DOCKET
09-IEP-1G
DATE RECD. Jul 13 2009

California Public Utilities Commission

33% RENEWABLES PORTFOLIO STANDARD
Implementation Analysis Preliminary Results

June 2009

Prepared by:

California Public Utilities Commission

PAUL DOUGLAS
Project Lead
RPS Program and Project Supervisor

ELIZABETH STOLTZFUS
Project Manager

ANNE GILLETTE
JACLYN MARKS
Lead Authors

Technical Analysis by:

Energy and Environmental Economics, Inc.
Aspen Environmental Group

Special Thanks to:

ARNE OLSON – Energy and Environmental Economics
SUSAN LEE – Aspen Environmental Group
SIMON EILIF BAKER – CPUC

1 Executive Summary

California lawmakers are currently developing legislation to increase the current 20% by 2010 Renewables Portfolio Standard (RPS) to 33% by 2020. The California Public Utilities Commission (CPUC) and California Energy Commission (Energy Commission) have endorsed this change and it is a key greenhouse gas (GHG) reduction strategy in the California Air Resources Board's (ARB) Assembly Bill (AB) 32 Scoping Plan. As the principal agency responsible for implementing the current RPS program, the CPUC has learned many lessons that can help guide the design of a higher mandate. In addition, several recent analyses have cast light on various aspects of renewable energy development and integration. Drawing on these resources and new analyses, staff at the CPUC developed this report in order to provide new, in-depth analysis on the cost, risk, and timing of meeting a 33% RPS. This report does not recommend a preferred strategy on how to reach a 33% RPS, but rather provides an analytical framework for policymakers to weigh the tradeoffs inherent in any future 33% RPS program for California.

Summary of key findings include:

- **Timeline:** Achieving 33% RPS by the year 2020 is highly ambitious, given the magnitude of the infrastructure buildout required.
- **Resources:** To meet the current 20% RPS by 2010 target, four major new transmission lines are needed at a cost of $4 billion. Three of these lines are already underway. To meet a 33% RPS by 2020 target, seven additional lines at a cost of $12 billion would be required. In addition, the 33% RPS target is projected to require almost a tripling of renewable electricity, from 27 terawatt hours (TWh) today to approximately 75 TWh in 2020.
- **Cost:** Electricity will be higher in 2020 regardless of the RPS requirements.
    - Even if California makes no further investments in renewable energy, this analysis projects that average electricity costs per kilowatt-hour will rise by 16.7% in 2020 compared to 2008 in real terms.
    - In 2020, the total statewide electricity expenditures of achieving a 20% RPS are projected to be 2.8% higher compared to a hypothetical all-gas scenario, where new electricity needs are met entirely with natural gas generation.
    - In 2020, the total statewide electricity expenditures of achieving a 33% RPS utilizing the current procurement strategy is projected to be 7.1% higher compared to the 20% RPS, and 10.2% higher compared to an all-gas scenario.
- **Policies:** Achieving a 33% RPS by 2020 requires tradeoffs amongst various policy goals and objectives. If the 2020 timeline is the most important policy priority, California must start implementing mitigation strategies such as planning for more transmission and generation than is needed to reach just 33%, pursuing procurement that is not dependent on new transmission, or concentrating renewable development in pre-permitted land that would be set aside for a renewable energy park.

APPROACH

Four Unique Renewable Resource Cases Created for Analysis

In order to conduct the implementation analysis, four unique renewable resource cases were developed. Each case represents a different 33% RPS procurement strategy to reaching the 33% RPS target. All cases assume current statutorily defined out-of-state deliverability requirements for renewables into California. Thus, these cases cannot be used to analyze the option of allowing out-of-state tradable renewable energy credits (REC) with no delivery requirement for RPS compliance.

- **33% RPS Reference Case:** This case represents California's current renewable procurement path, which is heavily dependent on new technologies, such as central station solar thermal.
- **High Wind Case:** This case demonstrates less reliance on in-state solar thermal and more reliance on less expensive wind resources in California and the Mexican state of Baja California.
- **High Out-of-State Delivered Case:** This case relies on construction of new, long-line, multi-state transmission to allow California utilities to procure large quantities of low-cost wind and geothermal resources from other western states (as noted above, this case does not include the use of tradable RECs with no delivery requirement).
- **High Distributed Generation (DG) Case:** This case assumes limited new transmission corridors can be developed to access additional renewable resources needed to achieve a 33% RPS. Instead, extensive, smaller-scale, renewable generation is interconnected to the distribution system or close to transmission substations.

In addition, a **20% RPS Reference Case** was developed to serve as a benchmark for cost comparisons between the cost of the current 20% RPS program and a 33% RPS in 2020. This reference case is comprised of California's likely renewable energy mix in 2020 based upon current state law and existing RPS contracts. As such, this case provides the most relevant benchmark against which to measure the incremental cost of various paths to meeting the higher 33% RPS target.

Two additional scenarios were developed to provide further points of reference:

- **All-Gas Scenario:** This scenario represents the resource mix in 2020 if no additional renewables were developed beyond 2007, and the rest of California's electricity needs were met with gas-fired generation. It supports comparisons between the cost of continuing investments in mostly natural gas and implementing a 33% RPS in 2020.
- **2008 Costs:** This scenario represents the current cost of electricity in California. It supports comparisons across the 2020 scenarios of increases relative to today's costs.

The report uses the four different possible 33% RPS cases to assess the costs and tradeoffs of each approach. It should be noted that:

- Projected costs are based on renewable technology costs and not the contract prices.
- The cost analysis assumes current technology costs, and makes no assumptions about the cost trajectory (up or down) of particular technologies over time due to potential transformation of the market.
- Average electricity costs per kilowatt hour are expressed as statewide averages and are not indicative of individual utilities' rates or the actual bills that consumers will pay.

Three Illustrative Timelines Created for Analysis

This report then uses the 33% RPS Reference Case to construct three illustrative timelines for achieving a 33% RPS. These timelines demonstrate how and when the state could plausibly build the necessary renewable generation and transmission to reach a 33% RPS. The timelines also offer insights into the increased need for public and private sector resources in order to quickly process the increased number of transmission and generation applications over the next 10 years.

- **Illustrative Timeline 1: Historical experience without process reform**

  This scenario is based on the state's experience with generation and transmission development over the last 10-15 years. The timeline assumes transmission planning, permitting, and construction processes that are almost entirely sequential.

- **Illustrative Timeline 2A: Current practice with process reform and no external risks**

  This scenario represents the development trajectory if California successfully implements transmission and generation process reforms that are already underway. Although not plausible since it does not include external risks that are beyond the state's control, this timeline serves to isolate the effect of the process reforms, and is the reference point that Timeline 2B is built upon.

- **Illustrative Timeline 2B: Current practice with process reform and external risks**

  This scenario represents the development trajectory if California successfully implements process reforms, but includes negative impacts and delays from external risks outside the direct control of state agencies, such as emerging technology risk, financing difficulties, and public opposition or legal challenges.

FINDINGS

Key Findings from Timeline Analysis:

The report finds that a 33% RPS in 2020 is highly ambitious, given the magnitude of the infrastructure buildout required

The magnitude of the infrastructure that California will have to plan, permit, procure, develop, and integrate in the next ten years is immense and unprecedented. This goal is more attainable with a commitment of significant new staff resources in both the public and private sectors. The conclusions below are based on an implementation analysis of the 33% RPS Reference Case.

- Timeline 1 reaches a 33% RPS in 2024. Using past practices as a guide, the scale of the transmission and generation buildout will take at least 14 years if implementation starts today. This timeline, however, assumes no external risks.
- Timeline 2A reaches a 33% RPS in 2021. This timeline assumes successful implementation of numerous process reforms now underway, which speed achievement of the 33% RPS from 2024 to 2021. This timeline represents a best case scenario as it assumes no external risks, no resource constraints in processing numerous transmission and generation applications, and that the California ISO is able to successfully implement its planned new process to review and approve more than one major transmission application per year.
- Timeline 2B does not reach the 33% RPS since two resource zones fail to develop due to risks outside of the state's control.

Numerous external risks could undermine the time savings achieved by process reforms

Several factors outside direct state control could undermine the gains realized through the various reform initiatives. These external risks could delay attainment of the 33% RPS target well beyond 2020, especially if California continues on its current renewable resource contracting path.

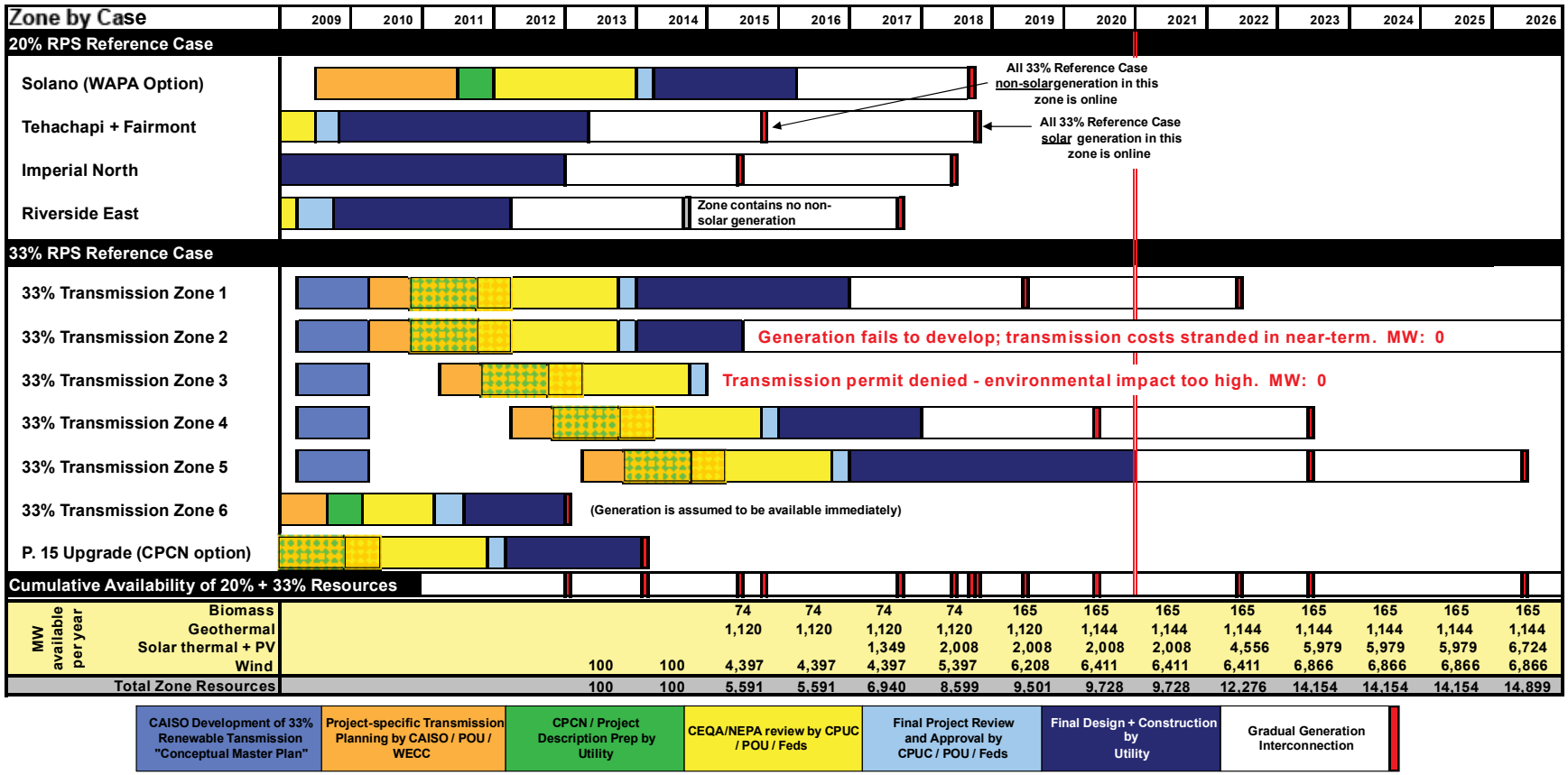
- Timeline 2B (see Exhibit A) illustrates how unanticipated contingencies could affect the timing of reaching the 33% RPS goal. External risks delaying this timeline include:
    - California's high reliance on relatively new technologies and companies
    - Scale of new infrastructure investment, which this analysis estimates at approximately $115 billion between now and 2020, in an uncertain financial environment
    - Environmental impacts of generation and transmission facilities that may require the use of large areas of undeveloped and perhaps pristine land
    - Legal challenges and public opposition to large-scale renewable energy infrastructure

California must start implementing mitigation strategies if achieving a 33% RPS by the year 2020 is the most important policy priority

Timeline 2B provides an example of a scenario in which, despite successful implementation of ambitious reforms, two resource zones fail to develop due to external risks. While Timeline 2B presents a hypothetical example, it illustrates the potential impact of real risks that California's current procurement strategy is not prepared to mitigate. Specifically, California's current procurement path is focused almost solely on central station renewable generation that is dependent on new transmission. In order to mitigate the risk that one resource zone would fail to develop, thereby delaying the achievement of a 33% RPS by several years, the state should consider a procurement strategy that adequately considers the time and risk, in addition to price, associated with particular renewable generation resources. The state may also wish to adopt risk mitigation strategies, such as:

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

Exhibit A. Illustrative Timeline 2B for the 33% RPS Reference Case: Current Practice With Process Reform and External Risks



Source: CPUC/Aspen

Result: The 33% RPS Reference Case is not achieved due to unexpected problems with the development of two zones and delays in deployment of large-scale solar projects. Regardless of the nature of the risks that may actually occur, realization of any risk could cause delay and have a significant impact on timing. Although the state does not have direct control over many of the risks facing renewable energy development, it could adopt strategies that would mitigate specific risks.

Key Findings from Renewable Resource and Cost Analysis

A 33% RPS is projected to require almost a tripling of renewable electricity, and nearly a doubling of new transmission lines

The 33% RPS Reference Case is projected to require an additional 75 TWh of renewable electricity, or nearly a tripling compared to the 27 TWh of delivered renewable electricity generated at the end of 2007. It is also projected to require seven new transmission lines to deliver the additional 75 TWh of electricity.

Exhibit B. Renewable Generation and Transmission Needed in 2020

20% RPS Reference Case would require	33% RPS Reference Case would require
35 TWh of new renewable electricity in 2020, in addition to **27 TWh** of generation from renewables in existence at the end of 2007	**75 TWh** of new renewable electricity in 2020, in addition to **27 TWh** of generation from renewables in existence at the end of 2007
4 New Major Transmission Lines at cost of **$4 Billion**	**7** Additional Major Transmission Lines at cost of **$12 Billion**

Electricity will be higher in 2020 regardless of the RPS requirements

Real electricity costs will be significantly higher in 2020 compared to 2008, regardless of whether California pursues a 20% or 33% RPS (see Exhibit B).

- Even if California makes no further investments in renewable energy (the all-gas scenario), the analysis projects that average statewide electricity costs per kilowatt hour will rise by 16.7% in 2020 compared to 2008 in real terms. This increase results from the need to maintain and replace aging transmission and distribution infrastructure, anticipated investments in advanced metering infrastructure and other smart grid capabilities, the cost of repowering or replacing generators to comply with once-through cooling regulations, and the cost of procuring new conventional generating resources to meet load growth.
- In 2020, the total statewide electricity expenditures of the 20% RPS Reference Case is projected to be 2.8% higher compared to the all-gas scenario.
- In 2020, the total statewide electricity expenditures of the 33% RPS Reference Case is projected to be 7.1% higher compared to the 20% Reference Case, and 10.2% higher compared to the all-gas scenario.

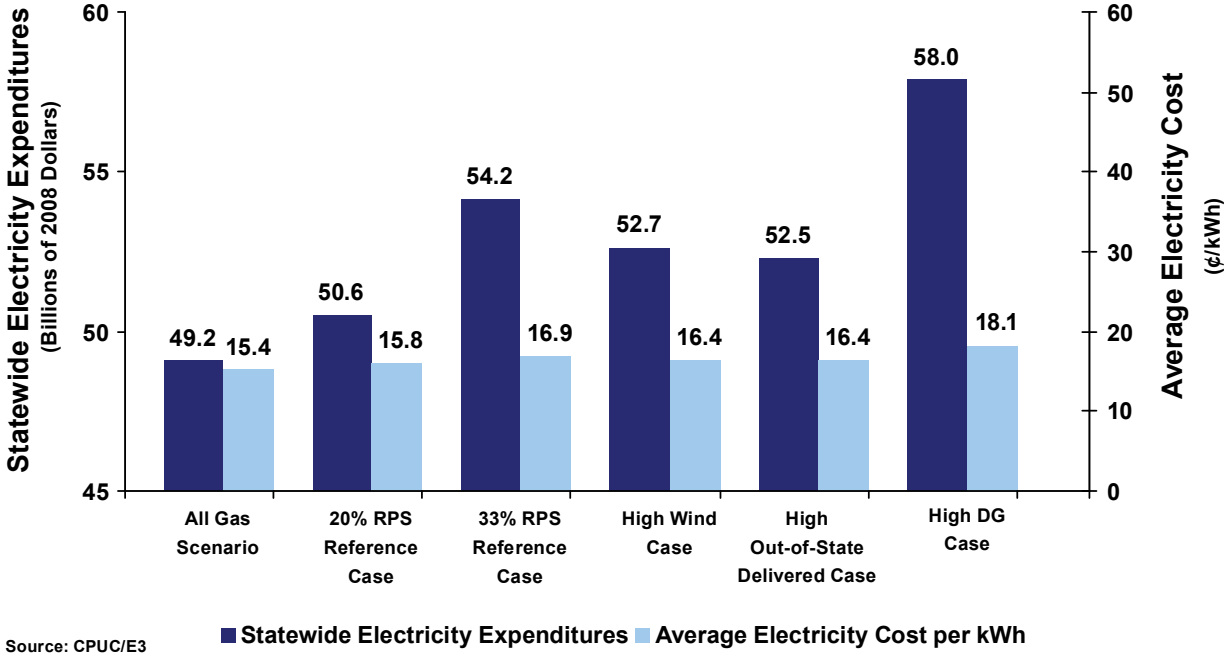
The 33% RPS Reference Case is the most expensive case relative to the alternative 33% RPS cases requiring new transmission lines; but it is still much less costly than the High DG Case (see Exhibit B)

The cost premium of meeting a 33% RPS does not vary greatly between the High Out-of-State Delivered Case and the High-Wind Case. Statewide electricity expenditures under these cases are $1.5 and $1.8 billion lower than the 33% RPS Reference Case, respectively, with the cost savings largely resulting from replacing large quantities of solar thermal resources with less costly wind resources.

The High DG Case adds almost twice the incremental costs of the 33% RPS Reference Case

The cost premium of the High DG Case is significantly higher than the 33% RPS alternative cases, with a 14.6% cost premium compared to the 20% RPS Reference Case, and a 7.0% cost premium compared to the 33% RPS Reference Case. This is due to the heavy reliance on solar PV resources, which are currently more expensive than wind and central station solar.

Exhibit C. Statewide Electricity Expenditures and Average Electricity Cost in 2020



Source: CPUC/E3

Findings from Sensitivity Analysis

Projecting the costs of different renewable and fossil-fired energy sources out to 2020 requires numerous assumptions about future conditions including load growth, equipment costs, and fuel prices. Many of these variables are highly uncertain, and some significantly influence the model's results. Accordingly, the study includes sensitivity analysis in three key areas, finding that:

- A 33% RPS can serve as a hedge against natural gas prices, but only under very high natural gas and GHG allowance prices. Thus, the hedging value in itself is not a very strong justification to do a 33% RPS.
- The interplay between energy efficiency achievement and renewable energy procurement highlights the need to analyze and plan for the interactions among the state's various policy goals. If the state does not plan for interactions, then a 33% RPS by 2020 could result in a surplus of energy or capacity and excess consumer costs.
- Dramatic cost reductions in solar PV could make a solar DG strategy cost-competitive with central station renewable generation. More analysis is necessary to determine the programmatic strategies necessary to achieve a high-DG scenario as well as the feasibility of high penetrations of solar PV on the distribution grid.

POLICY OBJECTIVES AND TRADEOFFS

Achieving a 33% RPS will require tradeoffs amongst various policy goals and objectives

There are multiple renewable procurement strategies that California could pursue to reach a 33% RPS, but each procurement path will reach the 33% RPS target on a different timeframe and will perform differently across the broad range of RPS policy objectives that stakeholders and decision-makers have articulated. See Exhibit D for a comparison of how each 33% RPS Case performs across the RPS policy objectives.

Exhibit D. Comparison of 33% RPS Cases Across RPS Policy Objectives

Policy Objective	33% RPS Reference Case	High Wind Case	High Out-of-State Delivered Case	High-DG Case
Cost	◒	●	●	○
Timing	○	◒	◒	◒
GHG Emission Reductions	●	●	●	●
Resource Diversity (Hedging Value)	●	●	●	●
Local Environmental Quality Air Quality	●	◒	○	●
Local Environmental Quality Land Use	○	◒	◒	●
In-state Economic Development	◒	◒	○	◒
Long-Term Transformation	●	○	○	●
Technology Development Risk	○	●	●	○

Legend:

● Case performs well ○ Case performs poorly ◒ Case is neutral

California IOUs are currently on a procurement path that in effect prioritizes long-term market transformation over other policy objectives. California's IOUs are depending on new renewable technologies, including solar thermal, to meet their RPS obligations. This procurement strategy may lead to long-term market transformation of the central station solar market, but due to risks inherent to new technologies, this strategy could result in higher prices and a longer development period that could delay achievement of a 33% RPS to after 2020.

RPS Policy Objectives Should Be Prioritized

As this analysis has shown, many of the policy objectives are mutually exclusive and in conflict with one another. Currently, the RPS procurement process is in effect dictating the timing, cost, and policy objectives of a future 33% RPS program. Thus, the tradeoffs are being decided through the utility procurement process, not by the policymakers or regulators. Using current RPS contracts as an example, market transformation and in-state economic development are the primary policy objectives that are being prioritized at the expense of meeting a 2020 timeline and minimizing customer costs. This results from lack of having a stated priority preference. Some of the key questions to help determine a priority preference include:

- Should California focus public investment and system planning efforts on developing and integrating technologies with significant long-term transformational potential such as solar thermal or solar PV?
- Should California focus on developing in-state resources? Up to what cost? What is the correct balance between in-state economic development and higher customer costs?
- Is California willing to delay the 2020 target in order to develop primarily California resources and stimulate new technologies and market transformation?
- Should California waive renewable energy delivery requirements for out-of-state resources if it is necessary to meet the 2020 target or pursue a lower cost strategy?
- Should the CPUC encourage the utilities to procure increased amounts of (currently) high-cost solar PV to mitigate the potential negative impact of delay due to failure of a resource zone?

NEXT STEPS

This report presents the preliminary results of the 33% RPS Implementation Analysis and does not include results from Phase 3, the final phase of this analysis. By the end of 2009, the final results will incorporate additional analyses. First, the California ISO will complete a study to determine the resource requirements to integrate the intermittent renewable resources needed for a 33% RPS. Second, the transmission cost estimates will be updated based on the latest information from the Renewable Energy Transmission Initiative (RETI) and the California ISO's conceptual transmission planning process. Finally, CPUC staff will identify and articulate solutions and strategies for addressing many of the risks and challenges identified throughout this report.