WESTCONNECT REGIONAL TRANSMISSION PLANNING

2016-17 PLANNING CYCLE

REGIONAL TRANSMISSION NEEDS ASSESSMENT REPORT

APPROVED BY WESTCONNECT PLANNING MANAGEMENT COMMITTEE ON

APRIL 19, 2017

Contents

1.0 Introduction

The purpose of this report is to summarize the regional transmission need identification phase of WestConnect's 2016-2017 Regional Transmission Planning Process ("Planning Process"). With stakeholder input, the Planning Subcommittee developed this report to document the regional transmission needs assessment and includes both minority and majority views on decisions and assumptions used in performing the assessment.

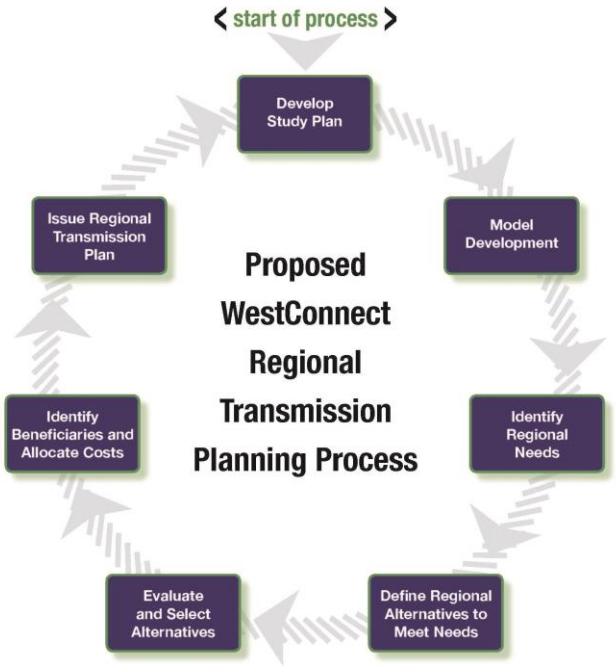
The Planning Management Committee (PMC), which has decision-making authority in the implementation of the Planning Process, approved, on December 21, 2016, the Planning Subcommittee's recommendation that no regional transmission needs were identified in the 2016-17 Regional Planning Process. This report provides documentation to the PMC in support of the Planning Subcommittee's recommendation with regard to the regional transmission need identification phase of the Planning Process.

1.1 WestConnect Regional Transmission Planning Process

The development of regional models is the third step in the planning process. The planning process was developed for compliance with Federal Energy Regulatory Commission (FERC) *Order No. 1000, Transmission Planning and Cost Allocation by Transmission Owning and Operating Public Utilities* (Order No. 1000).[1] The planning process is performed biennially, beginning in even-numbered years, and consists of the seven primary steps outlined in Figure 1.

[1] *All references to Order No. 1000 include any subsequent orders.*

Figure 1: WestConnect Regional Transmission Planning Process



Additional details of the planning process can be reviewed in the WestConnect Regional Planning Process Business Practice Manual (BPM), posted to the WestConnect website here. Readers can access the text of the FERC Order No. 1000 compliance documentation on the WestConnect website here and are encouraged to consult the compliance documentation and BPM for additional process information.

1.2 WestConnect 2016-17 Regional Study Plan

The first step in the Planning Process is the development of a 2016-2017 Regional WestConnect Study Plan ("Study Plan"). The Study Plan was approved by the PMC on March 16, 2016. The Study Plan identifies the scope and schedule of planning activities to be conducted during the planning cycle. The Study Plan also describes the models and studies to be developed in the model development portion of the Planning Process.

1.3 2016-17 Regional Model Development

The second step in the planning process is the development of regional models. Two types of studies are needed for the Planning Process: reliability ("power flow") and economic ("production cost model" or PCM). During the second, third, and fourth quarter of 2016, the Planning Subcommittee developed regional models that were used in the identification of regional transmission needs for the 2016-17 Planning Process. WestConnect conducted an assessment of the region's transmission needs using models developed for the 2026 timeframe, approximately 10 years into the future.

WestConnect regional assessments are centered on base cases and scenarios, which when taken together, provide a robust platform to identify the potential for regional transmission needs and emerging regional opportunities. Base cases are intended to represent "business as usual," "current trends," or the "expected future." Business-as-usual cases based on Transmission Owner (TO)-supplied forecasts for load, generation, public policy resources, and transmission plans. Base case assessments

may lead to the identification of regional transmission needs. Scenarios are intended to complement the base cases by looking at alternate, but plausible futures. They represent futures with resource, load, and public policy assumptions that are different in one or more ways than what is assumed in the base cases. Scenario assessments may lead to the identification of regional opportunities.

Table 1 lists the reliability and economic models that were developed for the 2016-17 cycle.

Table 1: WestConnect Planning Models

Reliability Model Case Summary			
	Case Name	**Case ID**	**Case Description and Scope**
Base Cases	**2026 Heavy Summer Base Case**	WC26-HS	Summer peak load conditions during 1500 to 1700 MDT, with typical flows throughout the Western Interconnection
	2026 Light Spring Base Case	WC26-LSP	Light spring load conditions between 0700 to 1000 MDT, with relatively high wind and solar generation
Scenario Cases	**CPP – WestConnect Utility Plans Scenario**	WC26-CPP1	Reflect individual WestConnect member utility plans for Clean Power Plan (CPP) compliance – *export hour of interest from PCM*
	CPP – Heavy RE/EE Build Out Scenario	WC26-CPP3	Additional coal retirements, additional RE/EE, minimal new natural gas generation – *export hour of interest from PCM*

Economic Model Case Summary			
	Case Name	**Case ID**	**Case Description and Scope**
Base Case	**2026 Base Case**	WC26-PCM	Business-as-usual case based on WECC 2026 Common Case with additional regional updates from PMC members.
Scenario Cases	**High Renewables**	WC26-PCM-HR	California 50% Renewable Portfolio Standard (RPS) with regional resources (Wyoming wind and New Mexico wind) *and* increase WestConnect state RPS requirement beyond enacted with other resources
	CPP – WestConnect Utility Plans	WC26-PCM-CPP1	Reflect individual WestConnect member utility plans for CPP compliance
	CPP – Market-based Compliance	WC26-PCM-CPP2	Model CO_2 price in WestConnect to achieve mass-based regional CPP compliance
	CPP – Heavy RE/EE Build Out	WC26-PCM-CPP3	Additional coal retirements, additional RE/EE, minimal new natural gas generation

For the 2016-17 cycle, the model development phase was finalized on October 18, 2016, with the PMC's approval of the 2016-17 Model Development Report (MDR). The MDR describes the development of the regional models that were created with assistance from WestConnect members and other stakeholders. The report details key model assumptions and parameters, such as study timeframe, horizon, area, the base transmission plan, and how public policy requirements were taken into account. Along with the MDR, the PMC approved the regional base models for use in assessments and approved the assumptions in the scenario models for continued development.

2.0 Regional Transmission Needs Assessment

The third step in the WestConnect regional planning process is the regional transmission needs assessment and identification of regional needs. This process began after the PMC approval of the regional models. The PMC also agreed to a phased approach to the assessments, in that the base assessments would be completed first, followed by the scenario assessments. This decision was based in part to the requirement that WestConnect identify regional needs by the end of the first year of the study cycle. This phased approach does not impact the WestConnect regional need identification as the scenario models do not drive regional needs, as explained further in the Study Plan. Therefore, this Regional Needs Assessment Report only captures the needs assessment performed on the Base Cases. The scenario assessments will be performed in 2017. Scenario assessments are information-only studies. Information on these scenario model assessments will be reviewed by the PMC and stakeholders as the studies are completed. The results of the scenario assessments will be documented in the final WestConnect Regional Transmission Plan Report.

The following sections outline the methods, assumptions, and results of the three types of regional need assessments: reliability, economic, and public policy.

2.1 Regional Reliability Need Assessment

WestConnect conducted the 2016-17 regional reliability assessment on two base cases: the 2026 Heavy Summer base case and the 2026 Light Spring base case. These models originated from cases developed and approved by the Western Electricity Coordinating Council (WECC). The assessment for regional needs was based on reliability standards adopted by the North American Electric Reliability Corporation (NERC) TPL-001-4 Table 1 (P0 and P1) and TPL-001-WECC-CRT-3-1 (Transmission System Planning Performance WECC Regional Criterion). Initial identification of regional issues for further review was defined as system performance issues impacting or between more than one TO Member system.

Study Procedure and Assumptions

The reliability assessment included extensive testing and multiple iterations of model refinements, simulations, participant review of results, and incorporation of modifications and comments into the subsequent round of simulations. The final assessment of the base cases with contingency analysis became the final system assessment.

The final evaluation of the base reliability assessment was limited to contingencies that could identify a regional need, as determined by the Planning Subcommittee. The intent was to minimize flagging local or "non-regional" issues. Contingency definitions for the steady-state power flow analysis were limited to N-1 contingencies for elements 230-kV and above, generator step-up transformers for generation with at least 200 MW capacity, and member-requested N-2 contingencies. All bulk electric system (BES)

branches and buses in the WECC model were monitored with violation reports filtered to exclude branch flows that increased less than 1% and voltage decline less than 0.5%.

Study Results

Upon a comprehensive review of the regional reliability assessment results, no regional needs were identified. This conclusion was reached because neither the Heavy Summer nor Light Spring assessments identified reliability issues that were between two or more WestConnect members or impacted two or more WestConnect members. Results from the assessment are provided in Appendix B and in a posted workbook that includes the underlying steady-state assessment results.[2] The results include one branch overload and a couple voltage issues within single-TO systems that were determined to be local issues and not regional.

2.2 Regional Economic Needs Assessment

WestConnect performed the 2016-17 regional economic assessment by conducting a PCM study on a 2026 base case along with sensitivity cases. The goal of the assessment was to test the base case and the Base Transmission Plan for economic congestion between more than one Transmission Owner with Load Serving Obligations (TOLSO) Member's area. The economic base case maintained consistent electric topologies with the reliability base cases within the WestConnect footprint.

Study Procedure and Assumptions

The Planning Subcommittee conducted the study and reviewed the PCM base case results for regional congestion (i.e., number of hours) and congestion cost (i.e., the cost to re-dispatch more expensive generation because of transmission constraints). The Planning Subcommittee's goal was to produce a list of the significantly congested elements based on the study assumptions identified for the WestConnect region. During the study work in 2016, modeling and data adjustments were made with each iteration of the PCM base case, and additional sensitivities were run to isolate and better examine regional facts that were challenging to capture within the software's functionality.[3] PCM issues such as the Phase Shifting Transformer (PST) modeling, energy imbalance market (EIM), and system nomograms, are recognized by the Planning Subcommittee which may affect the results and therefore require further vetting.

Given the regional focus of the WestConnect process, the Planning Subcommittee limited its congestion analysis to:

- Transmission elements (or paths/interfaces) between multiple WestConnect member TOs;
- Transmission elements (or paths/interfaces) owned by multiple WestConnect member TOs; and
- Congestion occurring within the footprints of multiple TOs that has potential to be addressed by a regional transmission project or non-transmission alternative.[4]

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[2] https://doc.westconnect.com/Documents.aspx?NID=17748

[3] *Work on the economic model is continuing.*

[4] *Congestion within a single TO's footprint (and not reasonably related or tied to other TO footprints) is out of scope of the regional planning effort and is alternatively subject to Order 890 economic planning requirements.*

Updates to base case

The 2026 PCM base case was developed from the WECC 2026 Common Case. A summary of the noteworthy changes and modeling enhancements made to the 2026 Common Case, as well as updates to the PCM software, are listed below.

- Numerous updates were made within the WestConnect footprint per WestConnect participant input and for consistency between the WestConnect reliability and economic models as well as outside of the WestConnect footprint per interregional coordination with Northern Tier Transmission Group (NTTG), California Independent System Operator (CAISO), ColumbiaGrid, and WECC.
- Updated reserve requirements for consistency with FERC 789
- Updated hurdle rate (wheeling charge) modeling based on the latest Open Access Transmission Tariff rate information, which included separate rates for peak and off-peak hours
    - Proxy modeling of the EIM was also developed and studied with a sensitivity case.
- Developed critical disturbances either submitted by TOLSO Members or those associated with WECC Transfer Paths
    - Initially developed as part of the base case, but ultimately, the TOLSO-submitted disturbances were studied as a sensitivity case
- Added "EPE Balance" and "TEP Local Gen"[5] nomograms and conditional constraints
- Updated PST modeling to ensure the branch thermal rating did not conflict with the operating range
- Used PCM software version in which the PST operating cost calculation logic was adjusted by the software vendor.[6]

Sensitivity Studies

As the base economic model was being developed and preliminary assessments were performed, there was considerable discussion around certain modeling assumptions. This discussion focused primarily on EIM, PSTs, and the inclusion of contingency modeling and sensitivity cases that were developed and run to explore these three issues.

- EIM: EIM refers to the real-time market to manage transmission congestion and optimize procurement of imbalance energy to balance supply and demand deviations for the balancing authorities that have agreed to participate in the CAISO EIM. Accurately modeling EIM in an hourly PCM presented a challenge. First, bids for resources in the EIM are generally submitted in short (5-15 minute) intervals rather the hourly PCM simulation's hour time step. Second, load to be served is known because it is a model input and therefore resources dispatched to meet the load match perfectly. Hence there is no imbalance. Third, the PCM uses assumed values for

[5] The terms "EPE Balance" and "TEP Local Gen" refer to names of specific nomograms in the PCM dataset.

[6] Even with this adjustment, model output related to certain lines with phase shifters continued to show some amount of congestion in situations where member's engineering judgement and historical experience ran contrary to the modeling result.

transmission charges while there are no transmission charges applied to resources that are eligible to be scheduled in the EIM. Although some WestConnect members participate to some extent in energy imbalance markets, it is not consistent throughout the WestConnect footprint. Preliminary assessments tried to model EIM participation (as currently planned/announced), but the group could not come to consensus on the appropriateness of having EIM in the base models. However, the EIM representation was included in sensitivity analyses. The approximate EIM representation in the sensitivity case was implemented by significantly reducing (by 90%) the hour-ahead, inter-area wheeling charge within the dispatch phase of the PCM simulation.

- PSTs: The study results from preliminary assessments yielded some interesting results attributed to how PSTs are represented in the PCM. In some instances, existing PSTs operated at a much different frequency in the PCM than they have historically operated in real-time. In addition, it was found that some PSTs were congested, which was not consistent with historic operating best practices for such facilities since they are normally used to relieve congestion rather than cause it. Some adjustments were made to the PST modeling to try to reflect expected operating characteristics and WestConnect agreed to refine the modeling in a reasonable manner, but it was decided that congestion issues associated with PSTs would be discounted until additional confidence could be gained in the PCM. In the PST sensitivity case used to evaluate the PST modeling, all PST-specific settings were removed and the PSTs were simply modeled as regular transformers.

- Contingencies: Modeling contingencies in a PCM can provide some insight as to how the system may perform when operators make adjustments to dispatch in anticipation of loading issues associated with particular contingencies. This is in contrast to contingency modeling in steady state power flow reliability cases that determine post-contingency loading on remaining elements with no change in resource dispatch. The PCM also evaluates how the system dispatch needs to adapt in each hour such that the modeled constraints in the pre- and post-contingency conditions are met. WestConnect members agreed to remove contingency modeling for the base assessment, but include it as a sensitivity study. The sensitivity case represented disturbances submitted by WestConnect members.

Study Results

The objective of the economic need assessment was to arrive at a set of congested elements that warranted testing for the economic potential for a regional project solution, recognizing that the presence of congestion does not always equate to a regional need for congestion relief at a particular location.

There was no regional congestion identified in the base case, and thus, there were no identified regional economic needs. For completeness, the Planning Subcommittee conducted the sensitivity studies described above to confirm that single modeling variables were not hiding potential regional congestion. Only the High Natural Gas Price sensitivity showed significant changes from the base case with generally higher congestion costs for internal system transmission congestion.

The congestion results for the base case and the PCM sensitivity studies are provided in Appendix C and in a posted workbook.[7]

[7] https://doc.westconnect.com/Documents.aspx?NID=17747

2.3 Public Policy Needs Assessment

The WestConnect Regional Planning Process is intended to identify regional needs and the more efficient or cost-effective solutions to satisfy those needs. Enacted public policy was considered in the Planning Process as a part of the base case development. Non-enacted or proposed public policies were considered as part of the scenario planning process. Enacted public policies were incorporated into the base models through the roll-up of local TO plans and their associated load, resource, and transmission assumptions. Given this, regional public policy needs can be identified one of two ways:

1) New regional economic or reliability needs driven by enacted Public Policy Requirements; or

2) Stakeholder review of local TO Public Policy Requirements-driven transmission projects and associated suggestions as to whether one or more TO projects may constitute a public policy-driven regional transmission need.

Study Procedure and Assumptions

WestConnect began the evaluation of regional transmission needs driven by public policy requirements by identifying a list of enacted public policies that impact local TO plans in the WestConnect planning region. This list was developed by the Planning Subcommittee in public meetings and posted in meeting materials. It was agreed that enacted public policies including but not limited to state RPS and distributed generation goals/set-asides would be represented in the base cases. The CPP would be addressed through scenario analysis.

Study Results

In conducting the regional reliability and economic assessments (see above) the Planning Subcommittee did not find any regional issues driven by enacted public policy requirements. Furthermore, stakeholders did not suggest or recommend the identification of a public policy-driven transmission need based on TO's local transmission plans. Based on these two findings, there are no identified public policy needs in the WestConnect 2016-17 regional planning process.

3.0 Stakeholder Involvement

The Planning Process is performed in an open and transparent manner. The Planning Subcommittee and PMC meetings held in support of the regional transmission needs assessment were open to the public, and each meeting provided an opportunity for stakeholder comment. Notice of all stakeholder meetings and stakeholder comment periods were posted to the WestConnect website[8] and distributed via email.

Open stakeholder meetings to discuss the WestConnect regional transmission needs assessment were conducted on November 17, 2017 and February 15, 2017. The meetings were announced through WestConnect's stakeholder distribution lists, and all stakeholders were invited to attend.

[8] *WestConnect Regional Planning meeting calendar is available here:* http://regplanning.westconnect.com/calendar_rp.htm

4.0 Conclusions and Next Steps

Based on the findings from the 2016-17 cycle analysis performed for reliability, economic, and public policy transmission needs as described in this Regional Needs Assessment Report, no regional transmission needs were identified in the 2016-17 assessment.

Since no regional transmission needs were identified, the PMC will not collect transmission or non-transmission alternatives for evaluation (as there will be no regional transmission needs to evaluate the alternatives against). Whether the scenario study work, and any regional opportunities it might bring to light, warrant further exploration and evaluation will be discussed among the PMC membership at a later point in the Planning Process.

5.0 Appendix A: Information Confidentiality

The Planning Subcommittee handled confidential information in accordance with the protocols outlined in the BPM. Although the Regional Planning Process is open to all stakeholders, stakeholders are required to comply at all times with certain applicable confidentiality measures necessary to protect confidential information, proprietary information, or Critical Energy Infrastructure Information (CEII).

As it related to the model development portion of the process, confidentiality protections were accorded for the following:

- WestConnect powerflow models are considered CEII. Based on this, during the case development process, only those entities having signed the appropriate Non-Disclosure Agreement (NDA) with WECC were granted access to the model. This iteration does not contain any information that is different from what would be typically contained in the original WECC base case.
- Certain generator procurement and contract information gathered during the RPS evaluation was considered commercially sensitive. Based on this assessment, that data was considered confidential and was not shared.
- WestConnect PCM is subject to the WestConnect Non-Disclosure Agreement, and its distribution was limited to signatures of that agreement.

6.0 Appendix B: Results of Reliability Need Assessment

Table 2: Results of Regional Reliability Assessment

2026 Base Case	Disturbance	Affected Element					Regional Need	Comment
		Owner/ Operator(s)	Affected Element	Value under Disturbance	Limit	Issue		
LSP	N/A (base case)	SPPC	CRTZ PIPE 120kV Bus (64175)	0.95 pu kV	0.95 pu kV	Low V	**NO**	Local Issue. Per NVE, can be fixed by turning off reactor in FCN-RBS line and putting Newmont generator at 1.03 pu.
			CRTZ S PIPE 120kV Bus (64387)	0.95 pu kV	0.95 pu kV	Low V	**NO**	
			CROSSROADS 120kV Bus (64655)	0.949 pu kV	0.95 pu kV	Low V	**NO**	
		LADWP	HYN1314G 230kV Bus (26155)	0.972 pu kV	0.978 pu kV	Low V	**NO**	Local issue. Per LADWP, can be fixed by switching on shunt 23 at SYL PF BUS 2 (26271).
			HYN1516G 230kV Bus (26156)	0.972 pu kV	0.978 pu kV	Low V	**NO**	
			HYN1112G 230kV Bus (26154)	0.972 pu kV	0.978 pu kV	Low V	**NO**	
			SYL PF BUS 1 230kV Bus (26270)	0.972 pu kV	0.978 pu kV	Low V	**NO**	
			SYL PF BUS 2 230kV Bus (26271)	0.971 pu kV	0.978 pu kV	Low V	**NO**	
			SYLMAR1 230kV Bus (26097)	0.971 pu kV	0.978 pu kV	Low V	**NO**	
HS	CACTUS - PPAPSN 230kV Line #C1 (14202-14278-C1)	APS	CACTUS - OCOTILLO 230kV Line #1 (14202-14219-1)	1036 A	1034 A	Branch Overload	**NO**	Local Issue. Per APS, detailed power flow case (rather than bulk power flow case) modeling eliminates this issue.
	Either CVSUB - MIDWAY 230kV Line #C1 (21007-21699-C1)	IID	MW1TAP 92kV Bus (21670)	0.943 pu kV	0.95 pu kV	Low V	**NO**	IID confirmed local issue and use of 0.95
			MIDWAY 230kV Bus (21699)	0.948 pu kV	0.95 pu kV	Low V	**NO**	

2026 Base Case	Disturbance	Affected Element					Regional Need	Comment
		Owner/ Operator(s)	Affected Element	Value under Disturbance	Limit	Issue		
	or CVSUB - MIDWAY 230kV Line #C2 (21007-21699-C2)		MIDWAY 92kV Bus (21700)	0.937 pu kV	0.95 pu kV	Low V	**NO**	low voltage was appropriate.

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7.0 Appendix C: Results of Economic Need Assessment

Table 3: Results of Regional Economic Needs Assessment (2026 Base Case)

Element Information		Total Congestion Hours (% Hrs) / Cost ($)	Regional Need	Comments
Owner/ Operator(s)	Branch/Path Name			
VEA|CAISO (WAPA-DSW/VEA Border)	MEAD S_230.0 - BOB SS_230.0	643 (7%) / $8,062K	**NO**	
NEVP|PG&E|CAISO	P24 PG&E-Sierra	493 (6%) / $1,286K	**NO**	Modeling Issue; NVE disagrees with the results[9]
NEVP (NEVP/BPA Border)	HIL TOP - HIL TOP	144 (2%) / $492K	**NO**	Congestion is negligible; PST eliminates it completely
PG&E|CAISO (TANC/PG&E Border)	LODI_230.0 - EIGHT MI_230.0	128 (1%) / $175K	**NO**	
LADWP	RINALDI_230.0 - AIRWAY_230.0	2 (0%) / $118K	**NO**	
TANC|WAPA-SN|BPA|PacifiCorp| PGE|CAISO	P66 COI	4 (0%) / $58K	**NO**	
LADWP|SCE|CAISO	P60 Inyo-Control 115 kV Tie	56 (1%) / $30K	**NO**	
PSCO	LEETSDAL_230.0 - MONROEPS_230.0	2 (0%) / $16K	**NO**	
NEVP|IPCO	P16 Idaho-Sierra	4 (0%) / $16K	**NO**	
LADWP|Anaheim|Riverside| Pasadena|Burbank|Glendale	P29 Intermountain-Gonder 230 kV	1 (0%) / $9K	**NO**	
IPCO (NEVP/IPCO Border)	MIDPOINT_345.0 - IDAHO-NV_345.0	3 (0%) / $6K	**NO**	
PNM	P48 Northern New Mexico (NM2)	3 (0%) / $3K	**NO**	
NEVP	CLARK 6 - CLARK	1 (0%) / $2K	**NO**	Congestion is negligible; internal NVE XF which may restrict Clark plant output

[9] *Comments from NVE: This path between Sierra (NVE) & PG&E (CAISO) is an inter-regional tie between the WC & CAISO footprint&; also, it is controlled by a PST. on the NVE's side. Proper modeling information was not obtained from PG&E/CAISO. The congestion is shown only in CAISO->NVE direction, which is limited by a CAISO nomogram to 100MW only (which is not applied to the model). The modeling issues, specifically application of available transmission capacity to the existing paths, application of proper TAC for multiple entities (including CAISO, which is outside of WC) are not resolved at this time & therefore the congestion result as a modeling issue and should be ignored. Furthermore, the amount and cost of congestion (if it would be real) cannot justify any potential mitigation projects.*

Element Information		Total Congestion Hours (% Hrs) / Cost ($)	Regional Need	Comments
Owner/ Operator(s)	Branch/Path Name			
LADWP|SCE|CAISO| Anaheim|Riverside	P61 Lugo-Victorville 500 kV Line	1 (0%) / $1K	**NO**	
NEVP|SCE|CAISO	P52 Silver Peak-Control 55 kV	2 (0%) / $0K	**NO**	
LADWP|PG&E|SCE|CAISO| SDG&E|CDWR|Pasadena| Anaheim|Riverside	P41 Sylmar to SCE	2 (0%) / $0K	**NO**	
PSCO	GREENWD_230.0 - MONACO12_230.0	1 (0%) / $0K	**NO**	
	Total Congestion Cost:	**$13,306K**		

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2 **Table 4: Results of Regional Economic Needs Assessment Sensitivity Analysis**

Element Information		Total Congestion Hours (% Hrs) / Cost ($)				Comments
Owner/ Operator(s)	Branch/Path Name	High Natural Gas Price ("HighNG")	Phase Shifters Converted to Normal Branches ("NoPST")	EIM Proxy Modeling ("WithEIM")	TOLSO-Submitted Contingencies ("WithOTG")	
APS	CTRYCLUB_230.0 - LINCSTRT_230.0	112 (1%) / $2,826K	150 (2%) / $1,657K	148 (2%) / $1,902K	127 (1%) / $1,599K	Internal to APS
NEVP|PG&E|CAISO	P24 PG&E-Sierra	769 (9%) / $2,038K	624 (7%) / $4,508K	237 (3%) / $629K	577 (7%) / $1,412K	
LADWP	TARZANA_230.0 - OLYMPC_230.0	21 (0%) / $1,414K	22 (0%) / $1,535K	16 (0%) / $955K	19 (0%) / $1,128K	
NEVP (NEVP/BPA Border)	HIL TOP - HIL TOP	442 (5%) / $1,891K	-	2 (0%) / $5K	162 (2%) / $564K	
LADWP	RINALDI_230.0 - AIRWAY_230.0	2 (0%) / $62K	3 (0%) / $155K	4 (0%) / $168K	4 (0%) / $156K	
SMUD|BPA|PacifiCorp| PGE|CAISO	P66 COI	12 (0%) / $233K	3 (0%) / $49K	8 (0%) / $137K	4 (0%) / $49K	
PSCO	LEETSDAL_230.0 - MONROEPS_230.0	-	3 (0%) / $18K	3 (0%) / $20K	-	
PNM	P48 Northern New Mexico (NM2)	4 (0%) / $42K	2 (0%) / $1K	2 (0%) / $2K	-	
PSCO	GREENWD_230.0 - MONACO12_230.0	10 (0%) / $110K	2 (0%) / $2K	2 (0%) / $1K	4 (0%) / $13K	

NEVP	CLARK 6 - CLARK	2 (0%) / $4K	4 (0%) / $17K	1 (0%) / $16K	3 (0%) / $9K	
LADWP|PG&E|SCE|CAISO| SDG&E|CDWR|Pasadena| Anaheim|Riverside	P41 Sylmar to SCE	1 (0%) / $0K	-	2 (0%) / $1K	-	
APS	MEADOWBK_230.0 - SUNYSLOP_230.0	-	-	-	10 (0%) / $393K	Internal to APS
NEVP	TRACY E_345.0 - VALMY_345.0	-	-	1 (0%) / $9K	-	Congestion is negligible; internal NVE path
PSCO	CABINCRK_230.0 - DILLON_230.0	13 (0%) / $70K	-	-	-	
WAPA-RM|PRPA| TSGT|UAMP	P30 TOT 1A	-	-	2 (0%) / $3K	-	
NVE|LADWP|CAISO|PacifiCorp	P32 Pavant-Gonder InterMtn-Gonder 230 kV	1 (0%) / $1K	2 (0%) / $4K	7 (0%) / $36K	3 (0%) / $8K	Congestion is negligible/non-existent
WAPA_RM|MBPP| PSCO|TSGT	P36 TOT 3	45 (1%) / $1,247K	-	-	-	
EPE|PNM|Tri-State	P47 Southern New Mexico (NM1)	7 (0%) / $61K	-	-	-	Congestion is negligible/non-existent, and appears only in the High NG case that assumed extreme prices outside the range of any recognized forecast.
NEVP|SCE|CAISO	P52 Silver Peak-Control 55 kV	64 (1%) / $9K	184 (2%) / $420K	2 (0%) / $0K	2 (0%) / $0K	
LADWP|SCE|CAISO| Anaheim|Riverside	P61 Lugo-Victorville 500 kV Line	3 (0%) / $21K	-	-	-	
	Total Congestion Cost:	**$10,029K**	**$8,367K**	**$3,884K**	**$5,330K**	

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