



Innovation and Investment in Energy

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Mar 22, 2019

California Independent System Operator
250 Outcropping Way
Folsom, California

Economic Studies: Congestion Quantification & Transmission Project Benefits

Dear Chairman Olsen and Governors,

LS Power commends CAISO staff for the work done under the 2018/19 Transmission Plan. CAISO staff performed a wide variety of studies in this cycle for Reliability, Economic and Policy-Driven assessments. In addition, Staff also took on several Special Studies, such as the Pacific Northwest Transmission Capability Assessment, Local Capacity Reduction analysis, Benefits of Large Energy Storage, and Frequency Response assessment. All these were key topics of interest to stakeholders and provided valuable insights.

Improvements could be made, however, in the economic analysis to quantify congestion on existing CAISO interties, and for quantifying benefits of Transmission Projects that improve CAISO's transmission capacity with neighboring Regions, such as LS Power's Southwest Intertie Project (SWIP-North). In addition, while CAISO started its investigation of whether additional transmission capacity on the Pacific AC Intertie (PACI) and Nevada Oregon Border (NOB) transmission paths can be made available for scheduling energy in the Day Ahead Market, this analysis was not brought to conclusion and no timeline was provided for its completion.

Given the above, while we support CAISO Management's recommendation of approval of the 2018/19 Transmission Plan by the CAISO Board, we recommend that the following improvements be made for 2019/20 Transmission Plan.

- (1) Modelling enhancements must be incorporated into CAISO's economic analysis such that intertie congestion, particularly along the PACI & NOB interfaces can be correctly quantified and addressed. Failure to capture the real congestion in planning studies has been costing CAISO ratepayers between \$50 to \$147 mm every year for last several

years¹. We believe CAISO's approach to quantifying this congestion needs to change. CAISO has been studying *physical congestion* on this path by running production cost modelling studies. The congestion as reported by CAISO DMM reports is actually *Day Ahead Scheduling (financial) congestion*. CAISO should investigate new or enhanced modelling tools that properly quantify this financial congestion. LS Power (through work done by Brattle Group) had previously submitted recommendations² on modelling improvements such that financial congestion can be correctly quantified. These recommendations have not yet been implemented by CAISO but we recommend that this gets done in 2019-20 TPP.

- (2) CAISO should conclude its investigation of whether additional transmission capacity on the existing PACI and NOB transmission paths can be made available in the Day Ahead Market early enough in the 2019/2020 TPP cycle to allow time to analyze whether new transmission facilities are necessary to resolve this congestion. This work to assess whether existing transmission capacity is available was taken up by CAISO in the 2018/19 TPP; however there is no information on when CAISO expects to complete it.
- (3) For projects such as SWIP North, which improve transfer capability between CAISO and other regions in the West, CAISO should quantify all benefits. Production cost simulation studies that CAISO relies upon for its economic analysis fall short of capturing additional economic benefits including:
 - (a) Financial benefits of improving Day Ahead scheduling capability between CAISO and neighboring regions. Improving transmission scheduling capability will alleviate Day Ahead financial congestion that is commonplace for several CAISO intertie paths such as PACI, COI & NOB
 - (b) GHG reductions and associated savings to CAISO
 - (c) Load Diversity & Flexible Reserve Capacity saving benefits by allowing additional import/export transactions between CAISO and neighboring regions
 - (d) Renewable Capital Cost savings – Diversity benefits from adding new transmission capacity with neighboring regions leads to reductions of renewable curtailments in California, which leads to capital cost savings for the same RPS goals.
- (4) For the economic analysis conducted under 2018/19 TPP, it wasn't clear if the 1000 MW of transmission capacity from Midpoint to Harry Allen that SWIP North offers for CAISO use was effectively modelled with *no* wheeling charges across NV Energy. If modelled

¹ As per 2017, 2016, 2013 CAISO DMM Annual Reports on Market Issues & Performance, PACI & NOB congestion combined was approximately \$50 mm in 2015, \$75 mm in 2016, \$100 mm in 2017. Prior to this, it was \$147 mm in 2014, \$62 mm in 2013, \$144 mm in 2012 and \$74 mm in 2011. DMM reports can be found at:

<http://www.aiso.com/Documents/2017AnnualReportonMarketIssuesandPerformance.pdf>

<http://www.aiso.com/Documents/2016AnnualReportonMarketIssuesandPerformance.pdf>

<http://www.aiso.com/Documents/2013AnnualReport-MarketIssue-Performance.pdf>

² LS Power comments (including Brattle findings) filed under 2017/18 TPP recommended modelling enhancements which can be found at:

http://www.aiso.com/Documents/LSPComments_2017-2018PreliminaryReliabilityResults.pdf

correctly, addition of SWIP North should extend CAISO's boundary to the Midpoint substation (with access to Idaho Power/PacifiCorp/BPA) and any MWs delivered to Midpoint should be able to get scheduled into CAISO markets without any hurdle on the new 1000 MW capacity path. We recommend that CAISO Staff further investigate this in 2019/20 TPP and consider either making modelling enhancement to existing tool or use a different tool for this analysis. This modeling approach, coupled with the aforementioned modeling enhancements to properly capture financial congestion, should enable CAISO to correctly quantify economic benefits of SWIP North.

As noted recently by Brattle Group³, SWIP North can help CAISO take advantage of price differentials between Midpoint and Harry Allen. Based on 12 months of recent LMP data from CAISO for EIM nodes at Midpoint (in Idaho Power) and Harry Allen (currently in NVE, soon to be part of CAISO after the Harry Allen to Eldorado 500 kV line goes into service in 2020), the LMP at Midpoint averaged around \$33/MWh and at Harry Allen around \$38/MWh, a difference of about \$5/MWh. Brattle found that:

"If the addition of the line resulted in a shift of 1,000 MW of generation from the high-cost end of the line to the low-cost end of the line, SWIP North would result in up to \$100 million of annual production cost savings. Even if only half of these benefits were realized, the production cost savings would still be \$50 million per year... Production cost savings in the range of \$50 – 100 million per year could provide sufficient benefits to justify the cost of SWIP North."

Further details on these issues can be found in LS Power's comments for CAISO 2018/19 Draft Transmission Plan and CAISO 2019/20 Draft Study Plan. These comments are attached to this letter. LS Power thanks the CAISO Board and Management for the opportunity to provide these comments and looks forward to working with CAISO staff during 2019/20 Transmission Planning Process.

Sincerely,



Sandeep Arora
Vice President

³ Brattle Group conducted analysis on behalf of LS Power in support of Reply Comments LS Power filed with CPUC for 2019-20 IRP proceeding. A copy of Brattle Memo is attached to this letter.

cc:

Mr. Stephen Berberich, President & CEO, CAISO

Mr. Keith Casey, VP Market & Infrastructure Development, CAISO

Mr. Mark Rothleder, VP Market Quality & Renewable Integration, CAISO

Mr. Neil Millar, Executive Director, CAISO

Mr. Paul Thessen, President, LS Power

Mr. John T. King, Exec Vice President, LS Power

Mr. Scott Carver, Senior Vice President, LS Power

Mr. Mark Milburn, Vice President, LS Power

Attachment A: LS Power comments to CAISO's 2018/19 Draft Transmission Plan

CAISO 2018/19 Draft Transmission Plan: Stakeholder Comments

Submitted by	Company	Date Submitted
Sandeep Arora (sarora@lspower.com) (925) 201 5252 Mark Milburn (mmilburn@lspower.com) (636) 534 3235	LS Power	2/28/19

LS Power appreciates the opportunity to submit comments on the 2018/19 Draft Transmission Plan “Draft Plan”. LS Power has comments for the following topics addressed in the Draft Plan.

Economic Studies:

PACI/NOB congestion:

CAISO has not demonstrated any progress on steps it intends to take to resolve this recurring issue that is costing ratepayers \$50mm to \$148mm annually. In previous stakeholder meetings CAISO indicated that it was going to investigate whether PACI/NOB Day Ahead congestion could be alleviated through market enhancements. If not, CAISO indicated that it would look to address this congestion through the Transmission Planning Process. Yet the Draft Plan does not directly address how it plans to alleviate this Day Ahead congestion, nor does it provide steps CAISO intends to take or the timeline for addressing this high cost problem. In the Draft Plan, CAISO concludes that *“the greatest opportunity is for the ISO market to gain access to the additional physical capacity that cannot currently be utilized in the ISO market. The ISO is accordingly investigating with its neighbors the possibility of accessing this capacity”*. LS Power first brought this issue to CAISO’s attention four years ago¹. It appears that another year has elapsed with no material progress on addressing the congestion. We recommend CAISO establish a deadline to conclude its investigation and create a timeline for resolving this issue and execute on it.

Consistent with our previous TPP comments, LS Power reiterates the importance of correctly modelling PACI/NOB congestion. The congestion on this path has been one of the top congestion issues in CAISO’s Day Ahead Markets for the last several years, resulting in CAISO ratepayers overpaying \$50 to \$100 million in each of the past 3 years². Similarly in 2011-2014 the congestion reported by DMM ranged

¹ Previous LS Power comments:

http://www.caiso.com/Documents/LSPowerComments2015-2016TransmissionPlanningProcessStakeholderMeetingNov16_2015.pdf

² As per 2017 CAISO DMM Annual Report on Market Issues & Performance, Section 8, Table 8.1, PACI & NOB congestion combined was approximately \$50mm in 2015, \$75 mm in 2016, \$100 mm in 2017. The report can be found at: <http://www.caiso.com/Documents/2017AnnualReportonMarketIssuesandPerformance.pdf>

from \$62mm to \$148mm³. This signals the need for additional transmission capacity that should pay for itself by allowing more economic transfers from the Pacific NW into California. Since this congestion doesn't get correctly quantified in the current planning models, CAISO's Transmission Planning Process does not properly identify the need for additional transmission capacity to relieve the reported congestion and reduce ratepayer costs. While CAISO should make efforts in correcting its economic study model, however, even if the model cannot fully replicate the historical congestion reported by CAISO's DMM, CAISO has enough consistent historical congestion data to support evaluation of transmission solutions in the TPP.

CAISO's Economic Study Model:

LS Power submitted modelling recommendations to CAISO to capture PACI/NOB congestion in the 2017/18 TPP through work that the Brattle Group conducted on behalf of LS Power⁴. CAISO must correct the Economic Study models to accurately capture the historical Day Ahead congestion on these paths. CAISO should investigate in particular whether the software it uses currently to perform production cost simulation work can be enhanced to capture transmission capacity rights and allow CAISO to alter wheeling rates to accurately represent transmission capacity arrangements. CAISO should look into using different software for performing this work if the software it currently uses cannot be used for this purpose. LS Power stands prepared to have detailed discussion with CAISO team on this, as needed.

SWIP North Economic Study:

CAISO staff conducted study to analyze economic benefits of the SWIP North project. The study compared WECC-wide production costs with and without SWIP North. LS Power has several comments on this study:

- 1) It is not clear whether CAISO was able to accurately model SWIP North as a 1000 MW wheel-free path from Midpoint (Idaho Power) to Eldorado (CAISO) as specified in LS Power's regional economic study request and interregional study request. If any hurdle rate was assumed in CAISO's production cost analysis for energy to wheel from Idaho Power to NV Energy to CAISO, this should be removed and study results revised. If the software CAISO uses cannot support this analysis accurately then CAISO should look into other tools that can do this.
- 2) It is not clear if CAISO's economic analysis accounted for several additional benefits that SWIP North, an out of state transmission project, can provide. Our understanding is that CAISO's TEAM methodology does not account for these benefits and these need to be accounted for to get a complete picture of overall benefits of a transmission project such as SWIP North.
 - (a) Green House Gas (GHG) reduction benefits:
SWIP North will enable an incremental 1000 MW of transmission capacity that can be used to import/export generation resources into/from CAISO. CAISO's analysis shows that "SWIP - North may allow more exports from California to other regions when there are renewable

³ See http://www.caiso.com/Documents/2014AnnualReport_MarketIssues_Performance.pdf

⁴ LS Power comments (including Brattle findings) filed under 2017/18 TPP can be found at: http://www.caiso.com/Documents/LSPComments_2017-2018PreliminaryReliabilityResults.pdf

energy surplus within California". This will certainly help reduce GHG emissions in California by allowing more renewable generators to remain online and displacing fossil fuel generation. CAISO should quantify GHG reductions and renewable curtailment reductions from SWIP North. An approach CAISO can take in quantifying these benefits would be similar to how CAISO calculates similar benefits for its Quarterly EIM benefits analysis. As per CAISO's Q4 2018 EIM report⁵ total avoided renewable curtailment volume in MWh for Q4 2018 was calculated to be 23,425 MWh. The environmental benefits of avoided renewable curtailment were noted to be significant and CAISO used an assumption that avoided renewable curtailments displace production from other resources at a default emission rate of 0.428 metric tons CO₂/MWh. We recommend similar approach be used in quantifying these benefits for projects like SWIP North. CPUC's study for 2017-18 IRP⁶ also noted significant benefits of out of state transmission in terms of GHG reduction, renewable curtailment reduction and lower renewable integration costs. CAISO should capture these benefits as it works on finalizing the Transmission Plan.

(b) Renewable capacity capital cost savings:

In CAISO's studies, SWIP North has shown to help reduce renewable curtailments in CAISO footprint by providing a conduit to export surplus renewable energy from California. As renewable curtailments are reduced, there will be capital cost savings as CAISO Load Serving Entities will not need to build incremental renewables to meet same RPS goals. These capital cost savings should be captured.

(c) Load Diversity/Reserve Capacity reduction benefits:

Enabling 1000 MW of transmission capacity from CAISO to neighboring Regions will allow the flexible ramping requirement for CAISO and the Regions to be reduced as they will be able to take advantage of the diversity of resources and shape of the load. These diversity saving benefits should be accounted for. CAISO's Quarterly EIM reports capture these benefits and this is an approach that CAISO Transmission Planning can use as well for this study.

- 3) CAISO's analysis concluded that *"The SWIP - North line may not provide incremental import from Northwest regions during some hours when there is no energy surplus in those regions depending on resource and transmission assumptions in Northwest regions in the model"*. The \$50mm to \$148mm of recorded historic congestion on the PACI/NOB paths that CAISO experiences every year demonstrates the contrary, i.e. there is enough economic energy

⁵ Western EIM Q4 report, page 14: <https://www.westerneim.com/Documents/ISO-EIMBenefitsReportQ4-2018.pdf>

⁶ Slide 12, CPUC's recommendation for CAISO TPP portfolios: http://www.cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/UtilitiesIndustries/Energy/EnergyPrograms/ElectPowerProcurementGeneration/irp/2018/Attachment%20B_%20IRP%20Proposed%20Portfolios%20for%20CAISO%202019%20TPP_final.pdf

available in PNW but there isn't sufficient transmission capacity for this economic energy to be scheduled into CAISO. In light of this, an incremental 1000 MW transmission capacity from SWIP North should allow CAISO to access this economic energy and lower the cost for its ratepayers.

- 4) CAISO's analysis concluded that *"lower priced imports can result in increased profits to out-of-state generation and reduced profits to ISO owned generation in the ISO footprint whose profits accrue to ISO ratepayers."* LS Power recommends that CAISO revisit this conclusion. If a project like SWIP North enables 1000 MW of new transmission capacity between the PNW and CAISO, will that enable some of the existing PNW resources that may be contracted to serve CAISO to schedule into California? If so, should the profits for those out-of-state generation resources be treated the same as profit for internal CAISO resources?
- 5) Based on CAISO's analysis of historical PACI/NOB congestion, it is quite evident that congestion is caused because not enough transmission capacity gets offered into the Day Ahead market for economic PNW resources to be able to schedule into CAISO. CAISO's economic analysis for SWIP North should quantify benefits of a new 1000 MW transmission capacity that can serve as a diverse transmission path and allow part or all of the economic PNW resources to schedule into CAISO through SWIP North. Further, this new transmission path would also reduce friction in scheduling, as is typically experienced in the West.

Reactive Support Projects at Round Mountain & Gates:

CAISO's reliability project proposals should be further refined as follows:

- 1) CAISO should test the effectiveness of looping the reactive support projects into two existing transmission lines between Round Mountain and Table Mountain substations, rather than limiting the proposals to connect to Round Mountain. Based on studies conducted by LS Power, looping into the two existing lines provides a more effective solution for addressing voltage issues at not just Round Mountain substation but also substations in the vicinity: Table Mountain and Maxwell. In addition, looping in provides the following incremental benefits as opposed to connecting directly into existing substation: a) Saves costs by avoiding expansion of existing Round Mountain substation and conversion of existing Ring bus to Breaker and a Half configuration as contemplated by PG&E b) Maximizes the scope of the project that will be subject to competitive solicitation, thereby allowing CAISO and its ratepayers an opportunity to select competitive proposals which will lead to potential cost savings c) Minimizes capital expenditures required from Pacific Gas & Electric Company (PG&E), which may be prudent for CAISO ratepayers and for ensuring that this reliability project gets completed in time, in light of recent financial events at PG&E.
- 2) In the Functional specifications released for Gates voltage support project, CAISO indicated that it will allow the use of SVC, STATCOM, Synchronous Condenser or Battery Storage as acceptable solutions. This somewhat contradicts with the discussion in Draft Plan where CAISO states that it prefers STATCOM as a solution at Gates. We recommend CAISO clarify in Final Transmission Plan

if it has a preference for a specific technology and/or whether one technology would be compared with another in its analysis. If so, CAISO should specify the parameters of how the technologies would be evaluated.

CAISO-PNW Increased Transfers Study

CAISO's conclusion on this study is that there is no capital upgrade required to increase COI N-S rating by 300 MW. While NERC TPL-001-04 standard treats the double line outage that drives COI Path Rating as Extreme Contingency (P7), but the WECC Path Rating Catalog still considers this as a NERC P6 contingency. Further, CAISO Operations is now treating this double line outage as conditionally credible and as referenced in the Market notice provided by CAISO Operations⁷ system conditions in Operations may trigger the need for CAISO to not treat these contingencies as credible events. Given this, relying on the less stringent criteria for planning purposes can pose reliability risk. We recommend CAISO reconsider its proposal to increase path rating of the existing COI path. Planning ratings should not be changed if these cannot be used at all time in Operations.

Bulk Storage Study

CAISO studied the economics of two large pump storage projects and concluded that the projects provided benefits; however a large portion of the benefits were from Net Market Revenues. We recommend that for any future similar analysis, CAISO should also consider long duration battery storage projects and OOS transmission projects. Both these alternatives can provide competing benefits with respect to GHG reduction, renewable curtailment reduction and production cost savings. This should allow CAISO to arrive at a more comprehensive and robust conclusion in this area.

LS Power thanks CAISO for the opportunity to provide these comments and stands committed to working with CAISO on any of the issues, as needed.

⁷ <http://www.caiso.com/Documents/Implementation-ConditionalCredibility-500kVCommonCorridorDoubleLineOutages-PGE.html>

Attachment B: LS Power comments on the 2019/20 TPP Study Plan and Economic Study Request

CAISO 2019/20 TPP Study Plan: Stakeholder Comments

Submitted by	Company	Date Submitted
Sandeep Arora (sarora@lspower.com) (925) 201 5252	LS Power Development, LLC	3/14/19

LS Power appreciates the opportunity to provide comments on the CAISO 2019/20 Draft Study Plan. Our comments are limited to Economic & Policy Studies for 2019/20 TPP.

Economic Study Request & Economic Project Submission

LS Power is hereby submitting an economic study request to CAISO for the 2019/20 Transmission Plan. The request is to study Day Ahead scheduling congestion at CAISO's intertie interfaces with the Pacific Northwest, namely the California Oregon Intertie (COI), Pacific AC Intertie (PACI) and Nevada-Oregon Border (NOB). In addition to this request, LS Power is also hereby submitting its Southwest Intertie Project North (SWIP-North) as an Economic project, to be modelled as a 1000 MW path of new transmission capacity between Idaho Power (Midpoint) and CAISO (Harry Allen¹), free of any wheeling charges. As a parallel path to existing major CAISO interties; COI, PACI, and NOB, SWIP-North provides an alternate path for economic energy from the Pacific Northwest into California, in addition to providing policy benefits for reducing GHG emissions and accessing out-of-state renewables.

For the past four planning cycles, LS Power has registered its concern that CAISO's economic studies performed for the Transmission Planning Process (TPP) consistently fail to capture the tens to hundreds of million \$'s in annual congestion costs along the PACI and NOB interfaces, and therefore the TPP consistently fails to identify economic benefits of the SWIP-North project. Since 2011, actual PACI and NOB congestion per CAISO DMM reports has been in the range of \$50 mm to \$145 mm per year. This contrasts with the less than \$1mm of annual congestion predicted in CAISO planning studies for the COI path².

Rather than rehashing our recommendations in detail similar to comments we have previously submitted, we are providing a brief summary of our recommendations on these issues below.

¹ CAISO's Harry Allen to Eldorado 500 kV Transmission line is under construction and scheduled to go in service in 2020.

² California Oregon Intertie (COI) comprises of three transmission lines that have a combined flow limit of 4800 MW N-S. CAISO TPP studies enforce this flow limit and capture any congestion on this path. In the Day Ahead scheduling world, congestion is witnessed across the Pacific AC Intertie (PACI) and Nevada-Oregon Border (NOB) scheduling interfaces. PACI is a subset of COI and has a scheduling limit of 3200 MW which represents scheduling rights of CAISO member entities on COI path. NOB is the scheduling interface for Pacific DC Intertie. It is rated at 3220 MW N-S and the transmission capacity is allocated between CAISO member entities and LADWP.

Details on these recommendations can be found within comments LS Power previously filed for 2018/19 Draft Study Plan³ and for 2018/19 Draft Transmission Plan⁴

- (1) CAISO should provide a timeline by when it expects to conclude whether additional transmission capacity on existing PACI, NOB transmission paths can be made available in the Day Ahead market. This work was taken up by CAISO in the 2018/19 TPP; however there is no information on when CAISO expects to complete it.
- (2) CAISO's congestion analysis for PACI, NOB, COI paths needs to take a completely different approach this year. CAISO should also study and quantify financial congestion on these paths in addition to physical congestion that it has been quantifying over the last few planning cycles.
- (3) CAISO should investigate whether its Production cost simulation tool is suitable for capturing financial congestion. CAISO should investigate improving its existing tool or should make use of a different tool so it can correctly capture financial congestion.
- (4) For the SWIP-North economic study, CAISO should calculate all benefits of a 1000 MW transmission capacity from Midpoint to Harry Allen, free of any wheeling charges. In prior planning cycles, CAISO has only quantified production cost savings but in the 2019/20 TPP CAISO should capture these additional benefits to CAISO ratepayers:
 - (a) Financial benefits of improving Day Ahead scheduling capability and thereby alleviating existing Day Ahead financial congestion that is common place for CAISO's PACI, COI, NOB paths
 - (b) GHG reductions and associated savings to CAISO
 - (c) Load Diversity & Flexible Reserve Capacity savings
 - (d) Renewable Capital cost savings.

A project such as SWIP-North improves transfer capabilities in/out of CAISO from several neighboring Balancing Authority Areas (BAAs) and hence will provide these benefits. These benefits are typically not captured as part of the TEAM methodology that CAISO uses for its production cost simulation studies. CAISO should conduct separate analyses to quantify these additional benefits.

- (5) For the SWIP-North economic study CAISO should ensure that the existing transmission path from Robinson Summit to Harry Allen ("ON Line") is limited to 1000 MW in the base case and is increased to 2000 MW only in the case with SWIP-North. As described below, SWIP-North will not only create a new 2000 MW path from Midpoint to Robinson Summit but a few terminal upgrades associated with the entire build out of SWIP will also increase transmission capacity of ON Line from 1000 to 2000 MW. A total of 1000 MW of transmission capacity from Midpoint to Harry Allen is offered for CAISO use as part of this economic study request. This will effectively move CAISO's BAA boundary station to Midpoint.
- (6) LS Power is aware of other out of state transmission projects that are in development. A few of these projects, such as Boardman to Hemingway and Gateway West, compliment benefits of SWIP-North. While CAISO may choose to study a few scenarios that combine SWIP-North with

³ LS Power comments filed for CAISO Draft Study Plan in 2018/19 TPP can be found at:
<http://www.caiso.com/Documents/LSPower-EconomicStudyRequest-Draft2018-2019StudyPlan.pdf>

⁴ LS Power comments filed for CAISO Draft Transmission Plan in 2018/19 TPP can be found at:
<http://www.caiso.com/Documents/LSPowerComments-Draft2018-2019TransmissionPlan.pdf>

one or more of these projects, this Economic Study requests evaluation of SWIP-North as a standalone project.

SWIP-North Project

SWIP-North is comprised of a 500 kV transmission line from Midpoint substation to Robinson Summit substation. Additional details of SWIP-North are included in the submission of SWIP-North as an Interregional Transmission Project in March 2018 under the 2018/19 TPP. After SWIP-North is built, LS Power's affiliate will attain approximately 1000 MW of new⁵ transmission capacity that will become available on the existing 500 kV transmission line that connects Robinson Summit to Harry Allen substation ("ON Line"), as per the Transmission Use and Capacity Exchange Agreement ("TUA") among LS Power affiliates and NV Energy, which is further described below. LS Power hereby proposes this new additional ~1000 MW capacity to be dedicated for CAISO use. In addition, the new 500 kV line from Harry Allen to Eldorado was approved by CAISO to be in-service by 2020. Upon completion of the Harry Allen to Eldorado project, Harry Allen will be a CAISO delivery point. Hence, if SWIP-North was selected by CAISO, CAISO will have access to a complete 500 kV path from Midpoint to Eldorado, approximately 575 miles.

Pursuant to the TUA with NV Energy, once SWIP-North is built there would be an exchange of capacity between LS Power affiliates and NV Energy. Upon completion of SWIP-North, NV Energy would get a share of the capacity between Midpoint and Robinson Summit and LS Power affiliate Great Basin Transmission would get a share of capacity between Robinson Summit and Harry Allen, without either party having to pay any amount to the other. As a result of this capacity exchange, LS Power's affiliate would have bidirectional transmission capacity on the entire path from Midpoint to Harry Allen, estimated at approximately 1000 MW. Therefore, LS Power's economic study request is that CAISO study the benefits of approximately 1000 MW of bidirectional transmission capacity between Midpoint and Harry Allen, which would be available to the CAISO market upon completion of construction of SWIP-North.

Proposed Policy & Inter Regional Studies

CAISO will conduct its policy-driven transmission assessment using base and sensitivity portfolios provided by the CPUC. The base portfolio will correspond to a statewide electric sector GHG reduction target of 42 MMT by 2030, while the sensitivity will correspond to a 32 MMT. At the Stakeholder meeting for the Draft Study Plan, CAISO stated that while the CPUC portfolios may contain out-of-state resources, the CAISO will not assess the need for out-of-state transmission nor will it reassess the previously submitted interregional transmission projects. CAISO proposes that it will only study the impact of out-of-state (OOS) resources by assuming injection points at CAISO boundary stations and only analyzing the impact of these injections to in-state CAISO transmission system. LS Power strongly disagrees with this CAISO proposal. We believe this approach is at odds with the expectation of CPUC's IRP process and will only provide limited insights to stakeholders, if any.

⁵ The Robinson Summit to Harry Allen 500 kV line is currently limited to ~975 MW of transmission capacity. Building SWIP North will increase transmission capacity of this line by ~1000 MW, which will be available to LS Power's affiliate and can be dedicated for CAISO use.

CPUC's 2017-18 IRP study showed significant benefits of out of state transmission which is why CPUC recommended inclusion of OOS transmission as a Policy Sensitivity study in CAISO's 2019/20 Transmission Plan. If CAISO's policy studies only look at in-state impacts of OOS renewables then a critical piece will be missed to determine how OOS renewables get delivered to CAISO boundaries.

We recommend that CAISO's policy studies include a comparison of active OOS transmission projects and make recommendations on viability and benefits of each project. A few attributes we offer here for consideration for comparing OOS transmission projects are: (1) Earliest possible In Service Date, (2) Capital Cost on a \$/MW basis, (3) Permitting status, (4) Ability to bring renewables into California from one or more OOS locations. In addition, any Economic and/or Reliability benefits these projects can bring to CAISO should also be considered. We recommend that this exercise be done in conjunction with CPUC's 2019-20 IRP proceeding. This analysis will help stakeholders understand merits of OOS renewables with new transmission and will help guide policy makers at CAISO and CPUC make important decisions on OOS transmission. Any transmission projects that stand out as part of this analysis as candidates that can provide multiple benefits should be considered as "least regrets" transmission solutions. Investment decisions for these least regrets transmission solutions should be made in a timely manner to ensure projects can be built to meet state policy goals.

LS Power thanks CAISO for the opportunity to provide these comments and looks forward to working with CAISO staff for 2019-20 TPP.

Attachment C: Brattle Group Memo to LS Power (Mar 15, 2019) in support of CPUC IRP 2019-20
Reply Comments

MEMORANDUM

TO: Sandeep Arora, Mark Milburn, LS Power

FROM: Michael Hagerty, John Higham, Hannes Pfeifenberger, and Judy Chang,
The Brattle Group

SUBJ: Preliminary Analysis to Support LS Power's Comments to CPUC

DATE: March 15, 2019

LS Power requested that we preliminarily analyze the relative costs of wind and transmission in Idaho and the potential production cost savings of adding SWIP North based on recent EIM prices. We provide in this memo the results of our analysis and details on the sources and assumptions used.

I. Relative Costs of Idaho Wind and Transmission

Based on recent cost and performance estimates of wind resources in Idaho and Wyoming and the publicly-available costs of the transmission necessary to deliver the wind generation to CAISO, Table 1 shows that the all-in costs of delivering Idaho wind generation to CAISO (\$79/MWh) is similar to the costs of delivering Wyoming wind (\$81/MWh). While the estimated average costs of Idaho wind generation are \$9/MWh higher than in Wyoming due to the lower capacity factor shown in the table below (37% in Idaho versus 44% in Wyoming), the transmission costs of delivering the Idaho wind are \$12/MWh lower because of the longer distance transmission projects needed to connect Wyoming to California.

This analysis attributes all of the costs of the transmission lines over the first 20 years of its life to delivering wind to California and does not account for the additional benefits that each of the transmission lines can provide to the system and to CAISO beyond delivering low-cost renewables to load centers during the initial 20 years of the projects' life. For example, SWIP North likely would also help reduce congestion in the EIM footprint and on the highly utilized COI path and reduce costs to California ratepayers.¹

¹ Johannes Pfeifenberger, Judy Chang, Michael Hagerty, Pablo Ruiz, and Cady Wiltsie, *Benefits of the Southwest Intertie Project-North (SWIP North)*, March 31, 2016. Available at: http://files.brattle.com/files/5722_benefits_of_the_southwest_intertie_project-north_swip_north.pdf

Table 1: Relative Costs of Delivering Idaho and Wyoming Wind to CAISO

	Idaho	Wyoming	Source/Notes
Capacity Factor (%)	37%	44%	PacifiCorp IRP ²
Capital Costs (\$/kW)	\$1,660/kW	\$1,660/kW	PacifiCorp IRP
Wind Costs (\$/MWh)	\$58/MWh	\$49/MWh (-\$9/MWh)	Conversion from \$/kW to \$/MWh based on CPUC IRP assumptions ³ and capacity factors
Transmission Costs (\$/kW)	\$541/kW ⁴	\$1,000/kW ⁵	Assumes 100% of transmission costs attributable to delivering wind
Levelized Transmission Costs (\$/kW-year)	\$68/kW-year	\$125/kW-year	Levelized over 20 years using 12.5% annual carrying charge based on CAISO 2018/19 economic planning assumptions ⁶
Levelized Transmission Costs (\$/MWh)	\$21/MWh	\$33/MWh (+\$12/MWh)	Based on capacity factors
Total Delivered Costs (\$/MWh)	\$79/MWh	\$81/MWh (+\$3/MWh)	Wind Costs + Levelized Transmission Costs

- ² We relied on the more recent and site-specific cost and performance estimates included in the on-going PacifiCorp 2019 IRP, compared to the estimates included in the CPUC 2017 IRP assumptions. See: Burns & McDonnell Engineering Company, Inc, *2018 Renewable Resources Assessment*, Prepared for PacifiCorp, October 3, 2018, p. 31 out of 81. Available at: http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Integrated_Resource_Plan/2019_IRP/Renewable_Resources_Assessment_for_the_2019_Integrated_Resource_Plan.pdf.
- ³ Energy and Environmental Economics, Inc, *RESOLVE Documentation: CPUC 2017 IRP*, September 2017, p. 37. Available at: http://cpuc.ca.gov/uploadedFiles/CPUCWebsite/Content/UtilitiesIndustries/Energy/EnergyPrograms/ElectPowerProcurementGeneration/irp/AttachmentB.RESOLVE_Inputs_Assumptions_2017-09-15.pdf.
- ⁴ Estimate provided to The Brattle Group by project sponsor, Great Basin Transmission, LLC.
- ⁵ Estimate based on capital cost projections for TransWest Express Transmission Project and Zephyr Transmission Project. Zephyr: London Economics International LLC, *Analysis of the Macroeconomic Impacts of the Proposed Zephyr Transmission Project*, May 20, 2013, p. 4. Available at: <http://www.datcllc.com/wp-content/uploads/2013/06/ZephyrEconomicBenefitsStudy-5.21.2013.pdf>. TransWest Express: TransWest Express LLC, “TWE Project: benefits for the country and local communities,” available at: <http://www.transwestexpress.net/>.
- ⁶ CAISO, “2018-2019 Transmission Plan,” February 4, 2019, p. 234, available at: http://www.caiso.com/Documents/Draft2018-2019_Transmission_Plan-Feb42019.pdf.

II. Energy Market Value of SWIP North based on EIM Prices

Idaho Power joined the Western Energy Imbalance Market (EIM) in April 2018. Since then, energy prices in Idaho Power—at the northern end of SWIP North—have varied considerably from the prices in NV Energy at the southern end of the line. Prices in the middle of the day tend to be lower in the NV Energy while prices during peak hours are higher.⁷ By providing a new path between these two EIM participants and a direct link into Southern California from there, the addition of SWIP North could in significant production cost savings across the WECC and reduced power prices to California consumers.

Table 2 below show the average prices from April 4, 2018 through March 14, 2019 at Midpoint and Harry Allen in the 5-minute and 15-minute EIM market. During this time, Midpoint averaged around \$33/MWh and Harry Allen around \$38/MWh, a difference of about \$5/MWh. However, the absolute average price difference is much higher. In the 11 months since IPCo joined the EIM, the average absolute difference in the hourly average of 5-minute LMPs at Midpoint and Harry Allen was \$12.65/MWh. The corresponding figure for 15-minute hourly LMPs was \$11.15/MWh.

If the addition of line resulted in the transmission of 1,000 MW of generation from the high-cost end of the line to the low-cost end of the line, the addition of SWIP North would result in up to \$100 million of annual production cost savings. Even if only half of these benefits were realized, the production cost savings would still be \$50 million per year.

Table 2: Real-Time Price Differentials between Midpoint and Harry Allen
(April 4, 2018 to March 14, 2019)

EIM Prices (Apr 4, 2018 to Mar 14, 2019)	Midpoint Average Price (\$/MWh)	Harry Allen Average Price (\$/MWh)	Average Price Difference (\$/MWh)	Average Absolute Price Difference (\$/MWh)	Annual Absolute Price Difference (\$/MW-year)
5-Minute Market	\$33.11	\$37.76	\$4.65	\$12.65	\$104,700
15-Minute Market	\$33.72	\$38.73	\$5.01	\$11.15	\$92,200

Source: CAISO EIM LMP data, downloaded from ABB Velocity Suite, IQ Dataset: ISO Real Time & Day Ahead LMP Pricing – All Price Nodes Hourly, March 14, 2019.

Production cost savings in the range of \$50 – 100 million per year could provide sufficient benefits to justify the costs of the \$541 million SWIP North, given its a 50-year levelized annual cost of \$63 million per year. The renewable integration benefits discussed above provided by SWIP North would be in addition to these production-cost-related benefits.

⁷ See: CAISO, Q4 2018 Report on Market Issues and Performance, February 13, 2019, p. 50. Available at: <http://www.caiso.com/Documents/2018FourthQuarterReportonMarketIssuesandPerformance.pdf>

Attachment D: LS Power's SWIP North Transmission Project

Southwest Intertie Project - North (SWIP N)

SWIP N is an approximately 275-mile, 500 kV single circuit AC transmission line project that connects the Midpoint 500 kV substation (NTTG: Idaho Power, PacifiCorp) in southern Idaho and the Robinson Summit 500 kV substation (WestConnect: NV Energy). LS Power has transmission rights from Robinson Summit to the Harry Allen 500 kV substation (WestConnect: NV Energy, and as of 2020 a CAISO point of interconnection upon completion of the Harry Allen to Eldorado 500 kV transmission line by LS Power affiliate DesertLink, LLC). SWIP N coupled with LS Power's Robinson to Harry Allen transmission rights (collectively referred to as the Southwest Intertie Project or SWIP) provides 1000 MW of new transmission capacity from Midpoint substation in Idaho Power to Harry Allen substation that can be dedicated to CAISO. This new connection to Idaho Power and PacifiCorp will provide CAISO with access to Idaho and Wyoming wind at a fraction of the cost that is currently being assumed for new transmission projects accessing out of state wind in the RESOLVE modelling.

The SWIP is an important regional project, as demonstrated by the federal, state, and local support that the project has received, and a critical component to spur additional development of renewable power generation resources throughout the western United States. SWIP will provide a pathway to deliver renewable energy from Nevada, Idaho, Montana, Wyoming and the Pacific Northwest into California. It also provides numerous other benefits for the western grid and the western planning regions as described herein.

The SWIP is being developed in two phases:

Phase 1 is the 231-mile southern portion of the SWIP that connects Robinson Summit (near Ely, Nevada) and Harry Allen (near Las Vegas, Nevada) and is now known as the One Nevada

Transmission Line (“ON Line”). ON Line has already been constructed through a joint effort between NV Energy (25% ownership) and an LS Power affiliate (75% ownership) to connect NV Energy’s northern Sierra Pacific Power Company system and their southern Nevada Power Company system for the first time. ON Line began commercial operations on January 1, 2014, and is operated by NV Energy. Under a contractual agreement between NV Energy and affiliates of LS Power, the capacity of ON Line is 100% to the benefit of NV Energy until Phase 2 is constructed. Despite being designed for a capacity in excess of 2000 MW, current estimated total transfer capability of the line is 1000 MW southbound and 600 MW northbound, generally limited by NV Energy’s 345 kV system that interconnects at Robinson Summit.

Phase 2 is the proposed 275-mile northern portion of the SWIP that connects Robinson Summit with Midpoint (near Twin Falls, Idaho), commonly known as SWIP N. A federally approved route for SWIP N has already been secured through a right-of-way grant issued by the Department of the Interior’s Bureau of Land Management (BLM) along with an approved Construction, Operation & Maintenance Plan and conditional Notice to Proceed. All NEPA studies and decisions have been completed. Remaining key development activities include completing the WECC path rating process, securing a few remaining private easements, obtaining one local approval, and obtaining a permit to construct from the Public Utilities Commission of Nevada. SWIP N development and final design activities could be completed to support start of construction within an estimated 12-18 months of approval of project cost recovery.

Upon completion of Phase 2, a FERC-approved capacity sharing arrangement will be triggered between LS Power and NV Energy. LS Power will retain control of approximately 1000 MW of the planned 2000 MW capacity of the total SWIP path (from Midpoint to Harry Allen) in both directions. In terms of cost allocation, the 231-mile ON Line portion of the path has already been constructed

and is being paid for by NV Energy, meaning no costs associated with the ON Line portion will be attributed to CAISO. Below is a project route map.

