Regional Transmission Plan Report

WestConnect 2022-23 Regional Transmission Planning Cycle

Approved by the WestConnect Planning Management Committee
December 13, 2023

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1. Executive Summary

The WestConnect 2022-23 Regional Transmission Plan Report ("Regional Plan Report") is based on an evaluation of the transmission network in the WestConnect region for the 10-year timeframe. This report summarizes the processes, assumptions, and technical methods used to develop the WestConnect 2022-23 Regional Transmission Plan ("Regional Transmission Plan"); this involves the evaluation of the transmission network across the WestConnect region to determine regional reliability, economic, and public policy driven transmission needs and seeks to identify the more efficient or cost-effective solutions for the needs.

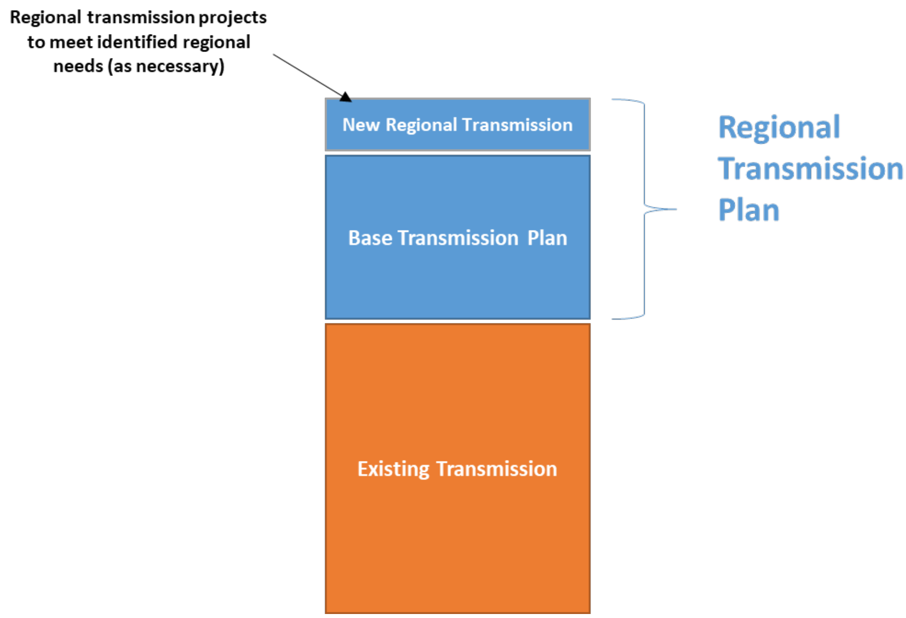
This Regional Plan Report is the final step of the WestConnect biennial Regional Transmission Planning Process ("Planning Process") and is intended to provide the reader with an overview of the core elements of the 2022-23 Planning Process. During the two-year planning cycle, the WestConnect Planning Management Committee ("PMC") produces detailed interim reports at the conclusion of each phase of the Planning Process, which are drawn from to create this Regional Plan Report. The interim reports contain significantly more detail than this Regional Plan Report and are made available on the WestConnect website. Their contents are summarized in **Table 1**.

Table 1: Summary of Interim Planning Documents for 2022-23 Planning Process

Interim Report	PMC Approval Date	Hyperlink	Contents
2022-23 Study Plan	March 16, 2022	Link	• Summary of study methods, models, tools, and analyses • Base Transmission Plan identified • Process schedule
2022-23 Model Development Report	December 14, 2022	Link	• Detailed assumptions and processes used to create models used to perform regional assessment • Analysis of Base Transmission Plan contents
2022-23 Regional Transmission Needs Assessment Report	January 18, 2023	Link	• Study results and findings from regional needs assessment
2022-23 Scenario Assessment Report	November 15, 2023	Link	• Study results and findings from scenario studies

The Regional Transmission Plan reflects the planned transmission that is necessary to meet the region's needs. The Regional Transmission Plan consists of the Base Transmission Plan, which is created at the beginning of each planning cycle to establish the assumed transmission network reflected in planning models for the 10-year timeframe, along with any regional transmission projects selected as the more efficient or cost-effective alternative to a regional need identified during the WestConnect regional assessments, as illustrated in **Figure 1**.

Figure 1: Regional Transmission Plan



The 2022-23 Base Transmission Plan includes 209 planned transmission projects, spanning 2360 miles, with a total estimated capital investment of $5,800 Million. 82% of these projects involve facilities below 230 kV. Since the 2020-21 WestConnect Regional Transmission Plan, the WestConnect region has seen 123 new planned projects, 32 previously planned projects go into service, 25 previously planned projects begin construction, and 48 previously planned projects which are no longer planned. As defined by WestConnect, "planned" facilities include projects that are expected to be in-service during the approaching 10 years and are required to meet enacted Public Policy Requirements, have a sponsor, and are incorporated in an entity's regulatory filings or capital budget, or have an agreement committing entities to participate and construct.

In evaluating the need for new regional transmission projects in the Regional Transmission Plan, WestConnect first determines the system's needs. WestConnect uses three types of assessments to identify regional needs: reliability, economic, and public policy. These assessments were respectively dependent on power flow models, a production cost model ("PCM"), and confirmation from each Transmission Owner with Load Serving Obligation ("TOLSO") member that these models reflect plans to meet enacted public policies impacting the region. **Table 2** summarizes the WestConnect Planning Models developed and analyzed in the 2022-23 Planning Process, which include "Base Case" models used to identify regional needs, and a "Sensitivity Case" used to evaluate the impact of wheeling charge modeling assumptions on the economic model results.

Table 2: WestConnect Planning Models for Regional Assessment

Case Name	Case Description and Scope
2032 Heavy Summer Base Case	Summer peak load conditions during 1500 to 1700 MDT, with typical flows throughout the Western Interconnection.
2032 Light Spring Base Case	Light load conditions during 1200 to 1400 MDT in spring months of March, April, and May with solar and wind serving a significant but realistic portion of the Western Interconnection total load. Case includes renewable resource capacity consistent with any applicable and enacted public policy requirements.
2032 Base Case PCM	Business-as-usual, expected-future case with (1) median load, (2) median hydro conditions and (3) representation of resources consistent with TOLSO-approved resource plans as of March 2022.

The reliability assessment for regional needs was based on reliability standards adopted by the North American Electric Reliability Corporation ("NERC") TPL-001-5.1 Table 1 (P0 and P1) and TPL-001-WECC-CRT-3.2 (Transmission System Planning Performance WECC Regional Criterion), and supplemented with any more stringent TOLSO planning criteria based on TOLSO member feedback. Regional issues subject to deeper investigation were defined as system performance issues impacting more than one Transmission Owner ("TO") Member system. The results of the reliability analyses identified three branch overloads within single-TO systems, which WestConnect determined to be local issues and not regional.

The economic assessment for regional needs involved reviewing the 2032 Base Case simulation 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) in order to determine a set of congested elements that warranted testing for the economic potential for a regional project solution, while also recognizing that the presence of congestion does not always equate to a regional need for congestion relief at a particular location. Similar to the reliability assessment, the review focused on the congestion issues impacting more than one TO Member system. The 2032 Base Case results identified 5 congested elements or paths in multi-TO systems and several congested elements or paths in single-TO systems, all of which WestConnect determined to be either local issues or minor congestion which does not warrant a regional need determination.

The public policy assessment was intended to identify any regional issues driven by enacted Public Policy Requirements. As part of the model development phase of the Planning Process, each TOLSO member provided express confirmation that the developed WestConnect 2032 economic and power flow models included all local planning assumptions driven by enacted Public Policy Requirements for study year 2032, to the extent a plan for compliance with the Public Policy Requirement was completed prior to the model development phase of the planning cycle.[1] WestConnect started this effort during the 2020-21 Planning Process to determine whether the WestConnect economic models indicated a renewable energy penetration trajectory consistent with enacted public policies. This additional work was driven by stakeholder interest and continues to be performed by comparing the region's modeled

[1] *In the context of FERC Order 1000, enacted Public Policy Requirements 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*

load and renewable energy in the regional Base Cases to prior planning cycle cases. WestConnect continues to find a reasonable trend towards WestConnect members meeting enacted Public Policy Requirements. During the regional reliability and economic assessments for this cycle, no regional issues were identified. If regional issues were identified in the assessments, WestConnect would then take the second step of evaluating if those issues were driven by actions needed to comply with Public Policy Requirements. No stakeholders suggested or recommended the identification of a regional public policy-driven transmission need following the WestConnect presentation to stakeholders of enacted public policies and local transmission solutions to Public Policy Requirements. As a result, there were no public policy-driven needs identified in the WestConnect 2022-23 Regional Planning Process.

Based on the findings from the 2022-23 planning cycle analyses performed for reliability, economic, and public policy transmission needs, **no regional transmission needs were identified in the 2022-23 assessment**. As a result, the PMC did not collect transmission or non-transmission alternatives for evaluation since there were no regional needs to evaluate the alternatives against, and the 2022-23 Regional Transmission Plan is identical to the 2022-23 Base Transmission Plan. The evaluations of multi-TO economic issues identified in the regional assessments are summarized in **Table 3.** There were no multi-TO reliability issues.

Table 3. Evaluation of Multi-TO Economic Issues

Multi-TO Economic Issue	Rationale provided for why this should not be a regional need
1. Path 48 Northern New Mexico	PNM, TSGT: The limited number of hours of congestion seen for this interface does not indicate a regional need.
2. Path 30 TOT 1A Interface	TSGT, WAPA-RMR: This result does not warrant establishing a regional need. The 20 hours or .23% of congestion for TOT1A can be considered noise and is less than previous study cycle results.
3. Path 36 TOT 3 Interface	BHC, TSGT, PSCO, WAPA-RMR: This result does not warrant establishing a regional need. The 1 hour of congestion for TOT3 can be considered noise and is less than previous study cycle results.
4. Story – Pawnee 230 kV	PSCO, TSGT: The limited number of hours of congestion seen for this interface does not indicate a regional need.
5. Dave Johnston – Laramie River 230 kV	BEPC, TSGT: The limited number of hours of congestion seen for this interface does not indicate a regional need.

The 2022-23 Planning Process also included a Scenario Study, which was used for information-only and considered an alternate, but plausible future. The Scenario Study was not used to identify regional needs and did not impact the Regional Transmission Plan. The Scenario Study shown in **Table 4,** was the High Clean Energy Penetration Scenario ("Scenario") Study, which was described in detail in the 2022-23 Study Plan and in Section 9 of this report.

Table 4: WestConnect Scenario Study

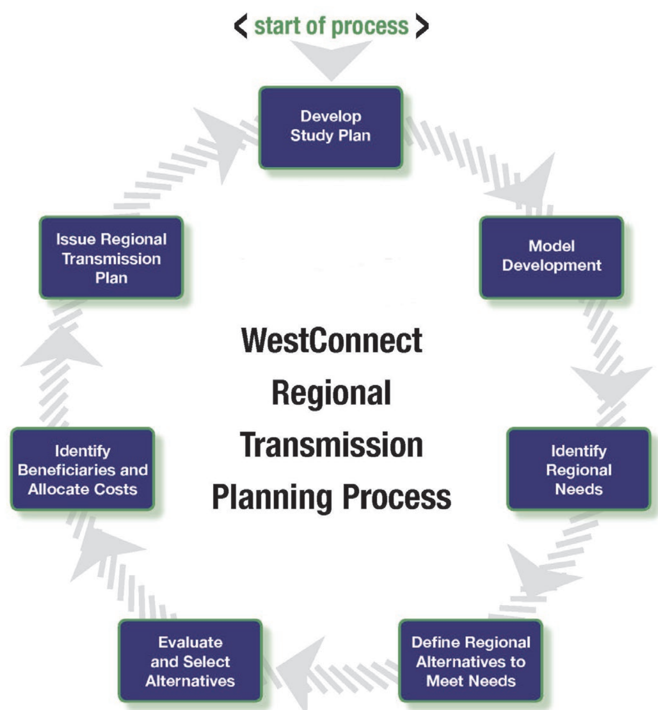
Scenario	Description and Scope
High Clean Energy Penetration Scenario	Evaluate the regional congestion in and reliability of a 2032 future in which the renewable and clean energy target-focused Public Policy Requirements of that study year are satisfied within the WestConnect footprint, as well as use the models representing this future to understand the gap between this future and a future in which the WestConnect footprint is carbon free.

2. Planning Management and Process

This WestConnect 2022-23 Regional Transmission Plan Report ("Regional Plan Report") is the final step of the WestConnect 2022-23 biennial Regional Transmission Planning Process ("Planning Process") and summarizes the processes, assumptions, and technical methods used to develop the WestConnect 2022-23 Regional Transmission Plan ("Regional Transmission Plan"), which identifies the more efficient or cost-effective transmission solutions for the region. The document also explains why projects were either included or not included in the Regional Transmission Plan.

The WestConnect Planning Process was developed for compliance with Federal Energy Regulatory Commission ("FERC") Order Number 1000 ("Order No. 1000"), Transmission Planning and Cost Allocation by Transmission Owning and Operating Public Utilities. The Planning Process consists of seven primary steps as outlined in **Figure 2**.

Figure 2: WestConnect Regional Transmission Planning Process



The Planning Process commences in even numbered years, resulting in the development of a Regional Transmission Plan every odd-numbered year. During the Planning Process, WestConnect seeks to identify regional reliability, economic, and public policy transmission needs. If regional transmission needs are identified, WestConnect solicits alternatives (transmission or non-transmission alternatives) from WestConnect members and stakeholders to meet the regional needs. WestConnect then evaluates the alternatives to determine which meet the region's needs more efficiently or cost-effectively. The selected alternatives are then identified in the Regional Plan Report. Identified alternatives submitted for the purposes of cost allocation may go through the cost allocation process if they are eligible and pass the cost/benefit thresholds established for the relevant category of project (reliability, economic, or public policy).

Additional details of the WestConnect Regional Transmission Planning Process can be reviewed in the WestConnect Regional Business Practice Manual ("BPM").

2.1 Planning Management

The WestConnect Planning Management Committee ("PMC") has overall responsibility for all WestConnect regional planning activities. The Planning Process activities are conducted under the direction of the PMC by the WestConnect Planning Subcommittee ("PS") and WestConnect Cost Allocation Subcommittee ("CAS"), and with input from PMC members and stakeholders, as described in greater detail in subsequent sections of this document.

2.2 Planning Region

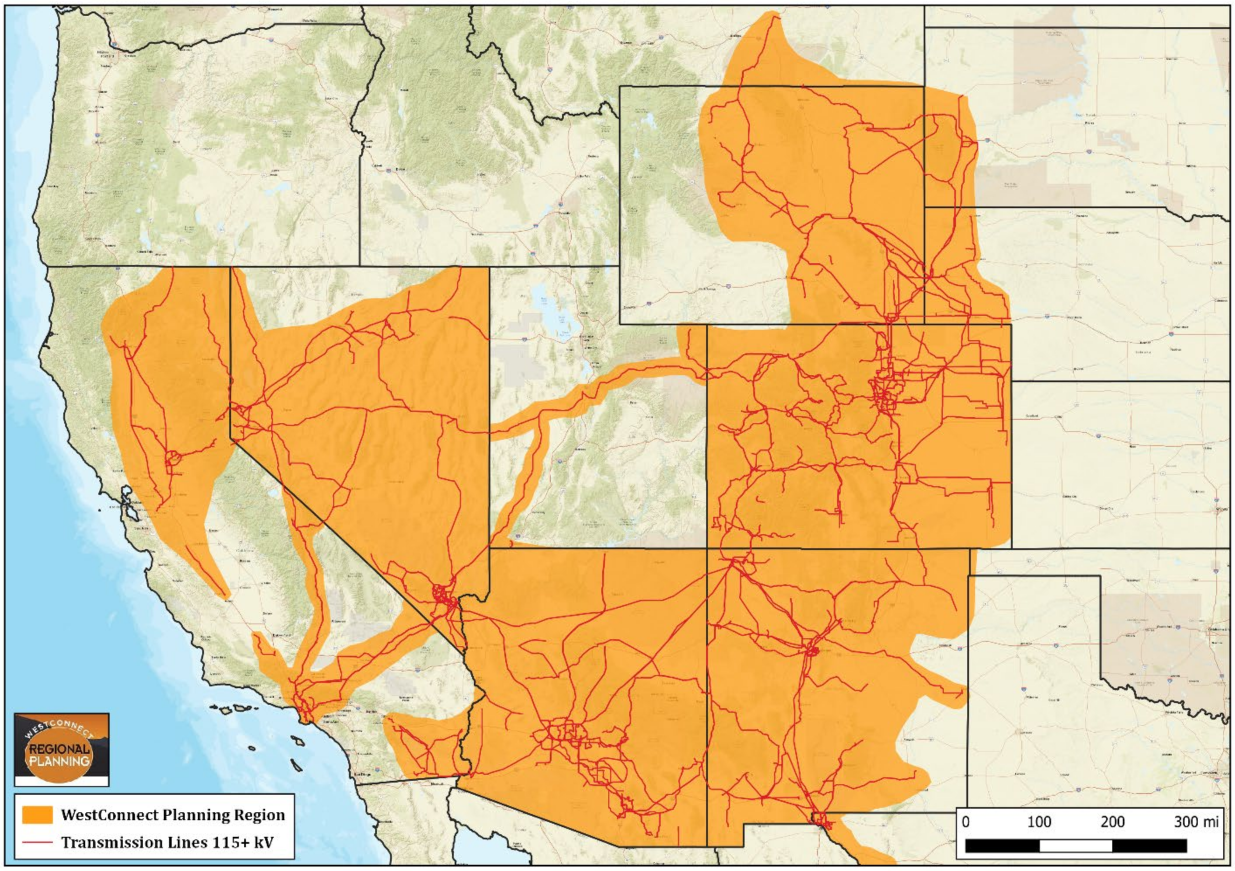
The WestConnect planning process evaluates regional transmission needs of the WestConnect planning region, which is defined as the combined footprints of signatories to the Planning Participation Agreement within the Transmission Owner with Load Serving Obligation ("TOLSO") Members. TOLSO Members participating in the WestConnect 2022-23 planning process, and the systems considered in the regional assessment included:

- Arizona Electric Power Cooperative, Inc.
- Arizona Public Service
- Basin Electric
- Black Hills Energy
- Colorado Springs Utilities
- Deseret Generation and Transmission Co-operative
- El Paso Electric
- Imperial Irrigation District
- Los Angeles Department of Water and Power
- Platte River Power Authority
- Public Service Company of New Mexico
- Sacramento Municipal Utility District
- Salt River Project
- Tucson Electric Power Company
- Transmission Agency of Northern California
- Tri-State Generation and Transmission
- Western Area Power Administration (Desert Southwest, Rocky Mountain, Sierra Nevada)
- Public Service Company of Colorado (Xcel Energy)

WestConnect conducts FERC Order No. 1000 regional transmission needs assessments for Transmission Owner ("TO") entities that are WestConnect members.[2] The approximate footprint of both member and participating TOs is shown in **Figure 3**.

[2] *All references to Order No. 1000 include any subsequent orders. (see Order No. 1000 Regional Compliance Orders)*

Figure 3: Approximate Footprint of WestConnect Member TOLSO Members and Participating TOs



In addition to the TOLSO members, the following PMC members from the Independent Transmission Developer Member Sector and Key Interest Group Sector also participate in the planning effort:

- Black Forest Partners
- Southwestern Power Group
- TransCanyon, LLC
- GridLiance Southwest, LLC
- Western Energy Connection, LLC
- Xcel Western Transmission Company

2.3 Local versus Regional Transmission Issues

For the purposes of the regional transmission needs assessment, a single-TO need impacts only the TO footprint in which it resides. Single-TO transmission issues and non-member issues are not within the scope of the WestConnect regional transmission planning process, and are not considered regional transmission needs. However, for the sake of completeness and study transparency, the PS reviews all identified single-TO system transmission issues to ensure that in combination, none of the issues are regional in nature. Single-TO system issues are the responsibility of the affected TO to resolve, if necessary.

Regional needs are generally defined by impacts to more than one TO. However, the PMC may determine that in some instances, transmission issues that impact more than one TO are still local, rather than regional, in nature. In such cases, WestConnect will provide an explanation as to how impacts are classified.

2.4 Documentation of the 2022-23 Planning Process

This Regional Plan Report is intended to stand on its own, providing an overview of the core elements of the 2022-23 Planning Process. However, this report does not include all details pertaining to the Planning Process. The PMC produces interim reports at the conclusion of each phase of the Planning Process. These interim reports are drawn from to create this Regional Plan Report. The interim reports contain significantly more detail than this Regional Plan Report and are made available on the WestConnect website. Specifically, the interim reports contain technical appendices that are referenced to but are not repeated in this document.

2.4.1 Study Plan

The scope of work for the 2022-23 Planning Process is documented in the 2022-23 Regional Study Plan ("Study Plan"), which was approved by the PMC on March 16, 2022. The Study Plan describes the Base Transmission Plan as well as the reliability, economic, and public policy assessments to be performed in the planning cycle. It covers the scope of work for model development, and provides technical guidance regarding the identification of regional needs.

2.4.2 Model Development Report

The Base Case models were approved by the PMC on September 21, 2022, and the regional model development process and the input assumptions for the regional planning models is documented in the 2022-23 Model Development Report ("Model Development Report"), which was approved by the PMC on December 14, 2022. The report describes the development process of the regional base models and details key model assumptions and parameters, such as study timeframe, study horizon, study area, the Base Transmission Plan, and how enacted public policies were considered. Along with the Model Development Report, the PMC approved the regional base models for use in regional assessments.

2.4.3 Regional Transmission Needs Assessment Report

The methods used to identify regional needs are documented in the 2022-23 Regional Transmission Needs Assessment Report ("Needs Assessment Report"), which was approved by the PMC on January 18, 2023. The Needs Assessment Report details the methods, assumptions, and results of the three types of regional needs assessments: reliability, economic, and public policy.

2.4.4 Scenario Assessment Report

In addition to describing the Base Case planning assessments used to identify regional transmission needs, the Study Plan also describes information-only scenario studies that consider alternate but plausible futures. Scenarios represent futures or system conditions with resource, load, and public policy assumptions that are different in one or more ways than what is assumed in the regional base models. The 2022-23 Scenario Assessment Report ("Scenario Assessment Report"), which was approved by the PMC on November 15, 2023, details the development process, study method, and results of the scenarios identified in the Study Plan.

3. 2022-23 Base Transmission Plan

WestConnect created the regional base transmission plan at the beginning of the 2022-23 Planning Process to establish the transmission network topology that is reflected in the regional planning models for the 10-year timeframe and evaluated in the regional needs assessments. The base transmission plan consists of the "planned" incremental transmission facilities included by TOs in local transmission plans,[3] as well as regional transmission facilities identified in previous regional transmission plans that are not subject to reevaluation.[4] It also includes any assumptions member TOs may have made with regard to other incremental regional transmission facilities in the development of their local transmission plans. "Conceptual" transmission projects are not included in the base transmission plan. As defined by WestConnect, "planned" facilities include projects that are expected to be in-service during the approaching 10 years and are required to meet Public Policy Requirements, have a sponsor, and are incorporated in an entity's regulatory filings or capital budget, or have an agreement committing entities to participate and construct.

The Base Transmission Plan may also include projects under development by independent transmission developer ("ITD") entities in the WestConnect planning region, to the extent there is sufficient likelihood of completion associated with these projects to warrant their inclusion in the Base Transmission Plan.[5] For the 2022-23 Regional Process, no ITD projects met the criteria for inclusion.

The base transmission plan was developed using project information collected via the WestConnect Transmission Plan Project List ("TPPL"), which serves as a project repository for TO member and TO participant local transmission plans as well as ITD projects. The TPPL data used for the 2022-23 Planning Process was based on updates submitted between December 1, 2021, and January 28, 2022. The full list of approved regional base transmission plan projects – prior to updates made during model development – can be found in **Appendix A** of the Study Plan.

3.1 2022-23 Regional Base Transmission Plan Projects

The 2022-23 Base Transmission Plan project list includes 209 planned transmission projects that consist of 74 new or upgraded transmission lines, 66 substations, 31 transmission line and substations, 22 transformers, and 16 other planned projects. From the data reported in the TPPL, these projects span a reported total of 2360 miles and add up to a total capital investment of $5.8 Billion.[6] **Table 5**, **Table 6**, and **Table 7** summarize the Base Transmission Plan by project type and voltage.

[3] Developed in accordance with Order No. 890 local planning processes. The Base Transmission Plan also includes any non-Bulk Electric System (non-BES) assumptions TO members may have made with regard to other incremental regional transmission facilities in the development of their local transmission plans.

[4] There were no regional transmission projects identified to meet regional need(s) in the 2020-21 planning cycle.

[5] A description of the criteria used to identify projects for inclusion in the Base Transmission Plan is in the BPM.

[6] 45% of the transmission line projects listed in the 2022-23 Base Transmission Plan did not report line mileage in the TPPL data and 70% of the projects did not report cost information in the TPPL data.

Table 5. Regional Base Transmission Plan Projects by Type, Mileage, and Investment ($K), based on TPPL data

Type of Project	Number of Projects	Length (Miles)	Planned Investment ($K)
Substation	66	-	$681,474
Transmission Line	74	1,329	$1,968,091
Transmission Line and Substation	31	1,031	$2,881,658
Transformer	22	-	$70,001
Other	16	-	$185,250
Total	209	2360	$5,786,474

Table 6. Number of TOLSO Regional Base Transmission Plan Projects by Voltage and TOLSO, based on TPPL data

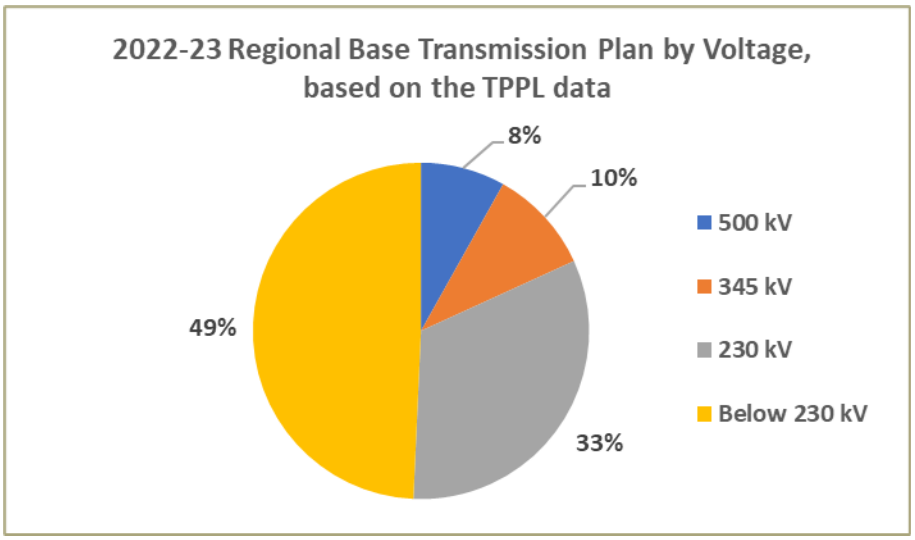
TOLSO	< 230 kV	230 kV	345 kV	500 kV AC	TBD	Total
Arizona Electric Power Cooperative	2	-	-	-	-	**2**
Arizona Public Service	-	10	1	3	-	**14**
Black Hills Energy	2	-	-	-	-	**2**
Black Hills Power	-	2	-	-	-	**2**
Cheyenne Light Fuel and Power	9	6	-	-	-	**15**
Colorado Springs Utility	4	3	-	-	-	**7**
Deseret Power	-	-	-	-	-	**-**
El Paso Electric Company	31	-	9	-	-	**40**
Imperial Irrigation District	1	1	-	-	-	**2**
Los Angeles Department of Water and Power	-	11	-	7	-	**18**
Platte River Power Authority	1	2	-	-	-	**3**
Public Service Company of Colorado/ Xcel Energy	2	6	1	-	-	**9**
Public Service Company of New Mexico	1	-	2	-	-	**3**
Sacramento Municipal Utility District	-	2	-	-	-	**2**
Salt River Project	2	9	-	4	-	**15**
Transmission Agency of Northern California	-	-	-	-	-	**-**
Tri-State Generation and Transmission Association	10	6	1	-	-	**17**
Tucson Electric Power	27	7	7	3	-	**44**
Western Area Power Administration - DSW	4	-	-	-	-	**4**
Western Area Power Administration - RMR	7	3	-	-	-	**10**
Western Area Power Administration - SNR	-	-	-	-	-	**-**
Total Projects	**103**	**68**	**21**	**17**	**0**	**209**

Table 7. Regional Base Transmission Plan Projects by Voltage, Mileage, and Investment ($K), based on TPPL data

Type of Project	Number of Projects	Length (Miles)	Planned Investment ($K)
500 kV	17	301.0	$1,020,994
345 kV	21	561	$1,701,156
230 kV	68	966	$1,688,444
Below 230 kV	103	533	$439,155
TBD	-	-	-
Total Projects	**209**	**2,361**	**$4,849,749**

Review of the of the 2022-23 regional base transmission plan projects showed that 49% were classified as below 230 kV, 33% were classified as 230 kV, 10% were classified as 345 kV, and 8% were classified as the 500 kV. **Figure 4** illustrates the percentage breakout for the 2022-23 regional base transmission plan projects by voltage.

Figure 4. 2022-23 Regional Base Transmission Plan Projects by Voltage, based on TPPL data



3.2 Updates to the 2020-21 Regional Transmission Plan Projects

Review of the 2020-21 Regional Study plan base transmission projects showed several projects have gone into service, started construction, or have had other updates to their development status. The full list of 2020-21 regional base transmission plan projects can be found in the [2020-21 Regional Transmission Plan](https://doc.westconnect.com/Documents.aspx?NID=20390&dl=1#page=59) Appendix A[7]. Updated information provided to the TPPL showed that 32 projects were placed in service, 25 projects were updated to under construction development status, 15 projects were updated to conceptual development status and 32 projects were withdrawn from the 2020-21 Regional Transmission Plan. The remaining 2020-21 regional base transmission plan projects continued as planned projects in the 2022-23 regional base transmission plan. Additionally, 123 new planned

[7] https://doc.westconnect.com/Documents.aspx?NID=20390&dl=1#page=59

projects were added to the TPPL and included in the 2022-23 regional base transmission plan. **Table 8** and **Table 9** summarize the updates to the 2020-21 regional base transmission plan projects.

Table 8. 2020-21 Transmission Plan Projects In-Service, Mileage, and Investment ($K), based on TPPL data

Type of Project	Number of Projects	Length (Miles)	Planned Investment ($K)
Substation	7	-	$37,170
Transmission Line	14	166	$29,851
Transmission Line and Substation	7	93	$84,157
Transformer	3	-	$5,279
Other	1	-	$250
Total Projects	**32**	**259**	**$156,707**

Table 9. 2020-21 Planned Projects Withdrawn or Changed to Conceptual by Voltage, based on TPPL data

New Status	Type	< 230 kV	230 kV	345 kV	Total
Conceptual	Substation	4	1	1	6
	Transmission Line	5	2	-	7
	Trans Line and Sub	1	-	-	1
	Other	-	1	-	1
	Subtotal	10	4	1	15
Withdrawn	Substation	7	1	-	8
	Transmission Line	15	1	-	16
	Trans Line and Sub	1	-	-	1
	Transformer	1	1	1	3
	Other	3	-	1	4
	Subtotal	27	3	2	32
	Total	**37**	**7**	**3**	**47**

3.3 Regional Base Transmission Plan Projects by State

The 2022-23 regional base transmission plan has projects in multiple states in the WestConnect footprint and in some instances, projects span multiple states. **Table 10** summarizes the number of projects by states with aggregated capital investment.

Table 10. 2022-23 Base Transmission Plan Projects by State, Mileage, and Investment ($K), based on TPPL data

State	Number of Projects	Length (Miles)	Planned Investment ($K)
Arizona	49	400	$1,346,239
California	15	179	$876,780
Colorado	33	999	$2,367,265
New Mexico	5	-	$104,900
South Dakota	1	-	-
Wyoming	9	58	$25,000
Multiple	97[8]	724	$1,066,290
Total Projects	**209**	**2360**	**$5,786,474**

[8] *Multi-state value is overstated due to aggregation of data during collection process*

Review of the 2022-23 regional base transmission plan projects by state showed that many (23%) of the projects are located in Arizona, 16% of the projects are located in Colorado, 7% are located in California, and 46% span multiple states. The remaining projects are located in in New Mexico, South Dakota, and Wyoming.

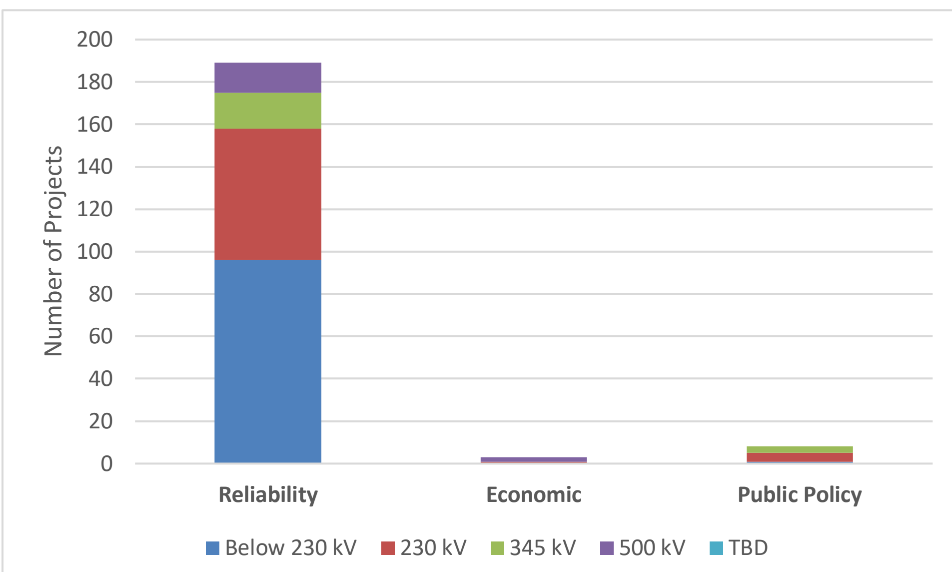
3.4 Regional Base Transmission Plan Projects by Driver

Review of the 2022-23 regional base transmission planned projects showed that nearly all of projects (90%) are primarily driven by reliability needs, 3% are primarily driven by public policy, and only 1% are primarily economic driven. **Table 11** and **Figure 5** below breakout the projects by voltage, and primary driver.

Table 11. 2022-23 Regional Base Transmission Plan Projects by Driver and Voltage based on TPPL data

Driver (Primary/Secondary)	< 230kV	230 kV	345 kV	500 kV	TBD	Total
Reliability	90	53	16	10	-	169
Reliability/Public Policy	2	8	1	4	-	15
Public Policy	1	2	2	-	-	5
Public Policy/Reliability	-	2	1	-	-	3
Other	6	1	1	1	-	9
Economic	-	-	-	2	-	2
Economic/Reliability	-	1	-	-	-	1
Reliability/Economic	4	1	-	-	-	5
Total Projects	**103**	**68**	**21**	**17**	**0**	**209**

Figure 5. 2022-23 Regional Base Transmission Plan Number of Projects by Primary Driver and Voltage, based on the TPPL data



4. Reliability Assessment

The purpose of the reliability assessment is to identify regional transmission needs in the 10-year timeframe. WestConnect conducted the 2022-23 regional reliability assessment on two Base Cases: a 2032 Heavy Summer case and a 2032 Light Spring case. The reliability assessment for regional needs was based on reliability standards adopted by the North American Electric Reliability Corporation NERC TPL-001-5.1 Table 1 (P0 and P1) and TPL-001-WECC-CRT-3.2 (Transmission System Planning Performance WECC Regional Criterion), and supplemented with any more stringent TOLSO planning criteria based on TOLSO Member feedback. Regional issues subject to deeper investigation were defined as system performance issues impacting, or between, more than one TO Member system.

4.1 Case Development

The information in this section summarizes each reliability model and provides details about the major assumptions incorporated into the reliability cases. The quality of the Base Cases and contingency definitions were improved by iteratively developing draft cases with contingency definitions and performing test simulations. After each draft and test simulation, data owners had the opportunity to examine the input and output data and submit corrections. This procedure resulted in seven review drafts of the base reliability models.

4.1.1 2032 Heavy Summer Base Case

Description: The case is designed to evaluate the Base Transmission Plan under heavy summer conditions. The seed case was the WECC 2032 Heavy Summer 1 Planning Base Case (32HS1), which was approved August 13, 2021. The 32HS1 case was updated with the latest topology (i.e., generator, load, and transmission) information from WestConnect participants while still representing typical heavy summer load conditions and generator dispatch.

Generation: Within WestConnect, the case features a dispatch of 40,028 MW of thermal, 8,480 MW of hydro, 4,461 MW of wind, 14,107 MW of solar, and 796 MW of Battery Storage resources.

Load: The aggregate coincident peak load level for the WestConnect footprint is 62,224 MW. The original WECC case represented the system coincident peak for a heavy summer condition between the hours of 1500 to 1700 MDT during the months of June – August. The intent was to continue these assumptions during its case development.

Transmission: No major planned transmission additions beyond the Base Transmission Plan were included in the case.

Other assumptions: WestConnect coordinated with NorthernGrid on certain assumptions during model development. The Boardman to Hemingway 500-kV Line (B2H) (a.k.a. Longhorn to Hemingway) was added for consistency with WECC and NorthernGrid transmission assumptions.

4.1.2 2032 Light Spring Base Case

Description: The purpose of the case is to assess Base Transmission Plan performance under light-load conditions with solar and wind serving a significant but realistic portion of the WestConnect total load. The seed case was the WECC 2033 Light Spring 1 Specialized Case (33LSP1), which was approved January 28, 2022.

Generation: Within WestConnect, the case features a dispatch of 23,359 MW of thermal, 4,707 MW of hydro, 3,701 MW of wind, 12,282 MW of solar, and -2,148 MW of Battery Storage resources.

Load: The total WestConnect load in the case is 42,498 MW, which is 68% of the WestConnect peak load in the WestConnect 2032 Heavy Summer Base Case. The load levels represent the system during 1200 to 1400 hours MDT during spring months of March, April, and May.

Transmission: Identical transmission assumptions as the 2032 Heavy Summer Base Case – see above for details.

Other assumptions: Identical other assumptions as the 2032 Heavy Summer Base Case – see above for details.

4.1.3 Other Data

The PS also considered the following when developing the reliability cases:

- **Operating Procedures** – Any special operating procedures required for compliance with NERC reliability standards were considered and included in the power flow cases.
- **Protection Systems** – The impact of protection systems including Remedial Action Scheme (RAS) required for compliance with NERC reliability standards were included in the power flow cases.
- **Control Devices** – Any special control devices required were included in the power flow cases.

4.2 Study Method

The scope of the reliability assessment was based on a list of comprehensive N-1 contingencies, plus TOLSO additions, in order to identify a regional need, as determined by the PS.[9] The intent was to minimize flagging and processing, local or "non-regional" issues. Contingency definitions for the steady-state contingency analysis were limited to N-1 contingencies for elements 230 kV and above, generator step-up ("GSU") transformers for generation with at least 200 MW capacity, and member-requested N-2 contingencies. Monitoring and violation reporting was performed for elements above 90-kV outside of the WestConnect footprint and member-identified elements within WestConnect footprint.

WestConnect also performed transient stability simulations. The PS surveyed the membership to develop the list of transient stability outages performed, which resulted in selecting ten disturbances across the WestConnect footprint.

System performance issues impacting, or between, more than one TO Member system were identified for further review by the PS. Local issues were reported for informational purposes. The local issues were not the focus of this assessment and were deferred to the applicable TOLSO Member.

4.3 Study Results and Findings

The 2022-23 WestConnect Model Development effort and preliminary Regional Needs Assessment indicated the potential for a single regional reliability issue resulting from the reliability assessment test. The issue was flagged for further discussion because of the involvement of multiple entities.

A summary of the issue follows:

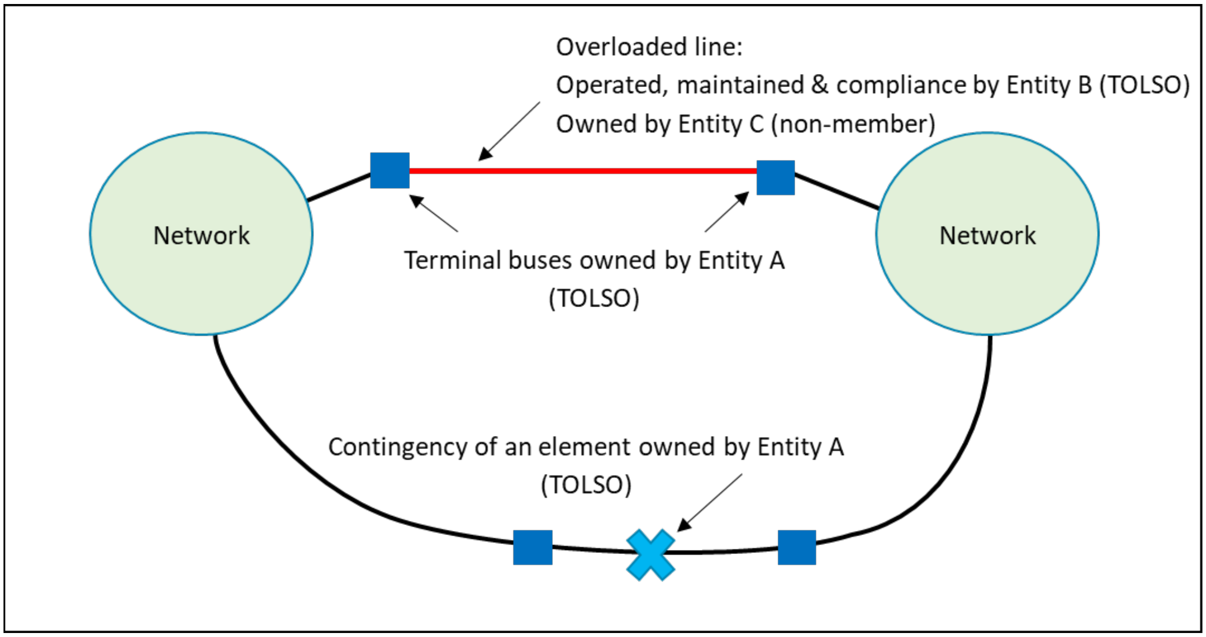
- A single contingency was found to result in an overload on a transmission element.

[9] *An initial list of automatically generated single branch ("N-1") outages for 230 kV and higher elements was created, and participants submitted any revisions to ensure the outages represented actual N-1 disturbances as well as any multi-element contingency definitions not automatically created.*

- The contingency is a transmission element owned by one entity (Entity A).
- The overloaded transmission line is operated and maintained by another entity (Entity B).
- The overloaded transmission line is owned by a third entity (Entity C).
- The substations at both ends of the overloaded transmission line are owned by Entity A.
- Entities A and B are TOLSO members of WestConnect.
- Entity C, the owner of the overloaded line, is not a member of WestConnect.

Figure 6 below shows a basic description of the issue.

Figure 6 Simple drawing of potential regional reliability issue



Upon a comprehensive review of the regional reliability assessment results, the PS concluded that even though the issue involved multiple entities in that a contingency on one entity's system caused an overload on another entity's transmission facility, the overloaded facility is owned by a single entity, and therefore should be considered a single-entity (local) issue. As a result, they recommended to the PMC at the November 16, 2022, 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 or impacted two or more WestConnect members. The reliability issues were presented to the PMC on October 12, 2022, and November 16, 2022.

5. Economic Assessment

WestConnect performed the 2022-23 regional economic assessment by conducting a production cost model ("PCM") study on a 2032 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 impacting more than one TOLSO member.

5.1 Case Development

The WestConnect 2030 PCM from the 2020-21 planning cycle served as the seed case for the WestConnect economic model 2032 Base Case. The PCM was reviewed and updated by WestConnect members during Quarters 2 and 3 of the 2022-23 planning cycle, and the Quarter 3 updates included assumptions pulled from the WECC 2032 Anchor Dataset (ADS) interconnection-wide 10-year PCM (WECC 2032 ADS PCM V2.0). The model was reviewed and updated by WestConnect members to maintain consistent electric topologies with the reliability base cases within the WestConnect footprint.

As with the reliability assessment, the economic assessment included testing and model refinements, simulations, participant review of results, and incorporation of modifications and comments into the subsequent round of simulations. After each draft and test simulation, data owners had the opportunity to examine the input and output data and submit corrections.

5.1.1 2032 Base Case

Description: The case is a production cost model (PCM) dataset designed to represent a likely, median 2032 future. The WestConnect 2030 PCM from the 2020-21 planning cycle served as the seed case for the WestConnect economic model 2032 Base Case. The WestConnect 2030 PCM was reviewed and updated by WestConnect during Quarters 2 and 3 of the 2022-23 planning cycle, and the Quarter 3 updates included select assumptions from the WECC 2032 Anchor Dataset (ADS) interconnection-wide 10-year PCM (2032 ADS PCM Beta), which were released in August 2022 . These updates were consistent with the process described below, which focuses on what updates were completed with the WECC 2032_ADS_PCM_Beta dataset as the reference.

Generation:

- The WestConnect latest generator-specific modeling was developed and used to update the dataset. This included but was not limited to: generator type, commission and retirement date, forced outage rate, outage duration, minimum and maximum capability with applicable de-rates for plant load or seasonal ambient temperature, minimum up and down times, fuel assignments, variable operations and maintenance and start-up costs, linkage to reserve modeling and regional/remote scheduling, linkage to operational nomograms, hydro fixed shape or load/price-driven scheduling, and hourly shapes. Table 12 provides a summary by fuel category of the generation updates made to the WECC 2032 ADS PCM V2.0. The positive (or negative) values represent the capacity (in MWs) and resulting generated energy (in GWh) added to (or removed from) the WECC 2032 ADS PCM V2.0 in order to create the WestConnect 2032 Base Case PCM.

Table 12: Generation Differences from WECC 2032 ADS PCM V2.0. Percentages are in reference to the totals in the WECC 2032 ADS PCM V2.0

Fuel Category	Differences, WestConnect less WECC PCM				Annual Generation (GWh)		Capacity (MW)	
	Annual Generation		Capacity					
	GWh	%	MW	%	WestConnect	WECC	WestConnect	WECC
Coal	12,861	37.17%	875	15.73%	47,466	34,605	6,434	5,559
Gas	30,062	32.48%	-412	-1.40%	122,622	92,560	29,064	29,476
Water	-1,547	-9.04%	-2,285	-31.89%	15,565	17,112	4,880	7,164
Uranium	1,083	3.96%	107	3.22%	28,450	27,367	3,436	3,328
Solar PV	-8,544	-23.08%	-1,853	-12.96%	28,482	37,026	12,450	14,303
Solar Thermal	30	5.21%	0	0.00%	601	571	250	250
Wind	2,912	8.49%	1,246	11.88%	37,220	34,308	11,733	10,487
Bio	-47	-5.18%	-23	-14.22%	861	908	139	163
Geothermal	-4,008	-49.83%	-809	-49.34%	4,037	8,045	830	1,639
BESS	4,493	132.84%	3,163	83.23%	7,875	3,382	6,964	3,800
Other	-26	-14.29%	503	83.61%	154	180	1,105	602
Overall	**37,268**		**512**		**293,332**	**256,064**	**77,284**	**76,772**

- The behind-the-meter distributed generation (BTM-DG) assumptions were retained from the WECC 2032 ADS PCM V1.0[10] which modeled them on the resource-side, with the exception of the TEPC load area (for which the BTM-DG and DR shapes were merged with the load shapes to model the BTM-DG and DR on the load-side). **Table 13** summarizes the amount of BTM-DG by area represented in the WestConnect 2032 Base Case PCM.

[10] *These BTM DG capacity values did not change from the last cycle*

Table 13: Behind-the-Meter Distributed Generation

Area Name	Capacity (MW)	Generation (GWh)	Capacity Factor (%)	Dispatch at Area Peak Load (% of Capacity)
AZPS	2,815	6,386	26%	40%
BANC	716	1,495	24%	48%
EPE	168	345	23%	72%
IID	199	453	26%	57%
LDWP	745	1,615	25%	63%
PNM	132	300	26%	31%
PSCO	1,513	2,971	22%	48%
SRP	438	999	26%	46%
TEPC	433	998	26%	22%
WACM	60	119	22%	66%
WALC	324	733	26%	49%

Load: WestConnect made minor modifications to the load shapes and forecasts included in the WECC 2032 ADS PCM Beta. No changes were made to the load forecasts for areas outside of WestConnect. **Figure 7** and **Figure 8** provide the annual load energy, various load snapshots (peak load and load during system/WECC peak), and the average load on a "PCM Area" basis. The PCM Areas are generally analogous to BAAs rather than specific utilities. The "PF Load" – load in the WestConnect 2032 Heavy Summer Base Case – is provided for a frame of reference, though, some difference between the PCM and power flow ("PF") load snapshots is typical given the below-listed considerations.

- The PF model focuses on an extreme or more-stressed-than-normal system condition whereas the economic model's load shapes do not contain extremely high or low load values since they are developed to support a median year-long simulation.
- The economic model load shapes do not include the impact of BTM-DG (except for TEPC) whereas the PF model loads may or may not contain BTM-DG.
- The economic model loads in the charts below include exports out of Western Interconnection via the direct current interties along the east side of the Western Interconnection – whereas they are not included in the PF load in the charts below.

Figure 7: WestConnect PCM Areas' Annual Demand (GWh) in WestConnect 2032 Base Case (PCM)

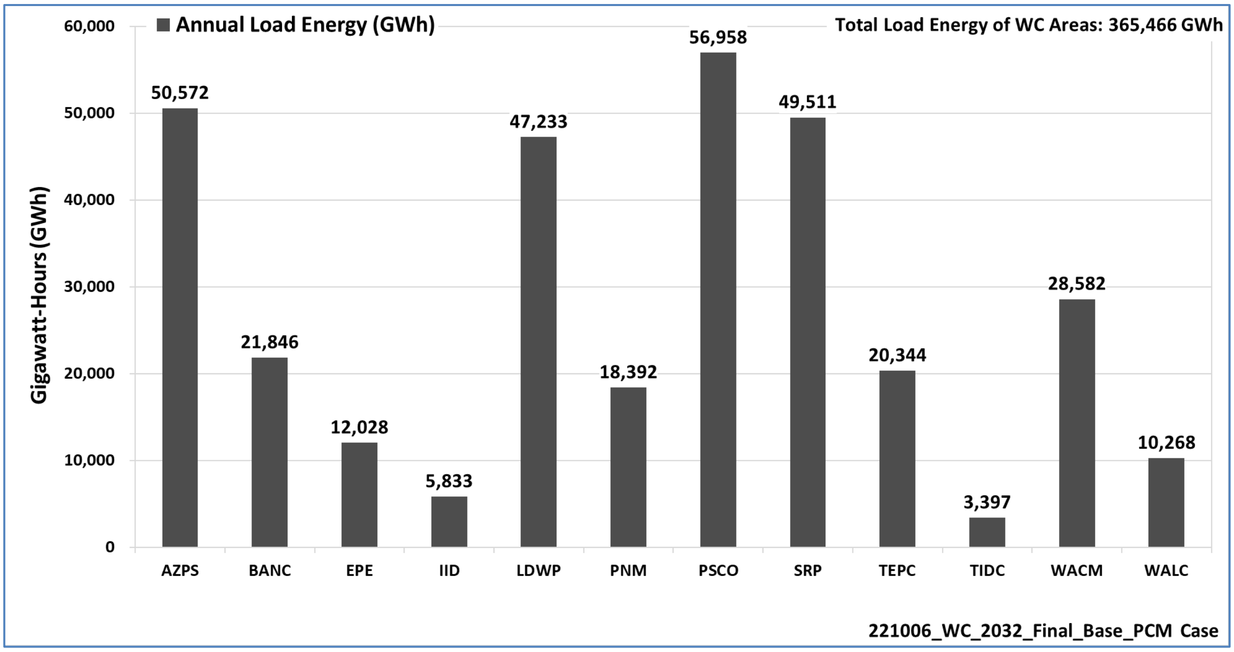
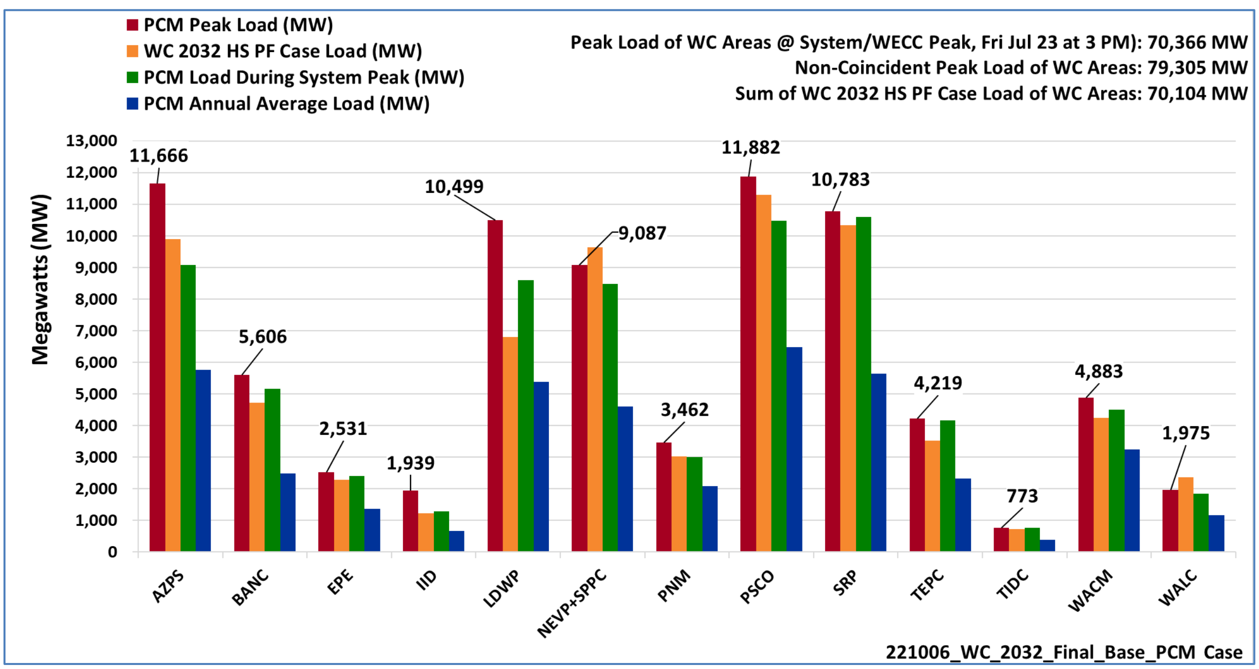


Figure 8: WestConnect PCM Areas' Peak Demand, Demand During System Peak, and Average Demand (MW) in WestConnect 2032 Base Case (PCM), shown with the Demand of the 2032 Heavy Summer Base Case



Transmission: The WECC 2032 ADS PCM Beta was updated with the WestConnect member topology to be consistent with the WestConnect Base Transmission Plan and the reliability model topology. WestConnect also reviewed the case for seasonal branch ratings, interfaces, and nomograms – making the below listed changes in each of these categories. The transmission topology outside of WestConnect, including the Common Case Transmission Assumptions, was not modified.

- Increased branch monitoring in the WestConnect footprint: Monitored transmission elements greater than 90 kV in WestConnect, greater than 200 kV outside of WestConnect, and all phase shifting transformers (PST) (phase angle regulators, or PAR).
- Updated interface definitions.

Other Assumptions:

- Any opportunity to more closely align the economic base case model with the reliability base case model was taken. For example, the summer and winter branch ratings and load distribution factors were aligned with the 2032 Heavy Summer Base Case.
- Fuel price forecasts and emission rate assumptions were initially pulled from the WECC 2032 ADS PCM Beta and subsequently updated with new coal prices accepted by the WECC PCDS as well as Member feedback. These assumptions are included in Appendix A of the Model Development Report.
- Reserve requirements modeling was updated from what was represented in the WECC 2032 ADS PCM Beta. These assumptions are summarized below:
    - Contingency Reserves: the default assumptions are provided below. LADWP and PNM provided higher spinning reserve assumptions to better represent their Balancing Authority's (BA's) operating practices.
        - Assumed a 50/50 split between spinning and non-spinning.
        - Assumed that NW and SW BA's locally meet 25% and 90% (respectively) of their contingency reserve requirement based on previous WECC models citing WECC EDT Phase 2 Benefits Analysis Methodology (October 2011 Revision).
        - Kept non-spinning requirement unmodeled since neither dataset currently has quick-start generator designations.
        - Kept spinning requirement modeled at BA and Reserve Sharing Group (RSG); however, a single set of RSG spinning requirements was modeled similar to the WECC 2032 ADS PCM Beta, except that RSG_RM was removed and the TPWR, PSCO, and WACM areas were included in RSG_NW.
    - Regulation Ancillary Service (AS) assumptions shown in **Table 14** were based on the CPUC Unified Resource Adequacy and Integrated Resource Plan Inputs and Assumptions – Guidance for Production Cost Modeling and Network Reliability Studies, March 29, 2019 (link).
    - Load Following AS assumptions are also shown in **Table 14.**

Table 14. Regulation and Load Following Ancillary Service Assumptions in WestConnect 2032 Base Case

AS	Ramping Response Requirement (minutes)	Requirement (at RSG level)	What it represents	What can contribute
Regulation Up	10	1.5% of Load	Security against unexpected loss of generation.	• Dispatchable thermals (excludes biomass/geothermal/nuclear/co-gen) generators subject to available headroom and ramp rate • Storage and hydro resources as constrained by headroom
Regulation Down				***Same as Reg Up contributors + Wind & Solar (no more than 10% of Maximum Capacity)***
Load Following Up	20	2.5% of load	Capacity reserved to accommodate load and/or renewable forecast error and sub-hourly deviations in forecasts. Not an actual product in most areas – proxy product to maintain reliability.	***Same as Reg Up contributors***
Load Following Down	20	1.5% of load		***Same as Reg Down contributors***

- Frequency Response AS assumptions were based on system-wide values from the NERC 2019 Frequency Response Annual Analysis (FRAA). This and the related assumptions are summarized in **Table 15**.

Table 15. Frequency Response Ancillary Service Assumptions in WestConnect 2032 Base Case

AS	Ramping Response Requirement (minutes)	Requirement (at RSG level)	What it represents	What can contribute
Frequency Response	1	1,253	• Response to frequency changes within one minute • 50% of constraint assumed to be met by hydro and renewable resources (full constraint is 2,506 MW)	• Storage, coal, and gas only • Limit gas-fired contribution to 8% of their capacity/headroom (via Ancillary Max Contribution)

- The below listed thermal generation modeling assumptions were taken from the WECC Intertek report dated May 12, 2020, "Update of Reliability and Cost Impacts of Flexible Generation on Fossil-fueled Generators for Western Electricity Coordinating Council."
  - Cost per start: used the warm, median values
  - Ramping limits
  - Minimum up and down times
  - Variable Operations and Maintenance (VOM) cost
- Wheeling charges, which represent the transmission service charges associated with transferring power between areas, were revised from the original WECC 2032 ADS PCM Beta values to peak and off-peak wheeling charges based on the latest Open Access Transmission Tariff (OATT) rate. These assumptions are provided in Appendix A of the Model Development Report. The WECC 2032 ADS PCM Beta also contained additional wheeling charges associated with modeling carbon emission charges applicable to California, and these rates were updated. Planning Subcommittee members reviewed these updates through draft model releases. Additional details for the wheeling charge modeling assumptions are included below:

    - The regular, inter-area wheeling charges were based upon the OATT on-peak and off-peak non-firm point-to-point transmission service charges (Schedule 8) as well as Schedule 1 (Scheduling System Control and Dispatch Service) and Schedule 2 (Reactive Supply and Voltage Control) charge components of transmission providers in the Western Interconnection.
    - Emission-related wheeling charges: The carbon emission charges applicable to California representing the California Global Solutions Act (AB 32) modeling and supplemental updates to the WECC 2032 ADS PCM Beta by the WECC Production Cost Data Subcommittee (PCDS) were implemented. Refer to the "Carbon emission charges updates" topic below for more details.
    - The WECC 2032 ADS PCM Beta included tiered wheeling constraints – zero wheeling charges up to a MW threshold and non-zero wheeling charges thereafter – on the Nevada, Idaho, Montana, and Canadian borders of the NW footprint as well as the PACE/APS border, and these wheeling charges were retained.
- Nomograms and transmission interfaces were modeled by starting with the WestConnect 2028 PCM, pulling in updates based on the WECC 2030 ADS PCM V1.0, and then enhanced with additional nomograms and conditional constraints provided by WestConnect members. These input conditions aim to address the operational needs of individual member systems, such as voltage support and other factors, including must run and must take conditions, that drive the need for certain generation resources to be committed in a particular way, consistent with the existing operational practices of the WestConnect member systems. The names of monitored interfaces are included in Appendix A of the Model Development Report. The "SMUD Op Nomogram", "EPE Balance", and "TEP Local Gen" were nomograms added to the model to commit local generation. In addition, other nomograms were added for generating plants containing a combination of solar PV and battery storage to ensure their combined output did not exceed their contractual limits, and others were added to ensure the battery storage only charged via the solar PV's output for certain plants.
- Carbon emission charges updates: Details are below, in 2020 dollars.
    - California: Updated to $64.293/MT based on the WECC PCDS' recommendation (CEC's 2019 IEPR Revised Carbon Price Projections) ("California Carbon Price Assumption")
        - In addition, the reduced emission factor for NW imports was also updated to 0.0117 MT CO_2e/MWh based on CARB Mandatory GHG Reporting - Asset Controlling Supplier. This affected the above-mentioned updates to the emission-related wheeling charges.
    - Alberta: Updated to $31.742/MT based on an Osler article RE Alberta carbon pricing
    - British Columbia: Updated to $49.015/MT based on British Columbia's Carbon Tax

5.1.2 Economic Sensitivity Models

Models were developed for sensitivity studies on the 2032 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.

2032 High Load Sensitivity Case

Description: Scaled up the hourly load shape of Balancing Areas within WestConnect so their annual peak and energy is a 100%+ percentage of their value in the 2032 Base Case:

- TEPC: 105% of both peak and energy
- All other WestConnect Areas: 120% of both peak and energy

2032 Low Hydro Sensitivity Case

Description: Replaced hydro modeling with WECC 2001-based hydro modeling data developed by WECC in conjunction with their 2024 Common Case PCM dataset.

2032 High Gas Price Sensitivity Case

Description: Increased all the natural gas prices to 140% of their value in the 2032 Base Case.

2032 System-Wide Carbon Emission Cost Sensitivity Case

Description: Applied CO_2 emission charges to all generators in WECC via the below updates to the 2032 Base Case:

- Applied the above-mentioned "California Carbon Price Assumption" as the carbon emission price for all generation in California, Oregon, and Washington
- Kept the Alberta and British Columbia carbon emission prices unchanged
- Removed the carbon emission wheeling charges from all California borders except with Baja California (CFE)
- Applied a carbon emission price of $44/metric ton CO_2e (2020 dollars) for all other generation in the WECC system

5.2 Study Method

The PS conducted the study and reviewed the 2032 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). Given the regional focus of the WestConnect process, the PS 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.[11]

5.3 Study Results and Findings

The objective of the economic assessment was to arrive at a set of congested elements that warranted testing for the economic potential for a regional project solution, while also 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 12, 2022 (link) and November 16, 2022 (link).

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[11] *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.*

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 16, 2022, 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**. Evaluations of each multi-TO system congestion issue in the Base Case results are summarized below. The PS determined all issues to be local and not regional in nature.

1. WECC Transfer Path 48 / Northern New Mexico (NM2) Interface was congested for 61 hours (0.70%), amounting to $1,102K in congestion cost. PNM and TSGT provided the rationale for why this should not identify a regional need:
    - The limited number of hours of congestion seen for these interfaces do not indicate a regional need.
2. WECC Transfer Path 30 (TOT 1A Interface) was congested for 20 (0.23%) hours, amounting to $913K in congestion cost. TSGT and WAPA-RMR provided the rationale for why this should not identify a regional need:
    - This result does not warrant establishing a regional need. The 20 hours or .23% of congestion for TOT1A can be considered noise and is less than previous study cycle results.
3. WECC Transfer Path 36 (TOT 3 Interface) was congested for 1 (0.01%) hour, amounting to $16K in congestion cost. BEPC, PSCO, TSGT, PSCO, and WAPA-RMR provided the rationale for why this should not identify a regional need:
    - This result does not warrant establishing a regional need. The 1 hour of congestion for TOT3 can be considered noise and is less than previous study cycle results.
4. The Story - Pawnee 230kV Line #1 was congested for 1 (0.01%) hour, amounting to $7K in congestion cost. PSCO and TSGT provided the rationale for why this should not identify a regional need:
    - The limited number of hours of congestion seen for these interfaces do not indicate a regional need.
5. The Dave Johnson – Laramie River 230kV Line #1 was congested for 2 (0.02%) hours, amounting to $0.57K in congestion cost. BEPC and TSGT provided the rationale for why this should not identify a regional need:
    - The 2 hours of congestion on the LRS-DJ 230kV line does not warrant establishing a regional need.

5.4 Sensitivity Studies

WestConnect concluded that there was no significant congestion to identify a regional need in the Base Case economic assessment. For completeness, the Planning Subcommittee conducted the sensitivity studies described above and confirmed that their different assumptions were not hiding potential regional congestion. The detailed results of the sensitivity cases are provided in **Appendix C**.

6. Public Policy Assessment

WestConnect administered the process for identifying regional transmission needs driven by enacted Public Policy Requirements. Enacted Public Policy Requirements 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 and including those enacted by local governmental entities, such as a municipality or county. Given this, regional public policy-driven needs are evaluated in the following 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.

6.1 Study Method

WestConnect began the evaluation of regional transmission needs driven by Public Policy Requirements for the 2022-23 planning cycle by soliciting TO members to identify enacted Public Policy Requirements in the region and to identify if any of the enacted Public Policy Requirements were driving local projects in the local TO's transmission plan that were incorporated in the base case models used in the WestConnect planning process. A list of enacted Public Policy Requirements in the region was documented in the Study Plan and this list was further refined by the PS in public meetings and posted in meeting materials. This list was provided to stakeholders to help evaluate if any Public Policy Requirement may result in a regional transmission need. WestConnect also described the local transmission projects that were driven by Public Policy Requirements and that were incorporated in the WestConnect base case models.

Table 16 lists all enacted public policies applicable to the WestConnect footprint, including Public Policy Requirements. A portion of the enacted public policies are driving planned local transmission projects reflected in the regional base economic and reliability models, whereas others are not currently driving planned local transmission projects. Each TOLSO member provided confirmation that, to the extent a plan for compliance with the Public Policy Requirements was completed prior to the model development phase of the WestConnect 2022-23 planning cycle, the WestConnect 2032 economic and reliability models reflect these public policies' conditions for the study year 2032. Company goals, although not Public Policy Requirements, such as the PNM Commitment to Carbon Free by 2040[12], were also considered in the development of the base models.

[12] *Public Service of New Mexico plans to produce 100% carbon free energy by 2040. Source: https://www.pnm.com/our-commitment*

Table 16. Enacted Public Policies Which Informed the2032 WestConnect Planning Models

Public Policy Requirement	Description
Arizona Renewable Energy Standard	Requires Investor-Owned Utilities (IOUs) and retail suppliers to supply 15% of electricity from renewable resources by 2025), with a minimum of 30% of the renewable resources provided by distributed generation
California AB398/SB32	Requires the California State Air Resources Board to approve a statewide greenhouse gas emissions limit equivalent to the statewide greenhouse gas emissions level in 1990 to be achieved by 2020 and to ensure that statewide greenhouse gas emissions are reduced to at least 40% below the 1990 level by 2030
California SB100	Requires Investor-owned utilities (IOUs) and municipal utilities to meet a 60% renewable portfolio standard (RPS) by 2030
California SB350	Requires IOUs and municipal utilities to meet a 50% RPS by 2030 and requires the establishment of annual targets for energy efficiency savings
Colorado HB 18-1270 (Energy Storage Procurement Act)	Directs the Commission to develop a framework to incorporate energy storage systems in utility procurement and planning processes. See C.R.S. § 40-2-201, et seq. The legislation broadly addresses resource acquisition and resource planning, and transmission and distribution system planning functions of electric utilities. Energy storage systems may be owned by an electric utility or any other person. Benefits include increased integration of energy into the grid; improved reliability of the grid; a reduction in the need for increased generation during periods of peak demand; and, the avoidance, reduction, or deferral of investment by the electric utility
Colorado HB 19-1261 and SB 1261 (GHG Reduction Bills)	HB 19-1261 requires the Air Quality Control Commission (AQCC) to promulgate rules and regulations for statewide greenhouse gas (GHG) pollution abatement. Section 1 of SB 1261 states that Colorado shall have statewide goals to reduce 2025 greenhouse gas emissions by at least 26%, 2030 greenhouse gas emissions by at least 50%, and 2050 greenhouse gas emissions by at least 90% of the levels of statewide greenhouse gas emissions that existed in 2005. A clean energy plan filed by a utility is deemed approved if the plan demonstrates an 80% reduction by 2030.
Colorado HB10-1001	Established Colorado Renewable Energy Standard (RES) to 30% by 2020 for IOUs (Xcel & Black Hills)
Colorado HB10-1365	Requires rate regulated utilities in CO with coal-fired generation to reduce emissions on the smaller of 900 MW of generation of 50% of a company's coal generation fleet. Full implementation to be achieved by 12/31/2017
Colorado SB 07-100	Requires IOUs to identify Energy Resource Zones, plan transmission to alleviate constraints from those zones, and pursue projects according to the timing of resource development in those zones
Colorado SB 18-009 (Energy Storage Rights Bill)	Protects the rights of Colorado electricity consumers to install, interconnect, and use energy storage systems on their property without the burden of unnecessary restrictions or regulations and without unfair or discriminatory rates or fees.
Colorado SB 19-077 (Electric Vehicles Bill)	The bill enables a regulatory approval process for electric utilities to invest in charging facilities and provide incentive rebates; thus, the investments and rebates may earn a return at the utility's authorized weighted-average cost of capital. Where approved, the costs for the investments and rebates may be recovered from all customers of the electric utility similar to recovery of distribution system investments. Natural gas public utilities may provide fueling stations for alternative fuel vehicles as non-regulated services only.

Public Policy Requirement	Description
Colorado SB 19-236 ("PUC Sunset Bill")	The primary purpose of this bill is to reauthorize the CPUC, by appropriations, for a seven-year period to September 1, 2026. Reauthorization is required by the sunset process. Additionally, the bill carries numerous requirements for utilities and the CPUC to achieve an affordable, reliable, clean electric system. Included in the bill are requirements to reduce the qualifying retail utility's carbon dioxide emissions associated with electricity sales to the qualifying retail utility's electricity customers by eighty percent from 2005 levels by 2030, and that seeks to achieve providing its customers with energy generated from one-hundred-percent clean energy resources by 2050. The bill also subjects co-ops to Colorado Public Utility Commission rulemaking.
Colorado SB13-252	Requires cooperative utilities to generate 20% of their electricity from renewables by 2020
Colorado SB21-072	This bill requires electric transmission utilities in Colorado to join an organized wholesale market (OWM) by January 1, 2030, provided that the OWM meets certain criteria set forth in the statute. This bill also creates the Colorado Electric Transmission Authority, a governmental entity that is authorized to independently develop and finance transmission projects.
Colorado HB21-1266	This bill is a broad policy measure to promote environmental justice in disproportionately impacted communities through the creation of an Environmental Justice Task Force. The bill requires wholesale generation and transmission cooperatives to file with the Public Utilities Commission a Clean Energy Plan to achieve 80% emissions reductions by 2030.
Colorado SB 21-246	The primary purpose of this bill is to direct the approval of plans for the electrification of buildings that use fossil fuel-based systems through existing demand side management programs.
Colorado HB21-1238	The primary purpose of this bill is to update the PUC's rules and decision-making process with respect to natural gas demand-side management programs including the use of the Social Cost of Carbon and Social Cost of Methane.
Colorado SB21-272	The primary purpose of this bill is to update the PUC's rules and decision-making process to better incorporate the impacts and benefits to underserved or disproportionately impacted communities and groups including workforces impacted by generation acquisition and retirement. Other requirements include how utilities finance resources or investments, the retirement of renewable energy credits, and the inclusion of the Social Cost of Carbon in resource planning decisions.
Executive Order 14057 (EO 14057), Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability (Dec. 8, 2021)	The President's executive order directs the federal government to use its scale and procurement power to achieve five ambitious goals: • 100 percent carbon pollution-free electricity (CFE) by 2030, at least half of which will be locally supplied clean energy to meet 24/7 demand; • 100 percent zero-emission vehicle (ZEV) acquisitions by 2035, including 100 percent zero-emission light-duty vehicle acquisitions by 2027; • Net-zero emissions from federal procurement no later than 2050, including a Buy Clean policy to promote use of construction materials with lower embodied emissions; • A net-zero emissions building portfolio by 2045, including a 50 percent emissions reduction by 2032; and • Net-zero emissions from overall federal operations by 2050, including a 65 percent emissions reduction by 2030.
New Mexico Efficient Use of Energy Act	Requires utilities to include cost-effective energy efficiency (EE) and demand response (DR) programs in their resource portfolios and establish cost-effectiveness as a mandatory criterion for all programs

Public Policy Requirement	Description
New Mexico Energy Transition Act (2019 SB 489)	Subject to the Reasonable Cost Threshold (RCT), the Energy Transition Act defines renewable energy requirements that are a percentage of a utility's retail energy sales and the type of utility: • By 2020, 20% for public utilities and 10% for cooperatives • By 2025, 40% for public utilities and cooperatives • By 2030, 50% for public utilities and cooperatives • By 2040, 80% for public utilities with provisions associated with carbon free generation • 100% carbon-free by 2045 for public utilities and by 2050 for cooperatives
SRP Sustainable Energy Goal	Reduce the amount of CO_2 emitted per megawatt-hour (MWh) by 65% from 2005 levels by 2035 and by 90% by fiscal year 2050.
Texas RPS	Texas RPS requires a total renewable capacity of 5,880 MW (which has already been achieved) by 2025 be installed in the state which is in turn converted into a renewable energy requirement. The renewable energy requirements are allocated to load serving entities based on their amount of retail energy sales as a percent of the total Texas energy served
Texas Substantive Rule 25.181 (Energy Efficiency Rule)	Requires utilities to meet certain energy efficiency targets

In an effort to engage stakeholders, the list of enacted Public Policy Requirements in the region and local projects in the TOs' local transmission plans that were driven by Public Policy Requirements was presented to stakeholders at the November 17, 2022, WestConnect Stakeholder meeting, as well as at the open PMC meeting held the day prior. A map of local TO planned projects that are driven by Public Policy Requirements was also presented. Stakeholders were asked to review the information and suggest to WestConnect possible regional public policy-driven transmission needs. An open stakeholder comment window was announced via posting on the WestConnect website and through an email to the WestConnect stakeholder distribution list for the purposes of collecting suggestions of possible regional public policy-driven transmission needs. The stakeholder comment window was open from November 17, 2022, through December 2, 2022, and invited comments on the WestConnect reliability and economic needs assessment results in addition to suggestions of possible regional public policy-driven transmission needs. No stakeholder comments were received by WestConnect.

6.2 Evaluating Progress

As with prior cycles, WestConnect conducted a high-level accounting and comparison of each PCM Area energy sales and renewable energy to observe if the energy penetration trajectory, based on data provided by members for the economic models, tracks with enacted public policies. The process is outlined below.

1. Annual generation consisting of Bio, Geothermal, Solar PV, Solar Thermal, & Wind were summed for each PCM Load Area as Renewable Energy ("RE"). The Reserve Capacity Distribution settings in the 2032 Base Case PCM were used to allocate resources to their appropriate remote load area.
2. Each PCM Load Area's "Energy Sales" was determined by taking the "Served Load Includes Losses", subtracting losses, adding the magnitude of negative generation (e.g., pumping loads

with hourly profiles), and subtracting behind-the-meter generation (e.g., distributed generator or DG-BTM, energy efficiency or EE, demand response or DR).

3. The "Renewable Energy" was divided by the "Energy Sales" as the "RE as % of Energy Sales" for the 2032 Base Case PCM and compared with these same values from the previous three planning cycles (to allow for comparison between planning cycles).

Only the single year results from each study year were used in the RE check and no banking of renewable energy from other years was assumed. **Figure 9** shows the results of the renewable energy check, which the Planning Subcommittee determined show a reasonable trend towards WestConnect members meeting enacted public policies. **Table 17** shows the losses and load including losses used to calculate the WestConnect Energy Sales. The results of the renewable energy check were also presented to stakeholders on November 17, 2022.

Figure 9. Sum of Energy Sales, Renewable Generation, and Overall RE as % of Energy Sales Based on Single-Year Results from the 2032 Base Case PCM and the Base Case PCM's from previous planning cycles

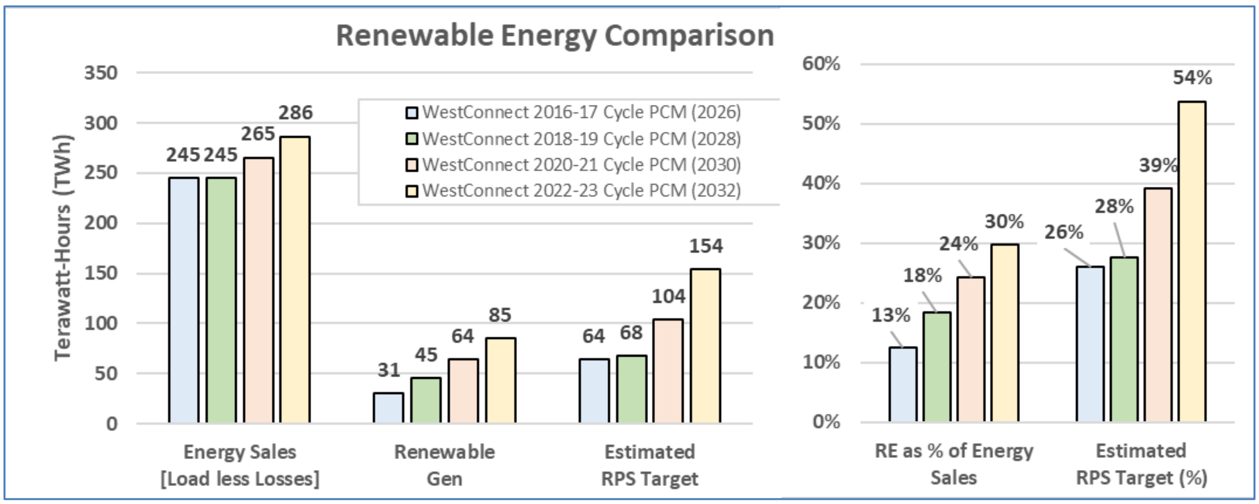


Table 17. BAA Losses and Served Load Including Losses used to calculate the WestConnect Energy Sales in the Renewable Energy Check

BAA	Losses (MWh)	Served Load Includes Losses (MWh)
AZPS	1,619,310	44,564,312
BANC	771,891	21,846,017
EPE	374,876	11,975,682
IID	199,304	4,791,888
LDWP	1,332,424	46,582,375
PNM	500,485	17,269,592
PSCO	1,839,963	55,987,612
SRP	1,687,780	48,656,614
TEPC	579,376	19,768,885
WACM	699,336	28,461,260
WALC	386,111	10,081,379
Total	**9,990,856**	**309,985,617**

6.3 Results and Findings

In conducting the regional reliability and economic assessments the PS did not find any regional issues, and as such, no further investigation of regional issues was done to determine if there were regional reliability and/or economic needs 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 the information shared at the November 17, 2022, stakeholder meeting, which included the results of the regional reliability and economic needs assessments, the list of Public Policy Requirements impacting the WestConnect region and local transmission projects driven by Public Policy Requirements. Based on these two findings, there are no identified public policy-driven needs in the WestConnect 2022-23 regional Planning Process. The WestConnect PMC approved the 2022-23 WestConnect Regional Transmission Needs Assessment Report on January 17, 2023, which did not identify any regional transmission needs driven by Public Policy Requirements

7. Regional Transmission Plan Summary

Based on the findings from the 2022-23 planning cycle analysis performed for reliability, economic, and public policy transmission needs as described in this report, no regional transmission needs were identified in the 2022-23 assessment.

Since no regional transmission needs were identified, the PMC did not collect transmission or non-transmission alternatives for evaluation since there were no regional transmission needs to evaluate the alternatives against. Given this, the 2022-23 Regional Transmission Plan is identical to the 2022-23 Base Transmission Plan, and it does not include any additional regional projects.

The full list of 2022-23 Regional Transmission Plan projects is provided in **Appendix A**.

8. Stakeholder Involvement and Interregional Coordination

8.1 Stakeholder Process

The WestConnect regional planning process is performed in an open and transparent manner to attain objective analysis and results. WestConnect invites and encourages interested parties or entities to participate in and provide input to the regional transmission planning process at all planning process stages. Stakeholders have opportunities to participate in and provide input to local transmission plans as provided for in each TO Member's OATT. Further, stakeholders have opportunities to participate in and provide input into subregional planning efforts within Colorado Coordinated Planning Group ("CCPG"), Sierra Subregional Planning Group ("SSPG"), and Southwest Area Transmission ("SWAT"). Finally, all WestConnect planning meetings are open to stakeholders.[13] Stakeholders' opportunities for timely input and meaningful participation are available throughout the WestConnect planning process. More specifically, the PS and PMC meetings held to support the regional transmission planning process were open to the public, and each meeting provided an opportunity for stakeholder comment. Notice of all meetings and stakeholder comment periods were posted to the WestConnect Calendar webpage and

[13] *At times, the PS and PMC convenes closed sessions for the purpose of addressing matters not appropriate for public meetings. Closed sessions typically address administrative, legal, and/or contractual matters, and include, from time to time, matters involving the handling and protections of non-public information."*

distributed via email. In addition, WestConnect accepted stakeholder comments on the interim reports created throughout the 2022-23 planning cycle. Further, open stakeholder meetings to discuss the WestConnect regional Planning Process were conducted on February 10, 2022, November 17, 2022, February 16, 2023, and November 16, 2023. The meetings were announced through the WestConnect website and stakeholder distribution lists, and all stakeholders were invited to attend.

The WestConnect PMC also manages a Stakeholder Tracking Document and an accompanying Stakeholder Comments webpage through which the PMC collects, tracks, and resolves stakeholder comments and concerns going forward.

8.2 Interregional Coordination

WestConnect coordinates its planning data and information with the two other established Planning Regions in the Western Interconnection (California Independent System Operator and NorthernGrid) by:

- Participating in annual interregional coordination meetings;
- Distributing regional planning data or information such as:
  - Draft and Final Regional Study Plan
  - Regional Transmission Needs Assessment Report
  - List of Interregional Transmission Projects ("ITP") submitted to WestConnect
  - Assessments and selection of ITPs into Regional Transmission Plan
  - Draft and Final Regional Transmission Plan
- Sharing planning assumptions if and when requested and subject to applicable confidentiality requirements; and
- Participating in a coordinated ITP evaluation process, as necessary, when an ITP is submitted to WestConnect as an alternative to meet an identified regional need. [14]

To the extent WestConnect received updated modeling data from TOs outside of the WestConnect planning region during the development of the regional models, it was considered, and if appropriate, incorporated into the regional models. The goal in seeking input from neighboring planning regions and TOs outside of the WestConnect planning footprint is to maintain external model consistency and align planning assumptions as closely as possible.

The process WestConnect utilizes to conduct its interregional coordination activities is described in the WestConnect Regional Planning Process BPM which is posted on the WestConnect website.

8.3 Interregional Project Submittals

An ITP is defined in the common tariff language developed for the Order No. 1000 interregional compliance filings as "a proposed new transmission project that would directly interconnect electrically to existing or planned transmission facilities in two or more planning regions and that is submitted into the regional transmission planning processes of all such planning regions." ITP proponents seeking to have their project included in the WestConnect Base Transmission Plan had the opportunity to do so at the beginning of the planning cycle. ITP proponents that wanted their ITP considered for cost allocation and/or to have their project evaluated to meet an identified regional need needed to submit their project to WestConnect via the WestConnect Regional Project Submittal Form no later than March 31,

[14] *Additional details regarding the ITP submittal and evaluation process can be found in the BPM.*

2022, so that WestConnect could coordinate the ITP evaluation process with all other Relevant Planning Regions.

WestConnect received the following ITP submittals for the 2022-23 Planning Process:

- North Gila – Imperial Valley #2

Details for each ITP submittal can be found on the Interregional Coordination webpage. WestConnect does not evaluate ITP submittals until regional transmission needs are identified. If regional needs are identified, then the ITPs have an opportunity to indicate which need they would seek to address, and the ITP would be studied alongside any other regional project submittals. However, since there were no regional transmission needs identified by WestConnect in the 2022-23 Planning Process, the submitted ITPs were not studied in this planning cycle.

9. Scenario Studies

Members or stakeholders propose scenarios for consideration in the WestConnect planning process through an open submittal window, as outlined in the WestConnect Business Practice Manual. WestConnect held the open window from December 1, 2021, through January 3, 2022. Several proposed scenarios were received as shown in **Table 18** below.

Table 18 Scenarios Received During Open Window for the 2022-23 Study Plan

Requestor	Description/Name
Clean Energy Advocate (CEA)	Updated clean energy targets and requirements (2032)
CEA	Thermal retirements (2032)
CEA	Electrification (2032)
CEA	Transmission line sensitivity analysis (2032)
CEA	20-year economy wide plan (2042)
CEA	Market sensitivity analysis (2032)
Lucky Corridor	New Mexico Renewable Energy Transmission (NM RETA) Export 2032
Ron Belval	Carbon Neutral Phase 1: 2032 Gap Analysis
Ron Belval	Carbon Neutral Phase 2: Carbon Neutral Study in WestConnect 2024-25 Cycle (2035, 2045, 2050 or other horizon models)
Xcel Energy	Carbon Free 2050
Xcel Energy	DC Macro Grid 2032
Xcel Energy	New Western Market Study 2032

The proposals were reviewed by the PS on January 11, 2022. A representative for each scenario request provided a presentation to the PS to summarize the request and answer questions. The PS also made attempts to consolidate the requests. Following the meeting, the PS conducted a survey to collect feedback from members on their preferred scenarios. During the PS meetings on January 25, 2022, and February 8, 2022, the PS reviewed member feedback and further discussed the scenarios and the number of scenarios that would be appropriate to study. The conversation led to the development of the single, High Clean Energy Penetration Scenario (Scenario). The PS agreed that the scenario assessment would involve both an economic, and a reliability study. The High Clean Energy Penetration Scenario was approved for inclusion and study by the WestConnect PMC for the 2022-2023 WestConnect Regional Planning Cycle and documented in the 2022-23 Study Plan.

9.1 Scenario Assessment

The purpose of the High Clean Energy Penetration Scenario Study was to evaluate the regional congestion in and reliability of a 2032 future in which the renewable and clean energy target-focused Public Policy Requirements[15] are satisfied within the WestConnect footprint. Another goal of the Scenario was to understand the gap between this future and a future in which the WestConnect footprint is carbon free.

The study began by updating the assumptions within the Base economic model in order to develop a scenario that would reasonably satisfy the renewable and clean energy target-focused Public Policy Requirements applicable to year 2032 as confirmed by TOLSO Members. Next, a reliability model was developed based on the renewable resource additions submitted for the economic modeling.

The economic assessment was performed using the same method as the Base economic assessment. Second, a reliability assessment was performed using the same steady state contingency analysis as the Base Regional Reliability Assessment.

As part of the economic assessment, a "carbon free gap analysis" was performed, based on the results of the economic assessment, which involved an accounting of the carbon emissions attributed to the WestConnect footprint in the 2032 High Clean Energy Penetration scenario to approximate the amount of further carbon reduction that would be necessary to make the WestConnect footprint carbon free by 2032.

9.1.1 Economic Assessment

As with the regional Base economic results, the Scenario economic results are separated into different groupings which include Multiple WestConnect entities, Possible Multiple WestConnect entities, and Single WestConnect entities, Multi-Regional. There were some congestion issues observed in the Scenario that were not present in the Base results. Also, there were some issues in the Base results that were not observed in the Scenario. Specifically, the Scenario exhibited significantly higher congestion on the TOT 1A Interface and the Story – Pawnee 230 kV line. Both of these interfaces showed 22% annual congestion in the Scenario results, but were less than 1% in the Base results. Both of these interfaces are Colorado transmission connections, or "seams", with other subregions in WestConnect and may be due to the addition of renewables in Colorado. **Table 19** shows the scenario congestion results.

9.1.2 Economic Sensitivity

During the preliminary scenario assessment runs, congestion was observed on local transmission elements. Specifically, some new renewable generation resulted in loading transformation needed to deliver that power to the higher voltage network. The PS agreed to evaluate a sensitivity to determine how mitigation of those local issues would impact the overall results. The sensitivity removed the constraints due to the transformation. The results showed that the local congestion issues were mitigated, which allowed more energy from those resources. However, there was minimal impact to overall regional-type congestion as shown in **Table 20**.

[15] *Exclusions will include, but are not limited to, requirements to join an organized market, requirements for energy efficiency or demand response, or requirements for electric vehicles. Members will review each Public Policy Requirement and decide the appropriate inclusions and exclusions*

Table 19 Scenario Congestion Results

Entities Involved	Line / Interface	Base Congestion Hours (% Hrs) / Cost (K$)	Scenario Congestion Hours (% Hrs) / Cost (K$)
LADWP|NorthernGrid|IPA	Intermountain - Mona 345kV Line #1-2	63 (0.72%) / $3.434	123 (1%) / $1,570
LADWP|IPA	Path 27 IPP DC Line Interface	1,243 (14%) / $5,132	1,192 (14%) / $5,327
TSGT|WAPA-RMR	Path 30 TOT 1A Interface	20 (0.23%) / $913	1,961 (22%) / $36,608
LADWP|IPA|NorthernGrid	Path 32 Pavant-Gonder IntMtn-Gonder 230 kV Interface	3 (0.03%) / $204	N/A
TSGT|PSCO|WAPA-RMR|BEPC	Path 36 TOT 3 Interface	1 (0.01%) / $16	N/A
LADWP|CAISO	Path 41 Sylmar to SCE Interface	8 (0.09%) / $35	N/A
PNM|TSGT	Path 48 Northern New Mexico (NM2) Interface	61 (0.7%) / $1,102	45 (0.51%) / $919
LADWP|CAISO	Path 61 Lugo-Victorville 500 kV Line Interface	56 (0.64%) / $2,080	20 (0.23%) / $322
BEPC|TSGT	Dave John – LRS Line #1	2 (0.02%)/ $0.57	95 (1%) / $838
PSCO|TSGT	Story – Pawnee 230 kV	1 (0.01%) / $7	1,920 (22%) / $38,731

Table 20 Sensitivity Congestion Results

Entities Involved	Line / Interface	Scenario Congestion Hours (% Hrs) / Cost (K$)	Sensitivity Congestion Hours (% Hrs) / Cost (K$)
LADWP|NorthernGrid|IPA	INTERMT - MONA 345kV Line #1-2	123 (1%) / $1,570	122 (1%) / $5,976
LADWP|IPA	Path 27 IPP DC Line Interface	1,192 (14%) / $5,327	1,257 (14%) / $4,799
TSGT|WAPA-RMR	Path 30 TOT 1A Interface	1,961 (22%) / $36,608	1,997 (23%) / $36,373
LADWP|IPA|NorthernGrid	Path 32 Pavant-Gonder IntMtn-Gonder 230 kV Interface	N/A	N/A
TSGT|PSCO|WAPA-RMR|BEPC	Path 36 TOT 3 Interface	N/A	N/A
LADWP|CAISO	Path 41 Sylmar to SCE Interface	N/A	N/A
PNM|TSGT	Path 48 Northern New Mexico (NM2) Interface	45 (0.51%) / $919	44 (0.50%) / $876
LADWP|CAISO	Path 61 Lugo-Victorville 500 kV Line Interface	20 (0.23%) / $322	20 (0.23%) / $315
BEPC|TSGT	Dave John – LRS Line #1	95 (1%) / $838	98 (1%) / $884
PSCO|TSGT	Story – Pawnee 230 kV	1,920 (22%) / $38,731	2,147 (25%) / $45,611

9.1.3 Economic Study Results

WestConnect members agreed that the economic portion of the scenario assessment demonstrated that the regional congestion would not be adversely impacted if renewable resources were in place to meet clean energy target-focused Public Policy Requirements in a 2032 future condition. At the June 20, 2023, PS meeting, members agreed that the economic assessment portion of the scenario could be considered complete. There were no objections from the PMC at their June 21, 2023, meeting. The PMC agreed that the resources provided for the economic assessment could be utilized for the reliability portion of the assessment.

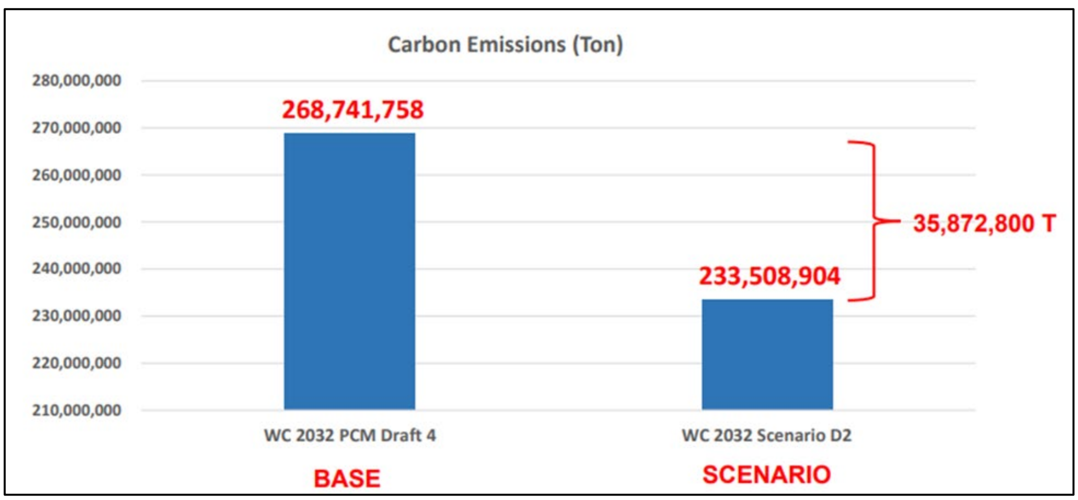
9.1.4 Carbon Gap Analysis

The GridView software program tracks three types of emissions in Short Tons (T): sulfur dioxide (SO2), nitrogen oxides (NOx), and carbon dioxide (CO2). The approximately 30,000 MW of additional resources that were added to the scenario economic model reduced the CO2 by about 13%. Table 21 below shows the reduction in SO2, NOx, and CO2. The reduction is also depicted in **Figure 10** below.

Table 21 Carbon and other emission levels

CASE:	SO2 Amt (Short Ton)	NOx Amt (Short Ton)	CO2 Amt (Short Ton)
WC 2032 PCM Base	223,008	310,606	268,741,758
WC 2032 Scenario	192,642	269,268	233,508,904

Figure 10 Carbon Gap Analysis



9.1.5 Reliability Assessment

9.1.5.1 Reliability Study Methodology

The scenario reliability assessment was performed using methodology consistent with the reliability needs assessment, and based on reliability standards adopted by the North American Electric Reliability Corporation (NERC) and WECC Standards and Criterion, and supplemented with any more stringent TOLSO member criterion. 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 above 90-kV in the reliability models were monitored. Members agreed that transient stability analysis was not necessary.

Prior to initiating the reliability assessment, the PS discussed specific issues with the scenario and developed a more definitive scope for the analysis. Several aspects of the study required additional details as discussed below.

9.1.5.2 Case Development

The Study Plan did not specifically state how the reliability modeling should be performed, other than the reliability of the scenario would be evaluated using the same contingency analysis as the Regional Reliability Assessment. The Planning Subcommittee discussed two options. One would be to utilize the regional reliability models, and the other would be to explore the export of certain hours from the production cost model used for the scenario. The PS consensus was to utilize the base reliability model. Members agreed to provide information as to how to dispatch the new resources as well as where to sink that generation using existing resources.

9.1.5.3 Generation Dispatch

The Planning Subcommittee discussed whether new resources should be dispatched at nameplate, similar to how resources are modeled in Large Generation Interconnection Procedure processes, or if they should be dispatched at lower output levels, similar to how they are generally modeled in the regional base models. Modeling at higher levels could lead to more transmission stress and provide members with information regarding what network upgrades might be needed for those types of conditions. Additionally, the higher stress conditions and potential transmission solutions could provide beneficial information for WestConnect stakeholders. However, the higher output could result in a need for subregional exports between balancing areas within the WestConnect footprint. Since multiple entities could require the need for export, there would likely be a need for multiple reliability models, the creation of which would add complexity into the development and coordination among members. Also, some members expressed reluctance to evaluate stress conditions that result from uncertain resource levels and placement. The Planning Subcommittee consensus was to allow members to dispatch the new resources at lower than nameplate levels and be consistent with how they modeled renewable generation in the base reliability models. Members could model the new generation at higher levels at their discretion.

9.1.5.4 Subregional vs. Regional Study

The PS considered evaluating the reliability portion of the scenario assessment on a subregional basis. Since there was a significant amount of generation that needed to be added, it could be beneficial to break the WestConnect region into smaller subregions to accommodate those resources and allow for power transfers between the subregions. However, since the PS agreed that the new generation resources could be dispatched at lower than nameplate levels, members felt that they could redispatch existing resources without having to export to other areas. That methodology eliminated the need to divide the region into subregions.

9.1.5.5 Reliability Modeling Seasonal Conditions

Members also discussed whether light spring conditions should also be evaluated in addition to the heavy summer conditions. Since both conditions were studied for the base regional assessment, there would be some consistency with the scenario study. Studying both conditions could also provide additional insight into how the system might be stressed under different conditions. However, since a light load model would have lower output of existing thermal generation, the redispatch required to accommodate the new resources would likely lead to export conditions for certain entities, leading back to the need for multiple subregional models. As a result, the PS decided to focus on a heavy summer model for the scenario study.

9.1.6 Reliability Study Results

Once members agreed to the specific methodology considerations described above, the resources that were added to the economic model were included into the 2032 Heavy Summer Base Case to create the 2032 Scenario Reliability Case. Each affected member provided specific dispatch information for the renewable resources added to the reliability model, including the output level of each resource, and how to reduce existing units to balance the generation from the new resources.

The scenario reliability assessment indicated that there were no regional-type reliability issues associated with the High Clean Energy Penetration Scenario Study.

WestConnect members agreed that the assessment demonstrated that the WestConnect region could maintain system reliability, even if renewable generation is added by 2032 to satisfy known Public Policy Requirements. At the September 19, 2023, PS meeting, members agreed that the reliability assessment portion of the scenario could be considered complete. There were no objections from the PMC at their September 20, 2023, meeting.

9.2 Scenario Summary

In summary, the High Clean Energy Penetration Scenario demonstrated that the WestConnect member system could accommodate the additional resources required to meet public policy goals and objectives. Neither the economic study nor the reliability study indicated any regional-type issues.

Appendix A – 2022-23 Regional Transmission Plan[16]

The tables below include the planned projects in the 2022-23 Regional Transmission Plan, organized by Subregional Planning Group (SPG).

SWAT Base Transmission Plan Projects for 2022-23 Regional Planning Cycle

Sponsor	Project Name	Development Status as of February 2022	Voltage	In 2020-21 Regional Transmission Plan?	In-Service Date
Arizona Electric Power Cooperative	Marana Substation Capacitor Bank	Planned	115 kV	Yes	2024
Arizona Electric Power Cooperative	Marana Substation Rebuild	Planned	115 kV	No	2024
Arizona Public Service	Avery 230/69kV Substation	Planned	230 kV	No	2022
Arizona Public Service	Broadway 230kV Lines	Planned	230 kV	Yes	2024
Arizona Public Service	Chevelon Butte Wind Generation Tie Line Project	Planned	345 kV	No	2023
Arizona Public Service	Contrail 230kV Lines	Planned	230 kV	Yes	2024
Arizona Public Service	Jojoba-Rudd or TS21 500 kV Line	Planned	500 kV AC	No	2028
Arizona Public Service	North Gila - Orchard 230kV Line	Planned	230 kV	Yes	2022
Arizona Public Service	Relocation of the Morgan-Pinnacle Peak 230kV and 500 kV Lines	Planned	500 kV AC	No	2022
Arizona Public Service	Runway 230kV Lines	Planned	230 kV	No	2022
Arizona Public Service	Runway Additional 230kV Lines	Planned	230 kV	No	2024
Arizona Public Service	Stratus 230kV Lines	Planned	230 kV	Yes	2022
Arizona Public Service	Three Rivers 230kV Transmission Line Project	Planned	230 kV	Yes	2024
Arizona Public Service	TS17 230kV Lines	Planned	230 kV	Yes	2025
Arizona Public Service	TS2 230kV Lines	Planned	230 kV	Yes	2024
Arizona Public Service	TS22 500 and 230kV Lines	Planned	500 kV AC	No	2024
El Paso Electric Company	Add 345 kV ring bus to VADO substation. Split Newman 345 kV to Afton_N 345 kV line tapping in-and-out to VADO 345 kV bus.	Planned	345 kV	Yes	2030

[16] *The project information provided in Appendix A is dated March 18, 2020, the approval date of the WestConnect 2022-23 Regional Study Plan.*

Sponsor	Project Name	Development Status as of February 2022	Voltage	In 2020-21 Regional Transmission Plan?	In-Service Date
El Paso Electric Company	Afton North (Two) 224 MVA 345/115 kV Autotransformers (New)	Planned	345 kV	No	2025
El Paso Electric Company	Afton North-Airport 115 kV Line (New)	Planned	115 kV	No	2025
El Paso Electric Company	Afton North-Vado 115 kV Double Bundled Line (New)	Planned	115 kV	No	2026
El Paso Electric Company	Afton-Afton North 345 kV Double Bundled Line (New)	Planned	345 kV	No	2025
El Paso Electric Company	Apollo-Cox Line 69 kV to 115 kV (Moongate-Apollo Portion - Rebuild)	Planned	115 kV	No	2024
El Paso Electric Company	Arroyo-Cox 69 kV to 115 kV (Arroyo-Moongate Portion - Reconductor)	Planned	115 kV	No	2023
El Paso Electric Company	Caliente-MPS 16700 115 kV Line (Reconductor)	Planned	115 kV	No	2027
El Paso Electric Company	CE2 Capacitor Banks (New)	Planned	115 kV	No	2025
El Paso Electric Company	CE-2 Substation (New) and Related 115 kV West Loop Line Reconfiguration	Planned	115 kV	No	2025
El Paso Electric Company	CE-3 Substation (New) and Related 115 kV West Loop Line Reconfiguration	Planned	115 kV	No	2027
El Paso Electric Company	CE4 Capacitor Banks (New)	Planned	115 kV	No	2027
El Paso Electric Company	CE-4 Substation (New) and Related 115 kV West Loop Line Reconfiguration	Planned	115 kV	No	2027
El Paso Electric Company	Coyote-Pine 115 kV Line (Reconductor)	Planned	115 kV	No	2026
El Paso Electric Company	In-and-Out into Otero 345 kV and In-and-Out into Picante 345 kV Substation from Caliente-Amrad 345 kV Line (Amrad to Otero)	Planned	345 kV	No	2023
El Paso Electric Company	In-and-Out into Otero 345 kV and In-and-Out into Picante 345 kV Substation from Caliente-Amrad 345 kV Line (Otero to Picante)	Planned	345 kV	No	2023
El Paso Electric Company	In-and-Out into Otero 345 kV and In-and-Out into Picante 345 kV Substation from Caliente-Amrad 345 kV Line (Picante to Caliente)	Planned	345 kV	No	2023

Sponsor	Project Name	Development Status as of February 2022	Voltage	In 2020-21 Regional Transmission Plan?	In-Service Date
El Paso Electric Company	In-and-Out into Vado 345 kV Substation from Afton North-Newman 345 kV Line	Planned	345 kV	No	2026
El Paso Electric Company	Jornada-Arroyo 115 kV Line (Reconductor/Rebuild)	Planned	115 kV	No	2024
El Paso Electric Company	Leasburg Capacitor Banks (New)	Planned	115 kV	No	2026
El Paso Electric Company	Leasburg Substation	Planned	115 kV	No	2026
El Paso Electric Company	McCombs Substation (New) and Related 115 kV Line Reconfiguration	Planned	115 kV	No	2023
El Paso Electric Company	Move Sparks 115/69 kV autotransformer to Felipe substation	Planned	115 kV	Yes	2024
El Paso Electric Company	New Amrad SVC/STATCOM device connecting on high-voltage side to Amrad 345 kV side using its own dedicated step-up step up transformer.	Planned	345 kV	No	2026
El Paso Electric Company	NW2 (Verde) Substation 50 MVA Transformer	Planned	115 kV	Yes	2026
El Paso Electric Company	Patriot Substation Transformer (T2) Addition	Planned	115 kV	Yes	2023
El Paso Electric Company	Pine Switching Station 115 kV (New)	Planned	115 kV	No	2026
El Paso Electric Company	Pine-Seabeck 115 kV Line (New)	Planned	115 kV	No	2026
El Paso Electric Company	Pipeline Substation 2x50 MVA Transformer Additions	Planned	115 kV	Yes	2021
El Paso Electric Company	San Felipe Capacitor Banks (New)	Planned	115 kV	No	2025
El Paso Electric Company	San Felipe Substation 115/69 kV (New)	Planned	115 kV	No	2025
El Paso Electric Company	Seabeck Switching Station 115 kV (New)	Planned	115 kV	No	2025
El Paso Electric Company	Seabeck-Horizon 115 kV Line (New)	Planned	115 kV	No	2025
El Paso Electric Company	Seabeck-San Felipe 115 kV Line (New)	Planned	115 kV	No	2024
El Paso Electric Company	Sparks-San Felipe Line (Conversion/Reconductor) 69 kV to 115 kV	Planned	115 kV	No	2026
El Paso Electric Company	Uvas Substation 24 MVA Transformer Addition	Planned	115 kV	Yes	2030
El Paso Electric Company	Vado 224 MVA Vado 345/115 kV Autotransformer (New)	Planned	345 kV	No	2026
El Paso Electric Company	Vado Substation 115 kV (New)	Planned	115 kV	No	2026

Sponsor	Project Name	Development Status as of February 2022	Voltage	In 2020-21 Regional Transmission Plan?	In-Service Date
El Paso Electric Company	Vado-Anthony 115 kV Line Double Bundled (Reconductor)	Planned	115 kV	No	2027
El Paso Electric Company	Vado-Salopek 115 kV Double Bundled Line (Reconductor)	Planned	115 kV	No	2027
Imperial Irrigation District	92kV “R” Line Network Upgrades	Planned	Below 115 kV	Yes	2023
Imperial Irrigation District	Path 42 RAS Revision and Rating Increase	Planned	230 kV	No	2023
Los Angeles Department of Water and Power	Add voltage support at Toluca Station	Planned	230 kV	Yes	TBD
Los Angeles Department of Water and Power	Adelanto-Rinaldi Line 1 Clearance Mitigation	Planned	500 kV AC	No	2025
Los Angeles Department of Water and Power	Apex-Crystal Transmission Line	Planned	500 kV AC	Yes	2024
Los Angeles Department of Water and Power	Barren Ridge Voltage Support	Planned	230 kV	Yes	2022
Los Angeles Department of Water and Power	Clearance Mitigation Upgrade for Adelanto-Toluca Line 1	Planned	500 kV AC	No	2026
Los Angeles Department of Water and Power	Clearance Mitigation Upgrade for Victorville Rinaldi Line 1	Planned	500 kV AC	No	2023
Los Angeles Department of Water and Power	Haskell Bank H (PP1-Haskell L1)	Planned	230 kV	Yes	2022
Los Angeles Department of Water and Power	McCullough-Victorville series cap upgrade	Planned	500 kV AC	Yes	2024
Los Angeles Department of Water and Power	New Receiving Station X (LAX)	Planned	230 kV	Yes	2023
Los Angeles Department of Water and Power	New Rosamond Station	Planned	230 kV	Yes	2025
Los Angeles Department of Water and Power	Reconductor Barren Ridge - Haskell Canyon 230 kV Line 1	Planned	230 kV	Yes	TBD
Los Angeles Department of Water and Power	Re-conductor Rinaldi-Tarzana 230kV Line 1 & 2	Planned	230 kV	Yes	2024

Sponsor	Project Name	Development Status as of February 2022	Voltage	In 2020-21 Regional Transmission Plan?	In-Service Date
Los Angeles Department of Water and Power	Re-conductor Valley-Toluca 230 kV Lines 1&2	Planned	230 kV	Yes	TBD
Los Angeles Department of Water and Power	Scattergood-Olympic Cable B	Planned	230 kV	Yes	2022
Los Angeles Department of Water and Power	Tarzana-Olympic 1A & 1B 138 kV conversion to 230 kV	Planned	230 kV	Yes	2025
Los Angeles Department of Water and Power	Upgrade Circuit Breakers at Victorville 500kV	Planned	500 kV AC	No	2023
Los Angeles Department of Water and Power	Upgrade Lugo-Victorville Line 1 & terminal equipment	Planned	500 kV AC	Yes	2024
Los Angeles Department of Water and Power	Upgrade Toluca-Hollywood Line 1 Underground Cable	Planned	230 kV	No	2025
Public Service Company of New Mexico	Belen Phase Shifting Transformer	Planned	115 kV	No	2023
Public Service Company of New Mexico	Dagger Point Switching Station	Planned	345 kV	No	2023
Public Service Company of New Mexico	Rio Puerco Switching Station update for Proxy RPS	Planned	345 kV	Yes	2027
Salt River Project	Abel - Pfister - Ball 230kV	Planned	230 kV	No	2023
Salt River Project	Browning 500/230 kV Transformer 3	Planned	500 kV AC	No	2024
Salt River Project	Browning 500/230 kV Transformer 4	Planned	500 kV AC	No	2027
Salt River Project	Coolidge - Hayden Reroute 115kV	Planned	115 kV	Yes	2024
Salt River Project	Coolidge Expansion Project	Planned	500 kV AC	No	2024
Salt River Project	High-Tech Interconnect Project (HIP)	Planned	230 kV	No	2024
Salt River Project	Palo Verde – Hassayampa 18 ohm series reactor addition on each of the three lines	Planned	500 kV AC	Yes	2023
Salt River Project	Project Huckleberry	Planned	230 kV	No	2024
Salt River Project	Reconductor Anderson - Kyrene 230 kV	Planned	230 kV	No	2027
Salt River Project	Reconductor Corbell - Santan 230 kV	Planned	230 kV	No	2027
Salt River Project	Reconductor Orme - Rudd 230 kV #1	Planned	230 kV	No	2027

Sponsor	Project Name	Development Status as of February 2022	Voltage	In 2020-21 Regional Transmission Plan?	In-Service Date
Salt River Project	Reconductor Orme - Rudd 230 kV #2	Planned	230 kV	No	2027
Salt River Project	Red Hawk 230kV	Planned	230 kV	No	2023
Salt River Project	Southeast Power Link	Planned	230 kV	Yes	2023 (Ph1), 2027 (Ph2)
Salt River Project	Superior - Silver King 115kV Reroute	Planned	115 kV	Yes	2027
Tri-State Generation and Transmission Association	Breaker Addition at Escalante Substation	Planned	230 kV	Yes	2023
Tri-State Generation and Transmission Association	Frontier Reactor Addition	Planned	115 kV	Yes	2023
Tri-State Generation and Transmission Association	Hernandez 115/69kV T2 Transformer Replacement	Planned	115 kV	Yes	2024
Tucson Electric Power	500/345kV Transformer addition at Pinal West	Planned	500 kV AC	No	2022
Tucson Electric Power	500/345kV Transformer addition at Westwing	Planned	500 kV AC	No	2022
Tucson Electric Power	Bopp-Donald 138/13.8kV Substation	Planned	138 kV	No	2026
Tucson Electric Power	Bopp-Donald to Midvale 138kV line	Planned	138 kV	No	2027
Tucson Electric Power	Catron 345/34.5 kV Substation	Planned	345 kV	Yes	2022
Tucson Electric Power	Catron Loop-in to Springerville-Greenlee 345 kV line	Planned	345 kV	Yes	2023
Tucson Electric Power	Corona 138/13.8 kV Substation	Planned	138 kV	Yes	2029
Tucson Electric Power	Cottonwood to Bopp-Donald 138kV line	Planned	138 kV	No	2026
Tucson Electric Power	Craycroft-Barril 138/13.8 kV Substation	Planned	138 kV	Yes	2027
Tucson Electric Power	DMP 138 kV, Conversion to breaker-and-a-half substation	Planned	138 kV	Yes	2024
Tucson Electric Power	DMP 230/138kV Transformers	Planned	230 kV	No	2025
Tucson Electric Power	DMP to Vail 230kV line	Planned	230 kV	No	2027
Tucson Electric Power	East Loop 138kV Conversion to breaker-and-a-half substation	Planned	138 kV	No	2027
Tucson Electric Power	Golden Valley 230kV Transmission Line	Planned	230 kV	No	2027
Tucson Electric Power	Greenlee Capacitor Additions	Planned	345 kV	Yes	2023
Tucson Electric Power	Greenlee Loop-in to Springerville-Vail 345 kV line	Planned	345 kV	Yes	2023

Sponsor	Project Name	Development Status as of February 2022	Voltage	In 2020-21 Regional Transmission Plan?	In-Service Date
Tucson Electric Power	Hartt 138/13.8 kV Substation	Planned	138 kV	Yes	2024
Tucson Electric Power	Irvington - East Loop 138 kV Transmission Line	Planned	138 kV	Yes	2022
Tucson Electric Power	Kantor Capacitor Bank Addition for Hermosa	Planned	138 kV	No	2023
Tucson Electric Power	Lago Del Oro 138/13.8 kV Substation	Planned	138 kV	Yes	2028
Tucson Electric Power	Marana 138/13.8 kV Substation	Planned	138 kV	Yes	2024
Tucson Electric Power	Marana 138-kV Transmission Line	Planned	138 kV	Yes	2024
Tucson Electric Power	Naranja 138/13.8 kV Substation	Planned	138 kV	Yes	2028
Tucson Electric Power	Naranja Capacitor Bank Addition	Planned	138 kV	Yes	2028
Tucson Electric Power	New 138kV line North Loop to Naranja to La Canada	Planned	138 kV	Yes	2028
Tucson Electric Power	New 230kV Yard at DMP Substation	Planned	230 kV	No	2025
Tucson Electric Power	New 230kV Yard at Tortolita Substation	Planned	230 kV	No	2025
Tucson Electric Power	New 230kV Yard at Vail Substation	Planned	230 kV	No	2027
Tucson Electric Power	Olsen 138/13.8 kV Substation	Planned	138 kV	Yes	2030
Tucson Electric Power	Orange Grove Capacitor Bank Addition	Planned	138 kV	No	2025
Tucson Electric Power	Patriot 138/13.8 kV Substation	Planned	138 kV	Yes	2022
Tucson Electric Power	Rancho Vistoso - Lago Del Oro 138kV Line	Planned	138 kV	Yes	2028
Tucson Electric Power	Rillito 138kV Conversion to breaker-and-a-half substation	Planned	138 kV	No	2025
Tucson Electric Power	Rio Rico 138kV Switchyard	Planned	138 kV	Yes	2023
Tucson Electric Power	Rio Rico Capacitor Bank Addition	Planned	138 kV	Yes	2023
Tucson Electric Power	Sears Wilmot 138/13.8 kV Substation	Planned	138 kV	Yes	2025
Tucson Electric Power	Springerville-Catron 345 kV Circuits 1 and 2 Uprate	Planned	345 kV	Yes	2023
Tucson Electric Power	TEPTDA 138kV Substation	Planned	138 kV	No	2027
Tucson Electric Power	Tortolita 500/230kV Transformers	Planned	500 kV AC	No	2025
Tucson Electric Power	Tortolita to DMP 230kV line	Planned	230 kV	No	2025
Tucson Electric Power	Vail 345/230kV Transformers	Planned	345 kV	No	2027
Tucson Electric Power	Vine 138/13.8 kV Substation (was UA North)	Planned	138 kV	Yes	2024

Sponsor	Project Name	Development Status as of February 2022	Voltage	In 2020-21 Regional Transmission Plan?	In-Service Date
Tucson Electric Power	Whetstone 138kV Substation	Planned	138 kV	No	2022
Tucson Electric Power	Winchester to Vail 345kV line uprate	Planned	345 kV	Yes	2023
Western Area Power Administration - DSW	Bouse – Kofa	Planned	161 kV	Yes	2025
Western Area Power Administration - DSW	Dome Tap-Gila	Planned	161 kV	Yes	2022
Western Area Power Administration - DSW	Kofa – Dome Tap	Planned	161 kV	Yes	2025
Western Area Power Administration - DSW	Parker – Blythe	Planned	161 kV	No	2026

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CCPG Base Transmission Plan Projects for 2022-23 Regional Planning Cycle

Sponsor	Project Name	Development Status as of February 2022	Voltage	In 2020-21 Regional Transmission Plan?	In-Service Date
Black Hills Energy	Rodriguez 115/13.2 kV Distribution Substation	Planned	115 kV	Yes	2023
Black Hills Energy	West Station - Hogback 115kV	Planned	115 kV	Yes	2023
Black Hills Power	Lookout - Wyodak 230 kV rebuild.	Planned	230 kV	Yes	2022
Black Hills Power	Rapid City DC Tie RAS Redesign	Planned	230 kV	Yes	TBD prior to 2026
Cheyenne Light Fuel and Power	Allison Draw - Campstool 115 kV Line	Planned	115 kV	No	TBD prior to 2026
Cheyenne Light Fuel and Power	Allison Draw - CPGS 115 kV Line	Planned	115 kV	No	TBD prior to 2026
Cheyenne Light Fuel and Power	Allison Draw 115 kV Substation	Planned	115 kV	No	TBD prior to 2026
Cheyenne Light Fuel and Power	Bison - Orchard Valley 115 kV Line	Planned	115 kV	No	TBD prior to 2026
Cheyenne Light Fuel and Power	Bison - West Cheyenne 115 kV Line	Planned	115 kV	No	TBD prior to 2026
Cheyenne Light Fuel and Power	Bluffs 230 kV Substation	Planned	230 kV	No	TBD prior to 2026
Cheyenne Light Fuel and Power	Orchard Valley - King Ranch 115 kV Line	Planned	115 kV	No	TBD prior to 2026
Cheyenne Light Fuel and Power	Orchard Valley 115 kV Substation	Planned	115 kV	No	TBD prior to 2026
Cheyenne Light Fuel and Power	Sweetgrass - Bluffs 230 kV Line	Planned	230 kV	No	TBD prior to 2026
Cheyenne Light Fuel and Power	Sweetgrass - South Cheyenne kV 115 kV Line	Planned	115 kV	No	2023
Cheyenne Light Fuel and Power	Sweetgrass 115 kV Substation	Planned	115 kV	No	2023
Cheyenne Light Fuel and Power	Sweetgrass 230 kV Substation	Planned	230 kV	No	TBD prior to 2026

Sponsor	Project Name	Development Status as of February 2022	Voltage	In 2020-21 Regional Transmission Plan?	In-Service Date
Cheyenne Light Fuel and Power	West Cheyenne - Sweetgrass 230 kV Line	Planned	230 kV	No	TBD prior to 2026
Cheyenne Light Fuel and Power	West Cheyenne - Windstar 230 kV Line	Planned	230 kV	No	TBD prior to 2026
Cheyenne Light Fuel and Power	West Cheyenne 230 kV Substation	Planned	230 kV	No	TBD prior to 2026
Colorado Springs Utility	Central System Improvement - Kelker Substation Rebuild - New Kelker-Southplant 115kV Line	Planned	115 kV	No	2026
Colorado Springs Utility	Claremont Transformer	Planned	230 kV	No	2024
Colorado Springs Utility	Flying Horse Flow Mitigation	Planned	115 kV	No	2024
Colorado Springs Utility	Flying Horse Power Transformer	Planned	115 kV	No	2025
Colorado Springs Utility	Kettle Creek 115/12.5kV Power Transformer Addition	Planned	115 kV	No	2023
Colorado Springs Utility	New Horizon Substation and Transformer Addition	Planned	230 kV	No	2023
Colorado Springs Utility	North System Improvement - Briargate Sub Expansion	Planned	230 kV	No	2023
Platte River Power Authority	Drake - Timberline 115kV Line Rebuild	Planned	115 kV	No	2025
Platte River Power Authority	Longs Peak 230/115kV T1 Transformer Replacement	Planned	230 kV	No	2025
Platte River Power Authority	Timberline 230/115kV Transformer T3 Replacement	Planned	230 kV	Yes	2024
Public Service Company of Colorado/ Xcel Energy	Ault-Cloverly Transmission Project	Planned	115 kV	Yes	2024
Public Service Company of Colorado/ Xcel Energy	Avery Substation	Planned	230 kV	Yes	2022
Public Service Company of Colorado/ Xcel Energy	Colorado's Power Pathway	Planned	345 kV	No	2027
Public Service Company of Colorado/ Xcel Energy	Daniels Park to Prairie Reconductor 230kV	Planned	230 kV	No	2023

Sponsor	Project Name	Development Status as of February 2022	Voltage	In 2020-21 Regional Transmission Plan?	In-Service Date
Public Service Company of Colorado/ Xcel Energy	Gilman-Avon 115 kV Transmission Line	Planned	115 kV	Yes	2024
Public Service Company of Colorado/ Xcel Energy	Greenwood - Denver Terminal 230kV transmission line	Planned	230 kV	Yes	2022
Public Service Company of Colorado/ Xcel Energy	Midway Transformer Upgrade	Planned	230 kV	No	2023
Public Service Company of Colorado/ Xcel Energy	Mirasol Switching Station 230kV (Formerly Badger Hills)	Planned	230 kV	Yes	2022
Public Service Company of Colorado/ Xcel Energy	Stagecoach Switching Station	Planned	230 kV	No	2024
Tri-State Generation and Transmission Association	Archer - Stegall Sectionalization Project	Planned	115 kV	No	2024
Tri-State Generation and Transmission Association	Badger Creek - Big Sandy 230 kV	Planned	230 kV	No	2028
Tri-State Generation and Transmission Association	Big Sandy - Burlington 230 kV Uprate	Planned	230 kV	No	2028
Tri-State Generation and Transmission Association	Boone - Huckleberry 230 kV	Planned	230 kV	No	2026
Tri-State Generation and Transmission Association	Breaker Addition at Cahone Substation	Planned	115 kV	Yes	2023
Tri-State Generation and Transmission Association	Breaker Addition at Redtail Substation	Planned	115 kV	No	2022
Tri-State Generation and Transmission Association	Burlington - Burlington (KCEA) 115kV Line Rebuild	Planned	115 kV	Yes	2024
Tri-State Generation and Transmission Association	Burlington - Lamar 230 kV	Planned	230 kV	No	2025
Tri-State Generation and Transmission Association	Cahone - Empire Uprate	Planned	115 kV	No	2023
Tri-State Generation and Transmission Association	Milk Creek Switchyard on Craig-Meeker 345kV line	Planned	345 kV	Yes	2023
Tri-State Generation and Transmission Association	Rolling Hills Substation	Planned	115 kV	Yes	2026

Sponsor	Project Name	Development Status as of February 2022	Voltage	In 2020-21 Regional Transmission Plan?	In-Service Date
Tri-State Generation and Transmission Association	Shaw Ranch Substation	Planned	115 kV	Yes	2026
Tri-State Generation and Transmission Association	Slater Double Circuit Project	Planned	115 kV	No	2024
Tri-State Generation and Transmission Association	Valent Switchyard on Walsenburg - Gladstone 230 kV line	Planned	230 kV	No	2022
Western Area Power Administration - RMR	Blue Mesa	Planned	115 kV	Yes	2026
Western Area Power Administration - RMR	Brush KY1A	Planned	115 kV	No	2025
Western Area Power Administration - RMR	Estes-Flatiron 115-kV rebuild	Planned	115 kV	Yes	2023
Western Area Power Administration - RMR	Glendo Podolak upgrade	Planned	115 kV	No	2024
Western Area Power Administration - RMR	Golden Prairie Sectionalizing	Planned	115 kV	Yes	2027
Western Area Power Administration - RMR	Midway KV1A Replacement	Planned	230 kV	Yes	2022
Western Area Power Administration - RMR	Sand Creek Tap	Planned	115 kV	Yes	2025
Western Area Power Administration - RMR	Stegall Bus Sectionalization	Planned	230 kV	Yes	2025
Western Area Power Administration - RMR	Weld KV1A	Planned	230 kV	No	2023
Western Area Power Administration - RMR	Wiggins KY1A	Planned	115 kV	No	2025

SSPG Base Transmission Plan Projects for 2022-23 Regional Planning Cycle

Sponsor	Project Name	Development Status as of February 2022	Voltage	In 2020-21 Regional Transmission Plan?	In-Service Date
Sacramento Municipal Utility District	Hurley 230 kV bus-tie breaker	Planned	230 kV	Yes	Summer 2023
Sacramento Municipal Utility District	SVEC 230 kV Switching Station	Planned	230 kV	No	Fall 2023

Appendix B – Economic Assessment Results

Branch & Path Congestion

					All Year		
Assumed Grouping	**Entities Involved**	**Branch PF Owner(s)**	**Bus PF Owner(s)**	**Branch or Path Name**	**Avg Flow (MW)**	**Congestion Hours (% Hrs) / Cost (K$)**	**Penalty Cost Cost (K$) / % of Congestion**
Multiple WC Entities	|PNM|TSGT|		PN1 New Mexico|TSGT New Mexico|EPE El Paso Electric Company|Tucson Electric Power|PN2 New Mexico|Arizona Public Service|Tri-State G&T	P48 Northern New Mexico (NM2) Interface	112	61 (0.70%) / 1,102	
	TSGT|WAPA-RMR		WAPA L.M.|DG&T|Tri-State G&T	P30 TOT 1A Interface	113	20 (0.23%) / 913	
	TSGT|PSCO|WAPA-RMR|BEPC		Tri-State G&T|WAPA L.M.|PSColorado|Basin Electric Power Coop.	P36 TOT 3 Interface	464	1 (0.01%) / 16	
	PSCO|TSGT	PSColorado		STORY - PAWNEE 230kV Line #1 (73192_70311_1)	-196	1 (0.01%) / 7	
	BEPC|TSGT|	Basin Electric Power Coop.		DAVEJOHN - LAR.RIVR 230kV Line #1 (65420_73107_1)	-125	2 (0.02%) / 0.57	
Possibly Multiple WC Entities	PSCO|TSGT	PSColorado		STORY - PAWNEE 230kV Line #1 (73192_70311_1)	-196	1 (0.01%) / 7	

Branch & Path Congestion

					All Year		
Assumed Grouping	**Entities Involved**	**Branch PF Owner(s)**	**Bus PF Owner(s)**	**Branch or Path Name**	**Avg Flow (MW)**	**Congestion Hours (% Hrs) / Cost (K$)**	**Penalty Cost Cost (K$) / % of Congestion**
Single WC Entity, Multi-Regional	LADWP|IPA		Intermountain Power Agency	P27 Intermountain Power Project DC Line Interface*	1,128	1,243 (14%) / 5,132	2,772 / 54%
	LADWP|NorthernGrid|IPA	Intermountain Power Agency		INTERMT-MONA 345kV Line Ckt 1&2 (26043_65995_1&2)	-4	63 (0.72%) / 3,434	
	LADWP|CAISO		Southern California Edison|City of Los Angeles	P61 Lugo-Victorville 500 kV Line Interface	667	56 (0.64%) / 2,080	
	LADWP|IPA|NorthernGrid		Intermountain Power Agency|Sierra Pacific Power Co.	P32 Pavant-Gonder InterMtn-Gonder 230 kV Interface	55	3 (0.03%) / 204	
	LADWP|CAISO		City of Los Angeles|Southern California Edison	P41 Sylmar to SCE Interface	-371	8 (0.09%) / 35	
	DG&T|NorthernGrid		PacifiCorp - East|DG&T	P33 Bonanza West Interface	-289	2 (0.02%) / 2	

Member Responses:

Branch or Path Name	Entities Involved	Member Response
P48 Northern New Mexico (NM2) Interface	|PNM|TSGT	The limited number of hours of congestion seen for these interfaces do not indicate a regional need.
P30 TOT 1A Interface	TSGT|WAPA-RMR	This result does not warrant establishing a regional need. The 20 hours or .23% of congestion for TOT1A can be considered noise and is less than previous study cycle results.
P36 TOT 3 Interface	TSGT|PSCO|WAPA-RMR|BEPC	This result does not warrant establishing a regional need. The 1 hour of congestion for TOT3 can be considered noise and is less than previous study cycle results.
STORY - PAWNEE 230kV	PSCO|TSGT	The limited number of hours of congestion seen for these interfaces do not indicate a regional need.
DAVEJOHN - LAR.RIVR 230kV	BEPC|TSGT	The 2 hours of congestion on the LRS-DJ 230kV line does not warrant establishing a regional need

Potential Economic Issues

PS Recommendation

- ➢ A response for each issue was provided by affected entities.
- ➢ No responses indicated a regional need.
- ➢ The PS concurred with the responses provided.

The PS recommends that the economic issues not be considered regional economic needs.

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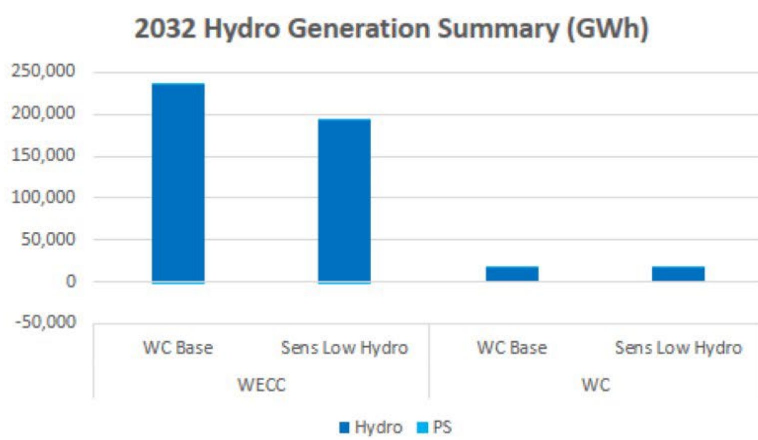
Appendix C - Economic Sensitivities

Low Hydro

- The 2032 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
- WECC developed the associated PCM inputs, which reflect the appropriate energy targets in addition to the hydro system's reactivity to price and load movement when the water supply is lower than normal



Metric	Fleet	Case	Hydro	PS	PS Pump
Generation (GWh)	WECC	WC Base	234,508	1,666	-3,098
		Sens Low Hydro	193,625	1,698	-3,110
	WC	WC Base	16,009	985	-1,516
		Sens Low Hydro	16,298	1,034	-1,551
Capacity (MW)	WECC	WC Base	63,433	4,054	
		Sens Low Hydro	63,433	4,054	
	WC	WC Base	4,991	2,311	
		Sens Low Hydro	4,991	2,311	
Capacity Factor	WECC	WC Base	42.1%	4.7%	-8.7%
		Sens Low Hydro	34.8%	4.8%	-8.7%
	WC	WC Base	36.5%	4.9%	-7.5%
		Sens Low Hydro	37.2%	5.1%	-7.6%

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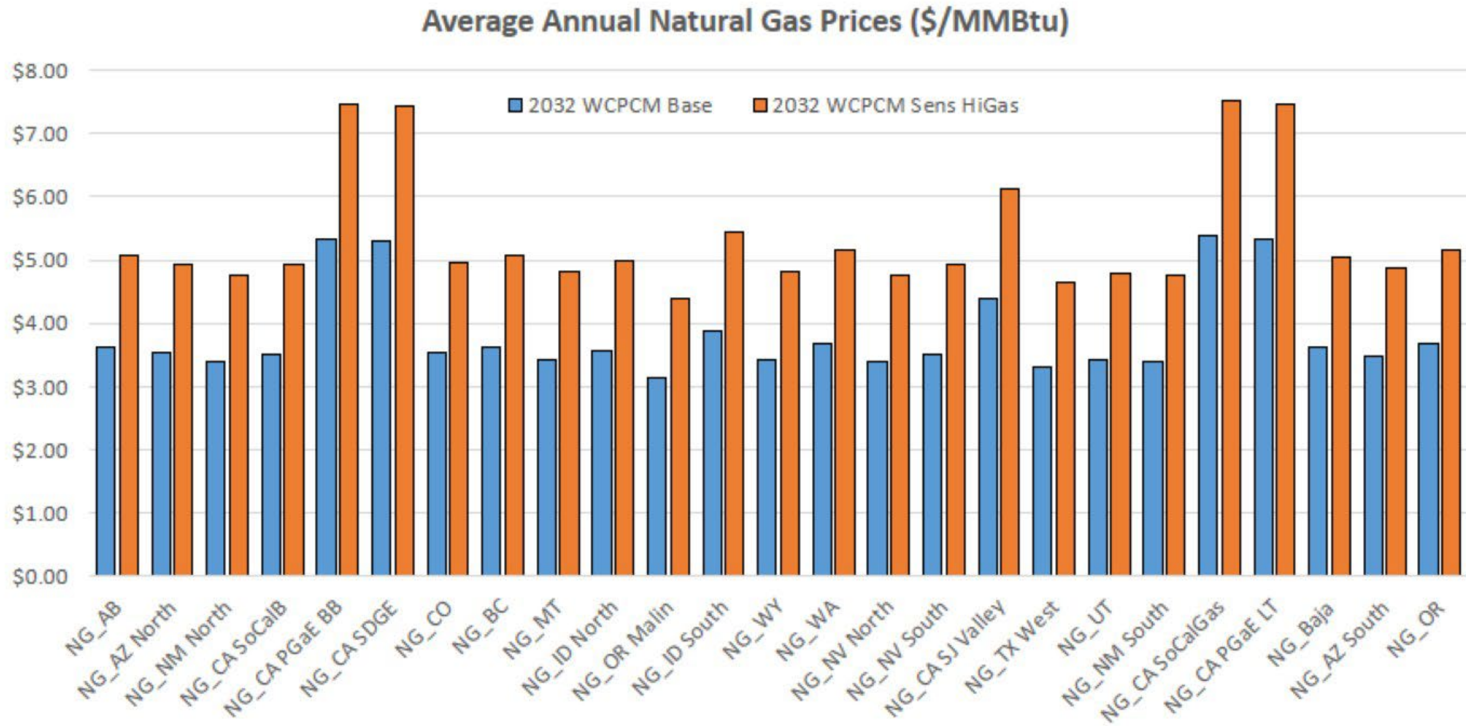
High Gas Prices



- Assumed natural gas prices 40% higher than the base case
  - Base Case annual average gas price: $3.84/MMBtu
  - Sensitivity Case annual average gas price: $5.37/MMBtu

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High Load Forecast

		2032 WCPCM Base		2032 WCPCM sens High Load Forecast			
LoadAreaName	RegionName	Peak (MW)	Energy (GWh)	Peak Inc %	Energy Inc %	Peak (MW)	Energy (GWh)
AZPS	SW_AZPS	8,991	42,945	120%	120%	10,789	51,534
BANC	CA_BANC	5,491	21,074	120%	120%	6,589	25,289
EPE	SW_EPE	2,651	12,240	100%	100%	2,651	12,240
IID	CA_IID	1,319	4,600	120%	120%	1,583	5,520
LDWP	CA_LDWP	10,313	45,250	120%	120%	12,376	54,300
PNM	SW_PNM	3,053	16,860	120%	120%	3,664	20,232
PSCO	RM_PSCO	11,702	54,608	120%	120%	14,042	65,530
SRP	SW_SRP	10,543	46,969	120%	120%	12,652	56,363
TEPC	SW_TEPC	4,136	19,190	105%	105%	4,343	20,149
WACM	RM_WACM	4,794	27,762	120%	120%	5,753	33,314
WALC	SW_WALC	1,863	9,738	120%	120%	2,236	11,686

- Sensitivity case assumed peak loads and annual energy 20% higher than the base case unless member feedback stated otherwise

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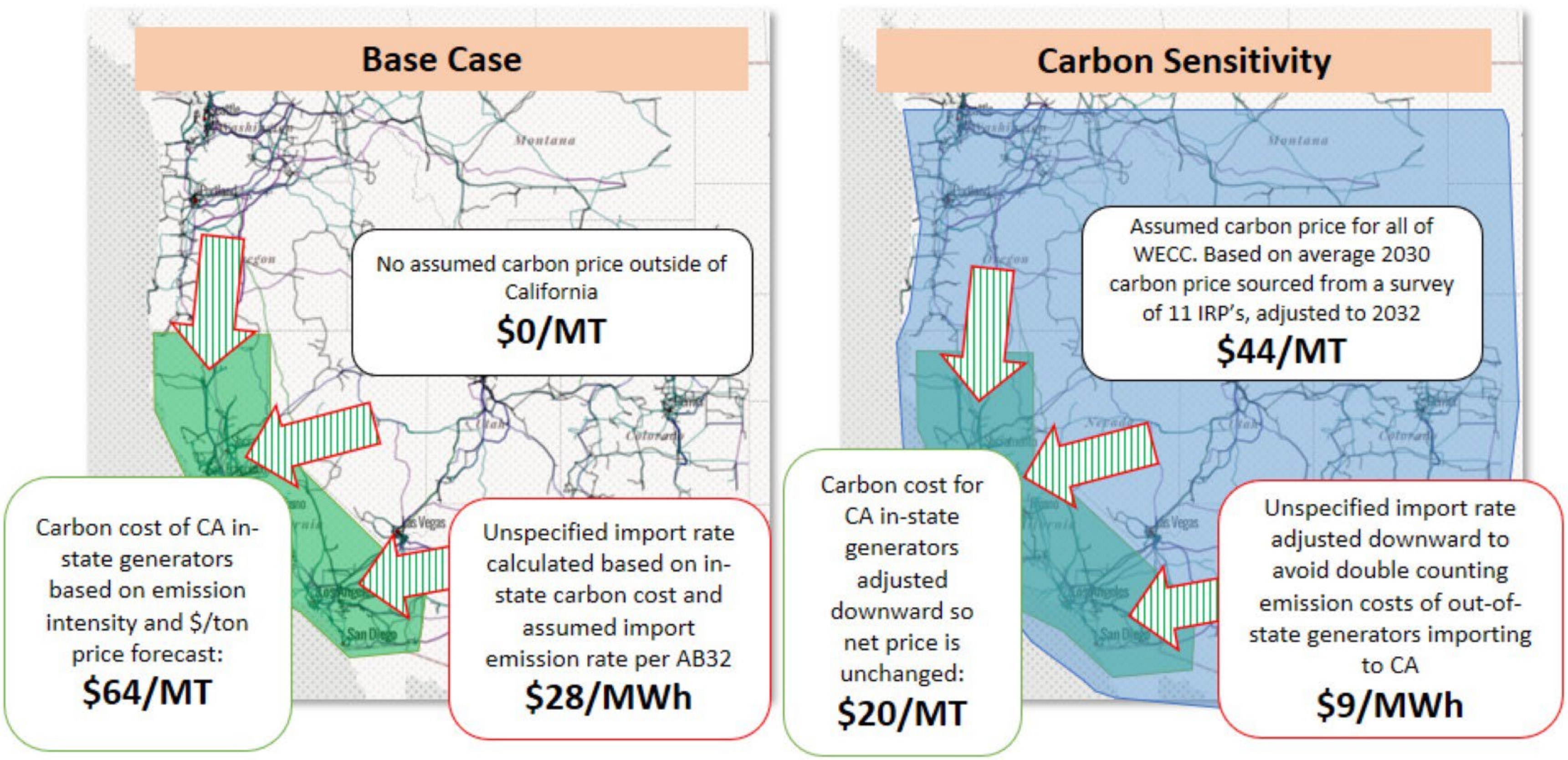
System Carbon Price



CA In-state/Specified Resources:	**$64/MT**	$20/MT + $44/MT = **$64/MT**
CA Imports:	**$64/MT** ($28/MWh)	$20/MT ($9/MWh) + $44/MT = **$64/MT**
WECC System adder:	**$0/MT**	**$44/MT**

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Economic Sensitivities - Congestion

Assumed Grouping	Branch or Path Name	Congestion Hours (% Hrs) / Cost (K$)				
		Base	Low Hydro	High Gas	High Load	System Carbon Price
Multiple WC Entities	P48 Northern New Mexico (NM2) Interface	61 (0.70%) / 1,102	60 (0.68%) / 1,041	53 (0.61%) / 987	8 (0.09%) / 45	58 (0.66%) / 1,387
	P30 TOT 1A Interface	20 (0.23%) / 913	19 (0.22%) / 788	12 (0.14%) / 1,344	248 (3%) / 123,357	5 (0.06%) / 626
	P36 TOT 3 Interface	1 (0.01%) / 16		1 (0.01%) / 32	96 (1%) / 159,513	1 (0.01%) / 68
	DAVEJOHN - LAR.RIVR 230kV Line #1 (65420_73107_1)	2 (0.02%) / 0.57	3 (0.03%) / 4	1 (0.01%) / 8	3 (0.03%) / 1,390	
	P39 TOT 5 Interface				13 (0.15%) / 12,675	
	TRCY PMP-HURLEY S 230kV Line Ckt 1&2 (37585_37010_1&2)		3 (0.03%) / 1,088		25 (0.29%) / 7,170	
	W.RV.CTY - CALAMRDG 138kV Line #1 (79264_79265_1)				1 (0.01%) / 71	
	WESTWNGW - PINPK 230kV Line #1 (14231_19062_1)				7 (0.08%) / 3,736	
Possibly Multiple WC Entities	STORY - PAWNEE 230kV Line #1 (73192_70311_1)	1 (0.01%) / 7	3 (0.03%) / 7	1 (0.01%) / 31		
	DEERVALY - WESTWNGE 230kV Line #1 (14207_14259_1)				14 (0.16%) / 3,255	
	HESPERUS - WATRFLW 345kV Line #1 (79072_79990_1)				11 (0.13%) / 4,420	
	MIDWAYBR - RD_NIXON 230kV Line #1 (73413_78857_1)				4 (0.05%) / 55	
	SAN_JUAN - SANJN PS 345kV Line #1 (10292_79060_1)				12 (0.14%) / 4,396	
	ST.VRAIN - LONGPEAK 230kV Line #1 (70410_78105_1)				2 (0.02%) / 25	
	TRCY PMP-HURLEY S 230kV Line Ckt 1&2 (37585_37010_1&2)		3 (0.03%) / 1,088		25 (0.29%) / 7,170	
Single WC Entity, Multi-Regional	P27 Intermountain Power Project DC Line Interface	1,243 (14%) / 5,132	2,239 (26%) / 7,896	847 (10%) / 3,786	317 (4%) / 1,542	1,520 (17%) / 8,173
	INTERMT-MONA 345kV Line Ckt 1&2 (26043_65995_1&2)	63 (0.72%) / 3,434	290 (3%) / 17,638	75 (0.86%) / 3,511	207 (2%) / 31,930	496 (6%) / 8,465
	P61 Lugo-Victorville 500 kV Line Interface	56 (0.64%) / 2,080	32 (0.37%) / 1,498	42 (0.48%) / 2,311	143 (2%) / 13,286	51 (0.58%) / 2,832
	P32 Pavant-Gonder InterMtn-Gonder 230 kV Interface	3 (0.03%) / 204	5 (0.06%) / 825	2 (0.02%) / 82	20 (0.23%) / 3,366	3 (0.03%) / 273
	P33 Bonanza West Interface	2 (0.02%) / 2	1 (0.01%) / 0.57		3 (0.03%) / 116	
	P41 Sylmar to SCE Interface	8 (0.09%) / 35	6 (0.07%) / 28	10 (0.11%) / 50	267 (3%) / 19,532	21 (0.24%) / 81
	P28 Intermountain-Mona 345 kV Interface				8 (0.09%) / 5,733	
	P29 Intermountain-Gonder 230 kV Interface				10 (0.11%) / 526	
	PHSHFT XOVER - YELLOWTL WST 230kV Line #1 (630041_73632_1)				9 (0.10%) / 2,727	
	Total Multi-TO Congestion ($):	**2,031,988**	**2,921,181**	**2,369,840**	**300,787,318**	**2,080,823**
	Total Single-TO Congestion ($):	**197,607,522**	**336,882,640**	**203,202,098**	**2,289,773,193**	**229,468,694**
	Total Non-WestConnect Congestion ($):	**1,182,675,221**	**1,253,269,842**	**1,302,681,380**	**1,819,432,129**	**1,102,098,354**
	Total Multi-TO Congestion (% Change):		**44%**	**17%**	**14703%**	**2%**
	Total Single-TO Congestion (% Change)):		**70%**	**3%**	**1059%**	**16%**
	Total Non-WestConnect Congestion (% Change)):		**6%**	**10%**	**54%**	**-7%**

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Economic Sensitivities - Congestion

		Avg Flow (MW)				
Assumed Grouping	**Branch or Path Name**	**Base**	**Low Hydro**	**High Gas**	**High Load**	**System Carbon Price**
Multiple WC Entities	P48 Northern New Mexico (NM2) Interface	112	115	123	396	117
	P30 TOT 1A Interface	113	108	96	-29	39
	P36 TOT 3 Interface	464		475	569	303
	DAVEJOHN - LAR.RIVR 230kV Line #1 (65420_73107_1)	-125	-152	-122	-76	
	P39 TOT 5 Interface				221	
	TRCY PMP-HURLEY S 230kV Line Ckt 1&2 (37585_37010_1&2)		141		181	
	W.RV.CTY - CALAMRDG 138kV Line #1 (79264_79265_1)				-16	
	WESTWNGW - PINPK 230kV Line #1 (14231_19062_1)				205	
Possibly Multiple WC Entities	STORY - PAWNEE 230kV Line #1 (73192_70311_1)	-196	-220	-194		
	DEERVALY - WESTWNGE 230kV Line #1 (14207_14259_1)				-195	
	HESPERUS - WATRFLW 345kV Line #1 (79072_79990_1)				-94	
	MIDWAYBR - RD_NIXON 230kV Line #1 (73413_78857_1)				24	
	SAN_JUAN - SANJN PS 345kV Line #1 (10292_79060_1)				94	
	ST.VRAIN - LONGPEAK 230kV Line #1 (70410_78105_1)				265	
	TRCY PMP-HURLEY S 230kV Line Ckt 1&2 (37585_37010_1&2)		141		181	
Single WC Entity, Multi-Regional	P27 Intermountain Power Project DC Line Interface	1,128	847	1,304	1,619	819
	INTERMT-MONA 345kV Line Ckt 1&2 (26043_65995_1&2)	-4	50	-110	-73	601
	P61 Lugo-Victorville 500 kV Line Interface	667	573	749	588	423
	P32 Pavant-Gonder InterMtn-Gonder 230 kV Interface	55	77	55	36	50
	P33 Bonanza West Interface	-289	-262		-207	
	P41 Sylmar to SCE Interface	-371	-310	-393	-600	-402
	P28 Intermountain-Mona 345 kV Interface				-73	
	P29 Intermountain-Gonder 230 kV Interface				8	
	PHSHFT XOVER - YELLOWTL WST 230kV Line #1 (630041_73632_1)				102	

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Economic Sensitivities – Area Summary

Metric	Region	Base	Low Hydro	High Gas	High Load	SysCarb Price	% Change from Base Case: Low Hydro	% Change from Base Case: High Gas	% Change from Base Case: High Load	% Change from Base Case: SysCarb Price
LMP ($/MWh)	AZPS	29.04	29.47	41.00	52.49	52.06	1%	41%	81%	79%
	BANC	64.47	81.58	78.67	120.77	76.92	27%	22%	87%	19%
	EPE	31.00	32.08	43.47	53.22	56.37	3%	40%	72%	82%
	IID	55.79	56.38	67.81	74.84	60.07	1%	22%	34%	8%
	LDWP	64.07	66.87	76.75	108.41	73.35	4%	20%	69%	14%
	PNM	29.81	31.06	41.74	55.37	55.00	4%	40%	86%	84%
	PSCO	34.50	37.09	46.43	93.14	61.05	8%	35%	170%	77%
	SRP	29.54	30.00	41.56	54.81	52.86	2%	41%	86%	79%
	TEPC	29.84	30.50	41.76	52.77	54.44	2%	40%	77%	82%
	WALC	24.99	25.46	36.35	46.13	49.00	2%	45%	85%	96%
	WACM	35.06	38.25	46.89	73.23	63.20	9%	34%	109%	80%
MCC ($/MWh)	AZPS	-16.44	-19.54	-16.65	-15.46	-8.81	19%	1%	-6%	-46%
	BANC	17.45	30.78	18.92	51.14	14.62	76%	8%	193%	-16%
	EPE	-17.26	-19.96	-17.71	-18.20	-8.57	16%	3%	5%	-50%
	IID	10.45	7.51	10.33	7.64	-0.54	-28%	-1%	-27%	-105%
	LDWP	16.34	15.23	16.14	36.86	9.35	-7%	-1%	126%	-43%
	PNM	-17.56	-20.12	-18.35	-16.91	-9.00	15%	4%	-4%	-49%
	PSCO	-10.81	-11.95	-10.90	24.26	-0.70	11%	1%	-325%	-94%
	SRP	-16.14	-19.25	-16.35	-13.36	-8.28	19%	1%	-17%	-49%
	TEPC	-17.05	-20.04	-17.60	-16.81	-8.82	18%	3%	-1%	-48%
	WALC	-20.56	-23.63	-21.34	-21.50	-12.24	15%	4%	5%	-40%
	WACM	-9.45	-10.16	-9.44	5.93	2.34	7%	0%	-163%	-125%
MCE ($/MWh)	WECC	45.08	49.25	57.24	66.70	60.34	9%	27%	48%	34%

Total Unserved Load (MWh)

	Base	Low Hydro	High Gas	High Load	SysCarb Price
AZPS	0	0	0	3,446	0
BANC	0	0	0	2,157	0
EPE	0	0	0	310	0
IID	0	0	0	38	0
LDWP	0	0	0	0	0
PNM	0	0	0	7,334	0
PSCO	0	0	0	52,932	0
SRP	0	0	0	12,376	0
TEPC	0	0	0	1,169	0
WALC	0	0	0	53	0
WACM	0	0	0	9,907	0

- Congestion results in High Load scenario are primarily driven by a lack of generation to meet load in the Rocky Mountain region, not by any direct transmission constraints

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Economic Sensitivities – Gen Fleet

Metric	Case	Nuclear	Coal	Gas	Hydro	PS	Geothermal	Blomass	Other	BESS	Solar	Wind
Capacity (MW)	Base	3,436	6,434	29,064	4,880	1,887	830	0	1,037	6,964	12,700	11,733
	LowHydro	3,436	6,434	29,064	4,880	1,887	830	0	1,037	6,964	12,700	11,733
	HiGas	3,436	6,434	29,064	4,880	1,887	830	0	1,037	6,964	12,700	11,733
	HiLoad	3,436	6,434	29,064	4,880	1,887	830	0	1,037	6,964	12,700	11,733
	SysCarbPrice	3,436	6,434	29,064	4,880	1,887	830	0	1,037	6,964	12,700	11,733
Generation (GWh)	Base	28,450	47,466	122,622	15,565	743	4,037	0	154	7,875	29,083	37,220
	LowHydro	28,450	46,333	127,023	15,980	791	4,037	0	248	8,110	29,084	37,223
	HiGas	28,450	49,657	120,220	15,565	729	4,037	0	147	8,180	29,058	37,219
	HiLoad	28,450	49,361	161,288	15,565	1,283	4,038	0	481	8,438	29,068	37,208
	SysCarbPrice	28,450	25,272	142,167	15,565	554	4,038	0	176	6,730	29,091	37,226
Spillage (MWh)	Base	0	0	0	0	0	1,944	0	0	0	44,081	255,079
	LowHydro	0	0	0	0	0	1,310	0	0	0	43,213	251,521
	HiGas	0	0	0	0	0	1,966	0	0	0	68,414	256,022
	HiLoad	0	0	0	0	0	519	0	0	0	58,709	266,849
	SysCarbPrice	0	0	0	0	0	661	0	0	0	35,410	249,073
CO2e (Short Tons)	Base	0	49,925,067	56,954,857	0	0	0	0	65,837	0	0	0
	LowHydro	0	48,685,159	59,169,161	0	0	0	0	154,880	0	0	0
	HiGas	0	52,319,971	55,481,345	0	0	0	0	66,480	0	0	0
	HiLoad	0	52,009,708	77,097,213	0	0	0	0	391,405	0	0	0
	SysCarbPrice	0	26,729,792	66,115,238	0	0	0	0	71,611	0	0	0
CO2e Cost (M$)	Base	0	0	682	0	0	0	0	3	0	0	0
	LowHydro	0	0	784	0	0	0	0	7	0	0	0
	HiGas	0	0	658	0	0	0	0	3	0	0	0
	HiLoad	0	0	927	0	0	0	0	10	0	0	0
	SysCarbPrice	0	1,055	2,737	0	0	0	0	4	0	0	0
LMP ($/MWh)	Base	29.15	31.16	37.93	35.74	45.08	47.49		43.26	32.80	36.79	33.21
	LowHydro	29.61	33.43	40.76	37.67	47.02	48.09		45.60	33.63	38.15	36.49
	HiGas	40.86	42.36	49.94	47.86	57.26	58.94		55.29	44.48	48.51	44.34
	HiLoad	49.79	65.35	74.66	62.45	69.28	64.83		73.44	57.11	63.92	64.71
	SysCarbPrice	52.50	58.34	59.39	57.48	61.36	56.41		60.31	53.87	56.17	54.90
MCC ($/MWh)	Base	-15.17	-12.31	-7.43	-9.18	-0.89	4.82		-2.45	-12.20	-8.33	-9.49
	LowHydro	-18.14	-13.73	-8.23	-10.84	-2.59	2.09		-3.72	-14.88	-10.53	-10.20
	HiGas	-15.32	-12.60	-7.55	-9.10	-1.05	4.87		-2.62	-12.55	-8.68	-9.80
	HiLoad	-15.97	0.23	7.09	-4.34	0.83	1.66		5.30	-9.92	-3.59	0.22
	SysCarbPrice	-6.77	-1.66	-1.69	-2.84	-0.36	-0.70		-1.26	-6.52	-4.56	-2.84

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Economic Sensitivities – Generation (GWh)

Region	Case	Nuclear	Coal	Gas	Hydro	PS	Geothermal	Biomass	Other	BESS	Solar	Wind
AZPS	Base	9,957	0	17,425	20	0	0	0	0	4,400	4,611	4,985
	LowHydro	9,957	0	17,230	24	0	0	0	0	4,560	4,614	4,986
	HiGas	9,957	0	17,307	20	0	0	0	0	4,590	4,612	4,985
	HiLoad	9,957	0	22,866	20	0	0	0	7	4,718	4,618	4,989
	SysCarbPrice	9,957	0	18,744	20	0	0	0	0	3,606	4,618	4,988
BANC	Base	0	0	8,397	5,240	0	0	0	36	0	448	1,164
	LowHydro	0	0	10,963	4,526	0	0	0	96	0	448	1,164
	HiGas	0	0	8,109	5,240	0	0	0	37	0	448	1,164
	HiLoad	0	0	10,727	5,240	0	0	0	134	0	448	1,164
	SysCarbPrice	0	0	9,759	5,240	0	0	0	37	0	448	1,164
EPE	Base	5,406	0	6,231	0	0	587	0	0	44	1,474	0
	LowHydro	5,406	0	6,291	0	0	587	0	0	46	1,474	0
	HiGas	5,406	0	5,941	0	0	587	0	0	46	1,474	0
	HiLoad	5,406	0	6,929	0	0	588	0	0	45	1,474	0
	SysCarbPrice	5,406	0	6,460	0	0	588	0	0	40	1,474	0
IID	Base	130	0	1,484	239	0	2,202	0	0	725	1,996	0
	LowHydro	130	0	1,472	274	0	2,202	0	2	734	1,997	0
	HiGas	130	0	1,367	239	0	2,202	0	0	759	1,997	0
	HiLoad	130	0	1,917	239	0	2,202	0	18	755	1,997	0
	SysCarbPrice	130	0	1,252	239	0	2,202	0	0	780	1,997	0
LDWP	Base	3,483	0	21,221	1,474	309	563	0	99	195	3,989	3,783
	LowHydro	3,483	0	22,116	1,387	316	563	0	120	199	3,989	3,783
	HiGas	3,483	0	20,594	1,474	311	563	0	91	205	3,989	3,783
	HiLoad	3,483	0	27,206	1,474	561	563	0	110	280	3,989	3,765
	SysCarbPrice	3,483	0	24,326	1,474	345	563	0	114	280	3,989	3,783
PNM	Base	3,490	978	3,421	56	0	0	0	2	645	4,810	8,573
	LowHydro	3,490	919	3,281	92	0	0	0	4	658	4,804	8,575
	HiGas	3,490	1,013	3,271	56	0	0	0	2	652	4,787	8,572
	HiLoad	3,490	1,017	4,048	56	0	0	0	34	674	4,784	8,574
	SysCarbPrice	3,490	330	3,707	56	0	0	0	4	554	4,808	8,575

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Economic Sensitivities – Generation (GWh)

Region	Case	Nuclear	Coal	Gas	Hydro	PS	Geothermal	Biomass	Other	BESS	Solar	Wind
PSCO	Base	0	10,573	23,763	58	210	0	0	12	601	4,195	15,033
	LowHydro	0	10,588	24,520	68	219	0	0	14	582	4,195	15,033
	HiGas	0	10,639	23,574	58	208	0	0	12	590	4,195	15,033
	HiLoad	0	10,658	34,001	58	331	0	0	88	611	4,195	15,034
	SysCarbPrice	0	5,455	30,864	58	85	0	0	13	354	4,195	15,034
SRP	Base	5,984	10,313	23,510	445	65	685	0	0	679	4,392	350
	LowHydro	5,984	10,035	23,992	517	65	685	0	0	718	4,395	350
	HiGas	5,984	11,966	22,584	445	62	685	0	0	725	4,389	350
	HiLoad	5,984	11,621	31,156	445	147	685	0	0	716	4,395	350
	SysCarbPrice	5,984	2,875	26,164	445	30	685	0	0	603	4,395	350
TEPC	Base	0	3,085	9,731	3	0	0	0	0	492	1,503	567
	LowHydro	0	3,085	10,002	4	0	0	0	0	510	1,503	567
	HiGas	0	3,128	9,875	3	0	0	0	0	512	1,503	567
	HiLoad	0	3,048	12,313	3	0	0	0	0	532	1,503	567
	SysCarbPrice	0	1,583	11,048	3	0	0	0	0	460	1,503	567
WACM	Base	0	19,692	1,386	2,992	100	0	0	5	0	1,252	2,765
	LowHydro	0	18,911	1,218	3,147	133	0	0	12	0	1,252	2,765
	HiGas	0	19,859	1,292	2,992	89	0	0	5	0	1,252	2,765
	HiLoad	0	20,072	2,156	2,992	185	0	0	90	0	1,252	2,765
	SysCarbPrice	0	14,683	2,541	2,992	35	0	0	7	0	1,252	2,765
WALC	Base	0	2,825	6,053	5,039	59	0	0	0	94	412	0
	LowHydro	0	2,794	5,939	5,942	59	0	0	0	103	412	0
	HiGas	0	3,052	6,306	5,039	59	0	0	0	99	412	0
	HiLoad	0	2,946	7,968	5,039	59	0	0	0	108	412	0
	SysCarbPrice	0	347	7,301	5,039	59	0	0	0	54	412	0

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