TransCanyon, LLC Cross-Tie, Independent Market Report

DEPARTMENT OF ENERGY TRANSMISSION FACILITATION PROGRAM PART 2 APPLICATION

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TABLE OF CONTENTS

Executive Summary

TransCanyon, LLC retained consultants at The Brattle Group to complete this independent market report of the Cross-Tie Project (Cross-Tie or the Project) for submission to the U.S. Department of Energy (DOE) as a part of Cross-Tie's Part 2 application to the Transmission Facilitation Program for capacity contracts. Cross-Tie is a high-voltage alternating current (HVAC) 500 kV transmission project between the Clover 500 kV substation near Mona, Utah and the Robinson Summit 500 kV substation (Robinson) in Nevada. Cross-Tie creates a new 1,500 MW transmission path in the central region of the western U.S. power system to address a wide range of market needs and to assist the western states in meeting their increasing renewable generation goals.

Cross-Tie provides value to power customers in the Western Electricity Coordinating Council (WECC) and to potential rights-holders on the line in a number of ways:

- Creating a new path in the western U.S. power system between the PacifiCorp East (PACE) and NV Energy (NVE) Balancing Authority Areas (BAAs), relieving congestion between those systems, allowing resources and load in either BAA—and connected neighboring BAAs—to sell and buy power at more advantageous prices relative to cost of their local generation.
- Enabling the interconnection of new, high-value renewable resources. Resources that interconnect through Cross-Tie can be delivered, most immediately, to PacifiCorp and NV Energy to help them meet increasing renewable generation needs. In addition, the central location of the project in the WECC allows renewable resources interconnecting through Cross-Tie to be delivered to other key regional load centers, including to (1) the Los Angeles Department of Water and Power (LADWP) at the Intermountain Power Project (IPP) using LADWP's existing rights at the Clover substation, (2) the California Independent System Operator (CAISO) administered market by wheeling through NVE's system, and (3) Arizona by wheeling through NVE's system. The renewable resource available along the proposed path of Cross-Tie are competitive with other renewable resources in the region, and likely offer higher value than similar renewable resources interconnected in areas that have already experienced abundant renewable development and related price-reducing effects (e.g., additional solar resources in southern California).
- Increasing the value of existing large-scale generation resources by opening up access to new markets for their output. In particular, Cross-Tie creates opportunities for existing renewable resources that are "bottled up" in their local systems and face low prices or even curtailment due to an abundance of transmission-constrained but simultaneously-producing renewable energy.
- Creating additional grid redundancy that provides added reliability and resiliency for the power system in the WECC. Especially, during extreme weather events and wildfires that are occurring more frequently in the Western U.S., Cross-Tie forms a new pathway from the Southwest to the Pacific Northwest, by adding transfer capability between NV Energy (which is tightly interconnected with the Southwest) and PacifiCorp (which is tightly interconnected with the Northwest), which can help deliver power across the entire WECC region. This type of interregional transfer of power

across the WECC has proven to be extremely beneficial during these type of events, as extreme conditions have tended to impact one sub-region of the WECC but not all of them simultaneously.

- Reducing GHG emissions by reducing curtailments, helping to interconnect more renewable resources more quickly and at a lower cost, creating the opportunity to allow for more efficient thermal generation and to displace less efficient generation.

The most likely avenue for the DOE to recover its investment in the Project is through the sale of transmission rights on Cross-Tie. Specifically, once it is clear that the project will be developed and placed into service, the most likely buyer of transmission rights on Cross-Tie are renewable or storage developers that are hoping to build projects along the proposed path of the Project, looking to interconnect and deliver output to markets across the west. Once future delivery is assured, these developers will be able to enter into contracts to deliver power to load-serving entities or large power consumers (e.g., data centers, industrial customers, etc.) in Utah, Nevada, Arizona, or California. The potential for renewables to interconnect through Cross-Tie is demonstrated in the non-binding expression of interest submitted by Arevia Power, envisioning 800 MW of wind, 600 MW of solar, and 350 MW of battery storage located along the proposed route of Cross-Tie.[1] Several of the benefits described above can be monetized by these rights holders, increasing the value DOE can receive for selling its rights on Cross-Tie.

The remainder of this report elaborates on and quantifies (where possible) the value provided by Cross-Tie, relying on analyses of recent historical data in the WECC and a WECC-wide production cost simulation model conducted in 2021 on behalf of TransCanyon and PacifiCorp to assess the value of Cross-Tie and other transmission assets in the region.

[1] Mark Boyadjian (Arevia Power), Letter to Jason Smith (Transcanyon, LLC) re Non-Binding Expression of Interest in Cross-Tie Service, June 1, 2023.

I. Market Issues Addressed by Cross-Tie

We address several ways Cross-Tie provides value to customers by addressing important market issues and needs that exist in the WECC today. These include allowing for increased market transactions and the resulting congestion relief and production cost benefits, adding redundancy and resilience to the power system in the WECC, expanding access to diverse renewable resources for potential clean energy buyers, and integrating and interconnecting new renewable resources. We identify competing efforts to address the same market needs and the synergies Cross-Tie provides with these other efforts.

A. Production Cost Savings from Increased Market Transactions Across Cross-Tie

We undertook two analyses to demonstrate how Cross-Tie will reduce congestion on the system and lower production costs between the PACE and NVE BAAs: (1) an analysis of historical prices from the Western Energy Imbalance Market (EIM) and (2) a forward-looking analysis using prices from our simulated 2032 WECC model. Each analysis relies on identifying how Cross-Tie enables the displacement of higher-cost resources with lower-cost resources, consistent with prices at Robinson and Clover.

Production cost savings can take the form of reduced fuel and operating costs created by switching from higher-cost generation to lower-cost generation. This switching decreases the cost of serving load and increases the off system sales revenues for generation owners. Production cost benefits can be achieved using Cross-Tie by buying power at the low-priced end of the line, transporting it over the line, and selling it at the high-priced end. This creates additional off system sales revenue for generation owners on the low-priced end of the line, and reduces the cost of power for load at the high-priced end of the line. A portion of this benefit would be captured by the rights holders on Cross-Tie, by either executing this transaction and retaining the trading profits, or by selling transmission service to a third party that executes the transaction.

For the historical analysis, we use recent historical EIM prices at Robinson and Clover for the last five years to determine how often Cross-Tie would have been used to transfer power between those points, if it had been in-service, and then estimate the production cost savings that transfer on Cross-Tie would have created.

As a first step in estimating the production cost savings Cross-Tie would have created in recent years, we determine how much power would have flowed on the line and how that would have impacted prices at either end of the line (Robinson and Clover). To determine how much power would have been transferred on Cross-Tie, we observe the historical EIM price difference between Robinson and Clover and assume the line would have flowed at max capacity when the price difference was greater than or equal to $15/MWh.[2] Based on this analysis, we see 956 GWh of market transfers per historical year on Cross-Tie.

To estimate how prices at Robinson and Clover would have responded to the hypothetical transfers on Cross-Tie, we conducted a simulation of two regions in the WECC with- and without 1,000 MW of new transmission between the regions.[3] From this simulation, we observe that prices converge about $1/MWh on average over the course of the simulated year due to the 1,000 MWs of new transfer capability on the system. We scaled the impact on prices up to match the 1,500 MW capacity of Cross-Tie, and applied the estimated price response to the historical hourly EIM prices at Clover and Robinson over the last five years, in the hours when we determined Cross-Tie would have been utilized to transfer power between the two locations.

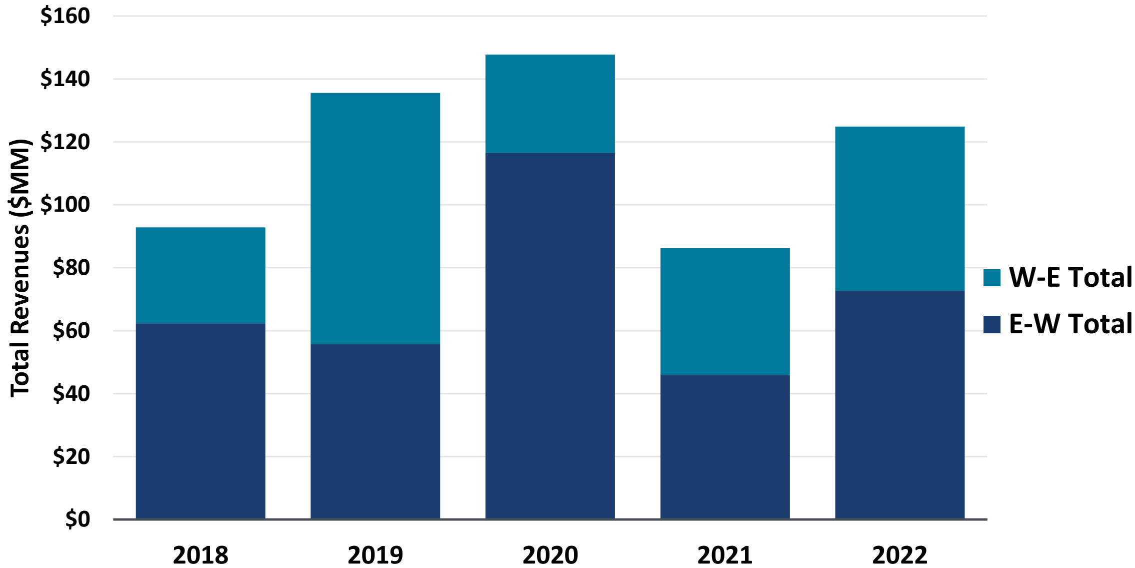
We calculate the estimated production cost savings Cross-Tie would have generated had it been in service over the last five years as the price difference (reflecting the marginal generation costs in both regions) between Robinson and Clover times the flows on Cross-Tie. As shown in Figure 1, Cross-Tie would have created between $86 million and $148 million in production cost savings per year. As also shown, most of the annual value is associated with east-to-west transactions over the Project, which reflects the value of moving low-cost generation from the PACE BAA and the Pacific Northwest beyond that into NVE, CAISO, and the broader Southwest region.

The rights holders on Cross-Tie would be able to monetize the majority of this benefit by using their rights to buy power at the low-priced end of the line and sell it at the high-priced end of the line. Alternatively, the right holders could monetize a smaller share of this benefit by selling transmission service to a power marketer that would then execute these transactions.

2 The financial model provided by TransCanyon indicates that the transmission rate for Cross-Tie in its first full year in service will be $7.50/MWh, declining to $6.32/MWh by its 10th year in service. Alternatively, we estimate the transmission cost of a 30-year PPA for solar facility located along the proposed path of Cross-Tie to be $8.84/MWh (see Section III.A). We would not expect to see any transactions on the line unless the price difference between Robinson and Clover exceeded the cost of transmission service. Although transfers would be profitable in any hour when the price difference exceeded the cost of transmission service, we assume transfers do not occur unless the price difference hits $15/MWh to account for price uncertainty at the time when transactions are scheduled and the risk aversion of the rights holders to take on that risk. This provides a conservative estimate of hypothetical historical transfers and production cost savings due to Cross-Tie.

3 See Appendix A for a description of this analysis.

FIGURE 1: RECENT HISTORICAL PRODUCTION COST SAVINGS DUE TO CROSS-TIE



In addition to the historical analysis, a 2032 nodal market simulation and benefit-cost study conducted on behalf of TransCanyon and PacifiCorp demonstrates that Cross-Tie offers significant production cost savings. For this forward-looking analysis, we use the study's simulated 2032 prices at Robinson and Clover to (1) illustrate how much prices converge between the two locations and (2) then estimate the production cost savings due to transactions over Cross-Tie. We simulated two cases for 2032. The first case included all existing transmission assets in the WECC, but did not include Cross-Tie and some of the PacifiCorp Gateway projects. The second case, built on the first, included Cross-Tie and PacifiCorp's Gateway projects along with additional Wyoming wind resources interconnected to the Gateway projects. The simulations show that the addition of Cross-Tie is forecasted to bring the prices at Robinson and Clover closer together by approximately 38%, reducing price difference between Robinson and Clover from $6.34/MWh in the no-Cross-Tie case to $3.93/MWh in the case with Cross-Tie. The price convergence between Robinson and Clover demonstrates that Cross-Tie creates production cost savings that will accrue to customers and/or generation owners in the region and to the rights holders on Cross-Tie.

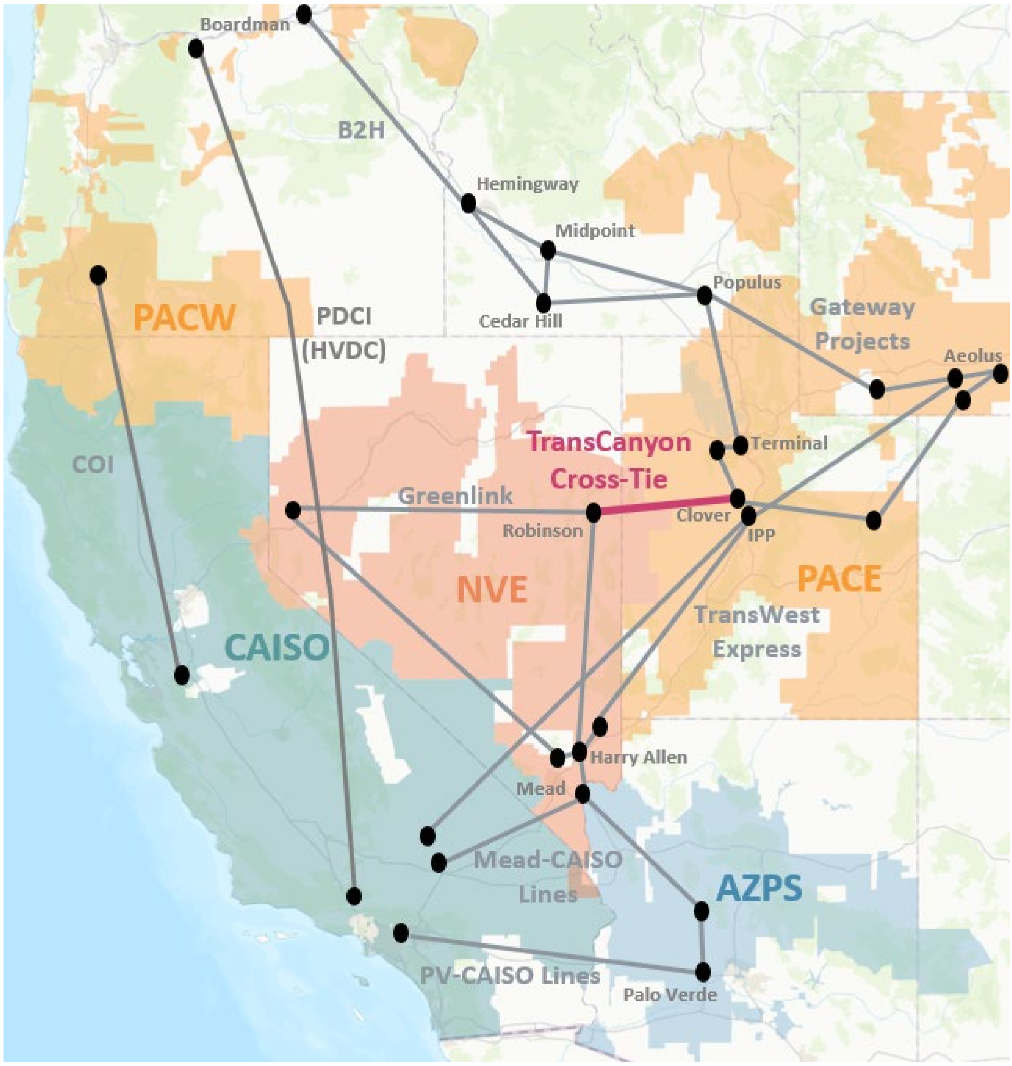
The 2032 simulations also show that it is economic to use 55% of Cross-Tie's total capacity. The majority of this value occurs during hours in the middle of the day, when excess solar production from California reduces prices on the western side of Cross-Tie (Robinson), creating the opportunity for profitable market transactions to the eastern end of the line (Clover). Compared to the historical analysis, the 2032 simulation results illustrate how the value provided by Cross-Tie changes as the resource mix in the region moves away from fossil fuels towards renewable resources. By 2032, the amount of renewable resources in the Southwest implies that the majority of production cost savings created by Cross-Tie comes from accessing low-cost excess solar generation in the midday hours to displace thermal generation in PACE and the Pacific Northwest. The production cost savings due to simulated 2032 transactions over Cross-Tie is $32 million per year (in 2021 dollars).[4] As described above, this value can be captured by the right holders on Cross-Tie if they choose to execute these transactions, or they could choose to sell transmission service to a third party that executes the transaction.

B. Increased Grid Redundancy Provided by Cross-Tie Improves Reliability and Resiliency

Cross-Tie interconnects the PACE and NVE balancing authorities, as well as with several other proposed major transmission lines in the area, thereby significantly enhancing transmission redundancy and overall resilience in the Western power system. As shown in Figure 2 below, Cross-Tie provides a valuable link between two parts of the Western power system that are otherwise not well interconnected. On the eastern side of Cross-Tie, PacifiCorp is building large new transmission projects that, when coupled with existing infrastructure, will greatly increase the transfer capability between Wyoming, Utah, Idaho, Oregon, and Washington. On the western side of Cross-Tie, NV Energy is building several large transmission projects to expand transfer capability across their system and there is significant existing transmission infrastructure that runs from southern Nevada into California, connecting the Meade trading hub (where the Hoover Dam is located) and surrounding areas to load centers and solar generation in California. Similarly, there is existing transmission infrastructure and new projects under development that connect Arizona (mostly from the Palo Verde nuclear plant) to California. Lastly, there are several transmission lines running north from California to Oregon and Washington. Figure 2 shows how Cross-Tie provides a link between two systems of major transmission lines that each span several states: (1) the PacifiCorp system connecting Wyoming and Utah to the Pacific Northwest, and (2) the system that connects Nevada, Arizona, and California up to the Pacific Northwest. Cross-Tie augments the ability to transfer power between these two parts of the WECC, and creates a direct new path connecting the Southwest to the Pacific Northwest.

4 The estimated flows and production cost savings are likely understated in the simulated results. This occurs between production cost simulations generally understate price variability between regions. Moreover, the 2021 simulations do not include updates to resources plans in the WECC announced since 2021. In CAISO alone, the current resource plan shows more than 10 GW of additional renewables online by 2032 and significantly higher reliance on out-of-state renewables compared to the 2021 plan’s projection used in these simulations. The additional renewable generation investments and reliance on out of state resources tends to increase the opportunity for and value of market transactions.

FIGURE 2: SIGNIFICANT EXISTING AND APPROVED TRANSMISSION INFRASTRUCTURE IN THE WECC



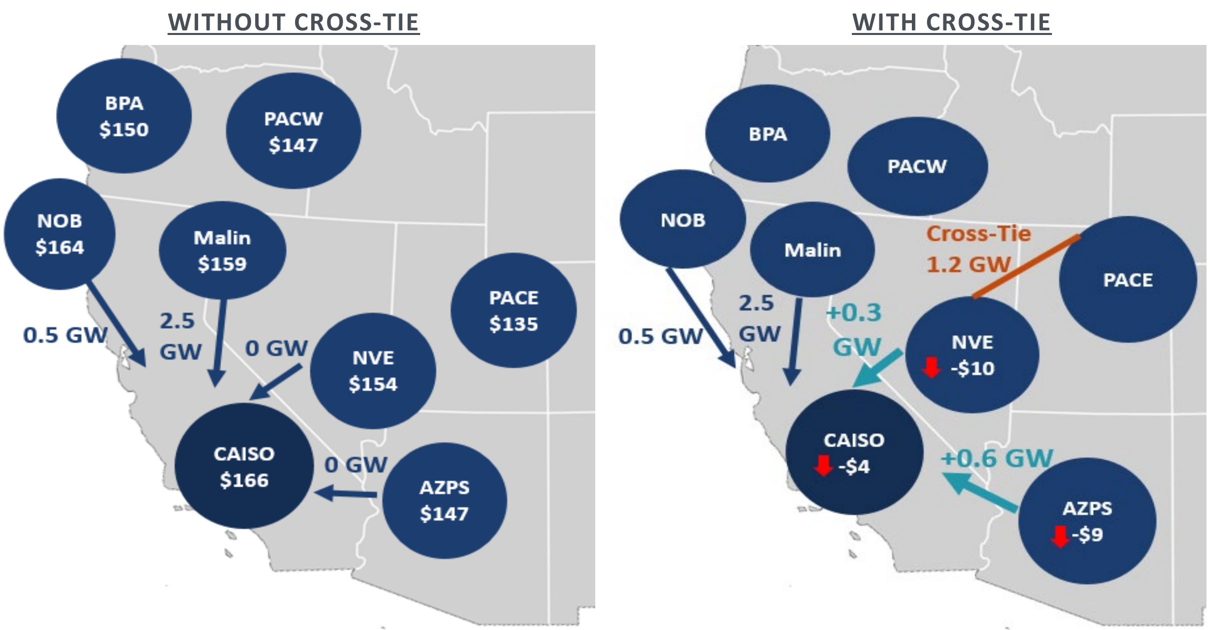
Sources and notes: Existing transmission lines based on WECC OASIS maps, accessible here. CAISO lines from maps accessible here. PacifiCorp Gateway project maps are available here, Nevada Energy's Greenlink maps are accessible here, and Ten West Link maps are accessible here. Line locations are approximate.

The system redundancy and new path created by Cross-Tie is especially valuable in light of the WECC's recent experience with extreme weather and its impact on the electric grid. The Western U.S. has experienced several instances of extreme system conditions over the past several years, including facility outage or derates, historic wildfires, periods of unexpectedly steep ramping of renewable resources, historically high load, extended wide-reaching heat waves, drought conditions, and high natural gas prices. The additional pathway created by Cross-Tie helps to deliver power from diverse regions of loads in the rest of the footprint during these extreme events. For example, CAISO has derated the California-Oregon Intertie (COI) transfer capacity on several occasions and at critical times due to wildfire risks. In those instances, CAISO relies more heavily on imports from other neighboring regions, such as Nevada and Arizona. Cross-Tie enables more power to flow into Nevada from Utah, Wyoming, and other eastern areas, which can free up resources in Nevada to supply California load when imports into California are unavailable from the Pacific Northwest due to derates on COI.

The results of our 2021 benefit-cost study for Cross-Tie and the PacifiCorp projects illustrate the value of system redundancy and resiliency provided by Cross-Tie during difficult system conditions. We simulated two weeks of extreme system conditions in that study. The first week reflects some of the same conditions experienced during recent emergency events in the summer in CAISO. We modeled high load throughout the Southwest, higher gas prices, transmission derates into CAISO, and generation outages in CAISO. Figure 3 shows how the transmission system is used to send power into CAISO during CAISO's peak load hour during that event and prices paid by load across the WECC.

Without Cross-Tie and certain segments of the Gateway projects, the left map of Figure 3 shows zero imports into CAISO from NVE or Arizona Public Service Company (AZPS), as both regions are also facing high demand, and their dispatchable capacity is already committed to serve their own load. The right map shows imports into CAISO are possible in the case with Cross-Tie with substantial reductions in the market prices paid by loads throughout the region. While imports into CAISO from the Pacific Northwest remain the same, the addition of Cross-Tie enables more power to flow into NVE and AZPS from PacifiCorp East, freeing up more power to be sold from Nevada and Arizona into CAISO. CAISO is able to import almost 1 GW more during the event's peak load hour, with Cross-Tie flowing power east to west at its 1,500 MW maximum capacity.

FIGURE 3: CAISO IMPORTS AND REGIONAL LOAD PRICES DURING SIMULATED HEAT WAVE

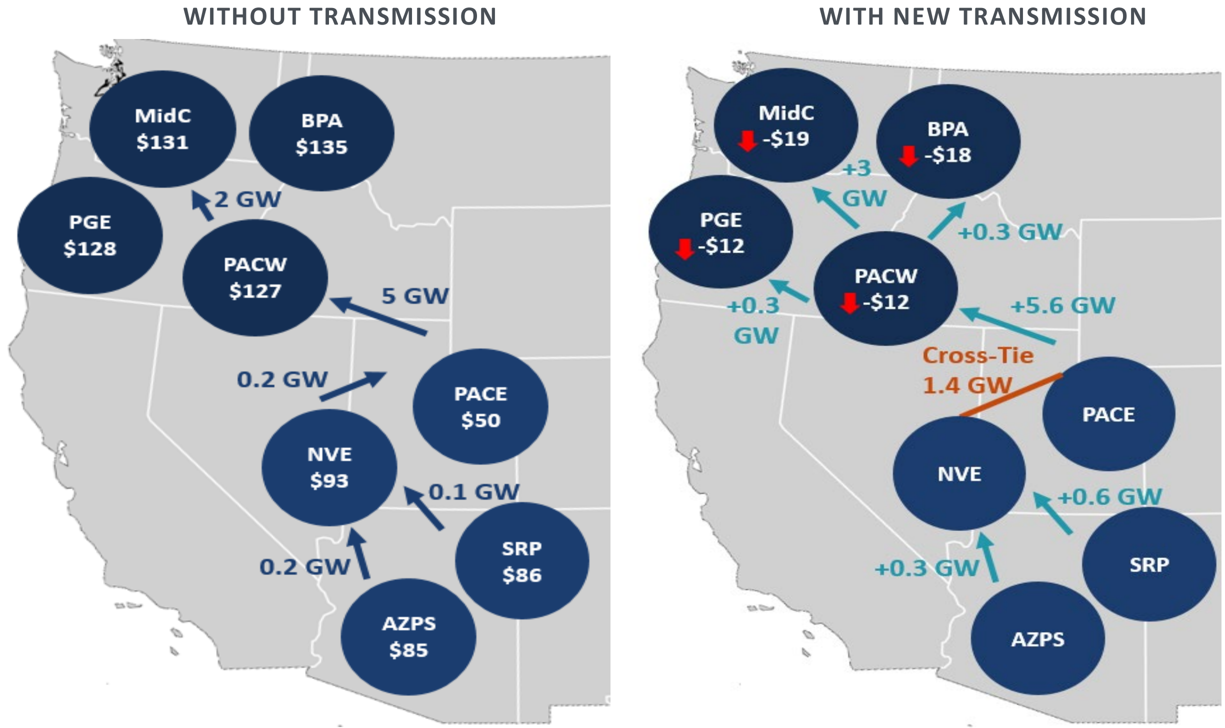


Sources and notes: data from Brattle's 2021 benefit-cost study of Cross-Tie and selected PacifiCorp Gateway projects. The hour represented in the charts is the CAISO peak load during the simulated heat wave.

The second simulated event reflects conditions experienced during a recent winter cold snap in the Pacific Northwest, which we accounted for by modeling high load throughout the Northwest and higher gas prices. Figure 4 shows flows into the Pacific Northwest during the peak load hour of our simulated cold snap. The map on the left shows flows into the Pacific Northwest and load prices in the case without Cross-Tie. In this case, we see only 200 MW flowing from NVE to PACE, which sends 5,000 MW into the Pacific Northwest. With Cross-Tie, shown on the right of Figure 4, flows from NVE to PACE (over

Cross-Tie) increase by 1,000 MW, creating more opportunity (along with PacifiCorp's Gateway projects) to sell power from PACE into the Pacific Northwest.

FIGURE 4: PACIFIC NORTHWEST IMPORTS AND REGIONAL LOAD PRICES DURING SIMULATED COLD SNAP



Sources and notes: Data from Brattle's 2021 benefit-cost study of Cross-Tie and selected PacifiCorp Gateway projects. The hour represented in the chart is the Bonneville and PacifiCorp West BAAs peak load hour during the simulated cold snap.

C. Increased Access to Renewable Resources Reduces Costs of Achieving Clean Energy Standards

Cross-Tie will facilitate interconnection and market access for renewable resources being developed near the Project. Notably, Cross-Tie's central geographical and electrical location will create generation interconnection and opportunities for low-cost renewable resources to deliver their power to markets in Utah, Nevada, Arizona, and California. Demand for renewables resources in these areas is increasing rapidly, especially over the next 10 years, supported by clean-energy policy targets of states and utilities throughout the region and recent federal policy.

In light of this rapid growth in renewable development, interconnection queues across the WECC are experiencing substantial backlogs, particularly in the region surrounding the Cross-Tie project, including the NVE, PACE, and CAISO service areas. The Project can help alleviate the backlog by increasing the generation interconnection capacity of the system and, in particular, accommodating projects being developed along the line between Clover and Robinson.

D. Integration of New Renewables and Increased Transfer Capability in the Region Reduces GHG Emissions

The 2032 simulation results allowed us to estimate the expected emissions reduction attributable to the transfer capability created by Cross-Tie. To develop this estimate, we calculated an hourly marginal GHG emissions rate (tons/MWh) for each region on either side of Cross-Tie (the NVE and PACE BAAs) in each hour of the annual simulation. Using simulated flows on Cross-Tie and the marginal emissions rate in the exporting region and the importing region, we were able to determine how much the flows over Cross-Tie reduce GHG emissions. This analysis is provided in section IV.E. below.

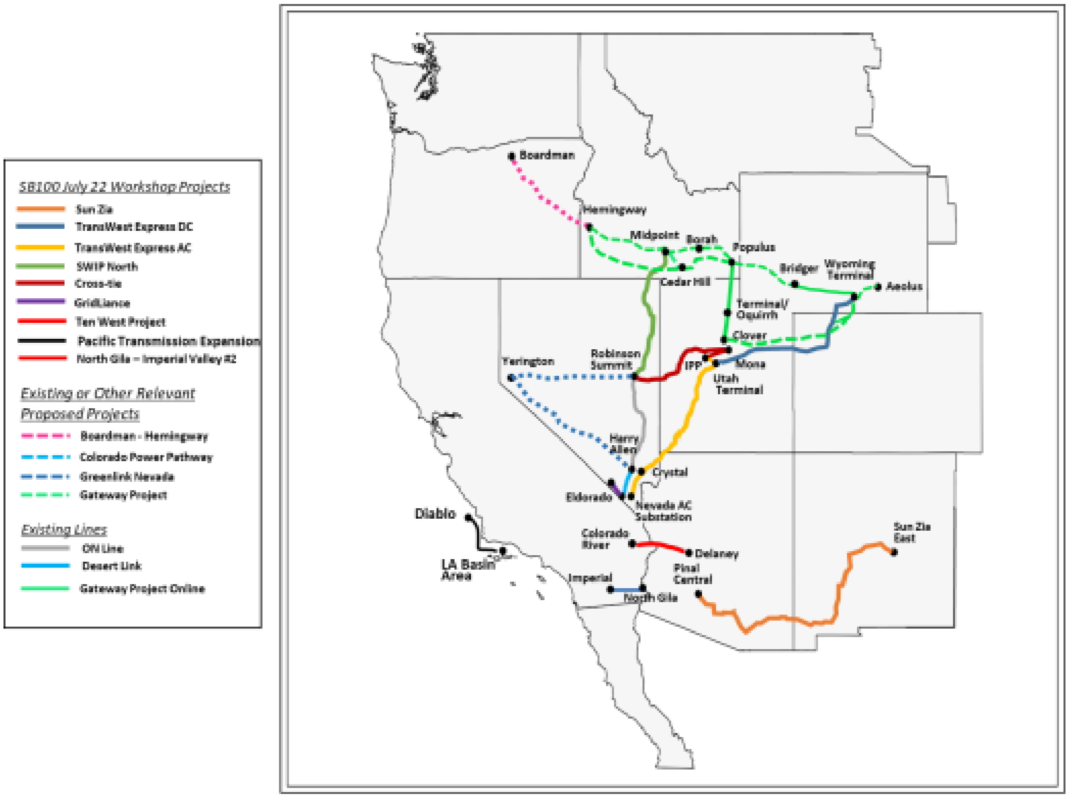
Cross-Tie as a major link between PACE and NVE creates a larger pathway from the Pacific Northwest and Wyoming to the Southwest and California to reduce curtailments and displace emitting resources. Cross-Tie will also enable a reduction to thermal generation from higher-emitting resources and replacement with generation from lower-emitting resources by increasing the dispatch of highly efficient gas-fired generation resources in the PACE BAA. Cross-Tie creates a new pathway for these efficient resources to sell into NVE and the CAISO markets, displacing less efficient gas-fired resources in those areas. Based on our WECC modeling, we estimate that on average each MWh of market transactions across Cross-Tie reduces GHG emissions by 0.11 tons. We estimate that market transactions across Cross-Tie in a representative future year (2032) provides over 800,000 tons of avoided GHG emissions.

In addition to the emissions reduction created by incremental transfer capability, we anticipate Cross-Tie will drive additional reductions in GHG emissions by facilitating interconnection for additional non-emitting resources, as discussed in Section III.D. Alleviating the backlog in generator interconnection queues will help integrate more renewable resources faster and at a lower cost, further displacing thermal resources in the region and reducing emissions.

E. Other Efforts to Resolve Market Issues

Cross-Tie is being developed near several other major transmission projects, which, if developed, would likely deliver complimentary benefits. These other transmission projects being developed in the WECC aim to achieve similar objectives as Cross-Tie: to interconnect and deliver new renewable generation resources to meet the quickly-growing demand for clean energy in the region. The CAISO's 20-Year Transmission Outlook identifies several transmission projects currently under development in the WECC, shown in Figure 5 below. Based on the findings of the CAISO 20-Year outlook, we expect that all of these proposed transmission projects are necessary to interconnect and deliver the quantity of renewables required to meet regional demand.

FIGURE 5: MAJOR TRANSMISSION PROJECTS ACROSS WECC FROM CAISO 20-YEAR OUTLOOK



Sources and notes: CAISO, 20-Year Transmission Outlook, May 2022.

The CAISO's long-term outlook concludes that interconnecting and transporting renewable generation from areas with high quality resources (e.g., Wyoming and New Mexico for wind and southern California/Arizona for solar) to load centers will require multiple new transmission paths across the WECC. This includes not only increased transfer capability into and out of the CAISO market, but also additional pathways from the Pacific Northwest to the Southwest and increased east-west transfer capability from New Mexico to California and Wyoming to California.

The central location of Cross-Tie within the WECC transmission system implies that most of the proposed projects shown in Figure 5 would compliment the Project and likely add to its attractiveness and value for potential off-takers. Several of the proposed projects interconnect either directly with Cross-Tie or near it, which provides more options and improved market access for the rights-holders on Cross-Tie. For example, the Southwest Intertie Project-North (SWIP-North) would interconnect Idaho Power with Robinson Summit, allowing renewables that interconnect through Cross-Tie to access Idaho with only one wheel.[5] Similarly, TransWest Express connecting Wyoming to southern Nevada is in the process of integrating itself into the CAISO grid and transmission tariff under CAISO's proposed Subscriber Participating Transmission Owner (SPTO) model. This would create a CAISO scheduling point in central Utah, only 5 miles from the eastern end of Cross-Tie, allowing for the delivery of Nevada and

5 The potential for joint development of SWIP-North capacity by Idaho Power and CAISO would allow power delivered over Cross-Tie to access the Idaho Power and CAISO BAAs without paying a wheeling fee.

Utah renewable resources interconnected to Cross Tie into California, providing complimentary opportunities with the TransWest Express and other transmission infrastructure in central Utah (e.g., PacifiCorp's Gateway projects).

II. Existing and New Generation Resources Likely to Access Cross-Tie

Our analysis shows that existing renewable resources, particularly solar in California, and efficient gas-fired existing resources in the PACE BAA are likely to use Cross-Tie to access new markets, avoid curtailments, increase the value of their production, and displace higher-cost GHG-emitting resources. We find that new renewable resources, particularly those being developed along the 200-mile length of Cross-Tie's proposed route are likely to utilize the Project to interconnect and deliver their output to off-takers in NVE, PACE, LADWP, AZPS, CAISO, or other balancing areas in the region.

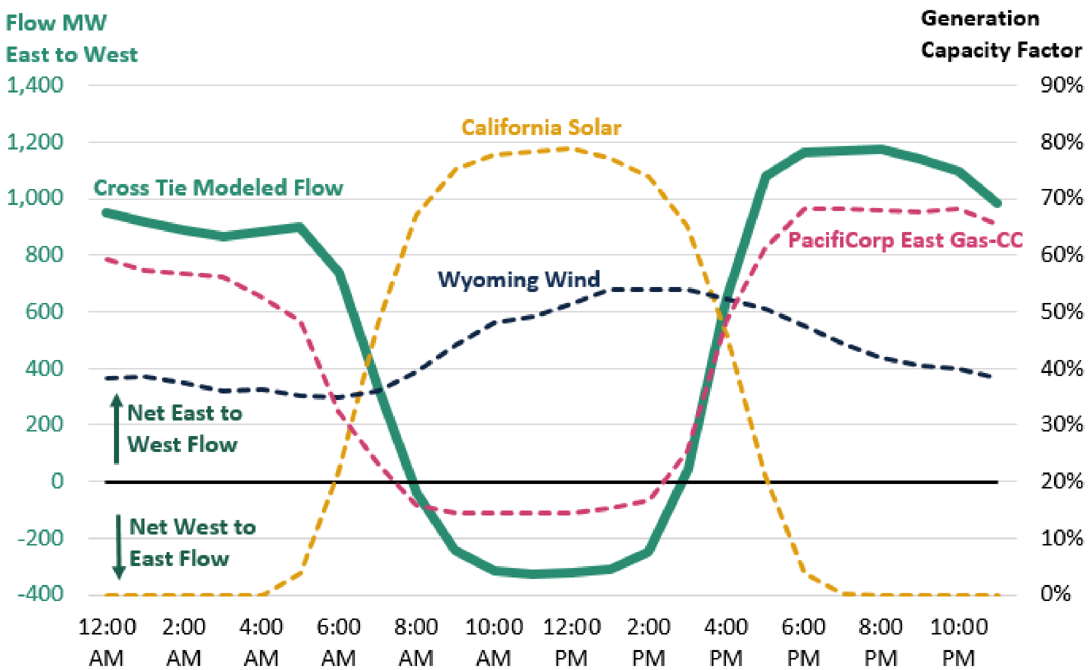
A. Existing Resources Likely to Access to Cross-Tie

Cross-Tie will increase the value of existing renewable resources in the region by providing expanded market access for these resources, and increasing the value of those resources in two ways: (1) enabling them to sell their output at higher prices in neighboring BAAs, and (2) by avoiding curtailments. In particular, renewable resources that tend to suffer from low prices and curtailment due to large amounts of similarly-producing renewable resources that tend to be located in the same areas on the grid. Accessing new markets for these "bottled-up" renewables can greatly increase their value. In addition to existing renewable resources accessing Cross-Tie, existing efficient gas generation in PACE's BAA can access the Project to displace less efficient gas in NVE and CAISO.

Our 2021 simulations of the WECC power system in 2032 demonstrates how Cross-Tie increases the value of existing generation resources by allowing them to access new markets and sell their output at higher prices. The results for 2032 show that flows on Cross-Tie closely correlate with times of high renewable production on either side of the line. In hours when wind resources in Wyoming and Idaho are producing at high capacity factors (the evening and morning hours) and when efficient gas in PACE can economically displace less-efficient in NVE and CAISO, we observe flows west on Cross-Tie into NVE and the greater Southwest region beyond NVE (CAISO and AZPS). At times when California and Nevada solar are producing at high levels (during midday hours), we observe flows to east, into PACE and through PACE into the Pacific Northwest, and a corresponding reduction in thermal generation in the PACE BAA.

The modeled 2032 flows, shown in Figure 6 below, indicate that Cross-Tie flows east-to-west in the evening and morning hours, when wind in Wyoming is producing at relatively high capacity factors and efficient gas in PACE is available to displace less-efficient gas in NVE and CAISO. Cross-Tie reverses flow during the middle of the day to allow the CAISO and Southwest utilities to export surplus solar to Utah and areas further north and east in the WECC. This dynamic is likely to be larger than predicted in our simulation, due to accelerated deployment of solar and wind throughout the West over the last two years compared to the assumptions in our 2021 analyses. This model includes future projected resource mix assumptions as of 2021, which have been increased significantly. As a result, our 2032 simulations have over 10 GW less CAISO solar than the 2023–2024 California TPP[6] and 10 GW less PacifiCorp renewables compared to their 2023 IRP.[7] These 20 GW of additional renewable generation not captured in our simulations would only increase demand for and value of Cross-Tie.

FIGURE 6: SIMULATED 2032 CROSS-TIE AVERAGE FLOWS BY HOUR OF THE DAY VS. AVERAGE SIMULATED CAPACITY FACTOR OF RESOURCES IN THE REGION



Sources and notes: The left Y-axis and green line shows the simulated flows on Cross-Tie, with positive flows representing west-to-east flows and negative flow representing east-to-west flows. The right Y-axis and dashed lines show the capacity factors of the resources displayed on the chart. The chart shows the average capacity factor of a California Solar, Wyoming Wind, and the highest capacity factor PacifiCorp gas combined cycle unit across the day on the right axis.

An analysis of recent historical curtailments in the region shows that curtailed energy already represents a significant lost value for renewable resources. These curtailments are poised to grow in the coming years. In 2023, CAISO curtailed nearly 2.5 TWh of renewables, mostly solar.[8] Additional transmission capability, such as that provided by Cross-Tie, would have enabled some of that curtailed solar to be delivered to loads elsewhere in the WECC.

The results from our 2032 simulation similarly show that Cross-Tie helps reduce curtailments by providing additional capacity for export surplus solar energy into other parts of the WECC. As the direction of flow on Cross-Tie reverses midday to move surplus solar from the Southwest to the rest of

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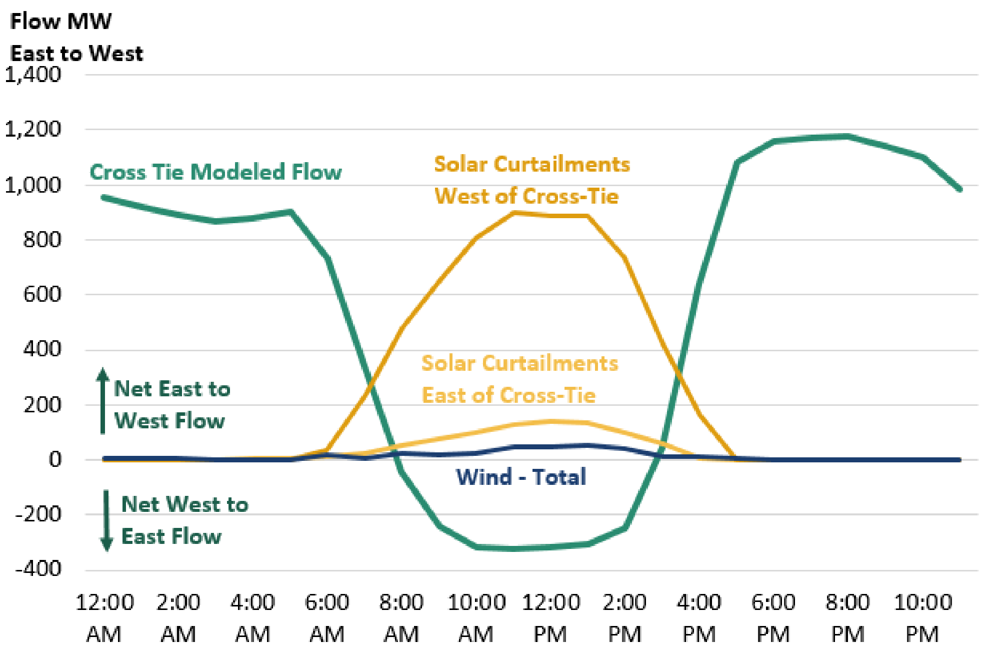
[6] See Proposed Electricity Resource Portfolios for the 2023-2024 Transmission Planning Process, California Public Utilities Commission, October 22, 2022. (CPUC 2023–2024 TPP portfolio)

[7] PacifiCorp 2023 IRP, Volume I, March 31, 2023.

[8] See CAISO Wind and Solar Curtailment Report, December 31, 2022.

the WECC, average solar curtailments are reduced by up to 900 MW per hour at peak solar generation. As shown in Figure 7 below, annual solar curtailments fall 2.3 TWh/year in the BAAs lying to the southwest of Cross-Tie (e.g., CAISO, LADWP, NVE), while solar curtailments to the east of the Project, predominantly in Utah, fall another 0.3 TWh. Cross-Tie thus enables solar output to flow out of California and Nevada to PacifiCorp East and other locations with less solar capacity and higher midday prices, while also allowing Utah solar to flow west during days with low solar generation in California, exploiting the diversity of solar production across the region. This bidirectional diversification reduces curtailments on both sides of the line, displaces thermal generation, lowers prices, and reduces greenhouse gas emissions in the region.

FIGURE 7: CROSS-TIE MODELED FLOWS AND REDUCTION IN CURTAILMENTS, 2032 AVERAGE BY HOUR OF THE DAY



Sources and notes: Positive flows onCross-Tie represent average net west to east flows and negative represent average net east to west flows. Western WECC includes all California entities while the Eastern WECC includes PacifiCorp, NV Energy, Public Service Company of Colorado (PSCO), Northwest Montana, Public Service Company of New Mexico (PNM), Arizona entities, and El Paso Electric (EPE).

Notably, these findings are likely near the low-end of actual future curtailments and Cross-Tie-related benefits. As described above, since our 2021 study, California resource plans identified an additional 10 GW of new CAISO solar that will be in-service by 2032, but which was not included in our model.[9] Similarly, the most recent PacifiCorp Integrated Resource Plan (IRP) includes an additional 10 GW of renewables compared with the 2032 resource mix simulated in our 2021 study.[10] These renewable generation additions would further increase the diversification benefit Cross-Tie can provide by creating additional transfer capability between PACE, NVE, adjacent areas.

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[9] See e.g., CPUC 2023–2024 TPP portfolio at 20–21.

[10] See e.g., PacifiCorp 2023 IRP, Volume I, March 31, 2023.

B. New Renewable Resources Likely to Access Cross-Tie

Cross-Tie will help interconnect renewable resources being developed in the WECC but that are backlogged in generation interconnection queues. For resources being developed along the greater than 200-mile long proposed path of Cross-Tie, the Project will serve as a fast-track alternative to generation interconnection through the existing backlogged queue processes in NVE, PACE, CAISO, LADWP, or other BAAs in the region.

In particular, renewable and storage resources in development near Clover (PACE), Robinson (NVE), or anywhere along the proposed path of the Project between these points, seeking access to LADWP, CAISO, or other BAAs in the region would be able to interconnect through Cross-Tie. The option to interconnect through Cross-Tie provides a valuable alternative should interconnection costs or timelines through other systems be prohibitively high. The more timely and cost-effective interconnection of additional clean-energy resources will be critical to satisfy western decarbonization mandates. Furthermore, the quality of renewable resources available for development along the proposed Cross-Tie path are relatively high compared to other locations in the region. For example, publicly available data on solar resources in Utah indicate that they produce at a capacity factor over 30%, which is consistent with the best solar resources in other parts of the Southwest (e.g., Arizona, southern California, and Nevada) and better than in the rest of the WECC.

While resources under development along the proposed path of Cross-Tie are the most likely ones to access Cross-Tie, potential users of the Project include new resources under development further afield in WECC. For example, new wind resources under development in Wyoming would be able to use capacity on Cross-Tie to deliver into NVE, CAISO, AZPS, or other BAAs in the Southwest. This would only require transmission in PACE or other utilities in addition to Cross-Tie. The further away resources are from Cross-Tie, however, the more expensive it will be to utilize Cross-Tie to deliver renewable generation to customers, due to the need for additional wheeling fees.

However, the large demand for renewables in the WECC has forced load-serving entities to look further afield for clean resources regardless of the costs incurred to deliver that power back to their native load. For example, LADWP's study of how it could achieve 100% clean energy anticipates the need for new wind resources located in Wyoming and Utah, and interconnected to LADWP's system at IPP.[11] The presence of Cross-Tie can help interconnect and integrate additional Utah wind generation, if being developed along the path of the line, as it can be delivered to LADWP at IPP. Similarly, the California Public Utilities Commission (CPUC) and CAISO now project that over 5,000 MW of out-of-state wind will be needed by 2028 to achieve California GHG policy goals, of which over half will be developed in Wyoming and New Mexico.[12]

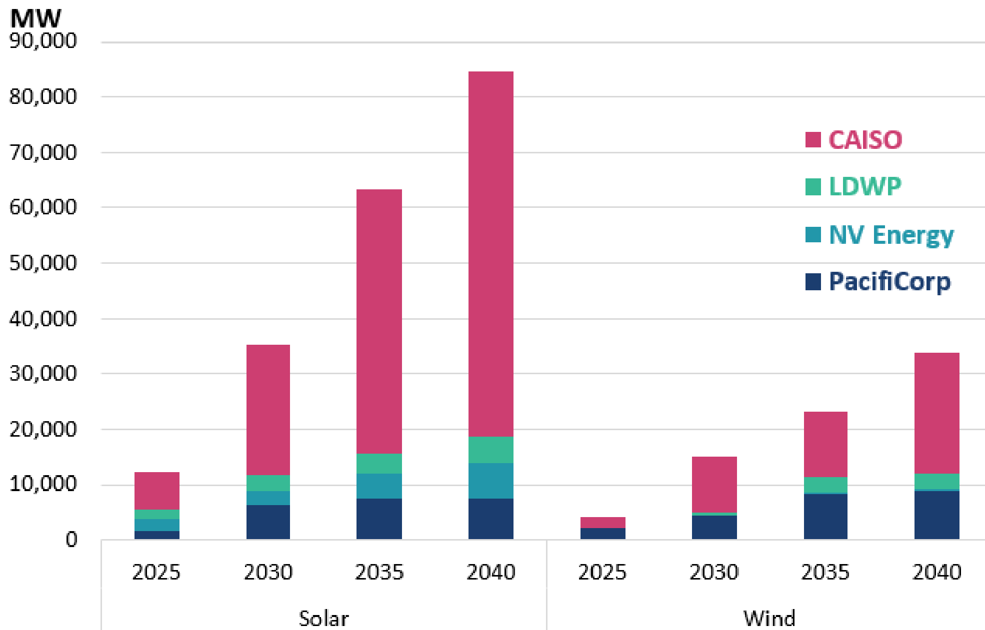
Renewable and storage additions are poised to explode in the WECC, increasing more than threefold between 2025 and 2030, as shown in Figure 8 below. This anticipated growth coincides directly with the Cross-Tie in-service date of December, 2026. The BAAs at either ends of Cross-Tie (PACE and NVE) are

[11] LA 100 Study, National Renewable Energy Laboratory, at Chapter 6, 50–51, Figure 25.

[12] CPUC 2023–2024 TPP portfolio at 74.

planning to add almost 10,000 MW of solar and 5,000 MW of wind (in PACE) by 2030. In addition, CAISO is planning to add more than 20,000 MW of new solar by 2030, and LADWP is hoping to add approximately 2,000 MW. These totals include the planned additions from the published planning processes, but do not include renewable resources contracted directly with large power consumers in the region, which will further add to renewable generation needs.

FIGURE 8: PROJECTED CUMULATIVE SOLAR AND WIND ADDITIONS



Sources and notes: CAISO data from CPUC 2023–2024 TPP portfolio 30 MMT scenario. PacifiCorp data from their 2023 IRP. NV Energy data from their 2021 IRP. LADWP data from their long-term strategic plan. Figure shows anticipated demand for indicated region.

The rapid growth in demand for and projected expansion of renewable energy, shown in Figure 8, is being driven by a suite of state and local energy policies and utility goals throughout the western U.S. Notably, California and Washington have committed to a pathway of 100% clean electricity by 2045, with Oregon pursuing an even more aggressive 2040 mandate.[13] Los Angeles has set a 100% clean energy goal by 2035, and Nevada has a 100% clean energy goal by 2050.[14] Where state goals are not policy drivers, utility or local commitments forecast similar shifts in resource mix, such as AZPS's pledge

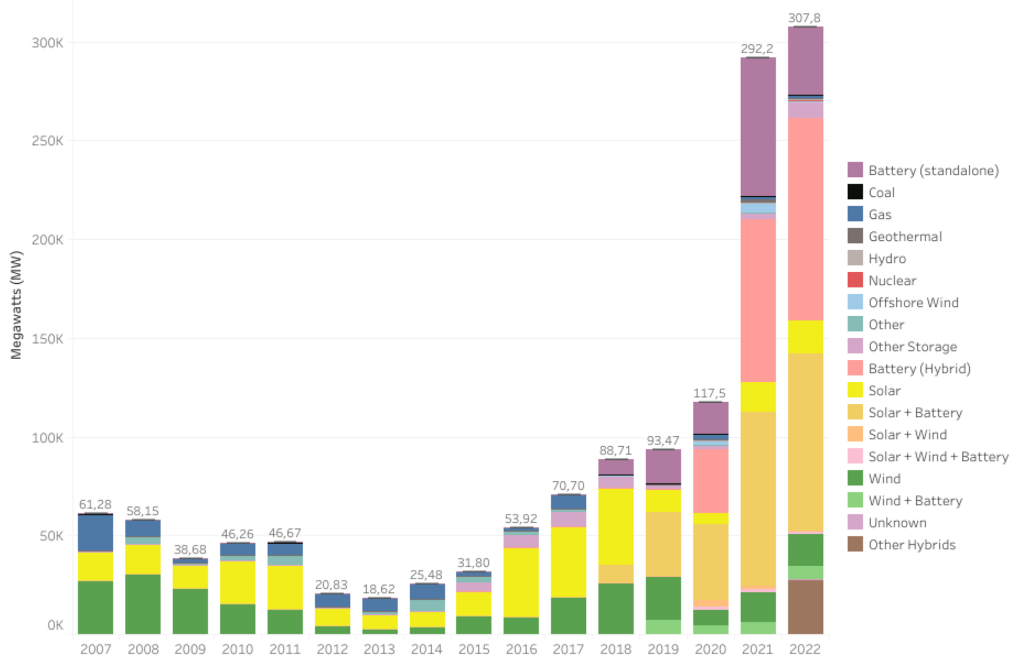
13 See SB 100 Joint Agency Report, California Energy Commission; Clean Energy Transformation Act, Washington State Department of Commerce; Oregon Clean Energy Targets (House Bill 2021), Oregon Department of Environmental Quality.

14 See Council votes for 100% renewable LADWP energy by 2035, a decade sooner than planned, Los Angeles Daily News, September 1, 2021; LA 100 Study, National Renewable Energy Laboratory; Renewable Portfolio Standard, Nevada Public Utilities Commission.

to achieve 100% emissions-free by 2050, Idaho Power's intention to meet 100% by 2045, and the pledge of nearly two-dozen Utah communities to pursue 100% by 2030.[15]

As shown in Figure 9, the exponential growth in renewable generation investments in the WECC has led to a corresponding growth in generation interconnection queues in the last few years—increasing nearly four-fold since 2018 to meet identified needs. Much of this increase has been concentrated in Nevada, Utah and Arizona, as well as CAISO,[16] which are all regions that can be served by resources interconnecting through Cross-Tie.

FIGURE 9: TOTAL CAPACITY IN QUEUES—CAISO AND WESTERN INTERCONNECT



Sources and notes: Lawrence Berkeley National Labs, Generation, Storage, and Hybrid Capacity in Interconnection Queues.

The trend toward more renewable generation investment is likely to increase further in light of recent federal legislation providing support for the development of new clean energy resources. Key provisions include the expansion and extension of a suite of tax credits for renewable and zero-carbon energy, including a $27.5/MWh PTC and 30% ITC and a suite of available bonus incentives for qualifying projects.[17] These incentives will have the effect of turbo-charging development of renewable resources,

15 See AZPS sets course for 100 percent clean energy future, AZPS; Clean Today, Cleaner Tomorrow®, Idaho Power; Utah 100 Communities.

16 Lawrence Berkeley National Labs, https://emp.lbl.gov/generation-storage-and-hybrid-capacity. See tab [Western non-ISO] and tab [Trends], with just West (non-ISO) and CAISO selected.

17 See D.C. Steinberg, et al., Evaluating Impacts of the Inflation Reduction Act and Bipartisan Infrastructure Law on the U.S. Power System, National Renewable Energy Laboratory, March, 2023, at 5, n.14.

with the National Renewable Energy Laboratory (NREL) forecasting a 25–38% increase in renewable deployment compared to a pre-policy status quo.[18]

III. Expected Delivered Cost of Electricity and Load Likely to Purchase Delivered Electricity

We analyzed the delivered cost of electricity for the resources that are most likely to utilize Cross-Tie as well as the revenues and market value right-holders on Cross-Tie could expect. While a wide range of renewable resources are being developed along the path of the Project, we chose to focus on solar resources for this analysis. We find that solar along the proposed path of Cross-Tie is cost competitive with other resources options in the region, and such projects are likely to recover their costs in the market, making them prime candidates for development and seeking rights on Cross-Tie. In addition to these solar resources, other resources are also likely to seek interest in Cross-Tie capacity to meet the large demand created by western decarbonization goals described above.

A. Delivered Cost of Electricity for Resources Likely to Purchase Rights on Cross-Tie

To estimate the delivered cost of electricity, we focus on solar resources in Utah, which are among the most cost-effective resources that are likely to purchase rights on Cross-Tie.[19] In addition to the cost of developing those solar resources, we add the cost of transmission rights on Cross-Tie, which enables those resources to interconnect and deliver their output to PACE or NVE directly at either end of the line, or to LADWP without incurring additional transmission cost.[20] Furthermore, the off-taker (e.g., a power purchasing agreement (PPA) counterparty) of the solar facility that holds the rights on Cross-Tie

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[18] See Id. at iv.

[19] For this analysis, we chose to focus on the low-cost solar resources that are abundant along the path of Cross-Tie. However, there is evidence that other types of resources are likely to be developed along the proposed path of Cross-Tie. For example, wind and storage developers have indicated that they have projects in development that could use Cross-Tie to interconnect, including a non-binding statement of interest from Arevia for approximately 1,750 MW consisting of solar, wind, and storage resources. See Appendix B. Attachment 2: Independent Market Report, of DOE's Part 2 RFP requests the delivered costs of energy for resources delivered by alternative transmission options. Given the number of potential other options in the WECC, and the need for non-public information and data to calculate accurately the delivered cost of energy through other transmission options, we have not developed those estimates in this report. Moreover, as discussed in other sections of this report, all of these alternative options are valuable and will be needed to meet existing clean energy policies and targets.

[20] With additional transmission service, renewable output delivered at Robinson could be wheeled to CAISO, AZPS, or other neighboring BAAs.

to deliver the output of the solar, would have the ability to execute trades for market energy over Cross-Tie in hours of low or moderate solar output. The profits from these market trades using rights on Cross-Tie are an offset against the cost of the delivered energy from the solar facility.

As a first step, we rely on the PacifiCorp 2023 IRP that provides estimates of the all-in capital cost of developing Utah solar, which has an estimated capacity factor of 31%. Using the PacifiCorp IRP data, we estimate the levelized cost for Utah solar is about $86 million/year, which equates to $21.37/MWh based on its estimated capacity factor.[21]

Next, we use the Cross-Tie financial model to estimate the transmission cost to deliver the solar for the 30 year life of the asset. We use Cross-Tie's revenue requirement over the first full 30 years that the line is expected to be in-service, and calculate the levelized annual revenue requirement of the line, which is approximately $65 million/year. Based on the estimated capacity factor of UT solar, this equates to about $16/MWh in transmission costs to deliver the output of the Utah solar resource.

Last, we evaluate the trading profits that the solar owner could earn through market-based trading of power between Robinson and Clover when the solar is not producing at maximum output. We conduct this analysis in two stages. First, trading profits using the historical EIM prices from 2018 to 2022.[22] Second, we use the 2032 simulated flows on Cross-Tie and prices at Robinson and Clover from our benefit-cost study to determine trading profits that the solar owner could make with the excess rights on Cross-Tie. We interpolate between the historical average and 2032 estimate to approximate annual trading profits in the early years of Cross-Tie's operating life and levelize that stream of profits. We estimate that the solar owner could generate about $29 million/year in trading profits using the excess rights on Cross-Tie, making the net transmission costs for the solar facility about $8.84/MWh.

Accounting for the levelized cost of Utah solar, the cost of transmission rights on Cross-Tie, less the trading profits that can be made with the excess transmission rights, we determine that the all-in delivered cost of Utah solar over Cross-Tie is $30.22/MWh. That includes the $21.37/MWh for the solar and $8.84/MWh for transmission (less the trading profits using excess rights).

B. Energy Market Value of Delivered Resources

We compare the all-in levelized cost of delivered solar generation over Cross-Tie to its market value by analyzing prices at Robinson and Clover (taking the higher prices at either location) to estimate the market value of the assumed production profile of Utah solar. We conduct this analysis in two ways, first using the historical EIM prices at Robinson and Clover, and second using our simulated 2032 prices from the 2021 study, which includes the impact of adding Cross-Tie. We find that the output of a typical Utah solar facility would have had a market value of $33/MWh on average when considering the historical EIM over the past 5 years. Similarly, the same Utah solar production profile will have a market value of $20/MWh in 2032, based on our simulated prices in that year. The projected decline in market value

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[21] See Appendix A for a description of how we levelize the cost of the solar and Cross-Tie transmission service.

[22] This analysis is similar to the Adjusted Production Cost analysis conducted in Section I.A, except it accounts for the solar production.

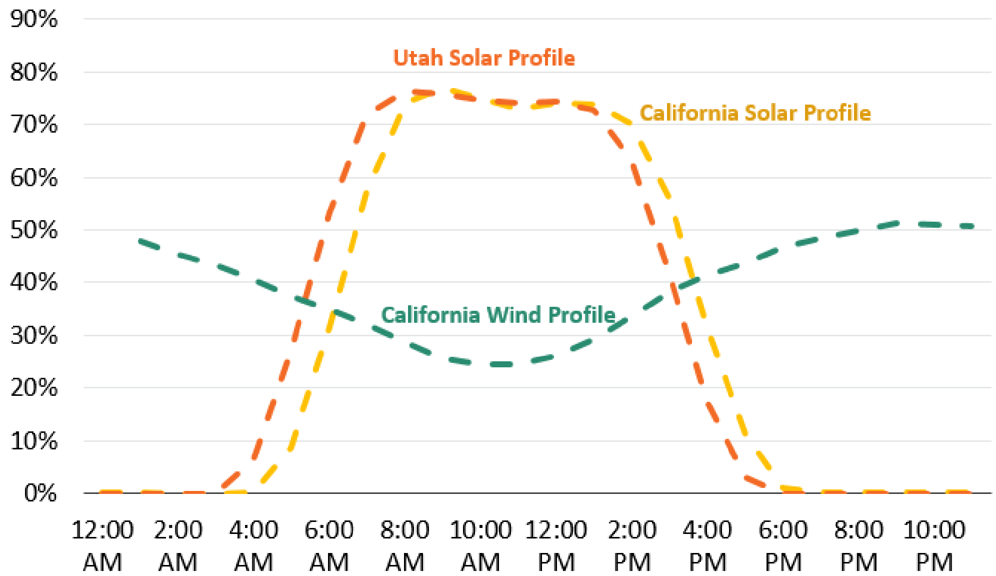
moving towards 2032 is due to the development of significantly more solar resources in Nevada and Utah over the next decade. However, even at the lower projected future market revenue, Utah solar connected to Cross-Tie would be able to earn almost the entire all-in cost (taking into account additional market-based trading revenues over Cross-Tie transmission rights when the solar facility is not producing) in the near-term years, and a significant portion of its all-in cost into the 2030s. All renewable resources, especially solar, are likely to suffer from declining market value as more zero-variable cost resources come onto the system.

C. Resource Adequacy Value

In addition to their energy market value, renewable resources interconnected through Cross-Tie will offer resource adequacy value. In addition, by leveraging the diversity of production between locally interconnected renewable resources along Cross-Tie's proposed path and other renewable resources and loads in the region, Cross-Tie itself can help provide resource adequacy to the region.

For example, when comparing Utah solar to California solar, solar further east in WECC begins generating earlier in the day when California solar is still ramping up and California wind is ramping down after its early morning peak. During winter peaking periods, Utah solar better serves morning peaks in California than local wind or solar. Looking at typical hourly load and renewable generation profiles, we find that Utah solar produces at an average capacity of 43% factor during CAISO's winter morning peak, while local California solar and wind generate at a 29% and 23% capacity factor, respectively. As shown in Figure 10 below, the annual average hourly profile for Utah solar starts early in the day, providing some additional resource adequacy value for California load-serving entities in the morning hours. There may be an opportunity for a developer of Utah solar to monetize this comparative resource adequacy value in the form of a PPA with a California load-serving entity that includes a premium for the diverse production profile compared to local California solar.

FIGURE 10: AVERAGE PROFILES OF CALIFORNIA AND UTAH RENEWABLES RESOURCES



Sources and notes: Renewable production profiles from Cambium for resources in Utah and NREL for CAISO.

Additional factors, beyond the different production profiles of renewables near Cross-Tie compared to other areas in the region, are likely to further increase the resource adequacy benefit provided by Cross-Tie. For example, because California, Nevada, and Utah all face different periods of system peak, Cross-Tie improves the ability for the system to transfer power into particularly stressed areas of the system to avoid future load-shed events and increase reliability (see Figures 3 and 4). Potential resource adequacy benefits are even larger if Cross-Tie is used to interconnect other resources types, such as Utah wind, or used to help deliver renewables from further afield, such as WY wind or flexible hydro power from the Pacific Northwest.

D. Estimate of GHG Emission Reduction and Value of Reduction

We estimate avoided GHG emissions due to Cross-Tie in two parts. First, we estimate the emissions reduction created by the renewable resources interconnecting through Cross-Tie, using Utah solar as an illustrative renewable resource. Second, we account for any market transactions that are likely to occur in hours when the output of the solar is not utilizing all the rights on Cross-Tie. Our methodology is described in Appendix A, and the results of our analysis are presented in Attachment 5a provided by TransCanyon in their Part 2 application.

Our analysis shows that Cross-Tie will be responsible for 19.5 million tons of CO_2 emissions reductions between 2028 and 2050, which is 850,000 tons/year on average over that time period. In 2028, we find that Cross-Tie will avoid 1.34 million tons of CO_2, which will decline to 0.46 million tons in 2050, as fossil resources retire or are dispatched less in the wake of more renewable resources coming onto the system.

The precise locations of the avoided GHG emissions are difficult to pinpoint, however there are multiple load centers that would be served by market transfers over Cross-Tie, which means any of them could benefit from reduced emissions due to by the Project. These include not only the service areas of NVE and PACE (directly connected to Cross-Tie), but also CAISO, LADWP, or in Arizona.

IV. Impact of Cross-Tie on Regional Economic Growth

We estimate the economic stimulus benefits of Cross-Tie based on a review of other studies that have analyzed the impact of infrastructure on economic output and job creation from transmission and renewable generation development, and apply those studies to the specific characteristics of Cross-Tie. We additionally present information on the estimated tax revenues generated by Cross-Tie, prepared by TransCanyon, LLC.

Development of transmission infrastructure can provide substantial employment and economic output during both the construction and operation phases. To estimate the employment and economic stimulus created by the capital investment made to build Cross-Tie, we first surveyed existing studies on the economic benefits of transmission infrastructure investments in the western and central U.S. and scaled the benefits to the projected capital costs of Cross-Tie. As shown below, we estimate that Cross-Tie will result in over 2,400 full time equivalent (FTE) jobs directly created by the project and an additional 1,700 FTEs through associated economic activity (almost 4,100 FTEs in total). The total economic activity stimulated by Cross-Tie amounts to around $761 million.

FIGURE 11: ECONOMIC GROWTH BENEFITS OF CROSS-TIE

Study		Region	FTE Jobs & Output per $1 MM Tx Investment		
			Direct FTE (#)	Total FTE (#)	Output ($ MM)
2011 Brattle WIRES	**[1]**	US	4.25	12.5	$2.5-$3.33
2010 Brattle SPP	**[2]**	SPP	3.9	4.3	$0.90
2021 London Economics International WIRES	**[3]**	SPP	3.46	7.7	$1.35
		WECC	3.63	8.3	$1.38
Brattle Nebraska Study	**[4]**	Nebraska	3.96	6.6	$1.10
2011 NREL	**[5]**	Wyoming		4.8	
Assumption for Cross-Tie Estimation	**[6]**		3.74	6.35	$1.18
Cross-Tie Estimation (Total tx investment of $644 MM)	**[7]**		**2,407**	**4,089**	**$761**

Sources and notes: Estimates in row [6] are the average of rows [2]-[5]. [1]: J. Pfeifenberger, et al., Employment and Economic Benefits of Transmission Infrastructure Investment, The Brattle Group, May, 2011; [2]: J. Pfeifenberger, et al., Job and Economic Benefits of Transmission and Wind Generation Investments in the SPP Region, The Brattle Group, March, 2010; [3]: London Economics International, Transmission Investment for Economic Stimulus and Climate Change, May, 2021; [4]: J. Chang, et al., Nebraska Renewable Energy Exports, The Brattle Group, December 12, 2014; [5]: NREL, Jobs and Economic Development from new Transmission and Generation in Wyoming, March, 2011.

In addition to the investment made directly in Cross-Tie, the Project would enable the development of renewable resources along the proposed path of the line in Utah and Nevada. We reviewed existing studies on the employment and economic growth benefits of solar development in Nevada and Utah and calculated the benefits associated with each. As shown below, we find that 1,500 MW of solar developed in Utah and/or Nevada would create over 12,000 FTEs directly created by the investment in the renewable projects, and almost 14,000 FTEs when include jobs created by the associated economic activity. The total economic activity stimulated by the investment in 1,500 MW of solar along the propose path of Cross-Tie amounts to over $4 billion.

FIGURE 12: ECONOMIC IMPACTS OF UTAH & NEVADA SOLAR CAPACITY

Study		Region	FTE Jobs & Output per $1 MM Tx Investment		
			Direct FTE (#)	Total FTE (#)	Output ($ MM)
2015 DGA	**[1]**	NV	9.7		0.6
2004 NREL	**[2]**	NV	4.8	9.2	4.7
2021 NREL JEDI Model	**[3]**	UT	4.3	5.1	1.4
2021 NREL JEDI Model	**[4]**	NV	4.2	5.0	1.1
Assumption for UT/NV Solar Estimation	**[5]**		5.75	6.44	1.95
UT/NV Solar Estimation (Total investment of $2.2 B)	**[6]**		**12,368**	**13,858**	**4,199**

Sources and notes: Estimates in row [5] are the average of rows [1]-[4].
[1]: David Gardiner and Associates (DGA), Powering Up Nevada: A Report on the Economic Benefits of Renewable Electricity Development, published by the Nevada Governor's Office of Energy, January 2015; [2]: R. K. Schwer & M. Riddel, The Potential Economic Impact of Constructing and Operating Solar Power Generation Facilities in Nevada, published by NREL, February 2004. [3], [4]: Estimated using the NREL Jobs & Economic Development Impact (JEDI) Photovoltaics Model PV05.20.21, released May 2021.

The Cross-Tie financial model submitted by TransCanyon in its Part 2 application, provides information on the local property tax and income tax the Project would pay during construction and while in-service. Tax revenues generated by the Project will provide additional benefit to the local economies along the path of the line, providing revenue stream for local governments to use on local infrastructure and services. The Cross-Tie financial model indicates that property taxes incurred during the construction of Cross-Tie, assuming a tax rate of 1.35% (inflated at 2% annually), will total around $8.2 million. In addition, over the 60-year expected service life of the Project, property taxes accrued will amount to $9.1 million per year. Income taxes paid out from the start of construction to the end of Cross-Tie's lifetime will be $4.7 million per year.

V. Value of Cross-Tie to DOE as an Anchor Tenant

Our assessment of Cross-Tie demonstrates that there is significant value for the rights holders on the project, and benefits for the market as a whole and power customers in the region. We see several potential approaches for the DOE to recover its investment in Cross-Tie. The most likely approach for the DOE to recover their investment is to sell its rights on Cross-Tie prior to the line going into service. In this case, the most likely counterparty for that sale would be a renewable developer building projects along the proposed path of the line. Alternatively, the DOE could retain its rights on Cross-Tie after the line goes in-service, and contract with a market participant for long-term rights to its capacity. Several types of market participants are likely to be interested in procuring the capacity on Cross-Tie, to capture the market benefits summarized in this report. Cross-Tie has identified interest from renewable developers along the proposed path of the line, as cited earlier in the report.

Our report has demonstrated the viability of the most likely way the DOE will be able to recover its investment in Cross-Tie, by **interconnecting renewables and providing deliverability to several load centers in the WECC.** Our analysis of the delivered cost of energy for renewables along the proposed path of Cross-Tie demonstrated that Utah solar, delivered via Cross-Tie, is an attractive resource. This analysis shows that the renewable developer would be able to earn sufficient revenues in the energy market to support the project, increasing the likelihood that the developer would be able to secure a PPA with a load-serving entity in the region. The unique position of the Cross-Tie line allows for the delivery of renewables interconnected on the Project directly to NVE and PACE, and also to LADWP (through their rights from Clover to IPP), CAISO, and Arizona utilities (both through NVE).

The value provided by Cross-Tie depends on several factors that may change in the coming years in the WECC. These evolving market conditions may increase the value of Cross-Tie, or present risks for DOE in recovering their investment. We summarize and assess various evolving market conditions that may positively or negatively affect the value of owning the rights on Cross-Tie, presented in the table below.

TABLE 1: IMPACTS OF MARKET CONDITIONS ON CROSS-TIE PROJECT VALUE

Market Variable	Increase Market Value	Decrease Market Value
Decarbonization Policies & Subsidies for Renewables	Faster adoption of decarbonization goals will increase demand and need for renewables and interconnection rights	Policies that push back on renewable development or decarbonization trends are likely to reduce the value of Cross-Tie
Increased Load Growth & Changing Patterns due to Electrification	Accelerated load growth and new load patterns due to electrification will increase need for access to low cost resources, especially during peak and overnight hours, and increase the value of flexibility/redundancy on the transmission system	Slower adoption of electrification and shifting demand to solar producing hours or off-peak hours may reduce value of flexibility
Transmission Development	Mixed value drivers related to development of other transmission projects. Many of the other proposed transmission projects in the region are synergistic with Cross-Tie, implying that development of those projects would increase the value of Cross-Tie, while delayed development or cancellation would diminish value for Cross-Tie. The development of other proposed projects many have the opposite effect on Cross-Tie	
Transmission Costs	Cross-Tie costs are lower than expected	Cross-Tie costs are higher than expected
Storage Development	Mixed value drivers related to development of storage resources. In many cases, Cross-Tie can help increase the value of new storage resources, by allowing storage resources to access higher-priced sales and lower-cost charging opportunities. In other instances, storage resources may reduce the value of Cross-Tie by reducing the need to transport energy over the transmission system to access higher energy market prices	
Natural Gas Prices	Higher natural gas prices create additional congestion, and therefore increase price differences across Cross-Tie	Lower natural gas prices reduce congestion and value of market transactions
Market Expansion	Cross-Tie's central location in a potential regional market creates substantial value for Cross-Tie rights-holders. As part of a regional market, renewable interconnected through Cross-Tie could access any load center in the market footprint without paying additional transmission charges, greatly increasing value of those resources. Any market integration should carefully consider the change in value associated with transmission rights and/or the possibility of tariff-based cost recovery	

Appendix A

A.1 Brattle 2021 Benefit-Cost Study for TransCanyon and PacifiCorp

The Brattle Group in 2021 conducted a benefit cost analysis for PacifiCorp and TransCanyon aimed at studying some of the proposed Gateway transmission projects and Cross-Tie. The study used the WECC Anchor Dataset, regional resource plans, and other data from PacifiCorp and TransCanyon to model the WECC in 2032 using Power Systems Optimizer (PSO), a state-of-the-art production cost simulation model licensed from Enelytix. We used a nodal model to simulate a base case in 2032 without the new transmission projects and a change case that added in certain segments of the Gateway projects, Cross-Tie, and 1,500 MW of new wind located in Wyoming and interconnected with the Gateway projects.

As part of the 2021 study, the Brattle Group closely coordinated development of WECC modeling assumptions with TransCanyon and PacifiCorp. PacifiCorp provided updated fuel price forecasts for 2032 and forecasts of transmission path ratings throughout the WECC. PacifiCorp, NV Energy, and Arizona Public Service each provided anticipated resource mixes for their service territories. PacifiCorp also provided Brattle updated forecasts for transmission path ratings in 2032 throughout the WECC. Additionally, Brattle updated the CAISO resource mix using the 2021 California Transmission Planning model, and California greenhouse gas prices.

As part of these efforts, Brattle added several new features to the WECC model to better identify and quantify transmission benefits. Such improvements included incorporating day-ahead renewable and load forecast errors to the model, based on data provided by PacifiCorp and TransCanyon and data from the CAISO's OASIS website. Brattle also modeled two extreme weather weeks, a typical summer heat wave week in the Southwest, and a cold snap week in the Pacific Northwest.

For this report, we used the 2021 modeling results to calculate the following metrics:

- The estimated 2032 energy market value and line utilization of Cross-Tie
- The estimated 2032 greenhouse gas emissions savings from Cross-Tie
- The average flows by hour of day in 2032 on Cross-Tie
- The 2032 market value of Utah solar
- The extreme-week and grid resiliency benefits of Cross-Tie in a simulated cold snap and heat wave.

The 2021 results are also the basis for Figure 3, Figure 4, Figure 6, and Figure 7 of this report, which used modeled generation, line flows, local marginal prices, and regional results to analyze the differences between the modeled base case without the new transmission elements and the change case with the new elements.

A.2 Price Elasticity Analysis using GridSIM

GridSIM is The Brattle Group's proprietary capacity expansion model. It optimizes capacity expansion and system dispatch to satisfy hourly demand, capacity requirements, and clean energy policies at lowest cost, subject to additional constraints simulating real-world system operations. GridSIM forecasts energy prices and grid capacity given investment and operating cost assumptions. We use GridSIM to simulate the price responsiveness of the WECC power system to the addition of new transmission. We simulated two near-identical GridSIM models, one a business-as-usual case and one with an additional 1,000 MW of transmission capability between the CAISO and the Great Basin region (BASN) (NVE, PACE, and IPCO BAAs) regions in the model.

We analyze the price effect of this additional transmission capability by comparing modeled hours between both cases, bucketing these hours based on observed price differentials between the CASO and BASN regions in GridSIM. In the same hours, deviations in the price differential seen in the post-line case are directly attributable to flows on the added 1,000 MW of transmission capacity.

The relationship between prices in the pre-line model and those from the post-line model *in the same hours* is applied to real-time EIM prices recorded at Robinson and Clover, scaled up to 1,500 MW when estimated flows would have exceed 1,000 MW. This set of derived prices serve as a proxy for the effect of market transfers along Cross-Tie, and are used to estimate production cost savings, delivered costs of electricity, wheeling and congestion revenues as applicable.

We provide below the key assumptions we relied on for the GridSIM modeling:

- **Geographic Scope:** We modeled the WECC power system with zones for California (CASO, ZP26, and CANO), BASN, Rocky Mountain, Northwest, and Southwest.
- **Annual Demand**: For California, annual total and peak load forecasts are from California Energy Commission (CEC) load forecasts for the 2022 CEC IEPR,[23] the CEC's 2021 SB 100 Joint Agency Report,[24] and the CEC's Deep Decarbonization in a High Renewable Future Report.[25] Annual load forecasts for the other WECC zones are from the Energy Information Administration (EIA) Annual Energy Outlook (AEO) Reference Case projections.[26] Modeled base load shapes are based on 2020 hourly utility load data from the FERC 714 database, aggregated for each region, and scaled to match AEO forecasts of peak and total demand.

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23 California Energy Commission. 2022 Integrated Energy Policy Report Update. February 2023. https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report/2022-integrated-energy-policy-report-update

24 California Energy Commission. 2021 SB 100 Joint Agency Report. March 2021. https://www.energy.ca.gov/publications/2021/2021-sb-100-joint-agency-report-achieving-100-percent-clean-electricity

25 California Energy Commission. Deep Decarbonization in a High Renewables Future. June 2018. https://www.energy.ca.gov/sites/default/files/2021-06/CEC-500-2018-012.pdf

26 US Energy Information Administration. Reference Case Projections. 2022. https://www.eia.gov/outlooks/aeo/tables_ref.php

- **Generation Resources**: GridSIM models existing generation and storage capacity consistent with the AEO 2021 Reference Case.[27] Planned assets with near-term commercial online dates are added. Generating units retire at the end of their specified economic lifetimes (based on assumptions from the NREL Regional Energy Deployment System (ReEDs) model). For California, renewable generation profiles were sourced from the California Public Utilities Commission (CPUC)'s Unified Resource Adequacy (RA) and Integrated Resource Plan (IRP) Modeling Datasets 38 million metric tons (MMT) Portfolio—2030 Renewables Profiles from May 2022.[28] Other zones' renewable generation profiles are from NREL's Renewable Energy Potential Model (ReV) with adjustments based on regional historical capacity factors.

Cost Assumptions: Existing resource variable O&M and heat rates based on the NEMS database. New resource overnight capital costs, variable O&M, and fixed O&M assumptions are from NREL's 2022 Annual Technology Baseline (ATB) "Moderate" Case trajectories, varying by zone.[29] Near term natural gas fuel prices for 2025 and 2030 are based on regional forward market data sourced from MI Forward via S&P Global Market Intelligence Capital IQ Pro as of April 4, 2022.[30] After 2030, prices escalate annually based on the long-run Henry Hub natural gas price trajectory from the 2021 AEO.[31] We include updated ITC and PTC assumptions based on the Inflation Reduction Act.

A.3 Transmission and Solar Costs

To estimate the transmission rate used for Cross-Tie, we take the total revenue requirement of Cross-Tie from the financial model provided by TransCanyon over the first 30 full years of the line. We use a real ATWACC used by TransCanyon in the financial model to levelize the first 30 years of revenue requirement to obtain an annualized estimate of $73 million per year, for the 1,500 MW of Cross-Tie. From this annualized revenue requirement, we calculate the hourly rate on a $/MWh basis for our analysis of the delivered cost of energy by dividing the annual levelized revenue requirement by expected output of Utah solar, crediting the rights holder with other energy market revenues earned using their rights on Cross-Tie.

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27 US Energy Information Administration. Documentation of the National Energy Modeling System (NEMS) Modules. https://www.eia.gov/outlooks/aeo/nems/documentation/

28 California Public Utilities Commission. Unified Resource Adequacy (RA) and Integrated Resource Plan (IRP) Modeling Datasets. 2022. https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-power-procurement/long-term-procurement-planning/2022-irp-cycle-events-and-materials/unified-ra-and-irp-modeling-datasets-2022

29 National Renewable Energy Laboratory, 2022 Annual Technology Baseline. https://atb.nrel.gov/electricity/2022/index

30 S&P Global Market Intelligence Capital IQ Pro. MI Forward Natural Gas Forward Prices. April 4, 2022. https://www.capitaliq.spglobal.com/web/client?auth=inherit#markets/commoditiesChart

31 US Energy Information Administration. Reference Case Projections. 2022. https://www.eia.gov/outlooks/aeo/tables_ref.php

We perform a similar analysis to estimate the levelized revenue requirement of 1,500 MW of Utah solar. We use cost estimates and representative capacity factors from the 2022 NREL ATB for our levelization, and assume a 30-year lifetime for the plant. This gives us a levelized annual revenue requirement of $21.37/MWh.

A.4 Avoided GHG Emissions Analysis

We estimate avoided GHG emissions from flows across Cross-Tie, by analyzing the marginal emissions rates in the BAAs on either side of Cross-Tie (NVE and PACE) and the expected flows over Cross-Tie.[32] We conduct this analysis in two stages. First, we account for the emissions reduction created by the renewable resources interconnecting through Cross-Tie, using Utah solar as an illustrative renewable resource that could interconnect through Cross-Tie. Second, we account for any market transactions that are likely to occur in hours when the output of the solar facility is not utilizing all the rights on Cross-Tie. To the extent market transactions on Cross-Tie flow from the lower-emitting BAA to the higher-emitting BAA, we attribute a reduction in GHG emissions based on the difference in the marginal emissions rates in the two BAAs and the magnitude of flows on Cross-Tie.

In the first stage, which accounts for the production a 1,500 MWs of Utah solar interconnected through Cross-Tie, we analyze the hourly output of the solar and assume it displaces the marginal emissions rate in either NVE or PACE (we use the BAA with the lower marginal emissions rate in that hour to provide a conservative estimate of emissions reductions). We conduct this analysis for each year provided in the NREL Cambium data set from 2028 through 2050, and then interpolate between the years provided in the data set to provide estimates for the future years not simulated by NREL.

In the second stage, which account for potential emissions reductions caused by market transactions conducted when the solar facility is not utilizing all the rights on Cross-Tie, we conduct the analysis in two ways. First, using historical EIM prices from 2018-2022 to estimate market transactions and related emissions reductions, which gives us an estimated emissions reduction for near-term years. Second, using our simulated 2032 results, which gives us a medium-term estimate of emissions reductions. We interpolate between those two to fill in the years from 2028 to 2032 in Attachment 5a, and then extrapolate the same trend to complete the years from 2032 to 2050.

For the analysis of emissions reduction due to market transactions, when solar is not producing, we rely on NREL's 2024 and 2032 simulated marginal emissions rates. The 2024 rates, the earliest year provided by NREL, are used as a proxy for near-term emissions rates and applied to the historical analysis. The 2032 rates are applied to our 2032 simulation results. We study the correlation between the price delta from NVE to PACE, using NREL's simulated prices, and the marginal emissions rates provided by NREL. This gives us a representative value for the avoided emissions due to market transactions between NVE and PACE, based on the price delta between the two BAAs. Generally, we find that as the price delta

[32] We rely on marginal emissions rates from NREL's 2022 Cambium Mid-Case data sets, released January 2023, which provide hourly short run marginal emissions rates at the BAA and sub-BAA level.

between the two BAAs grow the emissions reduction increases as higher-prices generation resource typically have higher emissions rates.

For the historical analysis, we estimate market transactions on Cross-Tie based on EIM prices at Robinson and Clover across the last five years, accounting for price convergence as described previously in our analysis of the delivered cost of energy. Based on our estimated historical transactions in each year from 2018 to 2022 by observing the price delta between NVE and PACE and applying the appropriate emissions rate reduction from the analysis described above. We do this for all five historical years, using the 2024 NREL emissions rates. We then average the five years and use that as the estimated 2024 emissions rate reduction due to market transactions.

For the 2032 analysis, we use the simulated flows on Cross-Tie (netting out the expected flows due to the solar production) and the simulated prices at Robinson and Clover. We apply the same relationship between the price delta and emissions rates as described above using NREL's 2032 emissions rates. This gives us estimated 2032 emissions reductions due to market transactions on Cross-Tie when the interconnected solar is not producing.

Appendix B

ARE VIA
POWER

900 S. Pavilion Center Drive, Suite 150
Las Vegas, NV 89144

June 1st, 2023

Jason Smith
President
TransCanyon, LLC
One Arizona Center,
400 East Van Buren Street, Suite 350
Phoenix, AZ 85004

Re: Non-Binding Expression of Interest in Cross-Tie Service

Mr. Smith,

As previously discussed, Arevia Power is interested in the possibility of interconnecting certain of its planned facilities to TransCanyon, LLC's Cross-Tie Transmission Line ("Cross-Tie"). Arevia's planned facilities which could potentially be connected to Cross-Tie include:

800 MW of approximately 28% capacity factor wind generation
600 MW of approximately 30% capacity factor solar generation
350 MW of battery storage

The foregoing represents a non-binding expression of interest by Arevia Power in Cross-Tie, which non-binding interest is subject to further discussions.

Very truly yours,

Mark Boyadjian
Managing Partner
Arevia Power LLC

List of Acronyms

AEO	Annual Energy Outlook
ATB	Annual Technology Baseline
ATWACC	After-Tax Weighted Average Cost of Capital
AZPS	Arizona Public Service Company
B2H	Boardman-to-Hemingway
BAA	Balancing Authority Area
BASN	Great Basin Region
BPA	Bonneville Power Administration
CAISO	California Independent System Operator
CANO	CAISO North
CASO	CAISO South
CEC	California Energy Commission
COI	California-Oregon Intertie
DOE	Department of Energy
EIA	Energy Information Administration
EIM	Energy Imbalance Market
EPE	El Paso Electric
FERC	Federal Energy Regulatory Commission
GHG	Greenhouse Gas
GW	Gigawatt
GWh	Gigawatt Hour
HVAC	High-Voltage Alternating Current
IPCO	Idaho Power Company
IPP	Intermountain Power Project
IRP	Integrated Resource Plan
ISO	Independent System Operator
kV	Kilovolt
LADWP	Los Angeles Department of Water and Power
MidC	Mid-Columbia Trading Hub
MMT	Million Metric Tons
MW	Megawatt
MWh	Megawatt Hour
NOB	Nevada-Oregon Border Trading Hub
NREL	National Renewable Energy Laboratory
NVE	NV Energy

O&M	Operations & Maintenance
PACE	PacifiCorp East
PACW	PacifiCorp West
PDCI	Pacific Direct Current Intertie
PGE	Portland General Electric
PNM	Public Service Company of New Mexico
PPA	Power Purchase Agreement
PSCO	Public Service Company of Colorado
PSO	Power Systems Optimizer
RA	Resource Adequacy
ReEDs	Regional Energy Deployment System
ReV	Renewable Energy Potential Model
SPTO	Subscriber Participating Transmission Owner
SRP	Salt River Project
SWIP-N	Southwest Intertie Project-North
TWh	Terawatt Hour
U.S.	United States
WECC	Western Electricity Coordinating Council