WESTCONNECT REGIONAL TRANSMISSION PLANNING

2020-21 PLANNING CYCLE

MODEL DEVELOPMENT REPORT

APPROVED BY WESTCONNECT PLANNING MANAGEMENT COMMITTEE ON

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1.0 Introduction

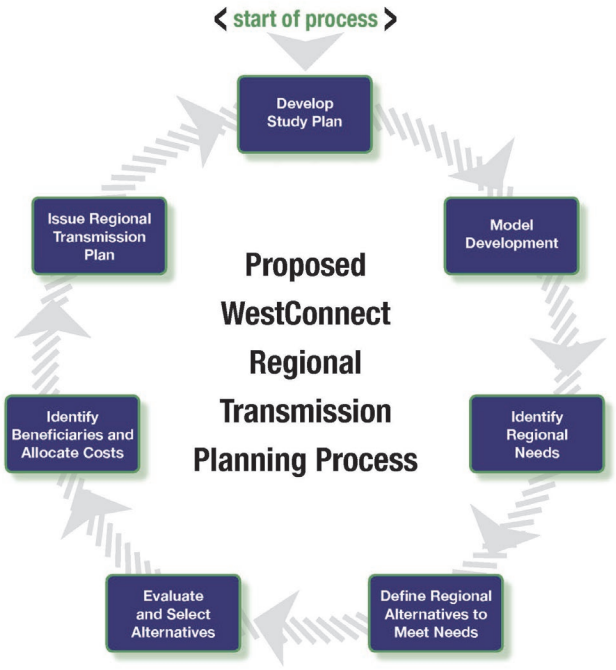
The purpose of this report is to summarize the model development phase of WestConnect's 2020-21 Regional Planning Process. The Planning Subcommittee, which is responsible for developing WestConnect's regional models, has compiled this report to document major assumptions that have been incorporated into 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 used during the transmission assessment. The results of the regional transmission assessment will be documented in the 2020-2021 Regional Transmission Needs Assessment Report.

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 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 (link). Readers can access the text of the FERC Order No. 1000 compliance documentation on the WestConnect website (link) and are encouraged to consult the compliance documentation and BPM for additional process information.

1.2 WestConnect 2020-21 Regional Study Plan

The first step in the planning process is the development of a Regional Study Plan. The 2020-21 WestConnect Study Plan ("Study Plan") was approved by the PMC on March 18, 2020. 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 to be developed in the model development portion of the Planning Process.

2.0 Model Development Overview

During the second, third, and fourth quarter of 2020, the Planning Subcommittee developed the regional models to be used in the identification of regional transmission needs for the 2020-21 Planning Process. Two types of studies are performed in the Planning Process: reliability ("power flow") and economic ("production cost model" or PCM) studies. WestConnect will conduct an assessment of the region's transmission needs using models developed for the 2030 timeframe, approximately 10 years into the

future. WestConnect will also perform information-only scenario studies, as outlined in the Study Plan, which are designed to evaluate alternate but plausible futures.[2]

Table 1 lists the reliability and economic models developed for the 2020-21 cycle for the purposes of identifying regional transmission needs.

Table 1: WestConnect Regional Needs Assessment Planning Models

WestConnect Base Case Name	Case Description	Seed Case(s)
2030 Heavy Summer Base Case	Summer peak load conditions during 1500 to 1700 MDT, with typical flows throughout the Western Interconnection.	WECC 2030 Heavy Summer 1 ADS Planning Base Case (30HS1)
2030 Light Spring Base Case	Light load conditions during 1000 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.	WECC 2030 Light Spring 1-S Base Case (30LSP1S)
2030 Base Case PCM	Business-as-usual, expected-future case with median load and hydro conditions and representation of resources consistent with enacted public policies.	WECC 30HS1, WestConnect 2028 PCM from 2018-19 planning cycle, and WECC 2030 2030 ADS PCM V1.0

Study Area

The WestConnect planning process evaluates the regional transmission needs solely for 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 2020-21 planning process is available on the WestConnect website (link). PMC Members and participants updated WECC models, as described in more detail below, to 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 a reasonable level of 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.

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

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 document each specific assumption.

2030 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 2030 Heavy Summer 1 ADS Planning Base Case dated October 28, 2019 (30HS1), which was updated with the latest topology (i.e., generator, load, and transmission) information from WestConnect participants. 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 48,194 MW of thermal, 8,416 MW of hydro, 3,621 MW of wind, and 10,992 MW of solar resources.

Load: The aggregate coincident peak load level for the WestConnect footprint is 67,257 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: No major planned transmission additions beyond the Base Transmission Plan were included in the case.

Other assumptions: WestConnect coordinated with the California Independent System Operator (California ISO) and NorthernGrid on certain assumptions during model development. A summary of the changes is below.

- Updates in the California ISO footprint: The planned solar generation in the Valley Electric Association (VEA) footprint was revised to a total capacity of 700 MW (from the 1,098.4 MW modeled in the WECC 30HS1 Base Case) based on coordination between WestConnect, NV Energy, and the California ISO.
- Updates in the NorthernGrid footprint: The Boardman to Hemingway 500-kV Line (B2H) (a.k.a. Longhorn to Hemingway) was added for consistency with WECC and NorthernGrid transmission assumptions.

2030 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 seed case was the WECC 2030 Light Spring 1 Scenario Case dated December 9, 2019 (30LSP1-S).

Generation: Within WestConnect, the case features a dispatch of 27,442 MW of thermal, 5,471 MW of hydro, 3,887 MW of wind, and 7,601 MW of solar resources. The case description of the WECC 30LSP1-S included wind and solar dispatch targets shown in **Figure 2**.

Figure 2: Wind and Solar Dispatch Targets from the WECC 30LSP1-S Case Description

Area	Average Dispatch (% of Cap), Weighted by Cap, Type and Area		
	Wind Turbine	Solar PV	Solar Thermal
Alberta	40%		
Arizona	41%	84%	99%[2]
B.C.Hydro	20%		
El Paso		82%	
Idaho	62%	64%	
IID		97%	
LADWP	45%	94%	
Mexico-CFE	42%	80%	
Montana	47%	47%	
Nevada		86%	79%
New Mexico	46%	80%	
Northwest	57%	50%	
PACE	48%	63%	
PG&E	61%	90%	
PSCo	37%	72%	
San Diego	48%	91%	
Sierra	52%	91%	79%
SCE	41%	91%	100%[2]
WAPA R.M.	49%	47%	
WAPA U.W.		47%	

[2] For percent values near or at 100% of nameplate capacity, Data Submitters should provide the maximum recorded output of any existing Wind Turbine, Solar PV and Solar Thermal resources in their area if 100% of nameplate capacity is not feasible. Future resources should be modeled with the expected maximum dispatch value.

Load: The total WestConnect load in the case is 40,701 MW, which is 61% of the WestConnect peak load in the WestConnect 2030 Heavy Summer Base Case. The load levels represent the system during 1000 to 1400 hours MDT during spring.

Transmission: Identical transmission assumptions as the 2030 Heavy Summer Base Case – see above for details.

Other assumptions: Identical other assumptions as the 2030 Heavy Summer Base Case – see above for details.

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 (PF) cases.
- **Protection Systems** – The impact of protection systems including RAS required for compliance with NERC reliability standards will be included in the PF cases.
- **Control Devices** – Any special control devices required will be included in the PF 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 and submit corrections. This procedure resulted in six review drafts of the base reliability models.

4.0 Economic Model Descriptions

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

2030 Base Case

Description: The case is a production cost model (PCM) dataset designed to represent a likely, median 2030 future. The WestConnect 2028 PCM from the 2018-19 planning cycle served as the seed case for the WestConnect economic model 2030 Base Case. The WestConnect 2028 PCM was reviewed and updated by WestConnect during Quarters 2, 3, and 4 of the 2020-21 planning cycle, and the Quarter 3 updates included assumptions from the WECC 2030 Anchor Dataset (ADS) interconnection-wide 10-year PCM ("2030 ADS PCM V1.0"), dated June 30, 2020. These updates were consistent with the process described below, which focuses on what updates were completed with the WECC 2030 ADS PCM V1.0 dataset as the reference.

Generation:

- 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. **Table 2** provides a summary by fuel category of the generation updates made to the WECC 2030 ADS PCM V1.0. The positive (or negative) values represent the capacity (in MWs) and resulting generated energy (in GWh) added to (or removed from) the WECC 2030 ADS PCM V1.0 in order to create the WestConnect 2030 Base Case PCM.

Table 2: Generation Differences from WECC 2030 ADS PCM V1.0.
Percentages are in reference to the totals in the WECC 2030 ADS PCM V1.0

Fuel Category	Differences, WestConnect less WECC PCM				Annual Generation (GWh)		Capacity (MW)	
	Annual Generation		Capacity					
	GWh	%	MW	%	WestConnect	WECC	WestConnect	WECC
Coal	(27,251)	-37.6%	(3,968)	-31.6%	45,282	72,533	8,573	12,540
Gas	22,751	17.2%	3,299	8.8%	154,651	131,899	40,618	37,319
Water	(1,335)	-6.4%	(613)	-6.5%	19,630	20,965	8,854	9,467
Uranium	2,568	8.1%	129	3.2%	34,116	31,548	4,132	4,003
Solar PV	1,867	7.0%	(1,718)	-12.0%	28,704	26,837	12,653	14,371
Solar Thermal	(29)	-3.6%	(106)	-24.9%	766	795	319	425
Wind	2,967	10.7%	776	9.2%	30,820	27,853	9,214	8,438
Bio	316	91.8%	(6)	-5.2%	659	344	102	108
Geothermal	(4,544)	-38.3%	(35)	-2.1%	7,318	11,862	1,581	1,616
BESS	2,155	154.4%	819	37.0%	3,551	1,396	3,034	2,215
Other	(288)	-1.6%	401	3.4%	17,862	18,150	12,102	11,702
Overall	**(822)**		**(1,023)**		**343,360**	**344,182**	**101,181**	**102,204**

- Through coordination with the California ISO and San Diego Gas & Electric (SDG&E), two solar resources located at the Hassayampa substation in the WECC 2030 ADS PCM V1.0 were excluded from the WestConnect models. "Mesquite Solar 5" (300 MW) was found in the California ISO generation queue, but has not been modeled in recent WECC Base Cases so was determined to be too tentative for inclusion in the WestConnect regional models. "SILVER RIDGE MOUNT SIGNAL 3" (250 MW) was found to be duplicative of the "DW GEN2 G3A_23442_1" and "DW GEN2 G3B_23443_1" resources in the WECC 2030 ADS PCM V1.0 (Tenaska Imperial Solar Energy Center West & South resources in the WestConnect 2030 Base Case)

- The behind-the-meter distributed generation (BTM-DG) assumptions were retained from the WECC 2030 ADS PCM V1.0 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 3** summarizes the amount of BTM-DG by area represented in the WestConnect 2030 Base Case PCM.

Table 3: Behind-the-Meter Distributed Generation

Area Name	Capacity (MW)	Generation (GWh)	Capacity Factor (%)	Dispatch at Area Peak Load (% of Capacity)
AZPS	2,815	6,377	26%	48%
BANC	716	1,493	24%	45%
EPE	316	746	27%	65%
IID	199	452	26%	69%

Area Name	Capacity (MW)	Generation (GWh)	Capacity Factor (%)	Dispatch at Area Peak Load (% of Capacity)
LDWP	745	1,611	25%	76%
NEVP	599	1,380	26%	70%
PNM	132	300	26%	58%
PSCO	1,513	2,969	22%	66%
SPPC	83	177	24%	63%
SRP	438	997	26%	52%
TEPC	433	996	26%	67%
WACM	60	119	22%	53%
WALC	324	732	26%	66%

Load: WestConnect made minor modifications to the load shapes and forecasts included in the WECC 2030 ADS PCM V1.0. No changes were made to the load forecasts for areas outside of WestConnect. **Figure 3** and **Figure 4** 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 2030 Heavy Summer Base Case – is provided for a frame of reference, though, some difference between the PCM and 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 3: WestConnect PCM Areas' Annual Demand (GWh) in WestConnect 2030 Base Case (PCM)

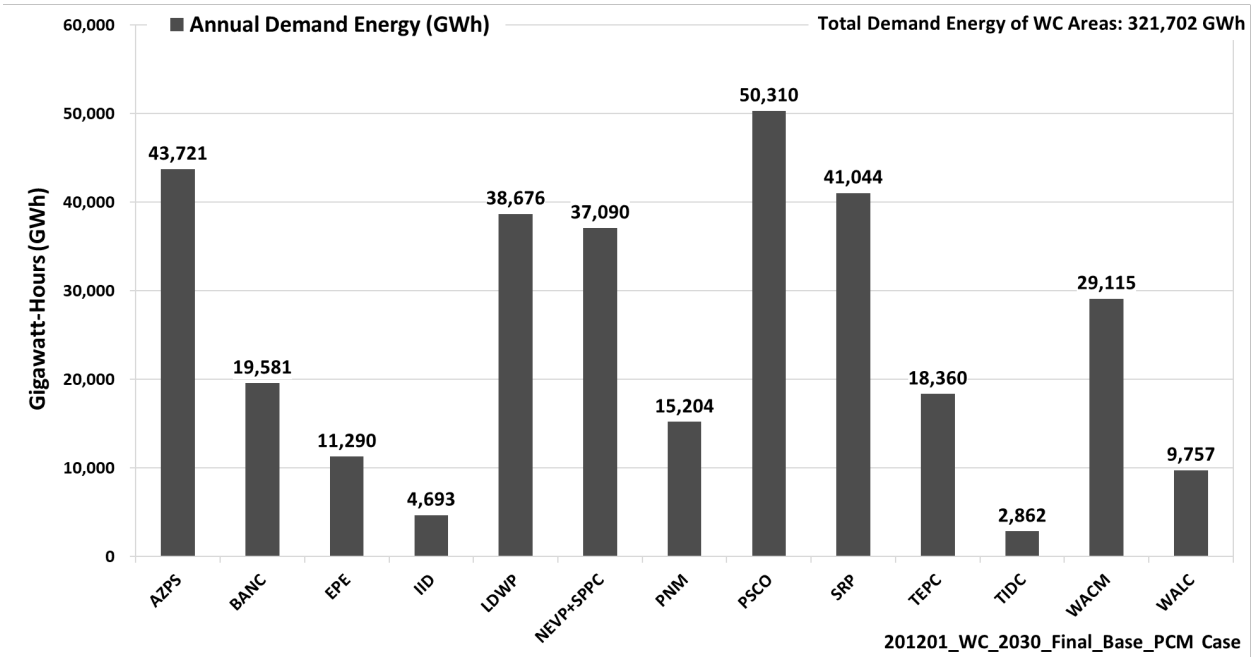
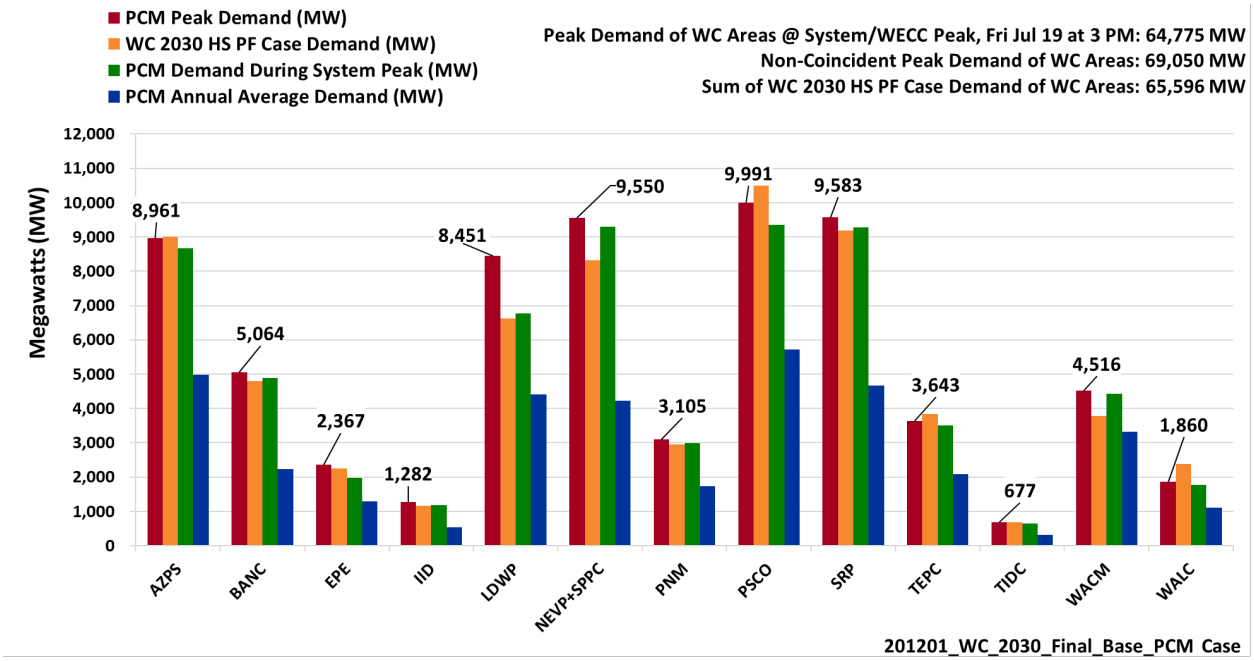


Figure 4: WestConnect PCM Areas' Peak Demand, Demand During System Peak, and Average Demand (MW) in WestConnect 2030 Base Case (PCM), shown with the Demand of the 2030 Heavy Summer Base Case



Transmission: The WECC 2030 ADS PCM V1.0 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 2030 Heavy Summer Base Case.
- Fuel price forecasts and emission rate assumptions were initially pulled from the WECC 2030 ADS PCM V1.0 and subsequently updated with new coal prices accepted by the WECC PCDS during their meeting on April 14, 2020 as well as Member feedback. These assumptions are included in Appendix A.
- Reserve requirements modeling was updated from what was represented in the WECC 2030 ADS PCM V1.0. 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 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 2030 ADS PCM V1.0, 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 4** were based on the CPUC Unified Resource Adequacy and Integrated Resource Plan Inputs and Assumptions – Guidance for Production Cost Modeling and Network Reliability Studies, February 20, 2018 (link).
    - Load Following AS assumptions shown in **Table 4** were based on the CPUC SERVM model for their 2018-19 IRP (link).

Table 4. Regulation and Load Following Ancillary Service Assumptions in WestConnect 2030 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 5**.

Table 5. Frequency Response Ancillary Service Assumptions in WestConnect 2030 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 2030 ADS PCM V1.0 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. The WECC 2030 ADS PCM V1.0 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 2030 ADS PCM V1.0 by the WECC Production Cost Data Subcommittee (PCDS) were implemented. Refer to the "Carbon emission charges updates" topic below for more details.
    - The WECC 2030 ADS PCM V1.0 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. 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

4.1 Economic Sensitivity Models

Models were developed for sensitivity studies on the 2030 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 described below.

2030 High Load Sensitivity Case

Description: Scaled up the hourly load shape of BAAs within WestConnect so their annual peak and energy is a 100%+ percentage of their value in the 2030 Base Case:

- AZPS: 107.03% of peak; 110.38% of energy
- BANC:
    - January-May: 106.5% of peak; 107.15% of energy
    - June-September: 100.65% of peak; 103.9% of energy
    - October-December: 107.15% of peak; 107.8% of energy
- EPE: 101.26% of both peak and energy
- NEVP & SPPC: 102.5% of both peak and energy
- PNM: 116% of peak; 118% of energy
- IID, LDWP, PSCO, SRP, TEPC, WACM, and WALC: 120% of both peak and energy

2030 Low Hydro Sensitivity Case

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

2030 High Gas Price Sensitivity Case

Description: Increased all the natural gas prices to 140% of their value in the 2030 Base Case.

2030 System-Wide Carbon Emission Cost Sensitivity Case

Description: Applied CO_2 emission charges to all generators in WECC via the below updates to the 2030 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 $45/metric ton CO_2e (2020 dollars) for all other generation in the WECC system

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. In this context, enacted public policies are state or federal laws or regulations, meaning enacted statutes (i.e., passed by the legislature and signed by the executive) and regulations promulgated by a relevant jurisdiction, whether within a state or at the federal level. Enacted public policies that are subject to significant uncertainty within the planning horizon are also considered, but only as a part of a scenario.

Table 6 summarizes the enacted public policies that were driving local transmission projects reflected in regional base economic and PF models. This table was originally in the WestConnect 2020-21 Regional Study Plan and has been scaled down in this report to show the enacted public policies driving local transmission needs. After their review of the models, each TOLSO member provided confirmation that the WestConnect 2030 economic and PF models met these public policies' conditions for the study year 2030.

Table 6. Enacted Public Policies Incorporated into 2030 WestConnect Planning Models

Enacted Public Policy	Description
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
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
Colorado HB10-1001	Established Colorado Renewable Energy Standard (RES) to 30% by 2020 for IOUs (Xcel & Black Hills)
Colorado SB13-252	Requires cooperative utilities to generate 20% of their electricity from renewables by 2020
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
New Mexico Efficient Use of Energy Act	Require 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

Enacted Public Policy	Description
Texas Substantive Rule 25.181 (Energy Efficiency Rule)	Require utilities to meet certain energy efficiency targets
New Mexico Energy Transition Act (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
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

Renewable Energy Check

During the model development process, there was interest in seeing if the WestConnect economic models indicated a renewable energy penetration trajectory consistent with enacted public policies. To address this interest, WestConnect conducted a high-level accounting and comparison of each PCM Area's energy sales and renewable energy via the process 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 RE for the SRP PCM Area also included specific hydro and a combined solar & battery generation that was counted as RE based on SRP's plan to meet its public policy requirements, but hydro was otherwise not counted as RE. The Reserve Capacity Distribution settings in the 2030 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 2030 Base Case PCM and compared with these same values from the 2028 Base Case PCM and the 2026 Base Case PCM from the previous two cycles (to allow for comparison between 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 5** 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 7** shows the losses and load including losses used to calculate the WestConnect Energy Sales.

Figure 5. Sum of Energy Sales, Renewable Generation, and Overall RE as % of Energy Sales Based on Single-Year Results from the 2030 Base Case PCM and the Base Case PCM's from previous cycles

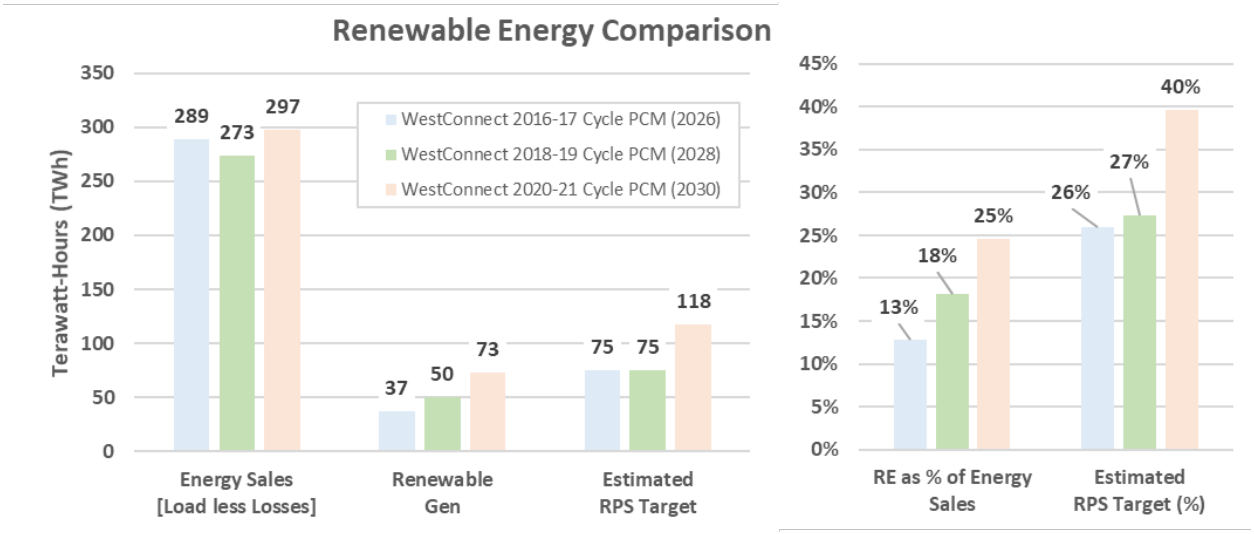


Table 7. BAA Losses and Served Load Including Losses used to calculate the WestConnect Energy Sales in the Renewable Energy Check

BAA	Losses (MWh)	Served Load Includes Losses (MWh)
AZPS	1,236,080	44,432,928
BANC	658,492	20,239,556
EPE	308,374	11,463,913
IID	158,792	4,416,263
LDWP	908,888	37,910,278
NEVP+SPPC	1,141,331	37,163,031
PNM	406,059	14,832,892
PSCO	1,455,003	51,117,735
SRP	1,259,463	41,359,275
TEPC	530,484	18,799,324
WACM	519,517	28,699,977
WALC	325,626	9,981,756
Total	**8,908,109**	**320,416,929**

6.0 Summary of Regional Base Transmission Plan

WestConnect created the regional base transmission plan at the beginning of the 2020-21 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, as well as regional transmission facilities identified in previous regional transmission plans that are not subject to reevaluation.[3] 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.

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 independently developed projects. The TPPL data used for the 2020-21 Planning Process was based on updates submitted as of January 2020, with subsequent updates to the data made by members as of November 13, 2020. 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 2020-21 Regional Study Plan.

6.1 2020-21 Regional Base Transmission Plan Projects

The 2020-21 Base Transmission Plan project list includes 212 planned transmission projects that consist of 74 new or upgraded transmission lines, 66 substations, 29 transmission line and substations, 24 transformers, and 19 other planned projects. From the data reported in the TPPL, these projects span a reported total of 821 miles and add up to a total capital investment of $799.3 Million.[4] **Table 8**, **Table 9**, and **Table 10** summarize the Base Transmission Plan by project type and voltage.

Table 8. Regional Base Transmission Plan Projects by Type, Reported Mileage, and Reported Investment ($K), based on the TPPL data

Type of Project	Number of Projects	Length (Miles)	Planned Investment ($K)
Substation	66	-	$201,399
Transmission Line	74	586	$288,644
Transmission Line and Substation	29	235	$287,532
Transformer	24	-	$14,580
Other	19	-	$7,095
Total	212	821	$799,250

[3] *There are not any re-evaluation projects in the 2020-21 Base Transmission Plan.*

[4] *45% of the transmission line projects listed in the 2020-21 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 9. Number of TOLSO Regional Base Transmission Plan Projects by Voltage and TOLSO, based on the TPPL data

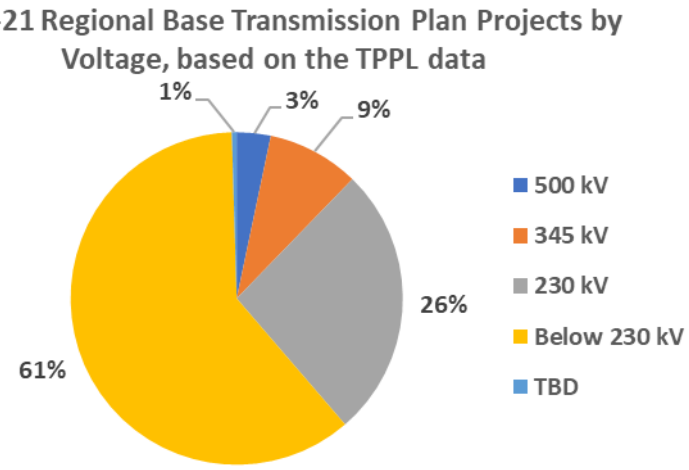
TOLSO	< 230 kV	230 kV	345 kV	500 kV AC	TBD	Total
Arizona Electric Power Cooperative	2	1	-	-	-	**3**
Arizona Public Service	-	7	-	-	-	**7**
Black Hills Energy	8	-	-	-	-	**8**
Black Hills Power	-	5	-	-	-	**5**
Cheyenne Light Fuel and Power	4	-	-	-	-	**4**
Colorado Springs Utility	-	-	-	-	-	**-**
Deseret Power	-	-	-	-	-	**-**
El Paso Electric Company	24	-	3	-	-	**27**
Imperial Irrigation District	1	1	-	-	-	**2**
Los Angeles Department of Water and Power	1	16	-	5	1	**23**
NV Energy	11	6	4	-	-	**21**
Platte River Power Authority	-	2	-	-	-	**2**
Public Service Company of Colorado/ Xcel Energy	4	3	1	-	-	**8**
Public Service Company of New Mexico	1	-	2	-	-	**3**
Sacramento Municipal Utility District	-	2	-	-	-	**2**
Salt River Project	2	1	-	1	-	**4**
Transmission Agency of Northern California	-	-	-	-	-	**-**
Tri-State Generation and Transmission Association	16	7	2	-	-	**25**
Tucson Electric Power	46	2	7	1	-	**56**
Western Area Power Administration - DSW	5	-	-	-	-	**5**
Western Area Power Administration - RMR	4	3	-	-	-	**7**
Western Area Power Administration - SNR	-	-	-	-	-	**-**
Total Projects	**129**	**56**	**19**	**7**	**1**	**212**

Table 10. Regional Base Transmission Plan Projects by Voltage, Reported Mileage, and Reported Investment ($K), based on the TPPL data

Type of Project	Number of Projects	Length (Miles)	Planned Investment ($K)
500 kV	7	0.1	-
345 kV	19	73	$93,427
230 kV	56	268	$271,453
Below 230kV	129	480	$434,370
TBD	1	-	-
Total Projects	**212**	**821**	**$799,250**

Review of the of the 2020-21 regional base transmission plan projects showed that 61% were classified as below 230 kV, 26% were classified as 230 kV, 9% were classified as 345 kV; 3% were classified as the 500 kV; and 1% was classified as TBD. **Figure 6** illustrates the percentage breakout for the 2020-21 regional base transmission plan projects by voltage.

Figure 6. 2020-21 Regional Base Transmission Plan Projects by Voltage, based on the TPPL data



6.2 Updates to the 2018-19 Regional Transmission Plan Projects

Review of the 2018-19 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 2018-19 regional base transmission plan projects can be found in the 2018-19 Regional Transmission Plan Appendix A[5]. Updated information provided to the TPPL showed that 35 projects were placed in service, 14 projects were updated to under construction development status, 4 projects were updated to conceptual development status and 24 projects were withdrawn from the 2018-19

[5] https://doc.westconnect.com/Documents.aspx?NID=18530&dl=1#page=41

Regional Transmission Plan. The remaining 2018-19 regional base transmission plan projects continued as planned projects in the 2020-21 regional base transmission plan. Additionally, 99 new planned projects were added to the TPPL and included in the 2020-21 regional base transmission plan. **Table 11**, **Table 12**, and **Table 13** summarize the updates to the 2018-19 regional base transmission plan projects.

Table 11. 2018-19 Regional Base Transmission Plan Projects In-Service, Reported Mileage, and Reported Investment ($K), based on the TPPL data

Type of Project	Number of Projects	Length (Miles)	Planned Investment ($K)
Substation	10	-	$31,700
Transmission Line	16	248	$124,558
Transmission Line and Substation	3	-	-
Transformer	3	-	$6,700
Other	3	-	$63,909
Total Projects	**35**	**248**	**$226,867**

Table 12. 2018-19 Regional Transmission Plan Projects Under Construction, Reported Mileage, and Reported Investment ($K), based on the TPPL data

Type of Project	Number of Projects	Length (Miles)	Planned Investment ($K)
Substation	5	1	$8,000
Transmission Line	5	30	$17,500
Transmission Line and Substation	2	45	$85,000
Transformer	1	-	$7,800
Other	1	-	$3,700
Total Projects	**14**	**76**	**$122,000**

Table 13. 2018-19 Planned Regional Transmission Plan Projects Withdrawn or Changed to Conceptual by Voltage, based on the TPPL data

New Status	Type	< 230 kV	230 kV	345 kV	Total
Conceptual	Transmission Line	3	-	-	3
	Transmission Line and Substation	-	1	-	1
Withdrawn	Substation	14	-	-	14
	Transmission Line	7	-	-	7
	Transmission Line and Substation	1	-	-	1
	Transformer	-	-	1	1
	Other	1	-	-	1
	Total	**26**	**1**	**1**	**28**

6.3 Regional Base Transmission Plan Projects by State

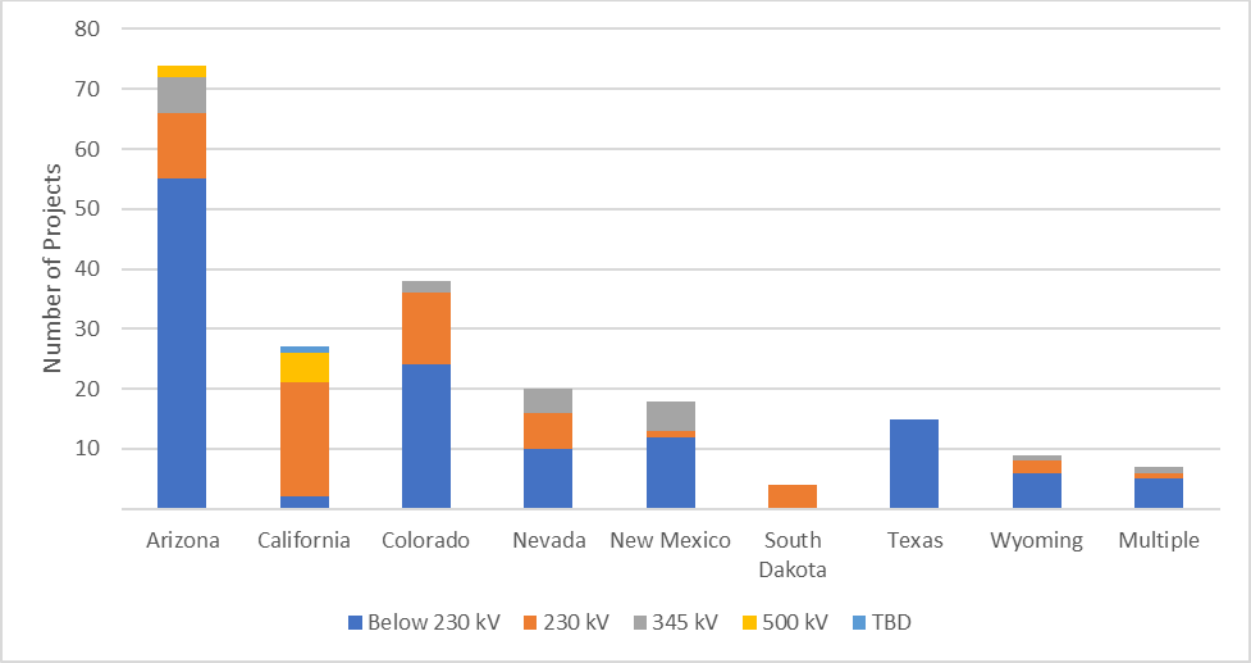
The 2020-21 regional base transmission plan has projects in multiple states in the WestConnect footprint and in some instances, projects span multiple states. **Table 14** summarizes the number of projects by states with aggregated capital investment.

Table 14. 2020-21 Regional Base Transmission Plan Projects by State, Reported Mileage, and Reported Investment ($K), based on the TPPL data

State	Number of Projects	Length (Miles)	Planned Investment ($K)
Arizona	74	275	$270,869
California	27	7	$0
Colorado	38	321	$373,402
Nevada	20	1	$0
New Mexico	18	21	$2,872
South Dakota	4	148	$62,530
Texas	15	21	$0
Wyoming	9	17	$53,177
Multiple	7	11	$36,400
Total Projects	**212**	**821**	**$799,250**

Review of the 2020-21 regional base transmission plan projects by state showed that many (35%) of the projects are located in Arizona, 18% of the projects are located in Colorado, 13% are located in California, and 3% span multiple states. The remaining projects are located in in Nevada, New Mexico, South Dakota, Texas, and Wyoming. **Figure 7** illustrates the breakout of projects by voltage and state.

Figure 7. 2020-21 Regional Base Transmission Plan Projects by Voltage and State, based on the TPPL data



6.4 Regional Base Transmission Plan Projects by Driver

Review of the 2020-21 regional base transmission planned projects showed that nearly all of projects (94%) are primarily driven by reliability needs, 4% are primarily driven by public policy, and the remaining 2% are primarily economic driven. Further review showed that the majority are primarily reliability driven projects below 230 kV (59%). **Table 15**, **Table 16**, and **Figure 8** below breakout the projects by length, planned investment costs, and voltage.

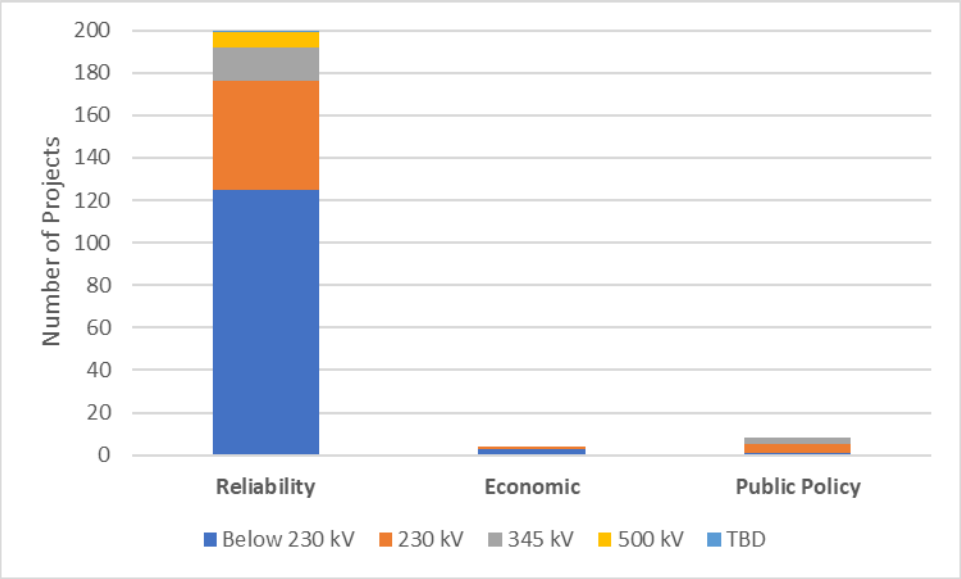
Table 15. 2020-21 Regional Base Transmission Plan Projects by Driver, Reported Mileage, and Reported Investment ($K), based on the TPPL data

Driver (Primary/Secondary)	Number of Projects	Length (Miles)	Planned Investment ($K)
Reliability	183	708	$694,775
Economic	4	13	$28,250
Public Policy	6	-	-
Reliability/Economic	7	100	$64,226
Reliability/Public Policy	10	-	$12,000
Economic/Reliability	-	-	-
Economic/Public Policy	-	-	-
Public Policy/Reliability	2	-	-
Public Policy/Economic	-	-	-
Total Projects	**212**	**821**	**$799,250**

Table 16. 2020-21 Regional Base Transmission Plan Projects by Driver and Voltage, Reported Mileage, and Reported Investment ($K), based on the TPPL data

Driver (Primary/Secondary)	< 230kV	230 kV	345 kV	500 kV	TBD	Total
Reliability	117	45	14	6	1	183
Economic	3	1	-	-	-	4
Public Policy	1	4	1	-	-	6
Reliability/Economic	5	1	1	-	-	7
Reliability/Public Policy	3	5	1	1	-	10
Economic/Reliability	-	-	-	-	-	
Economic/Public Policy	-	-	-	-	-	
Public Policy/Reliability	-	-	2	-	-	2
Public Policy/Economic	-	-	-	-	-	0
Total Projects	**129**	**56**	**19**	**7**	**1**	**212**

Figure 8. 2020-21 Regional Base Transmission Plan Number of Projects by Primary Driver and Voltage, based on the TPPL data



7.0 Scenario Studies

Two scenarios are included in the Study Plan, which WestConnect will perform on an "information-only" basis. Details regarding the process used to develop the scenarios and their purpose in the planning process is located in the Study Plan and provided below for quick reference:

- **Committed Uses Study**: The purpose of the Committed Uses Study is to improve PCM results. The lack of modeling contractual rights to transmission capacity in previous WestConnect production cost models is a key critique. This scenario will allow the PMC to examine the impacts of modeling these contracts and potentially allow for improved modeling. WestConnect Members will work to explicitly model existing contracts – based on OASIS and member-submitted data – for both generator off-take and transmission uses to determine impacts on WestConnect economic study findings. This may involve removal or adjustment of certain wheeling charge assumptions. Importantly, only firm long-term (month or longer) commitments that are under contract should be included, such that any requests under study or received (and not currently under contract) would be excluded.

- **New Mexico Export Stress Study**: The purpose of the New Mexico Export Stress Study is to evaluate the reliability of the WestConnect regional system when power flows east-to-west from New Mexico. The study will be performed using a realistic New Mexico east-to-west export condition from the WestConnect 2030 Base Case production cost model. The export condition will be defined, technically, based on simulation results from the WestConnect 2030 Base Case production cost model filtered for hours in which New Mexico exports high levels of east-to-west flow across WestConnect.

8.0 Next Steps

The Planning Subcommittee compiled this report to document major assumptions that have been incorporated into the base regional models and their sensitivity cases. 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 needs assessment was conducted in parallel with the later stages of the model development process 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.

The scenario assessment will be conducted after the regional needs assessment and will culminate with a report from the Planning Subcommittee to the PMC. That report will document the findings of the scenario assessments and propose recommendations on any potential regional *opportunities*.

9.0 Appendix A: 2030 Base Case (PCM) Assumptions

This appendix contains select modeling assumptions reflected in the WestConnect 2030 Base Case.

Table 17. Annual Average of Fuel Price Assumptions (2020$/mmBtu) in WestConnect 2030 Base Case PCM

Fuel Name	Annual Average of Fuel Prices (2020$/mmBtu)	Fuel Name	Annual Average of Fuel Prices (2020$/mmBtu)
Bio_Agri_Res	0.54	Coal_Wyodak	0.854
Bio_Blk_Liquor	0.01	Geothermal	0.001
Bio_Landfill_Gas	2.26	NG_AB	2.118
Bio_Other	2.9	NG_AZ North	2.776
Bio_Sludge_Waste	0.001	NG_AZ South	2.83
Bio_Wood	2.88	NG_Baja	2.935
Coal_Alberta	1.257	NG_BC	3.086
Coal_Apache	1.958	NG_CA PGaE BB	4.058
Coal_Bonanza	1.455	NG_CA PGaE LT	4.562
Coal_CA_South	2.958	NG_CA SDGE	4.301
Coal_Centennial_Hard	1.007	NG_CA SJ Valley	3.565
Coal_Centralia	1.911	NG_CA SoCalB	2.865
Coal_Colstrip	1.007	NG_CA SoCalGas	4.278
Coal_Comache	1.355	NG_CO	2.886
Coal_Coronado	2.522	NG_CO_Rifle	1.68
Coal_Dry_Fork	0.492	NG_CO_Shafer	1.65
Coal_Four_Corners	2.025	NG_ID South	3.165
Coal_Hayden	1.618	NG_MT	2.279
Coal_Hunter	1.281	NG_NM North	2.721
Coal_Huntington	1.414	NG_NM South	2.693
Coal_ID	2.014	NG_NV North	3.872
Coal_Jim_Bridger	2.014	NG_NV South	3.638
Coal_LRS	1.13	NG_OR	3.165
Coal_Martin_Drake	1.105	NG_OR Malin	3.248
Coal_Neil_Simpson	0.623	NG_TX West	2.733
Coal_Nixon	1.109	NG_UT	3.318
Coal_NV	1.926	NG_WA	3.064
Coal_Pawnee	1.258	NG_WY	2.59
Coal_Springerville 3	2.19	Oil_DistFuel_TSGT	21.82
Coal_Springerville 4	2.497	Oil_DistillateFuel_2	21.622
Coal_Springerville12	2.47	Petroleum Coke	1.41
Coal_Sunnyside	1.414	Uranium	0.703
Coal_Wygen	0.621	Waste_Heat	0.001

507 **Table 18. Fuel Emission Rates by Type (lb/mmBtu) in WestConnect 2030 Base Case PCM**

Fuel Groups or Fuel Name	Fuel Emission Rates by Type (lb/mmBtu)			Fuel Groups or Fuel Name	Fuel Emission Rates by Type (lb/mmBtu)		
	SO_2	NO_X	CO_2		SO_2	NO_X	CO_2
"Bio" Fuels	0.00579	0.1766362	130	Coal_Martin_Drake	0.6911747	0.552889	204.7532
"NG" Fuels	0.0006	0.08	117	Coal_Naughton	0.07	0.1	205.2
Coal_Alberta	0.35	0.5	205	Coal_Navajo	0.571	0.459146	205.0311
Coal_Apache	0.571	0.459146	205.0311	Coal_Neil_Simpson	0.07	0.1	205.2
Coal_Bonanza	0.6911747	0.552889	204.7532	Coal_Nixon	0.6911747	0.552889	204.7532
Coal_CA_South	0.3303097	0.3824139	203.5343	Coal_NV	0.112818	0.3485	202.6215
Coal_Centennial_Hard	0.6911747	0.552889	204.7532	Coal_Pawnee	0.6911747	0.552889	204.7532
Coal_Centralia	0.621817	0.288333	205.2	Coal_Rawhide	0.6911747	0.552889	204.7532
Coal_Colstrip	0.6911747	0.552889	204.7532	Coal_San_Juan	0.3303097	0.3824139	203.5343
Coal_Comache	0.6911747	0.552889	204.7532	Coal_Springerville 3	0.571	0.459146	205.0311
Coal_Coronado	0.571	0.459146	205.0311	Coal_Springerville 4	0.571	0.459146	205.0311
Coal_Craig	0.6911747	0.552889	204.7532	Coal_Springerville12	0.571	0.459146	205.0311
Coal_Dave_Johnston	0.07	0.1	205.2	Coal_Sunnyside	0.6911747	0.552889	204.7532
Coal_Dry_Fork	0.07	0.1	205.2	Coal_Valmy	0.112818	0.3485	202.6215
Coal_Escalante	0.3303097	0.3824139	203.5343	Coal_Wygen	0.07	0.1	205.2
Coal_Four_Corners	0.571	0.459146	205.0311	Coal_Wyodak	0.07	0.1	205.2
Coal_Hayden	0.6911747	0.552889	204.7532	DefaultFuel	0.35	0.276	200
Coal_Hunter	0.6911747	0.552889	204.7532	Geothermal	0.00579	0.1766362	20
Coal_Huntington	0.6911747	0.552889	204.7532	Oil_DistFuel_TSGT	0.00579	0.1766362	156.3
Coal_ID	0.6911747	0.552889	204.7532	Oil_DistillateFuel_2	0.00579	0.1766362	156.3
Coal_Intermountain	0.6911747	0.552889	204.7532	Petroleum Coke	0	0.028	224
Coal_Jim_Bridger	0.07	0.1	205.2	Uranium	0	0	0
Coal_LRS	0.07	0.1	205.2	Waste_Heat	0	0	0

508
509 **Table 19. WestConnect Inter-Area Wheeling Rate Assumptions in WestConnect 2030 Base Case PCM. Non-public**
510 **wheeling charges provided by WestConnect members are excluded from this table: WACM export wheel.**

From Zone	To Zone	From PCM Area(s)	To PCM Area(s)	Wheeling Charge ($/MWh)	
				Peak Hours	Off-Peak Hours
AB_AESO	BC_BCHA	AESO	BCHA	2.338	2.338
AB_AESO	NW_NWMT+	AESO	NWMT, WAUW	5.2	5.2
BC_BCHA	AB_AESO	BCHA	AESO	9.915 up to 590 MW, then 3.131	9.915 up to 590 MW, then 3.131
BC_BCHA	NW_BPAT+	BCHA	BPAT, CHPD, DOPD, GCPD, SCL, TPWR	0 up to 1571 MW, then 7.755	0 up to 1571 MW, then 7.755
BS_IPCO	NW	IPFE	AVA, BPAT, CHPD, DOPD, GCPD, PACW, PGE, SCL, TPWR	0 up to 2160 MW, then 2.912	0 up to 2160 MW, then 2.912
BS_IPCO	SW_NVE	IPFE	NEVP	4.64	2.59
BS_PACE	<Any>	PAID	<Any>	6.902	3.283
CA_BANC+	<Any>	BANC, TIDC	<Any>	2.3	2.3

From Zone	To Zone	From PCM Area(s)	To PCM Area(s)	Wheeling Charge ($/MWh)	
				Peak Hours	Off-Peak Hours
CA_CFE	CA_CISO	CFE	CIPB, CIPV, CISC, CISD, VEA	12.2	12.2
CA_CISO	<Any>	CIPB, CIPV, CISC, CISD, VEA	<Any>	11.5	11.5
CA_IID	<Any>	IID	<Any>	3.06	3.06
CA_LDWP	<Any>	LDWP	<Any>	9.31	4.42
NW	BS_IPCO	AVA, BPAT, CHPD, DOPD, GCPD, PACW, PGE, SCL, TPWR	IPFE	0 up to 1080 MW, then 2.103	0 up to 1080 MW, then 2.103
NW	NW_NWMT+	AVA, BPAT, CHPD, DOPD, GCPD, PACW, PGE, SCL, TPWR	NWMT, WAUW	0 up to 1215 MW, then 2.103	0 up to 1215 MW, then 2.103
NW_BPAT+	<Any>	BPAT, CHPD, DOPD, GCPD, SCL, TPWR	<Any>	3.99	3.99
NW_BPAT+	BC_BCHA	BPAT, CHPD, DOPD, GCPD, SCL, TPWR	BCHA	0 up to 1201 MW, then 2.103	0 up to 1201 MW, then 2.103
NW_BPAT+	SW_NVE	BPAT, CHPD, DOPD, GCPD, SCL, TPWR	NEVP	0 up to 120 MW, then 2.103	0 up to 120 MW, then 2.103
NW_NWMT+	<Any>	NWMT, WAUW	<Any>	4.56	4.56
NW_NWMT+	BS_PACE	NWMT, WAUW	PAID	0 up to 192 MW, then 5.166	0 up to 192 MW, then 5.166
NW_NWMT+	NW	NWMT, WAUW	AVA, BPAT, CHPD, DOPD, GCPD, PACW, PGE, SCL, TPWR	0 up to 2016 MW, then 5.166	0 up to 2016 MW, then 5.166
NW_PACW	<Any>	PACW	<Any>	6.902	3.283
NW_PGE	<Any>	PGE	TH_Malin	1.02	1.02
RM_PSCO	<Any>	PSCO	<Any>	8.238	4.753
SW_AZPS	<Any>	AZPS	<Any>	7.338	4.102
SW_AZPS	BS_PACE	AZPS	PAID	0 up to 300 MW, then 7.338	0 up to 300 MW, then 4.102
SW_EPE	<Any>	EPE	<Any>	5.706	3.326
SW_NVE	<Any>	NEVP	<Any>	7.09	4.28
SW_PNM	<Any>	PNM	<Any>	6.042	5.448
SW_SRP	<Any>	SRP	<Any>	4.36	2.48
SW_TEPC	<Any>	TEPC	<Any>	7.1	3.686
SW_WALC	<Any>	WALC	<Any>	1.811	1.811

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512 **Table 20. Names of Monitored Interfaces in WestConnect 2030 Base Case PCM**

Monitored Interface Names	
_IPP DC pole balancing	P62 Eldorado-McCullough 500 kV Line
Delisted-P22 Southwest of Four Corners	P65N Pacific DC Intertie (PDCI)
Delisted-P23 Four Corners 345/500 Qualified Path	P65S Pacific DC Intertie (PDCI)
Delisted-P50 Cholla-Pinnacle Peak	P66 COI
Delisted-P51 Southern Navajo	P71 South of Allston
FlowMonitor_18009_180514_1	P73 North of John Day
P01 Alberta-British Columbia	P75 Hemingway-Summer Lake
P02 Alberta-Saskatchewan	P76 Alturas Project
P03 Northwest-British Columbia	P77 Crystal-Allen
P03East Side NW-BC	P78 TOT 2B1
P03West Side NW-BC	P79 TOT 2B2
P04 West of Cascades-North	P80 Montana Southeast
P05 West of Cascades-South	P81 Southern Nevada Transmission Interface (SNTI)
P06 West of Hatwai	P82 TotBeast
P08 Montana to Northwest	P83 Montana Alberta Tie Line
P14 Idaho to Northwest	P84 Harry Allen - Eldorado (HAE)
P15 Midway-LosBanos	P85 SNTI + HAE
P16 Idaho-Sierra	Palo Verde East
P17 Borah West	SeriesRctrLine_10231_12038_1
P18 Montana-Idaho	SeriesRctrLine_12008_12007_1
P19 Bridger West	SeriesRctrLine_30560_30527_1
P20 Path C	SeriesRctrLine_30692_30690_1
P24 PG&E-Sierra	SeriesRctrLine_30700_30527_1
P25 PacifiCorp/PG&E 115 kV Interconnection	SeriesRctrLine_30700_30697_1
P26 Northern-Southern California	SeriesRctrLine_34727_34700_1
P27 Intermountain Power Project DC Line	SeriesRctrLine_34742_34704_1
P28 Intermountain-Mona 345 kV	SeriesRctrLine_60275_60278_1
P29 Intermountain-Gonder 230 kV	SeriesRctrLine_73414_78664_1
P30 TOT 1A	xy AZ-CA
P31 TOT 2A	xy WY-UT
P32 Pavant-Gonder InterMtn-Gonder 230 kV	z Aeolus South
P33 Bonanza West	z Aeolus West
P35 TOT 2C	z CA IPP DC South
P36 TOT 3	z CA PG&E-Bay
P37 TOT 4A	z ID Midpoint West
P38 TOT 4B	z CG Columbia Injection
P39 TOT 5	z CG Net COB (NW AC Intertie)
P40 TOT 7	z CG North of Echo Lake
P41 Sylmar to SCE	z CG North of Hanford
P42 IID-SCE	z CG Paul-Allston
P45 SDG&E-CFE	z CG Raver-Paul
P46 West of Colorado River (WOR)	z CG South of Boundary
P47 Southern New Mexico (NM1)	z CG South of Custer
P48 Northern New Mexico (NM2)	z CG West of John Day
P49 East of Colorado River (EOR)	z CG West of Lower Monumental
P52 Silver Peak-Control 55 kV	z CG West of McNary
P54 Coronado-Silver King 500 kV	z CG West of Slatt
P55 Brownlee East	zzz N Path 18 Exp 2
P58 Eldorado-Mead 230 kV Lines	zzz N Path 18 Imp 2
P59 WALC Blythe - SCE Blythe 161 kV Sub	zzz N Path 22_part1
P60 Inyo-Control 115 kV Tie	zzz N Path 22_part2
P61 Lugo-Victorville 500 kV Line	

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