

DOCKETED

Docket Number:	15-RETI-02
Project Title:	Renewable Energy Transmission Initiative 2.0
TN #:	214339
Document Title:	RETI 2.0 Western Outreach Project Report
Description:	October 28, 2016 Revised Version, Prepared by Western Interstate Energy Board with technical support from Energy Strategies LLC
Filer:	Misa Milliron
Organization:	California Energy Commission
Submitter Role:	Commission Staff
Submission Date:	11/2/2016 8:33:30 AM
Docketed Date:	11/2/2016

RETI 2.0

WESTERN OUTREACH PROJECT REPORT

Prepared by Energy Strategies, LLC for submission under Agreement with
the Western Interstate Energy Board

October 28, 2016 (*revised version*)



Acknowledgements

This report was prepared by Energy Strategies, LLC (“Energy Strategies”) as an account of the work done by the Western State Energy Board (WIEB) at the request of the California Natural Resources Agency.

Project Lead: Thomas Carr, Western Interstate Energy Board

Project Steering Committee:

Angela Dykema, Director, Governor’s Energy Office, Nevada
Brian Turner, Natural Resource Agency, California
Chris Worley, Governor’s Energy Office, Colorado
Doug Little, Commissioner, Arizona Corporation Commission
Jeff Blend, Department of Environmental Quality, Montana
Tony Usibelli, Department of Commerce, Washington

Technical support:

Keegan Moyer
Caitlin Liotiris
Kathleen Fraser
Brooke Kimball

Funding for technical support to this project was provided by Energy Innovation, LLC. Additional funding was provided by the National Association of State Energy Officials.

Energy Strategies, LLC
215 South State Street, Suite 200
Salt Lake City, UT 84111
(801) 355-4365

Western Interstate Energy Board
1600 Broadway, Suite 1700
Denver, CO 80202
(303) 573-8910

Document Revisions

Energy Strategies made several revisions and clarifications in this report on October 28, 2016. These revisions were made to ensure that assumptions and data used in the report were based entirely on publicly available information or studies. These revisions impact information on pages 51, 56, 61, 62 and 70. The revisions did not impact any of the recommendations associated with the report. In some instances, the format information is presented in has been updated to better present the publicly available data/assumptions.

Disclaimers

This report was prepared by Energy Strategies as an account of work done by WIEB and Energy Strategies at the request of the California Natural Resources Agency. The findings and recommendations in the report are the work product of WIEB staff¹ and have not been reviewed, endorsed or approved by the Board of the Western Interstate Energy Board.

Neither WEIB, nor Energy Strategies, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by WIEB. The views and opinions of authors expressed herein do not necessarily state or reflect those of WEIB or Energy Strategies, nor do they reflect the views of Energy Strategies' clients.

Energy Strategies provides this report, which is sourced from publicly available information and discussion with Western Outreach stakeholders, for the benefit of our clients. While we consider the sources reliable, we do not represent the information as accurate or complete. Clients and readers of this report should not rely solely on this information for decision-making purposes.

¹ With technical support from Energy Strategies.

CONTENTS

1. EXECUTIVE SUMMARY	6
2. INTRODUCTION	16
2.1. THE WESTERN OUTREACH PROJECT.....	16
2.2. PURPOSE OF THIS REPORT.....	18
2.3. LIMITATIONS	19
3. WESTERN RENEWABLE ENERGY MARKETS.....	20
3.1 DRIVERS, TRENDS, AND CHALLENGES OF WESTERN RENEWABLE ENERGY MARKETS	21
3.2. RENEWABLE RESOURCE TECHNOLOGIES AND LOCATIONS.....	33
3.3. TRANSMISSION SYSTEM CONSTRAINTS AND REGIONAL TRADE OPPORTUNITIES	37
4. ACCESSING HIGH-QUALITY OUT-OF-STATE RENEWABLES	49
4.1. WESTERN TRANSMISSION PROJECTS	49
4.2. TRANSFER CAPACITY TO CALIFORNIA.....	55
4.3. IMPACT ON CALIFORNIA EXPORT CAPABILITY	63
4.4. IMPACT ON THE INTEGRATED TRANSMISSION SYSTEM AND MARKET EFFICIENCY	67
4.5. PROJECT SUMMARY AND SCENARIOS.....	70
5. RECOMMENDATIONS.....	73
6. APPENDIX A: TRANSMISSION PROJECT REFERENCES	86
7. APPENDIX B: SUPPLEMENTAL FIGURES	88
8. APPENDIX C: FOCUS QUESTIONS	90

ACRONYMS AND ABBREVIATIONS

APS	Arizona Public Service
ATC	Available Transfer Capability
BLM	U.S. Bureau of Land Management
CAISO	California Independent System Operator
COI	California-Oregon Intertie
CEC	California Energy Commission
CCA	Community Choice Aggregators
CPUC	California Public Utilities Commission
EIM	Energy Imbalance Market
FEIS	Final Environmental Impacts Statement
GHG	Greenhouse Gas
IOU	Investor-Owned Utility
IPP	Intermountain Power Plant
IRP	Integrated Resource Plan
ITC	Investment Tax Credit
LSE	Load Serving Entity
NPCC	Northwest Power and Conservation Council
ON-Line	One Nevada Line
PCC	Product Content Category
PG&E	Pacific Gas and Electric Company
PV	Photovoltaic
PNM	Public Service Company of New Mexico
PPA	Power Purchase Agreement
PTC	Production Tax Credit
RAS	Remedial Actions Scheme
REC	Renewable Energy Credit
RETI	Renewable Energy Transmission Initiative
RFI	Request for Information
RFP	Request for Proposals
RPS	Renewable Portfolio Standard
SDG&E	San Diego Gas and Electric
SCE	Southern California Edison
TAFA	Transmission Assessment Focus Areas
TEPPC	Transmission Expansion Planning Policy Committee
TTIG	Transmission Technical Input Group
WECC	Western Electricity Coordinating Council
WIEB	Western Interstate Energy Board
WSPP	Western Systems Power Pool

1. EXECUTIVE SUMMARY

The California Energy Commission (CEC), California Public Utilities Commission (CPUC), and the California Independent System Operator (CAISO), the California Office of the U.S. Bureau of Land Management (BLM), and the California Natural Resource Agency, sponsored the Renewable Energy Transmission Initiative (RETI) 2.0 to help inform California decision-makers of the implications and options for meeting the state’s 2030 Renewable Portfolio Standard (RPS) and greenhouse gas (GHG) mandates. The Western Interstate Energy Board (WIEB) accepted a request to support the effort by conducting outreach to Western states and stakeholders outside of California – a task referred to as the Western Outreach project. The purpose of the Western Outreach project was to collect input from Western stakeholders regarding the availability of renewable energy and electric transmission that could contribute to meeting California’s renewable energy and GHG objectives. This report summarizes the feedback stakeholders provided through the project and is WIEB’s work product providing input into the overall RETI 2.0 process.

RETI 2.0 and the Western Outreach are not regulatory proceedings. They offer insights, scenarios, and recommendations to help reach California’s 2030 energy and environmental goals.² This document captures the viewpoints of a range of Western stakeholders that participated in the project, including state or federal agencies and regulators, public and private utilities, transmission system operators and developers, generation developers, and members of the environmental advocacy communities. Best efforts were taken to convey the voice and perspective offered by these groups, while also expanding and building

² For additional information regarding RETI 2.0, please see: energy.ca.gov/reti

on their ideas and suggestions regarding out-of-state resource and transmission development.

The Western Outreach project captured stakeholder feedback through two public workshops where participants and panelists provided comments in response to a set of “focus questions” that WIEB designed to focus the scope of the project.

The focus questions solicited stakeholder feedback on:

- 1) Western demand and supply of renewable energy;
- 2) Constraints associated with renewable energy deployment;
- 3) Market opportunities; and
- 4) Transmission expansion proposals and configurations.

Stakeholder feedback and corresponding observations for each area are summarized as follows:

Renewable Demand: RPS mandates across the West are growing, but aggressive procurement in recent years has either reduced or delayed incremental need for significant amounts of new resources. California utilities are on track to meet their 2020 RPS targets, but given that by 2030 California utilities will require twice as much renewable energy as the other Western states combined, California is seen as the primary RPS-driven opportunity by the development community. Corporate buyers and community choice aggregators are growing sources of demand, but their market impacts could prove to be less regional in nature if they look to procure near the communities they serve.

Renewable Supply: The supply of renewable resources has become increasingly competitive on an economic basis due to the combined impact of technology improvements, cost declines, and federal tax incentives. Power Purchase Agreement (PPA) prices continue to fall across the nation as a result, and there are thousands of MWs of

renewable energy in development across the West eager to sign such agreements with off-takers. The supply is both geographically and technologically diverse and in some instances, aligns closely with coal plant retirements – which may result in latent transmission capacity. The Transmission Assessment Focus Areas (TAFAs) identified by RETI 2.0 have been confirmed through the Western Outreach based on the magnitude of high-quality resources in development in those locations.

Constraints: Participants repeatedly cited the absence of available transmission capacity into California as the biggest issue limiting out-of-state renewable resource development. There are limited options to deliver resources to the import/export TAFAs identified by RETI 2.0, and with few exceptions, new transmission will be needed in order for resources to reach the state.

Export constraints were identified for California’s excess renewable energy generation. Southwestern utilities may find themselves in a similar position as California within five to 10 years, suggesting they could also have excess generation during the “belly of the duck.” The Northwest has its own challenges, especially as it relates to the management of the region’s hydro system. Conceptually, the idea of ramping down hydro to take advantage of low-cost excess solar is a potential economic solution. However, the Northwest hydro system has a springtime overgeneration issue (when it is a “seller”) and has a series of complex flexibility limitations attributable to the physical layout of the dams and strict environmental constraints.

Market Opportunities: In the spirit of facilitating more efficient dispatch and system utilization in a future with increasing levels of renewable generation, stakeholders suggested that both the Energy Imbalance Market (EIM) and the potential regional market as could offer significant

benefits, but also contemplated a number of market products and enhancements that could be implemented more immediately to complement these efforts. Non-firm or conditional firm transmission was cited as a means to increase transmission utilization and deliver more renewable resources to California using the existing grid. However, stakeholders cautioned that, historically, financiers of renewable generation projects were disinclined to have the facility's output curtailed in instances when non-firm or conditional firm transmission was unavailable. Another example was a "duck belly" power product that would facilitate trade of excess solar energy across the West and other shorter-duration power blocks to address predictable intraday shortages and surpluses. Power marketers were eager to provide their input into the process to identify market solutions to the evolving resource mix and sought future consultation with transmission and resource planners.

Transmission expansion proposals and configurations: The Western Outreach identified 12 Western transmission projects that see a portion of their overall benefit tied to overcoming the transmission constraints associated with delivering high-quality renewable resources to California. Several of the projects are in advanced development; nearly 3,300 line miles of transmission have both (1) received federal Final Environmental Impact Statements (or Records of Decisions) *and* (2) are in either Phase 2 or Phase 3 of the Western Electricity Coordinating Council (WECC) Path Rating Process. These advanced development projects combined have the potential to deliver up to 10,000 MW of renewable resources to California in increments ranging between ~500 to ~3,000 MWs. They propose to deliver resources from across the West, although Wyoming and New Mexico are the most common sources given the prevalence of high-quality, low-cost, and temporally uncorrelated wind in those areas. In addition to resource delivery benefits, congestion relief, reliability

enhancements, and future market efficiency would likely be realized upon the projects' completion. This report describes a handful of build-out scenarios that could be useful to California decision-making processes, as the projects efficacy in facilitating California's RPS and GHG reduction goals is evaluated.

In compiling the input received by stakeholders, several potential next steps were identified. These suggested action items, which are expanded on in the last section of this report, are summarized as follows:

1. Convene Further Regional Collaboration

During the Western Outreach project, several subjects were identified that could benefit from further collaboration across the West. Though the participants in such collaboration could include a diverse set of actors throughout the electricity industry, including balancing authorities, load serving entities, transmission owners and operators, power marketers, and project developers, California and other state agencies could play a valuable role in convening and facilitating the following collaborative endeavors. The three types of collaboration discussed during the Western Outreach project include: Western resource planning coordination, new market products, and study of coal unit retirement implications.

- a. Facilitate Western Resource Planning Coordination** – Several participants mentioned that a coordination forum where resource planners could identify planning efficiencies and power exchange opportunities would help utilities meet their local needs at the lowest cost. Given the evolving resource mix, utilities net short or net surplus position in the varying hours and seasons will not remain the status quo. Thus, this type of coordination could

facilitate long-term market contracts, jointly procured transmission and resources, broader understanding of evolving utility operational strategies, and an opportunity to interact with regional transmission planners. WIEB's former Resource Planners Forum could be reconvened to serve this purpose.

b. Design, Promote, and Review New Market Product(s) for Overgeneration Conditions – The Western Outreach effort considered power and transmission market solutions through which California and Western states' existing and planned renewable fleet could be better utilized. One method discussed was the creation of new power market products to take advantage of California's renewable energy overgeneration in the day-ahead and longer-term markets, and to facilitate imports to meet morning and evening ramping needs. It would also be valuable to consider power purchase arrangements that would identify alternate markets for imports into California during overgeneration conditions. Western Outreach participants also discussed the possibility for broader use of conditional firm transmission service to maximize the utilization of existing transmission. These types of market-based solutions, along with EIM expansion and regional market expansion, should be considered in parallel to transmission and resource investment opportunities.

c. Assess Coal Retirement Impacts on Transmission Capacity – Repurposing transmission freed up from coal retirements is, and will continue to be, a common strategy for increasing access to renewable-rich areas. If California chooses to pursue such a

strategy, RETI 2.0 should consider initiating a follow-on technical assessment in coordination with other Western utilities to identify planned and potential coal retirements and anticipated plans for east-to-west transmission use. This information could be a useful input to California's RPS planning efforts, while also helping to evaluate the feasibility and potential timing of transmission projects that may rely on such capacity.

2. Update Resource and Transmission Data Used in Decision Making

a. Update Transmission Cost Assumptions in California Planning

Tools – Transmission project sponsors provided cost estimates into the RETI 2.0 process that could be used to update California planning tools, such as the RPS Calculator or the Integrated Resource Plan (IRP) proceedings. California should also consider using generic costs, such as those generated from the TEPPC Capital Cost Calculator, in order to bookend and vet the developer values.

b. Request Information from Out-of-State Resource and

Transmission Combinations – This recommendation recognizes that there are several advanced transmission and resource project combinations that could provide California utilities with realistic and actionable cost information to replace the conceptual, generic information currently used in planning. California entities could use a Request for Information (RFI) as a tool to gather commercial-grade information from renewable developers, in partnership with existing and prospective transmission service providers, through a

process that respects the confidential nature of certain aspects of the response. This would give recipients of the information, namely the CAISO, CPUC, and utility procurement departments, unique and detailed insight into what the procurement of out-of-state renewable resources and transmission might look like from an economic and technical perspective. Grid expansion to remote resources has been in the planning stages for more than 10 years by entrepreneurial enterprises. Now, on the cusp of the next major RPS planning effort, may be a good time to allow this community to respond to California’s developing “need” for a geographically broad and technologically diverse resource set.

c. Review and Update Out-of-State Resource Costs for Planning

Tools – Stakeholders provided information that suggests that reductions in the capital cost for geothermal facilitates and technology improvements in wind turbines have increased the capacity factor of what have historically been lower-capacity factor wind regimes. Stakeholders felt that these developments should be considered by California in future planning exercises.

d. Evaluate Available Transfer Capability between New Transmission Projects and the California Transmission System

System – A number of transmission projects terminate near, but not directly within, the RETI 2.0 import/export TAFAs. RETI 2.0 focused the in-state analyses on evaluating transmission availability and impacts once the resource reaches the import/export TAFE on the California border, leaving a gap in evaluating the full benefit (and cost) of these projects. RETI 2.0 could proceed in several

ways, but gathering information about the technical and commercial availability of transmission in these areas will enable a thorough evaluation of these types of transmission projects.

3. Address Barriers to Entry for Out-of-State Resources – In reviewing the challenges faced by out-of-state resource and transmission developers, it became apparent that several barriers have limited their progress to date. Western Outreach participants discussed the following topics and strategies that California policy makers, utilities, and regulators should consider.

- a. Review Aggregation and Eligibility Requirements** – First, in some cases, market demand may need to be aggregated to facilitate such a significant investment, and currently, no mechanism exists to do so. Secondly, some RPS procurement processes have impractical eligibility requirements for out-of-state renewables whose delivery would rely on a yet-to-be-built transmission project. A review of these barriers, and others may be needed if California is to move forward with significant resource development outside of the state.

- b. Incorporate Opportunity Cost or Scenario Analysis of Out-of-State Options when Evaluating Procurement and Transmission Plans** – Stakeholders mentioned that the approaching years will be a critical decision-making period for Western renewable development, market integration, and transmission expansion. The opportunity cost of not making infrastructure decisions and investments today could be significant. Two of the biggest drivers of

benefits that could be accrued as a result of near-term regional transmission and resource investment are (1) PTC expiration in 2019 and (2) the enhanced efficiencies of an energy market operating with a more robust regional transmission system. The PTC represents a time-constrained opportunity that, if captured over the coming years, could help pay for a robust regional transmission system that could facilitate additional long-term follow-on economic savings as expanded regional markets are realized.

- c. Consider RPS and IRP Policy that Allows Action to be Taken Now on Out-of-State Resources** – The Western Outreach project has shown that substantial work has occurred throughout the West to develop rich renewable resource areas, and transmission project developers have shouldered significant planning and permitting risks to bring their respective projects to a point where on-line dates within five years are realistic and feasible. The market response has been significant, although, given the scale of these projects, the tools used to consider and implement this response need examination. One potential track is California’s new IRP planning process, which could facilitate investment-level analysis of these public policy-enabling projects at the CAISO.

These recommendations, provided by WIEB staff, are presented with the goal of overcoming some of the challenges identified in the Western Outreach project and facilitating broad regional development of renewable resources and transmission across the West.

2. INTRODUCTION

In an effort to inform California decision makers about the transmission implications of accessing and integrating additional renewable energy to meet California's new RPS and GHG objectives by 2030, the CEC, CPUC, and the CAISO initiated the Renewable Energy Transmission Initiative (RETI) 2.0. The BLM and the California Natural Resource Agency are also sponsoring entities of the RETI 2.0 Initiative.

RETI 2.0 is intended to be an open, transparent, and science-based process to explore the renewable generation resources in California and throughout the West, consider critical land use and environmental constraints, and identify potential transmission opportunities that could access and integrate renewable energy with the most environmental, economic, and community benefits. While RETI 2.0 is not a regulatory proceeding itself, the insights, scenarios, and recommendations it develops will frame and inform future transmission and resource planning proceedings with stakeholder-supported strategies to help reach California's 2030 energy and environmental goals.³

2.1. The Western Outreach Project

At the request of the California Natural Resources Agency, WIEB conducted outreach to Western states and stakeholders outside of California to gather input from across the Western Interconnection regarding the availability of renewable energy and electric transmission that could contribute to meeting California's renewable energy and GHG objectives, which include at least a 50 percent

³ For more information regarding RETI 2.0, please see: energy.ca.gov/reti

renewable portfolio standard (RPS) and a 40 percent GHG reduction – both of which must be accomplished by 2030 or earlier. The Western Outreach efforts will serve to inform the RETI 2.0 process already underway.

Stakeholders, including state or federal agencies and regulators, tribal governments, public and private utilities, transmission system operators, generation developers, transmission developers, and members of the consumer and environmental advocacy communities, were invited and encouraged to provide comments.

To facilitate stakeholder engagement and comments, WIEB hosted two public workshops centered on renewable resources, policy, and transmission options. The first workshop was held on August 12, 2016, in Portland, Oregon, and focused on transmission and resource issues pertaining to the Northwest, and the Intermountain region. The second workshop took place on September 1, 2016, in Las Vegas, Nevada, and provided a Southwestern perspective on the discussion topics. The option to participate by webinar and/or phone was made available at both workshops to allow for broad stakeholder participation across the West. The format of workshops included panels of diverse industry leaders and state representatives who were invited to share their thoughts on a number of focus questions and provide other pertinent insights.

The public was encouraged to ask questions and provide comments during each panel session. In addition, all stakeholders were invited to submit written comments. The agendas, focus questions, presentations, and recordings from

the workshops have been made available on the RETI 2.0 website.⁴ Additionally, the focus questions used in the workshops can be found in Appendix C.

The themes discussed in this report are an amalgamation of feedback provided in stakeholder presentations, workshop discussions, and written comments received between August 12 and September 9, 2016. In addition, existing analyses were gathered by the report authors and used to support or expand certain themes in this report.

2.2. Purpose of this Report

This report is intended to capture the “voice” of the other Western states and stakeholders to aid California entities as they explore renewable generation and transmission system opportunities. This report summarizes and synthesizes the comments received from stakeholders, highlights common themes, and provides recommendations to help inform California transmission and resource planning.

The content of this report aims to explore potential combinations of renewable resources throughout the West that could help California attain its RPS and GHG goals and to build greater understanding of the transmission needs and implications associated with the various renewable scenarios. Moreover, this report contains information intended to build an increased understanding of Western renewable energy markets and developments and opportunities for renewable energy trading opportunities between California and the West. Lastly, this report contains recommendations aimed at helping the West realize those opportunities. These recommendations were developed after reviewing the content and common themes that were discussed by stakeholders and are

⁴ energy.ca.gov/reti/reti2/documents/index.html

intended to provide California’s agencies with options to consider if they determine that further assessment of out-of-state renewable transmission opportunities warrant further review and analysis.

This report was prepared by WIEB with support from Energy Strategies, LLC (“Energy Strategies”). Funding for this report was provided by Energy Innovation, LLC and the National Association of State Energy Officials.

2.3. Limitations

It is important to note that this is a high-level, policy-oriented report, not a technical study report. The contents are based on stakeholder comments, existing studies and sources, and WIEB’s and Energy Strategies’ own analysis, and no independent verification of the sources used nor the information in this report was undertaken. While the authors of this report believe its contents to be factual, some issues contemplated are directional and not intended to represent definitive technical conclusions. Moreover, as RETI 2.0 did not conduct new modeling efforts as part of the initiative, the information in this report is not based on any new data or modeling. Lastly, the projections in this report are subject to a number of variables; therefore, these projections should not be interpreted as a definitive representation of future conditions. For example, uncertainties related to Western energy market expansion and RPS resource content categories were considered, but not evaluated as a part of this effort.

3. WESTERN RENEWABLE ENERGY MARKETS

The RETI 2.0 process explored California's anticipated incremental need to reach its 2030 RPS and GHG goals and found that between 25 and 108 TWh, or approximately 7,000 to 31,000 MW of additional renewable energy capacity (see Appendix B) could be required.⁵ Further, in June 2016 under the RETI 2.0 framework, the Transmission Technical Input Group (TTIG) found that it is unlikely CAISO's existing transmission system would be able to provide full deliverability for the capacity required to reach its 50 percent RPS.⁶ Therefore, a critical outcome of RETI 2.0 and Western Outreach effort is to better understand how out-of-state resources and existing or new transmission may contribute to reaching California's 2030 RPS and GHG goals, while also minimizing overgeneration and curtailment issues through increased access to export markets.

As noted during both workshops, constraints on the existing transmission system may inhibit or prevent significant delivery of renewable resources to California. However, there are opportunities to increase imports to California and to enable exports from California to the rest of the West during certain times of day and in certain seasons. Additionally, other factors, including new power market products or transmission service contracts, and known and expected coal plant retirements, may create opportunities to better utilize the existing system to deliver renewable energy across the West. Participants also discussed trends in resources and markets and how these factors must be considered when

⁵ Brian Turner, RETI 2.0. Slide 12:
doCKETpublic.energy.ca.gov/PublicDocuments/15-RETI-02/TN213506_20160906T113113_Panel_1_Presentation__Brian_Turner.pdf

⁶ Interim Report on Current and Planned Transmission to Support the RETI 2.0 Process. Page 7:
doCKETpublic.energy.ca.gov/PublicDocuments/15-RETI-02/TN211758_20160608T153018_TTIG_Interim_Report.pdf

analyzing the capability of the existing system to deliver to or export from California.

The themes covered in this section are organized as follows:

- Drivers, trends, and constraints of Western renewable energy markets
- Renewable resource technologies and locations
- Transmission system constraints and regional trade opportunities

3.1 Drivers, Trends, and Challenges of Western Renewable Energy Markets

The changing landscape of state RPS policies, federal tax incentives, technological advancements, cost declines, new market participants, and coal plant retirements introduce complexity for utilities and other buyers deciding when, how much, and which renewable energy resources to procure. This section explores these topics individually; however, as Western Outreach participants noted, these topics are deeply interrelated.

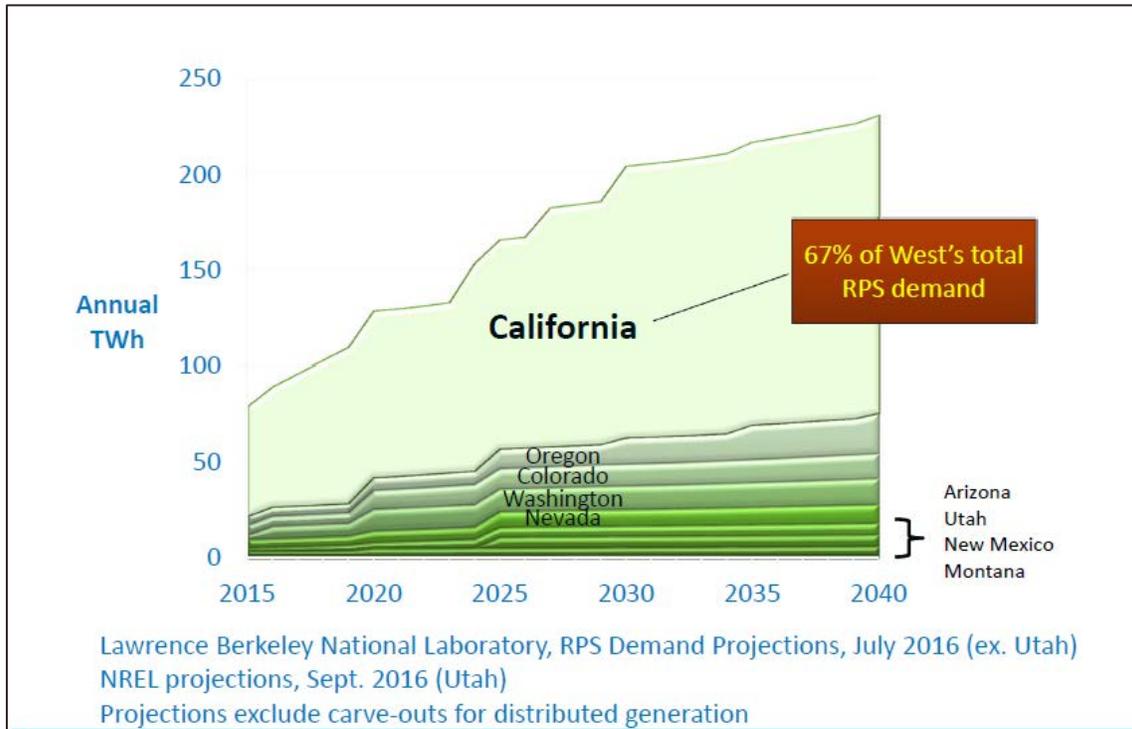
3.1.1. RPS Policy

In recent years, the demand for renewable energy across the Western U.S. has largely been driven by RPS mandates, with California having the largest share of demand. As shown in Figure 1, demand for renewables in California to meet RPS obligations is twice as much as all other Western states combined.⁷ While the rest of the Western states may have relatively less demand than California, RPS targets in those states are on the rise. Earlier this year, Oregon passed

⁷ David Hurlburt, NREL. Slide 5:
doCKETpublic.energy.ca.gov/PublicDocuments/15-RETI-02/TN213505_20160906T113114_Panel_1_Presentation__David_Hurlbut.pdf

legislation to increase its RPS to 50 percent by 2040, making it one of the most aggressive RPS policies in the country. Figure 12 in Appendix B summarizes state RPS requirements throughout the U.S.

Figure 1: Western U.S. Demand for Renewables Under Existing State RPS Requirements⁸



While RPS policy has historically driven demand for renewables procurement, panelists at the Western Outreach workshops indicated that recent renewable investment activity is more a function of the declining cost of renewable resources, rather than policy mandates. Utility representatives also noted that there is currently a lack of urgent procurement need to meet RPS or other policy

⁸ David Hurlbut, NREL. Slide 3: doCKETpublic.energy.ca.gov/PublicDocuments/15-RETI-02/TN213505_20160906T113114_Panel_1_Presentation__David_Hurlbut.pdf

mandates, as many states report “on-track” statuses toward meeting their respective RPS obligations. In fact, many major utilities may not require significant new renewables to meet RPS demand until at least the mid to late 2020s. For instance, in Oregon, PacifiCorp is not forecasting to be net short renewables until 2028⁹ and NV Energy will have excess renewables until the 2025-2030 timeframe.¹⁰

California utilities are also reportedly on track to exceed their 33 percent RPS obligation in 2020.¹¹ Workshop participants suggested that based on recent CPUC filings, many utilities in California are not forecasting to be net short renewables for at least another 10 years, and could, therefore, be scaling back the pace of procurement. A presenter noted that Pacific Gas and Electric Company (PG&E) and Southern California Edison (SCE) are not forecasting to be net short until 2026-27, while San Diego Gas and Electric (SDG&E) is not forecasting to be net short until 2036.¹² Table 1 summarizes the three largest California investor-owned utilities’ (IOUs) percentages of renewable procurement through 2014 and the percentage of renewables contracted to come online by 2020. SDG&E will far exceed the 33 percent 2020 obligation and may require relatively little incremental procurement to reach 50 percent by 2030.

⁹ PacifiCorp. Slide 111:
pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Integrated_Resource_Plan/2017_IRP/PacifiCorp_2017_IRP_PIM03_8-25-2016_to_8-26-2016.pdf

¹⁰ Angia Dykema, State of Nevada, Governor’s Office of Energy.
westgov.adobeconnect.com/_a976899620/p7xrigkcumh/?launcher=false&fcsContent=true&pbMode=normal

¹¹ CA RPS Homepage cpuc.ca.gov/RPS_Homepage

¹² Michael Wong, E.ON. Slide 5:
docketpublic.energy.ca.gov/PublicDocuments/15-RETI-02/TN213502_20160906T113116_Panel_1_Presentation__Michael_Wong.pdf

Table 1: California IOU Renewable Procurement Status¹³

	Actual RPS Procurement Percentage in 2014	Percentage of RPS Procurement Currently Under Contract for 2020
PG&E	28.0%	37.0%
SCE	23.2%	36.9%
SDG&E	31.6%	43.1%

California’s significant progress toward meeting RPS obligations further suggests that new investment in renewables across the West over the next 10 years will be driven more by favorable economic conditions for renewable energy generation and other policies, such as GHG reduction targets, than by RPS policies alone.

3.1.2. Federal Tax Credits

As discussed above, while RPS policies have historically been a dominant factor in driving renewable energy investment, federal tax credits created attractive financial incentives for renewables development, and thus, procurement, to thrive. The Investment Tax Credit (ITC) and Production Tax Credit (PTC) were extended once again in December 2015 by the Consolidated Appropriations Act but will be phased out or reduced over the next few years.¹⁴ The ITC will continue to provide a credit for 30 percent of qualified solar investment

¹³ cpuc.ca.gov/RPS_Homepage

¹⁴ See the ITC and PTC phase out schedule in Figure 13 in Appendix B

expenditures until the end of 2019, and then will slowly ratchet down to 10 percent by 2022. Meanwhile, wind projects that begin construction through 2019 will receive a declining portion of the full PTC for every MWh generated for 10 years. Projects that begin construction after 2019 will not be eligible to receive the credit. These incentives dramatically improve economics for would-be buyers of renewable energy and provide stability for developers with long project development timelines.¹⁵

However important the role of the federal tax credits in shaping the rate of uptake of renewables to date, the recent extension of the ITC and PTC may not be enough of a driving force in some Western states to incentivize near-term investment. At the Portland workshop, PacifiCorp highlighted the time-critical opportunity to take advantage of these credits in the near term at their full value to secure low-cost renewable resources to meet RPS obligations in Oregon, California, and Washington. To that end, PacifiCorp issued Requests for Proposals (RFP) earlier this year for renewable resources and renewable energy credits (REC) to consider the cost savings of procuring with the maximum PTC and ITC value. Though responders offered more than 6,000 MW of renewable projects, PacifiCorp ultimately found that RECs were more cost-effective than capacity additions, based on the 2016 RFP responses.¹⁶ This outcome suggests that the value of the PTC and/or the ITC alone is not always sufficient to drive new investment, particularly when many proposals require additional

¹⁵ For additional analysis that discusses the anticipated growth of renewables attributed to the ITC and PTC extensions, see NREL report from February 2016: *Impacts of Federal Tax Credit Extensions on Renewable Deployment and Power Sector Emissions* nrel.gov/docs/fy16osti/65571.pdf

¹⁶ Rick Link, PacifiCorp. docketpublic.energy.ca.gov/PublicDocuments/15-RETI-02/TN212867_20160819T105151_Panel_1_presentation__Rick_Link.pdf

transmission build or upgrade costs and RECs are available from operating or planned renewable facilities.

Moreover, the run-up to the anticipated expiration of the ITC at the end of 2015 may have contributed to a solar "buying spree." With the recent ITC extension, off-takers now have until 2020 to capture the full ITC value. Despite this incentive, the precipitous drop-off in solar materials and installation costs (discussed in Section 3.1.4) combined with a recent over-procurement period is perhaps a stronger incentive to delay near-term investment, absent a pressing RPS obligation.

Table 2: Summary of 2016 PacifiCorp Renewable Resource and REC RFP¹⁷

Renewable Resource RFP Summary	
Renewable Resource Type	Capacity Offered (MW)
Wind	3,012
Solar	2,987
Geothermal	55
Total	6,054
Total Capacity Procured	0 MW

¹⁷ PacifiCorp. Slide 68:
pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Integrated_Resource_Plan/2017_IRP/PacifiCorp_2017_IRP_PIM02_7-20-16.pdf; and PAC 2017 IRP presentation (8/25/16 – 8/26/16)

PacifiCorp. Slide 110:
pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Integrated_Resource_Plan/2017_IRP/PacifiCorp_2017_IRP_PIM03_8-25-2016_to_8-26-2016.pdf

REC RFP Summary	
Total RECs Offered by Bidders	31.2 million RECs from more than 800 MW of resource capacity
Total RECs Procured	Not disclosed, but projects have an aggregate capacity of over 168 MW for vintages ranging from 2014-2036
RECs procured from projects in	CO, OR, UT
RECs to be used to meet RPS in	CA, OR, WA

3.1.3. New Market Participants

Utilities are no longer the only buyers of long-term Power Purchase Agreement (PPA) contracts for wind and solar energy. Large corporations and Community Choice Aggregators (CCAs) are becoming major market participants as they seek more freedom to make energy choices that meet their sustainability and climate goals. Almost half of U.S. Fortune 500 companies have renewable energy, GHG reduction, and/or energy efficiency goals.¹⁸ Companies with enormous energy needs are seeking out states with favorable non-utility participation laws to construct data centers and other facilities for on-site and

¹⁸ Ceres Report.
ceres.org/resources/reports/power-forward-2.0-how-american-companies-are-setting-clean-energy-targets-and-capturing-greater-business-value

virtual PPAs. For instance, Google committed to purchasing more than 2.5 GW of renewable energy capacity to power its operations around the world.¹⁹

These types of corporate commitments could significantly impact new demand, particularly in parts of the West that have not traditionally forecasted significant load growth. While corporate buyers may have a discernible impact on total demand, these buyers may focus primarily on least-cost power purchase agreements and siting projects in local areas to provide local economic benefits. Therefore, transmission capacity and access to markets is not a major focus, as developers and incumbent utilities negotiate interconnection and transmission service.

Participants noted that the growth of CCAs in California has the potential to dramatically influence renewable demand in the state. CCAs typically allow their customers to select from a suite of energy products, giving them the flexibility to decide the percentage of renewable energy they would like to purchase. The product offerings are often well beyond RPS targets, with many CCAs giving customers the choice of 100 percent renewable energy for their home or business. Currently, only four jurisdictions have approved CCAs in California, but with more than 15 additional cities or counties exploring the possibility of customer choice aggregation, there is strong sentiment that substantial IOU load departure is imminent.²⁰ PG&E, for instance, expects an 18 percent drop in bundled sales by 2024 due to CCA-related load departure.²¹ If CCAs are successful in transferring a significant amount of IOU customers with strong

¹⁹ [google.com/green/energy/](https://www.google.com/green/energy/)

²⁰ leanenergyus.org/cca-by-state/california

²¹ [energy.ca.gov/2014_energy_policy/documents/2014-12-08_workshop/comments/Pacific%20Gas%20and%20Electric_Comments_on_Updated_Electricity_Demand_Forecast_2014-12-17_TN-74177.pdf](https://www.energy.ca.gov/2014_energy_policy/documents/2014-12-08_workshop_comments/Pacific%20Gas%20and%20Electric_Comments_on_Updated_Electricity_Demand_Forecast_2014-12-17_TN-74177.pdf)

interest in "green" energy, it will have a meaningful impact on demand for new renewables. However, the renewable procurement from a diverse array of CCAs is likely to be different in type and scale than the procurement practiced by the major California utilities. Further, Western Outreach participants pointed out that CCAs, like corporate buyers, may show a preference for local economic and environmental benefits.

3.1.4. Technology Improvements and Cost Declines

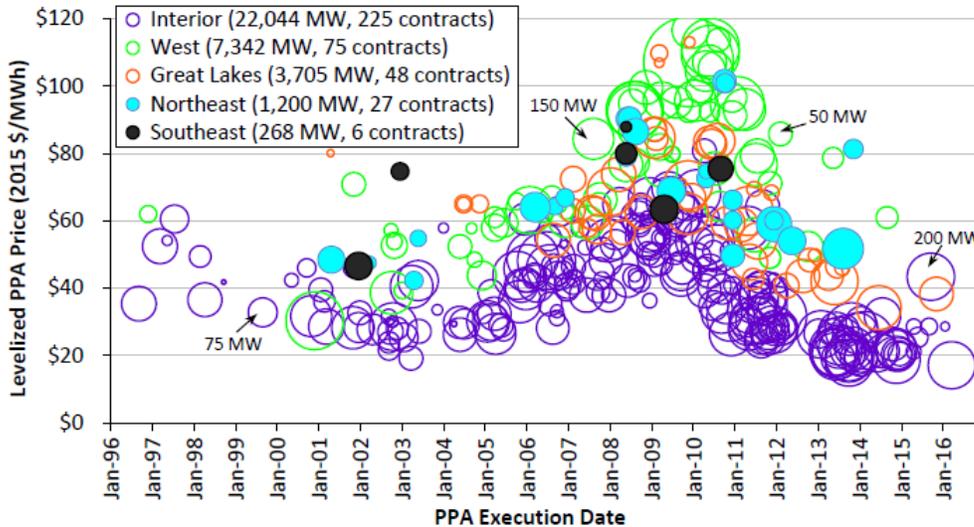
Wind

Over the past seven years, wind PPA prices in the U.S. dropped from around \$70 per MWh to as low as \$20 per MWh in some areas.²² Figure 2 shows the wind PPA cost trajectory since the mid-1990s. The steep PPA price decline is attributed to incremental increases in hub heights and rotor diameters (which increase capacity factors), combined with decreased capital expenditures. For instance, wind turbine pricing has dropped 20 to 40 percent since 2008.²³ Technology enhancements are also responsible for project development in lower wind speed areas, expanding the overall geographic diversity of potential wind resource development.

²² LBNL, 2015 Wind Technologies Market Report. Page ix: emp.lbl.gov/sites/all/files/2015-windtechreport.final_.pdf

²³ Ibid., page 52.

Figure 2: Levelized Wind PPA Prices by PPA Execution Date and Region²⁴



Note: Area of "bubble" is proportional to contract nameplate capacity

Source: Berkeley Lab

Solar

Over the past five years, solar PPA prices dropped from around \$100 per MWh to below \$50 per MWh, and in some cases, closer to \$30 per MWh.²⁵ Figure 2 shows the PPA cost trajectory beginning around 2008. This precipitous drop can be attributed to a similarly rapid decline in the installed costs for solar, which decreased 45 percent between 2010 and 2015 and continues to fall.²⁶ These cost improvements, combined with the recent ITC extension, will likely facilitate a continued strong interest in solar as a cost-competitive resource. However, a common theme throughout the RETI 2.0 and Western Outreach initiatives was

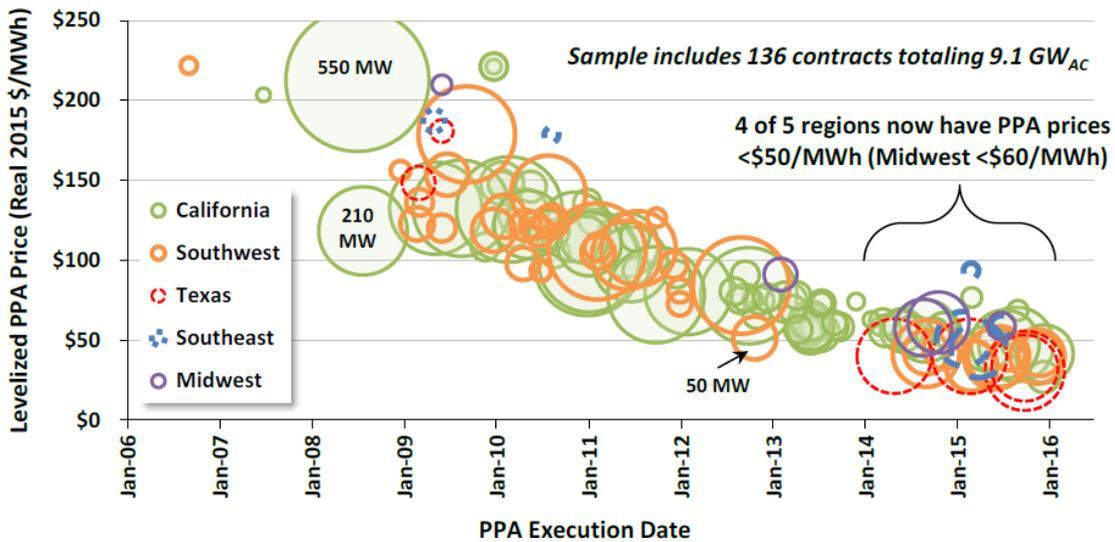
²⁴ Ibid., page 62.

²⁵ LBNL 2015 Solar report. Page 30: emp.lbl.gov/sites/all/files/lbnl-1006037_report.pdf

²⁶ Page 12: emp.lbl.gov/sites/all/files/lbnl-1006037_report.pdf

the potential challenges for integration of high levels of solar and the need for mitigating these risks, including resource diversity and exports.

Figure 3: Levelized Solar PPA Prices by Region, Contract Size and PPA Execution Date²⁷



3.1.5. Coal Plant Retirements and Latent Capacity

Presenters in the Western Outreach workshops noted substantial coal-fired resources coming offline in the West, including: (1) more than 2,700 MW in the Northwest by 2025;²⁸ (2) approximately 2,400 MW in the Navajo and Four Corners region that recently came offline or will be retired by 2019;²⁹ (3) up to

²⁷ LBNL, Utility-Scale Solar 2015. Page 29:
emp.lbl.gov/sites/all/files/lbnl-1006037_report.pdf

²⁸ Cameron Yourkowski. Slide 3:
http://docketpublic.energy.ca.gov/PublicDocuments/15-RETI-02/TN212868_20160819T105152_Panel_1_presentation__Cameron_Yourkowski.pdf

²⁹ David Hurlbut. Slide 14:
docketpublic.energy.ca.gov/PublicDocuments/15-RETI-02/TN213505_20160906T113114_Panel_1_Presentation__David_Hurlbut.pdf

1,800 MW that could be retired in central Utah in 2025;³⁰ and (4) 800 MW in Nevada by the end of 2019, as required by SB 123.³¹ Relying on this information alone, *at least* 7,700 MW of coal generation will be retired over the approaching 10 years, and the actual number of MWs retired could be higher. The possibility of utilizing the transmission capacity that may be freed up by their retirement was a focus for many stakeholders. This type of “repurposing” is currently proposed in New Mexico, where several wind projects plan to utilize some of the transmission capacity made available by the retirement of units at Four Corners to deliver wind energy to California. This potential for latent capacity utilization could also open new markets for renewable energy development to replace retired coal resources.

Despite this common theme in both workshops, many stakeholders noted the potential challenges associated with renewables replacing coal throughout the West. For instance, stakeholders mentioned that there is a shortage of technical and reliability studies demonstrating the transmission capability that would exist when known and expected coal plant retirements occur, and the need to study line and path ratings across the WECC footprint to account for coal-fired baseload resources coming offline. Participants in the Western Outreach workshops noted that these planning exercises could be conducted on a multi-regional scale to better inform resource and transmission plans for a broad geographic footprint (e.g., the Southwest). Note that some transmission planners were more optimistic and contented that remedial actions schemes (RAS) and

³⁰ Ibid. Slide 15.

³¹ Angie Dykema. Slide 4:
doCKETpublic.energy.ca.gov/PublicDocuments/15-RETI-02/TN213504_20160906T113115_Panel_1_Presentation__Angie_Dykema.pdf

power electronics could be used to maintain system stability absent the coal generation.

Additionally, feedback from the Western Outreach workshops suggested that transmission capacity freed up by coal plant retirements might be used to serve local customer needs, and thus, may not be available to deliver energy to California. For instance, in the future, PacifiCorp may consider strategic renewable procurement to align the timing and location of renewable procurement with the retirement of its coal units.

Lastly, it was noted that coal plant retirements may not necessarily provide any incremental transmission capability directly into California anyway; participants indicated that transmission bottlenecks into the California market may be the largest factor preventing incremental import of renewable generation to California.

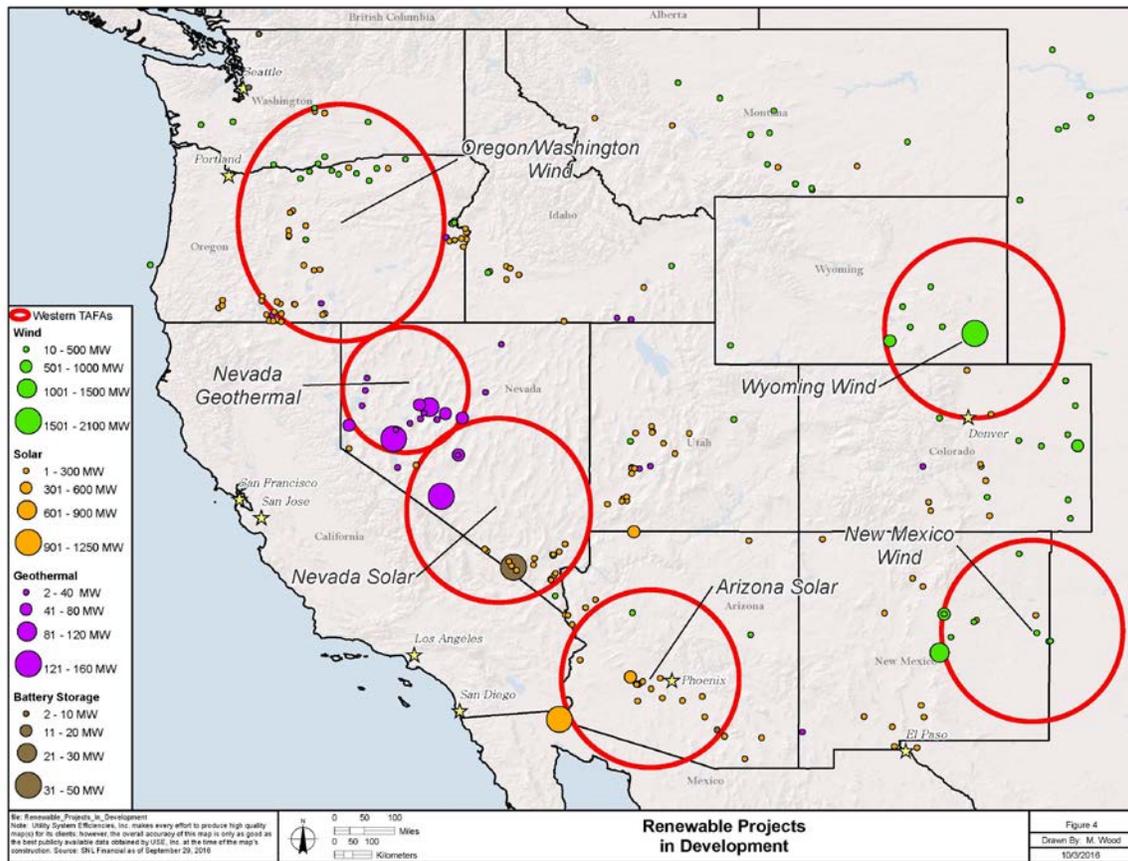
3.2. Renewable Resource Technologies and Locations

Participants in the Western Outreach effort consistently noted that solar photovoltaic (PV), wind, and geothermal have high potential for significant growth in the West. Energy storage technologies were also mentioned as a critical component of enabling more renewables to serve load in other Western states and allow for increased renewable energy imports into California. Tucson Electric Power recently received approval for two combined solar and storage projects in its service territory that are scheduled to begin construction this year.³²

³² tep.com/news/energy-storage

The map below in Figure 4 overlays the known renewable energy projects in various stages of development with each TAFE identified by the RETI 2.0 process. Table 3 shows this same data broken down by state and resource type.

Figure 4: Western Wind, Solar, and Geothermal Projects under Development, Overlaid with Proposed New Transmission Lines and TAFAs³³



³³ Project data sourced from S&P Global Financial (SNL) on September 29, 2016. The project data is not comprehensive and does not include all projects currently in development across the West.

Table 3: Western Wind, Solar, and Geothermal Projects under Development by State (excluding California)³⁴

State (excludes CA)	Solar (MW)	Wind (MW)	Geothermal (MW)
Arizona	2,676	326	-
Colorado	383	1,894	30
Idaho	280	202	80
Montana	10	1,571	-
North Dakota	-	620	-
New Mexico	408	4,113	5
Nevada	2,191	80	979
Oregon	433	2,819	43
South Dakota	-	130	-
Utah	1,145	338	75
Washington	6	780	-
Wyoming	-	5,971	-
Total Development (outside of CA)	7,532	18,842	1,212

Note that the map and table identify thousands of MWs of geothermal, wind, and solar projects currently in varying stages of development outside of California and across the West. These projects are geographically and technologically diverse and have strong correlation to the identified out-of-state resource TAFAs. Moreover, there are numerous Western transmission projects being developed to

³⁴ Project data accessed through S&P Global Financial (SNL) on September 29, 2016. The project data is not comprehensive and does not include all projects currently in development across the West.

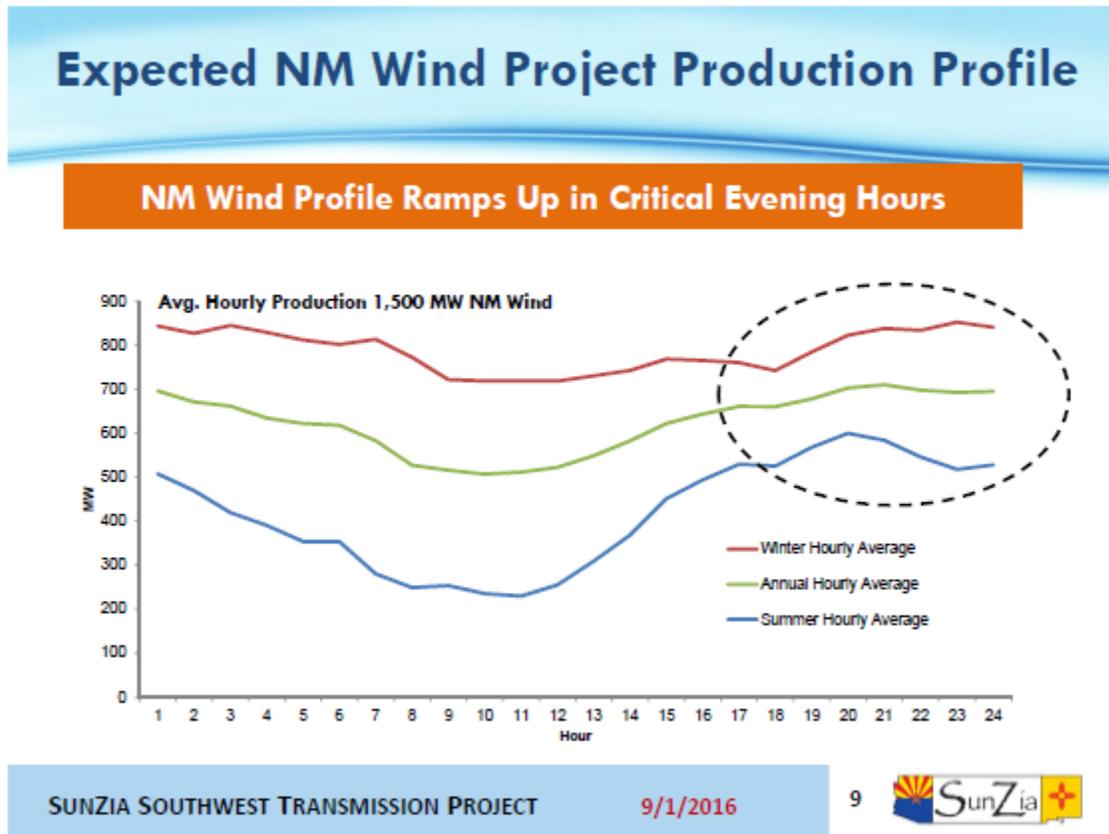
deliver these resources to California. These projects will be covered in detail later in the report.

3.2.1. Resource diversity

Out-of-state renewable resources, particularly certain wind regimes, have the unique advantage of increasing hourly production during the early evening hours, complementing California's late afternoon ramping needs as solar PV generation scales back. During its public workshops prior to the Western Outreach project, the RETI 2.0 Plenary Group addressed the geographic diversity benefits that out-of-state wind brings and identified this geographic and technology diversity as a significant priority for the state's resource and transmission planning. The CPUC's RPS calculator proceeding is working to update the cost-benefit input assumptions for out-of-state resources, and California utilities and stakeholders have identified out-of-state resources as a potential priority consideration in the state utilities' new GHG-focused Integrated Resource Planning requirements.

Transmission developers at the workshops highlighted the diversity benefits that high-quality Wyoming and New Mexico wind resources could offer California. For example, Figure 5 shows the average hourly production of wind in New Mexico.

Figure 5: Estimated New Mexico Wind Profile³⁵



3.3. Transmission System Constraints and Regional Trade Opportunities

Significant renewable energy project development is underway across the Western Interconnection, but according to panelists at the Western Outreach workshops, the biggest bottleneck to additional renewable generation delivery to

³⁵ Doug Fant,, SunZia. Slide 9:
docketpublic.energy.ca.gov/PublicDocuments/15-RETI-02/TN213499_20160906T113109_Panel_3_Presentation__Doug_Fant.pdf

California is the availability of transmission capacity. Commenters noted that, based on their experience, no significant firm capacity is available on the existing transmission system to allow delivery of many high-quality out-of-state renewables to California. While the existing system has some capability to deliver limited amounts of high-quality resources, such as Nevada geothermal and some additional wind from Oregon and Washington, there is limited capability for delivering significant amounts of Wyoming and New Mexico wind to California. There are also a number of challenges related to exporting excess generation from California to other load areas. This section reviews Western Outreach participant feedback regarding the potential pathways and limitations to importing and exporting power across the West as well as potential market solutions to make the existing grid more efficient.

3.3.1. Import Paths and Constraints

Stakeholders noted that Paths 49 and 46 (the primary path between Arizona and California) have limited capability for further deliveries, primarily due to congestion on the California side of the path. Thus, substantial incremental deliveries from Arizona into California on that path are unlikely. Participants explained that deliveries from Nevada into California may be aided by the future development of the Eldorado-Harry Allen line, but the ability to deliver resources from central or northern Nevada will be restricted by the available capacity on the One Nevada (ON) Line, which, it was noted, is filling up very quickly.

3.3.2. Export Paths and Constraints

Many presenters opined on the potential for existing transmission paths to be used to export generation during times California may experience oversupply conditions. While there was generally interest in this concept, several challenges were noted. Particularly, stakeholders highlighted the need to carefully consider

the timing of exports in comparison to the resources and load profiles in potential export markets.

Southwest Export Opportunities

During the Las Vegas workshop, panelists noted that when considering the Southwest area as an export opportunity, there are existing constraints in moving power from Palo Verde to southeast Arizona and from Phoenix into the Tucson load pocket.³⁶ If these constraints could be removed, there would be greater ability to both import power to California and send excess power from California to Arizona and other southern load areas. When considering regional transmission opportunities, the focus tends to be on large-scale, long-distance transmission solutions, but presenters pointed out that, in the Southwest at least, local upgrades in the Palo Verde, Phoenix, and Tucson areas might be highly beneficial to allowing additional flows between California and its southeastern neighbors.

It was noted that some critical paths in the West, which might be used as export paths from California to the Southwest, do not have WECC Path Ratings to flow in the west-to-east direction. Notably, Path 49 lacks a west-to-east path rating, meaning that the reliability implications of sending power on that path from California to Arizona have not been sufficiently studied in the planning horizon. Though the lack of a Path Rating from west-to-east may not prevent the sale of transmission capacity in the west-to-east direction in the near term, stakeholders pointed out the importance of starting to study the potential reliability impacts associated with total power flows occurring in the west-to-east direction along

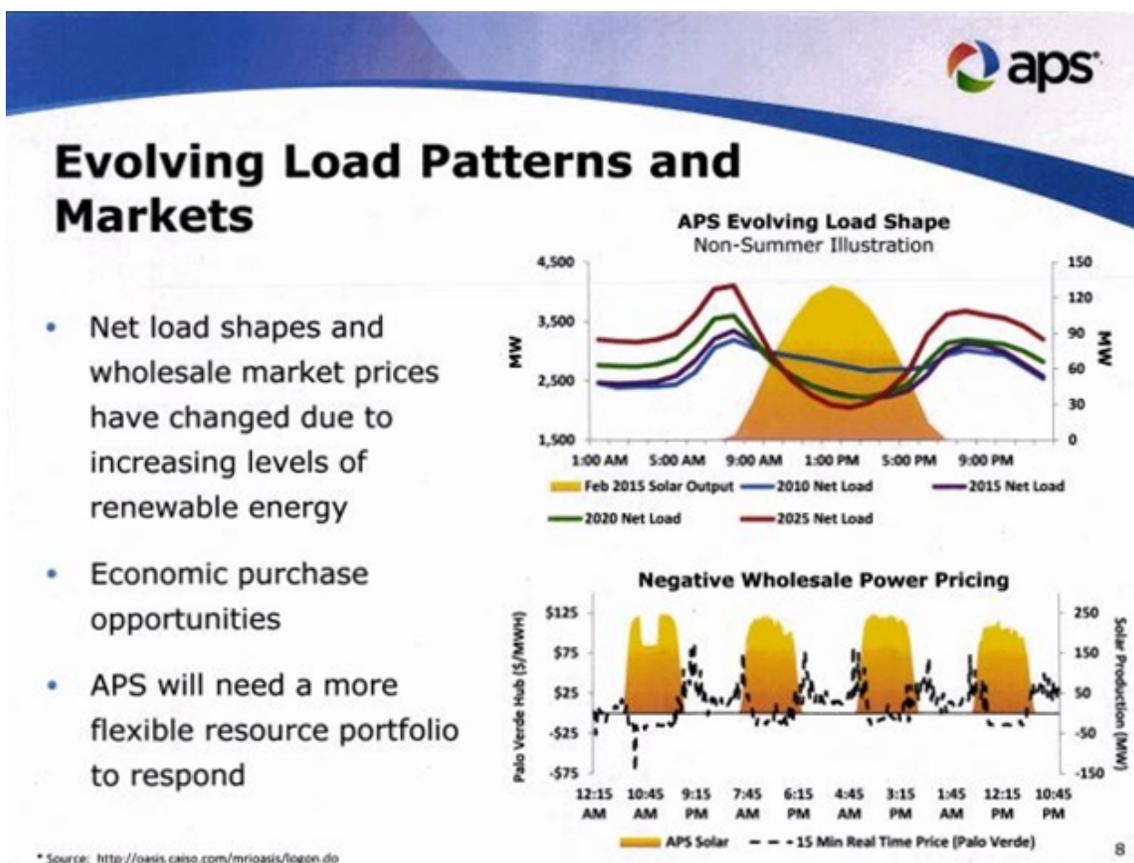
³⁶ doCKETPUBLIC.energy.ca.gov/PublicDocuments/15-RETI-02/TN213495_20160906T113104_Panel_2_Presentation__Patrick_Harwood.pdf

Path 49. With a lack of apparent reliability studies on west-to-east flows on Path 49, it is not possible to know if problems, such as transient or underlying facility overloads, may occur. A reliability study on flows in this direction would be a prudent undertaking before such a time when total power flows may occur in the west-to-east direction. This same concern exists for the Paths that might carry New Mexico wind into Arizona load centers (and eventually into California on Path 49).

Stakeholders also noted that further analysis is required to understand the size of the potential export market that might exist in the Southwest. It was noted that Arizona load may be able to absorb some of the “belly of the duck” in California, but due to the similarity of renewable resource characteristics in California and this region, the appetite for California excess generation may be limited. Figure 6 illustrates that Arizona Public Service (APS), for instance, is expected to experience shifts in net load shapes similar to those expected in California. If the region experiences the growth in solar resources that its technical potential and economics suggest is possible, then during times California is experiencing overgeneration problems and is in need of export opportunities, the Southwest may also have overgeneration or very little need for incremental generation, because solar resources in the Southwest are producing at the same time. In such a case, the solar energy trade opportunities may be limited to the hour or two time zone difference in the morning and evening.

Therefore, the Southwest offers some potential export opportunities, but requires further analysis of the size of the export market and planning horizon studies (including Path Rating studies) to determine the capability of the system to flow power from west-to-east.

Figure 6: Arizona Public Service Evolving Load Patterns³⁷



Northwest Export Opportunities

In the Northwest, the transmission paths are optimized for flows from north-to-south and from east-to-west. In fact, RAS were designed to maximize the flows in these directions across the major Northwest paths. However, many paths do not have established RAS to facilitate larger flows in the south-to-north or west-to-east direction. Despite the absence of RAS in the direction to facilitate exports

³⁷ APS. Slide 8:
aps.com/library/resource%20alt/APS%20ACC%20Workshop%20Presentation%207-18-16.pdf

from California, it was pointed out that there is currently 3,000 MW of *northbound* long-term firm Available Transfer Capability (ATC) on the California-Oregon Intertie (COI).³⁸

It was noted that recent Northwest Power and Conservation Council (NPCC) studies assume that California will supply about 3,000 MW of excess power to the Northwest. That figure is cited as conservative by NPCC staff, and largely constrained by the capability of the transmission system. The NPCC expects that, in the winter months that were studied, California's export of excess generation is limited not by the availability of generation but by the capability of the transmission system.

During the Portland workshop, panelists and stakeholders explored the possibility of utilizing the Northwest hydro system more dynamically to absorb excess generation from California (by displacing hydro generation) and to help meet (along with Northwest wind) ramping energy needs in California in the evening hours. While the regions have a long history of agreement promoting seasonal exchange of energy, participants discussed whether a more frequent, intraday pattern of trade could emerge.

This discussion generated significant interest and stakeholders identified both opportunities and concerns. While the Northwest may be able to absorb California's excess generation at some times of the day and some times of the year, and at least some transmission capacity exists to do just that, the Northwest has its own overgeneration concerns in some seasons, particularly during the spring runoff. Stakeholders pointed out a variety of considerations

³⁸ Anders Johnson, BPA. Slide 4: doCKETpublic.energy.ca.gov/PublicDocuments/15-RETI-02/TN212866_20160819T105154_Panel_2_presentation__Anders_Johnson_and_Ravi_Aggarwal.pdf

related to the Northwest hydro system. Three key considerations for the Northwest as an export market are described below:

1. Northwest Overgeneration

The Northwest experiences overgeneration primarily in the spring months, due to hydro conditions associated with the spring runoff and the abundance of wind energy from the major wind projects along the Columbia River Gorge and elsewhere in Northwest at the same time. Thus, loads in the Northwest should not be counted on to absorb California's excess generation during the spring. More capability for export to the Northwest is expected in the summer, fall, and, particularly, the winter. Unfortunately, spring is when California overgeneration issues are anticipated to be the most severe.

2. Flexibility of the Hydro System

Northwest stakeholders pointed out that the Northwest hydro system is not as flexible as some may think. Along the Columbia River, a number of dams are aligned one behind the other. Once water is released from Grand Coulee, it must flow through the entire system, consisting of 11 dams. While there is some capability to hold the water back in each dam, it is limited, and this constraint reduces the hydro system's flexibility from what may be perceived by those outside the Northwest.

3. Environmental Constraints are Critical

Environmental constraints are critical and must be taken into account. Panelists noted that environmental and wildlife constraints decreased the capability of the existing Northwest hydro system by about 1,200 MW and

have further reduced its flexibility. Environmental constraints are complex and may hamper the ability of the hydro system to “balance” California’s needs.

In the Northwest, the transmission system has the capability to act as an export path, but resource characteristics of the hydro system may sharply limit the flexibility of the system, as well as the total demand for exports from California, during the spring in particular. Participants agreed that more study of this potential would be helpful.

3.3.3. Market Products and Design

During the Portland workshop, particularly, stakeholders discussed the need for liquid markets and efficient market design to facilitate more transactions between California and other areas in the West. Discussions ranged from finding mechanisms to better utilize existing transmission capability, to creating new market products, to increasing the utilization of existing market and transmission products (such as conditional firm and non-firm transmission). Additionally, there was discussion of the expansion of the EIM and the formation of a regional ISO, which may offer various benefits for power imports and exports across a broader region. While this report acknowledges those possible futures, it is not focused on reiterating the issues and opportunities associated with EIM expansion or development of a regional ISO.

The use of non-firm transmission or conditional firm transmission may be an avenue to explore for incremental renewable energy deliveries into California. However, discussions during the workshops revealed that while these types of transmission products allow for more efficient use of the existing grid, they have not been used frequently by renewable developers. Partly because of the rarity of major deals with non-firm transmission rights, developers find that non-firm and

conditional firm transmission rights present difficulties in financing generation projects and increase the likelihood of a revenue shortfall due to curtailment. Participants noted that modifications to PPA structures, including guaranteed payments for generators, might increase the likelihood that non-firm and conditional firm transmission service would be utilized, which in turn could increase the amount of renewable energy imported to California. Perhaps the best parallel to the non-firm or conditional firm transmission service offered in the non-ISO areas of the West is energy-only deliverability status within the CAISO. California continues to review and assess the potential benefits of energy-only as it compares to full-capacity deliverability.³⁹

Operating agreements between balancing authorities may also increase the ability to import renewables into California. The use of dynamic scheduling and pseudo-ties between balancing authorities can increase the market value of out-of-state resources, because dynamically scheduled renewables into a California balancing authority area can qualify as RPS Product Content Category (PCC) 1.

Power markets could also be designed in a way that allows for efficient use of the transmission system and encourages more flexibility in the trading of power, including the sale of excess generation in California to other regions. For instance, the Western Systems Power Pool (WSPP) is investigating creating various products, including a “duck belly” product covering the middle of the day when solar generation is expected to be high, and other on-peak products to capture the morning and evening ramps. Market products, such as these, may be necessary to better capture renewable characteristics and reflect the level of “firmness” buyers can expect when purchasing excess solar generation or other

³⁹ To continue to draw parallels, full capacity deliverability in the CAISO could be thought of as similar to the firm transmission capacity that is offered under utility tariffs in the rest of the West.

renewable output. These types of market products and discussions will be critical to developing efficient trading of renewable generation between California and other Western areas.

Stakeholders noted that under current practices, about 10-15 percent of the total capability on COI might be available for use for EIM transfers and other “dynamic” or intra-hour uses. More capacity may be available at certain times if current transmission users were able to rely less on self-schedules in one-hour blocks. If the West intends to better coordinate and share its resource diversity and flexibility to enable more imports into California and more exports from California, structures must be put in place to allow full and flexible use of the transmission system.

One outcome of RETI 2.0 may be for the appropriate parties to consider creating an overgeneration market product and to provide guidance to potential purchasers on the level of firmness they can expect from such a product. Furthermore, as the operational and resource/transmission planning worlds continue to blend as their system challenges become intertwined, power marketers participating in the RETI 2.0 Western Outreach suggested that participation and consultation with power marketers and their decision criteria and process in power trading are an important input, as given the right tools and market products, they can capture operational efficiencies that may have otherwise been missed.

3.3.4. Other Operational Considerations

In considering the capability of the existing system and the possibility to use the transmission system to import power from the rest of the West to California and to export excess generation from California to other areas of the West, panelists and stakeholders discussed a number of other operational considerations. Below

are a few concerns that were identified as critical in facilitating the most efficient flow of renewable generation across the Western Interconnection:

- The use of distributed generation, especially if combined with storage across larger swaths of the West, may increase the availability of capacity on the existing transmission system. However, a scenario where distributed generation, particularly solar, grows quickly without additional storage, may exacerbate the need for transmission capability in the early evening hours, further limiting import and export opportunities. Participants hypothesized that in this future scenario, other utilities, such as those in Arizona, would be expected to need their transmission capacity to deliver power to their own loads during the “neck of the duck.” This need for transmission capacity would occur at roughly the same time as California’s need to ramp-up generation to meet the “duck neck.” Thus, during this time, one could expect transmission to be completely, or nearly completely, utilized. This future scenario would further limit the ability for power export from California during the early evening hours, as existing transmission capacity to load centers in the southwest would be fully utilized.
- Climate change may impact the seasonality of hydro conditions as more rain falls and there is less snowpack. Stakeholders noted that the hydro system in the Northwest can only store about 30 percent of the annual precipitation volume and relies on snowpack to store the bulk until summer. Reduction in snowpack may decrease the ability of the hydro system to store power to deliver in the later months and may increase the needs for power in the Northwest in the summer and fall months, in particular. Again, the implications of such potential changes are unclear – for instance, it would likely reduce the total availability of flexible Northwest hydro to help balance western renewables, including California’s;

however, it may increase the total size of the export market in the Northwest in summer and fall.

- Participants noted that EIM benefits are significant, and those benefits are sometimes limited by existing transmission capacity between these entities. Continuing to enable EIM and other methods of sharing and automatic transmission use will be critical.

Overall, participants focused on the dynamic state of the electric utility industry today and the significant number of variables that are in flux that must be considered in transmission and resource investment decisions. Trends in resource choices and economics, weather patterns, and markets must all be weighed when considering the capability of the existing system to deliver to or export from California.

4. ACCESSING HIGH-QUALITY OUT-OF-STATE RENEWABLES

Each of the two Western Outreach workshops included transmission-focused sessions where project developers and stakeholders reviewed transmission expansion proposals, their costs and benefits, along with the planning initiatives and scenarios that would lead to an efficient use and build-out of the Western transmission system.

4.1. Western Transmission Projects

Twelve Western transmission proposals were presented during Western Outreach workshops or collected through stakeholder comments. Table 4 outlines this suite of projects. All of these projects, which are at varying stages in the development process, submit that at least a portion of their total project benefits are tied to delivering renewable resources to the California market. A map of the proposed transmission projects is shown in Figure 7.

Several of the focus questions posed to transmission project panelists and stakeholders hoped to solicit responses that would reveal the technical abilities and attributes of each proposed project. For instance, some of the projects propose direct interconnection with the CAISO grid, suggesting that they could deliver resources to the California transmission footprint without relying on any intermediate transmission service. Alternatively, other proposed projects look to leverage transmission capacity on the existing or planned transmission system in order to link up resource rich areas with the CAISO. The various projects differ in this attribute, as well as in terms of the resources they access, their potential to export surplus energy out of California during overgeneration conditions, regulatory status, among other equally critical factors.

Table 4: Proposed Western Transmission Projects⁴⁰

Project Name	Voltage (kV)	Project Transfer Capability (MW) ⁴¹	In-service Date (Year)	Developer Estimated Cost (\$M) ⁴²	TEPPC Capital Cost Calculator Estimate (\$M) ⁴³	Length (Miles)	Permitting Status	WECC Path Rating Process Status	Origin	Termination	Sponsor
Centennial West	600 kV HVDC	3500	Not provided	2500	4370	900	Filed SF-299 to BLM	Not started	Guadalupe, NM	Mira Loma, CA	Clean Line Energy Partners
Cross-Tie	500 kV AC	700-1600	2024	670	550	213	Advisory Notice filed; SF-299 to BLM	Not started	Mona, UT	Robinson Summit, NV	TransCanyon

⁴⁰ Project information sources used to compile this summary are included in Appendix A.

⁴¹ Refers to project capacity and not amount that would be delivered to California. Multiple values or ranges indicate dependencies or phasing of projects.

⁴² Project costs were taken directly from project developer estimates and were not independently verified.

⁴³ The TEPPC Transmission Calculator Capital Cost Calculator was developed and vetted through the WECC/TEPPC stakeholder process. This assessment applied those cost assumptions to obtain a high-level estimate of project costs. While these cost estimates capture basic project attributes such as line mileage, voltage, and number of substations, they do not consider detailed design and routing assumptions, which resulted in a number of simplifying assumptions including: bus and breaker configurations, land type, BLM cost zones, conductor type, inclusion of shunts or series capacitors, among others. The base cost assumptions developed by TEPPC are documented in this report: https://www.wecc.biz/Reliability/2014_TEPPC_Transmission_CapCost_Report_B+V.pdf. Values are provided in 2016 dollars.

Project Name	Voltage (kV)	Project Transfer Capability (MW) ⁴¹	In-service Date (Year)	Developer Estimated Cost (\$M) ⁴²	TEPPC Capital Cost Calculator Estimate (\$M) ⁴³	Length (Miles)	Permitting Status	WECC Path Rating Process Status	Origin	Termination	Sponsor
Gateway South	500 kV AC	600 ⁴⁴	2020-2024	1470	1020	400	Final BLM EIS	Phase 3	Aeolus, WY	Clover, UT	PacifiCorp
Gateway West	230/500 kV AC	600 ⁴⁵	2019-2024	3210	2590	1000	Partial BLM ROD	Phase 3	Windstar, WY	Hemingway, ID ⁴⁶	PacifiCorp
Gateway Full (both projects)	230/500 kV AC	3000	2019-2024	4680	3,610	1400	See above	Phase 3	See above	See above	PacifiCorp

⁴⁴ Publicly available information states that if only one Gateway project (e.g. Gateway West or Gateway South) is placed into service individually, the transfer capability for the project would initially be 600 MW and then increase to 1500 when both projects come into service. This is due to path rating studies that were limited by PacifiCorp's largest single contingency. Internal study work referenced by project sponsors contends that 1500 MW of transfer capability may be possible for either of the projects individually if contingency assumptions are revised. However, the information supporting a 1500 MW transfer capability is not publicly available and therefore is noted here but is not assumed as the default transfer capability for the projects. Source for ratings: Patrick Reiten, PacifiCorp Transmission; input to RETI 2.0; http://docketpublic.energy.ca.gov/PublicDocuments/15-RETI-02/TN210188_20160205T131352_Matthew_McVee_Comments_PacifiCorp_Comments_Related_to_the_Trans.pdf

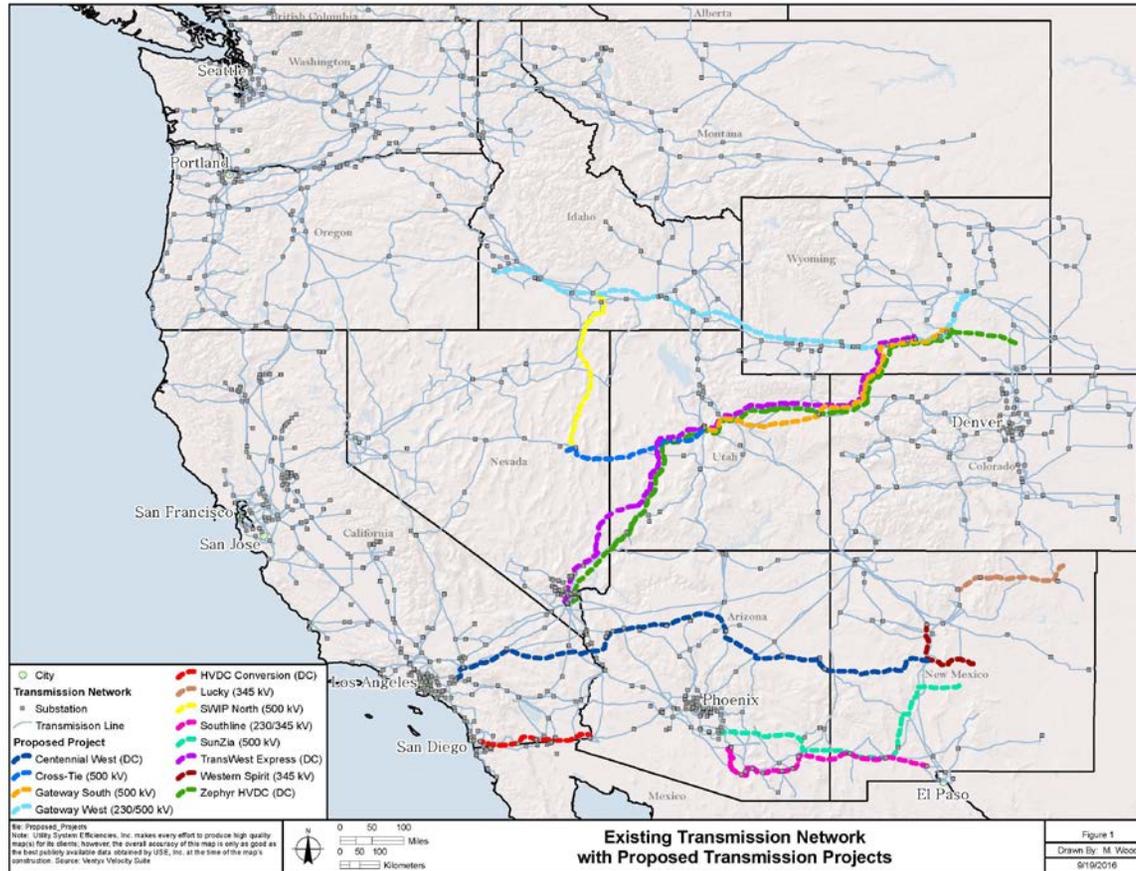
⁴⁵ Ibid.

⁴⁶ The full Gateway West project is assumed, but a phased buildout that does not extend to Hemingway would still enable Wyoming wind export

Project Name	Voltage (kV)	Project Transfer Capability (MW) ⁴¹	In-service Date (Year)	Developer Estimated Cost (\$M) ⁴²	TEPPC Capital Cost Calculator Estimate (\$M) ⁴³	Length (Miles)	Permitting Status	WECC Path Rating Process Status	Origin	Termination	Sponsor
Lucky Corridor	345 kV AC	700	2020	154	240	130	Not provided	Not started	Gladstone, NM	Ojo, NM	Lucky Corridor, LLC
Southline	230/345 kV AC	1000	2018-2020	800	930	370	ROD from BLM/WAPA	Phase 3	Afton, NM	Saguaro/Tortolita, AZ	Hunt Power, Black Forest Partners
Southwest Powerlink HVDC Conversion	450 kV DC	3000	2021-2025	900-1000	2420	165	Not initiated	Not started	North Gila, AZ	Miguel, CA	SDG&E
SunZia	500 kV AC	1500-3000	2020	1000-2000	1360-2140	515	BLM ROD	Phase 3	Near Corona, NM	Pinal Central, AZ	SouthWestern Power Group
SWIP North	500 kV AC	1700	2021	500	730	275	BLM ROD & ROW secured and Notice to Proceed secured	Phase 2	Midpoint, ID	Robinson Summit, NV	LS Power
TransWest Express	600 kV DC	1500-3000	2021	2400-3000	2460-3200	730	FEIS in 2015, ROD expected in 2016	Phase 2b	Near Platte, WY	Eldorado/Mead, NV	TransWest Express
Western Spirit	345 kV AC	1000	2019	200	260	140	Initiated; SF-299 filed to BLM	Not started	Near Corona, NM	Rio Puerco, NM	Clean Line Energy Partners

Project Name	Voltage (kV)	Project Transfer Capability (MW) ⁴¹	In-service Date (Year)	Developer Estimated Cost (\$M) ⁴²	TEPPC Capital Cost Calculator Estimate (\$M) ⁴³	Length (Miles)	Permitting Status	WECC Path Rating Process Status	Origin	Termination	Sponsor
Zephyr	500 kV DC	2,100-3000	Mid-2020's	2000-3500	2560-3220	525-850	Active, but in suspension; SF-299 filed to BLM	Not started	Chugwater, WY	Eldorado, NV or Delta, UT	DATC

Figure 7: Western Transmission Projects Accessing Out-of-State Resources⁴⁷



⁴⁷ Project routing was obtained from public sources. Routes shown have not been endorsed by project sponsors.

In order to provide RETI 2.0 with planning information on the proposed projects, as well as the opportunities and benefits they offer in assisting California in meeting its 2030 RPS and GHG goals, this section summarizes key project attributes made available through the workshop presentations and other publicly available sources. In describing these proposals, certain projects were paired together in configurations that attempt to maximize renewable resource access and other combined project attributes. In other instances, it is more appropriate to review projects individually. In all cases, it should be understood that while the assessment is grounded on technical project attributes drawn from public materials, some of the information is based on verbal panelist responses and assumptions made by the authors of this report. This is especially true as it pertains to project impacts under an expanded regional system operator, exact transmission path ratings for combinations of future projects, potential for supporting California energy exports and project risk factors related to permitting.

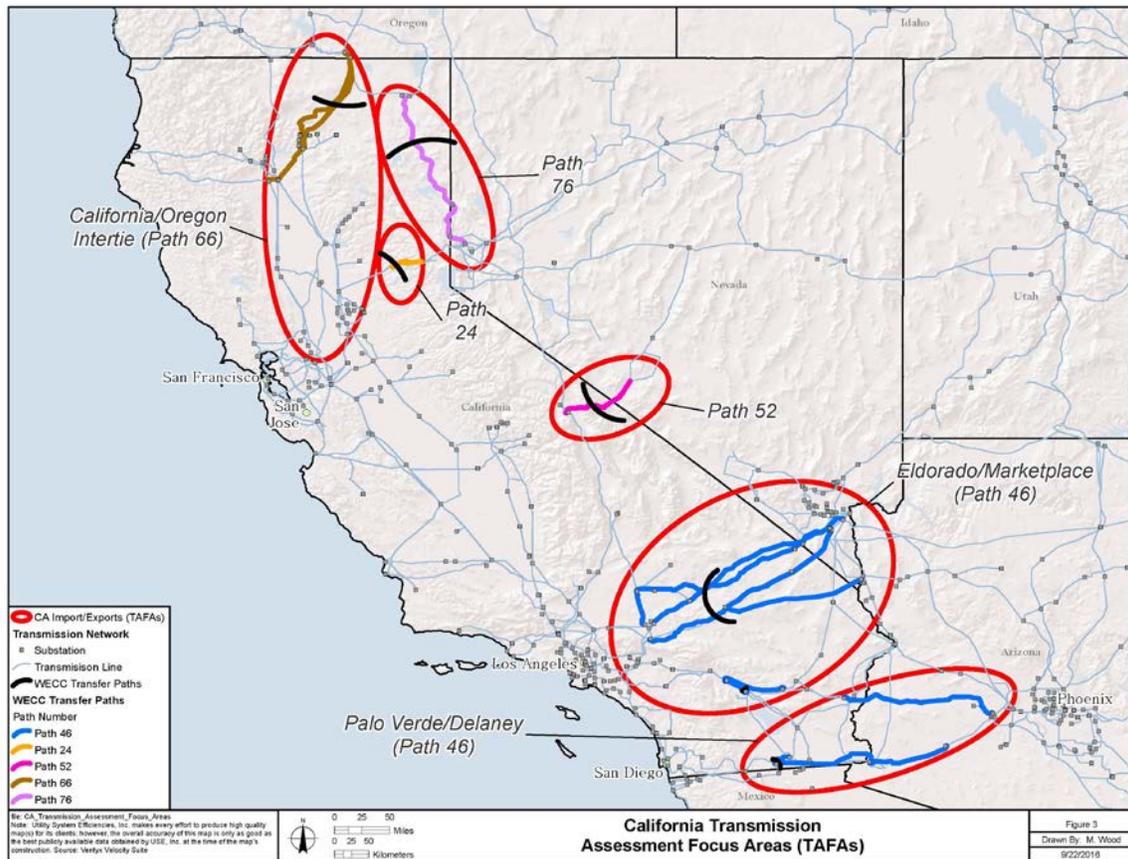
In the sections below, the proposed projects and project combinations are reviewed for their: (1) transfer capacity to California; (2) ability to increase California export capability; and (3) impact on the integrated transmission system and market efficiency.

4.2. Transfer Capacity to California

One of the main purposes of the Western Outreach project was to assess the capability of new transmission to deliver out-of-state renewable energy to California. The interaction between the transmission projects proposing to deliver renewable resources to California and the existing grid interties, import paths, and the California in-state transmission grid is very complex. Uncertainty surrounding the requirements for energy deliverability and RPS accounting rules further clouds the picture. The TTIG indicated that they intend to evaluate a range of power injections at the import/export TAFAs, each of which is identified

in Figure 8. The TTIG analysis will help RETI 2.0 better understand what in-state transmission upgrades may be required to receive energy from out-of-state resource and transmission projects.

Figure 86: Import/Export TAFAs Identified by RETI 2.0



To inform and complement this parallel analysis being conducted by the TTIG, this section estimated the transfer capacity each of the proposed out-of-state transmission projects (and combinations thereof) offered. The capacities reported are informed by: (1) public project information; (2) information stemming from the project’s Path Rating progress reports; and (3) additional information provided through the RETI 2.0 public process and in some instances verified through discussions with project sponsors.

Note that the potential MWs that could be delivered or transferred to California under each transmission configuration are estimates. Technical studies evaluating the interplay between certain projects would need to be performed in order to confirm these values – especially for those projects that have not initiated the WECC Path Rating Process. In several situations, assumptions had to be made regarding the availability of transmission capacity on the existing system.

This information is intended to help RETI 2.0 better understand what transmission expansion configurations can offer in terms of delivering MWs of renewable energy to the California import/export TAFAs previously identified by RETI 2.0.

Table 5: Summary of Transmission Configurations and Potential Transfer Capacity to California TAFAs

Transmission Configuration	Additional Details	Transfer Capacity to California Import/Export TAFE	Import/Export TAFE delivery
Western Spirit	Proposes to deliver New Mexico wind to Rio Puerco area Public Service Company of New Mexico (PNM), and then rely on existing transmission system to deliver resources to Four Corners, then California. Delivery is contingent on transmission capacity from Four Corners to the identified import/export TAFAs.	1,000	Eldorado/Mead/ Marketplace or Delaney/Palo Verde
Lucky Corridor	Proposes to deliver New Mexico wind resources to Ojo (PNM area), at which point the power would be delivered to Four Corners and then California via the existing transmission system. Delivery of full amount is contingent on transmission capacity from Four Corners to the identified import/export TAFAs.	700	Eldorado/Mead/ Marketplace or Delaney/Palo Verde

Transmission Configuration	Additional Details	Transfer Capacity to California Import/Export TAFE	Import/Export TAFE delivery
Centennial West	HVDC project with terminals in eastern New Mexico, western Arizona, and southern California would directly deliver renewables to the California grid. Project would interconnect with the CAISO balancing authority.	3,500	Inside CAISO system, near Mira Loma
TransWest Express	Proposed HVDC (or AC) configuration that would directly deliver either 1,500 or 3,000 MW of Wyoming wind to the CAISO transmission system at Eldorado/Mead through a phased build-out. Project would interconnect with the CAISO balancing authority.	1,500-3,000 depending on phasing	Eldorado/Mead/ Marketplace
Zephyr	Proposed HVDC project would directly deliver 3,000 MW of Wyoming wind to the CAISO grid in the Eldorado Valley. Project would interconnect with the CAISO balancing authority.	3,000	Eldorado/Mead/ Marketplace

Transmission Configuration	Additional Details	Transfer Capacity to California Import/Export TAFE	Import/Export TAFE delivery
Zephyr (to IPP)	Project configuration terminates near Delta, Utah (IPP), at which point transmission capacity anticipated to be opened up on the IPP DC line from the retirement of the Intermountain Power Plant (IPP) would directly deliver 1,900 MW to California. ⁴⁸	1,900 ⁴⁹	Inside California system; Adelanto DC-AC converter substation
Southwest Powerlink HVDC Conversion	HVDC upgrade to existing Southwest Powerlink anticipates a final rating of 3,000 MW, which would provide approximately 500-1,000 MW of <i>additional</i> import capability between Arizona and California on Path 46 (West of River) and Path 49 (East of River). Upgraded facilities would continue to be operated by the CAISO.	500-1,000	Upgrade is generally internal to CAISO system; enhances import capability
Southline	New-build and upgrade project that when fully built-out would deliver New Mexico wind and solar (or Arizona solar) to Saguaro/Tortolita in Arizona, at which point the existing system (or new build transmission) would be relied on to deliver resources to either the Eldorado or Palo Verde TAFAs. Delivery of full amount is contingent on transmission capacity from Saguaro/Tortolita to the identified import/export TAFAs.	1,000	Eldorado/Mead/ Marketplace or Delaney/Palo Verde

⁴⁸ It is assumed that the project sponsor, CAISO, or another California entity obtains 2,100 MW of transmission rights on the IPP DC line.

⁴⁹ Project capacity is 2100 MW, but delivered MWs may be limited to 1900 in accordance with IPP retirement

Transmission Configuration	Additional Details	Transfer Capacity to California Import/Export TAFE	Import/Export TAFE delivery
SunZia	Phased project enabling New Mexico wind to be delivered to Pinal Central, where the existing system or new build transmission would be relied on to deliver resources to Palo Verde. Delivery of full amount is contingent on transmission capacity from Pinal Central to the identified import/export TAFAs.	1,500-3,000	Eldorado/Mead/ Marketplace or Delaney/Palo Verde
Gateway West and SWIP North	Combination would enable 600 MW of Wyoming wind and 900 MW of Northern Nevada and/or Central Idaho resources to be delivered to Robinson Summit (NV), at which point it is assumed that ON-Line (SWIP South), which links Robinson Summit to Harry Allen, would deliver the resources to the California grid. ^{50 51}	1,500 (600 from Wyoming to CA import/export TAFE)	Eldorado/Mead/ Marketplace

⁵⁰ Note that *all* project combinations with transmission paths that require service between Robinson Summit and Harry Allen assume that DesertLink (Harry Allen to Eldorado 500 kV) is put into service on schedule.

⁵¹ Configuration assumes: (1) Gateway West is assigned an east-to-west rating of 600 MW (See Table 4); (2) NV Energy and LS Power capacity exchange upon completion of SWIP N. results in LS Power holding at least 1000 MW of transmission rights between Midpoint (Idaho) and Harry Allen (which would be a CAISO delivery point) and (3) 500 MW of NV Energy transmission rights on ON-Line are used for purposes of delivering California resources. This configuration and corresponding capacity estimate are not endorsed by the project.

Transmission Configuration	Additional Details	Transfer Capacity to California Import/Export TAFE	Import/Export TAFE delivery
Gateway South and Cross-Tie	Combination would enable 600 MW of Wyoming wind and 900 MW of Central Utah resources to be delivered to Robinson Summit (NV). This configuration assumes that 1500 MW of transmission capacity rights on ON-Line is used for the purposes of transferring resources to California. ⁵²	1,500 (600 from Wyoming to CA import/export TAFE)	Eldorado/Mead/ Marketplace
Gateway (full) and SWIP North and Cross-Tie	Full AC build-out of Gateway could allow for up to 3,000 MW of renewable resources to be delivered to Robinson Summit by SWIP North and Cross-Tie. However, anticipated capacity limitations between Robinson Summit and Harry Allen would limit delivery to the California system to 1,500 MW. ⁵³	1,500	Eldorado/Mead/ Marketplace

⁵² Configuration assumes: (1) Gateway South is rated at 600 MW north-to-south (see Table 4); (2) ON-Line rating is increased to 2,000 MW based on Cross-Tie and SWIP North providing similar electric benefits; and (3) 1,500 MW of transmission rights on ON-Line are used for purposes of delivering California resources. This configuration and corresponding capacity estimate are not endorsed by the project.

⁵³ Configuration assumes: (1) Gateway Projects each achieve 1,500 MW rating with both segments in-service (see Table 4); (2) ~50 percent of NV Energy's capacity on ON-Line and SWIP North (after the LS Power capacity exchange) is used for the purposes of delivering renewable resources to California. This configuration and corresponding capacity estimate are not endorsed by the project.

To develop these configurations, a number of assumptions were made regarding the use of the existing and planned transmission system. For renewable energy to reach the California grid under some of these configurations, contracted network capacity or new transmission additions in Arizona, Nevada, or New Mexico may be required. The information and estimated transfer capacities to California are based on a compilation of planning materials and studies, many of which would have interactions that were not considered through independent technical assessment. This information is indicative of the amount of renewable resources that could be transferred to California TAFAs under various configurations. It is not a conclusive transmission evaluation as this considers only one aspect of the projects' value proposition – delivering renewables.

The focus of this analysis was to maximize resource delivery to the identified TAFAs.⁵⁴ Once the additional energy is delivered to California from out-of-state transmission, it must compete for the same transmission capacity that in-state resources are seeking. This interaction between in-state resources and delivery of out-of-state resources will be explored by the Transmission Technical Input Group of RETI 2.0.

4.3. Impact on California Export Capability

As California continues to experience increased solar penetration, overgeneration is anticipated to present a growing challenge for the state. Absent

⁵⁴ California's RPS currently requires RECs to be procured under three PCCs. The PCCs range from RECs that are "bundled" with the energy (PCC1), those that are "firmed and shaped" (PCC2), and "unbundled" RECs where the environmental attribute is transferred separately from the energy (PCC3). The discussion above does not consider these requirements and limits its scope to the technical transfer capacity between resource rich areas and the California TAFAs. However, in most instances, the discussions surrounding the delivery of resources to TAFAs identified by RETI 2.0 most closely aligns with PCC1.

regionalization and a significant storage build-out, California can expect between 7-8 GWh of curtailment per day during the spring months within the 10-year timeframe (2026).⁵⁵ In addition to information about transmitting energy to California, the Western Outreach effort sought feedback regarding the transmission expansion proposal’s ability to support energy exports from California to the rest of the West. A more robust regional grid should enhance California’s ability to export overgeneration as opposed to curtailing it.

Unfortunately, substantial feedback was not received on this specific area, so additional follow-up work and outreach by RETI 2.0 is recommended. This lack of feedback is likely due to the complex nature of a robust market construct (outside of the EIM and CAISO full-market participation) that would enable these types of transactions to occur.

However, information collected on the various transmission projects combined with discussions about potential markets for excess generation allows for an estimation of the degree to which the proposals might facilitate exporting renewable energy from California. Table 6 summarizes this information.

Table 6: Export Potential of Transmission Proposals

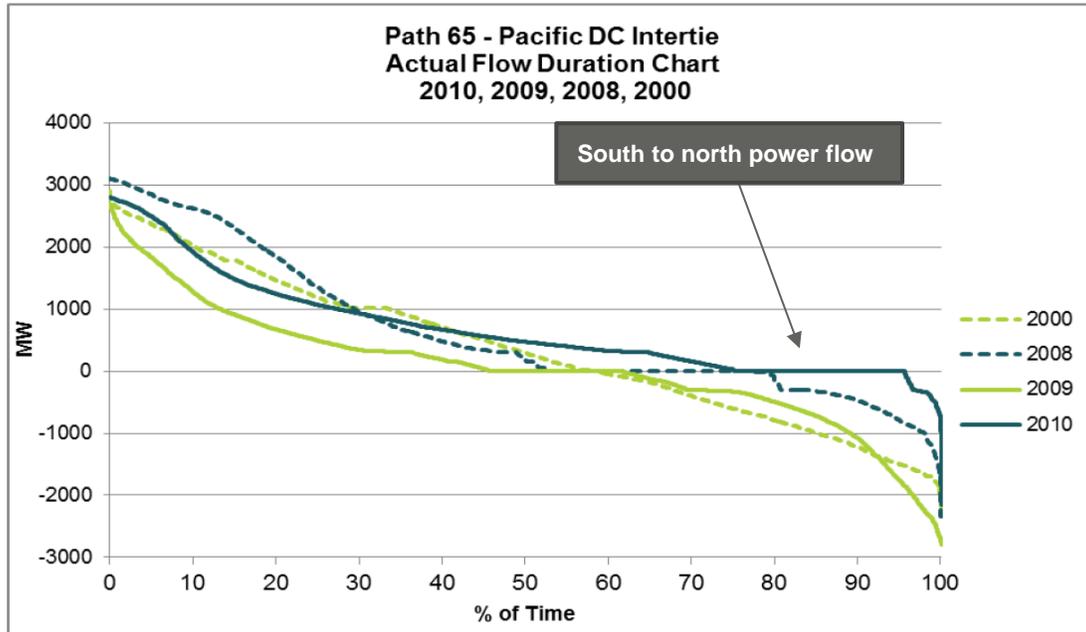
Transmission Configuration	Export Capacity and Ability	Potential Markets
Western Spirit	Projects are likely to have a minimal impact on California export options because they are geographically and electrically remote from the California transmission system. The existing system between California and central New Mexico would play a relatively larger role in accessing potential markets for overgeneration.	Public Service Company of New Mexico
Lucky Corridor		

⁵⁵ Final 2016 CPUC RPS Portfolios for long-term transmission planning – Default Scenario Results

Transmission Configuration	Export Capacity and Ability	Potential Markets
Centennial West	Depending on the projects design, HVDC lines and converters allow for bi-directional flow suggesting that if receiving markets materialize, these projects could facilitate significant exports. Figure 9, below, demonstrates this type of operation on the Pacific DC Intertie (PDCI), and existing DC line connecting southern California to the Northwest.	Arizona utilities, Public Service Company of New Mexico
TransWest Express		PacifiCorp and intermountain west
Zephyr		PacifiCorp and intermountain west
Zephyr (to IPP)		PacifiCorp and intermountain west
Southwest Powerlink HVDC Conversion	There is significant export capability from California to Arizona on Path 46 and Path 49 and adding this project would not enhance market access beyond western and central Arizona.	Arizona utilities
Southline	Project is integrated into existing system and could provide between 430-971 MW of west-to-east transfer capability. Project would pair with west-to-east transfer capacity on Path 46 and Path 49 to enhance energy exports to southern Arizona and New Mexico utilities.	El Paso Electric Company, Public Service Company of New Mexico, Tucson Electric Power
SunZia	Under current configuration, the eastern side of the project is not interconnected with the existing AC system (Lordsburg, Midpoint, and SunZia east substations). Therefore, the project would improve connection and export opportunities within the southeastern Arizona system (Pinal Central and Willow).	Tucson Electric Power
Gateway West and SWIP North	Project combinations involving SWIP North and Cross-Tie would improve transfer capability between NV Energy and PacifiCorp. Both projects could allow for enhanced CAISO exports by increasing capacity between Harry Allen and Robinson Summit. EIM benefits posed by these expansions are related and	NV Energy, PacifiCorp, Idaho Power
Gateway South and Cross-Tie		

Transmission Configuration	Export Capacity and Ability	Potential Markets
Gateway (full) and SWIP North and Cross-Tie	considered in the next section. However, many of these considerations are tied to the EIM. The projects do not directly increase capacity between California balancing agencies and potential energy markets.	

Figure 9: Historical Bi-Directional Flow of Path 65 (PDCI)⁵⁶



4.4. Impact on the integrated transmission system and market efficiency

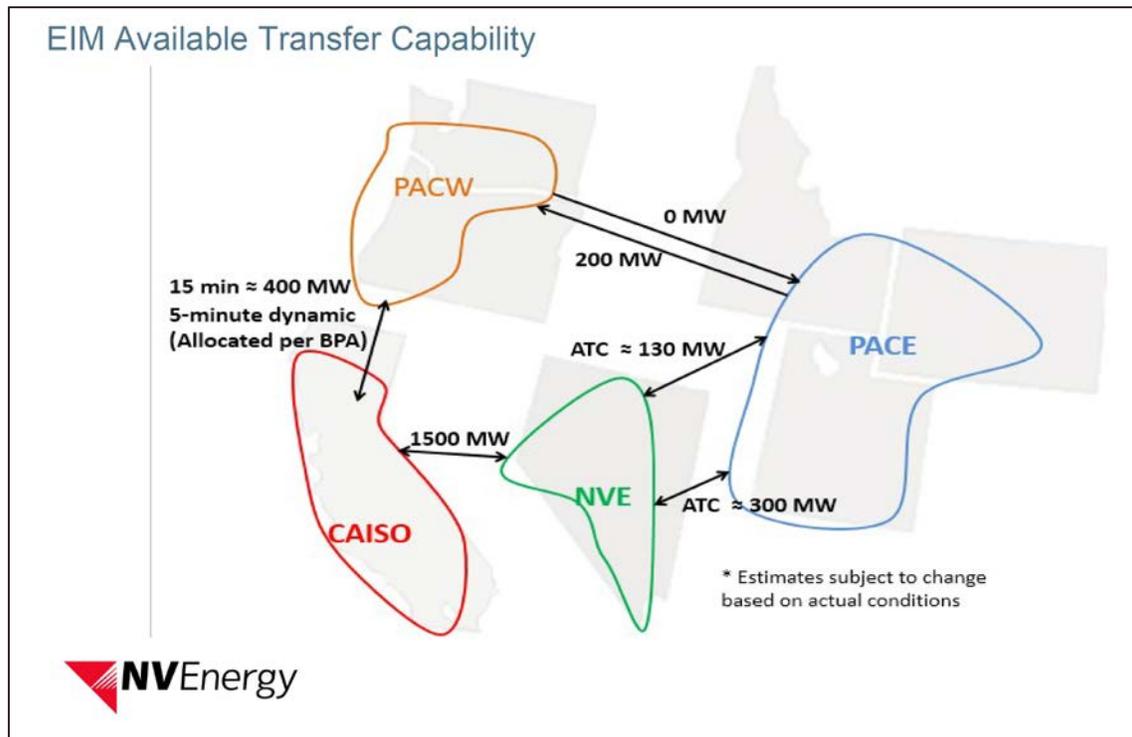
Aside from importing low-cost, high-capacity factor renewables and enhancing regional markets, the proposed projects offer broader benefits, including resource diversity benefits and other quantifiable impacts on the transmission system such as congestion relief. As documented in this report, Wyoming wind and New Mexico wind are both known for having generation profiles that would complement California's existing renewable fleet. A number of the projects listed in this section access those resource-rich areas.

⁵⁶ WECC Path Reports – September 4, 2013

A number of the projects would enhance the efficiency of the existing (or expanded) EIM as well as a future regional energy market. The SWIP North project is an excellent example of this. The project would increase transfer capability between NV Energy and PacifiCorp, which is currently limited to 430 MW (see Figure 10). The benefits posed by this increase are estimated at more than \$26 million per year.⁵⁷ Projects that connect current or future EIM participants, such as the Cross-Tie Project, are expected to have similar benefits in situations where EIM exchanges are transmission constrained. These benefits would likely increase under an expanded regional system operator. A number of the Southwestern transmission projects would provide similar benefits as more utilities in that region join the EIM.

⁵⁷ Sandeep Arora, LS Power:
doCKETpublic.energy.ca.gov/PublicDocuments/15-RETI-02/TN212871_20160819T105156_Panel_3_presentation__Sandeep_Arora.pdf

Figure 10: EIM Transfer Capability⁵⁸



Another benefit category that supports the business case of many of the proposed transmission lines is congestion relief. The COI is a historically congested path. When projects redirect loop flows in the Western system the congestion is relieved, capacity on the path is potentially freed up, and economic gains and efficiency can be realized.

In addition to congestion relief, economic dispatch benefits, and congestion relief, all of the projects would provide substantial reliability benefits.

While all of the projects mentioned in this report provide significant value by delivering low-cost, high-quality renewable resources to California, many of the

⁵⁸ Walter Spansel, NV Energy:
doCKETpublic.energy.ca.gov/PublicDocuments/15-RETI-02/TN213493_20160906T113105_Panel_2_Presentation__Walter_Spansel.pdf

project developers stressed the that the full slate of benefits offered by these projects should be considered in California’s planning processes.

4.5. Project Summary and Scenarios

Using the project-specific information and assumptions outlined in this report, the various projects and project combinations are summarized using high-level metrics, including line mileage, technology, capacity to California, in-service date, and total cost of the combined project configurations, as presented in Table 7.

This summary, like much of the information in this report, focuses on one value stream proposed by these projects – efficiently delivering renewable resources to California. Because of this limited focus and simplistic approach, this type of analysis is intended to inform, rather than guide or define, California’s decision making processes.

Another use of this information is to help RETI 2.0 and California decision makers visualize what an expanded regional grid might look like by defining the quantity of resources could be delivered if various combinations of the proposals were constructed, and which projects or combinations of projects could result in the magnitude of renewable resources in-line with what is being studied by the RETI 2.0 TTIG. The following table provides information on the anticipated timeframes for these configurations to come on-line, as well as information that could be used to inform phased build-out scenarios.

Table 7: Transmission Project Information Summary⁵⁹

Scenarios	Total Miles	Voltage (kV)	Capacity to California (MW)	Resource Details (MW)	Earliest In-Service Date	Developer Estimated Cost (\$M)	TEPPC Capital Cost Calculator Estimate (\$M)	\$M per MW of Capacity (Developer)	\$M per MW of Capacity (TEPPC Tool)	Additional transmission costs to deliver to TAFE?
Wyoming										
TransWest Express HVDC (1500)	730	600 kV HVDC	1,500	WY = 1500	2021	\$ 2,400	\$ 2,460	1.60	1.64	No
TransWest Express HVDC (3000)	730	600 kV HVDC	3,000	WY = 3000	2021	\$ 3,000	\$ 3,200	1.00	1.07	No
Zephyr	850	500 kV DC	3,000	WY = 3000	2025	\$ 3,500	\$ 3,220	1.17	1.07	No
Zephyr (to IPP)	525	500 kV DC	1,900	WY = 1900	2025	\$ 2,000	\$ 2,560	1.05	1.35	Potentially
Gateway (full) + Cross-Tie + SWIP North	1,888	500 kV AC	1,500	WY = 1500	2021	\$ 5,850	\$ 4,890	3.90	3.26	Likely
Wyoming & Nevada/Utah/Idaho										
Gateway South + Cross-Tie	613	500 kV AC	1,500	WY = 600, UT = 900	2024	\$ 2,140	\$ 1,570	1.43	1.05	Likely
Gateway West + SWIP North	1,275	500 kV AC	1,500	WY = 600, NV/ID = 900	2021	\$ 3,710	\$ 3,320	2.47	2.21	Likely
New Mexico										
Southline	370	230/345 kV AC	1,000	NMAZ = 1000	2020	\$ 800	\$ 930	0.80	0.93	Likely
SunZia (1500)	515	500 kV AC	1,500	NMAZ = 1500	2020	\$ 1,000	\$ 1,360	0.67	0.91	Likely
SunZia (3000)	515	500 kV AC	3,000	NMAZ = 3000	2020	\$ 2,000	\$ 2,140	0.67	0.71	Likely
Centennial West	900	600 kV HVDC	3,500	AZ = 3000	N/A	\$ 2,500	\$ 4,370	0.71	1.25	No
Lucky Corridor	130	345 kV AC	700	NM = 700	2020	\$ 154	\$ 240	0.22	0.34	Likely
Western Spirit	140	345 kV AC	1,000	NM = 1000	2019	\$ 200	\$ 260	0.20	0.26	Likely
Arizona										
Southwest Powerlink HVDC Conversion	165	450 kV DC	750	AZ = 750	2025	\$ 950	\$ 2,420	1.27	3.23	No

⁵⁹ See Table 4 and Table 5 for details on project and project scenario assumptions

One planning scenario potentially worth considering as California continues its planning is the identification of a set of “advanced development” projects. While many metrics could be used to identify advanced development of a transmission project, two potential candidates could be: (1) project has received a federal Final Environmental Impacts Statement (FEIS), or greater (e.g., Record of Decision) and (2) project has entered Phase 2 of the WECC Path Rating Process, or greater (i.e., Phase 3). Based on the information collected for this assessment and these criteria, advanced development projects would include Gateway South and West, Southline, SunZia, SWIP North and TransWest Express.

These five projects would form a reasonable foundation for near-term scenario analyses. However, all of the projects considered in this report have in-service dates prior to 2030, which would make them all practical candidates for supporting California’s 2030 RPS and GHG initiatives.

5. RECOMMENDATIONS

As described in the body of the report, the purpose of the Western Outreach project was to gather stakeholder input from across the Western Interconnection regarding the availability of renewable energy and electric transmission that could contribute to meeting California's renewable energy and GHG objectives by 2030. California has many options for high-quality, out-of-state renewable resources, transmission configurations to access those resources, and demand centers that may seek to purchase excess generation from California's renewable resources.

In addition to summarizing the various infrastructure build-outs stakeholders suggested, this paper offers the RETI 2.0 initiative potential next steps and recommendations⁶⁰ that could help California meet its policy goals. With this context, RETI 2.0 may want to consider the following:

1. Convene Further Regional Collaboration

During the Western Outreach project, several content areas were identified that could benefit from further collaboration across the west. Though the participants in such collaboration could include a diverse set of actors throughout the electricity industry, including balancing authorities, load serving entities, transmission owners and operators, power marketers and project developers, California and other state agencies could play a valuable role in convening and facilitating the following collaborative endeavors. The three types of collaboration discussed during the Western Outreach project include: Western resource planning coordination, new market products, and study of coal unit retirement implications.

⁶⁰ The recommendations in this report have not been reviewed or approved by the Board of the Western Interstate Energy Board.

a. Facilitate Western Resource Planning Coordination

Because of the expedited timeframe of the Western Outreach project, participation and feedback from California's neighboring utilities, particularly in regard to their resource and transmission planning departments, was limited. However, for those that did provide feedback, there were several voices advocating for a Western forum where utility resource planners could identify planning efficiencies and opportunities that would allow them to meet their local utility needs at the lowest cost. Examples of topics and goals that might be considered at such a forum include:

- Coordinate and identify exchange opportunities with the planning horizon such that one utility's short position in either energy, capacity, or RECs could be paired with neighbors with long positions in corresponding areas through market tools
- Share and align, and potentially, jointly procure needs, such as large chunks of renewable resources (and transmission if necessary)
- Educate each other on the operational constraints faced within the regional systems. For example, it could be beneficial for those outside of the Northwest to better understand how the Northwest's hydro system is operated and what constraints must be observed
- Transmission limitations that are impacting resource decisions
- Interact with transmission planners at a regional level

Given the amount of resource procurement uncertainty on the horizon, with new RPSs and potential Clean Power Plan implementation, the West may benefit from such a forum, which was referred to as a "meta-IRP" by one of the Western Outreach stakeholders. WIEB could consider reconvening the Resource Planners Forum to meet this need.

b. Design, Promote and Review New Market Product(s) for Overgeneration Conditions

A number of the focus questions contemplate the potential for exporting energy out of California during overgeneration conditions. While a number of the new transmission configurations discussed in this report would help facilitate such an exchange, several stakeholders contended that market products and better utilization of the existing system should be the priority. The message was: Do not focus on the infrastructure needs (for export) until the market products to facilitate the trading and exchange have been established.

Participants also recognized that the EIM is active and already has resulted in California exports under such conditions, but the impact is limited due to the number of participants, limited transmission capability, and timing limitations of the market (e.g., 15-minute imbalance). The regional market expansion would offer huge opportunities in this area, but due to the regulatory and technical hurdles, implementation would take time and be limited to those that choose to join.

There is much that California, the CAISO, neighboring utilities, and marketers can do in the next three to five years to deal with (or take advantage of) overgeneration and the duck curve. For example:

1. *Limit imports during overgeneration conditions:* Due to CAISO operational and market protocols, it is common for self-scheduled generation to be flowing *into* California during times that renewable resources are being curtailed. The CAISO should evaluate reasonable market signals to disincentive imports under these conditions, and load-serving entities (LSE) and power marketers should ensure that

contracts allow and markets support the resale of this contracted energy to other off-takers.

2. *New market products:* The CAISO, California and Western LSEs, power marketers, and other western stakeholder should continue to pursue the creation of a “duck-belly” product that would facilitate efficient power trading during overgeneration conditions, continuing discussions of the WSPP. While many of these have been discussed by WSPP and some may be implemented, an analysis of how well WSPP’s products will address this need should be undertaken. Ultimately, a common tradable product with clearly defined attributes available in the market could give rise to the type of interchange that RETI 2.0 appears to be interested in. It would also have the added benefit of using solar-driven overgeneration to displace thermal generation (and its associated emissions). The use of the product would not be limited to EIM entities or potential CAISO participating transmission owners – the reach and potential impact could be relatively immediate and geographically broad.
3. *Facilitate more flexible transmission service.* Renewable project developers, off-takers, and transmission providers could communicate and collaborate to improve the understanding and utilization of conditional firm transmission service. Transmission operators and LSEs should examine the common approaches to self-scheduling and hourly vs. intra-hour blocks to identify economically beneficial opportunities to make transfer capability available.

Considerations such as these should be evaluated alongside and in parallel to major infrastructure investment decisions. Ultimately, products such as

those contemplated above will allow the *existing* and *future* transmission grid to provide the greatest benefit to customers.

c. Assess Coal Retirement Impacts on Transmission Capacity

One of the key discussion areas in the Western Outreach effort centered on generation fleet trends, and specifically, how planned and potential coal plant closures could free up additional transmission capacity that could be used to deliver renewables to California. One common theme that emerged through the discussions was that California is not the only Western entity that may be interested in such a procurement strategy. A number of utilities from both the Northwest and Southwest described plans that had their owned or contracted transmission being repurposed to deliver renewable energy to their customers. Because of this, any analysis of transmission utilization post-coal plant retirement should look at the degree to which the former coal power off-takers will need new renewable resources, and whether all or a portion of the transmission capacity may be available for California.

Given these factors, if California chooses to pursue a renewable planning, procurement, and delivery strategy that involves repurposing transmission freed up by coal retirements, RETI 2.0 should direct a follow-on assessment evaluating planned and potential coal retirements and potential plans for future transmission use (e.g., will current transmission right holders of the impacted paths want to retain their rights for their own transactions?). If there is substantial capacity identified through this assessment, the transmission projects that connect resources to the sending end of the transmission path will have a path forward to reasonable assessment in the California planning processes. Although this type of follow-on assessment will hold its fair share of uncertainty, absent this follow-on work, it will be very difficult for California

decision makers to understand what extent this resource development and delivery concept can be relied on for the purposes of 50 percent RPS and GHG reduction planning.

2. Update Resource and Transmission Data Used in Decision Making

California LSEs, grid operators, and regulators use a variety of models and plans to perform resource planning, procurement, and transmission planning and authorization. During the Western Outreach project, participants stressed the importance of having recent, realistic, and commercially relevant information to populate these models. The following specific strategies or subjects could support the effort.

a. Update Transmission Cost Assumptions in California Planning Tools

The Western Outreach project was successful in surveying Western transmission projects for cost estimates. These costs can be combined with information about the potential MWs delivered by each project to facilitate updates in the RPS Calculator and/or IRP development effort. California should also consider using generic costs, such as those generated from the TEPPC Capital Cost Calculator, in order to bookend and vet the developer values.

b. Request Information from Out-of-State Resource and Transmission Combinations

During the Western Outreach effort, WIEB heard from 12 transmission projects currently in development. These projects represent a combined 5,688 miles of transmission, and in some instances, have been in development for more than 10 years. In fact, nearly 60 percent of the total transmission line miles in development have (1) received federal Final

Environmental Impact Statements (or “Records of Decisions”) *and* (2) are in either Phase 2 or Phase 3 of the WECC Path Rating Process. This suggests there are ample transmission solutions prepared to move into investment-stage analysis (versus planning-stage).

The commercial-readiness of these projects coinciding with California’s 50 percent RPS planning is not a coincidence – all of the projects mentioned in this report see at least a portion of their value tied to delivering renewable resources to the California market. However, numerous barriers to entry associated with accessing the California market have limited their commercialization (see Recommendation #3).

Given that many of these transmission projects are ready or nearly-ready for construction, if California wishes to pursue procurement of renewables that would be dependent on the development of one or more of these transmission projects, a RFI for renewable resources outside of the state could spur commercial inertia and create actionable information for California decision makers. The suggested RFI would have respondents (presumably renewable generation developers) propose specific renewable resource projects (e.g., wind, solar, geothermal) and partner or otherwise coordinate with transmission projects or other transmission delivery approaches in order to propose commercially viable out-of-state renewable resource options to help meet California’s RPS and GHG goals. The RFI would be informational and 100 percent confidential, meaning no project-specific proprietary or otherwise commercially sensitive information would be made public. The recipients of the RFI information would be a review committee that could include representatives from the CAISO, CPUC, CEC, and California utility/municipality resource procurement staff.

Through the CAISO's participation in the RFI, the grid-planner could be exposed to real-life project proposals that would help the CAISO in planning any system upgrades needed to facilitate in-state delivery of the resources – a process akin to the Large Generation Interconnection Procedure, but specific to resources reaching the state's grid via new or existing transmission. The CPUC's participation would expose staff to the components and range of out-of-state resource costs, allowing them to make better informed decisions about what generic values should be assumed in the CPUC's RPS planning (or IRP) efforts. Utility procurement staff, who routinely conduct RFPs for renewable resources to meet RPS obligations, would begin to learn how out-of-state responses to such RFPs may look, which would allow them to recommend changes to the utility procurement process (i.e., least-cost, best fit criteria) in order to better accommodate out-of-state generation.

This exercise could be conducted not as an alternative to in-state resource procurement, but in parallel. If California's goal is to implement a technologically- and geographically-diverse resource portfolio, an exercise such as this would help to align utility market signals for out-of-state resource and transmission developers, which in some instances, are only commercially feasible once a tipping point of needed capacity (MWs) has been achieved.

Many of these projects have been in the planning stages for years – this RFI would recognize that and begin to move past planning analysis and into investment evaluation, placing the onus on the resource and transmission development community to propose out-of-state options with sufficient detail to help decision-makers understand what exactly implementation may look like.

c. Review and Update Out-of-State Resource Costs for Planning Tools

As discussed in this paper, the Western Outreach project was informed on major developments regarding resource cost declines and technology enhancements, including major reductions in the capital cost for geothermal facilities and significant technology improvements in wind turbines that have increased the capacity factor of what have historically been lower-capacity factor wind regimes. Stakeholders felt that these factors, along with several others, should be considered by California in future planning exercises.

d. Evaluate Available Transfer Capability between New Transmission Projects and the California Transmission System

The transmission portion of the report reviewed a number of resource and transmission combinations that terminate near but not within the import/export TAFAs identified by RETI 2.0. With few exceptions, this would suggest the projects do not directly interconnect to a California balancing authority. Making the broad assumption that these projects and the renewable resources that they would deliver would seek to do so over long-term firm transmission rights, a planning-horizon assessment of the available transfer capability between project termination points and California balancing authority ties (or import/export TAFAs) could help identify if they present realistic options for delivering renewables to the state. This available capacity information, if significant, could be combined with the appropriate transmission service costs to help California entities evaluate the efficiency of these solutions relative to other alternatives that connect directly to import/export TAFAs or inside California. This could be accomplished through (1) a review of available transfer capability and associated wheeling costs; (2)

a cooperative project with Southwestern utilities (described in Recommendation #1); or (3) through an RFI process that would require renewable resource developers of out-of-state renewable resource to demonstrate this capability (see Recommendation #2).

3. Barriers to Entry for Out-of-State Resources

In reviewing the challenges faced by out-of-state resources and transmission, it became apparent that several barriers have limited their development to date. California policymakers, regulators, and utilities may wish to consider the following policy-oriented issues:

a. Review Aggregation and Eligibility Requirements

Feedback received from and discussions with out-of-state resource and transmission developers identified a consistent set of barriers that community feels they face in attempting to deliver their product (renewable energy) to the California market. Several of these barriers are listed below. Many of the other recommendations attempt to address these issues.

- *Market Demand for Large-Scale Transmission:* At present, there is not a process to aggregate demand for out-of-state renewable resources for the purposes of procurement. In order for some of these out-of-state projects to be viable, upwards of 1,000 MW of demand might be needed – and this demand would need to be coordinated. Currently, each utility conducts its procurement independently and often without coordination. From a timing perspective, this presents a challenge to the development community, as they would look to aggregate demand from multiple utilities over a number of years.

- *RFP Eligibility Criteria:* Some California utility RPS solicitation processes require RFP bidders to have a Phase 2 interconnection study (or greater) completed in order to be considered an “eligible” project. However, the classic chicken-and-egg problem makes this criterion difficult for out-of-state resources dependent on new transmission. Depending on the business model the developer employs, executed transmission service agreements with creditworthy entities, most likely the renewable developers, may be necessary to finance and construct the project. However, these entities cannot enter into such agreements until they have a guaranteed, long-term buyer for their output (i.e., a PPA). Without a PPA, the generation project cannot support the financing of the transmission project. Given this string of co-dependencies, selection criteria that limit evaluation of out-of-state proposals for renewable resources that require new transmission should be reconsidered.

In summary, initiating process and mechanisms that (1) aggregate procurement demand for commercially significant tranches of out-of-state resources and (2) facilitate qualified responses from out-of-state resources that lead to PPAs would, in combination, remove many of the barriers to entry this community faces.

b. Incorporate Opportunity Cost or Scenario Analysis of Out-of-State Options when Evaluating Procurement and Transmission Plans

Several stakeholders were of the opinion that the approaching years will be a critical decision period for Western transmission expansion. They felt that not making decisions and investments today could result missed

economic benefits. Two of the biggest drivers mentioned were associated with the timing of (1) PTC expiration and (2) broader market benefits.

Regarding the PTC, stakeholders felt that if California is seeking a geographically diverse and a technologically balanced system, action sooner than later may be in ratepayers' best interest, as the PTC presents a substantial saving opportunity. If ultimately the resources are procured in two to three years post-PTC (presuming it is not extended), the benefits of earlier procurement will have been missed.

A robust regional transmission buildout also has significant benefits to offer outside of accessing remote resources. These benefits come in the form of reduced congestion, enhanced EIM exchanges, and sufficient region-to-region transfer capability such that a regional market is truly impactful. The benefits of regionalization are significant, but can only be achieved with a robust regional grid, which was in fact, assumed as a part of California's recent SB-350 studies.⁶¹ With the Western system moving toward regionalization, the grid should be planned with that future mind.

a. Consider RPS and IRP Policy that Allows Action to be Taken Now on Out-of-State Resources

As demonstrated through the scenario analyses and specific project information in this report, Western transmission project developers have shouldered significant planning and permitting risk to bring their respective projects to a point such that on-line dates within the five-year timeframe are realistic and feasible. With California embarking on an IRP-based

⁶¹ See Volume 5, transmission assumptions

planning process, there is both concern and opportunity. The concern is that implementation will take time and inertia for out-of-state resource and transmission development may be lost. However, the opportunity is the process and approach is still being defined, and if California sees reasonable levels of benefits (relative to costs) tied to out-of-state resource and transmission development, the IRP process could allow for the identification of a quantity of out-of-state resources that could feed into the utility IRP efforts for confirmation. With the resource planning path set, the CAISO could then evaluate the different transmission options to deliver this quantity of resources to California. This decision track, or something like it, would lead to a more geographically and technologically diverse set of renewable resources whose low energy costs would support a regional transmission buildout that, in turn, would produce a stream of market-based benefits for years to come.

6. APPENDIX A: TRANSMISSION PROJECT REFERENCES

Centennial West	centennialwestcleanline.com/site/home
	docketpublic.energy.ca.gov/PublicDocuments/15-RETI-02/TN213498_20160906T113110_Panel_3_Presentation_Keith_Sparks.pdf
Cross-Tie	docketpublic.energy.ca.gov/PublicDocuments/15-RETI-02/TN212872_20160819T105157_Panel_3_presentation_Robert_Smith.pdf
	http://www.caiso.com/Documents/Cross-TieTransmissionLine_TransCanyon.pdf
Gateway Projects	docketpublic.energy.ca.gov/PublicDocuments/15-RETI-02/TN210188_20160205T131352_Matthew_McVee_Comments_PacificCorp_Comments_Related_to_the_Trans.pdf
	pacificcorp.com/tran/tp/eg.html
	gatewaywestproject.com/
	WECC Path Rating Catalog (2016) and communication from PacificCorp employees
	Mileage for Gateway West calculated using FEIS documentation
	Total project cost based on NTTG 2014 Planning Assumptions
docketpublic.energy.ca.gov/PublicDocuments/15-RETI-02/TN212878_20160819T105159_Panel_3_presentation_Richard_Vail.pdf	
Lucky Corridor	luckycorridor.com/description.html
Southline	southline-os.com
	southlinetransmissionproject.com
	docketpublic.energy.ca.gov/PublicDocuments/15-RETI-02/TN213497_20160906T113111_Panel_3_Presentation_Doug_Patterson.pdf
Southwest Powerlink HVDC Conversion	docketpublic.energy.ca.gov/PublicDocuments/15-RETI-02/TN213496_20160906T113111_Panel_3_Presentation_John_Jontry_and_Huang_Lin.pdf
	Basic project information provided directly by Project Sponsor upon request
SunZia	docketpublic.energy.ca.gov/PublicDocuments/15-RETI-02/TN213499_20160906T113109_Panel_3_Presentation_Doug_Fant.pdf

SWIP North	docketpublic.energy.ca.gov/PublicDocuments/15-RETI-02/TN212871_20160819T105156_Panel_3_presentation_Sandeep_Arora.pdf
	docketpublic.energy.ca.gov/PublicDocuments/15-RETI-02/TN213596_20160909T160238_SANDEEP_ARORA_Comments_Western_Outreach_workshops_LS_Power_com.pdf
TransWest Express	docketpublic.energy.ca.gov/PublicDocuments/15-RETI-02/TN212873_20160819T105158_Panel_3_presentation_David_Smith.pdf
	http://www.westconnect.com/filestorage/twe_itp_submittal_overview.pdf
Western Spirit	westernspiritcleanline.com/site/home
	docketpublic.energy.ca.gov/PublicDocuments/15-RETI-02/TN213498_20160906T113110_Panel_3_Presentation_Keith_Sparkes.pdf
Zephyr	docketpublic.energy.ca.gov/PublicDocuments/15-RETI-02/TN213500_20160906T113108_Panel_3_Presentation_Bill_Hosie.pdf

7. APPENDIX B: SUPPLEMENTAL FIGURES

Figure 11: Range of potential 2030 Renewable Energy Demand under different scenarios⁶²

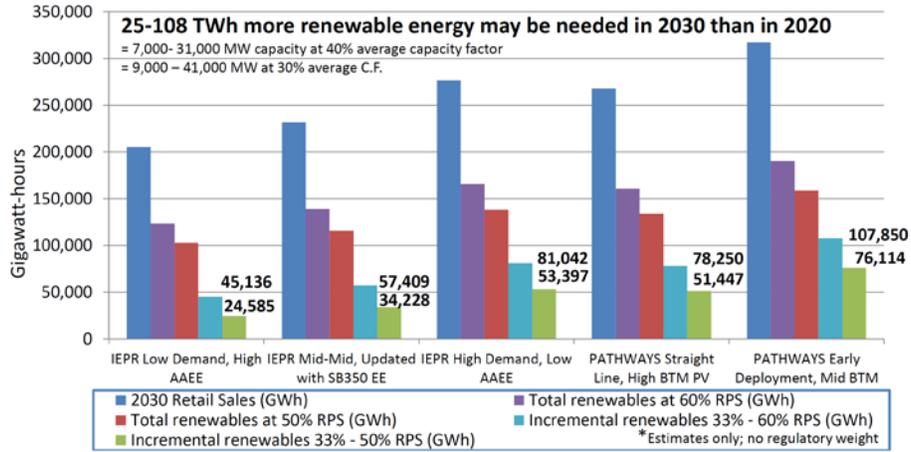
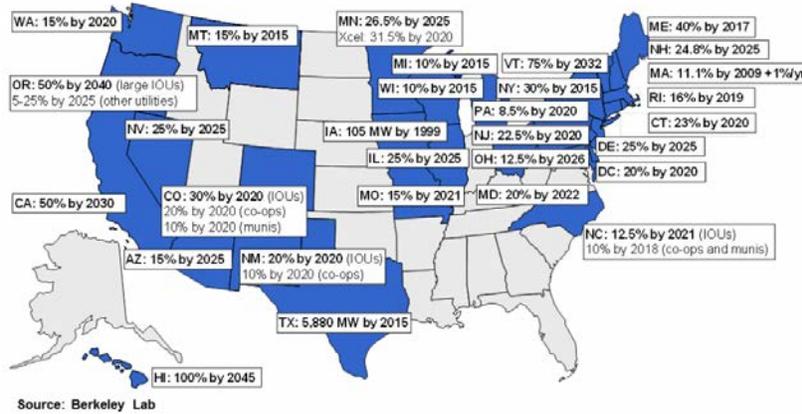


Figure 12: Renewable Portfolio Standards in U.S.⁶³



⁶² RETI 2.0 Plenary Session presentation

⁶³ LBNL RPS Resource Homepage: emp.lbl.gov/projects/renewables-portfolio

Figure 13: Federal Tax Incentive Phase Out Schedule

Construction Begins	Solar ITC	PTC	PTC equivalent value
Before 1/1/2017	30%	100%	\$0.0230/kWh
Before 1/1/2018	30%	80%	\$0.0184/kWh
Before 1/1/2019	30%	60%	\$0.0138/kWh
Before 1/1/2020	30%	40%	\$0.092/kWh
Before 1/1/2021	26%	0%	\$0.000/kWh
Before 1/1/2022	22%	0%	\$0.000/kWh
On or after 1/1/2022	10%	0%	\$0.000/kWh

Sources:

<http://energy.gov/savings/renewable-electricity-production-tax-credit-ptc>

<http://energy.gov/savings/business-energy-investment-tax-credit-itc>

8. APPENDIX C: FOCUS QUESTIONS

1) Setting the stage: Background on RETI 2.0 and regional perspectives

- 1) Renewable demand – How much additional renewable energy development in the west is likely? To serve state RPS mandates? To meet Clean Power Plan compliance? Driven by economics like declining costs, customer preferences and tax credits? To meet other policy objectives?
- 2) Renewable supply – Where, and in which technologies, is development of renewable energy most likely to occur in the next 15 years? Where are renewable developers pursuing projects? Where (and in which technologies) are utilities most interested in procurement? What role are consumer preferences playing in affecting supply?
- 3) Patterns of trade – How will the future mix of renewable energy change the historic pattern of daily or seasonal power flows in the Western Interconnection? What load areas in the West could potentially import surplus generation from California on a daily or seasonal basis?

2) The existing system: capacity, constraints, and current trends

- a) Existing transmission capacity and known constraints – What is the existing transmission capacity to deliver power from high-quality renewable energy areas to California load centers? Where are there known constraints that limit additional deliveries? What is the capacity or constraints to delivering California surplus renewables to potential out-of-state markets? What are the constraints to delivering out-of-state renewables to other load centers when California is in surplus? How is the deployment of advanced bulk electric system sensing and control technology expected to affect the need for transmission?
- b) Generation fleet trends – How will the current or potential coal plant closures affect the availability of transmission capacity for renewables to California? Will changes to the utilization of northwest hydro resources

- change the availability of transmission for renewable imports or exports to California? Are there other grid-scale storage projects that could materially impact the availability or need for transmission to deliver renewable energy to or from California?
- c) Institutional changes – How would increased use of “energy-only” (as opposed to fully-deliverable) renewables procurement affect transmission availability and need, and how likely are utilities to be interested in out-of-state energy-only procurement? How could the use of dynamic scheduling and other transmission contracting affect deliverability of renewables to California? How could the expansion of Energy Imbalance Market affect transmission availability? What other institutional reforms or balancing area agreements could improve utilization of existing capacity? Where are non-transmission alternatives processes in place and how will that affect the need for transmission?

3) Transmission expansion: Examining future build outs to access high-quality renewables

- a) Current expansion proposals – Is the RETI 2.0 list of regional transmission project proposals complete? Is the WECC Common Case Transmission Assumptions accurate? How could the transmission cost assumptions for out-of-state renewable energy in the CPUC RPS Calculator be improved? Which proposals have received the most interest from utilities in other states and why? What potential expansion scenarios do you think are most likely? Where have proposals not been made, but should? Where would other kinds of line upgrades or new technology obviate the need for expansion?
- b) Costs and benefits of transmission expansion options – What are the pros and cons of different configurations of transmission expansion? How would different expansion options affect deliverability directly to California?

Indirect (commercial) deliverability to California? Exports from California? Ability to defer imports during excess supply? Which configuration of potential transmission expansion options is most likely to support efficient dispatch and utilization of renewable diversity across the west? How should advanced transmission technologies and non-wires alternatives be considered in evaluating expansion options?

- c) Next steps - What additional planning initiatives could California pursue, alone or with federal or western state partners, to facilitate the more efficient utilization of existing transmission capacity for accessing renewable energy or the most efficient expansion of any new needed transmission capacity?