Southwest Intertie Project—North Independent Market Report

DOE PART 2 APPLICATION

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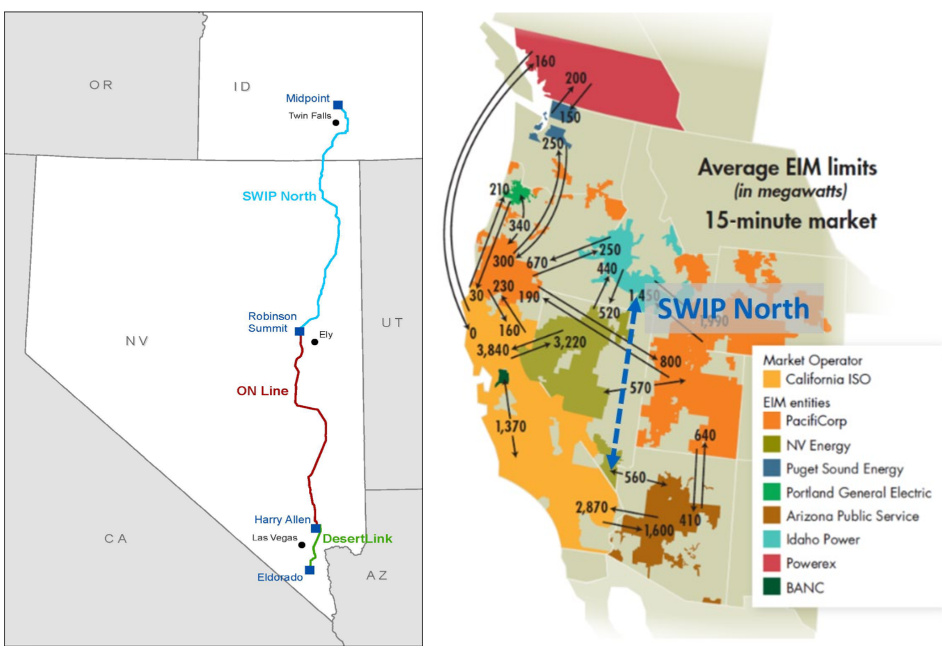
I. Background and Analytical Approach

Great Basin Transmission, LLC retained consultants at The Brattle Group to complete an independent market report of the Southwest Intertie Project-North (SWIP-North) as a part of its Part 2 application to the U.S. Department of Energy Transmission Facilitation Program. SWIP-North is a 500 kV transmission project between the Midpoint 500 kV substation in Idaho and Robinson Summit 500 kV substation in Nevada under development by Great Basin Transmission, LLC, as shown in Figure 1 below. SWIP-North creates a new path in the western U.S. power system that links Northwest utilities (such as PacifiCorp, Idaho Power, and others) to California and Southwest utilities, such as CAISO utilities, NV Energy, and Arizona Public Service. In conjunction with the One Nevada (ON) Line, SWIP-North will allow for 2,070 MW of north-to-south transfer capability from Midpoint 500 kV substation to Harry Allen 500 kV substation in Southern Nevada and 1,920 W of south-to-north capability from Harry Allen to Midpoint, under an existing agreement with NV Energy related to ON Line. When completed, LS Power will be entitled to about 55% of the capacity between Midpoint and Harry Allen (1,117.5 MW of north-to-south capacity and 1,072.5 MW of south-to-north capacity) and NV Energy will hold the remaining capacity. Throughout this report, we refer to LS Power's portion of the additional transfer capability as "SWIP-North Capacity."

FIGURE 1: LOCATION OF SWIP-NORTH PROJECT



Sources: LS Power, Southwest Intertie Project (SWIP)-North, December 03, 2020, p. 3; CAISO, 2019 Annual Report on Market Issues and Performance, July 6, 2020, p. 11.

To assess the market impacts of SWIP-North Capacity, we completed the following steps:

- Evaluated historical 2018 to 2022 hourly prices in the Western Energy Imbalance Market (EIM) to identify how the SWIP-North Capacity would have been utilized if it had been in operation, including the timing, scale, and value of market transactions across the line;
- Similarly, evaluated projected 2030 to 2040 hourly prices generated by our internal capacity expansion model, gridSIM, of the Western Electricity Coordinating Council (WECC) system (we provide details of the key assumptions used for developing the model in Appendix A);
- Reviewed the existing and new generation that is likely to utilize SWIP-North Capacity based on a database of existing resources, a review of current utility interconnection queues, and recent planning studies (including IRPs and transmission planning studies);
- Evaluated the additional value of SWIP-North to reduce the costs of achieving resource adequacy and reducing customer outages during extreme market conditions;
- Evaluated the delivered cost of electricity and GHG emissions reduction via SWIP-North Capacity from generation resources, from low price end to loads on the high price end;
- Estimated the employment and economic growth benefits to the region of the development of the SWIP-North transmission and associated renewable energy;
- Evaluated the revenues that DOE could receive for the ownership of SWIP-North Capacity.

Additional details on our approach are included in the appendix.

II. Market Issues Addressed by SWIP-North

SWIP-North adds transmission capacity between regions of WECC that currently have either limited transfer capacity between them or experience high levels of congestion on parallel paths. In addition, SWIP-North is located between regions with a diverse supply of low-cost renewable energy resources that are currently in development and seeking interconnection to the power system, but may be unable to cost effectively deliver its output to regions with significant demand for renewable energy generation without additional transfer capacity. SWIP-North will address significant market issues that currently exist in the Western power system associated with achieving renewable energy and decarbonization goals while maintaining a reliable and cost effective power system. These issues are likely to become even more significant as the system adds increasing amounts of renewable energy and energy storage resources to achieve state and utility GHG reduction goals.

Below we summarize the primary market issues addressed by SWIP-North, which include:

- Limited capacity between the Northwest and Southwest to increase cost effective market transactions;
- Limited access to cost effective renewable energy resources;
- Need for additional redundancy to limit the impact of extreme market conditions;
- Limited capacity to leverage load diversity benefits and increase reliability.

We then address whether alternative transmission proposals will be able to provide similar value to the WECC system.

A. Increase Cost Effective Market Transactions

Currently there is limited capacity between the Northwest and Southwest, which prevents cost effective market transactions and results in congestion on the existing system and higher costs to customers. Historically, north-to-south congestion on the existing transmission paths from the Northwest into California, including the California-Oregon Interface (COI) and the Nevada-Oregon Border (NOB) path, have limited cost effective imports that could lower electricity prices for California ratepayers. Annual congestion has averaged $94 million per year on COI and $44 million per year on NOB from 2017 to 2021.[1] CAISO forecasts that high levels of congestion will persist (about $50 million per year on COI) into the early 2030s.[2]

In addition, south-to-north congestion on Path 26 within CAISO has increased over the past several years during peak solar producing hours, with Path 26 congestion having the "greatest impact on average 15-minute prices in 2021" of any internal CAISO path.[3] CAISO forecasts Path 26 congestion will increase to $47 million per year in its latest planning study.[4] Path 26 congestion limits the ability for CAISO to export excess generation from the southern portion of CAISO, NV Energy, and Arizona utilities to the northern portion of CAISO and the Northwest. Alternative paths for exporting excess solar from Southern California and the Southwest,

1 CAISO refers to the AC intertie from the Northwest that crosses COI as "Malin 500." CAISO, 2021 Market Issues and Performance Report, July 2022, p. 211.

2 CAISO, 2022–2023 Transmission Plan, Appendix G: Production Cost Simulation and Economic Assessment Detailed Results, May 18, 2023, p. G-23.

3 CAISO, 2021 Market Issues and Performance Report, July 2022, p. 205.

4 CAISO, 2022–2023 Transmission Plan, Appendix G: Production Cost Simulation and Economic Assessment Detailed Results, May 18, 2023, p. G-23.

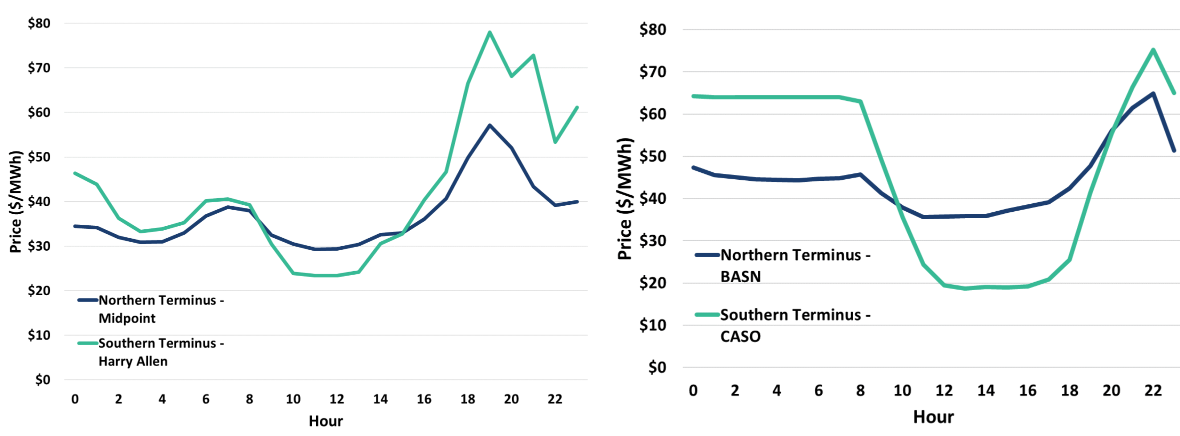
including NOB and the Intermountain Power Project (IPP) high voltage direct current (HVDC) line, face limitations from selling into bilateral markets and reversing flow of HVDC lines.

SWIP-North creates an alternative path around the congested constraints (e.g., COI and Path 26) and connects portions of WECC that are currently weakly connected. This will allow for increased cost effective market transactions. The additional north-to-south capacity will allow low cost Northwest resources to meet peak demand periods in California and the Southwest, reducing costs and increasing reliability. In addition, the south-to-north capacity increases the capacity for exporting low cost surplus generation during peak solar-producing hours from CAISO, NV Energy, and Arizona utilities to Northwest load, both reducing costs and avoiding renewable energy curtailments.

To demonstrate the scale of market transactions enabled by SWIP-North Capacity, we analyzed historical 2018 to 2022 energy prices from the EIM (as a proxy for energy prices in the first-year SWIP-North is online) and projected 2030 to 2040 energy prices from our internal WECC simulations. Figure 2 below shows the price differences across SWIP-North based on historical EIM prices (Figure 2A) and projected 2040 energy prices from our internal simulations (Figure 2B); prices at the southern terminus at Harry Allen are shown as the green line and prices at the northern terminus at Midpoint are shown as the blue line. The historical hourly prices at Harry Allen exceeded prices at Midpoint by $15/MWh on average during peak and overnight periods between Hour 17 and Hour 2. Prices reverse in the middle of the day with prices higher at Midpoint than Harry Allen by $5/MWh between Hour 9 and Hour 14.

FIGURE 2: AVERAGE HOURLY ENERGY PRICES ACROSS SWIP-NORTH

(A) HISTORICAL 2018–2022 PRICES (B) PROJECTED 2040 PRICES



The forward-looking prices show that these trends in prices between Midpoint (represented by the BASN region) and Harry Allen (represented by the CASO region) are projected to follow a similar pattern but with larger price differentials due to rising electrification demand and the transition to clean energy resources.[5] Mid-day prices are lower at the southern end of the line than the northern end for longer stretches during solar producing hours and the overnight hour price differentials persist longer than observed historically.

Adding LS Power's SWIP-North Capacity to the system will allow generation at the lower priced end of the line to increase its output, offsetting higher cost generation at the other end and reducing customer costs. Based on historical prices, we estimate that the approximately 1,100 MW of SWIP-North Capacity would have enabled 1,290 GWh per year of cost effective market transactions as shown in Table 1, with 710 GWh per year from north-to-south and 580 GWh per year from south-to-north.[6] In 2040, SWIP-North Capacity would enable significantly more market transactions (7,326 GWh per year) due to the greater disparity in prices projected across the power system. In the case in which an Idaho wind developer procures long-term rights to the north-to-south capacity of SWIP-North, the total utilization of the line increases to 4,976 GWh per year with 3,745 GWh of Idaho wind delivered to the Southwest or California and 1,241 GWh of market transactions utilizing the remaining available capacity based on historical market conditions. In 2040, the utilization of the line increases to 10,821 GWh/year with 3,745 GWh of Idaho wind delivered and 7,076 GWh/year of market transactions.

TABLE 1: ESTIMATED ANNUAL UTILIZATION OF LS POWER'S SWIP-NORTH CAPACITY

	Standalone *GWh*	ID Wind *GWh*
2018-2022 Avg.	1,290	4,976
2030	3,734	7,176
2040	7,326	10,821

The utilization of the SWIP-North Capacity and its associated customer benefits will increase further with the introduction of the Extended Day Ahead Market (EDAM), as transmission will be scheduled and utilized without incurring wheeling charges. We estimate that by 2040 SWIP-North utilization will increase to 9,669 GWh of market transactions in the Standalone case and 12,414 GWh of transactions in the Idaho wind case.

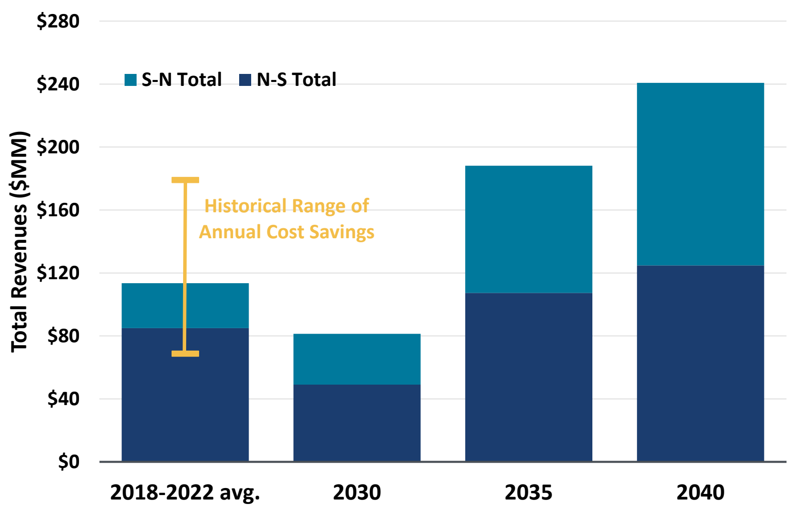
By increasing cost effective market transactions, SWIP-North will reduce the total production costs across WECC of serving customer demand. Based on historical prices, adding SWIP-North

5 Note that Harry Allen 500 kV substation is a part of the CAISO system.

6 We conservatively assume that market participants will schedule power across SWIP-North when there is at least at $15/MWh difference in prices across the line 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.

Capacity would have reduced annual average production costs by $113 million per year, ranging from $69 million per year based on 2021 prices to $179 million based on 2022 prices, as shown in Figure 3 below. Production cost savings in 2030 are projected to be $81 million per year, within the range of recent historical years, and then rise to $241 million per year in 2040. From 2030 to 2040, SWIP-North Capacity production cost savings increase considerably, primarily due to increased flows in the south-to-north direction (shown in the lighter blue bar) with increasing Southwest solar capacity. Over the life of the line, SWIP-North Capacity could provide up to $1.1 billion to $3.3 billion in present value cost savings to ratepayers based on the projected energy prices.

FIGURE 3: ESTIMATED PRODUCTION COST SAVINGS OF SWIP-NORTH



Our analysis demonstrates that the addition of SWIP-North Capacity will add a valuable new path to the WECC system that allows for cost effective transactions between the Southwest and Northwest, reducing costs of serving customer demand by $241 million in 2040. We provide more detail on the daily and seasonal timing of market transactions, the types of existing resources likely to utilize the line, and the delivered cost of energy via SWIP-North Capacity in the remainder of the report.

B. Access Cost Effective Renewable Energy Resources

Load serving entities (LSEs) in California, the Southwest, and the Northwest are seeking cost-effective renewable energy resources that will allow them to achieve GHG emissions reduction and renewable energy procurements goals at least cost to their customers. Load forecasts across the WECC show a growing need for additional generation to meet increasing demand. For example, CAISO peak demand could increase by almost 30% from 2031 to 2040.[7]

However, the LSEs currently have limited access to a diverse set of cost effective renewable energy resources due insufficient transmission capacity currently available. SWIP-North provides LSEs at both ends of the line access to renewable energy resources that otherwise would be inaccessible or prohibitively costly to access.

For example, the California Public Utilities Commission (CPUC) has identified a growing need for out-of-state (OOS) wind, specifically Idaho wind, to meet its future GHG reduction goals through its Integrated Resource Planning (IRP) process and provided CAISO resource portfolios for transmission planning purposes that reflect those needs, as shown in Figure 4 below. The Inflation Reduction Act (IRA) and the Infrastructure Investment and Jobs Act (IIJA) will further increase the demand for renewables by reducing their cost to customers.

- For CAISO's 2021–2022 transmission planning process (TPP), CPUC identified 1,062 MW of OOS wind, noting that the resources may be sited in Idaho, Wyoming, or New Mexico;[8]
- For the 2022–2023 TPP, CPUC increased OOS wind to 1,500 MW, including 1,062 MW of wind from either Idaho or Wyoming and 438 MW in New Mexico;
- In the 2023–2024 TPP, CPUC further increased OOS wind to 4,828 MW, including 1,000 MW of Idaho wind, 1,500 MW of Wyoming wind, and 2,328 MW of New Mexico wind.[9]

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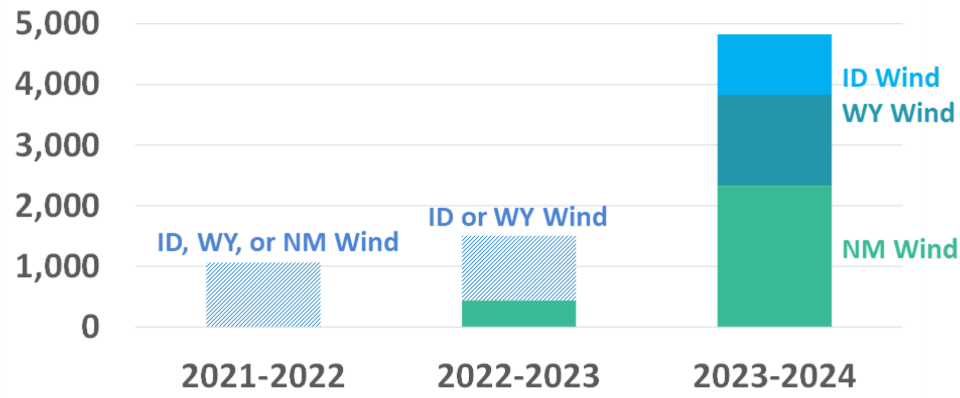
[7] CAISO, 20-Year Transmission Outlook, May 2022, p. 1

[8] The CPUC develops the resource portfolios to be studied by CAISO in their TPP assessments.

[9] CPUC, Proposed Electricity Resource Portfolios for the 2023-2024 Transmission Planning Process, October 20, 2022, p. 74. The CAISO 2022–2023 Transmission Plan identifies 1,062 MW of OOS wind resources in its base case from Wyoming or Idaho that require new transmission. Further, its sensitivities include a case with 1,500 MW of OOS wind from WY and a case with 1,000 MW of Idaho wind. The 2023-2024 base plan matches the current Transmission Plan sensitivity, increasing out-of-state wind.

FIGURE 4: OUT-OF-STATE WIND CAPACITY IN CAISO'S ANNUAL TRANSMISSION PLANNING STUDIES



This trend demonstrates the growing importance of OOS wind, and in particular Idaho wind, for California meeting its decarbonization goals. However, there is insufficient transmission capacity currently available for Idaho wind to deliver its output to the CAISO market. SWIP-North will provide CAISO LSEs the necessary transfer capacity to deliver the Idaho wind generation to the CAISO system, diversify their renewable energy sources, reduce GHG emissions more than a similar quantity of solar resources, and reduce solar curtailments.

Northwestern LSEs, such as Idaho Power Company (IPCo) and PacifiCorp, could also use the SWIP-North south-to-north capacity to access lower cost generation located in CAISO or the Southwest. In their 2021 IRP, IPCo modeled a sensitivity with 200 MW of SWIP-North south-to-north capacity that resulted in the lowest cost of all four portfolios evaluated, but IPCo did not include SWIP-North in its Preferred Portfolio due to uncertainty about the project's viability and available partners.[10] IPCo is currently in the middle of its 2023 IRP process and is evaluating the option of procuring up to 1,072.5 MW of south-to-north capacity from SWIP-North that could be used to procure excess generation from California or the Southwest.[11]

Both the CPUC and IPCO planning studies demonstrate the need for utilities to procure a diverse set of renewable energy resources to meet their GHG reduction goals at least cost to customers. In both cases and potentially others, SWIP-North provides the needed capacity to procure out-of-state resources that they would otherwise be unable to access. As discussed in Section VI below, the DOE could sell capacity on its portion of SWIP-North to renewable generation, LSEs, or other market participants for providing access to out-of-state renewable energy resources.

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[10] Idaho Power Company, Integrated Resource Plan, December, 2021. The sensitivity assumed that SWIP-North would enable 200 MW of S-N capacity in the winter and 100 MW in the summer.

[11] Idaho Power Company, Transmission Update Spring 2023, April 27, 2023.

We provide more detail on the location and amount of renewable energy resources that could be enabled by SWIP-North in Section III below.

C. Redundancy for Delivering NW Resources to CA

CAISO and other markets in the western U.S. have experienced several instances of extreme market conditions over the past several years, including historic wildfires, extended and wide-reaching heat waves, and high natural gas prices. SWIP-North diversifies the transmission-related risk of delivering Northwest imports into California during these extreme events. SWIP-North provides an alternative path for mitigating potential reliability risks and blackouts caused by similar future events.

As noted above, the existing infrastructure between California and the Northwest is frequently constrained and unable to increase imports to serve California customers during recent extreme events. For example, during the August 2020 blackouts, 330 MW of Northwest resources with California resource adequacy contracts were unable to serve California customers because the Malin intertie across COI (from Oregon to California) was derated due to a long-term transmission outage in Oregon.[12] This case demonstrates that additional imports were available from the Northwest but unable to sell into CAISO due to the COI constraint, increasing the amount of customers that lost power. SWIP-North could have provided additional transfer capability during the blackouts to deliver the available imports and limit the need for the outages. Increasing access to imports by 330 MW via SWIP-North during a 4-hour outage would provide 1,320 MWh of additional generation and $7–14 million of societal value per event, based on an assumed value of lost load of $5,000–$10,000/MWh.

Looking forward, the increasing frequency and severity of wildfires pose a significant risk to transfer capability into CAISO that is likely to further constrain low-cost imports. The California Energy Commission (CEC) documented the risks of wildfires-related transmission outages for California, specifically focusing on COI/Path 66.[13] They found that wildfires near transmission paths may force CAISO to cut power to those paths during periods of future wildfire threats. More frequent occurrence of these events significantly increases the insurance value provided by SWIP-North's expanded transfer capability between the Northwest and California.

[12] CAISO, Preliminary root cause analysis, Mid-August 2020 Heat Storm, October 2020.

[13] Dale, et al., Assessing the Impact of Wildfires on the California Electricity Grid, September 2018.

The DOE could sell either short-term or long-term contracts for its portion of SWIP-North capacity to power marketers or LSEs to utilize the new transfer capability during extreme market conditions like these.

D. Load Diversity Benefits Reduce Reliability Costs

Achieving resource adequacy requirements to ensure system reliability and resilience will continue to be a focal point across WECC as the system transitions to greater reliance on renewable energy and energy storage resources. SWIP-North Capacity provides load diversity benefits to California and other neighboring systems by providing access to additional firm capacity or non-firm energy imports that could avoid future load-shed events and increase reliability and resource adequacy in the CAISO footprint. The load diversity of the Northwestern and Southwestern systems connected by SWIP-North allows the regions to support each other when there is a reliability event in one region. Without SWIP-North, load diversity benefits cannot be captured due to insufficient transmission capacity; and additional capacity resources would need to be built in each region at higher total costs of meeting system reliability needs.

The load diversity benefits of SWIP-North could be realized in the near-term as IPCo has already identified a need in its current IRP process for additional winter capacity and is currently considering procuring up to 1,072.5 MW of south-to-north capacity on SWIP-North to meet that need.[14] SWIP-North provides IPCo access to 500 MW of excess winter capacity available in the Southwest due to a winter peak load that is 13 GW lower than the summer peak for the Southwest utilities, demonstrating how SWIP-North allows IPCo to take advantage of the load diversity between IPCo (short of capacity in the winter) and the Southwest utilities (excess winter capacity). Relying on existing surplus Southwest winter capacity to meet IPCo's capacity requirement avoids $66 million per year in costs of building a new capacity resource in Idaho, assuming an IPCo-specific new capacity costs of $132/kW-yr.[15]

CAISO and the Southwest could similarly take advantage of the load diversity benefits provided by SWIP-North. To estimate the load diversity benefits to CAISO, we evaluated historical peak demand patterns for CAISO, PacifiCorp East, and IPCo, as shown in Table 2 below.

- For CAISO and PacifiCorp East, 871 MW of PacifiCorp East capacity is available in 2025 to avoid CAISO reliability events due to load diversity. With 776 MW of existing capacity, SWIP-

[14] Idaho Power Company, Transmission Update Spring 2023, April 27, 2023, pp. 23–28.

[15] Idaho Power Company, 2021 Integrated Resource Plan, Appendix C: Technical Report, December 2021, p. 38

North can provide access to 95 MW of additional imports. In 2035, 150 MW of additional imports would be available from PacifiCorp East.

- For CAISO and IPCo, load diversity could allow 600 MW of IPCo resources to be available to CAISO in 2025 and 700 MW in 2035 to avoid reliability events. SWIP-North provides direct transfer capability between CAISO and Idaho Power of 1,000 MW for the first time, which could provide up to 600–700 MW of capacity value in the 2025 to 2035.

TABLE 2: 2025 LOAD DIVERSITY BENEFITS FOR CAISO ACROSS SWIP-NORTH

	CAISO & PacifiCorp East	CAISO & Idaho Power
Total Non-Coincident Peak	63,855 MW	58,727 MW
Total Coincident Peak	62,984 MW	58,106 MW
Difference	**871 MW**	**621 MW**
Existing Transfer Capability	776 MW	---
Additional Resources	**95 MW**	**621 MW**

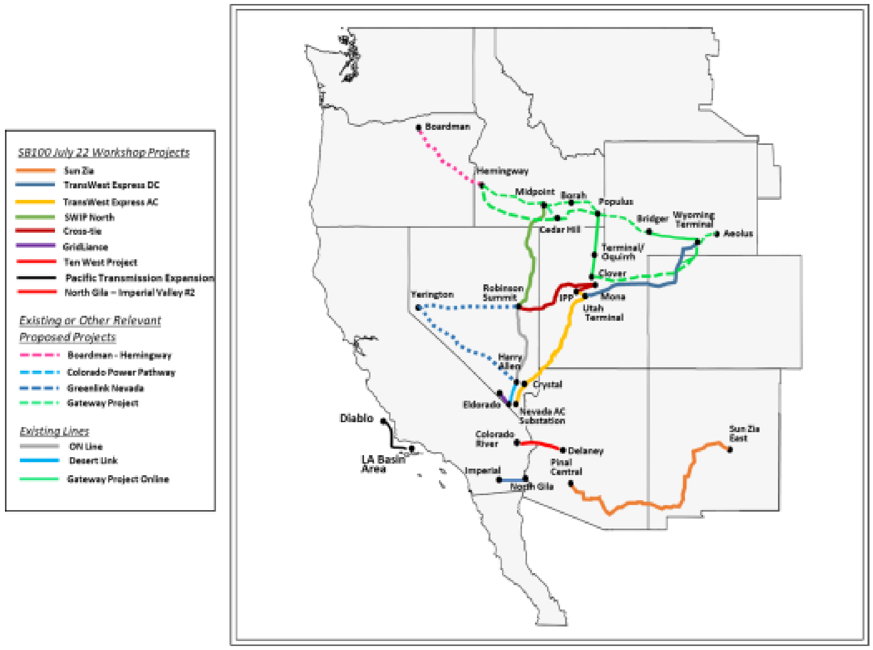
Source: Existing transfer capability for CAISO & Pacificorp East is from Pacificorp's 2015 modeling transmission constraint assumption, see https://www.caiso.com/Documents/StudyBenefits-PacifiCorp-ISOIntegration.pdf

Based on this analysis of incremental transmission and peak-load diversity, SWIP-North Capacity will provide access to non-firm energy imports from PacifiCorp East and Idaho Power during California peak load events with up to 700–950 MW of capacity-equivalent value during 2025–2035. We estimate that the load diversity value of up to 700–950 MW of capacity-equivalent non-firm imports is $97–$131 million per year, based on recent California RA prices.

E. Other Efforts to Resolve WECC Transmission Needs

Several other transmission projects across the West are proposed to increase transfer capability for delivering renewable energy to load centers and increasing market transaction, as shown in Figure 5 below from the CAISO 20-Year Outlook study. Several of them are already in the process of being constructed or have been constructed, such as Ten West Link, DesertLink, Greenlink Nevada, ON Line, Boardman-Hemingway line, and the Gateway Projects. Other proposed projects like SWIP-North are still in development, including SunZia (New Mexico to Arizona), Cross Tie (Utah to Nevada), and TransWest Express (Wyoming to Nevada).

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



Source: CAISO, [20-Year Transmission Outlook](), May 2022.

Each of these projects provides unique upgrades to the WECC system increasing transfer capability between portions of the system that will support the development of a more diverse set of renewable energy resources and capture load diversity and market price differentials. Based on the finding of the 20-year outlook and the scale of transmission likely to be needed to cost effectively achieve future renewable energy and GHG goals, we expect that most, if not all, of these projects will be necessary. The CAISO 20-Year Outlook noted that the four currently proposed projects, SWIP-North, Cross Tie, TransWest Express, and Sunzia, will provide access to approximately 6,000 MW of the 9,900 MW of OOS wind capacity that CAISO requires to meet its long-term decarbonization goals, indicating that each of the projects would be required along with additional not-yet-defined projects.

Across the proposed projects, the SWIP-North Capacity provides unique benefits to the system by providing a direct connection between PacifiCorp and Idaho Power, who own capacity at the northern terminus of SWIP-North (Midpoint), and NV Energy and CAISO, who own capacity at the southern terminus (Harry Allen). SWIP-North Capacity provides the least constrained and lowest cost path for entities in the Northwest (WA, OR, ID) to sell into CAISO and Southwest, and vice versa, especially when there is congestion on existing paths along the Pacific coast. The more direct access between systems reduces the wheeling costs and transaction costs for scheduling trades on SWIP-North, which will increase the volume and value of market transactions that can occur across the line with commensurate cost reductions to consumers. In addition to SWIP-North, both Cross Tie and TransWest Express will provide greater transfer capability between systems in the Rocky Mountain region of WECC (primarily UT and WY) and CAISO and the Southwest. In contrast to these paths, the northern end of SWIP-North is located near proposed wind generation projects that can satisfy CAISO's need for Idaho wind resources by a single transaction across SWIP-North, instead of procuring transmission rights across multiple systems (if sufficient capacity exists). Similarly, SWIP-North will provide CAISO market participants a direct path for selling excess generation during peak-solar hours to markets in the Northwest at the northern end of SWIP-North.

III. Generation Supported by SWIP-North

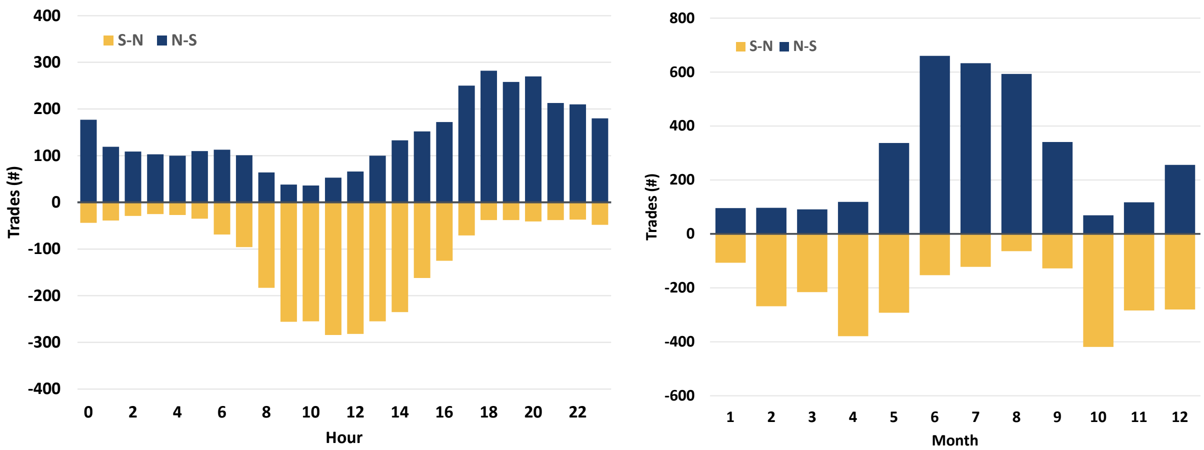
SWIP-North increases transfer capability between systems that are highly interconnected and include a large and diverse set of existing generation resources and the potential for building several different types of new renewable energy resources. For that reason, identifying with precision the generation type, capacity, and timing of generation resources that will be supported by SWIP-North is challenging. However, current market data and forward-looking simulations indicate that SWIP-North Capacity can allow already-available, low-cost generation to ramp up and new generation resources to be built.

Below, we first summarize the market data indicating the ability for existing generation resources supported by SWIP-North Capacity, and then describe in the following section the new generation resources that are likely to do so.

A. Existing Generation Supported by SWIP-North

SWIP-North Capacity will enable increased bi-directional transfer of electricity across the WECC system, allowing lower cost resources to displace higher cost resources by increasing their access to new markets. Based on our analysis of recent historical prices, shown in Figure 6 below, SWIP-North will primarily increase north-to-south flows into California and the Southwest (dark blue bars) to meet peak demand during evening and overnight hours, with the most frequent transactions coinciding with peak demand hours in June to August. Transactions from south-to-north (yellow bars) into the northwest tend to occur instead during the middle of the day and during shoulder months in the spring and fall when solar generation within California and the Southwest exceeds local demand.

FIGURE 6: AVERAGE NUMBER OF TRADES BY HOUR OF DAY AND MONTH (2018–2022)



As noted above, we are unable to identify the exact generation resources that will increase their output to sell power across this SWIP-North Capacity, but given expectations for when transactions will occur, we can estimate which ones are likely to do so. For north-to-south flows, the marginal resources in the Northwest that are likely to be available to increase generation include natural gas-fired power plants, large hydro facilities, and (in future years) output from battery storage facilities. For south-to-north flows, we expect that curtailed solar and natural gas-fired power plants will increase their output to sell power to the Northwest. Based on the projected price trends shown in Figure 2 above, we expect future years to show similar trends in the timing of flows and the types of generation that will increase their output to take advantage of the SWIP-North Capacity.

B. Development of New Renewable Energy Resources

SWIP-North is likely to increase renewable energy development located in the regions near the ends and along the route of the transmission line. SWIP-North will result in greater development of renewable energy resources because it provides LSEs that are aiming to reduce their GHG emissions access to low-cost resources. As noted above, entities at both ends of the line have been considering the benefits of procuring new renewable resources via SWIP-North: primarily solar resources in the Southwest delivered to Idaho and the Northwest, and wind resources in Idaho and the Northwest delivered to the Southwest and California.

We reviewed the current interconnection queue reports from CAISO, NV Energy, PacifiCorp, and IPCo to identify the types and amounts of renewable energy resources under development that could utilize SWIP-North. Currently, there are 43 GW of solar, 57 GW of battery storage, 6 GW of onshore wind, and 350 MW of geothermal in development in these regions that are scheduled to come online before 2030, as shown in Table 3 below.[16] While not everything in the queue will ultimately be built, transmission access is in many cases inhibiting progress for these new resources.

TABLE 3: RENEWABLE ENERGY CAPACITY IN INTERCONNECTION QUEUE

State	Southern CA	Nevada	Southern ID	Southwestern WY
Solar	20,683	13,404	8,238	570
Wind	1,235	1,718	1,802	700
Battery	45,120	11,496	-	-
Geothermal	0	351	-	-

Sources and Notes: Interconnection queue data from Nevada Energy, PacifiCorp, and Idaho Power Company OASIS sites for resources coming online between 2023 and 2030.

Amongst the proposed resources, the SWIP-North south-to-north capacity is most likely to support the development of solar capacity in California and Nevada that can reach Northwestern utilities, such as IPCo and PacifiCorp. The construction of the already approved Greenlink transmission projects in Nevada will provide additional transfer capacity for solar resources developing in the western portion of the state to reach SWIP-North and markets to the north. SWIP-North's north-to-south transfer capability is most likely to support the development of Idaho wind capacity, as California is currently pursuing this resource to meet its future decarbonization goals, and could also increase geothermal capacity located in Nevada to provide a dispatchable clean energy resource to meet California's peak demand needs.

We provide below a summary of the characteristics for renewable energy resources that may be developed with the addition of SWIP-North in Table 4 below.

[16] OASIS interconnection data, LS Power internal data, and Hitachi ABB Energy Velocity Suite.

TABLE 4: SUMMARY OF POTENTAL NEW GENERATION RESOURCES

	CA		NV		ID		WY	
Resource	Expected Capacity Factor	Proposed Online Date	Expected Capacity Factor	Proposed Online Date	Expected Capacity Factor	Proposed Online Date	Expected Capacity Factor	Proposed Online Date
Solar	34%	2024-2026	34%	2023-2029	24.2%-30.2%	2023-2027	24.2% - 30.2%	-
Wind	34%	2024-2034	34%	2024-2027	37%	2024-2026	44%	2025
Geothermal	-	-	80%	2024-2026	-	-	-	-

Sources and Notes: Capacity Factors by location and resource type from Pacificorp's and CPUC IRP resource options and performance assumptions. [17]

IV. Delivered Cost and GHG Emissions Reductions of SWIP-North

SWIP-North enables cost effective electricity delivery from new and existing generation resources that would not otherwise have access to the transmission needed to serve demand. In this section, we estimate the delivered cost of Idaho wind to CAISO LSEs relative to the costs of procuring additional in-state solar and the costs of electricity delivered via SWIP-North capacity during periods in which cost effective transactions would be expected to occur. We compare Idaho wind costs to California solar costs because additional in-state solar is the most likely resource to be procured by CAISO LSEs to meet its GHG reduction goals in the absence of procuring Idaho or other out-of-state wind.

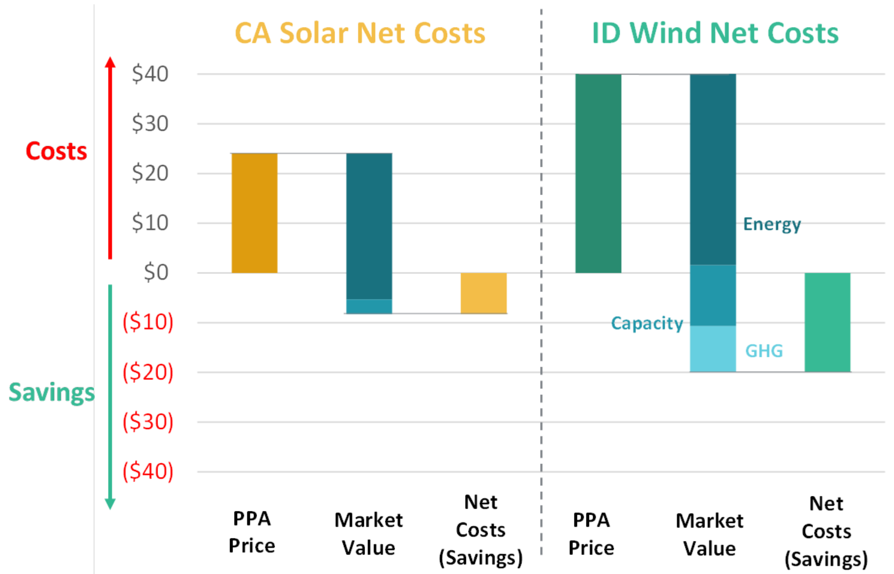
Based on our analysis of the combined cost of Idaho wind and SWIP-North, we estimate that the levelized cost of delivering Idaho wind via SWIP-North is $40/MWh, including $34/MWh for the wind generation facility (including interconnection costs) and $6/MWh for SWIP-North Capacity to deliver the power to CAISO.[18]

17 Pacificorps, 2023 Integrated Resource Plan Volume1, March 31, 2023, page 188-190; PCUC, "Inputs & Assumptions, 2022-2023 Integrated Resource Planning (IRP)", June 2023, page69-72.

18 The estimated cost of delivering Idaho wind via SWIP-North of $6/MWh is based on the first-year levelized revenue requirement of $63 million per year (see appendix for more details) and the projected 2030-2040 congestion revenues for LS Power's SWIP-North Capacity of $40 million per year (see Section VI below). We assume the remaining $22 million of revenue requirements is recovered via the contract for 3,750 GW of generation from an 1,100 MW Idaho wind resource, which results in a transmission cost adder for delivering Idaho wind via SWIP-North of $6/MWh. The costs recovered via the wind contract could be lower if an entity procures south-to-north capacity to deliver Southwest resources to the Northwest, as explained below, further reducing the costs to be recovered via the wind contract.

While the total costs of Idaho wind via SWIP North ($40/MWh) is higher than California solar ($24/MWh), the higher energy, capacity, and GHG value of Idaho wind relative to California solar results in customer net cost savings for procuring Idaho wind. As shown in Figure 7 below, the net delivered costs of Idaho wind is $12/MWh lower for California ratepayers relative to an equivalent amount of in-state solar generation. Procuring ID wind reduces the net present value of total CAISO customer costs by $333 million over the economic life of SWIP-North.

FIGURE 7: NET DELIVERED COST SAVINGS FOR CA SOLAR AND ID WIND



We estimated the net delivered cost savings of Idaho wind based on the following components:

- **Delivered Cost (PPA Price)**: The Idaho wind of $36/MWh is based on wind generation capital cost projections from the NREL 2022 ATB plus the interconnection costs for a proposed Idaho wind farm at Midpoint 500 kV substation, assuming a 30-year life. As noted above, we add to the wind costs an incremental $6/MWh for transmission costs. We estimate CA solar contract prices of $24–29/MWh based on CPUC cost projections and a recent LBNL market report.[19] CAISO transmission costs are not included, because for both resources, the costs for delivering the output from its point of injection in CAISO to load will be the same, based on the CAISO transmission access charge (TAC). CAISO is currently pursuing significant transmission upgrades downstream in southern California that will support both in-state solar or wind delivered by SWIP-North.[20]

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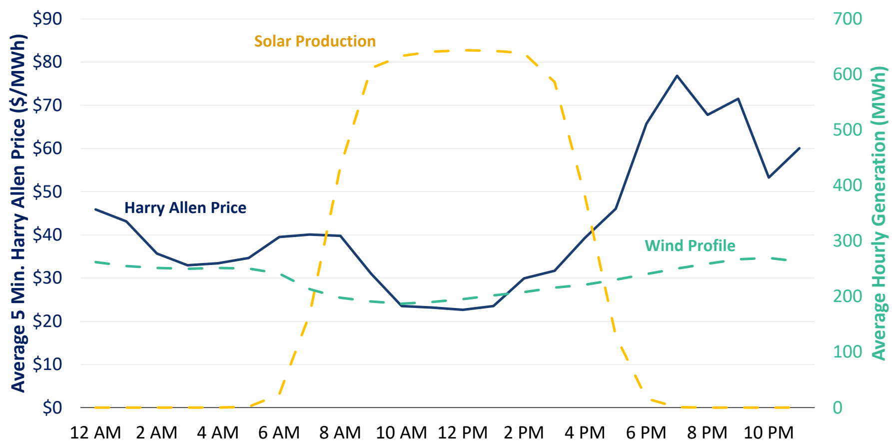
19 CPUC, Inputs & Assumptions: 2019-2020 Integrated Resource Planning, February 2020.
LBNL, Bolinger, et al., Utility-Scale Solar Data Update: 2020 Edition, November 2020. The 2022 LBNL Utility-Scale Solar Report publishes LevelTen solar PPA prices (2021–22) that align with our assumption.

20 CAISO, 2022-2023 Transmission Plan, May 18, 2023.

- **Energy Market Value**: The energy market value of Idaho wind and California solar is based on hourly generation profiles of each resource and hourly historical 2018–2022 prices for the Harry Allen node.[21] As shown in Figure 11 below, Idaho wind (dashed green line) generates more than California solar (dashed yellow line) during higher priced evening hours, which increases its energy market value compared to California solar. The energy market value of Idaho wind generation is on average $9/MWh higher than California solar.

FIGURE 8: 2018–2022 ENERGY PRICES AND RENEWABLE GENERATION BY HOUR OF DAY



Sources and Notes: ID wind generation profile provided by LS Power; solar generation profile based on CAISO assumptions in its transmission planning for resources in southern California. EIM prices from Hitachi ABB Energy Velocity Suite.

- **Resource Adequacy Value**: Using CPUC projections for the capacity value of renewable energy resources, 600 MW of ID wind delivers 144 MW of RA capacity compared to 36 MW of capacity value for 654 MW of CA solar.[22] We used the 85th percentile of California Resource Adequacy prices of $138/kW-year for resources procured in the SP26 region to meet local RA needs.[23] Based on these assumptions, Idaho wind provides an additional $9/MWh of RA value for Idaho wind compared to in-state solar.

- **GHG Emissions Reduction Value**: We estimate hourly marginal GHG emissions rates based on 2022 market data posted by CAISO and renewable generation profiles.[24] As shown in

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21 Historical LMPs downloaded from Hitachi ABB Energy Velocity Suite. Idaho wind profile provided by Great Basin Transmission and California solar profile from CAISO assumptions.

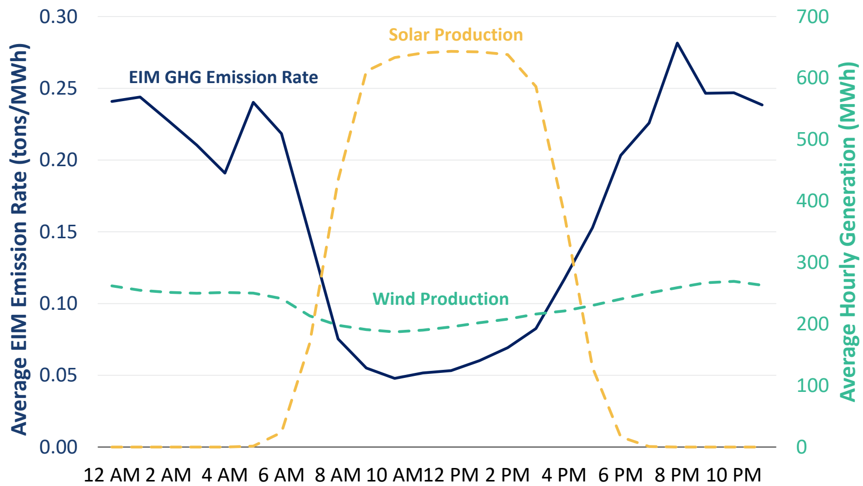
22 CPUC, Reliability Filing Requirements for Load Serving Entities' 2022 Integrated Resource Plans-Results of PRM and ELCC Studies, July 19, 2022.

23 The 85th percentile contract price for CAISO System RA contracts in SP26 is $11.50/kW-month. CPUC, 2021 RA report, March 2023, p. 16.

24 CAISO, Open Access Same-Time Information Systems (OASIS), Real Time EIM GHG Shadow Price ($/MWh) and the Greenhouse Gas Allowance Index Price ($/ton).

Figure 9 below, Idaho wind reduces 0.17 tons of GHG emissions per MWh on average, compared to 0.07 tons/MWh for California solar. Based on projected GHG allowance prices ranging from $43–$129/ton through the life of SWIP-North, Idaho wind avoids $9 per MWh compared to California solar.[25]

FIGURE 9: HISTORICAL GHG EMISSIONS RATES AND RENEWABLE GENERATION



Source: EIM import GHG emission rate calculated based on EIM Greenhouse Gas (GHG) Shadow Prices and Greenhouse Gas Allowance Index Prices reported on CAISO's OASIS page.

As discussed above, in addition to contracted Idaho wind generation, cost effective market transactions across SWIP-North Capacity will be able to flow on the remaining available north-to-south capacity, as well as from south-to-north. We estimate that the additional market transactions will reduce the hourly prices at each end of the line and further reduce customer costs. We estimate that average electricity prices at Harry Allen will be lowered by $1.0/MWh in hours with north-to-south flows across SWIP-North, and prices at Midpoint will similarly decrease by $0.6/MWh due to south-to-north flows via SWIP-North.[26]

SWIP-North will reduce GHG emissions by shifting generation from higher emitting resources to lower emitting resources. Based on projected GHG emissions rates from the NREL Cambium database, we estimate that: (1) the market transactions across SWIP-North Capacity on average reduce GHG emissions by 0.4 – 0.5 tons per MWh from 2030 to 2040 and (2) Idaho wind generation reduces GHG emissions by 0.3 – 0.4 tons per MWh.[27] Based on our analysis of the

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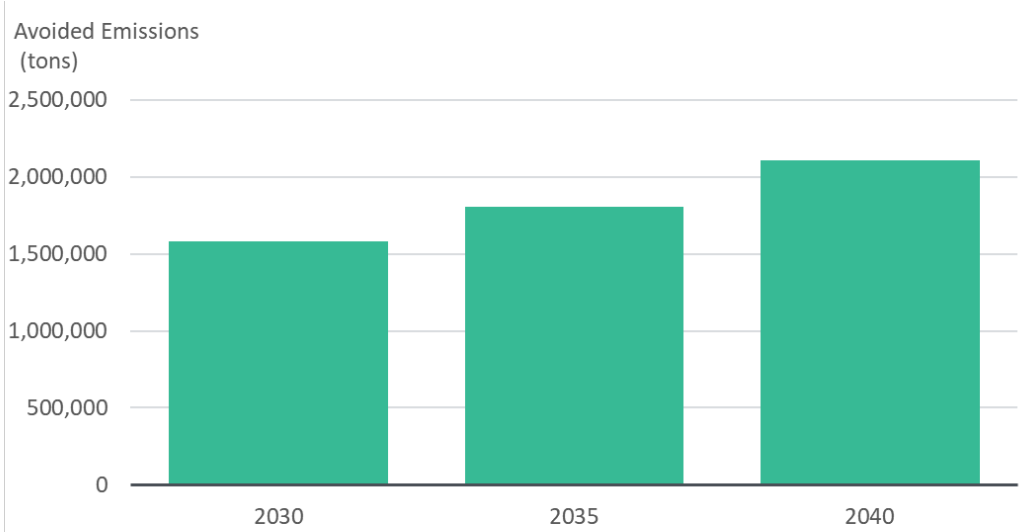
25 CED, 2022 IEPR GHG Allowance Price Projections, updated January 2023. Found at https://efiling.energy.ca.gov/GetDocument.aspx?tn=248410

26 See appendix for our approach to estimating price impacts of transfers over SWIP-North Capacity.

27 See appendix for our approach to estimating GHG emissions reductions of transmissions over SWIP-North Capacity.

utilization of the SWIP-North Capacity and avoided GHG emissions rates, we estimate that SWIP-North will reduce GHG emissions by 1.6 MMT in 2030 increasing to 2.1 MMT in 2040, as shown in Figure 10 below. GHG emissions reductions increase over time due to increased market transactions.

FIGURE 10: FORECASTED AVOIDED GHG EMISSIONS FROM SWIP-NORTH CAPACITY



V. Assessment of Economic Growth Benefits

The construction and operation of SWIP-North and the new renewable energy generation enabled by SWIP-North will provide significant local economic growth benefits to the communities where they are located. We provide below an estimate of the economic impacts, including employment and economic output, of these power sector projects.

A. Transmission Economic Stimulus Benefits

Development of new transmission projects can provide substantial regional employment and economic benefits during both the construction and operation phases of the project. To estimate the employment and economic benefits of SWIP-North to the region, we completed a survey of existing studies on the economic growth benefits of transmission development in the western and central U.S. and scaled the benefits to the projected capital costs of SWIP-North. As shown in Table 5 below, we estimate that SWIP-North capacity will result in over 3,000 full time equivalent (FTE) jobs directly created by the project and an additional 2,000 FTEs through associated economic activity. Moreover, SWIP-North capacity could provide around $1 billion in economic stimulus benefits.

TABLE 5: ECONOMIC STIMULUS BENEFITS OF SWIP-NORTH

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 SWIP North Estimation	**[6]**		3.74	6.35	$1.18
SWIP North Estimation (Total investment of $832 MM)	**[7]**		**3,110**	**5,282**	**$984**

Source and notes: Estimates in row [6] are the average of rows [2]-[5].

[1]: The Brattle Group, Employment and Economic Benefits of Transmission Infrastructure Investment, May 2011.

[2]: The Brattle Group, Job and Economic Benefits of Transmission and Wind Generation Investments in the SPP Region, March 2010.

[3]: London Economics International, Transmission Investment for Economic Stimulus and Climate Change, May 2021.

[4]: The Brattle Group, Nebraska Renewable Energy Exports, December 2014.

[5]: NREL, Jobs and Economic Development from new Transmission and Generation in Wyoming, March 2011.

B. Renewable Energy Economic Stimulus Benefits

We also estimated the economic growth benefits of the development of 1,100 MW of Idaho wind associated with the addition of SWIP-North Capacity. Similar to the transmission economic growth benefits, we reviewed existing studies on the employment and economic growth benefits of wind development in Wyoming, Nebraska, and the SPP market and calculated the benefits associated with each. We estimate that 600 MW of Idaho wind will result in over 3,000 FTE jobs and result in $3.4 billion in economic activity.

TABLE 6: ECONOMIC STIMULUS BENEFITS OF IDAHO WIND DEVELOPMENT

Study		Region	FTE Jobs & Output per $1 MM Tx Investment		
			Direct FTE (#)	Total FTE (#)	Output ($ MM)
2010 Brattle SPP	**[1]**	SPP	3.22	4.7	3.2
2014 Brattle Nebraska Study	**[2]**	NE	-	0.6	2.5
2011 NREL	**[3]**	Wyoming	1.0	2.5	-
Assumption for SWIP North Estimation	**[4]**		2.10	2.61	2.85
SWIP North Estimation (Total investment of $1.8 B)	**[5]**		**3,829**	**4,764**	**5,200**

Source and notes: Estimates in row [4] are the average of rows [1]-[3].

[1]: The Brattle Group, Job and Economic Benefits of Transmission and Wind Generation Investments in the SPP Region, March 2010.

[2]: The Brattle Group, Nebraska Renewable Energy Exports, December 2014.

[3]: NREL, Jobs and Economic Development from new Transmission and Generation in Wyoming, March 2011.

VI. Value of Anchor Tenant to DOE

Our assessment of the SWIP-North Capacity demonstrates that there are significant benefits that the project can provide to the market as a whole and several market participants in particular. Due to the multi-value and multi-regional nature of SWIP-North, we see several potential approaches for the DOE to recover the costs of becoming an anchor tenant on the project. The two most likely approaches for the DOE to recover their costs are: 1) to sell its capacity rights prior to the line going into service or 2) to retain its capacity rights and contract with a market participant for long-term rights to its capacity. Once it is certain that SWIP-North will be built, market participants will be interested in procuring the capacity to capture the market benefits summarized above. They include renewable energy developers, independent transmission developers, and LSEs at either end of the line.

We have already identified examples of recent commercial interest by market participants in procuring full or partial capacity on SWIP-North. CAISO evaluated the benefits of SWIP-North in its most recent transmission planning study for accessing Idaho wind and utilizing its capacity for market transactions and is “continuing to assess the SWIP North project proposed by LS Power for accessing wind resources in Idaho.”[28] IPCo is currently evaluating the potential of acquiring up to 1,000 MW of south-to-north capacity to take advantage of excess winter capacity in the Desert Southwest, but previously was unwilling to commit to the project in its

[28] CAISO, 2022-2023 Transmission Plan, May 18, 2023, p. 102.

2021 IRP due to limited insights into the feasibility of the project.[29] However, neither entity has yet chosen to move forward with a commitment to the project to date, most likely because the cost of making such a commitment will depend on the extent to which other parties commit as well. The DOE can provide the necessary impetus for moving the project forward and reducing the uncertainty around its development by obtaining a 50% share of LS Power's share of SWIP-North Capacity between Midpoint and Harry Allen.

To demonstrate that the DOE is likely to be able to recover its costs of purchasing 50% of the SWIP-North Capacity, we summarize below three sources of potential revenues to market participants (or cost savings to LSE's customers) for procuring DOE's capacity that exceed the annual levelized costs for the capacity of about $31 million per year:

- **Delivering Idaho Wind to California**: We demonstrated that Idaho wind via SWIP-North is an attractive resource for California entities to procure to meet their GHG goals. A market participant will be able to earn sufficient revenues through a 30-year contract with a CAISO LSE for Idaho wind to recover the assumed SWIP-North costs of $6/MWh and may earn potentially more revenues depending on the market conditions. Assuming the market participant can receive $6/MWh to $12/MWh of revenues from the wind PPA to recover SWIP-North costs, they will earn $11–22 million in annual revenues.[30]
- **Enabling Market Transactions**: Based on our estimate of future market prices and available SWIP-North Capacity after accounting for the delivery of Idaho wind, a market participant could earn annual average congestion revenues of $20 million from 2030 to 2040 from market transactions.[31] Congestion revenues are earned when the market participant that procures the capacity rights actively schedules transactions across the line to take advantage of price differences across the line. The congestion revenues are likely to be about 33% higher (an additional $7 million per year) in EDAM as market transactions will increase due to the lack of wheeling charges for the use of transmission.
- **Procuring Winter Capacity from Southwest**: By procuring the DOE's rights to the south-to-north capacity, IPCo, PacifiCorp, or other northwest utilities could contract for capacity during the winter months from the excess resources available in the Southwest to meet their winter resource adequacy requirements at lower costs than building new capacity

[29] Idaho Power Company, Integrated Resource Plan, December, 2021.

[30] The higher end of the range assumes that they can price their PPA to account for 50% of the difference in net delivered costs with California solar. The revenues are based on about 2,000 GWh of delivered wind.

[31] Congestion revenues are projected to increase from $6 million in 2030 to $45 million in 2040 as energy price differences across SWIP-North increase due to increasing solar penetration in the Southwest and California, as shown in Figure 2 above.

within its service territory. Based on our estimated costs of building new capacity resources in Idaho of $132/kW-year, we conservatively assume the northwest utilities could be willing to procure 500 MW of south-to-north rights on SWIP-North Capacity during the winter months for $20–30/kW-year, which would result in $5–8 million in revenues.[32] By procuring the south-to-north capacity rights, the utility could also earn the estimated congestion revenues on its south-to-north capacity noted above.

The projected revenues for procuring SWIP-North capacity depend on several factors that could vary from the assumptions we relied on in our analysis. We summarize the key market conditions could impact the future market value of SWIP-North in Table 7 below.

32 Idaho Power, Demand-Side Management 2022 Annual Report, p. 3.

TABLE 7: IMPACTS OF MARKET CONDITIONS ON SWIP-NORTH VALUE

Market Variable	Increase SWIP-North Market Value	Decrease SWIP-North Market Value
Decarbonization Policies	Faster adoption of decarbonization goals will increase power system demand and need for renewable energy	Delayed achievement of decarbonization goals either through slower electrification adoption or procurement of renewable energy
Load Growth and Shifts	Accelerated load growth due to electrification will increase need for access to low cost resources, especially during peak and overnight hours	Slower adoption of electrification and shifting demand to solar producing hours or off-peak hours
Transmission Development	Delayed development of other proposed projects identified in CAISO 20-Year Outlook to deliver OOS wind will increase demand for Idaho wind via SWIP-North	Delayed development of approved transmission projects at the southern end may limit access to CAISO and other Southwestern demand centers; transmission upgrades at COI or other upgrades parallel to SWIP-North may reduce congestion revenues
Generation and Storage Development	Accelerated development of low cost resources at the northern end that operate during peak demand and overnight hours, and solar at the southern end will increase supply to utilize SWIP-North; limited storage development in CAISO and other Southwestern utilities	Delayed or limited development of low cost resources at the northern end that operate during peak demand and overnight hours, and solar at the southern end; accelerated storage development in CAISO and other Southwestern utilities
Natural Gas Prices	Higher natural gas prices increase price differences across SWIP-North and result in higher congestion revenue	Lower natural gas prices reduce value of market transactions
Transmission Costs	SWIP-North costs are lower than projected	SWIP-North costs are higher than projected
Renewable Generation Costs	Wind costs decline faster than projected while solar costs decline slower than projected or increase	Wind costs decline slower than projected while solar costs decline faster than projected
Western Market Development	EDAM implemented, increasing market transactions across WECC	EDAM not implemented

Appendix A: Detailed Assumptions

We provide in the appendix additional details on our assumptions for the following analyses:

- Projected energy prices in GridSIM;
- SWIP-North utilization, price effect, production cost savings, congestion revenues, and GHG emissions reductions; and,
- SWIP-North revenue requirements.

A. Projected Energy Prices

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 for projecting energy prices in 2030, 2035, and 2040 at each end of SWIP-North. We provide below the key assumptions we relied on for developing the projected prices.

- **Geographic Scope:** We modeled the WECC power system with zones for California (CASO, ZP26, and CANO), Basin, Rocky Mountain, Northwest, and Southwest. Transfer limits between zones are based on the Energy Information Administration (EIA) Annual Energy Outlook (AEO) and WECC 2023 Anchor Dataset.
- **Annual Demand**: For California, annual total and peak load forecasts are from the California Energy Commission (CEC) load forecasts from the 2022 CEC IEPR,[33] the CEC's 2021 SB 100 Joint Agency Report,[34] and the CEC's Deep Decarbonization in a High Renewable Future Report.[35] Annual load forecasts for other WECC zones are from the AEO Reference Case

[33] 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

[34] 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

[35] 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

projections.[36] 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.[37]

- **Generation and Storage Resources**: GridSIM models existing generation and storage capacity consistent with the National Energy Modeling System (NEMS) database used by the EAI for the AEO Reference Case.[38] Planned assets with near-term commercial online dates are also modeled. Generating units retire at the end of their specified economic lifetimes based on assumptions from the NREL ReEDs model. For California, renewable generation profiles are from the California Public Utilities Commission (CPUC)'s Unified Resource Adequacy (RA) and Integrated Resource Plan (IRP) Modeling Datasets 38 MMT Portfolio—2030 Renewables Profiles from May 2022.[39] 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 cost, variable O&M, and fixed O&M assumptions are from NREL's 2022 Annual Technology Baseline (ATB) "Moderate" Case trajectories, varying by zone.[40] We incorporated updated ITC and PTC assumptions based on the Inflation Reduction Act. 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.[41] After 2030, prices escalate annually based on the long-run Henry Hub natural gas price trajectory from the 2021 AEO.[42]

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

37 Federal Energy Regulatory Commission. Form No. 714—Annual Electric Balancing Authority Area and Planning Area Report. 2020. https://www.ferc.gov/industries-data/electric/general-information/electric-industry-forms/form-no-714-annual-electric/data

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

39 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

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

41 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

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

- **New Resource Needs**: We accounted for renewable and GHG emissions requirements based on recent CPUC rulings and long-term legislative mandates for California and for all other states based on NEMS 2021 assumptions. Planning reserve margins for each region are based on AEO 2021.

B. SWIP-North Analysis based on Historical and Projected Energy Prices

We estimated the utilization of SWIP-North for market transactions and the impacts of flows across the line based on historical EIM prices and projected prices from GridSIM. We assumed that market participants will take advantage of differences in prices at each end of the line to schedule cost effective flows on SWIP-North. By transferring power from lower cost to higher cost regions of the system, the SWIP-North flows result in reductions in production costs, shifts in energy prices at each end of the line, and congestion revenues if price differences remain.

We used the following assumptions in our analysis:

- **SWIP-North Utilization**: As noted above, we assume that market participants will schedule flows up to the capacity limit of SWIP-North when historical or projected price differences across the line exceed $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.
- **SWIP-North Price Effect**: Flows across SWIP-North will impact energy prices at each end with prices increasing on the low-priced end and decreasing on the high-priced end. To estimate the price effect of SWIP-North based on projected prices, we ran GridSIM with an additional 1,000 MW of transfer capability between CASO and Basin (Additional 1,000 MW Case) and compared the results to the base case results. For each hour in the Base Case with a certain price difference, we calculated the change in prices at each end of the line from the Base Case to the Additional 1,000 MW Case. We then calculated the average change in prices at each level of price difference. For example, in hours when CASO prices are $35-40/MWh higher than Basin in the Base Case, the additional capacity provided by SWIP-North reduces CASO prices by $4/MWh and increases Basin prices by $3/MWh in the Additional 1,000 MW Case, resulting in prices converging on average by $7/MWh.
- **SWIP-North Production Cost Savings**: We estimate production cost savings based on the flow and energy price data, assuming that a generator with higher variable costs (equal to the average of pre-SWIP-North and post-SWIP-North energy prices at the high end of the line) will reduce its output and a generator with lower variable costs (equal to the average

of pre- and post-SWIP-North prices at the low end of the line) will increase its output, reducing total production costs.

- **SWIP-North Congestion Revenues**: We estimate congestion revenues across SWIP-North in hours in which the line is utilized for market transactions, accounting for the price effects noted above. Based on the example above, the price difference across SWIP-North will decrease from $35-40/MWh to $28-33/MWh, resulting in congestion revenues for the owner of capacity. If there is 1,100 MW of flow during a given hour and $30/MWh of price differences, congestion revenues for the market participant scheduling flows are $33,000, which we assume will be earned by the owner of the capacity rights.
- **SWIP-North GHG Emissions Reductions**: We used a similar approach to estimate the impact of SWIP-North utilization on GHG emissions as we did for the price effect, but instead using projected short-run GHG marginal emissions rates and energy price projections from the NREL Cambium dataset.[43] Based on hourly data for 2030, 2035, and 2040, we estimated differences in short-run marginal emissions rates in each zone at each increment of price differences between the two zones. For example, when Southern California prices are $30/MWh higher than Idaho prices in 2035, we estimated that the marginal emissions rate in Idaho is 0.3 tons/MWh lower than Southern California. We then estimated the reduction in GHG emissions due to flows across SWIP-North based on the projected energy price differences from GridSIM. For example, if projected prices are $30/MWh higher in Southern California in a given hour, we assume 1,100 MW of flows will be scheduled from Idaho to Southern California in that hour and GHG emissions will decrease by 330 tons.

C. SWIP-North Revenue Requirement

To estimate the cost of SWIP-North capacity, we calculated the annual transmission revenue requirement of SWIP-North capacity over the 52-year lifetime of the line using cost estimates provided by LS Power and standard assumptions for regulated revenue requirements. The first-year revenue requirement is projected to be $102 million, declining to $51 million in Year 30 as the project depreciates, as shown by the dark blue solid line in Figure 11 below. To estimate the transmission adder to include in a contract for the Idaho wind generation, we levelized the annual revenue requirements over the 30-year contract for Idaho wind, assuming that the contract price escalates annual at inflation (2.5%). This results in a first-year levelized revenue requirement of $63 million, as shown by the light blue dashed line below. The levelized revenue

43 NREL, Cambium, accessed June 2023.

requirement is calculated such that the present value of the two lines over the first 30 years are equivalent. If the DOE procures a 50% share of LS Power's SWIP-North Capacity, the first-year levelized revenue requirement would be $31 million.

FIGURE 11: SWIP-NORTH REVENUE REQUIREMENT