



WESTCONNECT REGIONAL TRANSMISSION PLANNING

2024-25 PLANNING CYCLE

REGIONAL TRANSMISSION NEEDS ASSESSMENT REPORT

APPROVED BY WESTCONNECT PLANNING MANAGEMENT COMMITTEE ON

JANUARY 15, 2025

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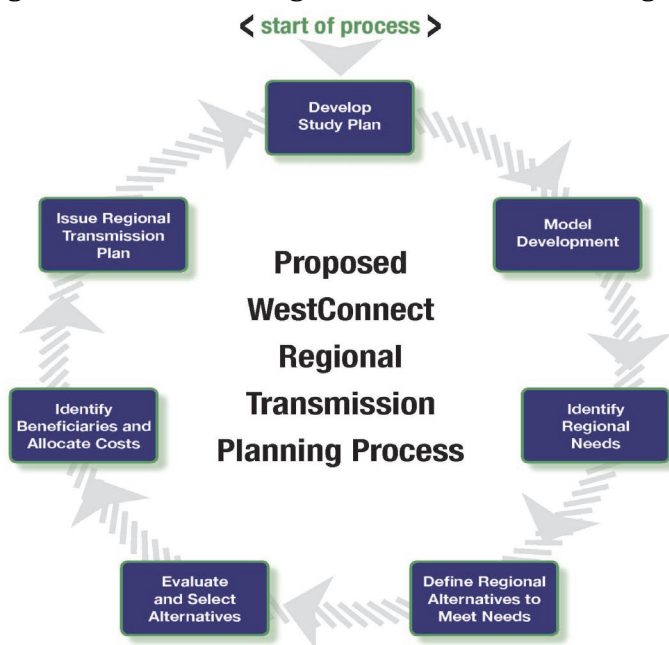
1.0 Introduction and Summary

The purpose of this report is to summarize the regional transmission need identification phase of the WestConnect 2024-25 Regional Transmission Planning Process (“Planning Process”). With stakeholder input, the Planning Subcommittee (PS) 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) has decision-making authority in the implementation of the Planning Process. On December 18, 2024, the PMC approved the recommendation by the Planning Subcommittee that no regional transmission needs were identified in the 2024-25 Regional Planning Process. This report provides documentation to the PMC in support of the Planning Subcommittee recommendation with regard to the regional transmission need identification phase of the Planning Process.

1.1 WestConnect Regional Planning Process

The identification of regional needs is the third step in the WestConnect Regional 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**.

Figure 1 WestConnect Regional Transmission Planning



Additional details of the Planning Process can be reviewed in the WestConnect Regional Planning Process Business Practice Manual (BPM²), 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 All references to Order No. 1000 include any subsequent orders.

² WestConnect Regional Planning Process Business Practice Manual, Version 2.0; Approved by the WestConnect Planning Management Committee on October 20, 2021

1.2 WestConnect 2024-25 Regional Study Plan

The first step in the Planning Process is the development of a Study Plan. [2024-25 WestConnect Study Plan](#) (“Study Plan”) was approved by the PMC on March 20, 2024. 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 WestConnect 2024-25 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 stability) and economic (production cost model or PCM). During the second, third, and fourth quarters of 2024, the Planning Subcommittee developed regional models that were used in the identification of regional transmission needs for the 2024-25 Planning Process. WestConnect conducted an assessment of the region’s transmission needs using models developed for the 2034 timeframe, approximately 10 years into the future. WestConnect will also perform information-only scenario studies, as outlined in the Study Plan, which are designed to evaluate alternate but plausible futures. As stated in the Study Plan, WestConnect regional assessments are centered on Base Cases and Scenarios, which when taken together, provide a robust platform that is used 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.” They are based on TO-supplied forecasts for load, generation, public policy resources, and transmission plans. Scenarios are intended to complement 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. The scenario assessment will be performed in 2025, and the results of the scenario assessments will be documented in a separate report. **Table 1** lists the reliability and economic models developed for the 2024-25 cycle.

Table 1 WestConnect Planning Models

Case Name	Case Description and Scope
2034 Heavy Summer Base Case	Summer peak load conditions, with typical flows throughout the Western Interconnection.
2034 Light Spring Base Case	Light load conditions during spring months of March, April, or May with solar and wind serving a significant but realistic portion of the Western Interconnection total load.
2034 Base Case PCM	Business-as-usual, expected-future case with (1) median load, (2) median hydro conditions and (3) representation of resources consistent with member-approved resource plans as of March 2024.

For the 2024-25 cycle, the Base Case models were approved by the PMC on October 16, 2024, and the documentation of the Base Case model development was finalized on December 18, 2024, with the PMC approval of the [2024-25 Model Development Report](#) (MDR). The MDR describes the development process of the regional base models 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 considered. Along with the MDR, the PMC approved the regional base models for use in assessments.

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. 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 Needs Assessment

WestConnect conducted the 2024-25 regional reliability assessment on two base cases: a 2034 Heavy Summer Base Case and a 2034 Light Spring Base Case. The WestConnect Heavy Summer Base Case originated from a case developed and approved by the Western Electricity Coordinating Council (WECC). The WestConnect Light Spring Case was developed from the WestConnect Heavy Summer Case. Details of the development of the reliability models can be found in the 2024-25 Model Development Report. The assessment for regional needs was based on reliability standards adopted by the North American Electric Reliability Corporation (NERC)³, WECC regional criteria⁴, and supplemented with any more stringent Transmission Owner with Load Serving Obligations (TOLSO) planning criteria based on TOLSO member feedback. 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 base case contingency and transient stability analysis became the final regional reliability assessment.

According to the BPM, “In the event a simulated outage produces NERC TPL violations in more than one TOLSO Member’s system, that violation may result in the identification of a regional reliability-driven transmission need. Some reliability studies that show potential reliability issues may not result in the identification of regional reliability needs based on the review and consideration of those issues by the PMC.”

The final evaluation of the base reliability assessment was limited to contingencies meeting specific voltage and generation criteria, as described below.

Steady State Contingency Analysis

Contingency definitions for the steady-state contingency 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 – i.e., elements above 90-kV – in the reliability models were monitored.

Transient Stability Analysis

The PMC agreed that the transient stability simulations studied in the 2022-23 study cycle would be repeated for this cycle. One disturbance from the 2022-23 study cycle was determined to be no longer viable due to changes in system topology, so nine transient stability simulations were performed.

³ [NERC TPL-001-5.1](#)

⁴ [TPL-001-WECC-CRT-4](#)

Study Results

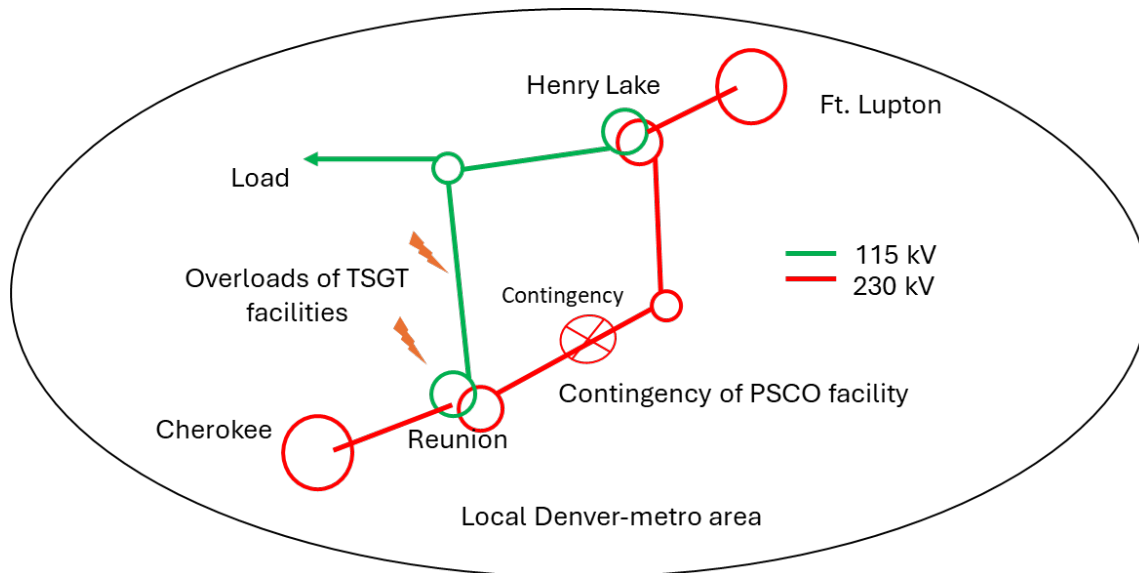
The 2024-25 WestConnect Regional Needs Assessment indicated the potential for a single regional reliability need. The issue was flagged for further discussion because of the involvement of multiple entities.

A summary of the issue follows:

- A contingency of a 230 kV line in the vicinity of the Denver-metro load area was found to result in overloads of two transmission facilities, also within the Denver-metro load area.
- The contingency is a 230 kV line owned by Public Service Company of Colorado (PSCO).
- The overloaded transmission facilities are owned by Tri-State Generation & Transmission (TSGT).
- PSCO and TSGT are TOLSO members of WestConnect.

The figure below shows a basic description of the issue.

Figure 2; Simple drawing of potential regional reliability issue



Upon a comprehensive review of the regional reliability assessment results, the PS concluded that although the issue involved multiple entities, with a contingency on one entity's system causing an overload on another entity's transmission facilities, the overloaded facilities are owned by a single entity. Therefore, any mitigation would likely only benefit that single entity (TSGT). As a result, the PS recommended to the PMC at the November 13, 2024, meeting that the single reliability issue not be considered a regional reliability need. This conclusion was reached because neither the Heavy Summer nor Light Spring assessments identified reliability issues that were between two or more WestConnect members that impacted two or more WestConnect members. The reliability issues were presented to the PMC on October 16, 2024 ([link](#)) and November 13, 2024 ([link](#)). The reliability results for the base case are provided in Appendix A.

2.2 Regional Economic Needs Assessment

WestConnect performed the 2024-25 regional economic assessment by conducting a PCM study on the 2034 Base Case along with four sensitivity cases. The goal of the assessment was to test the base case and the Base Transmission Plan for economic congestion that impacts more than one TOLSO Member.

The WECC 2034 ADS Version 1 (V1), released on July 5, 2024, PCM served as the seed case for the WestConnect economic model 2034 Base Case. That case was then reconciled with the WestConnect 2032 PCM and the case updated as needed during Quarters 2 and 3 of the 2024-25 planning cycle. The WestConnect PCM was then compared with the WECC 2034 ADS PCM Version 2 (V2), which was released on July 29, 2024. Detailed model and data assumptions are described in Section 4.0 of the 2024-25 Model Development Report.

WestConnect also evaluated four sensitivity cases that are described below.

Study Procedure and Assumptions

The Planning Subcommittee conducted the study and reviewed the 2034 Base Case PCM 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). As with the reliability assessment, the economic 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. Wheeling charge assumptions were further vetted through a sensitivity analysis described below.

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.⁵

Study Results

The objective of the economic needs 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.

The base economic regional Needs Assessments revealed five instances of congestion. Members that were affected by the economic issues were requested to assist the PS by providing narrative perspectives on the specific issues that affected them. Every affected member provided a narrative response to the PS.

The economic issues were presented to the PMC on October 16, 2024 ([link](#)) and November 13, 2024 ([link](#)).

The PS addressed the congestion issues individually. Upon a comprehensive review of the regional reliability assessment results, the PS determined the base economic congestion results did not result in the identification of any regional economic needs. The PS recommended to the PMC at the November 13, 2024, PMC meeting that the five economic congestion issues not be considered as regional economic needs. The congestion results for the base case PCM and detailed explanations are provided in Appendix B.

Sensitivity Studies

Economic models were also developed for sensitivity studies on the 2034 Base Case economic model to better understand whether regional transmission congestion may be impacted by adjusting certain input assumptions subject to significant uncertainty. The sensitivity analysis is intended to make relatively minor adjustments that would still remain within the expected future framework of the base models. The Planning Subcommittee determined four sensitivities of interest, and their assumptions are summarized below. The detailed assumptions are provided in Section 4.1 of the MDR.

⁵ Congestion within a single TO 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.

1. **2034 High Load Sensitivity Case:** The hourly load shapes of the Balancing Authority Areas (BAAs) within WestConnect were scaled up so their annual peak and energy was beyond their values in the 2034 Base Case to 120% of both peak capacity and energy.
2. **2034 Low Hydro Sensitivity Case:** The hydro modeling was replaced with WECC's 2001-based hydro modeling developed by WECC in conjunction with their 2024 Common Case PCM dataset.
3. **2034 High Gas Price Sensitivity Case:** Increased all the natural gas prices to 140% of their value in the 2034 Base Case.
4. **2034 System-Wide Carbon Emission Cost Sensitivity Case:** Applied CO2 emission charges to all generators in WECC via the below updates to the 2034 Base Case:
 - Applied a reduced carbon emission price of \$20 / MT (\$9/MWh) for all generation in California, Oregon, and Washington so the net change for units internally to these States remain the same (\$20/MT + \$44/MT = \$64/MT).
 - Kept the Alberta and British Columbia carbon emission prices unchanged at \$37 / MT.
 - Removed the carbon emission wheeling charges from all California borders except with Baja California (CFE)
 - Applied a carbon emission price of \$44/metric ton CO2e (2024 dollars) for all other generation in the WECC system

The economic sensitivities were presented to the PMC on November 13, 2024. The congestion results for the sensitivity cases and detailed explanations are provided in Appendix C.

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. In this context, enacted public policies are state or federal laws or regulations, meaning enacted statutes (i.e., passed by the legislature and signed by the executive) and regulations promulgated by a relevant jurisdiction, whether within a state or at the federal level. 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 driving local TO transmission including, but not limited to, state RPS and distributed generation goals/set-asides would be represented in the base cases. Stakeholders were invited to suggest possible regional public policy-driven transmission needs based on the enacted public policies driving local transmission needs and the associated list of local public policy-driven transmission projects, presented to the PMC on November 13, 2024.

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 regional public policy-driven transmission need based on this information. Based on these two findings, there are no identified public policy needs in the WestConnect 2024-25 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 website⁶ and distributed via email.

An open stakeholder meeting to discuss the WestConnect regional transmission needs assessment was conducted on November 13, 2024. The meeting was announced through the WestConnect stakeholder distribution lists, and all stakeholders were invited to attend.

There was an open stakeholder comment window between November 13, 2024, and December 4, 2024, for stakeholders to comment on the Draft 2024-25 Regional Needs Assessment as presented via the November 13, 2024 Stakeholder Meeting slides. WestConnect received one set of comments from a stakeholder regarding the regional assessment.

4.0 Conclusions and Next Steps

Based on the findings from the 2024-25 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 2024-25 needs assessment.

Since no regional transmission needs were identified, the PMC will not collect transmission or non-transmission alternatives for evaluation as there are no regional transmission needs to evaluate the alternatives against.

⁶ WestConnect Regional Planning meeting calendar: http://regplanning.westconnect.com/calendar_rp.htm
Stakeholder Comments webpage: http://regplanning.westconnect.com/stakeholder_comments.htm

5.0 Information Confidentiality

The Planning Subcommittee managed 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 power flow 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 and power flow models are subject to the [WestConnect Confidentiality Agreement](#) and their distribution was limited to signatories of that agreement.

Appendix A -Reliability Needs Assessment

2034 Heavy Summer Reliability Assessment Results

- No Contingency (P-0)
 - 5 branch flagged above Rating A
 - PNM 4, PSCo 1
 - 10 flagged bus voltage issues
 - PSCo 5, SRP 3, TSGT 2
- Contingencies (61 flagged issues)
 - 0 failed solutions
 - 32 flagged loadings above Rating B
 - PNM 1, PSCo 21, SRP 2, TSGT 6, WAPA-DSW 2
 - 15 flagged low bus voltages
 - PSCo 11, TSGT 4
 - 0 flagged high bus voltages
 - 14 flagged voltage deviations (8+% Voltage Decrease)
 - APS 2, PSCo 9, TSGT 3

2034 Light Spring Reliability Assessment Results

- No Contingency (P-0)
 - 2 branch flagged above Rating G
 - PNM 1, TSGT 1
 - 3 flagged bus voltage issues
 - PSCO 3
- Contingencies (14 flagged issues)
 - 0 failed solutions
 - 1 flagged loadings above Rating H
 - WAPA-DSW 1
 - 4 flagged low bus voltages
 - LADWP 3, TSGT 1
 - 5 flagged high bus voltages
 - LADWP 4, PSCO 1
 - 4 flagged voltage deviations (8+% Voltage Decrease)
 - TSGT 4

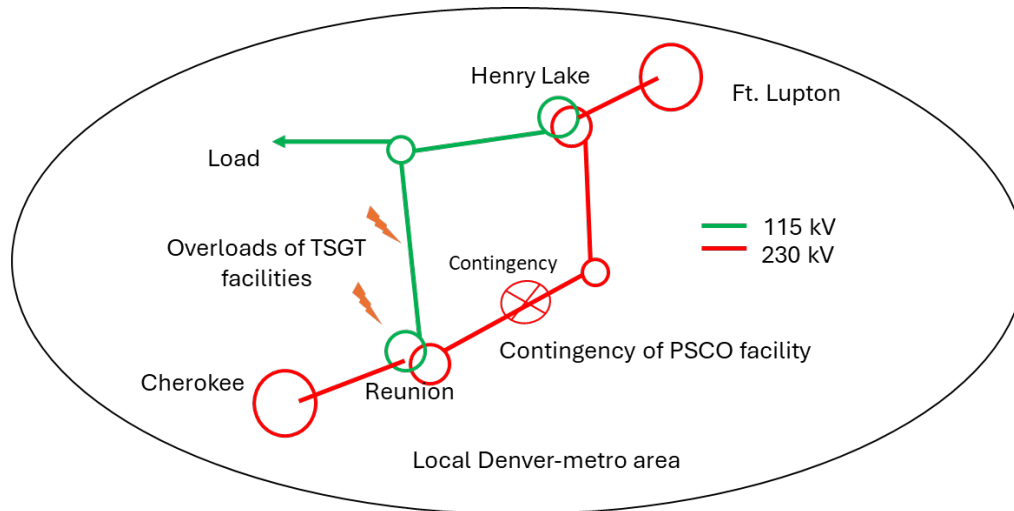
Appendix A -Reliability Needs Assessment

2034 Reliability Assessment Summary

Potential Reliability Need

- A single outage event causes multiple overloaded facilities owned by different owners.

Outage	Outage Owner	Loaded Element	Loaded Element Owner	Comments
PSCO 230kV Line	PSCO	Buckley – Smoky Hill 230kV	PSCO	PSCO: Local Issue Project exists for mitigation
		Prairie – Reunion 115kV	TSGT	TSGT: Local issue Known issues related to load growth. Loading not caused by contingency, but by the operational tripping of Henry Lake transformer. With enough load growth, the current Henry Lake mitigation is inadequate.
		Reunion 230/115kV Transformer	TSGT	



Resolution:

- All elements within Denver-metro area
- Contingency on PSCO system, Loadings only on TSGT facilities
- TSGT Comment:
 - “This is a local issue related to load growth. These overloads are caused not by the contingency, but by the resulting tripping of Henry Lake transformer. With enough load growth, the current mitigation becomes inadequate, this is a known issue.”
- Any mitigation would likely only benefit TSGT.

Appendix A -Reliability Needs Assessment

Potential Regional Reliability Need Decision

- Regional Assessment Results
 - The 2024-25 regional reliability assessment resulted in a single potential reliability need
 - A single outage event caused overloaded facility owned by different owners
 - Potential Need was described by affected entities as “local” in nature
 - No dispute from members at September, October or November PS meeting

- PS recommendation to PMC on November 13, 2024
 - *The PS recommended that the reliability issue from the Regional Assessment not be considered a regional need.*

- PS decision on December 17, 2024
 - Additional information was presented and discussed
 - PS addressed some of the stakeholder comments
 - *Consensus: The PS had no changes to their November 13, 2024, recommendation:*
 - *None of the potential issues should be considered a regional need:*

- PMC Decision on December 18, 2024
 - *The Planning Management Committee agreed with the Planning Subcommittee that the potential regional reliability issue identified in the 2024-25 Regional Assessment should not be considered a regional need.*

Appendix B - Economic Needs Assessment

2034 Economic Assessment Results

Multiple WestConnect Entities

Entities Involved	Branch or Path Name	Avg Flow (MW)	Flow Direction	Congestion Hours (% Hrs) / Cost (K\$)
TSGT WAPA L.M. PSCo BEPC	P36 TOT 3	919	N>S	138 (2%) / 10,032
BEPC TSGT NorthernGrid	DAVEJOHN - LAR.RIVR 230 kV Line	116	N>S	311 (4%) / 7,720
APS WAPA-DSW	PPAPS W - PINPK 230 kV Line	256	E>W	396 (5%) / 1,760
PSCO TSGT	CRAIG_YV - CRAIG 230 kV Line	73	W>E	723 (8%) / 1,005

Single WestConnect Entity, Possible Multi-Regional

Entities Involved	Branch or Path Name	Avg Flow (MW)	Flow Direction	Congestion Hours (% Hrs) / Cost (K\$)
WAPA-SNR CAISO	P15 Midway-LosBanos	3155	S>N	1658 (19%) / 80,760
LADWP NorthernGrid IPA	INTERMT - MONA 345 kV Line #1	298	W>E	2006 (23%) / 22,374
LADWP N3/N9 NV	P77 Crystal-Allen	689	W>E	1023 (12%) / 11,211
LADWP IPA	P27 Intermountain Power Project DC Line	305	N>S	2876 (33%) / 4,757
LADWP CAISO	P61 Lugo-Victorville 500 kV Line	722	N>S	639 (7%) / 3,229

Appendix B - Economic Needs Assessment

Member Responses

Branch or Path Name	Entities Involved	Member Response
P36 TOT 3	BEPC, PSCO, TSGT, WAPA-RMR	TOT3/Path 36 congestion is relatively low and there are many adjacent system changes presently occurring that are predicted to improve congestion. Although the amount has increased from previous cycle results this limited amount does not warrant a regional need at this time.
DAVEJOHN - LAR.RIVR 230 kV Line	BEPC, PSCO, TSGT, WAPA-RMR	Dave Johnston – Laramie River 230 kV congestion is relatively low but is attributed to increased neighboring Planning Region wind resources. This seems congestion is managed by inclusion of Phase Shifters at Anticline and buildout of the Gateway transmission project by PacifiCorp.
CRAIG_YV – CRAIG 230 kV Line	BEPC, PSCO, TSGT, WAPA-RMR	The observed congestion on this line does not warrant establishing this as a regional need as it is limited in duration, cost, and impact. The congestion is a direct result of serving local load and forecasted BTM generation. Additionally, the line and Craig YV terminal equipment are owned by PSCo. While the Craig substation equipment has mixed ownership, PSCo has full ownership of the terminal equipment for this line. This makes the congestion on this facility more similar to a single TO facility in nature.
PPAPS W – PINPK 230 kV Line	APS, WAPA-DSW	The observed congestion on this line does not justify designating it as a regional need. Both the congestion hours and cost of the congestion are minimal and do not warrant a capital investment. Historically, the line’s flows have remained well below the capacity. Additionally, reliance on a single data point for one West Connect cycle results raises concerns about the analysis’s reliability. WAPA recommends using multiple scenarios and years to provide a more robust reliable evaluation.
Path 15 Midway – Los Banos	WAPA-SNR CAISO	Not a regional issue – Path 15 and related facilities are part of the CAISO Planning Region. Possible topology issue in the PCM which originated from the WECC ADS. Unable to get a correction from WECC/CAISO prior to finalizing models.

Appendix B - Economic Needs Assessment

Potential Regional Economic Need Decision

Potential Economic Needs

- Regional Assessment Results
 - The regional assessment resulted in a single potential regional reliability need
 - The regional economic assessment resulted in 4 occurrences of congestion involving multiple WestConnect entities

- PS recommendation to PMC on November 13, 2024
 - *The PS recommended that the issues from the Regional Assessment not be considered regional needs.*

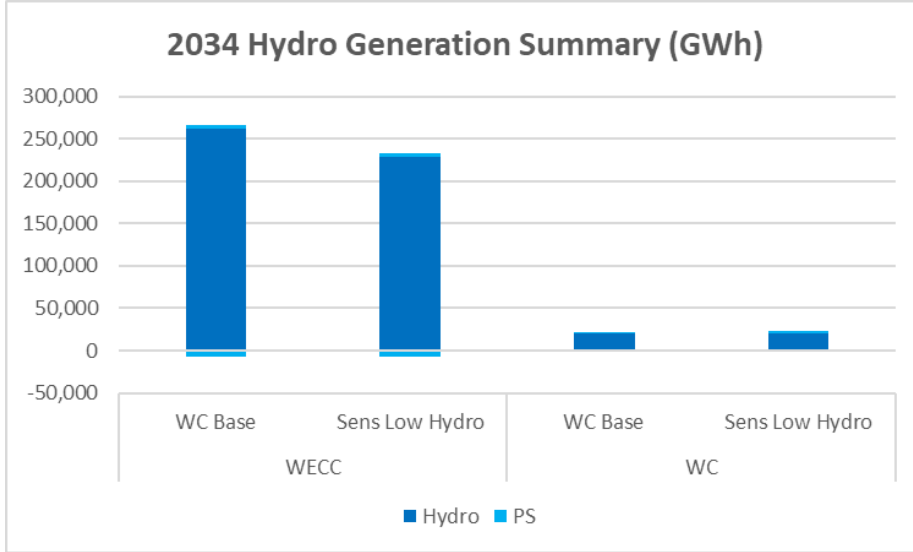
- PS decision on December 17, 2024
 - Additional information was presented and discussed
 - PS addressed some of the stakeholder comments
 - *Consensus: The PS had no changes to their November 13, 2024, recommendation:*
 - *None of the potential issues should be considered a regional need:*

- PMC Decision on December 18, 2024
 - *The Planning Management Committee agreed with the Planning Subcommittee that the potential regional reliability issue identified in the 2024-25 Regional Assessment should not be considered a regional need.*

Appendix C – Economic Sensitivities

Low Hydro

- The 2034 WCPCM Base Case uses a median year hydro condition. Hydro conditions from 2001 provide the best representation of hydro operations for a low water year. Low hydro shapes were derived from data developed by WECC for the 2024 TEPPC Common Case

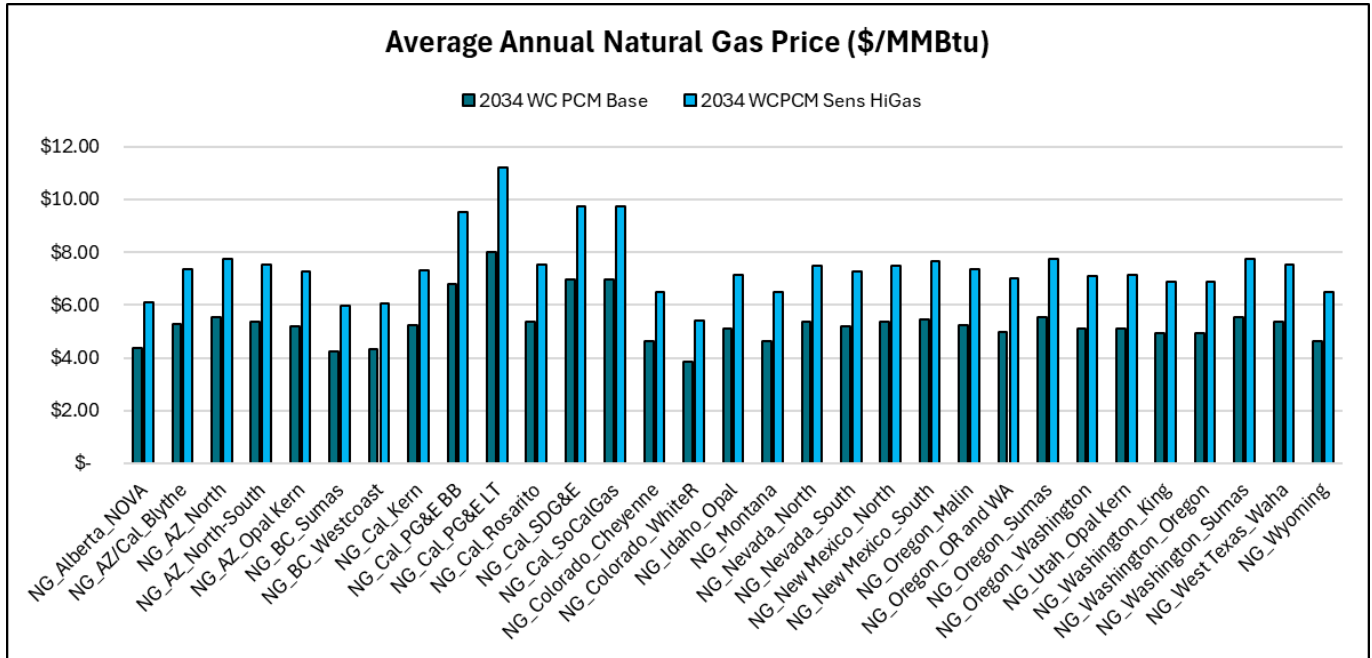


Metric	Region	Fuel Type	Hydro	PS	PS Pump
Generation (GWh)	WECC	WC Base	261,892	4,524	-7,037
		Sens Low Hydro	228,314	4,825	-7,485
	WC	WC Base	19,944	1,630	-1,946
		Sens Low Hydro	20,900	1,742	-2,120
Capacity (MW)	WECC	WC Base	72,278	6,046	6,046
		Sens Low Hydro	72,278	6,046	6,046
	WC	WC Base	7,129	3,351	3,351
		Sens Low Hydro	7,129	3,351	3,351
Capacity Factor	WECC	WC Base	41.3%	8.5%	-13.3%
		Sens Low Hydro	36.0%	9.1%	-14.1%
	WC	WC Base	31.8%	5.5%	-6.6%
		Sens Low Hydro	33.4%	5.9%	-7.2%

Appendix C – Economic Sensitivities

High Gas Prices

- Assumed natural gas prices 40% higher than the base case
 - Base Case annual average gas price: \$5.30/MMBtu
 - Sensitivity Case annual average gas price: \$7.43/MMBtu



Appendix C – Economic Sensitivities

High Load Forecast

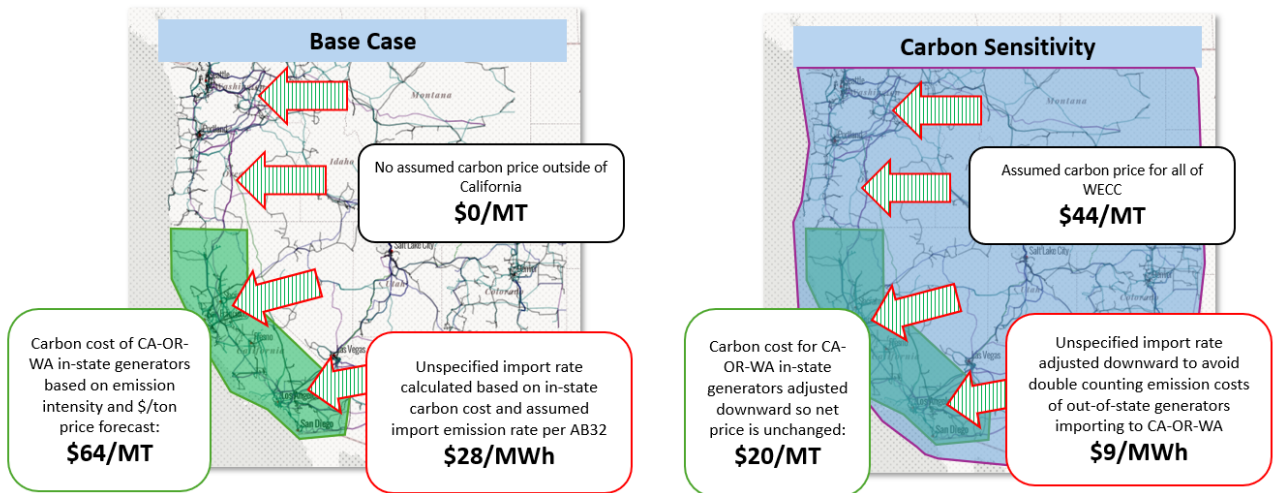
- Sensitivity case assumed peak loads and energy 20% higher than the Base Case

Area	Region	2034 WPCPM Base		2034 WPCPM sens High Load			
		Peak (MW)	Energy (GWh)	Peak Inc %	Energy Inc %	Peak (MW)	Energy (GWh)
AZPS	SW_AZPS	10,661	50,958	120%	120%	12,853	61,379
BANC	CA_BANC	5,252	18,967	120%	120%	6,325	22,858
EPE	SW_EPE	2,518	11,260	120%	120%	3,030	13,571
IID	CA_IID	1,183	4,035	120%	120%	1,422	4,861
LDWP	CA_LDWP	7,989	32,681	120%	120%	9,608	39,346
PNM	SW_PNM	3,092	15,376	120%	120%	3,721	18,550
PSCO	RM_PSCO	11,382	52,234	120%	120%	13,716	63,050
SRP	SW_SRP	11,322	51,221	120%	120%	13,624	61,692
TEPC	SW_TEPC	4,318	19,417	120%	120%	5,182	23,300
WACM	RM_WACM	6,700	40,181	120%	120%	8,059	48,323
WALC	SW_WALC	1,553	7,746	120%	120%	1,872	9,335

Appendix C – Economic Sensitivities

System Carbon Price

Carbon Sensitivity: Study Assumption



CA-OR-WA in-state/specified resources:	\$64/MT	$\$20/\text{MT} + \$44/\text{MT} = \$64/\text{MT}$
CA-OR-WA imports:	\$64/MT (\$28/MWh)	$\$20/\text{MT} (\$9/\text{MWh}) + \$44/\text{MT} = \$64/\text{MT}$
WECC system adder:	\$0/MT	\$44/MT

Appendix C – Economic Sensitivities

Congestion Summary

Assumed Grouping	Branch or Path Name	Congestion Hours (% hrs)/Cost(K\$)				
		Base	Low Hydro	High Gas	High Load	System Carbon Price
Multiple WC Entities	P36 TOT 3	138 (2%) / 10,032	82 (1%) / 1,542	128 (1%) / 3,423	600 (7%) / 557,608	131 (1%) / 3,620
	DAVEJOHN - LAR.RIVR 230 kV Line #1	311 (4%) / 7,720	196 (2%) / 4,193	422 (5%) / 13,389	915 (10%) / 148,314	369 (4%) / 12,304
	PPAPS W - PINPK 230 kV Line #1	396 (5%) / 1,760	409 (5%) / 1,435	418 (5%) / 2,485	873 (10%) / 6,216	361 (4%) / 1,626
	P46 West of Colorado River (WOR)	0	0	0	0	17 (%) / 0,163
	CRAIG_YV - CRAIG 230 kV Line #1	723 (8%) / 1,005	735 (8%) / 0,969	742 (8%) / 1,128	637 (7%) / 1,184	715 (8%) / 1,162
	PONCHA_E - N.GUNNSN 115 kV Line #1	0	80 (1%) / 4,327	81 (1%) / 4,020	248 (3%) / 25,885	83 (1%) / 4,520
	LAMAR_SWYD - LAMAR_C2 230 kV Line #1	0	136 (2%) / 0,252	133 (2%) / 0,203	0	0
	MONTROSE - HESPERUS 345 kV Line #1	0	0	48 (1%) / 1,537	160 (2%) / 32,945	0
	BONANZA - CRAIG 345 kV Line #1	0	0	0	331 (4%) / 216,219	0
	HESPERUS - WATRFLW 345 kV Line #1	0	0	0	177 (2%) / 83,579	0
DEERVALY - WESTWNGN 230 kV Line #1	0	0	0	323 (4%) / 4,266	0	
Single WC Entity, Multi-Regional	P15 Midway-LosBanos	1658 (19%) / 80,760	1925 (22%) / 82,188	1549 (18%) / 90,163	1405 (16%) / 65,188	1229 (14%) / 60,300
	INTERMT - MONA 345 kV Line #1	2006 (23%) / 22,374	2743 (31%) / 40,855	1987 (22%) / 26,867	1940 (22%) / 29,605	2061 (23%) / 30,632
	P77 Crystal-Allen	1023 (12%) / 11,211	1035 (12%) / 12,072	885 (10%) / 10,561	536 (6%) / 5,280	836 (10%) / 9,353
	P27 Intermountain Power Project DC Line	2876 (33%) / 4,757	2976 (34%) / 8,753	2682 (31%) / 5,350	2449 (28%) / 4,734	3674 (42%) / 8,441
	P61 Lugo-Victorville 500 kV Line	639 (7%) / 3,229	429 (5%) / 2,189	705 (8%) / 4,683	664 (8%) / 5,338	444 (5%) / 2,337
	BONANZA - MONA 345 kV Line #1	0	0	0	95 (1%) / 35,773	0
	MOEN-ELD SC3 - ELDORDO 500 kV Line #1	0	0	128 (1%) / 0,279	0	278 (3%) / 1,067
Total Multi-TO Congestion (\$)		\$19,799,835	\$7,796,176	\$19,530,215	\$714,651,192	\$16,381,009
Total Single-TO Congestion (\$)		\$351,235,427	\$2,199,721,200	\$410,161,617	\$524,517,270	\$408,658,109
Total Non-WestConnect Congestion (\$)		\$1,181,388,575	\$1,173,742,503	\$1,459,723,788	\$1,414,828,709	\$1,254,995,584
Total Multi-TO Congestion (% Change)			-61%	-1%	3509%	-17%
Total Single-TO Congestion (% Change)			526%	17%	49%	16%
Total Non-WestConnect Congestion (% Change)			-1%	24%	20%	6%

Appendix C – Economic Sensitivities

Congestion Summary

Assumed Grouping	Branch or Path Name	Avg Flow (MW)				
		Base	Low Hydro	High Gas	High Load	System Carbon Price
Multiple WC Entities	P36 TOT 3	919	836	931	1120	900
	DAVEJOHN - LAR.RIVR 230 kV Line #1	116	94	124	208	112
	PPAPS W - PINPK 230 kV Line #1	256	257	252	312	251
	P46 West of Colorado River (WOR)	0	0	0	0	8705
	CRAIG_YV - CRAIG 230 kV Line #1	73	73	73	69	73
	PONCHA_E - N.GUNNSN 115 kV Line #1	0	-38	-37	-44	-38
	LAMAR_SWYD - LAMAR_C2 230 kV Line #1	0	50	47	0	0
	MONTROSE - HESPERUS 345 kV Line #1	0	0	-287	-365	0
	BONANZA - CRAIG 345 kV Line #1	0	0	0	364	0
	HESPERUS - WATRFLW 345 kV Line #1	0	0	0	-400	0
DEERVALY - WESTWNGN 230 kV Line #1	0	0	0	-386	0	
Single WC Entity, Multi-Regional	P15 Midway-LosBanos	3155	3590	3121	2987	2917
	INTERMT - MONA 345 kV Line #1	298	366	291	297	279
	P77 Crystal-Allen	689	702	664	536	677
	P27 Intermountain Power Project DC Line	305	219	319	489	22
	P61 Lugo-Victorville 500 kV Line	722	765	698	625	635
	BONANZA - MONA 345 kV Line #1	0	0	0	-197	0
	MOEN-ELD SC3 - ELDORDO 500 kV Line	0	0	728	0	767

Appendix C – Economic Sensitivities

Area Summary

								% Change from Base			
Metric		Region	Base	Low Hydro	High Gas	High Load	System Carbon Price	Low Hydro	High Gas	High Load	System Carbon Price
LMP (\$/MWh)		AZPS	18.06	20.06	27.16	29.07	31.85	11%	50%	61%	76%
		BANC	67.21	79.86	80.94	82.70	65.53	19%	20%	23%	-2%
		EPE	15.64	17.95	24.50	24.91	28.54	15%	57%	59%	82%
		IID	38.64	40.56	47.10	46.41	34.71	5%	22%	20%	-10%
		LDWP	47.25	48.64	57.24	53.95	45.28	3%	21%	14%	-4%
		PNM	10.60	12.44	18.12	14.73	21.75	17%	71%	39%	105%
		PSCO	41.75	41.30	52.86	143.48	54.36	-1%	27%	244%	30%
		SRP	21.73	24.30	31.07	36.18	35.61	12%	43%	66%	64%
		TEPC	15.57	17.66	23.92	25.24	28.31	13%	54%	62%	82%
		WALC	11.84	13.35	19.97	20.06	24.27	13%	69%	69%	105%
		WACM	38.68	37.84	48.74	98.99	50.98	-2%	26%	156%	32%
MCC (\$/MWh)		AZPS	-22.79	-23.19	-23.51	-21.38	-12.40	2%	3%	-6%	-46%
		BANC	20.64	31.04	23.51	24.77	15.33	50%	14%	20%	-26%
		EPE	-27.74	-28.33	-29.21	-30.78	-18.71	2%	5%	11%	-33%
		IID	-2.21	-2.77	-3.31	-5.24	-9.33	25%	50%	137%	322%
		LDWP	3.19	2.10	2.77	-1.30	-2.32	-34%	-13%	-141%	-173%
		PNM	-31.20	-32.09	-33.42	-39.91	-23.49	3%	7%	28%	-25%
		PSCO	-3.99	-7.59	-3.69	82.55	4.07	90%	-7%	-2171%	-202%
		SRP	-19.61	-19.48	-20.11	-14.88	-9.16	-1%	3%	-24%	-53%
		TEPC	-25.26	-25.71	-26.66	-25.55	-15.88	2%	6%	1%	-37%
		WALC	-30.56	-31.61	-32.02	-34.29	-20.79	3%	5%	12%	-32%
		WACM	-4.99	-8.90	-5.08	41.43	3.04	78%	2%	-931%	-161%

Total Unserved Load (MWh)						
Region	Base	Low Hydro	High Gas	High Load	System Carbon Price	
AZPS	0	0	0	0	0	0
BANC	0	0	0	0	0	0
EPE	0	0	0	0	0	0
IID	0	0	0	0	0	0
LDWP	0	0	0	0	0	0
PNM	0	0	0	0	0	0
PSCO	0	0	0	92,982 (0.144%)	0	0
SRP	0	0	0	0	0	0
TEPC	0	0	0	0	0	0
WALC	0	0	0	0	0	0
WACM	0	0	0	15,704 (0.032%)	0	0

Appendix C – Economic Sensitivities

Generation Fleet

Metric	Case	Nuclear	Coal	Gas	Hydro	PS	Geothermal	Biomass	Other	BESS	Solar	Wind
Capacity (MW)	Base	3,500	3,080	30,587	7,129	3,351	602	0	4,167	24,749	34,404	15,039
	LowHydro	3,500	3,080	30,587	7,129	3,351	602	0	4,167	24,749	34,404	15,039
	HiGas	3,500	3,080	30,587	7,129	3,351	602	0	4,167	24,749	34,404	15,039
	HiLoad	3,500	3,080	30,587	7,129	3,351	602	0	4,167	24,749	34,404	15,039
	SysCarbPrice	3,500	3,080	30,587	7,129	3,351	602	0	4,167	24,749	34,404	15,039
Generation (GWh)	Base	28,950	17,884	70,830	19,944	1,630	3,634	0	4,316	26,638	84,414	47,067
	LowHydro	28,948	17,670	72,873	20,900	1,742	3,654	0	4,693	27,654	84,044	46,950
	HiGas	28,948	18,610	69,698	19,943	1,572	3,543	0	4,177	27,209	84,385	46,982
	HiLoad	28,948	19,607	104,960	19,945	1,406	3,859	0	7,474	25,887	86,197	47,655
	SysCarbPrice	28,948	18,119	67,426	19,941	1,592	3,356	0	4,520	26,805	85,253	47,274
Spillage (MWh)	Base	0	0	0	5,392	0	0	0	0	0	6,693,602	3,535,523
	LowHydro	0	0	0	5,722	0	0	0	0	0	7,064,115	3,651,816
	HiGas	0	0	0	5,865	0	0	0	0	0	6,723,158	3,620,396
	HiLoad	0	0	0	4,096	0	0	0	0	0	4,910,535	2,947,609
	SysCarbPrice	0	0	0	8,066	0	0	0	0	0	5,854,568	3,328,580
CO2e (Short Tons)	Base	0	5,725,547	23,437,480	0	0	489,421	0	1,697,372	0	0	0
	LowHydro	0	5,654,738	24,626,081	0	0	507,702	0	1,888,989	0	0	0
	HiGas	0	5,664,659	22,903,380	0	0	436,314	0	1,375,048	0	0	0
	HiLoad	0	6,260,835	39,645,865	0	0	571,338	0	4,231,195	0	0	0
	SysCarbPrice	0	5,771,760	22,096,575	0	0	396,044	0	1,535,054	0	0	0
CO2e Cost (M\$)	Base	0	0	421	0	0	11	0	43	0	0	0
	LowHydro	0	0	463	0	0	12	0	49	0	0	0
	HiGas	0	0	401	0	0	9	0	36	0	0	0
	HiLoad	0	0	605	0	0	14	0	103	0	0	0
	SysCarbPrice	0	335	1,016	0	0	8	0	72	0	0	0
LMP (\$/MWh)	Base	19.87	25.00	32.28	33.59	40.94	37.85	0	37.04	20.56	26.86	28.15
	LowHydro	22.03	24.41	34.57	29.88	42.25	39.63	0	39.00	22.44	28.80	29.18
	HiGas	28.97	32.89	42.13	43.29	51.36	46.36	0	47.50	29.48	36.21	37.24
	HiLoad	31.77	51.75	57.52	60.13	78.56	44.24	0	79.37	37.20	53.67	70.05
	SysCarbPrice	33.96	36.36	41.21	41.40	47.78	35.26	0	46.82	32.40	37.05	38.22
MCC (\$/MWh)	Base	-21.69	-15.90	-11.21	-9.60	-3.94	-1.83	0	-7.16	-22.22	-16.26	-14.07
	LowHydro	-22.06	-19.85	-11.68	-16.12	-5.58	-2.48	0	-8.06	-23.03	-17.08	-15.90
	HiGas	-22.37	-17.39	-11.63	-9.98	-4.12	-2.63	0	-7.15	-23.34	-17.05	-14.83
	HiLoad	-20.38	-0.66	2.19	5.06	20.75	-5.43	0	22.37	-17.34	-1.67	14.97
	SysCarbPrice	-11.11	-8.55	-6.16	-5.55	-1.17	-7.85	0	-1.45	-14.10	-9.87	-7.80

Appendix C – Economic Sensitivities

Generation Fleet (GWh)

Region	Case	Nuclear	Coal	Gas	Hydro	PS	Geothermal	Biomass	Other	BESS	Solar	Wind
AZPS	Base	10,131	0	7,176	0	0	89	0	50	12,392	24,342	4,829
	LowHydro	10,131	0	7,067	0	0	89	0	59	12,871	24,211	4,831
	HiGas	10,131	0	6,860	0	0	89	0	69	12,577	24,384	4,810
	HiLoad	10,131	0	11,587	0	0	92	0	335	11,957	25,223	4,961
	SysCarbPrice	10,131	0	6,980	0	0	86	0	60	12,204	24,814	4,920
BANC	Base	0	0	8,305	5,023	0	0	0	189	49	1,740	1,843
	LowHydro	0	0	9,173	5,554	0	0	0	253	108	1,740	1,872
	HiGas	0	0	7,905	5,023	0	0	0	116	52	1,740	1,854
	HiLoad	0	0	10,162	5,023	0	0	0	373	64	1,740	1,849
	SysCarbPrice	0	0	7,897	5,022	0	0	0	122	53	1,740	1,853
EPE	Base	5,501	0	2,270	0	0	0	0	0	2,093	6,314	209
	LowHydro	5,501	0	2,241	0	0	0	0	0	2,119	6,362	217
	HiGas	5,501	0	1,950	0	0	0	0	0	2,148	6,313	211
	HiLoad	5,501	0	3,438	0	0	0	0	0	2,012	6,597	222
	SysCarbPrice	5,501	0	1,848	0	0	0	0	0	2,140	6,368	213
IID	Base	132	0	664	1,488	0	3,054	0	11	357	1,123	0
	LowHydro	132	0	713	1,488	0	3,065	0	17	367	1,123	0
	HiGas	132	0	672	1,488	0	2,966	0	15	364	1,123	0
	HiLoad	132	0	852	1,489	0	3,230	0	50	361	1,123	0
	SysCarbPrice	132	0	515	1,486	0	2,814	0	15	372	1,123	0
LDWP	Base	3,544	0	14,674	1,417	620	19	0	1,050	1,209	4,582	2,404
	LowHydro	3,544	0	15,493	2,249	693	28	0	1,155	1,411	4,582	2,405
	HiGas	3,544	0	14,058	1,416	622	14	0	781	1,340	4,582	2,404
	HiLoad	3,544	0	18,762	1,417	556	48	0	1,641	1,203	4,582	2,404
	SysCarbPrice	3,544	0	12,412	1,417	716	0	0	1,053	1,479	4,582	2,404
PNM	Base	3,551	0	1,205	800	0	77	0	0	3,042	7,423	9,792
	LowHydro	3,551	0	1,124	862	0	77	0	0	3,106	7,592	9,639
	HiGas	3,551	0	1,502	800	0	78	0	0	3,113	7,383	9,691
	HiLoad	3,551	0	2,010	800	0	83	0	0	3,118	7,517	9,993
	SysCarbPrice	3,551	0	1,517	800	0	79	0	0	3,132	7,429	9,824
PSCO	Base	0	0	18,798	380	159	0	0	15	1,715	11,381	19,998
	LowHydro	0	0	19,165	381	164	0	0	15	1,739	11,444	19,991
	HiGas	0	0	18,670	380	147	0	0	16	1,747	11,381	20,015
	HiLoad	0	0	27,272	381	169	0	0	73	1,770	11,530	20,183
	SysCarbPrice	0	0	18,674	381	139	0	0	15	1,692	11,385	20,029
SRP	Base	6,089	0	6,132	94	757	395	0	77	1,430	8,689	1,898
	LowHydro	6,089	0	6,020	94	782	395	0	82	1,478	8,698	1,907
	HiGas	6,089	0	5,989	94	714	396	0	60	1,625	8,693	1,905
	HiLoad	6,089	0	11,955	94	577	407	0	630	1,254	8,734	1,916
	SysCarbPrice	6,089	0	5,615	94	648	377	0	71	1,561	8,716	1,912
TEPC	Base	0	4,907	4,424	0	0	0	0	2,733	2,613	7,830	1,150
	LowHydro	0	4,778	4,329	0	0	0	0	2,879	2,668	7,817	1,149
	HiGas	0	5,220	4,898	0	0	0	0	425	2,455	7,837	1,149
	HiLoad	0	5,437	8,402	0	0	0	0	1,145	2,355	7,996	1,175
	SysCarbPrice	0	5,299	4,738	0	0	0	0	377	2,437	7,912	1,166
WACM	Base	0	12,146	5,916	4,770	94	0	0	165	1,072	2,941	3,370
	LowHydro	0	12,134	6,175	3,754	103	0	0	196	1,099	2,939	3,368
	HiGas	0	12,369	5,813	4,770	89	0	0	155	1,118	2,942	3,370
	HiLoad	0	13,172	8,569	4,770	104	0	0	435	1,164	2,945	3,370
	SysCarbPrice	0	12,566	5,877	4,770	89	0	0	140	1,074	2,942	3,370
WALC	Base	0	831	1,267	5,971	0	0	0	26	665	8,049	1,574
	LowHydro	0	758	1,375	6,517	0	0	0	37	688	7,534	1,572
	HiGas	0	1,021	1,381	5,971	0	0	0	66	670	8,006	1,574
	HiLoad	0	998	1,952	5,971	0	0	0	142	629	8,210	1,582
	SysCarbPrice	0	254	1,353	5,971	0	0	0	67	661	8,242	1,583