20 percent or more, and the ongoing rate of growth in electricity prices will double for non-participants.[25] In a separate analysis, Energy + Environmental Economics (E3), under the supervision of the CPUC, estimated the annual net ratepayer cost of all net energy metering (NEM) generation consumed on-site and exported to the grid in 2020 to be approximately $1.1 billion for the California IOUs.[26] These analyses point out that rate structure will be critical in minimizing the rate impacts of a transformation in the electric industry. California's 2013 AB 327 (Perea) recognizes these challenges and sets the stage for an updated approach in California towards net metering and rate reform.[27]

Policymakers, utilities, and others need to *understand both the marginal costs of each major program and aggregated costs across programs*—information that is not readily available in California or in many other states.

While many laws in California require policymakers to take costs into account or even set "cost-effectiveness" criteria, there is no uniform approach to determining cost-effectiveness or the distribution of costs across the various sectors of society. New technologies may provide benefits that are not counted under existing tests. The common tests used in California for determining cost-effectiveness rely on estimated costs and benefits, yet the accuracy of those estimates is subject to uncertainty and potential political manipulation. And, as California adopts new technologies, such as the development of the smart grid, customer generation, and storage technologies, it will be determining for the first time their value to participants, utilities, and society at large.

There is little disagreement that new government policies and investments for a transformed electricity system must provide value and that, overall, electricity must remain affordable. Developing the tools to adequately assess costs and benefits, and to do so across programs, technologies, and delivery platforms will be challenging, but the consistent inclusion of affordability in an updated regulatory framework is essential.

Sustainability A search for environmental sustainability has been the driver of many of California's recent energy policies. Given AB 32, California's climate change law, sustainability encompasses greenhouse gas (GHG) emissions reductions, including the long-term objective of achieving the emission reduction goal of 80 percent by 2050 set by Governors Schwarzenegger and Brown.[28] But sustainability also includes compliance with federal air and water quality requirements, optimizing limited water

resources, protecting California's natural habitats, and considering the distribution of local environmental impacts. While many of these items are reviewed under the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA), California has no uniform approach to analyzing sustainability for its energy policies and programs. And, as discussed below, because the only GHG emissions caps or goals we have are set in terms of 2020 and 2050, there is growing concern that we define, sooner rather than later, a midcourse target for California's GHG emission reduction efforts. In order to have a workable framework, this third leg of sustainability will have to include a post-2020 target.

Systematizing Transparency and Risk Assessment within this Framework

Along with the three elements of an updated energy framework, any proposals for the future electricity framework should seek to systematize two methodological approaches—transparency and risk assessment. The 2012 Task Force paper provided several examples of the lack of transparency in California's electricity framework, particularly regarding energy costs and impacts on customer rates. In addition, the Little Hoover Commission recently described the lack of transparency in the different energy agencies' policy goals and priorities:

> As it pursues its energy goals, it is not clear whether California will achieve its environmental policy goals, as there is no single entity in the state looking at the system as a whole and ensuring the environmental policies linked to energy are implemented in concert. Energy and environmental goals have been enacted in a piecemeal fashion over time, not as part of a considered, integrated strategy. As a result, priorities are not clear.[29]

The Little Hoover Commission also identified the issue of conflicting data about costs, energy usage, and other assumptions across proceedings and venues. The way the data is collected and presented can be influenced by each agency's priorities (e.g., keeping the power flowing, keeping utility customer rates affordable, or ensuring compliance with state and federal regulations on energy generation, transmission, or pricing), resulting in unclear forecasts and reports.[30]

The second item needing consistent assessment methods is risk. Risk in electricity comes in many forms: a technology fails to develop or remains costly; energy efficiency does not materialize because of the myriad of voluntary decisions needed; flawed nuclear power plant upgrades force unanticipated closures; companies or utilities go bankrupt; cooperation among agencies stalls; state agencies are not provided staff for new programs, etc. California energy agencies have no systemic, statewide approach to assessing risk. Yet, electricity transformation depends on new technologies, new markets, and new players.[31] A unified method of risk assessment, consistent with standard procedures in the field of risk management, should be developed.

The increasing use of natural gas, for both direct end-use and the production of electricity, offers both opportunities and challenges in this regard. California is the second largest consumer of natural gas in the United States and a major producer. There is also a major natural gas focus with CHP. CARB data show that in-state

power plant CO_2 emissions grew in 2012, caused by increased reliance on natural gas-fueled generation due to the closure of the San Onofre Nuclear Generating Station (SONGS) and diminished hydropower production.[32]

Proposal 3: Investigate the Need for New California Electricity Analytical Capabilities through a Statewide Modeling Forum[33]

Economic and engineering analyses are critical tools for evaluating California's policy priorities; what sort of paths can feasibly meet the state's reliability, affordability, and sustainability objectives and what are the risks associated with those paths? More specifically, modeling methods can be used to identify impacts of renewable intermittency, distributed generation, and security concerns on reliability of electricity and natural gas supply; economic impacts including employment, gross state product, state revenues, trade balance, fuel price changes, energy and goods costs to consumers, and technology adoption; and sustainability impacts ranging from GHG and criteria pollutant emissions to water use, land use, and agricultural impacts. Through these types of metrics, models can be used to assess the impacts of policies on different stakeholders.

Because it is likely that no single model will be capable of achieving all of these objectives with the fidelity required by all of the stakeholders, a coordinated modeling framework must foster communication among and consistent assumptions across various modeling efforts. In addition to efforts on modeling coordination, new modeling methodologies will also be required. While Californian regulatory agencies already rely on a number of various economic and engineering tools, discussions with policymakers, technical experts, and stakeholders suggest that existing capabilities may be insufficient given the complexity and immensity of system-wide transformation now being envisioned.

Policy decisions are ultimately a matter of leadership and priorities, not model outputs. And no model will reliably tell the future. Nevertheless, analytical capabilities matter more than ever given the unprecedented complexity and scale of proposed energy system transformations. We therefore propose the creation of a California energy modeling forum as an expert advisory board to evaluate the current analytical capabilities of California's regulatory agencies, suggest any necessary improvements, and, if necessary, guide the implementation of the board's suggestions.[34]

Given that different questions require the development and use of different types of models, there are a number of specific questions to be faced in anticipation of California's transformation:

- Do existing or proposed models have an appropriate level of detail to characterize the currently-envisioned level of cross-sectoral integration while maintaining usefulness?

- How can engagement with other modeling communities be used to most appropriately capture interactions between reliability, economics, and sustainability concerns?

- What new data needs arise with proposed modeling efforts, and what steps can be taken to ensure the accuracy and usefulness of public datasets toward these ends?

- Is data availability and sharing sufficient, especially across agencies or other stakeholders, or is a new data warehousing effort required?

- Is agency staff able to understand and use these analytical tools on its own or are they seen as impenetrable black-boxes provided by third parties? How can modeling results be made more transparent to policymakers and stakeholders?

- What other gaps may exist in overall analytical capability to inform new policy objectives? For example, is it appropriate to expand the geographic scope of California's modeling efforts to include the broader West?

Ideally, analytical tools should help us to better explicitly understand the reliability, sustainability, and affordability ramifications of energy policy and regulatory decisions. Absent such tools, we may be pursuing policies and programs that will waste money or not provide needed results. Some examples of useful modeling analysis going forward include (but are not limited to):

- More rigorous analysis to assess the costs and benefits of distributed resources for California's electric utilities and the potential for change in these costs and benefits in the future as penetration rates increase and new technologies are integrated on both the customer and grid side of the meter. This type of analysis will likely require the coordination of distribution-level engineering models with economic models that account for the consequences of investment decisions as well as new operational paradigms.

- Understanding of potential changes due to alterations in rate structures, particularly in light of AB 327 (e.g., dynamic pricing or a modification of the current tiered rate structure).

- Modeling of GHG emissions in systems that include increasing levels of renewables while complying with current reliability standards. Such analysis, which would likely rely on detailed operations modeling, highlights the need for improved and higher resolution data sources.

Preliminary work should be done this year and include forming an energy-modelers group that works closely with the AB 32 update effort and climate modeling. Stanford University, the University of California, Lawrence Berkeley National Laboratory (LBNL), Caltech, and the National Renewable Energy Laboratory, as well as CEC, CARB, and private companies such as E3 and EnerNex have electricity and related modeling expertise that can assist significantly in this effort, particularly crosscutting analyses in areas such as water, energy, and climate.

This augmented modeling effort could mesh well with the current update of the AB 32 Scoping Plan. The University of California at Davis has initiated a California Climate Policy Modeling (CCPM) project that is bringing together policymakers, modeling groups and key stakeholders to improve the overall state of GHG emission modeling as well as development of possible scenarios for GHG emission modeling scenarios. The CCPM effort could be expanded to add an energy modeling forum, or a separate energy modeling forum could be developed that coordinates with the CCPM project.[35]

One lead-off topic to frame an ongoing California energy modeling forum effort might be to identify, working with policymakers and stakeholders, projected energy use and technology adoption scenarios through 2030 (as discussed in Proposal 4, below).[36] This process would both establish data sets that can serve as part of a common set of modeling assumptions and could be used to inform a set of best practices going forward for data sharing and development of common modeling assumptions.

In the early stages of a California energy modeling forum, it would also be useful to look to similar efforts in other regions. For example, the Northwest Power and Conservation Council (NWPCC) develops a twenty-year electric power plan, updated every five years, to inform the development of adequate and reliable energy at the lowest economic and environmental cost to the Northwest. Idaho, Montana, Oregon, and Washington are member states.[37] The modeling is done through a public process, advised by in-house and outside experts. Another example is the new twenty-year Long-term Planning Tool (LTPT) developed by the Western Electricity Coordinating Council (WECC) through a stakeholder process.[38] WECC created four scenarios shaped by technology innovation and economic growth in the North American Western Interconnection. It found, for example, that some transmission that appeared to be needed under a ten-year plan was not so identified under the twenty-year plan.

The point here is that modeling tools matter and California needs to prioritize such tools. We recommend establishing a multiparty California Energy Modeling Forum, convened by the major state agencies and under the purview of the governor's office with expert third-party participation.

Electricity Planning Is Becoming both More Regional and More Localized

California's electricity system is part of the larger Western Interconnection. Bulk power across this regional grid is coordinated by the Western Electricity Coordinating Council (WECC), which is comprised of electric industry representatives located in fourteen Western states, two Canadian provinces, and a portion of one Mexican state. California has traditionally imported large amounts of power from out-of-state. As California plans its post-2020 electric system, it will face decisions on use of Western markets and resources, ensuring WECC wide reliability especially in the face of greater regional dependence on natural gas, and other interstate issues. In addition, the October 2013 *Pacific Coast Action Plan on Climate and Energy* calls for integrating regional electricity grids and markets to achieve greater flexibility, reliability, and affordability.

At the same time, energy issues are becoming more granular and localized. Distributed generation, demand response, and energy efficiency all involve decisions at a very local level. Local reliability concerns are increasing, requiring continued planning down to individual distribution circuits.

For policymakers, these two trends—increasing regionalization and localization—are profound. Obtaining sufficient regional and local information, understanding how market structures at both regional and local levels can be enhanced, and engaging with the necessary stakeholders, particularly at the local level, call for new tools and approaches to electricity planning.

Proposal 4: Develop a 2030 Electricity Plan Integrated with 2030 Climate, Water, Air, and Transportation Goals

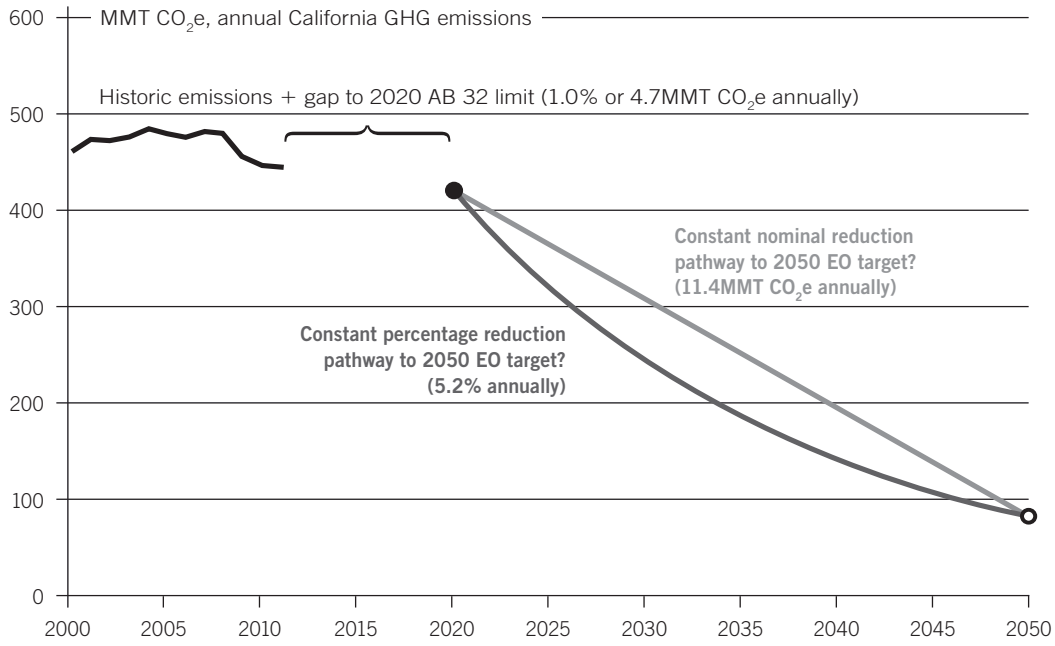
Drawing from the modeling effort described above, California needs to develop, in the near future, a detailed vision and roadmap for its electricity future that:

- focuses on 2030;
- presents a plan for the state's electricity transition using a framework focusing on reliability, affordability, and sustainability; and,
- includes specific links for integrating the state's electricity future with climate, water, air quality, and transportation goals.

The chair of CARB has recognized this need, calling for development of a "fully integrated and coordinated energy plan" that includes a range of policies, technologies, and investments needed to achieve the most-cost-effective mid-term and long-term emission reductions across the energy sector. She has proposed that a comprehensive program be developed for the state's electric and energy utilities by 2016.[39]

2030 Focus California's climate legal framework includes a specific GHG emission reduction limit for 2020, executive orders setting a 2050 goal, and a mandate for CARB

FIGURE 1: Framing the Path to 2050



Source: Adapted from California Air Resources Board, "Proposed First Update to the Climate Change Scoping Plan."[40]

to proceed with emission reductions post-2020. But what are the midpoint goals between 2020 and 2050, both economy wide and per sector, and what are the means to pursue them?

A logical starting place is to focus on 2030. CARB's proposed first scoping plan update includes a linear path to 2050 that shows two trajectories to 2050, one with a constant percent emission reduction (5.2 percent per year) and the other with a constant tonnage emission reduction (see above).

According to CARB, progressing toward California's 2050 climate target would require that emissions from 2020 to 2050 decline several times faster than the rate needed to reach the 2020 emissions limit.[41]

A recent third-party report recommended a 2030 goal on the order of 25 percent below 1990 levels.[42] An analysis by Lawrence Berkeley National Laboratory for CARB of different policy assumptions produced a range of scenarios that meet the 2020 target but vary from 208 to 396 million tons of statewide GHG emissions in 2030.[43] CARB's 2008 Scoping Plan did not discuss the specifics of a 2030 electricity system

for California that matched its GHG emission reduction trajectory but did state that the analysis assumed the following:

- Existing coal generation contracts would not be renewed,
- Well over half of electricity demand would be met with zero or near zero GHG emitting technologies (assuming nuclear power and large hydropower hold constant, which is not the case given the SONGS closure),
- Remaining electricity generation would come from natural gas combustion either in cogeneration or from highly efficient generating units,
- Energy efficiency and green building efforts between 2020 and 2030 would need to double the savings accomplished in 2020, and
- The number of electric, plug-in hybrid, and fuel cell vehicles would increase dramatically to about a third of the vehicle fleet.[44]

While this analysis was preliminary, much more is needed. To start, we need to understand how such a GHG reduction-oriented scenario might impact reliability, affordability, and the local environment.[45] Through 2020, a legislative requirement to reduce GHG emissions has given this criterion primacy over other potential energy-system objectives in forming regulatory scenarios. In looking to 2030, there is now an opportunity to evaluate energy-system transformation objectives—including GHG reductions—more holistically. But, given the likely dramatic steps needed by 2030, development of a goal and plan is time-critical.

Such steps might also indicate a certain degree of humility for planning to 2050. With technology development and policy development inherently uncertain, it is important to constrain this uncertainty by looking at intermediate points at which California can quickly and reliably assess whether it is on the right path and whether its goals are indeed realistic.

Development of a 2030 Electricity Plan Under a Reliability, Affordability, and Sustainability Framework The *2030 electricity plan* must be a single roadmap that integrates policies and programs, within and among agencies. *We do not discount that there is now unprecedented cooperation among individual agencies; but cooperation is not the same as integration.* While the CEC's IEPR, Renewable Action Plan, and the Zero Emission Vehicle Action Plan are all examples of collaborative efforts, they do not map how individual programs are integrated nor is there any cross-adoption of these plans by other agencies.[46] As discussed earlier, a structured framework, focused on reliability, affordability, and sustainability, which optimizes across these goals, is needed to chart a viable path to 2030. Equally important, some policies and programs

have conflicting outcomes regarding reliability, affordability, and sustainability. A common framework can identify conflicts and suggest optimization strategies.

Linkage of the 2030 Electricity Plan to Transportation, Water, Air Quality, and Climate Goals While the focus of the 2030 electricity plan should be a framework for the electricity sector, California needs a 2030 vision that addresses the electricity sector as one whose future is integrated at least with transportation, water, air quality, and climate. Until recently, electricity regulation occurred in relative isolation, focusing on development and delivery of power at reasonable rates. Likewise, transportation policies developed separately, since gasoline, diesel, and other non-electric fuels powered vehicles.[47] Water and electricity issues overlapped (e.g., the role of hydroelectricity in renewable portfolio standards, or the water/energy nexus in efficiency/conservation programs) but only on an ad hoc basis. Agency cultures and methods have evolved separately within each regulatory and technology ecosystem.

Climate change and the state's commitment to reducing GHG emissions as well as increasingly restrictive air quality requirements, however, have dramatically changed this historical approach. Legally and practically, energy, climate, air quality, water, and transportation are intertwined. While there is recognition of this linkage and significant coordinating efforts are occurring, a much stronger approach is needed, one in which the state's climate, energy, water, air quality and transportation programs are developed under an integrated framework.

Beyond 2020, the linkages among energy, climate, water, air quality, and transportation deepen dramatically.[48] Three studies have analyzed infrastructure changes that could potentially meet California's 2050 target of an 80 percent reduction in GHG emissions below 1990 levels.[49] While these studies provide a useful long-term vision, it is important to keep in mind that technologies are evolving rapidly, and in consequence, altering these models' presumed assumptions. 2050 is probably too far away to accurately draw lines between now and then, but in all of these scenarios, energy efficiency provides major reductions, with savings at far deeper levels than ever achieved. Second, the electric system is radically decarbonized, with over 90 percent of generation carbon-free. Third, the use of direct fuels in transportation, buildings, and industrial processes is switched primarily to (largely decarbonized) electricity. Electricity, as a percentage of energy end-use, would increase from a 2012 level of 15 percent to 55 percent in 2050.[50]

Thus, looking beyond 2020, the pursuit of reducing GHG emissions will produce major impacts on the electricity sector—through huge demands for energy efficiency and substantial new supplies of decarbonized electricity. In turn, the transportation sector will be deeply challenged to move from combustion of gasoline and diesel to a system that to a significant extent may be powered by electricity. As noted above, CARB's 2008 Scoping Plan included an analysis that assumed by 2030 electric, plug-in hybrid, and fuel cell vehicles would comprise about a third

of the state's vehicle fleet. Such technology scenarios are inherently uncertain and sufficient progress toward this estimate to date is already questionable.[51] Much more comprehensive thinking is needed about the reasonableness of such scenarios, as well as any electrification issues that might result from an electric vehicle-heavy future. For example, how would the role of utilities and other electricity providers change with large-scale electrification, and what types of electric pricing and market development would be needed support such a fundamental change?[52] What is the downside risk if such scenarios fail to materialize in the market? And what role might natural gas have in terms of both air quality and GHG emission goals in the transportation sector?[53]

Air quality issues, separate from climate, remain an important part of California's electricity future. The South Coast Air Quality Management District has observed that achieving the federally-mandated deadlines in 2023 and 2032 for ozone attainment in the South Coast Basin will be even more challenging than meeting GHG targets. The South Coast Basin will need to achieve reductions of 65 and 75 percent of NO_x (nitrogen oxides) beyond all currently adopted regulations for the 2023 and 2032 federal deadlines respectively.[54] These reductions dramatically impact the ability to use fossil-fired resources in Southern California.

Water linkages are also critical.[55] Nearly 20 percent of California's electricity and more than 30 percent of non-power plant natural gas is used for water-related purposes. Water is also critical to energy development: cooling, drilling, pumped storage, hydropower, and bioenergy. CARB states that water sector GHG emission reductions are primarily associated with reducing the amount of electricity and natural gas used in the water sector.[56] CARB has also concluded that state agency collaboration and policy alignment on water will require a foundation of information sharing and feedback and that both agency staff and executives will need to devote more time to interagency dialogue to ensure that policy differences are resolved with a full understanding of the consequences of decisions taken.[57] A recently released white paper provides an example of how energy use and GHG emissions associated with California's water and wastewater systems could be evaluated systematically.[58] The paper proposes development of GHG accounting guidance for water agencies that addresses the entire water use cycle, from procurement to treatment and discharge, which could encompass the energy aspects of water production, distribution, and usage. It also proposes a single energy, GHG, and water registry for data reporting by water agencies. As the report notes, the ability to comprehensively calculate the water, energy, and GHG impacts of water management decisions could help reduce public outlays by taking into account crosscutting valuations that are not accessible through traditional programs.[59] The CPUC also initiated its own rulemaking in late 2013 to develop a partnership framework between the investor-owned energy utilities and the water sector—both privately-owned water utilities regulated by the CPUC and public water and wastewater agencies—to co-fund programs that

reduce energy consumption by the water sector in supplying, conveying, treating, and distributing water.[60] The proceeding plans look at developing more robust methodologies for measuring the embedded energy savings from energy efficiency and conservation measures in the water sector and for determining the cost-effectiveness of these projects.

Australian Climate, Energy, and Water Policies: Conflicts and Synergies[61]
The Australia-United States Climate, Energy and Water Nexus Project (AUSCEW) was a three-year collaboration between the US Studies Centre located in Sydney, Australia, and the Australian National University. The group published a study in early 2013 analyzing Australian climate, energy, and water policies to "identify the risks of perverse outcomes between the three policy sectors."[62] The study identified four interventions to better enable integration and optimization of policies: better cross-sectoral knowledge to inform decisions; the identification of technologies with cobenefits; markets and broader cross-sectoral participation (including linking water and carbon markets); and better-integrated governance institutions.

Conclusion

The transformation of California's electricity system and the private investment needed to support it cannot be effectively enabled through disconnected decisions by the state's climate, energy, water, air quality, and transportation policymakers. In a keynote speech to energy utilities last year, CARB's chair, Mary Nichols, acknowledged the need for change:

> We know that pursuing pollution cuts cannot be done without coordinating with [other state policy priorities like air quality, goods movement, sustainable communities, and clean energy]—it wouldn't be effective, it would cost too much, and it would leave benefits to our economy, our environment, and our people on the table. . . . [T]he challenges we're navigating all at once cannot be done in isolation. I'd say it's like three-dimensional chess, but the metaphor is much too serene. It's more like multi-dimensional river rafting.[63]

California has a much-needed cooperative attitude. However, good faith cooperation is not the same as the institutional integration of planning, policies, and programs—especially over time periods that exceed any individual policymaker's tenure.

As stated at the outset of this paper, we do not know for sure the specific challenges that may come up between now and 2050 or even 2030. But we do know that the issues and solutions will be complex and unprecedented. If we are to successfully transform California's electricity sector, we must develop a consistent planning framework of reliability, affordability, and sustainability. We must update and streamline regulatory governance, expand our planning capabilities, and focus on identification of our 2030 goals and a viable roadmap to achieve those goals.

We must address risk but provide consistency, so that both the public and private sectors can respond to the challenges we face. And, in doing so, we will not only meet California's needs but provide a new framework of governance and planning for others.

Notes

1 Research and editing assistance provided by Cara Goldenberg (Dian Grueneich Consulting, LLC) and David Fedor (Hoover Institution).

2 Jeremy Carl, Dian Grueneich, David Fedor, and Cara Goldenberg, "Renewable and Distributed Power in California: Simplifying the Regulatory Maze—Making the Path for the Future," Hoover Institution, Stanford University (2012), 1.

3 The California Energy Commission (CEC) and the California Public Utilities Commission (CPUC) are the state's two major energy agencies. The decisions of the California Air Resources Board (CARB) and the State Water Resources Control Board (SWRCB) impact significantly the state's energy activities, as does a nongovernmental entity, the California Independent System Operator (CAISO), which operates much of California's transmission grid.

4 Germany is facing similar challenges. A recent report highlights its ambitions, challenges, and the critical roles that government energy policy and regulation play in the country's economic competitiveness. See "Toward a New Balance of Power—Is Germany Pioneering A Global Transformation of the Energy Sector?," The Boston Consulting Group, March 2013.

5 In December 2013, CAISO released a revised demand response (DR) and energy efficiency (EE) roadmap titled "Demand Response and Energy Efficiency Roadmap: Maximizing Preferred Resource," which identified four paths to advance DR and EE in California. Earlier in 2013, the CPUC issued a new Order Instituting Rulemaking (OIR) (R.13-09-011) to "Enhance the Role of Demand Response in Meeting the State's Resource Planning Needs and Operational Requirements." The purpose of the proceeding includes developing and adopting a roadmap on the future of demand response in California. The CEC 2013 Integrated Energy Policy Report (IEPR) also focuses on demand response and presents the CEC's own list of recommendations.

6 California Energy Commission, 2013 Integrated Energy Policy Report (IEPR), 80, http://www.energy.ca.gov/2013publications/CEC-100-2013-001/CEC-100-2013-001-CMF.pdf.

7 Ibid.

8 Ibid., 151.

9 California Public Utilities Commission, California Energy Commission, and California Independent System Operator, "Preliminary Reliability Plan for LA Basin and San Diego," draft, August 30, 2013.

10 For example, Track 4 of the CPUC's 2012 Long-term Procurement Planning (LTPP) rulemaking considered the local reliability impacts of the SONGS outage; however, the CPUC's final Track 4 decision does not mention how the CPUC decision meshes with the joint agency reliability plan.

11 There has been a start at this approach in the 2013 IEPR. CAISO has held transportation/Electrical Vehicle (EV) workshops with attendance by the CEC presiding commissioner and noticed in the CEC IEPR docket, to collect public input for both the CAISO and CEC proceedings. The needed additional step is to actually integrate agency decision-making, in a public setting, rather than have separate dockets and proceedings conducted by each entity.

12 On March 31, 2014, CAISO posted its final 2014–2015 TPP Unified Planning Assumptions and Study Plan. This plan referred to the original December 2013 draft joint staff document rather than the final version sent to CAISO in late February. Thus, it is not clear if CAISO will in fact use the assumptions and scenarios recommended by CPUC and CEC. In March 14, 2014 comments filed with CAISO, the CPUC staff requested verification as to whether CAISO's assumption on preferred resources and storage levels will be consistent with CPUC's LTPP assumptions. Comments by the CPUC's Office of Ratepayer Advocates dated March 13, 2014, raised related concerns that the CAISO planning assumptions are inconsistent with the CPUC's LTPP process.

13 One example is the 2010 MOU between the CPUC and CAISO seeking to integrate transmission-planning processes used by the two entities. It would be useful to determine the effectiveness of this and any other MOUs and identify additional areas for formal agreements.

14 A major foundation for California's advanced energy efforts is its "Loading Order Policy," first adopted by the energy agencies in the 2003 Energy Action Plan (EAP) and followed by state policymakers since then. The loading order provides that California, in meeting its energy needs, invests first in energy efficiency and demand-side resources, followed by renewable resources, and only then in conventional electricity supply. Final 2003 California Energy Action Plan, http://www.energy.ca.gov/energy_action_plan.

15 Many other states also have similar complexities, particularly in the rise of wholesale markets, and thus the challenges discussed here are not unique to California.

16 2003 California Energy Action Plan.

17 Reliable Electric Service Investments Act, Public Utilities Code section 399(b); emphasis added. While this paper focuses on reliability, safety is also an essential consideration in an integrated framework.

18 A fundamental task of CAISO is to "ensure the reliability of electric service and the health and safety of the public." California Public Utilities Code, section 345.5(b).

19 A major stakeholder has called upon the CPUC to inventory the realm of practices and technologies California uses to maintain safety and to examine how safety can be properly accounted for in the CPUC's reliability planning process. Comments of Environmental Defense Fund Regarding the Scoping Memorandum Issued on December 19, 2013, CPUC Docket, R.13-12-010, February 3, 2014.

20 James L. Sweeney, "The California Electricity Crisis," Hoover Institution, Stanford University, July 2002.

21 *Energy + Environmental Economics* (E3), "Investigating a Higher Portfolio Standard in California," January 2014.

22 Since our 2012 essay, California's power transmission and distribution infrastructure has been the target of physical attack which resulted in the destruction of seventeen transformers and severing of fiber optic communication cables at the San Jose Metcalf Substation, reducing power delivery capacity to Silicon Valley. The April 2013 midnight incident has raised calls to rethink the vulnerability of grid infrastructure, has resulted in an unplanned increase in utility security spending of $100 million over three years, and remains unsolved. (Rebecca Smith, "Assault on California Power Station Raises Alarm on Potential for Terrorism," *Wall Street Journal,* February 2014"; Vivien Ho, "PG&E offers $250K Reward in Substation Shooting," *San Francisco Chronicle,* April 20, 2014.

23 Carl, Grueneich, Fedor, and Goldenberg, "Renewable and Distributed Power in California," 10–19.

24 Peter Kind, "Disruptive Challenges: Financial Implications and Strategic Responses to a Changing Retail Electric Business," Edison Electric Institute (January 2013), 13.

25 Ibid., 5.

26 CPUC, *Energy + Environmental Economics Inc,* "California Net Energy Metering Ratepayer Impacts Evaluation," October 28, 2013.

27 The CPUC has an extensive public process to develop new residential rates that will be transitioned into effect over the next four years. The CPUC is also revising its NEM rules. Both of these activities are critical for addressing affordability.

28 Executive Orders S-3-05 (June 2005) and B-16-2012 (March 2012).

29 A study by Bloomberg New Energy Finance shows that emissions from in-state power generation increased 35 percent between 2012 and 2011. In contrast, the U.S. Energy Information Administration data shows a drop of 3.8 percent in energy-related CO_2 emissions in 2012, to the lowest levels since 1994 with power plant emissions falling nationally by 5.9 percent. With SONGS, 50 percent of SCE's electricity in 2011 came from GHG-free sources; that percentage dropped to 30 percent after the SONGS closure. California Energy Markets, Nov. 8, 2013, p. 9. Thus, how California balances cost, reliability, and sustainability is directly called into question when determining how much of the SONGS power will be replaced by gas-fired power.

30 Little Hoover Commission, "Rewiring California: Integrating Ideas for Energy Reform," report #214, December 2012, 29.

31 Ibid., 27.

32 The CEC produces a biennial Integrated Energy Resource Plan (IEPR) pursuant to Pub. Res. Code section 25301(a). The CEC's 2012 IEPR update identified risk as a major factor but also acknowledged that the institutional structure of multiple agencies with differing goals impedes adequate risk assessments. As stated in the CEC's 2012 report: "After assessing a range of different possible outcomes based on the assumptions in each scenario in terms of cost, reliability, and other metrics, the question is how to make an informed decision about which and how many resources to procure. CPUC staff identified the concept of 'deliverability risk assessment' in the 2008 Long-Term Procurement Plan rulemaking that essentially balances the policy-based goals for preferred resource development against the threat to reliability if such goals are not achieved on the desired time schedule. *The Energy Commission endorses this concept but recognizes the difficulty of balancing these competing goals given different missions and responsibilities.*" (CEC's 2012 IEPR, 42; emphasis added.)

33 We thank in particular Anthony Eggert, executive director of the UC Davis Policy Institute for Energy, Environment and the Economy; Paul deMartini, visiting scholar, Resnick Institute at the California Institute of Technology; and Elaine Hart and Jim Williams of E3 for input on this section.

34 As an example, the California Water and Environmental Modeling Forum (CWEMF) is a non-profit, non-partisan organization formed in 1994 whose mission is to increase the usefulness of models for analyzing California's water-related problems, http://www.cwemf.org.

35 The Stanford University-hosted "Energy Modeling Forum", for example, has successfully brought together public, private, and academic global energy and climate modeling teams each year since 1977 in a structured process to: (a) improve understanding of an important energy/environment problem by harnessing the collective capabilities of participating experts; (b) explain the strengths, limitations and caveats of alternative analytical approaches; and (c) identify high priority directions for future research. It would be a good template for a more focused California-oriented energy-modeling forum.

36 Broadening this to a Western-wide review would also be consistent with the recently adopted Pacific Coast Action Plan on Climate and Energy.

37 http://www.nwcouncil.org/media/6380/SixthPowerPlan_Ch9.pdf.

38 Western Electric Coordinating Council, "2013 Interconnection-wide Transmission Plan Summary," 22.

39 Mary Nichols, testimony before the Senate Committee on Environmental Quality: Select Committee on Climate Change and AB 32 Implementation, March 12, 2014.

40 "Proposed First Update to the Climate Change Scoping Plan: Building on the Framework", CARB, February 2014, 38, http://www.arb.ca.gov/cc/scopingplan/2013_update/draft_proposed_first_update.pdf.

41 Ibid., 27. CARB's 2008 Scoping Plan projected (assuming a statewide population growth of 12 percent between 2020 and 2030) that per-capita emissions would decrease on average just slightly less than 5 percent per year during the 2020–2030 period. In terms of per capita emissions per person, the trajectory would go from 13.3 tons in 2010 to 9.6 tons in 2020 and to 5.8 tons in 2030. CARB's 2008 Scoping Plan, 118.

42 Lee Friedman, "Electricity Pricing and Electrification for Efficient Greenhouse Gas Reductions," *Next 10* (July 2013) 21: "a specific interim goal for 2030, like 25 percent below the 1990 level."

43 Jeffery Greenblatt, "Estimating Policy-Driven Greenhouse Gas Emissions Trajectories in California: The California Greenhouse Gas Inventory Spreadsheet (GHGIS) Model," Lawrence Berkeley National Laboratory, report #6451E (November 2013), 28.

44 CARB's 2008 Scoping Plan, 119.

45 California's current electricity planning focuses on optimizing (e.g., "best fit/least cost") for the short-term (ten years or less). A focus on 2030 and beyond will move past this short-term focus to ensure that our investment decisions hold up for the longer-term.

46 One partial prior example is the California Long-Term Energy Efficiency Strategic Plan that was developed under CPUC leadership but with strong involvement of CEC, and endorsed and used by CPUC, CEC, and CARB.

47 The CEC's IEPR addresses transportation as well as electricity. However, the IEPR does not do a scenario-based approach to the future nor does it use a common analysis framework across programs or industries.

48 Climate change, such as decreased snowpack and greater storm severity, will also increasingly affect electric supplies and service. "U.S. Energy Sector Vulnerabilities to Climate Change and Extreme Weather," DOE/PI-0113, July 2013. See also California EPA's "Indicators of Climate Change in California," August 2013, 72.

49 The 2012 Task Force essay, pages 38 to 39, summarized the first study, James H. Williams, Andrew DeBenedictis, et al. "The Technology Path to Deep Greenhouse Gas Emissions Cuts by 2050: The Pivotal Role of Electricity," *Science,* 335, no. 6064 (January 2012) ["Williams et al."]. The other studies are California Council on Science and Technology, "California's Energy Future—The View to 2050," May 2011, and Max Wei, James H. Nelson, et al., "Deep carbon reductions in California require electrification and integration across economic sectors," *Environmental Research Letters* 8, 2013.

50 Williams et al., 55.

51 California New Car Dealers Association, "2013 California Auto Outlook" (August 2013), http://www.cncda.org/secure/GetFile.aspx?ID=2583.

52 California has a goal of 1.5 million zero-emission vehicles (ZEVs) in California by 2025, as well as goals for light duty passenger vehicles and heavier vehicles such as freight trucks and public buses. The Governor's Office of Planning and Research (OPR) has produced a 2013 ZEV Action Plan. The plan, though, is more a summary of individual agency policies and programs, rather than a cross-agency, integrated plan that identifies a single agency in charge, barriers and opportunities, public and private funding levels, and the milestones needed to achieve the goal.

53 "Proposed First Update to the Climate Change Scoping Plan," CARB, February 2014, 55.

54 South Coast Air Quality Management District, Comments to CARB on Climate Change Scoping Plan First Update (discussion draft), October 31, 2013.

55 Stanford University's Water in the West Project recently released a comprehensive summary of research on conjoined management of water and energy resources. The report shows the need for development of analytical tools and planning to promote integrated water-energy management. "Water-Energy Nexus: A Literature Review," August 2013, http://stanford.io/15DGwAA.

56 "Proposed First Update to the Climate Change Scoping Plan," CARB, February 2014, 71.

57 Ibid., 74.

58 "California's Water—Energy-Climate Nexus," The Climate Registry and Water Energy Innovations, October 15, 2013.

59 Ibid., 23.

60 CPUC Rulemaking (R.) 13-12-011 "Order Instituting Rulemaking into Policies to Promote a Partnership Framework between Energy Investor Owned Utilities and the Water Sector to Promote Water-Energy Nexus Programs."

61 Jamie Pittock, Karen Hussey, and Samuel McGlennon, "Australian Climate, Energy and Water Policies: conflicts and synergies," *Australian Geographer* 44, no. 1 (2013) 3–22.

62 Ibid., 3.

63 Mary Nichols, Northern California Power Agency speech, January 23, 2013, Sacramento, California. The 2012 task force essay used the analogy for the electricity sector of designing a new aircraft while it is flying, without benefit of any written design plans (Carl, Grueneich, Fedor, and Goldenberg, "Renewable and Distributed Power in California," 23).

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