WestConnect Regional Transmission Planning

2016-17 Planning Cycle

Model Development Report

Approved by WestConnect Planning Management Committee on

October 18, 2016

Contents

1.0 Introduction

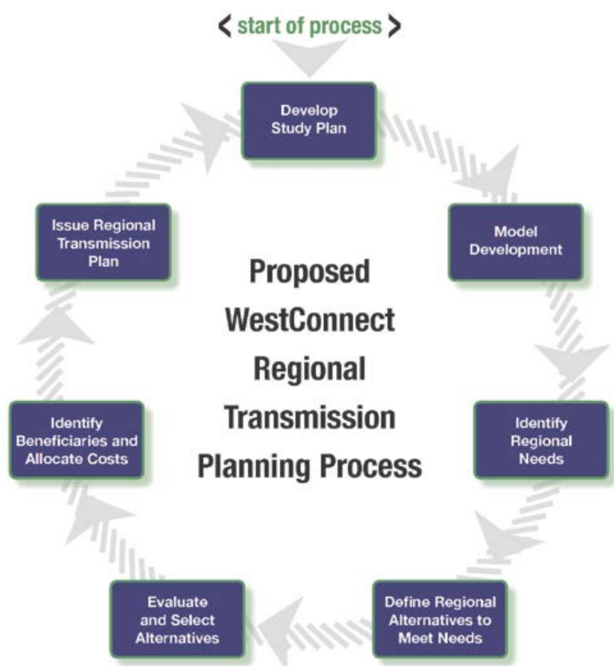
The purpose of this report is to summarize the model development phase of WestConnect's 2016-17 Regional Planning Process. The Planning Subcommittee, which is responsible for developing WestConnect's regional models, has compiled this report to document major assumptions that have been incorporated into the models. The objective of model development is to support the overall purpose of the Regional Planning Process, which is to identify regional transmission needs and the more efficient or cost-effective solutions to satisfy those needs. The Planning Management Committee (PMC), which has decision-making authority over the overall WestConnect planning process, approves the regional models that are then used during the transmission assessment stage of the planning process. A second purpose of this report, therefore, is to provide documentation to the PMC in support of the request for approval of the regional models.

1.1 WestConnect Regional Transmission Planning Process

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

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

Figure 1: WestConnect Regional Transmission Planning Process



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

1.2 WestConnect 2016-17 Regional Study Plan

The first step in the planning process is the development of a Regional Study Plan ("Study Plan"). The 2016-17 WestConnect Study Plan was approved by the PMC on March 16, 2016. The Study Plan identifies the scope and schedule of planning activities to be conducted during the planning cycle. The Study Plan also describes the models and studies to be developed in the model development portion of the Planning Process.

2.0 Model Development Overview

During the second and third quarter of 2016, the Planning Subcommittee worked to develop regional models that will be used in the identification of regional transmission needs and/or opportunities for the 2016-17 Planning Process. Two types of studies are needed for the Planning Process: reliability ("power flow") and economic ("production cost model" or PCM). WestConnect will conduct an assessment of the region's transmission needs using models developed for the 2026 timeframe, approximately 10 years into the future.

As mentioned in the Study Plan, WestConnect regional assessments are centered on Base Cases and Scenarios, which when taken together, provide a robust platform that is used to identify the potential for regional transmission needs and emerging regional opportunities. Base Cases are intended to represent "business as usual," "current trends," or the "expected future." They are based on TO-supplied forecasts for load, generation, public policy resources, and transmission plans. Scenarios are intended to complement Base Cases by looking at alternate but plausible futures. They represent futures with resource, load, and public policy assumptions that are different in one or more ways than what is assumed in the Base Cases.

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

Table 1: WestConnect Planning Models

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

Economic Model Case Summary			
	Case Name	**Case ID**	**Case Description and Scope**
Base Case	**2026 Base Case**	WC26-PCM	Business-as-usual case based on WECC 2026 Common Case with additional regional updates from PMC members.
Scenario Cases	**High Renewables**	WC26-PCM-HR	California 50% RPS with regional resources (Wyoming wind and New Mexico wind) *and* increase WestConnect state RPS requirement beyond enacted with other resources
	CPP – WestConnect Utility Plans	WC26-PCM-CPP1	Reflect individual WestConnect member utility plans for CPP compliance

	CPP – Market-based Compliance	WC26-PCM-CPP2	Model CO_2 price in WestConnect to achieve mass-based regional CPP compliance
	CPP – Heavy RE/EE Build Out	WC26-PCM-CPP3	Additional coal retirements, additional RE/EE, minimal new natural gas generation

Study Area

The WestConnect planning process evaluates the regional transmission needs solely of the WestConnect planning region, which is defined as the combined footprints of signatories to the Planning Participation Agreement (PPA) within the Transmission Owner (TO) Member Sector. A list of Members participating in the WestConnect 2016–17 planning process is available on the WestConnect website (PMC Members). PMC Members and participants updated WECC models, as described in more detail below to help create a more accurate representation of the WestConnect footprint in each case.

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. Details about the types of information received from external participants (e.g., planning regions, other TOs) are included in the model descriptions in the sections that follow.

3.0 Reliability Model Descriptions

The information in this section summarizes each reliability model and provides details about the major assumptions incorporated into the reliability cases. Note that the cases have detailed change records documenting specific data changes made to the original starting point case. This report summarizes each case and does not attempt to document each specific adjustment made to the regional models.

2026 Heavy Summer Base Case

Description: The case is designed to test the Base Transmission Plan under heavy summer conditions. The seed case was the WECC 2026 Heavy Summer 1 Base Case dated April 11, 2016 (2026 HS1a), which was updated with the latest topology (i.e., generator, load, and transmission) information from WestConnect participants and the load level and generator dispatch were updated to account for these updates while still representing typical heavy summer load conditions and generator dispatch.

Generation: Within WestConnect, the case features a dispatch of 59,046 MW of thermal and hydro resources and 5,180 MW of wind and solar resources.

Load: The aggregate coincident peak load level for the WestConnect footprint is 63,465 MW. The original WECC case represented the system coincident peak for a heavy summer conditions between the hours of 1500 to 1700 MDT during the months of June – August. WestConnect's intent was to continue these assumptions during its case development.

Transmission: Minor planned transmission additions beyond the Base Transmission Plan were included in the case and are listed below. Members were responsible for ensuring the case topology was consistent with Base Transmission Plan.

- NV Energy's East Tracy - Valmy 345 kV Line Wavetrap Removal, in-service 2017
- NV Energy's Re-termination of Tracy - Pah Rah 120 kV line, in-service 2018

Other assumptions:

- CAISO resource re-dispatch: Wind and PV generation in SDG&E and SCE were increased by 1,230 MW to achieve a 1,200 MW increase in flow from CAISO to WestConnect: 341 MW of SDG&E PV, 92 MW of SCE Wind, and 797 MW of SCE PV. The increased CAISO to WestConnect flow was necessary to achieve load and resource balance given the revisions made to the seed case's load level and generator dispatch within the WestConnect footprint. CAISO feedback indicated that it was reasonable that PV would be close to full output rather than zero during the summer peak snapshot, and there were PV generators – identified per turbine type – in the SCE and SDG&E areas not fully dispatched in the seed case, so these generators' dispatch was increased to full output to provide the bulk of the dispatch increase. Beyond that, several wind generators – chosen since they had the largest available capacity in the seed case snapshot – were dispatched up to achieve the desired CAISO to WestConnect flow increase.

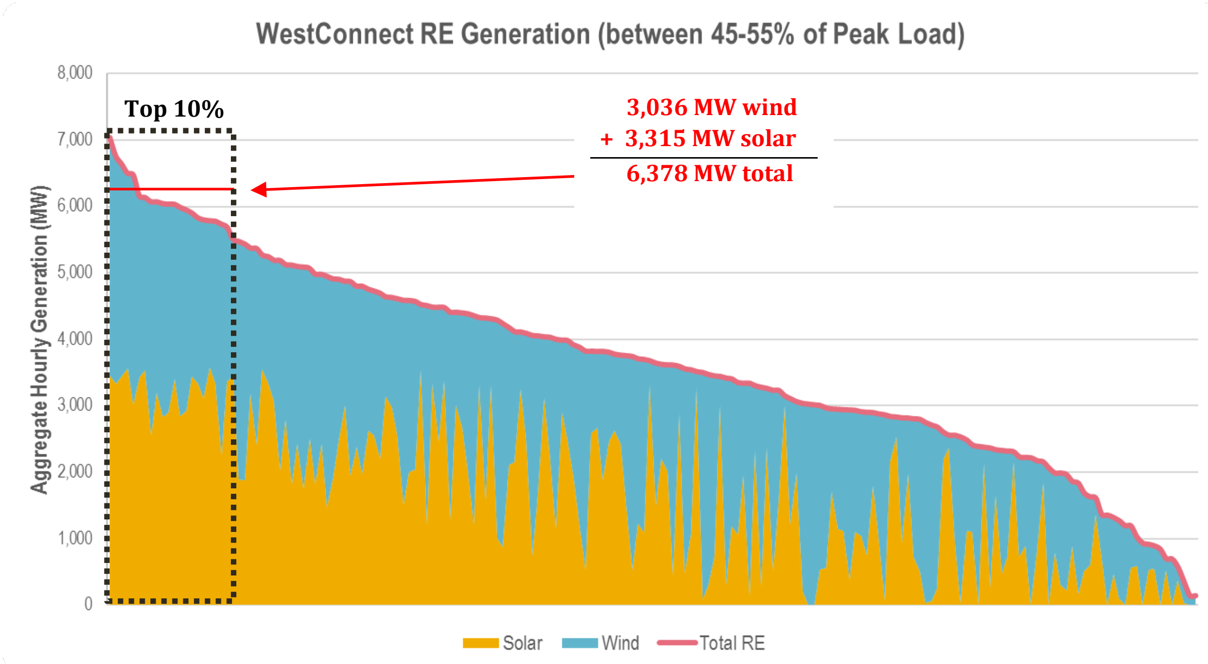
2026 Light Spring Base Case

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 WestConnect's total load. The case does not include renewable resource capacity additions *beyond* what is already planned and included in the WestConnect base case future – the case intends to represent likely and expected system conditions. As explained more fully below, the dispatch of the renewable resources was adjusted from the original WECC base case to better reflect the potential system conditions described above. The WECC 2026 LSP1-S case served as the seed case to which the modifications and updates where made.

Generation: Simulated historical weather data was used to adjust the dispatch level for all wind and solar resources in the WestConnect footprint.[2] The use of hourly wind and solar production data ensured a realistic and geographically matched dispatch of non-thermal resources across the WestConnect footprint. To identify the wind and solar dispatch level, the hourly wind and solar production data described above was filtered to only include data corresponding to mid-morning morning hours between 0700 and 1000 MST when load was between 45-55% of the WestConnect peak. The reduced set of hourly wind and solar production data for WestConnect during these hours is shown in Figure 2. WestConnect opted to represent a wind and solar dispatch consistent with the average of the top 10% of generation hours (after ranking by combined MW output). This resulted in a case with 3,063 MW of wind and 3,315 MW of solar (photovoltaic and thermal storage) generation (dispatch) in WestConnect, which would serve 19% of the total WestConnect light-spring load in the case.

[2] *The National Renewable Energy Laboratory (NREL) has created hourly solar and wind meso-scale production data for about 30,000 sites throughout the Western Interconnection. The shapes are based on meteorological modeling that produces historical wind speed and irradiance data for locations across the West. These shapes are used by WECC to develop energy production profiles for wind and solar generation resources in their Common Case production cost modeling dataset. The 2024 Common Case, whose data was used for the analysis described herein, used NREL profiles representing the 2005 historical weather year.*

Figure 2: Hourly Production Data used to Estimate Wind and Solar Dispatch



After the wind and solar generators were re-dispatched, as outlined above (based on their geographically-specific generation profiles), the thermal fleet was re-dispatched by PMC members to balance load and resources, keeping interchange between regions and areas roughly the same as in the original WECC case.

The roughly 6,000 MW of wind and solar energy dispatched across WestConnect during the mid-morning hours, as modeled in this case, is intended to represent a realistic and likely future. This level of renewables served 19% of the total WestConnect load in this hour, as noted above. While poor data availability for actual historical hourly wind and solar generation data prevents benchmarking of this specific condition, several anecdotes suggest that the condition is feasible and realistic. For example, Xcel Energy commonly sees hours where wind provides more than 50% of their load – on October 31, 2013, wind supplied more than 61% of customers' energy needs.[3] In 2015, NV Energy's northern Nevada area and southern Nevada area served 31.3% and 21.2% of their respective loads with renewables. This suggests that there were hours when renewable generation served portions of NV Energy's load in excess of 20-30%.[4] These are just two examples, among many others, that suggest serving 19% of the spring mid-morning WestConnect load with renewables is reasonable.

Load: WestConnect member loads were adjusted slightly from the seed case to attempt to more closely correlate the load forecast to the wind and solar dispatch. The nature of the adjustment (i.e., up, down) was specific to each transmission owner. The total WestConnect load in the case is 30,606 MW, which is

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[3] *http://nawindpower.com/online/issues/NAW1512/FEAT_04_How-Colorado-Sets-Wind-Generation-Records.html; https://www.xcelenergy.com/energy_portfolio/renewable_energy/wind*

[4] *https://www.nvenergy.com/brochures_arch/RenewableGenerationsBrochure_2016.pdf*

48% of the WestConnect peak load in the WestConnect 2026 Heavy Summer Base Case. The load levels represent the system during the mid-morning hours between 0700 and 1000 MST, which was also used to develop the wind and solar generator dispatch.

Transmission: Identical transmission assumptions as the 2026 Heavy Summer Base Case – see above for details.

Other assumptions:

- CAISO resource re-dispatch: To accommodate WestConnect's changes to interchange and load-gen levels, the two SCE Alameda generators were increased by 160 MW and the SCE area slack bus was reduced 40 MW, resulting in a net increase of 280 MW in SCE.
- No changes were made to the loads and resources (including wind and solar) outside of the WestConnect region. The original WECC 2026 LSP1-S seed case assumptions were modeled outside of the WestConnect footprint, which was intended to model wind at 30% of nameplate capacity around hours 0300 to 0500 MST. Thus, when the regional assessment is conducted, the results will be based on the assumptions used for this model, including how neighboring loads and resources were represented, which could influence the magnitude and direction of interregional power flow. A deep understanding of the degree to which neighboring regions and areas can be relied on for reliability services, such as initial frequency response, will not be an outcome of this study.
- Below please find links to prior Planning Subcommittee meeting slides where the strategy and approach used to develop the 2026 Light Spring case was discussed:
    - https://doc.westconnect.com/Documents.aspx?NID=17021&dl=1
    - https://doc.westconnect.com/Documents.aspx?NID=17013&dl=1

2026 CPP Utility Plans Scenario

Description: This scenario was designed to reflect individual WestConnect member plans for Clean Power Plan (CPP) compliance, or a similar low-carbon future. Certain members, specifically those in Arizona, had previously developed utility-coordinated, state-level analysis that was used as input assumptions for this scenario. The case consists of coal and gas retirements (beyond what is included in the base case), additional renewable energy, and replacement resources for the coal and gas retirements. The purpose of the case is not to test the system for CPP compliance. Rather, the case was intended to gather various plans, compile them into an economic model in order to identify a stressed but realistic operating condition, and then test the performance of the WestConnect Base Transmission Plan under these conditions though this reliability scenario study.

Generation: Generator retirements, replacements, repowerings, and additional renewables are summarized in Appendix A. In aggregate, the scenario includes:

- 1,332 MW of coal retirements (in addition to what is included in the base case);
- 444 MW of gas retirements;
- 175 MW of repowered generation;

- 1,127 MW of gas-fired replacement generation (NGCTs and NGCCs); and
- 595 MW of additional renewable resources.

Load: Load forecasts were not changed from the base case for this scenario.

Transmission: Identical transmission assumptions as the 2026 Heavy Summer Base Case – see above for details.

Other Assumption:

- Stressed hour export and reliability assessment: This scenario was initially constructed as an economic model. Once the economic model is approved by the PMC, the Planning Subcommittee will review hourly data and identify an hour that represents a stressed operating condition. This operating condition will be exported into the power flow model in the form of WestConnect generator dispatch and load levels, where a regional reliability assessment will be performed. The transmission modeling is already consistent between the economic and reliability models.
- Areas outside of WestConnect: Note that when exporting the dispatch and load levels of a stressed hour from the production cost model to a power flow, WestConnect was not able to perform these tasks for the areas outside of WestConnect. This issue will be further addressed when addressing study caveats in the regional assessment report.

2026 CPP Aggressive Scenario

Description: This scenario was designed to reflect a future where significant changes to the region's generation portfolio are made for the purposes of CPP compliance, or a similar low-carbon future. The assumptions were developed by PMC members and stakeholders, leading to a case with aggressive coal retirements and a generation replacement strategy that relies heavily on renewable resources. The purpose of the case is not to test the system for CPP compliance or to achieve a particular carbon reduction goal. Rather, the case was designed to aggressively test the performance of the WestConnect Base Transmission Plan under a future with a low-carbon generation portfolio that looks substantially different from what is in-service today.

Generation: Generator retirements, replacements, repowerings, and additional renewables are summarized Appendix A. In aggregate, the scenario includes:

- 4,188 MW of coal retirements (in addition to what is included in the base case, and +2,856 MW compared to CPP1);
- 444 MW of gas retirements;
- 175 MW of repowered generation;
- 1,158 MW of gas-fired replacement generation (NGCTs and NGCCs); and
- 10,369 MW of additional renewable resources (wind, solar and geothermal).

The replacement capacity assumptions are important for this scenario. It was agreed that the capacity lost due to retirements was to be replaced by a combination of gas-fired resources and renewables. New gas-fired resources would contribute 25% of the lost capacity (in MWs), and new renewables would contribute 75% of the capacity. The retired resources and replacement gas-fired resources were assumed to contribute each MW of nameplate capability to system peak. The contribution of renewable resources to system peak load was approximated using effective load carrying capability (ELCC) parameters calculated in a recent WECC resource adequacy assessment of the WECC 2026 Common Case.

ELCC measures a generator's contribution to overall resource adequacy and is a function of the generator's energy delivery, in terms of time, and its ability to reduce system Loss of Load Expectation as a result of this delivery. Thus, wind and solar each contribute differently to system peak and at factors measurably less than dispatchable generators. What this assumption does, in effect, is require additional MWs of renewable resources be added to the system in order to roughly maintain system resource adequacy at levels prior to the retirements – an initial goal of the study. Note that the ELCC parameters were not recalculated as additional resources were added to the system. Since this assessment is transmission-oriented and not a resource or capacity planning exercise, this approach to estimate resource adequacy was deemed to be reasonable.

Load: Load forecasts were not changed from the base case for this scenario. Energy efficiency (EE) and distributed generation (DG) levels were not adjusted either.

Transmission: Identical transmission assumptions as the 2026 Heavy Summer Base Case – see above for details.

Other Assumption:

- Stressed hour export and reliability assessment: This scenario was initially constructed as an economic model. Once the economic model is approved by the PMC, the Planning Subcommittee will review hourly data and identify an hour that represents a stressed operating condition. This operating condition will be exported into the power flow model in the form of WestConnect generator dispatch and load levels, where a regional reliability assessment will be performed. The transmission modeling is already consistent between the economic and reliability models.

- Areas outside of WestConnect: Note that when exporting the dispatch and load levels of a stressed hour from the production cost model to a power flow, WestConnect was not able to perform these tasks for the areas outside of WestConnect. This issue will be further addressed when addressing study caveats in the Regional Transmission Assessment Report.

Contingency Definitions, Dynamic Data, and Other Considerations

The regional reliability models identified as "base cases" will be used to identify regional transmission needs. Scenarios will be limited to identifying regional opportunities. Both assessments will be conducted using contingency definitions that were designed to limit the analysis to identifying regional transmission issues.

An initial list of automatically created single branch ("N-1") outages 230 kV and higher was created and participants also submitted multi-element contingency definitions not automatically created. Participants reviewed the outage list and (a) identified invalid single branch outages to remove, and (b) identified other contingencies not included in the list that could potentially flag regional transmission issues.

The dynamic data needed to support the transient stability simulations was developed by first taking the dynamic data from the WECC seed cases and appending additional or revised dynamic data per participant submittals.

The Planning Subcommittee also considered the following when developing the cases:

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

4.0 Economic Model Descriptions

The reliability base models and economic base models maintained consistent electric topologies (e.g., matching load, generator, and branch models) throughout their development.

2026 Base Case

Description: The case is a PCM dataset designed to represent a likely, median 2026 future. The 2026 TEPPC-approved interconnection-wide 10-year PCM ("2026 Common Case V1.0" or "26CC-1.0") and its accompanying Release Notes served as the seed case for the WestConnect economic model 2026 Base Case. The WECC Common Case was reviewed and updated by WestConnect during Quarters 2 and 3 of the 2016–17 planning cycle consistent with the process described below.

Generation:

- WestConnect made significant changes to the amount of generation represented in the generator stack in order to maintain consistent topology with the reliability models. The below table provides a summary by fuel category. The negative values shown below represent the capacity (in MWs) and resulting energy (in GWh) removed from the WECC 2026 Common Case V1.0 in order to make the generation included in the WestConnect 2026 Base Case PCM consistent with the generation modeled in the 2026 Heavy Summer and 2026 Light Spring power flow base cases.

Table 2: Generation Changes Made to WECC 2026 Common Case

Fuel Category	Changes from 26CC-1.0	
	Annual Generation (GWh)	Capacity (MW)
Gas	(6,102)	(4,897)
Water (Hydro)	(644)	(207)
Solar PV	(5,202)	(2,235)
Solar Thermal	(1,680)	(647)
Wind	(6,402)	(2,661)

Fuel Category	Changes from 26CC-1.0	
	Annual Generation (GWh)	Capacity (MW)
Bio	(700)	(126)
Geothermal	(6,754)	(971)
Other	(227)	(32)
Overall	**(27,712)**	**(11,777)**

- WestConnect's 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.

- The behind-the-meter distributed generation modeled on the resource-side was retained from the WECC Common Case and is summarized in the table below.

Table 3: Behind-the-Meter Distributed Generation Retained from WECC 2026 Common Case

Area Name	Capacity (MW)	Generation (GWh)	Capacity Factor (%)	Dispatch at Area Peak (% of Capacity)
AZPS	937	1,854	23%	1%
BANC	323	552	20%	17%
EPE	44	89	23%	14%
IID	68	134	22%	46%
LDWP	984	1,765	20%	29%
NEVP	67	133	23%	50%
PNM	248	491	23%	23%
PSCO	500	906	21%	14%
SPPC	83	158	22%	40%
SRP	438	872	23%	0%
TEPC	433	863	23%	9%
TIDC	114	199	20%	39%
WACM	384	555	17%	46%
WALC	324	645	23%	16%
WAUW	2	3	17%	12%

Load: WestConnect made minor modifications to the load shapes and forecasts included in the WECC Common Case. No changes were made to the load forecasts for areas outside of WestConnect. The below charts provide the annual load energy various load snapshots (peak load and load during system/WECC peak), and the average load on an area basis. The "PF Load" – load in the WestConnect 2026 Heavy Summer Base Case – is provided for a frame of reference, though, some difference between the PCM and PF load snapshots is typical given their different foci: the power flow 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.

Figure 3: Annual Load (GWh) in WestConnect 2026 Base Case (PCM)

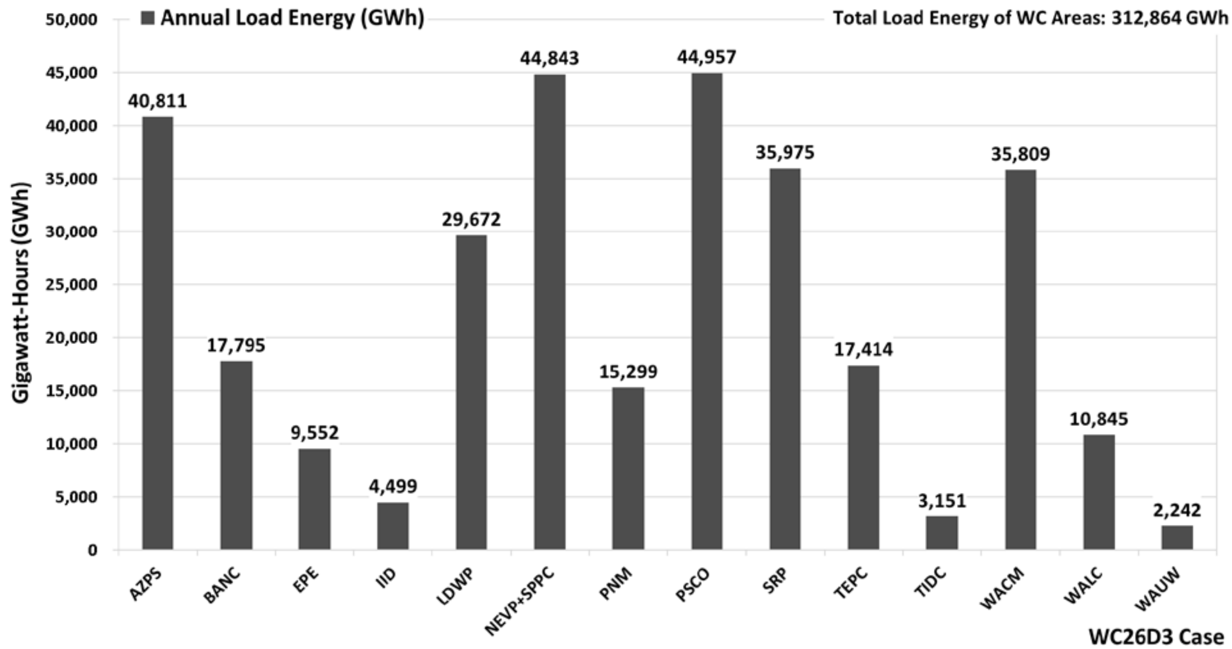
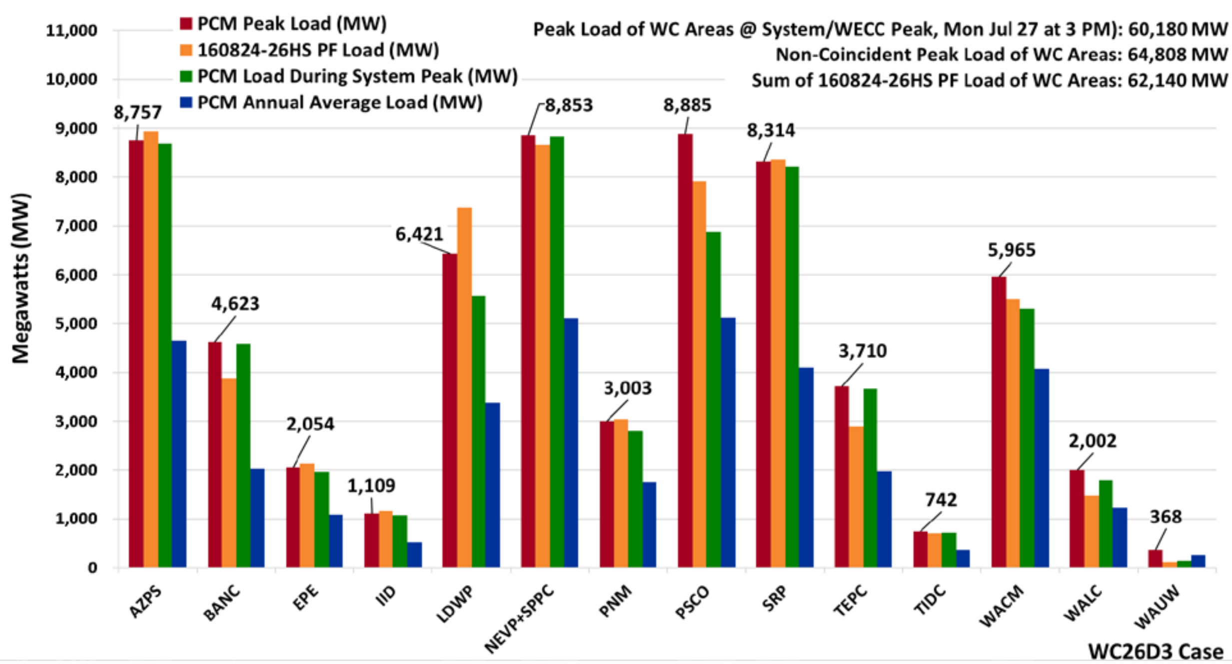


Figure 4: Peak Load (MW) in WestConnect 2026 Base Case (PCM) [with Losses] and Heavy Summer Base Case [No Losses]



Transmission: The WECC 2026 Common Case 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 bus and branch monitoring in the WestConnect footprint
    - Monitoring of all load buses
    - Monitoring of transmission lines ≥ 200 kV and transformers ≥100 kV
- Updated interface definitions
- Removal of the LADWP 25% minimum generation nomogram

Other Assumptions:

- Any opportunity to more closely align the economic base case model with the reliability base case model was taken. For example, branch ratings were taking from the summer and winter ratings in the WC26HS power flow case and load distribution factors were aligned with the WC26HS case.
- Fuel price forecasts and emission rate assumptions were taken from the WECC Common Case. These assumptions are included in Appendix B.
- Reserve requirements modeling was consistent with the WECC Common Case.
- Hurdle rates, which represent the costs and market friction associated with transferring power between areas were revised from the original 2026 Common Case values to peak and off-peak wheeling charges based on the latest Open Access Transmission Tariff (OATT) rate and Energy Imbalance Market (EIM) modeling information. These assumptions are provided in Appendix B. The WECC 2026 Common Case also contained additional hurdles rates associated with modeling carbon emission charges applicable to California, Alberta, and British Columbia. These rates were maintained. Planning Subcommittee members reviewed these updates through draft model releases and meeting presentations. More details for the hurdle rate modeling assumptions are included below.
    - The wheeling costs incorporated into the hurdle rates were based upon the OATT on-peak and off-peak transmission charges, inclusive of mandatory 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. Market friction is composed of commitment and dispatch friction rates. [5]
    - The friction and trading margin rates are adders intended to allow the model results to align with current business practices and/or observed historical patterns which were a $1/MWh trading margin assumption and $4/MWh market friction assumption. The market friction portion is only applied in the commitment step whereas all other charges are applied in both the commitment and dispatch steps of the PCM simulation.

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[5] *The commitment friction rate differs from the dispatch friction rate, because the commitment friction rate aims to reflect WestConnect utilities' commitment practices. They usually do not plan their resources to serve non-native load.*

- EIM adjustment to wheels (September 19, 2016 meeting): To emulate the impact of the EIM, the hour-ahead dispatch hurdle rates between known EIM entities are reduced to 10% of the hurdle rate value described above. While removing or significantly reducing hour-ahead dispatch rates between EIM entities is not a perfect modeling solution for a sub-hourly market tool, it is common practice and a reasonable assumption for hourly modeling. The list of entities impacted by this modeling is summarized below:

Current EIM participants:	Future EIM participants:

• CAISO
• PacifiCorp
  o Rocky Mountain Power
  o Pacific Power
• NV Energy
  o Nevada Power
  o Sierra Pacific Power
	• Puget Sound Energy (2016)
	• Arizona Public Service (2016)
	• Portland General Electric (2017)
	• Idaho Power (2018)

- Emission-related wheeling charges: Discussed in the August 16, 2016, meeting, after which WECC provided an update to the WECC 2026 Common Case's original California Global Solutions Act (AB 32) modeling – included in WECC's Version 1.3 release of the 2026 Common Case – to reflect the latest California Air Resource Board (CARB) emission rate for unspecified sources. WestConnect implemented the updated AB 32 modeling and did not update the Alberta or British Columbia emission-related hurdle rates.

- Nomograms and transmission interfaces outside of WestConnect were modeled by starting with the WECC Common Case, and then reflecting the additional nomograms and conditional constraints that are 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.

2026 High Renewables Scenario

Description: The purpose of this scenario is to evaluate the performance of the WestConnect Base Transmission Plan under a future with a significant build-out of renewable resources within and near the WestConnect footprint. The study assessment will include an evaluation of regional congestion and public policy resource curtailment as a part of the evaluation of the performance of the WestConnect Base Transmission Plan.

The scenario will ultimately represent a future where a *portion* of California's 50% RPS requirement is met with resources located in or near the WestConnect footprint *and* WestConnect states increase their

RPS 50% from current levels. These two public policy drivers will be evaluated in separate and then combined studies in order to create as much information as possible from the study effort.

Generation: The modeling of incremental renewable resources beyond what is included in the 2026 Base Case is the key assumption for this case. An overview of the assumptions is provided below.

- Incremental resource capacity added to 2026 Base Case:
  - 2,000 MW of wind in Wyoming
  - 2,000 MW of wind in New Mexico
  - Sufficient renewable resources to support a 50% increase to PMC members' RPS requirements.
    - This requirement was estimated by taking the TOLSO member loads times the scenario RPS requirement less the TOLSO member loads times the enacted RPS requirement.
    - The calculation, when performed for all of WestConnect, results in the need for approximately 38,000 GWh of incremental renewable generation.
    - These resources will be located within or near the states for which they are required.

The following table provides a TO-level summary of the additional renewable resources that will be modeled to represent a 50% increase to current RPS levels.

Table 4. Renewable Energy Requirement Calculation Summary

Area	New Renewable Energy Needed (GWH)	RPS Assumptions	
		Enacted RPS (%)	Scenario RPS (%)
AZPS	2,704	15.0%	22.5%
EPE	116	10.0%	15.0%
NEVP+SPPC	6,544	25.0%	37.5%
PNM	1,591	20.0%	30.0%
PSCO+CSU	6,466	30.0%	45.0%
SRP	2,605	15.0%	22.5%
TEPC	1,276	15.0%	22.5%
WACM	3,591	20.0%	30.0%
WALC	797	15.0%	22.5%
BANC	3,000	33.0%	50.0%
IID	767	33.0%	50.0%

LDWP	5,607	33.0%	50.0%
Total	**38,654 GWh**		

The following table shows how the capacity of the additional renewable resources are distributed.

Table 5. Renewable Generator Capacity Distribution

State	Area	New Renewable Energy Expected (GWh)	Capacity (MW)			
			Wind	Solar	Geothermal	TOTAL
AZ	AZPS	2,704	116	874	-	990
	SRP	2,605	127	843	-	970
	TEPC	1,276	62	413	-	475
	WALC	797	91	152	-	243
CA	BANC	3,000	489	571	-	1,060
	IID	767	-	29	93	122
	LDWP	5,607	914	1,067	-	1,981
CO	PSCO	6,466	780	557	-	1,337
	WACM (CSU)		253	181	-	434
	WACM (TSGT)	3,591	287	235	-	522
	WACM (Other)		287	175	-	462
NM	PNM	1,591	254	182	-	436
	EPE	116	5	38	-	43
NV	NEVP	6,544	-	1,218	-	1,218
	SPPC		113	504	303	920
	Subtotal	***38,653***	***3,778***	***7,039***	***396***	***11,213***
WY	PAWY (OOS CA)	7,884	2,000	-	-	2,000
NM	PNM (OOS CA)	7,884	2,000	-	-	2,000
	Total	**54,421**	**7,778**	**7,039**	**396**	**15,213**

The Planning Subcommittee is currently developing the detailing siting and resource type assumptions that will locate the 54,000 GWh of renewable resource. These assumptions will first be vetted by the Planning Subcommittee, then reviewed by the PMC before this scenario model is finalized.

Load: Load levels will be maintained as modeled in the 2026 Base Case – see above for details.

Transmission: Identical transmission assumptions as the 2026 Base Case – see above for details.

Other Assumption: None.

2026 CPP – WestConnect Utility Plans Scenario

Please see "Section 3 Regional Reliability Models" for a description of this scenario. The economic model and reliability model will have identical assumptions for the scenario.

2026 CPP – Market-based Compliance Scenario

Description: This scenario was intended to reflect a future where CO_2 emissions reductions outlined in the CPP are achieved through mass-based compliance by assigning a dollar per ton value to CO_2 emissions. While it is unlikely that the entire Western Interconnection or all of WestConnect would seek a mass-based compliance approach to the CPP, modeling a CO_2 price can serve as a proxy for the region's general compliance with the CPP.

At the time this scenario was designed, CPP implementation has been stayed by the Supreme Court and there is significant uncertainty about states' plans for CPP implementation. Thus, this is a scenario study that is simply intended to better understand how assigning a value to CO_2 impacts the WestConnect transmission system and Base Transmission Plan.

Generation: There will be no resource additions or retirements from the 2026 Base Case. The CO_2 price modeling will be conducted as follows:

- CO_2 emissions from affected electric generating units (EGUs) identified in the CPP within Arizona, Colorado, New Mexico, Nevada, and the Navajo Nation will be assigned a dollar per ton cost that will be increased until the collective emissions from these EGUs is roughly equal to or less than 116 million short tons. This value was selected as the emission reduction target as it represents the aggregated interim Environmental Protection Agency ("EPA") CPP goal associated with the 2026 timeframe (for the states listed above). The New Source Complement, which would increase the total emission target and expand the set of covered resources, is not included in this assessment.
- For California generators, AB 32 cap-and-trade modeling will be maintained as in the original 2026 Base Case.[6] This assumption is consistent with predictions that current California policy will be sufficient for that state to achieve the reductions outlined in the CPP.
- EGUs across the rest of WECC (i.e., western states not listed above) will be assigned a simplifying CO_2 emission cost of $15/ton. This cost is intended to serve as a proxy for emission reduction actions these states may take. WestConnect opted not to optimize and iterate on a CO_2 cost for these states in order to simplify the analysis and focus the modeling on the WestConnect region.

This modeling approach may have to be revised, depending on the results of initial model runs. If that is the case, the PMC will be briefed on the issues encountered and the Planning Subcommittee will propose an alternative modeling approach for PMC consideration.

Load: Load levels will be maintained as modeled in the 2026 Base Case – see above for details.

Transmission: Identical transmission assumptions as the 2026 Base Case – see above for details.

Other Assumption: None.

2026 CPP – Heavy RE/EE Build Out Scenario

Please see "Section 3 Regional Reliability Models" for a description of this scenario. The economic model and reliability model will have identical assumptions for the scenario.

[6] *2026 Common Case V1.0 - Release Notes, "Modeling the California Global Warming Solutions Act of 2006 (AB 32)"*

5.0 Modeling Public Policy

Enacted public policies are considered early in the planning process and are incorporated into the base models (both reliability and economic) through the roll-up of local TO plans and their associated load, resource, and transmission assumptions. Enacted public policies that are subject to significant uncertainty within the planning horizon are also considered, but only as a part of a scenario. Examples of several scenario studies addressing "uncertain" public policies can be found on the prior pages. The WestConnect regional models address the following public policy issues:

- State renewable portfolio standards
- Clean Power Plan
- Distributed generation

6.0 Uncertainties of Economic Modeling

Economic (Production Cost) planning studies, regardless of software, require vigorous pre-and-post review and validation. In particular, some production cost models simulate unit commitment and dispatch, minimizing the operational costs of meeting hourly load and ancillary service requirements across the entire interconnection, given generation operating constraints and transmission topology and path (flowgate) limits. The Western Interconnection does not operate under a consolidated energy market and thus, many utilities, including WestConnect PMC members, serve customer load primarily with output from their individually or jointly-owned resources along with supplementary generation from short-term and/or long-term bilateral energy contracts. The result of production cost simulation assuming a single organized Locational Marginal Price (LMP) WestConnect market could be different from the sum of simulations of multiple Balancing Area markets. Therefore, pre- and post-review processes are essential to account for differences between a single organized LMP market utilized in the production cost model and bilateral markets that are prevalent in the west.[7] In this example, and many others, planning models do not always align with actual operation.

This example demonstrates the importance of carefully considering modeling results updating and enhancing models whenever possible, to reflect the realities of the system, including how transactions in the WestConnect region may be impacted by such factors as the existence of ownership and contractual rights, operating practices, known system conditions, and transmission constraints. WestConnect strives to have the regional models represent the current and expected future of the region. The efforts taken by the Planning Subcommittee during the model development process, however, do not eliminate the need for a strong post-model run evaluation process. The review and validation part of the process is aimed at evaluating the degree to which the output of the model can be relied on for identifying regional transmission needs in the WestConnect region and solutions to those regional needs such that the solutions would yield production cost savings that will actually be received, with relative certainty by the relevant WestConnect transmission owners' retail distribution service territories.

[7] *It is important to note that the PMC's use of production cost modeling does not replace or impose changes to the resource planning processes and selections made by individual PMC members.*

7.0 Next Steps

The Planning Subcommittee compiled this report to document major assumptions that have been incorporated into the regional models. The Reliability Base Models outlined in this report are complete[8], and upon PMC approval of this document, the Planning Subcommittee will begin finalizing regional reliability assessments performed using the Base Models. Some of the Reliability Scenario Models described in this report are complete, while others have vetted assumptions outlined in this document that are still being incorporated into models. With respect to the Economic Base Model, efforts to make the model more representative of the WestConnect region are continuing. The PMC will be briefed by Planning Subcommittee leadership as the Economic Base Model and the remaining Scenario Models become ready for assessment. [9] However, through approval of this report and the assumptions contained herein, the Planning Subcommittee has sufficient direction to proceed in finalizing all models and assessments outlined as a part of the 2016-17 Study Plan.

Both draft and final versions of the regional models are made available to PMC Members and others that have executed the WestConnect Confidentiality Agreement.

The regional transmission assessment, which will be conducted during Q4 of 2016, is anticipated to be complete by early December and will culminate with a report from the Planning Subcommittee to the PMC. That report will document the findings of the regional assessments and propose recommendations on any potential regional needs and/or opportunities.

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[8] *Subject, of course, to the caveats addressed in Section 6.0 with respect to the need to scrutinize model outputs and make continuing adjustments and updates.*

[9] *These efforts will proceed forward into the fourth quarter of 2016, but even after this time, incorrect or incomplete modeling data inputs and assumptions will be addressed and corrected as they are discovered, providing an iterative process of reviewing and updating the models during the process.*

8.0 Appendix A: Scenario Assumptions

8.1 2026 CPP Utility Plans Scenario Assumptions

RETIREMENTS

State	Name	Unit ID	Capacity (MW)	Online Date	Retirement Date	Fuel Type	Prime Mover	Base Case	Scenario
AZ	Cholla	1	116	5/1/1962	**12/31/2024**	Coal	ST	Not retired	Retire unit
AZ	Cholla	3	271	5/1/1980	**12/31/2024**	Coal	ST	Not retired	Retire unit
AZ	Cholla	4	380	6/1/1981	**12/31/2024**	Coal	ST	Not retired	Retire unit
NV	Sunrise	3	70	6/1/1991	**12/31/2024**	Gas	CT	Not retired	Retire unit
NV	Sunrise	4	70	6/1/1991	**12/31/2024**	Gas	CT	Not retired	Retire unit
NV	Sunrise	5	70	6/1/1991	**12/31/2024**	Gas	CT	Not retired	Retire unit
NV	Valmy	1	265	12/1/1981	**12/31/2023**	Coal	ST	Not retired	Retire unit
NV	Valmy	2	300	5//1/1985	**12/31/2023**	Coal	ST	Not retired	Retire unit
NV	Ft. Churchill	1	117	9/1/1968	**12/31/2023**	Gas	ST	Not retired	Retire unit
NV	Ft. Churchill	2	117	9/1/1971	**12/31/2025**	Gas	ST	Not retired	Retire unit

SPECIFIED REPLACEMENTS

State	Name	Unit ID	Capacity (MW)	Online Date	Retirement Date	Fuel Type	Prime Mover	Base Case	Scenario
AZ	APS footprint HV Bus	1	172	1/1/2026	NA	Gas	CT	Not in case	Add units
NV	Reid Gardner	1	152	1/1/2024	NA	Gas	CT	Not in case	Add units
NV	Tracy	1	77	1/1/2022	NA	Gas	CT	Not in case	Add units
NV	Valmy	1	574	1/1/2023	NA	Gas	CC	Not in case	Add units
NV	Ft. Church	1	152	1/1/2026	NA	Gas	CT	Not in case	Add units

8.2 2026 CPP Aggressive Scenario Assumptions

The generators highlighted in red, below, are those that are retired beyond the identified retirements in the CPP Utility Plan Scenario.

CPP3 Retirements

State	Name	Unit ID	ter Capacity (M	Online Date	tirement Da	Fuel Type	Prime Move	Base Case	Scenario	Impacted TO/Area
AZ	Cholla	1	116	5/1/1962	**12/31/2024**	Coal	ST	Not retired	Retire unit	AZPS
AZ	Cholla	3	271	5/1/1980	**12/31/2024**	Coal	ST	Not retired	Retire unit	AZPS
AZ	Cholla*	4	380	6/1/1981	**12/31/2024**	Coal	ST	Not retired	Retire unit	AZPS
NV	Sunrise	3	70	6/1/1991	**12/31/2024**	Gas	CT	Not retired	Retire unit	NEVP
NV	Sunrise	4	70	6/1/1991	**12/31/2024**	Gas	CT	Not retired	Retire unit	NEVP
NV	Sunrise	5	70	6/1/1991	**12/31/2024**	Gas	CT	Not retired	Retire unit	NEVP
NV	Valmy	1	265	12/1/1981	**12/31/2023**	Coal	ST	Not retired	Retire unit	SPPC
NV	Valmy	2	300	5//1/1985	**12/31/2023**	Coal	ST	Not retired	Retire unit	SPPC
NV	Ft. Churchill	1	117	9/1/1968	**12/31/2023**	Gas	ST	Not retired	Retire unit	SPPC
NV	Ft. Churchill	2	117	9/1/1971	**12/31/2026**	Gas	ST	Not retired	Retire unit	SPPC
AZ	ApacheST3	3	175	9/1/1979	**12/31/2025**	Coal	ST	Not retired	Retire unit	AEPCO
AZ	Springerville_1	1	420	6/1/1985	**12/31/2025**	Coal	ST	Not retired	Retire unit	TEPC
NM	San Juan	1	373	12/1/1976	**12/31/2025**	Coal	ST	Not retired	Retire unit	PNM
NM	San Juan	4	544	4/1/1982	**12/31/2025**	Coal	ST	Not retired	Retire unit	PNM
CO	Martin_Drake_6	6	83	10/1/1968	**12/31/2025**	Coal	ST	Not retired	Retire unit	CSU
CO	Comanche_1	1	325	12/1/1972	**12/31/2025**	Coal	ST	Not retired	Retire unit	PSCO
CO	Comanche_2	2	335	12/1/1974	**12/31/2025**	Coal	ST	Not retired	Retire unit	PSCO
CO	Martin_Drake_7	7	131	7/1/1974	**12/31/2025**	Coal	ST	Not retired	Retire unit	CSU
CO	Craig	1	470	7/1/1980	**12/31/2025**	Coal	ST	Not retired	Retire unit	TGST

*Cholla 4 is operated by APS on behalf of PacifiCorp (PACW)

REPOWERINGS

State	Name	Unit ID	Capacity (MW)	Online Date	Retirement Date	Fuel Type	Prime Mover	Base Case	Scenario
AZ	Apache Station	ST2	175	1/1/1979	**12/31/2017**	Coal	ST	Not retired	Retire unit
AZ	Apache Station Retrofit	ST2	181	1/1/2018	**1/1/2035**	Gas	ST	Not in case	Add unit

	Retired Capacity	Replacement Capacity		RE Ratio Assumption			RE ELCC Assumptions				RE Capacity to Add (MW)			
Impacted TO/Area	Coal and Gas (MW)	Gas (MW)	RE (MW)	Wind	Solar	Geothermal	Region	Wind	Solar	Geothermal	Wind	Solar	Geothermal	TOTAL
AEPCO	175	44	131	15%	85%	0%	AZ-NM-NV	24%	42%	100%	82	266	-	348
AZPS	767	192	575	15%	85%	0%	AZ-NM-NV	24%	42%	100%	360	1,164	-	1,524
CSU	214	53	160	70%	30%	0%	RMPA	24%	45%	100%	468	107	-	575
NEVP	210	53	158	0%	100%	0%	AZ-NM-NV	24%	42%	100%	-	375	-	375
PNM	917	229	688	70%	30%	0%	AZ-NM-NV	24%	42%	100%	2,006	491	-	2,497
PSCO	660	165	495	70%	30%	0%	RMPA	24%	45%	100%	1,444	330	-	1,774
SPPC	799	200	599	0%	70%	30%	AZ-NM-NV	24%	42%	100%	-	999	180	1,179
TEPC	420	105	315	15%	85%	0%	AZ-NM-NV	24%	42%	100%	197	638	-	834
TGST	470	118	353	70%	30%	0%	RMPA	24%	45%	100%	1,028	235	-	1,263
*Cholla 4 is operated by APS on behalf of PacifiCorp (PACW). AZPS retired capacity was reduced by 380 MW and the replacement resources will be modeled in PACW.												< Total Renewables (MW)		10,369
							ELCC Assumptions from WECC 2026 RECAP Analysis					< Total Gas (MW)		1,158

9.0 Appendix B: 2026 Base Case (PCM) Assumptions

This appendix contains select modeling assumptions reflected in the WestConnect 2026 Base Case (PCM) which, unless otherwise noted, were taken from the 2026 TEPPC-approved interconnection-wide 10-year PCM.

Figure 5: WECC Assumptions for Fuel Prices by month (2016$/mmBtu)

Fuel Name in Model	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bio_Agri_Res	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54
Bio_Blk_Liquor	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Bio_Landfill_Gas	2.29	2.29	2.29	2.29	2.29	2.29	2.29	2.29	2.29	2.29	2.29	2.29
Bio_Other	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.87	2.87
Bio_Sludge_Waste	0	0	0	0	0	0	0	0	0	0	0	0
Bio_Solid_Waste	0	0	0	0	0	0	0	0	0	0	0	0
Bio_Wood	2.93	2.93	2.93	2.93	2.93	2.93	2.93	2.93	2.93	2.93	2.93	2.93
Coal_Alberta	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31
Coal_AZ	2.52	2.52	2.52	2.52	2.52	2.52	2.52	2.52	2.52	2.52	2.52	2.52
Coal_CA_South	1.76	1.76	1.76	1.76	1.76	1.76	1.76	1.76	1.76	1.76	1.76	1.76
Coal_CO_East	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96
Coal_CO_West	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96	1.96
Coal_ID	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33
Coal_MT	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14
Coal_NM	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31	2.31
Coal_NV	3.13	3.13	3.13	3.13	3.13	3.13	3.13	3.13	3.13	3.13	3.13	3.13
Coal_PNW	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
Coal_UT	3.12	3.12	3.12	3.12	3.12	3.12	3.12	3.12	3.12	3.12	3.12	3.12
Coal_WY_E	2.66	2.66	2.66	2.66	2.66	2.66	2.66	2.66	2.66	2.66	2.66	2.66
Coal_WY_PRB	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.13
Coal_WY_SW	3.28	3.28	3.28	3.28	3.28	3.28	3.28	3.28	3.28	3.28	3.28	3.28
Geothermal	0	0	0	0	0	0	0	0	0	0	0	0
NG_AB	5.308	4.721	4.285	4.9	4.602	4.911	4.466	4.284	3.978	4.097	4.612	5.469
NG_AZ North	5.052	5.088	4.743	4.836	4.867	4.913	4.975	4.739	4.581	4.797	5.047	5.583
NG_AZ South	5.274	5.31	4.96	5.054	5.086	5.133	5.195	4.955	4.795	5.014	5.269	5.815
NG_Baja	5.366	5.406	5.014	5.119	5.155	5.208	5.278	5.009	4.83	5.075	5.36	5.971
NG_BC	5.356	4.763	4.323	4.944	4.643	4.955	4.506	4.322	4.014	4.133	4.653	5.518
NG_CA PGaE BB	4.891	4.928	4.57	4.667	4.699	4.747	4.811	4.566	4.402	4.626	4.886	5.442
NG_CA PGaE LT	5.601	5.64	5.263	5.365	5.399	5.45	5.517	5.258	5.086	5.322	5.596	6.183

Fuel Name in Model	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
NG_CA SDGE	5.83	5.872	5.459	5.57	5.608	5.663	5.737	5.454	5.265	5.523	5.824	6.467
NG_CA SJ Valley	4.998	5.036	4.671	4.769	4.803	4.851	4.917	4.666	4.499	4.727	4.993	5.562
NG_CA SoCalB	5.087	5.125	4.754	4.854	4.888	4.937	5.004	4.749	4.579	4.811	5.081	5.66
NG_CA SoCalGas	5.988	6.031	5.618	5.729	5.767	5.822	5.896	5.613	5.424	5.682	5.982	6.625
NG_CO	4.955	4.857	4.909	4.698	4.494	4.592	4.525	4.291	4.349	4.57	4.637	5.247
NG_ID North	5.224	4.628	4.185	4.809	4.507	4.82	4.369	4.184	3.874	3.995	4.517	5.387
NG_ID South	5.113	5.009	5.064	4.841	4.625	4.728	4.657	4.409	4.471	4.706	4.776	5.422
NG_MT	5.05	4.95	5.003	4.788	4.58	4.68	4.611	4.373	4.432	4.658	4.726	5.347
NG_NM North	4.893	4.927	4.595	4.684	4.715	4.759	4.818	4.591	4.439	4.647	4.888	5.404
NG_NM South	5.22	5.005	4.906	4.802	4.854	5.039	5.099	4.768	4.629	4.84	5.263	5.291
NG_NV North	5.498	5.393	5.449	5.224	5.006	5.11	5.038	4.788	4.851	5.087	5.158	5.809
NG_NV South	5.082	5.12	4.749	4.849	4.883	4.932	4.999	4.744	4.574	4.806	5.076	5.655
NG_OR	5.542	4.91	4.44	5.103	4.782	5.114	4.635	4.439	4.111	4.238	4.792	5.715
NG_OR Malin	5.051	4.948	5.002	4.782	4.568	4.67	4.6	4.355	4.417	4.648	4.718	5.356
NG_TX West	4.878	4.664	4.565	4.462	4.514	4.698	4.758	4.428	4.289	4.499	4.921	4.95
NG_UT	5.454	5.356	5.408	5.199	4.997	5.093	5.027	4.795	4.853	5.072	5.139	5.743
NG_WA	5.786	5.156	4.689	5.348	5.029	5.36	4.883	4.688	4.36	4.487	5.039	5.958
NG_WY	4.952	4.854	4.906	4.696	4.492	4.589	4.522	4.288	4.347	4.568	4.635	5.244
Oil_DistillateFuel_2	22.94	22.94	22.94	22.94	22.94	22.94	22.94	22.94	22.94	22.94	22.94	22.94
Oil_DistillateFuel_H	30.58	30.58	30.58	30.58	30.58	30.58	30.58	30.58	30.58	30.58	30.58	30.58
Oil_DistillateFuel_L	15.36	15.36	15.36	15.36	15.36	15.36	15.36	15.36	15.36	15.36	15.36	15.36
Petroleum Coke	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43
Propane	23.55	23.55	23.55	23.55	23.55	23.55	23.55	23.55	23.55	23.55	23.55	23.55
Purchased_Steam	1	1	1	1	1	1	1	1	1	1	1	1
Refuse	0	0	0	0	0	0	0	0	0	0	0	0
Synthetic Gas	6.99	6.99	6.99	6.99	6.99	6.99	6.99	6.99	6.99	6.99	6.99	6.99
Uranium	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89
Waste_Heat	0	0	0	0	0	0	0	0	0	0	0	0

Figure 6: WECC Assumptions for Fuel Emission Rates by Type (lb/mmBtu)

Fuel Name in Model	Emission Type			Fuel Name in Model	Emission Type		
	SO_2	NOx	CO_2		SO_2	NOx	CO_2
Bio_Agri_Res	0.00579	0.1766362	130	NG_CA PGaE LT	0.0006	0.08	117
Bio_Blk_Liquor	0.00579	0.1766362	130	NG_CA SDGE	0.0006	0.08	117
Bio_Landfill_Gas	0.00579	0.1766362	130	NG_CA SJ Valley	0.0006	0.08	117
Bio_Other	0.00579	0.1766362	130	NG_CA SoCalB	0.0006	0.08	117
Bio_Sludge_Waste	0.00579	0.1766362	130	NG_CA SoCalGas	0.0006	0.08	117
Bio_Solid_Waste	0.00579	0.1766362	130	NG_CO	0.0006	0.08	117
Bio_Wood	0.00579	0.1766362	130	NG_ID North	0.0006	0.08	117
Coal_Alberta	0.35	0.5	205	NG_ID South	0.0006	0.08	117
Coal_AZ	0.571	0.459146	205.0311	NG_MT	0.0006	0.08	117
Coal_CA_South	0.3303097	0.3824139	203.5343	NG_NM North	0.0006	0.08	117
Coal_CO_East	0.6911747	0.552889	204.7532	NG_NM South	0.0006	0.08	117
Coal_CO_West	0.6911747	0.552889	205.2	NG_NV North	0.0006	0.08	117
Coal_ID	0.6911747	0.552889	204.7532	NG_NV South	0.0006	0.08	117
Coal_MT	0.6911747	0.552889	204.7532	NG_OR	0.0006	0.08	117
Coal_NM	0.3303097	0.3824139	203.5343	NG_OR Malin	0.0006	0.08	117
Coal_NV	0.112818	0.3485	202.6215	NG_TX West	0.0006	0.08	117
Coal_PNW	0.621817	0.288333	205.2	NG_UT	0.0006	0.08	117
Coal_UT	0.6911747	0.552889	204.7532	NG_WA	0.0006	0.08	117
Coal_WY_E	0.464041	0.276	200	NG_WY	0.0006	0.08	117
Coal_WY_PRB	0.07	0.1	205.2	Oil_DistillateFuel_2	0.00579	0.176636	156.3
Coal_WY_SW	0.07	0.1	205.2	Oil_DistillateFuel_H	0.00579	0.176636	156.3
DefaultFuel	0.35	0.276	200	Oil_DistillateFuel_L	0.0006	0.116	161.3
Geothermal	0.00579	0.1766362	20	Petroleum Coke	0	0.028	224
NG_AB	0.0006	0.08	117	Propane	0.00579	0.176636	123.1133
NG_AZ North	0.0006	0.08	117	Purchased_Steam	0	0.028	224
NG_AZ South	0.0006	0.08	117	Refuse	0.00579	0.176636	130
NG_Baja	0.0006	0.08	117	Synthetic Gas	0.0006	0.08	117
NG_BC	0.0006	0.08	117	Uranium	0	0	0
NG_CA PGaE BB	0.0006	0.08	117	Waste_Heat	0	0	0

Figure 7: WestConnect Hurdle Rate Assumptions

Wheeling Zones	PCM Area(s)	WestConnect PCM Export Wheels ($/MWh)	
		Commitment Export Wheel	Dispatch Export Wheel
AB_AESO	AESO	11.200	7.200
BC_BCHA	BCHA	11.400	7.400
BS_IPCO	IPFE,IPMV,IPTV	9.740	5.74 (No EIM) 0.574 (EIM)
BS_PACE	PAID,PAUT,PAWY	11.314	7.314 (No EIM) 0.7314 (EIM)
CA_BANC+	BANC,TIDC	8.300	4.300

Wheeling Zones	PCM Area(s)	WestConnect PCM Export Wheels ($/MWh)	
		Commitment Export Wheel	Dispatch Export Wheel
CA_CFE	CFE	18.200	14.200
CA_CISO	CIPB,CIPV,CISC,CISD,VEA	17.500	13.5 (No EIM) 1.35 (EIM)
CA_IID	IID	8.822	4.822
CA_LDWP	LDWP	15.484	11.484
NW_AVA	AVA	11.770	7.770
NW_BPAT+	BPAT,CHPD,DOPD,GCPD,SCL,TPWR	9.990	5.990
NW_NWMT+	NWMT,WAUW	10.560	6.560
NW_PACW	PACW	11.314	7.314 (No EIM) 0.7314 (EIM)
NW_PGE	PGE	7.020	3.02 (No EIM) 0.302 (EIM)
NW_PSEI	PSEI	9.274	5.274 (No EIM) 0.5274 (EIM)
RM_PSCO	PSCO	12.708	8.708
RM_WACM	WACM	11.188	7.188
SW_AZPS	AZPS	11.918	7.918 (No EIM) 0.7918 (EIM)
SW_EPE	EPE	10.661	6.661
SW_NVE	NEVP,SPPC	11.857	7.857 (No EIM) 0.7857 (EIM)
SW_PNM	PNM	11.781	7.781
SW_SRP	SRP	9.534	5.534
SW_TEPC	TEPC	11.601	7.601
SW_WALC	WALC	7.811	3.811

Note: values will be updated to reflect on-off peak modeling capabilities of GridView, will also be removing $1/MWh loss adder to avoid duplication with LMP loss component.