# SCENARIO ASSESSMENT REPORT
# FOR THE
# HIGH CLEAN ENERGY PENETRATION SCENARIO

## WESTCONNECT 2022-23 REGIONAL TRANSMISSION PLANNING CYCLE

APPROVED BY WESTCONNECT PLANNING MANAGEMENT COMMITTEE ON

NOVEMBER 15, 2023

# Contents

# 1. Summary

The purpose of this report is to summarize the scenario assessment performed during the WestConnect 2022-23 Regional Transmission Planning Process (Planning Process). The Planning Subcommittee (PS) developed this report to document the assumptions, study methods, and findings from the scenario assessments. The intent of WestConnect scenario analysis is to look at alternate but plausible futures that may provide beneficial information to members and stakeholders[1]. They represent futures with resource, load, and public policy assumptions that are different in one or more ways than what is assumed in the Base Cases.

There was one scenario evaluated in the 2022-23 Study Cycle, which was the High Clean Energy Penetration Scenario (Scenario). The purpose of the Scenario 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 of that study year are satisfied within the WestConnect footprint, as well as use the models representing that future to understand the gap between that future and a future in which the WestConnect footprint is carbon free.

The Scenario was evaluated in two ways. First, congestion was evaluated using the same method as the Regional Economic Assessment. Second, reliability was evaluated, again using the same methods as for the Regional Reliability Assessment. A "carbon free gap analysis" was also performed which evaluated the approximate amount of carbon reduction that would be necessary to make the WestConnect footprint carbon free by 2032.

The results of the High Clean Energy Penetration Scenario analyses indicate that the WestConnect system is able to accommodate the resources necessary for meeting current clean energy public policy requirements. Congestion behavior differed from the Regional Economic Assessment, but did not present any results indicating that the planned system was not adequate to accommodate the new resources. Some new congestion issues surfaced that might warrant some additional evaluation in the future, but did not draw any concerns from members. There were no regional issues with the reliability of the Scenario. Some local issues based on locations of the new resources were observed, but members indicated that local mitigation would resolve those issues and did not warrant any additional analysis.

# 2. Background

The 2022-23 WestConnect Regional Planning Study Plan (Study Plan) was approved by the PMC on March 16, 2022. The 2022-23 Study Plan identifies the scope and schedule of activities conducted during the planning cycle. In addition to describing the Base Case planning assessments used to identify potential regional transmission needs, the Study Plan also describes information-only scenario studies that look at alternate but plausible futures. In the WestConnect Planning Process, 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 Base Case

[1] *WestConnect scenario studies are information-only and can not result in regional needs.*

assessments. The 2022-23 Study Plan describes the High Clean Energy Penetration Scenario as 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 that was agreed to by WestConnect members and stakeholders.

Proposals for scenarios enter into the Planning Process through a 30-day open submittal window as outlined in the WestConnect Business Practice Manual (BPM), which opens during Quarter 8 of the previous planning cycle. WestConnect held an open window for scenario submittals from December 1, 2021, through January 3, 2022. During the open window, stakeholders may provide proposals for specific scenarios for WestConnect to consider in its Study Plan. The PMC and PS can also develop scenarios for inclusion in the Study Plan. Once the scenario proposals are received, the PS evaluates the scenarios and makes a recommendation to the PMC on which ones should be included in the Study Plan and evaluated in the planning cycle. The PS may work with individual requestors to clarify the intent of the scenarios. The PS may also recommend combining scenarios that appear to have common goals, themes, or modeling assumptions.

**Table 1** below lists the scenarios received during the open window.

**Table 1 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 |

These scenario requests 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. 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.

## 2.1 General Methodology

The study began by updating the assumptions within the WestConnect 2032 Base Case PCM to develop the 2032 High Clean Energy Penetration PCM case that satisfied the renewable and clean energy target-focused Public Policy Requirements applicable to year 2032, confirmed by Transmission Owners with Load Serving Obligation (TOLSO) Members.[2] Next, a reliability model was developed by adding the resources into the 2032 heavy summer regional base powerflow model.

In order to complete the scenario assessment, WestConnect members agreed to divide the process into six tasks:

- Task 1: Base Economic Model Benchmarking

  The goal of his task was to review results from WC Base PCM model and determine, by state, what if any "gaps" exist between simulated clean energy levels and assumed state policy objective "targets". Task could involve adjusting "target" as needed, based on direction from members.

- Task 2: Economic Scenario Assessment

  The goal of this task was to implement portfolios of new resources identified in task 1 into Base Case PCM, creating the Scenario case.

- Task 3: Economic Carbon Free Gap Analysis

  The goal of this task was to use model results to compare carbon emissions from Base Model and High Clean Energy Penetration Scenario for WestConnect footprint.

- Task 4: Reliability Scenario Model Development

  The goal of this task was to develop reliability model(s) based on the new resources provided for the economic assessment.

- Task 5: Reliability Scenario Assessment

  The goal of this task was to use the reliability models to perform a reliability assessment, using methodologies consistent with the base regional assessments.

- Task 6: Documentation (Scenario Assessment Report)

  The goal of this task was to document the results of the Scenario Assessment.

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*[2] Public Policy Requirements are reflected in the WestConnect 2032 Base Case PCM through local planning assumptions (e.g., load, generation, demand response, etc.), to the extent a plan for compliance with the Public Policy Requirements has been completed by the TOLSO member. This scenario study presumes there will be gaps to fill, but should be revisited if that turns out to not be the case.*

# 3. Benchmarking

The first task was to benchmark the generation modeled in the base assessment against what might be needed to perform the scenario assessment. Energy Strategies developed Renewable Energy Check Workbook (RE Tool) to provide WestConnect members with an accounting of the generation that is intended to meet or help meet public policy requirements (also known as Renewable Portfolio Standards or RPS) in order to determine if any RPS gaps exist in the planning models. The RE Tool includes aggregated data, by member, of public policy requirements and renewable energy penetrations in the base model. The Planning Subcommittee agreed to review the information from the RE Tool and compare the renewable energy penetration in the base to the penetration needed to meet the objectives of the scenario, and develop plans to add resources to close any energy gaps.

There tends to be a gap between the generation resources modeled in base cases, compared to what might be required to meet public policy objectives. Reasons for the gap vary, and are not an indication of non-compliance, but more generally a factor of timing and uncertainties with project locations. For example, a state policy may require that a utility meet a certain standard by 2040, which is several years beyond the 10-year study horizon. As a result, the utility may not include generation that would be needed for that time frame. The spreadsheet tool can interpolate to estimate what might be needed for the 10-year time frame. Another reason is that some resource planners in some utilities may not have enough information to provide to transmission planners on where generation may need to be located, or the exact quantities.

Members were asked to review the assumptions that went into the workbook tool and provided feedback regarding targets, and other accounting assumptions from February through April 2023. Some feedback examples included what resources should be counted towards meeting RPS objectives, whether RPS targets had changed, and if the capacity factors for various types of renewable resources were reasonable and/or sufficient.

**Table 2** below shows the estimated RPS gaps for the Base condition, the revised values after member feedback, and the amounts of resources that members provided. Members provided data for additional resources that would meet or exceed the shortages listed.

**Table 2 RPS Gaps and Resources Provided**

| | Estimated RPS MW Shortage | | Resources Provided |
|---|---|---|---|
| Region | Base | Revised | (MW) |
| BANC | 3,890 | 3,443 | 3,072 |
| LDWP | 7,888 | 7,092 | 7,198 |
| PSCO | 5,989 | 5,967 | 6,414 |
| SRP | 3,340 | 3,340 | 3,339 |
| TEPC | 2,498 | 2,483 | 4,070 |
| WACM | 3,436 | 2,259 | 3,368 |
| WALC | 1,561 | 0 | 1,500 |
| WestConnect | 26,172 | 22,300 | 28,961 |

## 3.1 Data Submittal

Once the PS made a determination that the plan was reasonable, members were requested to provide resource data, both in terms of quantities, but also locations. Members also had the opportunity to provide any transmission plans that might be associated with the new resources. Members provided almost 30,000 MW of new resources. **Table 3** shows the types of resources submitted.

**Table 3 Resources Added by Type**

| Resource Type | Capacity (MW) |
|---|---|
| Solar | 14,399 |
| Battery Storage | 2,560 |
| Geo | 452 |
| Wind | 11,252 |
| DG-BTM | 234 |
| Hydrogen Gas | 273 |
| Bio | 32 |
| **Total** | **29,202** |

The following figures**, Figure 1**, and **Figure 2** show a comparison of the resources in the Base model compared to what was included in the scenario analysis.

**Figure 2 Renewable Generation – Scenario compared to Base**

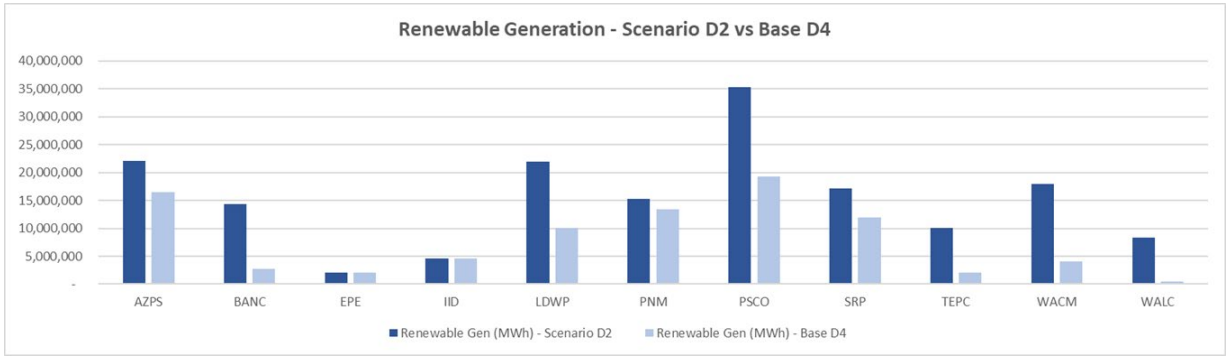



**Figure 1 Renewable Resource Types**

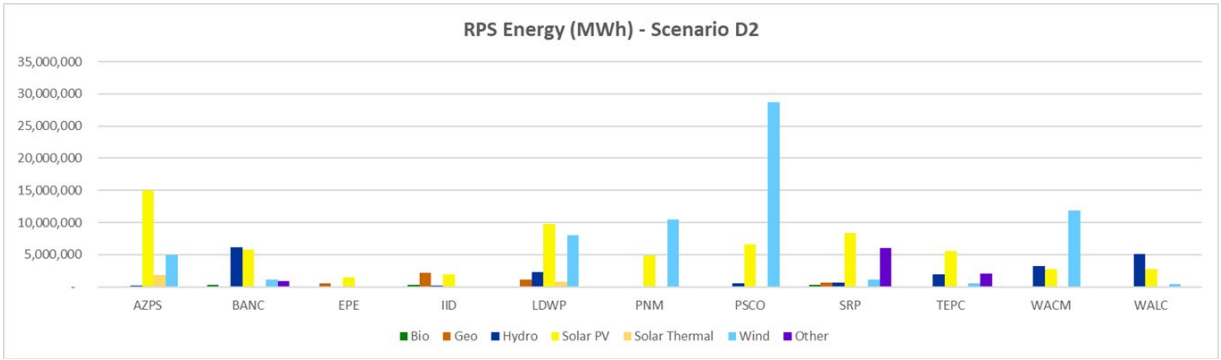
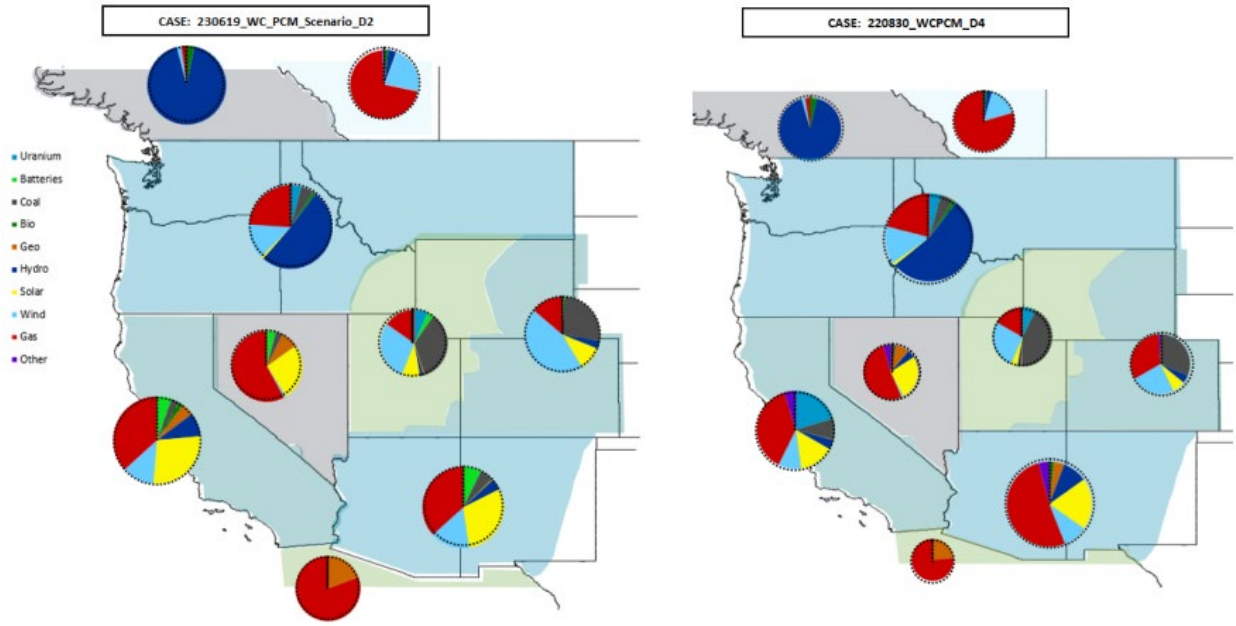


**Figure 3** shows the generation mix by region for both the Base and the Scenario.

**Figure 3 Generation Mix by Region**




# 4. Economic Assessment

## 4.1 Economic Study Methodology

It was thought that the economic model might be developed through several iterative rounds of review, given the numerous ways in which some of the Public Policy Requirements can be complied with. Even more so than in the Regional Assessments, the focus was on regional impacts rather than local issues. WestConnect Members were encouraged to utilize internal studies or other recent assessments that have investigated strategies for compliance with Public Policy Requirements, including, but not limited to, thermal generation retirements, generation and/or storage additions, demand-side programs, or local transmission expansion focused on new resource delivery. In addition to considering any gaps identified between the Public Policy Requirements in the Base economic model, with the use of the RE Tool, to the extent that transmission projects had been considered that could accommodate additional renewable generation, those could also be added to the scenario along with the new generation. However, no additional transmission projects were provided.

As per the 2022-23 Study Plan, the Scenario was evaluated in two ways. First, an economic assessment was performed using the same method as the Regional Economic Assessment. Second, a reliability assessment was performed using the same steady state contingency analysis as the Regional Reliability Assessment.

As part of the economic assessment, a "carbon free gap analysis" was performed to approximate the amount of further carbon reduction that would be necessary (from the Scenario assessment) to make the WestConnect footprint carbon free by 2032. The gap analysis was essentially an accounting of the carbon emissions attributed to the WestConnect footprint in the Scenario economic model.

## 4.2 Economic Assessment Results

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 Economic Assessment results. Also, there were some issues in the Base Economic Assessment results that were not observed in the Scenario results. **Table 4** shows the Scenario congestion results. 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 4 Scenario Congestion Results**

| Entities Involved | Line / Interface | ***Base Congestion*** Hrs (% Hrs) / Cost (K$) | ***Scenario Congestion*** *Hrs (%* Hrs) / Cost (K$) |
|---|---|---|---|
| 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 |

## 4.3 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 5**.

**Table 5 Sensitivity Congestion Results**

| Entities Involved | Line / Interface | ***Base Congestion*** Hrs (% Hrs) / Cost (K$) | ***Scenario Congestion*** *Hrs (%* Hrs) / Cost (K$) |
|---|---|---|---|
| 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 |

## 4.4 Economic Study Summary

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.

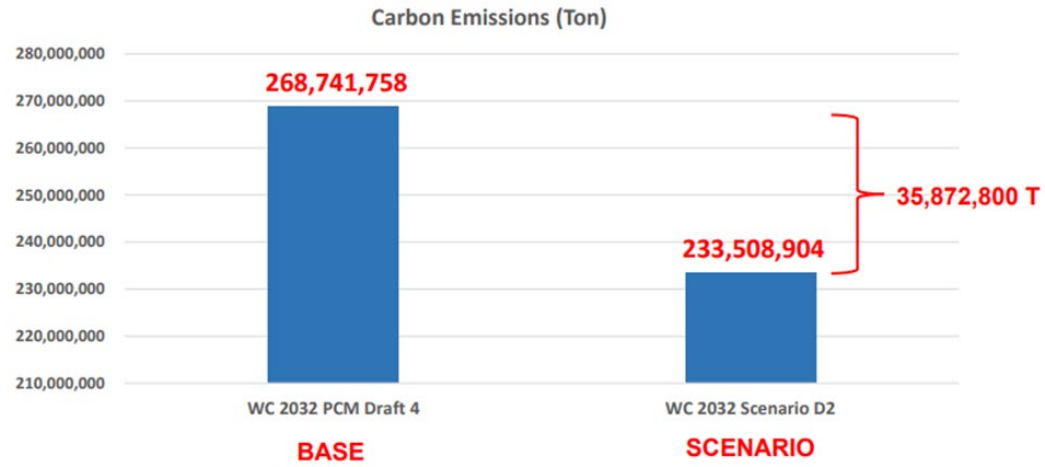
# 5. Gap Analysis

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 6** and **Figure 4** below shows the reduction in SO2, NOx, and CO2.

**Table 6 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 4 Carbon Emissions Gap**




# 6. Reliability Study

## 6.1 Reliability Study Methodology

The scenario reliability assessment was performed using methodology consistent with the Regional Reliability 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 refinements to the methodology as discussed below.

### 6.1.1 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 the Base Regional Reliability Assessment. The PS discussed the merits of utilizing the base reliability models, versus trying to export certain hours from the Scenario production cost model. The PS consensus was to utilize the base reliability model. Members agreed to provide information as to how to dispatch the new resources.

### 6.1.2 Generation Dispatch

The PS 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 base reliability models. Modeling at higher levels could lead to more transmission stress and provide members and stakeholders with information regarding what network upgrades might be needed for those types of conditions. However, the higher output could result in a need for subregional exports between balancing areas within the WestConnect footprint, and the likely 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 PS consensus was to allow members to dispatch the new resources at lower than nameplate levels and be consistent with how generation was modeled in the base reliability models. Members could model the generation at higher levels at their discretion.

### 6.1.3 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 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.

### 6.1.4 Reliability Modeling Seasonal Conditions

Finally, the PS discussed whether light spring conditions should also be evaluated in addition to the heavy summer conditions, since both conditions were studied for the Regional Reliability Assessment. Studying both conditions could 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. The PMC agreed with these decisions.

## 6.2 Reliability Study Results

Once the PS and PMC 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.

## 6.3 Reliability Study Summary

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.

# 7. Summary of Findings

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.