Optimizing California's Transmission System For Renewable Energy

California leads the nation in the transition to a reliable, clean energy economy. This transition is well underway and by 2030 our state could get two-thirds of its electricity from renewable sources.

Providing low-carbon electric service to the sixth largest economy in the world will require the development of significant amounts of new renewable resources, at local and grid scales, and a transmission system that can efficiently and cost-effectively move clean power when and where it is needed.

Cost-effective delivery of clean power can be limited by current transmission planning processes. Historically, transmission planning has focused on delivering *capacity* during the highest peak hour of the year in the interest of serving electric load reliably. This has often resulted in significant transmission upgrades for new renewable generation to achieve full deliverability status during system peak hours. In areas of high renewable resource potential that experience transmission capacity constraints, renewable resource development may stall given the expense and time requirements of upgrading the bulk transmission system. This can create a missed opportunity to efficiently and cost-effectively deliver additional clean energy. Such is the case in California's San Joaquin Valley, the focal area of this analysis, where the state has invested in new land use planning approaches to identify areas where utility-scale renewable resources can be developed with least impact to our state's iconic natural and working lands.

A more renewable-friendly transmission planning approach would focus on maximizing the delivery of *energy* throughout the year. This might require curtailment of renewable generation to avoid system overloads during the peak hour; however, curtailment is often more cost-effective than building a transmission upgrade to meet the highest possible use.

Planning in a way that minimizes development impact and conflict can support a sustained pace of renewable resource deployment while protecting wildlife habitat and the multiple benefits that nature provides, including carbon sequestration. As California plans to achieve multiple environmental policy goals—climate, clean energy, and nature conservation—grid operators should develop new transmission planning approaches that focus on maximizing the delivery of cost-effective and low-impact renewable energy throughout the year.

This Executive Summary was prepared by The Nature Conservancy as a summary of a detailed technical analysis and report prepared by Energy + Environmental Economics, sponsored by The Nature Conservancy. The views expressed in the summary are those of The Nature Conservancy.

Above: © Lara Weatherly for The Nature Conservancy

Transmission Planning for Renewables

Historically, California has planned its transmission under a Full Capacity Deliverability Status (FCDS) framework. FCDS is designed to ensure delivery capability during peak hours, rather than maximizing delivery of renewable energy throughout the year. This provides additional value for renewable generation, which under FCDS can be used to offset a portion of the off-taker's obligations under the California Public Utilities Commission's (CPUC) Resource Adequacy program. However, several of California's renewable resource rich areas are transmission-constrained under this framework, meaning that new bulk transmission investments are required for new renewable resources developed in these areas to achieve FCDS. These transmission investments can be cost prohibitive and discourage resources that might otherwise be cost-effective from being developed.

As California adds more clean energy to the system, planning for and procuring under an Energy- Only (EO) framework can reduce costs for ratepayers. EO resources cannot be counted against Resource Adequacy (RA) requirements, but may not require expensive transmission upgrades. Under FCDS, transmission capacity that could be used to deliver renewable energy to loads during off-peak hours is not being fully utilized. With EO, the generator can deliver energy when transmission is available, making it possible to add more generation without additional transmission investments. By evolving our current transmission planning approaches to accommodate EO resources, we can optimize use of the existing bulk transmission system and create a decision-framework for when and where new transmission investments provide the most value for grid operation and ratepayers.

New Transmission Planning Approaches Can Create Opportunities for Additional Cost-Effective Clean Energy Development

The California Independent System Operator (CAISO), the state's largest grid operator, has already taken steps to analyze the potential of EO resources to help California meet its 50% Renewables Portfolio Standard (RPS) goal while achieving ratepayer savings. In a 2015 Special Study[1], CAISO developed "rules of thumb" to understand the

Above: 470,000 acres of land have been identified as least-conflict for development in the San Joaquin Valley. Energy-Only procurement from new solar PV on this water-stressed farmland with degraded soil could help the region meet groundwater sustainability targets while bringing economic value to landowners. © *Lara Weatherly for The Nature Conservancy*

limits to adding EO resources in various locations before congestion became an issue. These rules of thumb indicated availability of over 26,000 MW of EO capacity on the existing system. This number is similar to the more than 23,000 MW of capacity available for EO resources identified in RETI 2.0[2]. In the 2017 CPUC Integrated Resource Plan (IRP)[3] Reference System Plan Proposal, about 25% of new renewable resources selected are EO which "may reduce ratepayer costs by avoiding unnecessary transmission development" according to the CPUC.

The time is ripe for CAISO to explore an EO transmission planning framework in the formal Transmission Planning Process. The Nature Conservancy commissioned an analysis with Energy + Environmental Economics (E3) to investigate, at a high level, what one such EO framework might look like using the San Joaquin Valley as a case study. Modeling suggests that evolving the state's transmission planning approach can increase the supply of cost-effective low carbon resources while better utilizing the high voltage transmission system in this region. However, rather than prescribing this particular method, we seek to add to CAISO's efforts thus far, and encourage CAISO to develop and pilot a framework which can be presented for stakeholder review in the Transmission Planning Process.

1 https://www.caiso.com/Documents/Updateon2015_50_SpecialStudy.pdf

2 Renewable Energy Transmission Initiative 2.0—California Natural Resources Agency, California Energy Commission, and California Public Utilities Commission.

3 CPUC IRP—http://cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/UtilitiesIndustries/ Energy/EnergyPrograms/ ElectPowerProcurementGeneration/irp/AttachmentA.CPUC_IRP_Proposed_Ref_System_Plan_2017_09_18.pdf

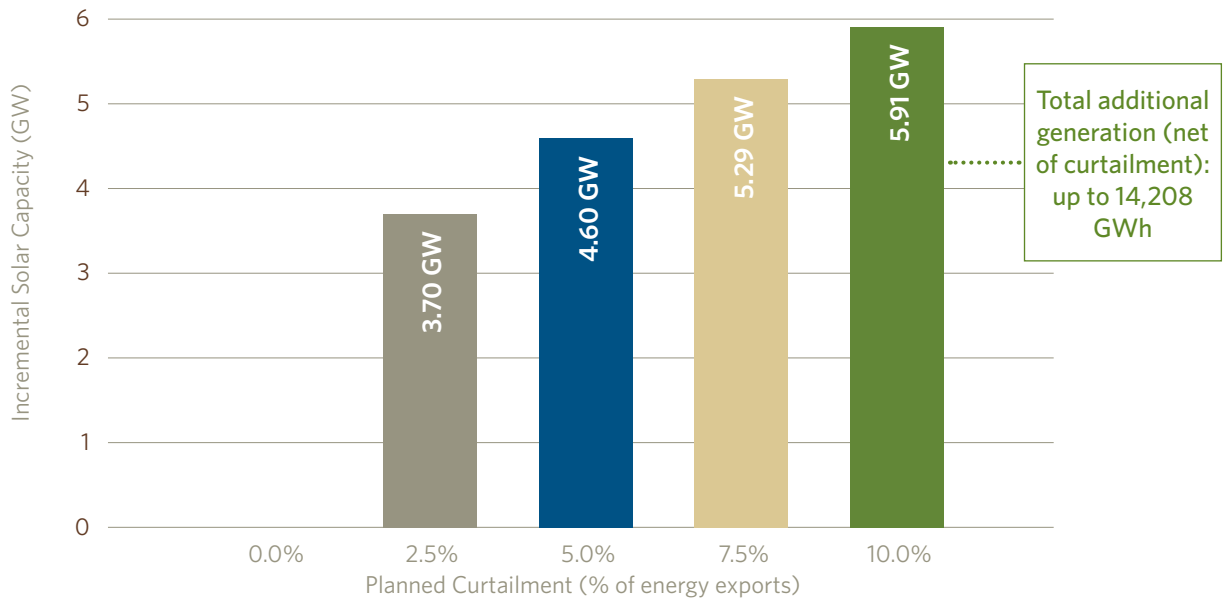
SAN JOAQUIN VALLEY CASE STUDY

Testing new methods for incorporating EO resources in zones with broad stakeholder support for renewable deployment can be beneficial and should be prioritized. For example, some project viability risks can be minimized when EO resource potential aligns with areas that have been identified as least-conflict or have been designated for renewable energy development.

The San Joaquin Valley, which has 24 percent of the state's installed solar generation[4], has 470,000 acres of land that may present the fewest land-use conflicts available for solar development[5] as identified in a recent stakeholder-led study. This number will most likely grow as state groundwater regulation drives significant acreage out of agricultural production. This water-stressed farmland with degraded soil could be converted to solar PV, helping the region meet groundwater sustainability targets while bringing economic value to landowners. However, transmission capacity constraints have been cited as a limiting factor to additional solar development in this region[6].

In partnering with E3, The Nature Conservancy sought to investigate the potential for EO clean energy resources in this area. High-level screening analysis from E3 suggests that an EO approach could allow almost 6,000 MW of additional solar development in the San Joaquin Valley with total additional generation of more than 14,000 GWh, relative to a case that allows no transmission-based curtailment. Those 6,000 MW represent two-thirds the amount needed to reach the 2030 greenhouse gas emission reduction target (statewide electric sector emissions of 42 MMT) reflected in the CPUC IRP Reference System Plan.

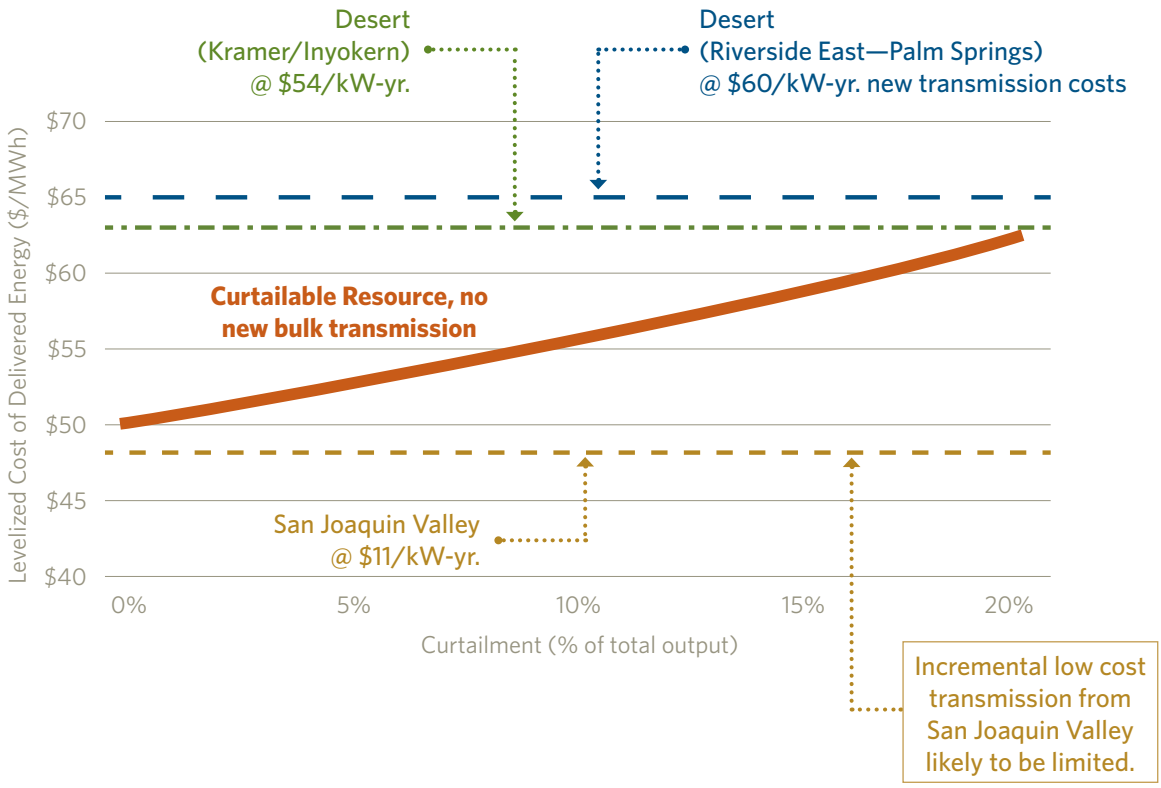
FIGURE 1. Incremental Solar Capacity as a Function of Planned Curtailment



4 Next10, "The Economic Impacts of California's Major Climate Programs on the San Joaquin Valley." March 2017, p. 45.
5 Center for Law, Energy & the Environment (CLEE), Ethan Elkind et al., "A Path Forward: Identifying Least-Conflict Solar PV Development in California's San Joaquin Valley," May 2016, p. 2.
6 Ibid, p. 62

FIGURE 2. Delivered Levelized Cost of Energy as a Function of Curtailment

On the cost side, EO resources from San Joaquin Valley may be more cost-effective than FCDS resources requiring new transmission from desert areas such as Riverside and Kramer.

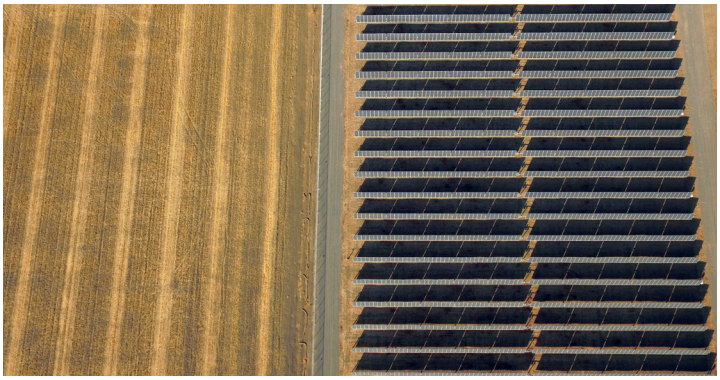


Methodology

To arrive at these high-level estimates, E3 estimated the quantity of additional solar that could be developed in the San Joaquin Valley given current system characteristics, but assuming different curtailment limits. The analysis was based on hourly electricity demand and generation over the course of a full year in each of three zones (NP15, SP15 and ZP26), as well as energy deliveries between zones.

E3 iteratively added solar generation to ZP26 (used as a proxy for the San Joaquin Valley) which could either: displace in-zone conventional generation resources, displace imports, be exported, or be curtailed up to a specified limit between zero and ten percent.

For the cost analysis, E3 compared the *delivered* cost of electricity per MWh. For FCDS, the delivered levelized cost of energy (LCOE, in $/MWh) was calculated by taking the base LCOE, adding the levelized cost of transmission investments required for FCDS, and subtracting the RA value derived from achieving FCDS status. For EO, delivered LCOE was calculated by taking the base LCOE and adding the cost of any curtailment by scaling the cost up based on fewer MWh of energy delivered (e.g., if 10% of energy is curtailed, the LCOE is scaled up by 1.0/0.9).



Above, Left: Westlands Solar Park. Building on areas identified as least-conflict and/or zoned for solar development provides benefits for climate and on-the-ground natural resource conservation. Right: Transmission infrastructure in the San Joaquin Valley. An Energy-Only approach makes it possible to add and deliver more solar generation using the existing bulk transmission system. © *Lara Weatherly for The Nature Conservancy*

Recommendations

New transmission planning approaches that focus on maximizing delivery of renewable energy throughout the year can help California access and deliver additional quantities of cost-effective clean energy. This value is further increased when an EO approach allows access to and delivery of cost-effective clean energy from areas of low conflict. The following recommendations for policy and decision makers identify actions to enable greater penetrations of EO renewable resources:

Incorporate Energy-Only Resources in Transmission Planning: CAISO should run an EO scenario in the Transmission Planning Process (TPP) to catalyze a discussion with stakeholders regarding how to design a framework for assessing transmission needed for EO resources. The framework should:

- Optimize for renewable energy delivery throughout the year, rather than focusing solely on capacity delivery during a peak hour;
- Consider multiple years of load, wind and solar data to provide a more accurate estimate of energy deliverability;
- Consider the transmission costs associated with expanding FCDS resources compared to the RA value they provide to inform decision-framework for when and where new transmission investments provide the most value for grid operation and ratepayers;
- Reveal how much renewable generation can be developed in each zone (including the displacement of fossil-fuel generation) under varying levels of curtailment;
- Seek to establish commercial structures for compensating generators and off-takers appropriately for providing grid integration support.

Enable Energy-Only Procurement: Electricity providers should create opportunities for generators to bid under an EO arrangement as the state moves towards a mix of FCDS and EO resources. We encourage Community Choice Aggregators (CCAs) to review existing Request For Offer (RFO) templates and consider updating current language that requires firm transmission capacity associated with renewable energy bids. We recommend the CPUC provide Investor Owned Utilities (IOUs) clear guidance through, for example, a standard contract form that facilitates EO bids.

Prioritize Energy-Only Resources in Areas of Least Conflict to Natural and Working Lands: Electricity providers, as well as agencies involved in resource and transmission planning, should prioritize areas that have been identified as least-conflict, and/or zoned specifically for the development of lower impact renewable energy. Minimizing land-use impacts of solar development has benefits for climate and on-the-ground natural resource conservation and may reduce project viability risks.

Incentivize Solar PV Development in the San Joaquin Valley: We encourage local government officials to continue to plan and create incentives for new solar PV development in areas of least conflict, especially in water stressed areas with impaired soils. Furthermore, the CPUC, CEC, CAISO, and electricity providers should recognize the environmental, economic, and public policy benefits of a large amount of solar development in the San Joaquin Valley. While transmission constraints have been cited as a barrier to solar PV deployment in the Valley, the findings of this high-level analysis reveal cost-effective opportunities for solar PV to be developed as FCDS or EO.