SWIP-North Benefits Analysis

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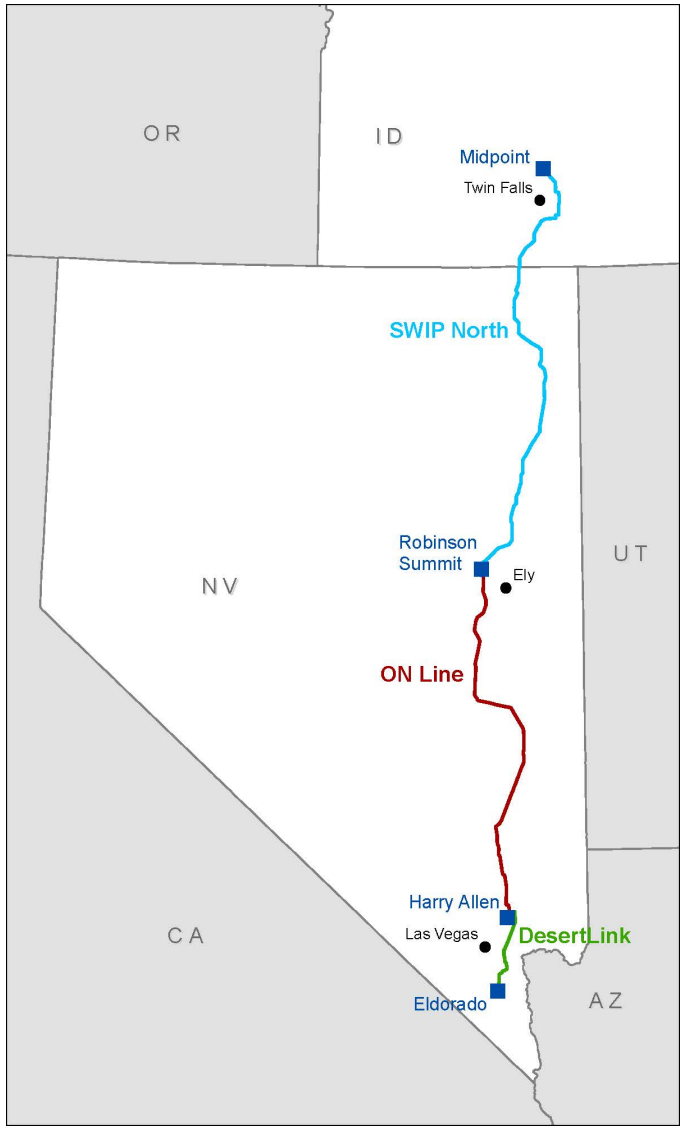
SUMMARY

Southwest Intertie Project (SWIP)



SWIP North is the final link of a transmission project that would create 1,000 MW of firm transmission rights from Idaho to California for CAISO

Phase I - ON Line (Robinson to Harry Allen) – Operating

- 231-mile, ~2000 MW, 500 kV transmission line in Nevada (~1000 MW reserved by NVE)
- Began commercial operations in January 2014
- First connection between Nevada Power Company and Sierra Pacific Power Company

Phase II - DesertLink (Harry Allen to Eldorado) – Operating

- 60-mile 500 kV transmission line near Las Vegas
- LS Power selected by CAISO via competitive solicitation pursuant to FERC Order 1000
- Robust cost containment package including caps on construction costs ($145.5 million), capital structure and ROE
- Operating since August 2020

Phase III - SWIP North (Midpoint to Robinson) – Permitted

- 275-mile, ~2000 MW, 500 kV transmission line in ID & NV (~1000 MW reserved by NVE)
- When completed, LS Power entitled to ~1000 MW from Midpoint to Harry Allen
- Links PacifiCorp, Idaho Power, and BPA to CAISO
- Nearly construction ready and could be online as early as June 2024

SUMMARY

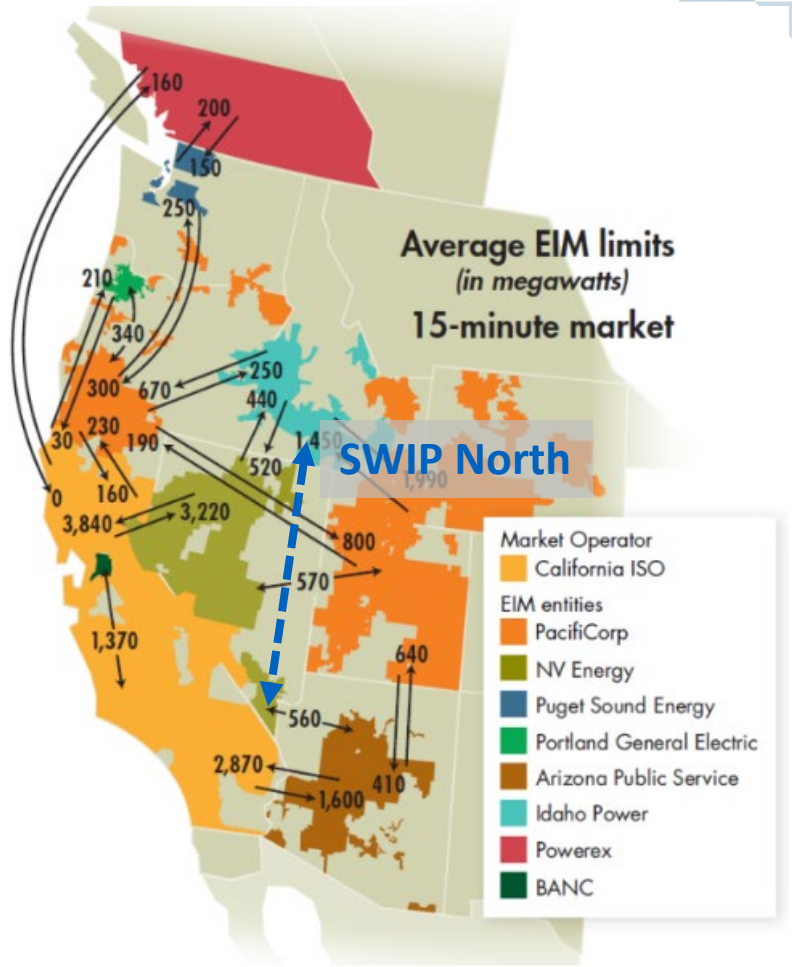
SWIP-N Increases Bi-directional Transfer Capacity across WECC

SWIP North adds transmission capacity to increase energy transfers between the Pacific NW and Southern CA that will:

1. Increase low-cost energy imports into CA by opening up access to NW resources, especially during evening peak demand hours
2. Reduce congestion on parallel paths (e.g., COI, PG&E-Sierra, SDG&E Double Tap-Friars)
3. Increase exports out of CA and reduce renewable curtailments
4. Increase reliability benefits due to load diversity across systems
5. Provide generation diversity benefits & reduce CA GHG emissions when coupled with OOS renewables, such as ID wind
6. Provide insurance value by reducing the impacts of extreme market conditions

In this study, we analyze the benefits that 1,000 MW of transfer capacity over SWIP North would provide to CAISO for two cases:

- First, as a **standalone project** facilitating wholesale power trading
- Second, paired with **1,000 MW of ID wind** contracted to CA



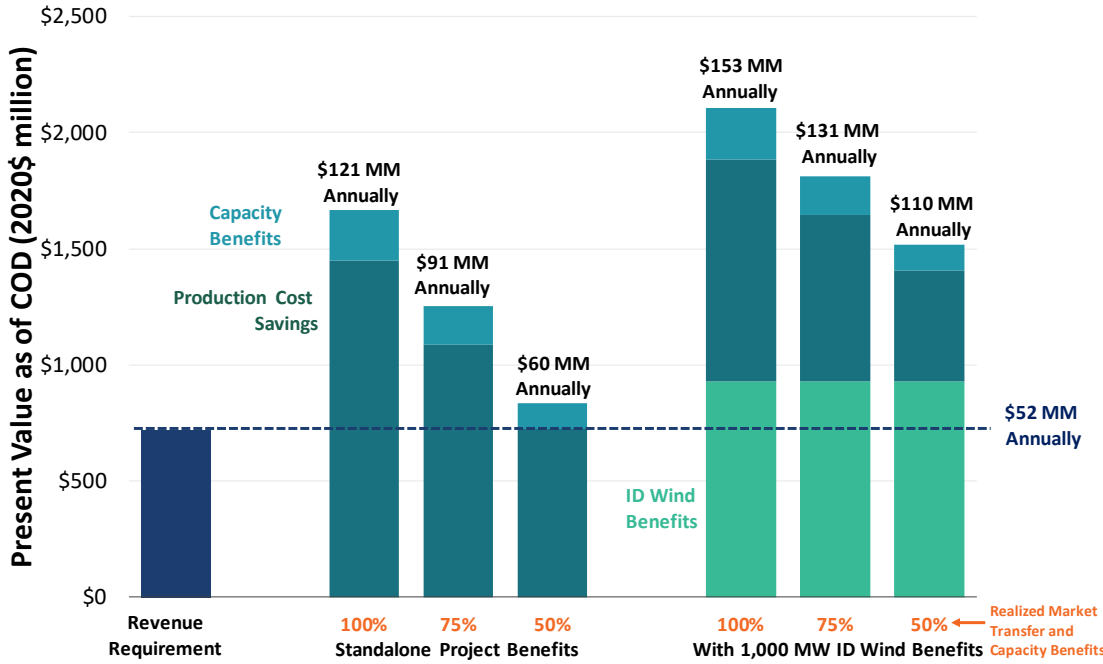
SUMMARY

SWIP North Reduces CAISO Ratepayer Costs

- As a **standalone project**, SWIP North could provide a present value of up to **$1.7 billion** in production and capacity cost savings and benefits to CAISO over its 50 year life based on our analysis of recent market conditions and the incremental inter-BAA transfers (imports & exports) it enables
- Even if recent market conditions were to change such that only 50% of the production cost and capacity benefits were realized ($830 million), SWIP North would still provide sufficient benefits to cover its $720 million present value of revenue requirements
- When coupled with OOS renewables, such as **1,000 MW ID wind**, the PV of SWIP North benefits are even higher, estimated at up to **$2.1 billion** over the life of the line
  - ID wind benefits alone pay for the line in this case
  - CA ratepayers would still receive a present value of up to $1.2 billion in market benefits at no additional cost

SWIP North Benefits and Costs

(Present Value and PV-equivalent Annualized Value)



Sources and Notes: Revenue requirement based on capital costs reported to CAISO during 2018 ITP process plus 9% AFUDC and first-year fixed O&M costs of $7 million. All other financial assumptions, including discount rate of 7% real, based on CAISO assumptions in its 2019-2020 economic planning study. Present value of costs and benefits assume a Dec 2024 commercial online date.

SUMMARY

Present Value of SWIP North Benefits

- **SWIP North as a Standalone Project**: Up to **$1.7 billion in cost savings** over the life of the project
  - Up to $1,450 million of production cost savings from increased market transfers, based on 2018-20 EIM prices across SWIP North
  - $220 million of resource adequacy benefits from diversity benefits between CAISO & PacifiCorp East
- **With 1,000 MW of ID Wind**: Up to **$2.1 billion in cost savings** by accessing 1,000 MW of ID wind
  - $930 million of public-policy cost savings from ID wind with lower net costs than CA solar (see next slide)
  - Up to $950 million of production cost savings, after transmission is used to deliver ID wind
  - $220 million of resource adequacy benefits from regional diversity benefits
- For both cases, SWIP North **benefits may be higher than these estimates** due to:
  - Lower Idaho prices with increased NW/WY wind and the addition of the Boardman-Hemingway line that increases the transfer capacity between PacifiCorp West and Idaho
  - Rising solar penetration that increases Southern CA's daytime exports and evening import demand
  - Increasing renewable integration value of diversifying CA renewables with NW wind and hydro
  - Increasing cost savings under extreme market conditions, such as recent wildfires and blackouts

Note: All cost savings and benefits are shown as the present value over the 50 year life of SWIP North as of the December 2024 online date, assuming a 7% (real) discount rate (similar to CAISO's assumption in its Transmission Planning Process).

SUMMARY

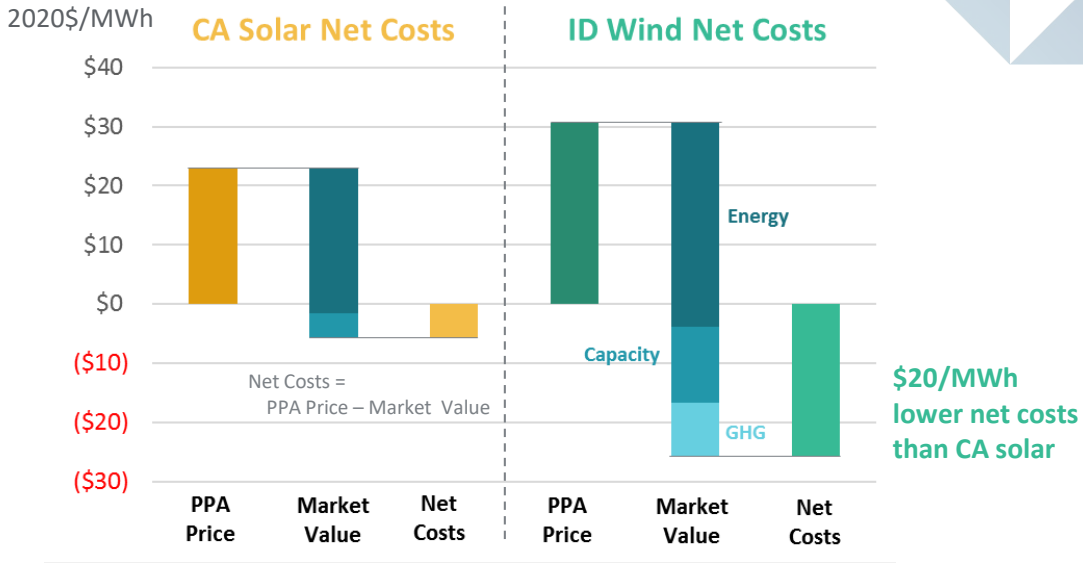
The Net Cost of ID Wind is Lower than that of CA Solar

While the headline PPA prices of ID wind are ~$3-8/MWh higher than CA solar, ID wind's output provides higher energy and capacity value and reduces more GHG emissions than CA solar such that the **net public-policy-related costs of ID wind to CA customers are $20/MWh lower than CA solar**

- **Energy Benefits: +$10/MWh** of avoided energy costs, based on 2018-2020 EIM prices
- **Capacity Benefits: +$9/MWh** of avoided capacity costs, based on recent RA costs and costs of new capacity
- **GHG Reduction Benefits: +$9/MWh** of avoided GHG costs due to 150% increase in GHG reductions, based on 2020 EIM emission rates and CEC's GHG price forecast

Procuring ID wind reduces the net present value of total CAISO customer costs by **$930 million** over the economic life of SWIP North

Net Cost of Renewable Energy Generation



2020$	CA Solar	ID Wind	Difference (ID Wind – CA Solar)
PPA Price	**$23/MWh**	**$31/MWh**	**+$8/MWh**
Total Value	**$29/MWh**	**$57/MWh**	**+$28/MWh**
Energy Value	$25/MWh	$35/MWh	+$10/MWh
Capacity Value	$4/MWh	$13/MWh	+$9/MWh
GHG Value	---	$9/MWh	+$9/MWh
Net Costs (Price – Value)	**-$6/MWh** ($25 - $29)	**-$26/MWh** ($31 - $57)	**-$20/MWh** ($8 - $28)

Production and Capacity Cost Savings of SWIP North

Market Transfer Benefits of SWIP North

To estimate the production cost savings of increasing energy market transfers across WECC, we analyzed historical 2018-2020 Energy Imbalance Market (EIM) prices on each side of the new path created by SWIP North

The absolute value of the historical EIM price difference provides a “bookend” estimate of the potential production cost savings for CAISO customers of increasing market transfers via SWIP North

- CAISO customers will benefit from increasing access to purchases of lower cost energy in Idaho, PacifiCorp East, and the Northwest to serve demand during evening peak and other high-price hours
- SWIP North will also increase CAISO’s ability to profitably export excess solar generation during mid-day hours and reduce renewable energy curtailments

We assume that energy transfers across SWIPNorth are a function of the price difference across the line, reaching 1000 MW at a price difference of $20/MWh or higher (see slide 9)

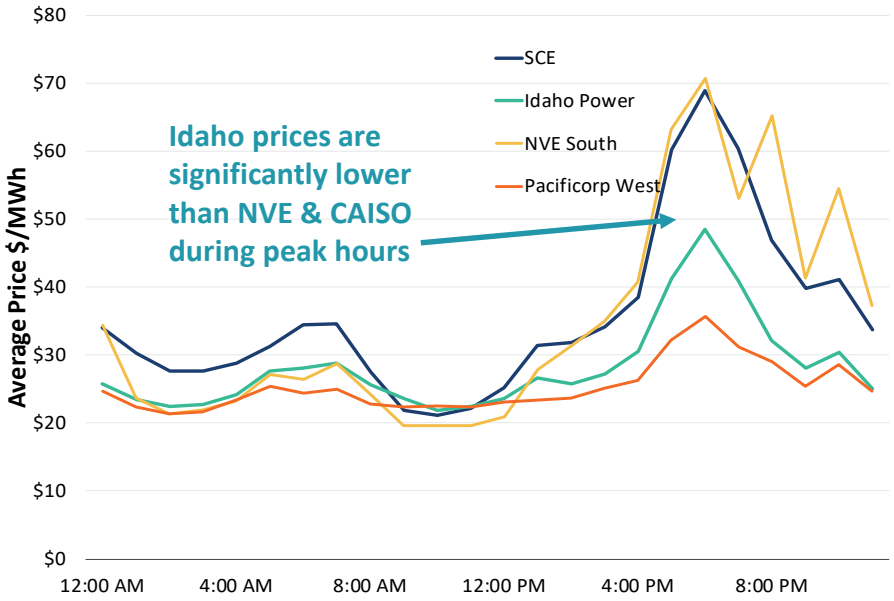
SWIP North Increases Access to Low-Cost NW Resources

Since Idaho Power joined the EIM in April 2018, prices at the northern end of SWIP North have been on average $13/MWh lower than NV Energy prices at the southern end, especially during peak demand hours

- Idaho prices likely will be lower on average in the future with increased wind generation in the Northwest and the new Boardman-Hemingway line further decreasing the price difference between Idaho and PacifiCorp West
- Prices are lower at the southern end of SWIP North 22% of hours, primarily during peak solar generation hours

EIM price differential is 3x higher during extreme market conditions, such as the August 2020 heat wave

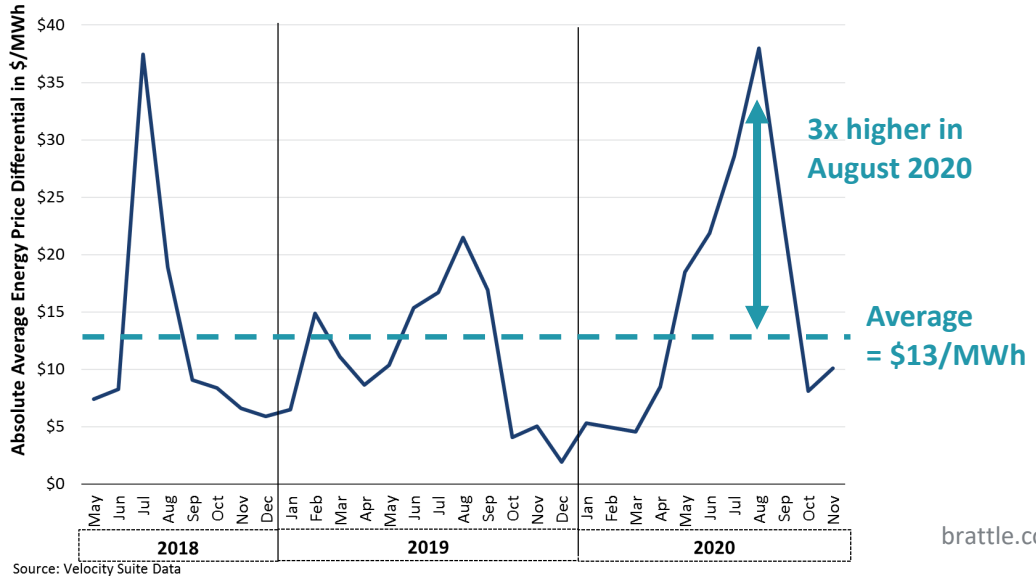
Zonal Average EIM Prices (Apr 2018 – Nov 2020)



Source: Velocity Suite Data

Monthly Average EIM Price Difference across SWIP North

based on Midpoint (Idaho) and Harry Allen (Nevada) Prices



Source: Velocity Suite Data

Estimated CAISO Flows across SWIP North

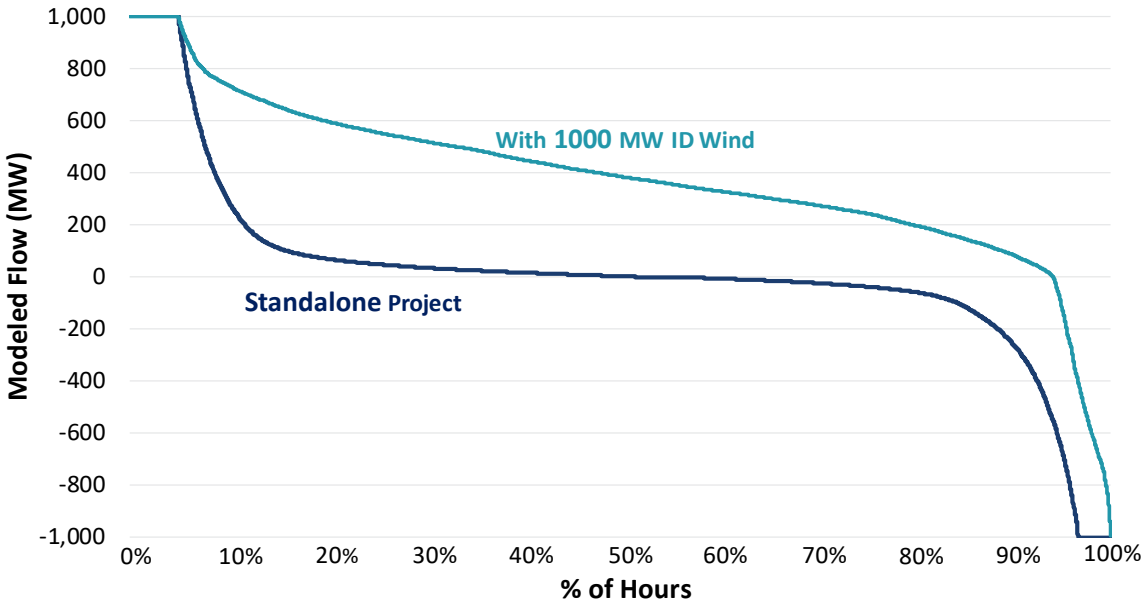
We conservatively estimate the sum of EIM and bilateral trade flows across SWIP North by assuming that the CAISO flow will be a function of the price difference across the path

- SWIP North hourly flows to/from CAISO are assumed to be 1,000 MW when price difference is greater than or equal to $20/MWh
- SWIP North flows are assumed to be proportionately less than 1,000 MW when price difference is less than $20/MWh (e.g., when the price difference is $10/MWh, the flow is assumed to be 500 MW)

Standalone Project: SWIP North flow is on average about 200 MW and reaches 1,000 MW during 8% of all hours

With 1,000 MW of ID Wind: 100% of ID wind flows over the line and the remaining capacity available for market transfers, which results in lower market transfer benefits but additional ID wind benefits (see slides 17-21)

Estimated CAISO SWIP North Flow Duration Curve*



Positive values represent North-to-South flows; negative values represent South-to-North flows.

*Note that this benefits analysis only accounts for the 1,000 MW of SWIP North transfer capacity that would be within CAISO (and new CAISO scheduling location at Midpoint); an additional 700-1,000 MW is expected to be allocated to NV Energy.

Bookend CAISO Ratepayer Cost Savings of Market Transfers

Based on historical 2018-2020 EIM prices and the estimated flows across the line, SWIP North would provide in the **Standalone Project** case up to $105 million/year of production cost savings to CAISO ratepayer and up to $69 million/year when paired with **1,000 MW of ID wind**

Estimated CAISO Ratepayer Production Cost Savings of SWIP North

Prices	Market	Midpoint Average Price ($/MWh)	Harry Allen Average Price ($/MWh)	Average Price Difference ($/MWh)	Average Absolute Price Difference ($/MWh)	Annual Absolute Price Difference ($/MW-year)	Annual Potential Savings ($ Millions /year)
Standalone Project	5 Minute	$27.58	$34.17	$6.59	$11.98	**$104,945**	**$104.9**
	15 Minute	$27.72	$34.06	$6.34	$10.15	**$88,914**	**$88.9**
With 1000 MW ID Wind	5 Minute	$27.59	$34.17	$6.58	$11.98	**$104,945**	**$69.2**
	15 Minute	$27.73	$34.06	$6.33	$10.15	**$88,914**	**$56.5**

Notes: Historical prices are for April 2018 to November 2020. "Average Absolute Price Difference" refers to the average of the absolute value of the price difference across SWIP North.

If these savings continue over the 50 year life of the line, SWIP North could provide up to $950 million to $1,450 million in present value cost savings to ratepayers, depending on whether the line is used to access ID wind

In addition, SWIP North may provide about 300 MW of congestion relief on COI based on WECC Path Rating and CAISO TPP studies that would provide additional benefits to CAISO ratepayers

Load and Resource Diversity Benefits of SWIP North

SWIP North provides additional infrastructure to the WECC system that allows CAISO and other CA entities to diversify their options for serving load during extreme market conditions, such as wildfires and heat events similar to August 2020

The existing infrastructure between California and the Northwest is frequently constrained and unable to increase imports to serve California customers during recent extreme events

- During the August 2020 blackouts, 330 MW of Northwest resources with RA contracts were unable to serve California customers
- 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

More frequent occurrence of these events significantly increases the insurancevalue (from a resource adequacy and deliverability perspective) provided by SWIP North's expanded transfer capability between the Northwest and California

SWIP North during August 2020 Blackouts

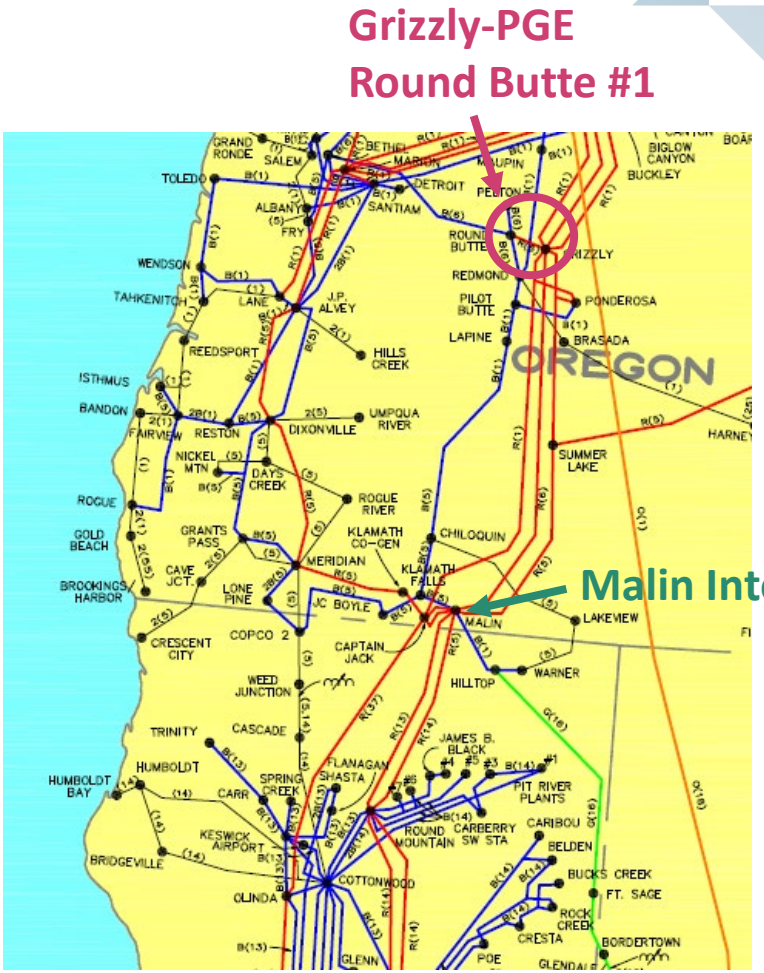
CAISO's Preliminary Root Cause Analysis notes thatMalin was derated due to a long-term transmission outage in Oregon.

- "[A] major transmission line [Grizzly-PGE Round Butte #1] in the Pacific Northwest upstream from the CAISO system was forced on outage due to weather and thus derated the California Oregon Intertie (COI)."
- "The derate reduced the CAISO's transfer capability by approximately 650 MW and congested the usual import transmission paths across both COI and Nevada-Oregon Border (NOB)."

Additional imports were available from the Northwest but unable to sell into CAISO due to the COI constraint

- "Because of this congestion [on COI], lower-priced non-RA imports cleared the market in lieu of higher-priced RA imports…"
- Derates kept out 330 MW of contracted RA imports.
- "In other words, more imports were available than could be physically delivered"

SWIP North could have provided additional transfer capability during the blackouts to deliver the additional imports and limit the need for the outages



Source: CAISO, Preliminary Root Cause Analysis Mid-August 2020 Heat Storm, October 2020.

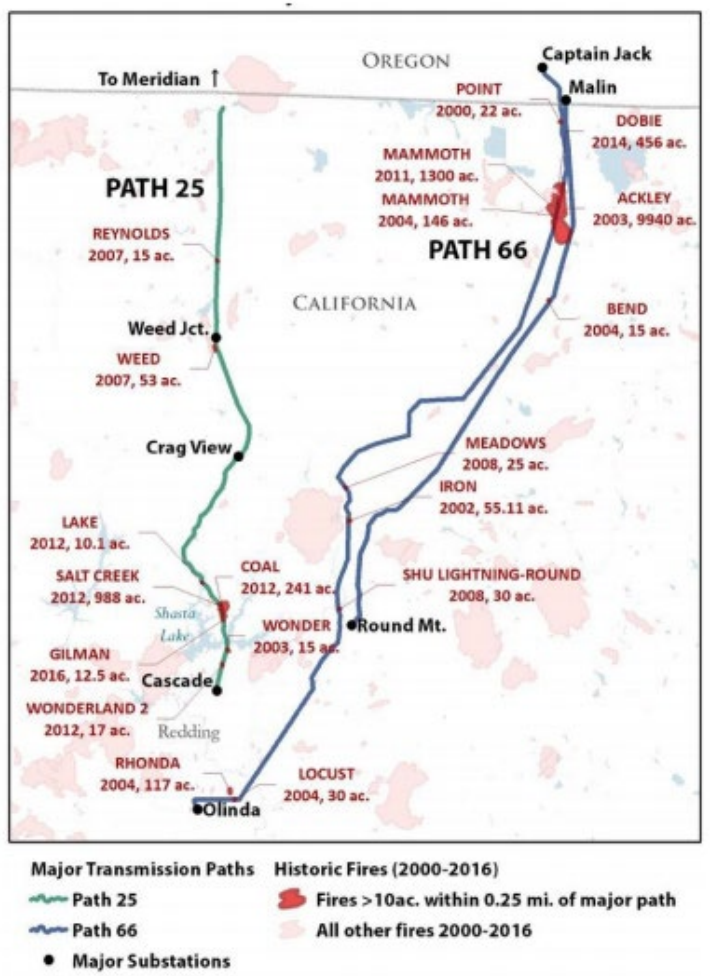
Wildfire Risks on COI/Path 66

SWIP North also diversifies the transmission-related risk of delivering Northwest imports into California during wildfire-related COI derates and thereby mitigating potential reliability risks and blackouts

The CEC documented the risks of wildfires-related transmission outages for California, specifically focusing on COI/Path 66

- "Paths 25 and 66 are two important WECC-defined transmission paths located in Northern California."
- "Both paths allow large imports of inexpensive hydropower from the Pacific Northwest. **Path 66, in particular, travels through forested areas subject to wildfires**."
- "In one Northern California subregion, over 100 wildfires occurred between 2000 and 2016, covering 15-20% of the land area. **Of those, 19 fires approached within a quarter mile of Paths 25 and 66.** Wildfires near transmission paths may force [CAISO] to cut power to those paths (line outages)."
- "This can increase generation costs and may disrupt customer service."

Wildfires Near Path 66 (2000 – 2016)



Source: Dale, et al., Assessing the Impact of Wildfires on the California Electricity Grid, September 2018.

Value of Increased Access to Non-Firm Energy Imports

SWIP North provides load and resource diversity benefits to California in excess of the estimated energy market value by providing access to additional non-firm energy imports that could avoid future load-shed events and increase reliability and resource adequacy in the CAISO footprint

Based on our analysis of incremental transmission and peak-load diversity across the line (see next slide), we conservatively assume that SWIP North will provide access to non-firm energy imports from PacifiCorp East and Idaho Power during California peak load events with at least 100 MW to 150 MW of capacity-equivalent value (and with deliverable, available non-firm energy as high as 700-950 MW)

- We conservatively estimate the load diversity value of only 100-150 MW of capacity-equivalent non-firm imports is $11-18 million per year
- Over the life of SWIP North, the incremental energy imports enabled by SWIP North provide an additional $220 million of capacity-value benefits to California

This incremental capacity benefit estimated for SWIP North is consistent with the observation that the NW had available capacity during the August 2020 outages, but insufficient transfer capability to deliver it to California

- An alternative valuation of capacity and resource adequacy benefit would be based on the ID and CA capacity cost difference of importing up to 1000 MW of firm capacity

Load Diversity-related Capacity Benefits of SWIP North

We analyzed differences in coincident and non-coincident peak demand between CAISO and two markets with access at the north end of SWIP North (Pacificorp East and Idaho Power) to determine the capacity that could be available to maintain CAISO reliability, even if it is unable to provide firm capacity

CAISO & 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 between CAISO and PacifiCorp in **2025**, SWIP North **provides access to 95 MW of additional imports**
- **In 2035, 150 MW** of additional imports would be available from PacifiCorp East

CAISO & Idaho Power

- Load diversity could allow 600 MW of Idaho Power 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
- May add capacity value of up to 600-700 MW during 2025-35

2025 Load Diversity 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 Pacificorp's 2015 modeling transmission constraint assumption https://www.caiso.com/Documents/StudyBenefits-PacifiCorp-ISOIntegration.pdf

Public-Policy Cost Savings of Idaho Wind relative to California Solar

Comparing the Net Costs of ID Wind vs CA Solar

CPUC planning processes focus on in-state solar as the primary source of new renewable generation, as seen in the January 2021 portfolio provided to CAISO for transmission planning

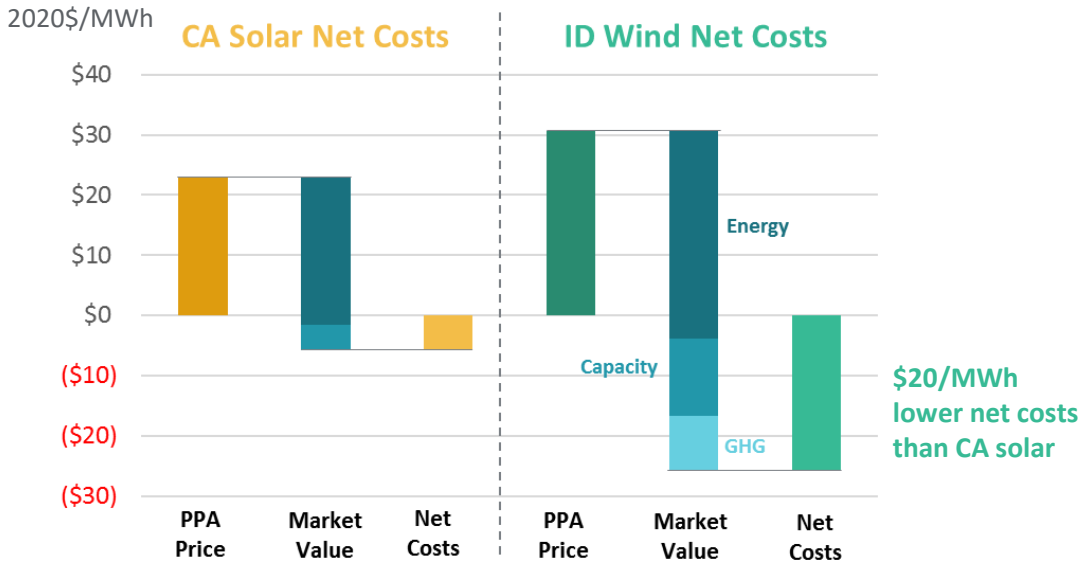
- CA Solar: +9,419 MW
- Out-of-State Wind: +1,062 MW (primarily in NM and WY)

While the first-year levelized costs of acquiring CA solar are about $3-8/MWh (in 2020 dollars) lower than Idaho wind…

- CA Solar: $23-28/MWh, based on CPUC cost projections and recent market data reported by LBNL
- ID Wind: $31/MWh, based on cost estimates for PacifiCorp IRP

…Idaho wind provides $20/MWh lower net cost renewable generation than CA solar because its market value more than offsets the higher costs of the PPA contract

Net Cost of Renewable Energy Generation



Sources and Notes: CPUC portfolio - CPUC, Decision Transferring Electric Resource Portfolios to California Independent System Operator for 2021-2022 Transmission Planning Process, R.20-05-003, January 7, 2021; CPUC solar costs - CPUC, Inputs & Assumptions: 2019-2020 Integrated Resource Planning, February 2020. LBNL solar costs – Bolinger, et al., Utility-Scale Solar Data Update: 2020 Edition, November 2020; ID wind costs – Burns & McDonnell, 2020 Renewable Resources Assessment, Rev. 1, Prepared for PacifiCorp, August 2020, p. 46; ID wind capacity factor of 38% based on onshore wind Class 6 resources in NREL 2020 Annual Technology Baseline; levelized costs of CA solar and ID wind based on a 35 year PPA term with escalation at 2% per year and financing assumptions from the CPUC's resource cost assumptions for 2019-2020 IRP.

ID Wind Avoids $10/MWh More Energy Costs than CA Solar

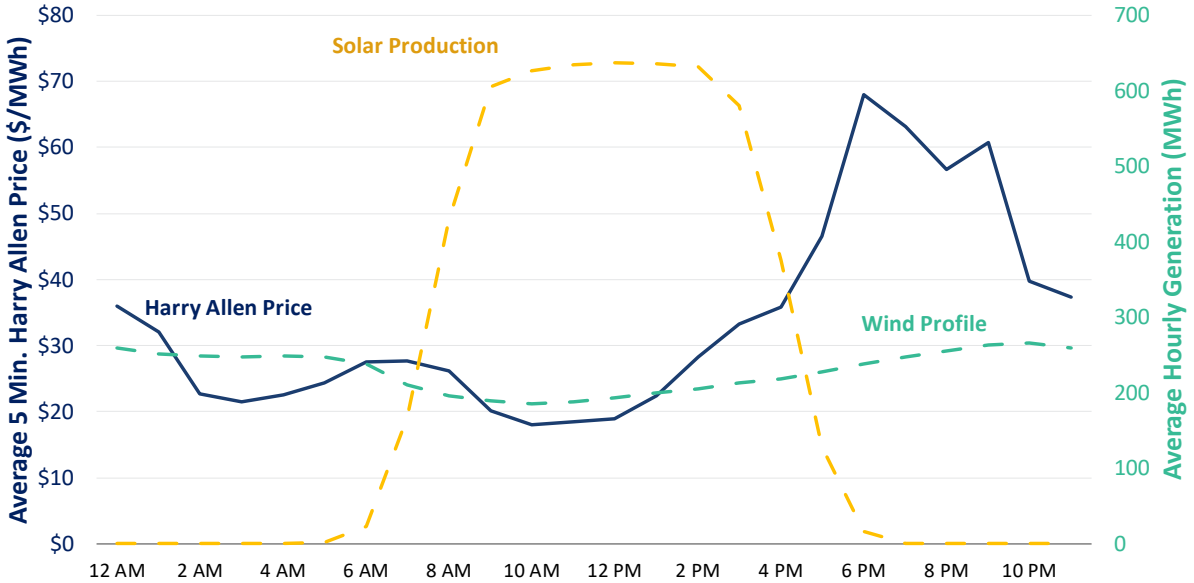
Idaho wind (green line) on average generates slightly more during evening hours than mid-day hours, which increases the market value of its output compared to California solar (yellow line)

- EIM prices at Harry Allen (blue line) are 3x higher during the evening hours than the middle of the day

Due to these factors, ID wind energy market value is on average $10/MWh higher than CA solar

- ID wind avoids $33 million more in energy market payments than CA solar per year

Historical EIM Prices and Renewable Generation



Source: Velocity Suite Data

Energy Market Value of ID Wind vs CA Solar

	Generation	Average Energy Price	Annual Energy Market Value
Idaho Wind	3,353 GWh	$35/MWh	$115.9 million
California Solar	3,353 GWh	$25/MWh	$82.8 million
Difference	0 GWh	**+$10/MWh**	**+$33.1 million**

Sources: ID wind generation profile provided by LS Power; solar generation profile based on CAISO assumptions in its transmission planning for resources in southern California.

ID Wind Avoids $9/MWh More RA Costs than CA Solar

The Resource Adequacy (RA) value of wind is projected by the CPUC to increase from 32% to 36% from 2025 to 2030 while solar decreases from 20% to 9%

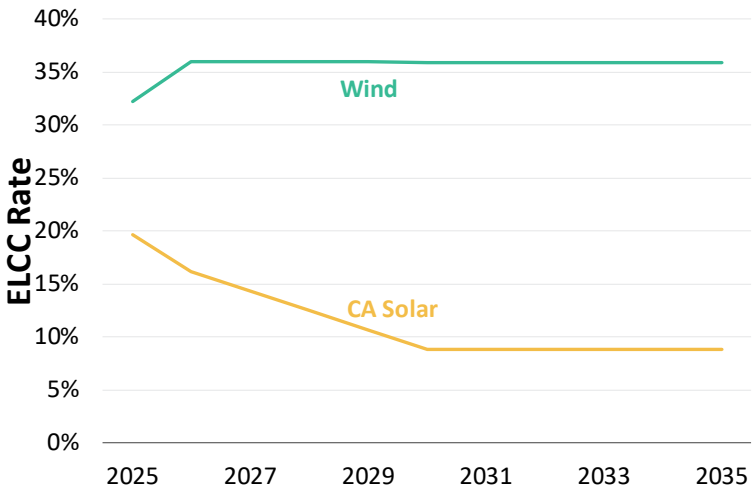
- 1,000 MW of ID wind in 2030 provides 359 MW of RA capacity
- CA solar, scaled to generate an equivalent amount of annual energy output, provides just 96 MW of RA capacity

The value of avoided RA capacity in California is $120/kW-year based on recent reference points

- CPUC's most recent RA report indicates that the highest cost (marginal) resources procured to meet RA needs is $120/kW-year
- CAISO's 2019 market report estimates the Net Cost of New Entry for new gas resources is $102-120/kW-year

ID wind provides an additional $29 million of RA value per year, or $9/MWh, compared to CA solar

Projected Wind and Solar ELCC



Source and notes: CPUC, Resource Data Template, June 15, 2020. Based on average ELCC for July, August and September.

RA Market Value of ID Wind vs CA Solar

	RA Capacity	Levelized RA Value	Annualized RA Capacity Value
Idaho Wind	359 MW	$13/MWh	$42.8 million
California Solar	96 MW	$4/MWh	$13.9 million
Difference	+263 MW	**+$9/MWh**	**+$28.9 million**

Sources: CPUC, 2018 Resource Adequacy Report, August 2019, p. 23; CAISO, 2019 Annual Report on Market Issues and Performance, June 2020, pp. 76-80.

ID Wind Avoids 146% More GHG Emissions than CA Solar

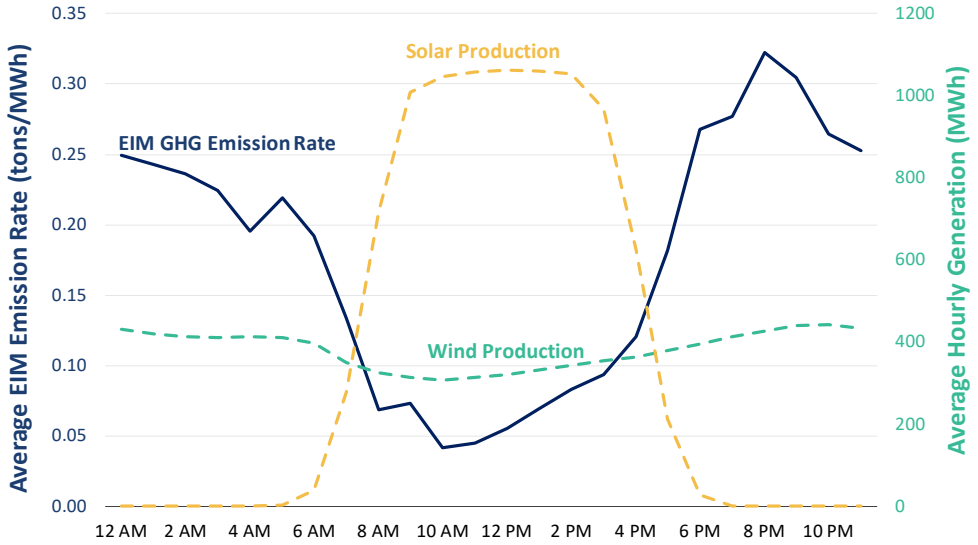
Marginal GHG emissions rate of serving CAISO demand (blue line) follows a similar pattern as EIM energy prices with the highest emissions during peak-load hours when less efficient units are on the margin

- GHG emissions rates are based on the marginal emissions rates of imports into CAISO in the EIM
- GHG emissions rate is zero when CAISO is a net exporter, causing the value to be very low during peak solar hours

ID wind (green line) on average reduces 0.19 tons of GHG emissions per MWh of output versus just 0.08 tons per MWh for CA solar (yellow line)

- ID wind on average reduces 146% more GHG emissions than a similar amount of generation from CA solar

Historical GHG Emissions Rates and Renewable Generation



Source: Velocity Suite Data & Wind and Solar Profiles

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.

ID Wind Avoids $9/MWh More GHG Costs than CA Solar

We estimated the value of the additional GHG emissions reductions of ID wind based on the CEC's recent projection of GHG allowance prices

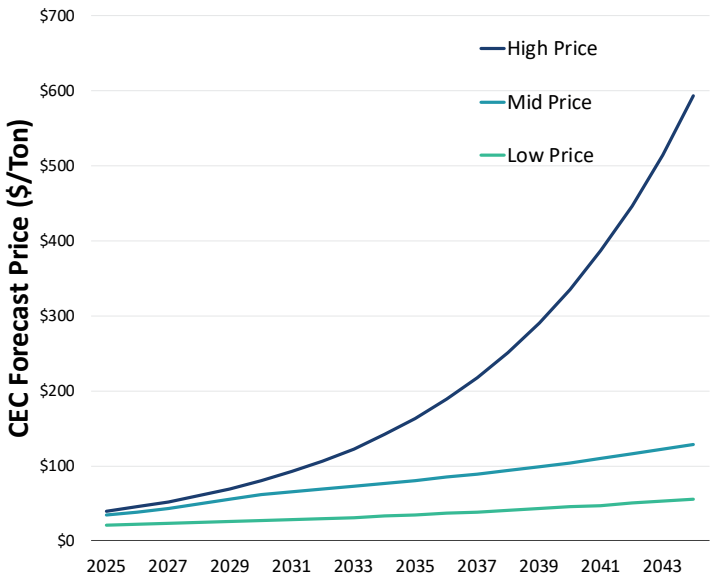
- CEC's mid GHG allowance prices rise from $34/ton in 2025 to $129/ton in 2045 (hold constant post-2045)
- GHG prices range from $56/ton to $594/ton in 2045

The additional 0.37 MMT per year of GHG emissions reductions avoids $13 million of GHG costs in 2025 and $48 million in 2045

Over the life of SWIP North, access to ID wind reduces the costs of reducing GHG emissions by $420 million, or $9 per MWh of wind generation

- The avoided GHG costs range from $190 million to $1,311 million based on the high and low price forecasts developed by the CEC

Projected GHG Allowance Prices



Source: CEC, 2019 IEPR Final GHG Allowance Price Projections, January 2020.

GHG Value of ID Wind vs CA Solar

	Generation	Avoided GHG Emissions Rate	Annual Avoided GHG Emissions	Annualized GHG Value
ID Wind	3,353 GWh	0.19 tons/MWh	0.62 MMT	$51.7 million
CA Solar	3,353 GWh	0.08 tons/MWh	0.25 MMT	$21.0 million
Difference	0 GWh	+0.11 tons/MWh	+0.37 MMT	$30.7 million

Appendix

APPENDIX

CAISO 2020-2021 Transmission Plan Analysis of SWIP North

CAISO released preliminary results of its analysis of SWIP North in its draft 2020-2021 Transmission Plan

- SWIP North modeled as providing 500 MW of north-to-south capacity and 1,700 MW of south-to-north capacity
- CAISO identified just $10 million/year of cost savings for SWIP North, or $150 million over the life of the line

There are several aspects of CAISO's analysis that underestimate the value of SWIP North to CAISO customers that should be addressed in future studies

1. **Low Base Case Congestion**: CAISO's Base Case identified just $13 million of congestion on COI and $9 million on PDCI ($22 million total), which is much lower than recent congestion on Malin and NOB interties of $80-230 million
2. **Limited SWIP North Transfer Capability**: CAISO model for SWIP North may not have captured all associated upgrades which is the likely cause for less flows on SWIP North in N-S direction (less than 600 MW in CAISO study) as compared to the 2,000 MW total capacity of SWIP North
3. **No CAISO Ownership**: CAISO assumes Nevada utilities own 100% of the line such that market transfers via SWIP North have to pay a $9/MWh hurdle to sell into CAISO (and vice versa); if CAISO owns 1,000 MW of SWIP North, market transfers would avoid the additional hurdle and flows across SWIP North would increase
4. **Lack of EIM Benefits**: CAISO doesn't model the benefits of SWIP North in the EIM, especially accounting for the real-time uncertainty in load and generation; over 50% of recent NW intertie congestion has been in RT market
5. **Additional Benefits**: CAISO's does not capture additional benefits, including the value under extreme market conditions, load diversity benefits, access to lower net cost renewables, and the value of renewable supply diversity

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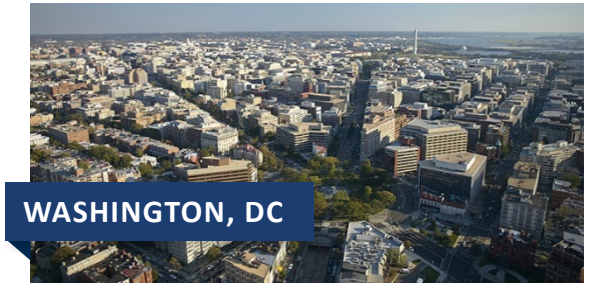
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