2014 Power Supply Assessment

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September 2014

WECC

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Contents

Introduction

The 2014 Western Electricity Coordinating Council (WECC) Power Supply Assessment (PSA) is an evaluation of generation resource reserve margins for the WECC summer and winter peak hours for the forecast period 2015 through 2024. The members of the Reliability Assessment Work Group (RAWG) have the responsibility to establish the tools, methodology, and data requirements for conducting the annual PSA. The responsibility, as assigned by the Planning Coordination Committee, is described in detail in the WECC PSA Policy.[1]

Purpose

The purpose of this report is to present the results of the PSA that was conducted during the third quarter of 2014. The studies cover the summer period from 2015 through 2024 and the winter period from 2015/16 through 2024/25. The input data represent the Loads and Resources (LAR) data submitted in March 2014 by the individual WECC Balancing Authorities (BA).

The capacity assessment identifies subregions within WECC that have the potential for electricity supply shortages for the study period based on reported actual and forecasted demand, existing and forecasted resource, and transmission transfer capability. The ABB/Ventyx modeling tool, Promod IV (Promod),[2] was used to conduct the assessment that includes 19 load and generation zones (zone) aggregated into the four subregions modeled for the PSA. The zonal results are aggregated to subregions to maintain load forecast confidentiality in years two and three of the forecast period as required by the WECC Information Sharing Policy.[3] The aggregation of zones into subregions is detailed in the Loads and Resources Methods and Assumptions[4] document and in Table 1.

Seasonal Planning Reserve Margins (PRM) are reported for each of the four subregions. The PRM is a measure of a subregion's ability to meet its total load requirements with resources in the subregion and transmission-constrained import capability from other subregions. The PRM is calculated as a percentage of resources (generation and transfers) and load, and is the percentage of capacity greater than demand.[5] The calculated PRM is compared to subregional Building Block reserve margins as this

[1] WECC Power Supply Assessment Policy: https://www.wecc.biz/Corporate/PSA_Policy.pdf
[2] Additional information regarding the Promod Model can be found on the ABB/Ventyx website. http://www.ventyx.com/en/enterprise/business-operations/business-products/promod-iv
[3] WECC Information Sharing Policy: https://www.wecc.biz/Corporate/Information Sharing Policy_06-05-14.pdf
[4] LAR Methods and Assumptions: https://www.wecc.biz/Reliability/2014LAR_MethodsAssumptions.pdf
[5] The PRM calculation indicates sufficient resources when the PRM is equal to or greater than the BBM.

assessment's indicator of reserve adequacy. These subregional PRMs are reported in the Summary of Assessment Results section, along with the associated Building Block reserve margins.[6]

Methodology

For purposes of reliability assessments, the WECC Region is divided into 19 zones. The zones are configured around demand centers and transmission hubs. The subregions and their zones are identified in Table 1 on page 3.

A production cost model is used to calculate a supply/demand balance and the associated power transfers among the zones. Resources are allocated to maintain capacity resource adequacy within the individual subregions first. Then available excess capacity is used to meet the needs of other subregions. Data elements needed for the model to calculate the WECC-wide and subregional PRMs are collected from the 38 BAs in WECC. These elements include:

- monthly and annual peak demand and energy forecasts;
- expected generation availability;
- actual hourly energy output of energy-limited resources; and
- a simplified transmission configuration that reflects nominal power transfer capability limits.

The assessment model is designed to measure the supply/demand margins based on the forecasts of monthly peak demands and expected available resources. While peak demand forecasts for future years are readily available from BAs, the forecasts for future resources additions are less certain. Therefore, the certainty associated with the results decreases as one looks further into the future.

Building Block Reserve Margin

The Building Block reserve margins (BBM) were developed under the direction of the Loads and Resources Subcommittee[7] to consider four uncertainties that BAs face:

1. Contingency Reserves;
2. Regulating Reserves;
3. reserves for generation forced outages; and
4. reserves for 1-in-10 weather events.

[6] The margins identified throughout the assessment are planning reserve margins and firm load would not be disrupted to maintain these margins. Rather, the margins are reference points that indicate areas that have lower reserves and smaller margins. The smaller margins are not forecasts of resource shortages. However, areas with smaller margins have a higher possibility, although not likelihood, of resource shortages associated with extreme events such as record-setting temperature deviations.

[7] The Loads and Resources Subcommittee was consolidated with the Reliability Performance Evaluation Work Group into the Reliability Assessment Work Group in March 2014.

Definitions and details of the BBM elements are available in the LAR Methods and Assumptions document.[8]

The Loads and Resources Subcommittee develops separate BBM values for each BA and then aggregated by subregion using a megawatt-based weighted average. It is important to note that the values for the planning reserve margins used in the PSA are not the requirements used by individual Load-Serving Entities, or their regulators, or local governing boards to evaluate their standards for individual resource adequacy. Moreover, they are not intended to supplant any of those requirements. There is at least one zone that is a competitive wholesale market for which there is no mandated reserve margin.

The Building Block reserve margin (BBM) used for each subregion is shown in Table 1.

Table 1 - Subregion Aggregation and Seasonal Margins

Subregion	Zones in Subregion	Balancing Authorities in Subregion	Summer BBM	Winter BBM
Northwest Power Pool (NWPP)	Alberta, Balancing Authority of Northern California, British Columbia, Idaho, Montana, Northern Nevada, Pacific Northwest, Southern Nevada, Utah, Western Wyoming	Alberta Electric System Operator, Avista Corporation, Balancing Authority of Northern California, Bonneville Power Administration - Transmission, British Columbia Hydro and Power Authority, Constellation Energy Control and Dispatch, Idaho Power Company, NaturEner Glacier Wind Energy, NaturEner West Wind, Nevada Power Company, Northwestern Energy, PacifiCorp - East, PacifiCorp - West, Portland General Electric Company, PUD No. 1 of Chelan County, PUD No. 2 of Grant County, PUD No. 1 of Douglas County, Puget Sound Energy, Seattle Department of Lighting, Tacoma Power, Turlock Irrigation District, Western Area Power Administration - Upper Great Plains West	15.5%	16.8%
Rocky Mountain Reserve Group (RMRG)	Colorado, Eastern Wyoming	Public Service Company of Colorado, Western Area Power Administration - Colorado-Missouri Region	13.2%	15.0%

[8] LAR Methods and Assumptions: https://www.wecc.biz/Reliability/2014LAR_MethodsAssumptions.pdf

Subregion	Zones in Subregion	Balancing Authorities in Subregion	Summer BBM	Winter BBM
Southwest Reserve Sharing Group (SRSG)	Arizona, Imperial Irrigation District, New Mexico	Arizona Public Service Company, Arlington Valley, El Paso Electric Company, Gila River Maricopa Arizona, Griffith Energy, Harquahala Generating Maricopa Arizona, Imperial Irrigation District, Public Service Company of New Mexico, Salt River Project, Tucson Electric Power Company, Western Area Power Administration - Lower Colorado Region	14.1%	15.0%
California/ Mexico (CA/MX)	Comisión Federal de Electricidad, Los Angeles Department of Water and Power, Northern CA, San Diego, Southern CA	California Independent System Operator, Comisión Federal de Electricidad, Los Angeles Department of Water and Power	15.0%	11.0%
WECC Total			14.7%	14.6%

Case Descriptions

A total of 10 cases are included in the 2014 PSA. Each case evaluates whether there are sufficient resources[9] (e.g., existing generation, planned and potential additions, and transmission import capacity) in each of the four subregions to meet the peak load forecast requirements. The cases are distinguished by season, by the category of certainty of new generation that is included in addition to existing resources, and by the intensity of the extreme weather impact. The cases are summarized in Table 2.

[9] See Generation Resources section on page 7 for description of resource classes.

Table 2 - Case Descriptions

Case	Season	New Resources	Margin
1	Summer	Class 1	Building Blocks
2	Summer	Class 1 and 2	Building Blocks
3	Summer	Class 1 through 3	Building Blocks
4	Summer	Class 1 through 4	Building Blocks
5	Winter	Class 1	Building Blocks
6	Winter	Class 1 and 2	Building Blocks
7	Winter	Class 1 through 3	Building Blocks
8	Winter	Class 1 through 4	Building Blocks
9	Summer	Class 1 through 3	All Subregions: 1-in-20 Temperature
10	Winter	Class 1 through 3	All Subregions: 1-in-20 Temperature

The common elements used in all of the cases include:

- existing generation as of December 31, 2013;
- Class 1 (Under Construction) generation additions[10];
- scheduled maintenance/inoperable generation;
- hydro energy under adverse water conditions; and
- total firm and non-firm demand.

Datasheets containing aggregated demand, capacity, and transfers for all cases and subregions are available on the WECC website.[11]

Temperature Adder

The impacts of a 1-in-20 year temperature demand event were examined in Case 9 for summer and Case 10 for winter. These cases included resources in classes 1, 2 and 3.

[10] The term "additions" refers to both generation additions and retirements.
[11] PSA datasheets: https://www.wecc.biz/ReliabilityAssessment

The WECC BAs were asked to report their load sensitivity to temperature (megawatts per degree Fahrenheit for both summer and winter), the temperatures on which their reported 1-in-2 demand forecasts were based, and their temperature extremes. Historical temperature data for the Western Interconnection load centers was developed for the period 1990 to 2004 by a consultant at Lawrence Berkeley National Laboratory. Historic temperature data for the period of 2005-2013 was requested in WECC data requests. A statistical process was used to convert the 1-in-2 year weather demand supplied in the data request responses to a 1-in-20 year weather demand condition. This process is described in detail in the Temperature Adders section of the Loads and Resources Methods and Assumptions document.

Demand

BA historical hourly load shapes are averaged and scaled by BA-level peak demand and energy load forecasts (1-in-2 year probability). The scaled BA-level hourly load shapes are aggregated to create region and subregion coincident 1-in-2 year load projections. The BA-level peak demand and energy load forecasts are based on assumed average weather and expected economic conditions. The total internal demands presented in the datasheets[12] for this assessment reflect extractions of the demands coincident with the WECC Region seasonal (summer and winter) peak maximum demands.

The non-firm demands include interruptible and load management demands as reported in the LAR data request responses. The BA-level forecast submittals to WECC are generally based on their most recently-approved forecasts. As such, there may be a significant time lapse between expected conditions at the time the forecast preparation was initiated and the expected conditions as of the publication of this assessment. This time-lapse effect may result in over-forecasts during declining economic conditions and under-forecasts during periods of rapid economic expansion.

Generation Resources

Resources represented in the WECC assessment model are limited to generation that is available, or is expected to be available, to serve the forecasted load during the seasonal peaks. Any generation that is not metered by a BA’s energy management system is excluded, as is the load that is being served by that generation. Hence, distributed generation, such as residential rooftop solar facilities and other behind-the-meter generation and its associated load is not included in this assessment. The LAR data request responses contain a list of existing generation as well as planned generation additions, changes, and retirements.[13] Below is a description of the generation resource classes.

- Existing Generation is generation that is available (in-service) as of December 31, 2013.

[12] PSA datasheets: https://www.wecc.biz/ReliabilityAssessment
[13] A detailed list is available in the PSA datasheets.

- New Generation is reported in four classes (reported as of December 31, 2013):
  - Class 1: Generation additions/retirements that were reported to be under active construction as of the reporting date of December 31, 2013 and are projected to be in-service/retired prior to January 2019. Class 1 also includes facilities or units that have a firm retirement date within the assessment period[14] as a result of regulatory requirements or corporate decisions.
  - Class 2: Generation additions/retirements that were reported to have:

    1) received regulatory approval or are to undergo regulatory review;

    2) a signed interconnection agreement; or

    3) an expected on-line/retirement date prior to January 2021.

    This class includes resources that were expected to be in-service as early as Class 1 resources, but did not meet the test of being under construction; or have an estimated retirement date within the assessment period.
  - Class 3: Generation additions/retirements that were reported and met the North American Electric Reliability Corporation (NERC) criteria for Tier 2[15] but do not qualify as WECC Class 1 or 2 resources.
  - Class 4: Generation additions/retirements that were reported and met the NERC criteria for Tier 3.[16]

Hydro generation in the model is constrained by annual energy limits. Actual energy production from the year 2003 is modeled to limit Northwest Hydro generation and the actual energy production for the year 2002 is modeled to limit California Hydro generation. These two years were selected by WECC's Transmission Expansion Planning Policy Committee (TEPPC) Data Work Group as low water years and best reflect adverse hydro conditions.

Inoperable generation and scheduled maintenance are treated as reductions in available capacity. Inoperable generation is reported in the LAR data request responses. The model calculates scheduled maintenance considering seasonal demand peaks to maximize available capacity during the individual subregional peak periods, not for the entire Western Interconnection. The majority of the summer outages are scheduled for generation in the Canada and Northwest subregions. Other areas try to have all their units available for the summer peak. The generation owners in the summer peaking subregions usually schedule their maintenance in the fall or spring.

[14] The assessment period is from 2015 through 2024 for summer and from 2015/16 through 2024/25 for winter.
[15] Definition included in the NERC Long-Term Reliability Assessment (LTRA): http://www.nerc.com/pa/RAPA/ra/Pages/default.aspx.
[16] Ibidem.

Variable generation modeling of wind resources is based on curves created using at least five years of actual hourly wind generation data. Solar resource energy curves were created using up to five years of actual hourly solar generation data.

Transmission and Capacity Transfers

For modeling purposes, the Western Interconnection is separated into 19 load area zones. These zones are used in a simplified transmission model to calculate potential transfers among zones. The simplified model reflects path transfer capacities among the 19 zones and includes wheeling costs and loss factors as supplied by the BAs. The wheeling costs for each path are used to calculate the transfer costs for any imports into a zone. The wheeling costs range from $0.00 to $6.48 per MWh. The LAR data request asks that transmission line losses be included in all demand forecasts, therefore a loss factor of zero (0) percent is used in the model. Note that neither the wheeling cost nor the loss factor impedes the model from importing surplus resources to meet load.

WECC's assessment process is based on system-wide modeling that aggregates BA-based load and resource forecasts by geographic subregion with conservatively assumed power transfer capabilities limits between the subregions. The transfer capability limits are presented on the zonal topology diagrams included in the LAR Methods and Assumptions document[17] and in Appendix A – Zonal Topology Diagrams. The model allows transfers between the subregions only if excess capacity is available after the BBM has been met in the individual subregions. This modeling approach excludes a representation of contractual commitments by individual entities and assures that capacity margins reflect potential conditions that are independent of variable contractual transfer assumptions.

Remotely owned resources—resources that are physically located in one BA area or subregion, but are owned by an entity or entities located in another BA's geographic footprint or subregion—are also modeled as transfers.[18]

Transfers with other regional councils, such as the Midwest Reliability Organization and the Southwest Power Pool, are ignored in this assessment as this would require unsupported assumptions regarding the amount of surplus or deficit generation in those councils.

Summary of Assessment Results

The results that are included in this report are an indication of the ability of the four WECC subregions to meet their load requirements with internal generation and imports from other subregions or zones under the specified conditions. The methods used and the associated results are limited by the modeling tool and what resources are included in the studies. WECC staff also recognizes that the

[17] LAR Methods and Assumptions: https://www.wecc.biz/Reliability/2014LAR_MethodsAssumptions.pdf
[18] Modeled remote resources are limited to Bridger, Colstrip, Craig, Four Corners, Hayden, Hoover, Intermountain, Navajo, Palo Verde, and San Juan. No other adjustments are made for other joint plants or firm capacity purchases.

specific subregions may have adopted other tools, metrics and study assumptions that could result in different conclusions. For example, the Northwest region, via the Northwest Power & Planning Council, completed an assessment in 2012 that indicates risk (above the adopted regional standard) to resource adequacy if additional dispatchable resources are not built by 2017.

The results, as detailed in in the following sections show sufficient generation resources exist or have been proposed such that all subregions meet the calculated BBM.

Study Caveats

Among the important caveats that should be considered when reviewing these results are:

1. The analysis is based on LAR data submitted in March 2014. The demand forecasts and reported resources for each BA were “locked” as of May 2014. New generation projects announced after the data were “locked” are not included in the resource totals.
2. WECC does not speculate which units may retire due to environmental requirements or financial considerations. Therefore, only generating units that were reported with a planned retirement date are incorporated in these studies.
3. Results of this assessment may differ from the results of similar assessments performed by other parties.
4. Case results are specific to the assumptions used for these studies. The use of different assumptions will produce different results.
5. Transmission constraints apply only between zones. All generation within a zone is deemed deliverable within the zone.
6. Promod IV is an energy planning and analysis software tool that has production cost dispatch model capability. The model transfers resources from areas with surplus generation to deficit areas, considering transfer path constraints and transmission losses. Simultaneous flows, loop flows, and other transfer restrictions are approximated by the restricted transfer limits that were used in the studies, but the model is a transport model, not a power flow model.
7. The Promod model allows WECC staff to capture the Western Interconnection coincidental peak demand. The model uses static hourly demand curves for each BA within WECC. These curves were created by averaging five years of actual hourly demand for each BA. Promod uses an algorithm with the amounts of monthly peak and energy supplied by each BA to modify these curves for each year of the study period. The algorithm “fixes” the monthly peak at the amount supplied by the BA and adjusts the curves up or down to match the demand under the curve to the annual energy reported. This process “flattens” the annual demand curve if the energy load growth rate exceeds the peak demand growth rate. The

process also "peaks" the annual curve if the energy load growth rate is less than the peak demand growth rate.

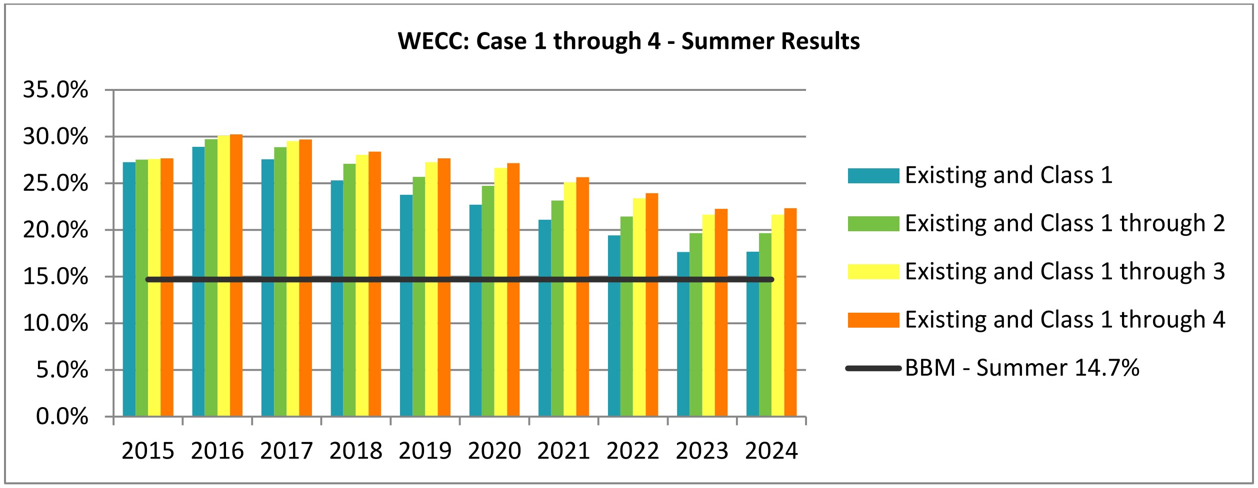
8. For hydro plants in the Northwest and California, the model employs an algorithm that shapes the available hydro energy based on the shape of the area's energy load. This means there can be hydro capacity that is unavailable because it is constrained by the available energy in the hydro system.

9. Variable generation modeling of wind resources is based on curves created using at least five years actual hourly wind generation data. The data is averaged into six four-hour blocks for each day of each week of the year. Solar resource energy curves were created using up to five years actual hourly solar generation data. The data is averaged into three-block curves for each day of each week of the year. The use of average generation removes the hourly peaks and valleys in wind and solar generation while maintaining a reasonable representation of variable energy output.

10. As utilities adjust their procurement processes to rely on renewable resources in compliance with various state Renewable Portfolio Standards, and to rely less on highly-visible central station projects, the limitations of the current resource classification process become more visible. The current process may not capture short lead-time projects, such as wind and solar, that are being developed.

Summary of Assessment Results: WECC – Summer

The numbers represented here are a summary from the PSA datasheets and cannot be used independently to replicate the assessment results. For complete information, please access the PSA datasheets posted on the WECC website.



WECC: Case 1 – Existing/Class 1 Resources Summer Results	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Net Internal Demand	153,954	153,533	155,872	158,226	160,345	162,172	163,745	165,415	167,175	169,314
Anticipated Internal Capacity	196,764	200,099	200,690	200,332	200,219	199,706	199,012	198,562	198,416	198,011
Wind Expected On-Peak MW	6,697	6,697	6,697	6,697	6,697	6,697	6,697	6,697	6,697	6,697
Percentage of Wind Capacity	32.2%	32.2%	32.2%	32.2%	32.2%	32.2%	32.2%	32.2%	32.2%	32.2%
Solar Expected On-Peak MW	2,177	2,177	2,177	2,177	2,177	2,177	2,177	2,177	2,177	2,177
Percentage of Solar Capacity	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%	37.5%
Hydro Expected On-Peak MW	40,608	40,608	40,563	40,561	40,561	40,561	40,435	40,435	40,435	40,435
Percentage of Hydro Capacity	62.1%	62.1%	62.1%	62.1%	62.1%	62.1%	62.1%	62.1%	62.1%	62.1%
Anticipated Resource Reserve Margin MW	41,990	44,390	43,010	40,058	38,124	36,858	34,551	32,110	29,489	27,093
Anticipated Resource Reserve Margin %	27.3%	28.9%	27.6%	25.3%	23.8%	22.7%	21.1%	19.4%	17.6%	16.0%

Summary of Assessment Results: WECC – Winter

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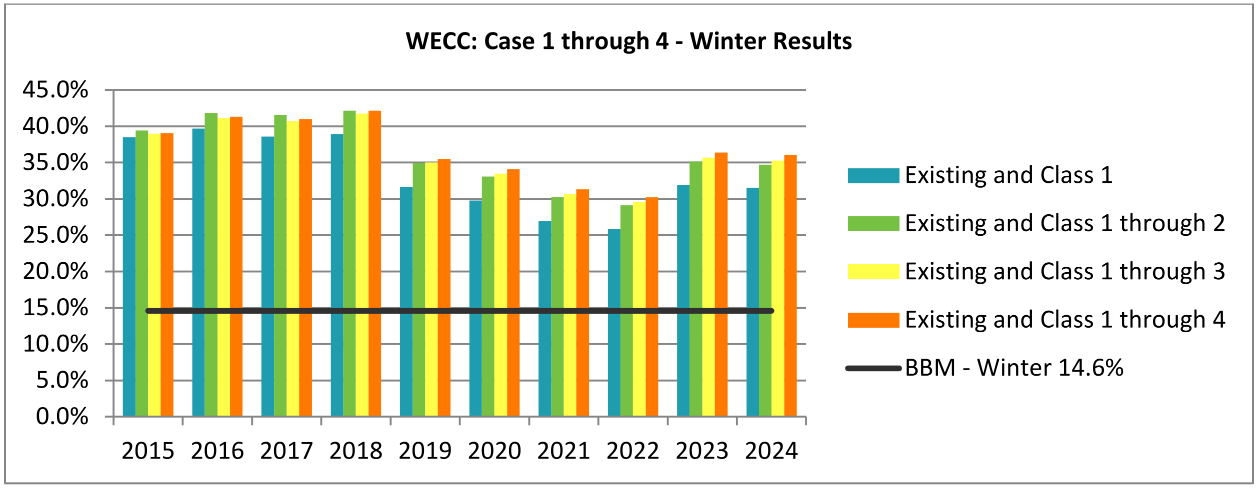

WECC: Case 1 – Existing/Class 1 Resources Winter Results	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Net Internal Demand	134,687	136,069	137,950	139,690	141,432	143,158	144,752	146,266	147,646	148,780
Anticipated Internal Capacity	191,492	194,477	194,743	194,168	194,055	193,519	192,808	192,357	192,209	191,804
Wind Expected On-Peak MW	4,855	4,855	4,855	4,855	4,855	4,855	4,855	4,854	4,854	4,854
Percentage of Wind Capacity	23.4%	23.4%	23.4%	23.4%	23.4%	23.4%	23.4%	23.4%	23.4%	23.4%
Solar Expected On-Peak MW	50	50	50	50	50	50	50	50	50	50
Percentage of Solar Capacity	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%	0.9%
Hydro Expected On-Peak MW	36,887	36,887	36,843	36,841	36,841	36,841	36,718	36,718	36,718	36,718
Percentage of Hydro Capacity	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%	58.3%
Anticipated Resource Reserve Margin MW	51,827	54,013	53,194	54,357	44,778	42,608	39,022	37,819	35,646	34,894
Anticipated Resource Reserve Margin %	38.5%	39.7%	38.6%	38.9%	31.7%	29.8%	27.0%	25.9%	24.1%	23.5%

Summary of Assessment Results: NWPP – Summer

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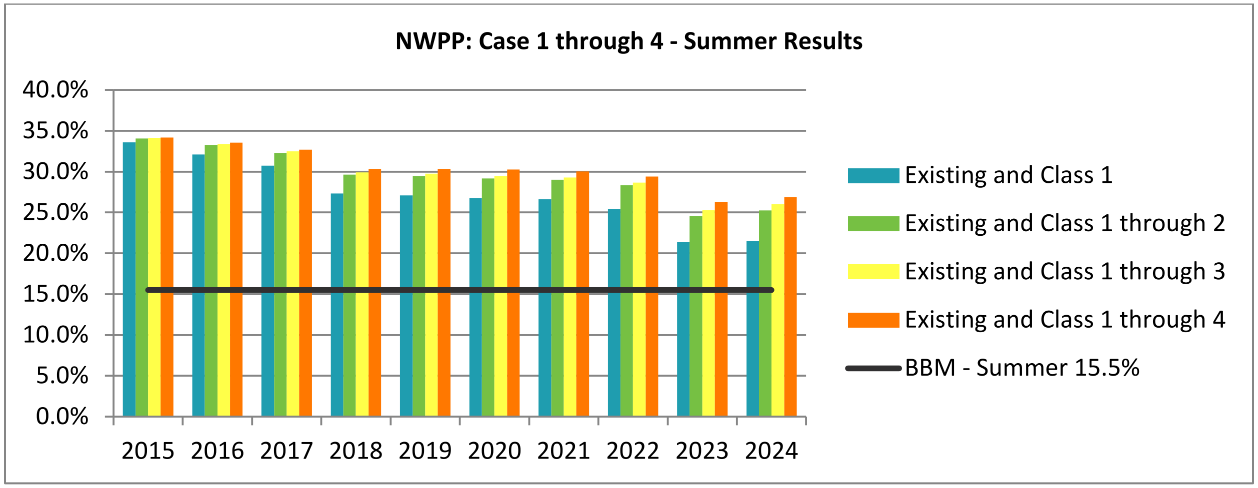

NWPP: Case 1 – Existing/Class 1 Resources Summer Results	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Net Internal Demand	65,467	66,913	68,408	69,847	70,973	71,920	72,762	73,567	74,542	75,831
Anticipated Internal Capacity	89,144	89,763	89,718	89,478	89,365	89,365	88,859	88,492	88,492	88,235
Wind Expected On-Peak MW	3,479	3,479	3,479	3,479	3,479	3,479	3,479	3,479	3,479	3,479
Percentage of Wind Capacity	31.2%	31.2%	31.2%	31.2%	31.2%	31.2%	31.2%	31.2%	31.2%	31.2%
Solar Expected On-Peak MW	197	197	197	197	197	197	197	197	197	197
Percentage of Solar Capacity	52.1%	52.1%	52.1%	52.1%	52.1%	52.1%	52.1%	52.1%	52.1%	52.1%
Hydro Expected On-Peak MW	35,466	35,466	35,421	35,419	35,419	35,419	35,293	35,293	35,293	35,293
Percentage of Hydro Capacity	71%	71%	71%	71%	71%	71%	71%	71%	71%	71%
Imports	1,254	1,143	1,701	1,193	3,504	5,075	5,887	4,551	4,084	6,290
Exports	2,861	1,659	1,047	799	1,658	2,966	2,301	228	367	367
Anticipated Resource Reserve Margin MW	21,980	21,486	21,033	19,088	19,241	19,255	19,360	18,626	15,889	13,427
Anticipated Resource Reserve Margin %	33.6%	32.1%	30.7%	27.3%	27.1%	26.8%	26.6%	25.3%	21.3%	17.7%

Summary of Assessment Results: NWPP – Winter

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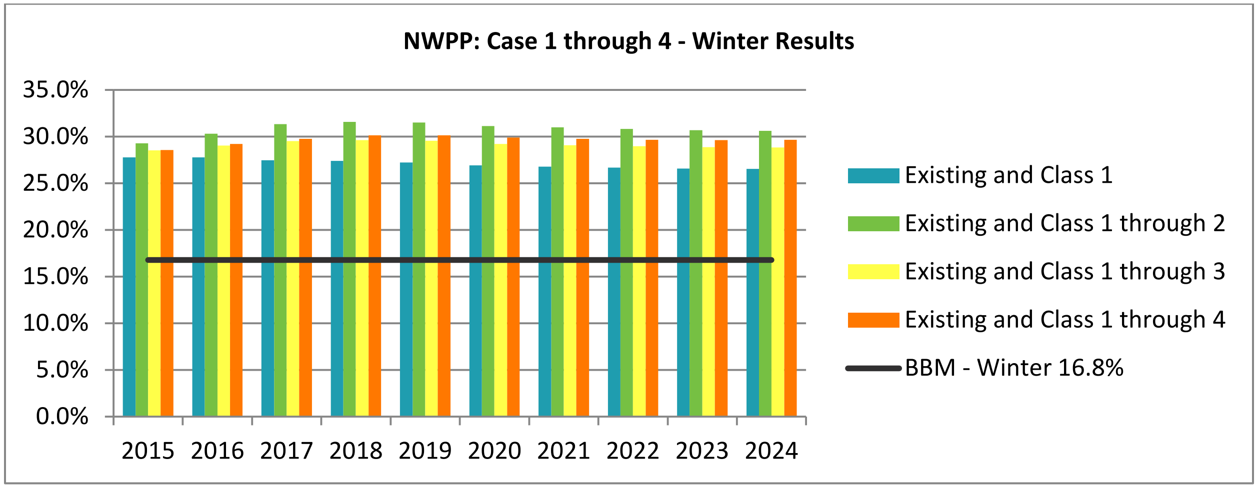

NWPP: Case 1 – Existing/Class 1 Resources Winter Results	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Net Internal Demand	70,453	71,461	72,892	74,105	75,165	76,157	77,097	77,995	78,864	79,587
Anticipated Internal Capacity	89,145	89,062	89,018	88,778	88,665	88,665	88,153	87,786	87,786	87,529
Wind Expected On-Peak MW	3,258	3,258	3,258	3,258	3,258	3,258	3,258	3,258	3,258	3,258
Percentage of Wind Capacity	29.2%	29.2%	29.2%	29.2%	29.2%	29.2%	29.2%	29.2%	29.2%	29.2%
Solar Expected On-Peak MW	0	0	0	0	0	0	0	0	0	0
Percentage of Solar Capacity	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Hydro Expected On-Peak MW	33,695	33,695	33,652	33,649	33,649	33,649	33,526	33,526	33,526	33,526
Percentage of Hydro Capacity	69%	69%	69%	69%	69%	69%	69%	69%	69%	69%
Imports	4,331	3,840	6,203	9,286	9,512	9,425	13,264	14,022	15,220	15,004
Exports	366	366	366	367	366	228	229	228	367	366
Anticipated Resource Reserve Margin MW	19,575	19,855	20,029	20,301	20,470	20,494	20,664	20,819	20,969	21,138
Anticipated Resource Reserve Margin %	27.8%	27.8%	27.5%	27.4%	27.2%	26.9%	26.8%	26.7%	26.6%	26.6%

Summary of Assessment Results: RMRG – Summer

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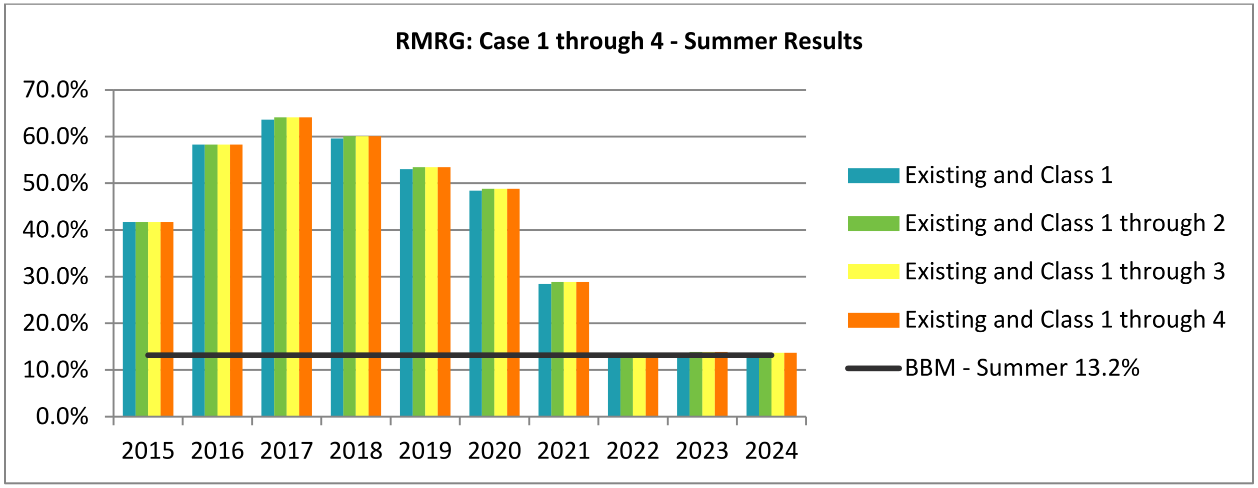
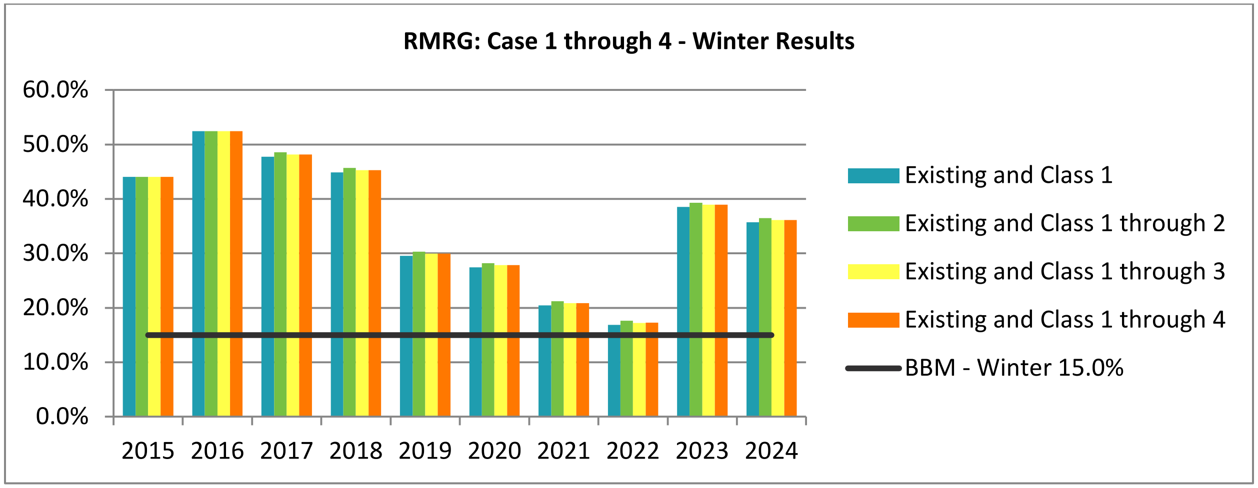


RMRG: Case 1 – Existing/Class 1 Resources Summer Results	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Net Internal Demand	10,660	9,533	9,663	9,824	9,966	10,107	10,232	10,281	10,419	10,616
Anticipated Internal Capacity	15,067	15,424	15,424	15,240	15,240	15,156	15,066	15,066	15,066	15,066
Wind Expected On-Peak MW	718	718	718	718	718	718	718	718	718	718
Percentage of Wind Capacity	29.7%	29.7%	29.7%	29.7%	29.7%	29.7%	29.7%	29.7%	29.7%	29.7%
Solar Expected On-Peak MW	54	54	54	54	54	54	54	54	54	54
Percentage of Solar Capacity	42.8%	42.8%	42.8%	42.8%	42.8%	42.8%	42.8%	42.8%	42.8%	42.8%
Hydro Expected On-Peak MW	778	778	778	778	778	778	778	778	778	778
Percentage of Hydro Capacity	39.6%	39.6%	39.6%	39.6%	39.6%	39.6%	39.6%	39.6%	39.6%	39.6%
Imports	598	558	860	860	860	728	453	98	235	235
Exports	414	414	414	414	414	882	2,380	3,450	3,423	3,053
Anticipated Resource Reserve Margin MW	4,446	5,555	6,151	5,857	5,283	4,895	2,907	1,366	1,401	1,412
Anticipated Resource Reserve Margin %	41.7%	58.3%	63.7%	59.6%	53.0%	48.4%	28.4%	13.3%	13.4%	13.3%

Summary of Assessment Results: RMRG – Winter

The numbers represented here are a summary from the PSA datasheets and cannot be used independently to replicate the assessment results. For complete information, please access the PSA datasheets posted on the WECC website.



RMRG: Case 1 – Existing/Class 1 Resources Winter Results	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Net Internal Demand	9,717	9,861	10,011	10,120	10,241	10,380	10,518	10,648	10,775	10,905
Anticipated Internal Capacity	15,067	15,479	15,479	15,295	15,295	15,189	15,089	15,089	15,089	15,089
Wind Expected On-Peak MW	682	682	682	682	682	682	682	682	682	682
Percentage of Wind Capacity	28.2%	28.2%	28.2%	28.2%	28.2%	28.2%	28.2%	28.2%	28.2%	28.2%
Solar Expected On-Peak MW	0	0	0	0	0	0	0	0	0	0
Percentage of Solar Capacity	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Hydro Expected On-Peak MW	384	384	384	384	384	384	384	384	384	384
Percentage of Hydro Capacity	19.8%	19.8%	19.8%	19.8%	19.8%	19.8%	19.8%	19.8%	19.8%	19.8%
Imports	235	255	235	235	254	97	97	97	235	235
Exports	414	209	440	414	1,709	1,709	2,414	2,409	2,504	2,434
Anticipated Resource Reserve Margin MW	4,278	5,173	4,781	4,542	3,024	2,846	2,151	1,794	1,859	1,895
Anticipated Resource Reserve Margin %	44.0%	52.5%	47.8%	44.9%	29.5%	27.4%	20.4%	16.9%	17.3%	17.4%

Summary of Assessment Results: SRSG – Summer

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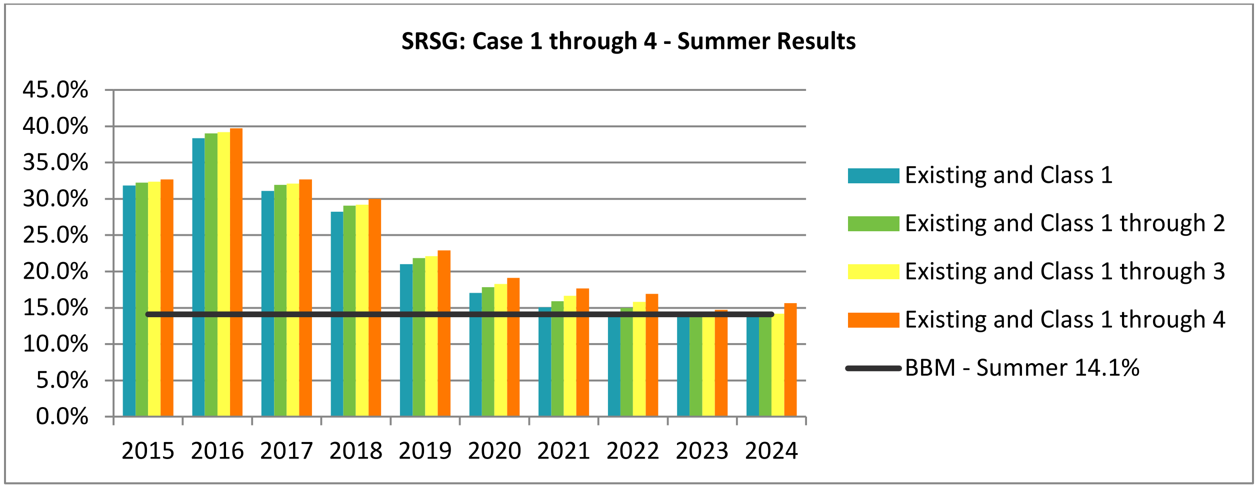

SRSG: Case 1 – Existing/Class 1 Resources Summer Results	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Net Internal Demand	22,217	22,339	22,852	23,390	23,958	24,325	24,731	25,312	25,811	26,326
Anticipated Internal Capacity	32,490	32,516	32,549	32,222	32,222	32,142	32,096	32,013	31,867	31,719
Wind Expected On-Peak MW	155	155	155	155	155	155	155	154	154	154
Percentage of Wind Capacity	19.6%	19.6%	19.6%	19.6%	19.6%	19.6%	19.6%	19.6%	19.6%	19.6%
Solar Expected On-Peak MW	361	361	361	361	361	361	361	361	361	361
Percentage of Solar Capacity	35.9%	35.9%	35.9%	35.9%	35.9%	35.9%	35.9%	35.9%	35.9%	35.9%
Hydro Expected On-Peak MW	1,072	1,072	1,072	1,072	1,072	1,072	1,072	1,072	1,072	1,072
Percentage of Hydro Capacity	25.6%	25.6%	25.6%	25.6%	25.6%	25.6%	25.6%	25.6%	25.6%	25.6%
Imports	251	1,171	1,681	1,085	381	382	382	446	1,097	1,125
Exports	3,048	2,555	3,976	3,123	3,350	3,845	3,814	3,241	3,008	2,044
Anticipated Resource Reserve Margin MW	7,072	8,566	7,106	6,601	5,033	4,144	3,729	3,583	3,657	3,714
Anticipated Resource Reserve Margin %	31.8%	38.3%	31.1%	28.2%	21.0%	17.0%	15.1%	14.2%	14.2%	14.1%

Summary of Assessment Results: SRSG – Winter

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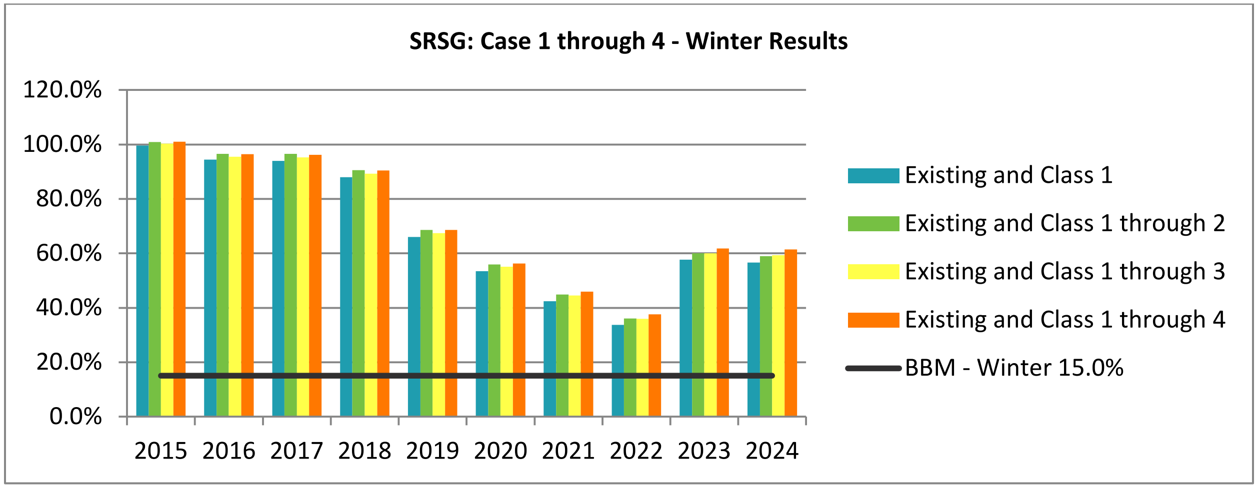

SRSG: Case 1 – Existing/Class 1 Resources Winter Results	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Net Internal Demand	15,314	15,526	15,796	16,099	16,506	16,842	17,144	17,466	17,808	18,090
Anticipated Internal Capacity	32,749	32,804	33,012	32,487	32,487	32,407	32,359	32,275	32,127	31,979
Wind Expected On-Peak MW	346	346	346	346	346	346	346	345	345	345
Percentage of Wind Capacity	43.8%	43.8%	43.8%	43.8%	43.8%	43.8%	43.8%	43.8%	43.8%	43.8%
Solar Expected On-Peak MW	0	0	0	0	0	0	0	0	0	0
Percentage of Solar Capacity	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Hydro Expected On-Peak MW	657	657	657	657	657	657	657	657	657	657
Percentage of Hydro Capacity	15.8%	15.8%	15.8%	15.8%	15.8%	15.8%	15.8%	15.8%	15.8%	15.8%
Imports	1,903	1,617	1,882	1,759	1,401	1,614	1,757	1,634	1,636	1,339
Exports	3,174	3,004	2,994	3,069	5,699	6,268	8,355	9,028	9,452	8,610
Anticipated Resource Reserve Margin MW	15,258	14,667	14,837	14,164	10,892	8,998	7,270	5,883	5,063	4,239
Anticipated Resource Reserve Margin %	99.6%	94.5%	93.9%	88.0%	66.0%	53.4%	42.4%	33.7%	28.4%	23.4%

Summary of Assessment Results: CA/MX – Summer

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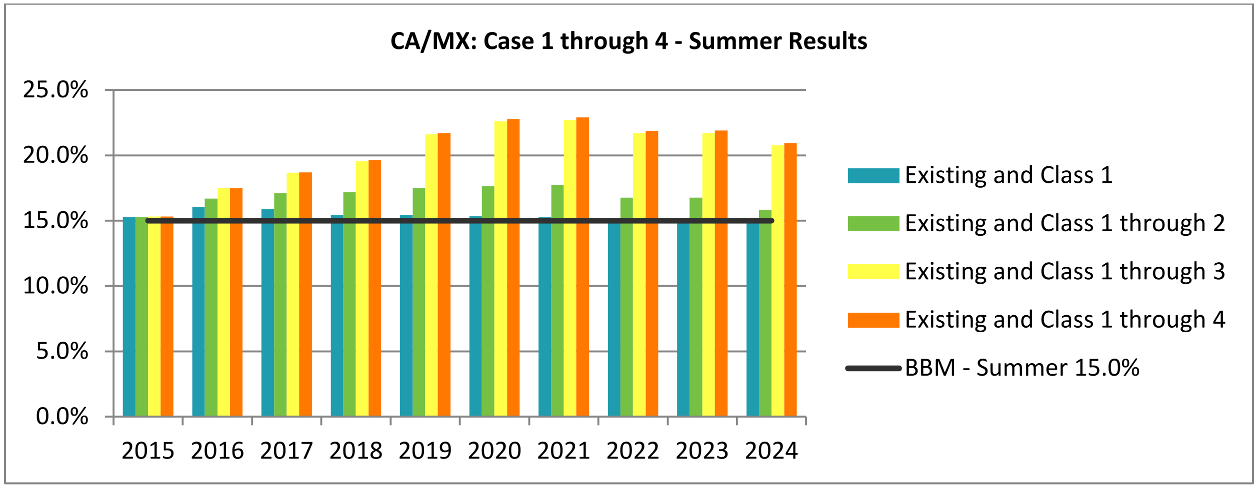

CA/MX: Case 1 – Existing/Class 1 Resources Summer Results	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Net Internal Demand	55,610	54,748	54,949	55,164	55,448	55,819	56,021	56,255	56,403	56,541
Anticipated Internal Capacity	60,063	62,396	62,999	63,392	63,392	63,042	62,991	62,991	62,991	62,991
Wind Expected On-Peak MW	2,345	2,345	2,345	2,345	2,345	2,345	2,345	2,345	2,345	2,345
Percentage of Wind Capacity	36.5%	36.5%	36.5%	36.5%	36.5%	36.5%	36.5%	36.5%	36.5%	36.5%
Solar Expected On-Peak MW	1,565	1,565	1,565	1,565	1,565	1,565	1,565	1,565	1,565	1,565
Percentage of Solar Capacity	36.4%	36.4%	36.4%	36.4%	36.4%	36.4%	36.4%	36.4%	36.4%	36.4%
Hydro Expected On-Peak MW	3,292	3,292	3,292	3,292	3,292	3,292	3,292	3,292	3,292	3,292
Percentage of Hydro Capacity	36.6%	36.6%	36.6%	36.6%	36.6%	36.6%	36.6%	36.6%	36.6%	36.6%
Imports	4,672	2,997	2,945	2,127	3,352	4,923	4,409	2,773	2,931	2,557
Exports	451	1,241	1,750	929	2,675	3,415	2,635	450	450	451
Anticipated Resource Reserve Margin MW	8,492	8,783	8,721	8,511	8,566	8,564	8,555	8,534	8,542	8,540
Anticipated Resource Reserve Margin %	15.3%	16.0%	15.9%	15.4%	15.4%	15.3%	15.3%	15.2%	15.1%	15.1%

Summary of Assessment Results: CA/MX – Winter

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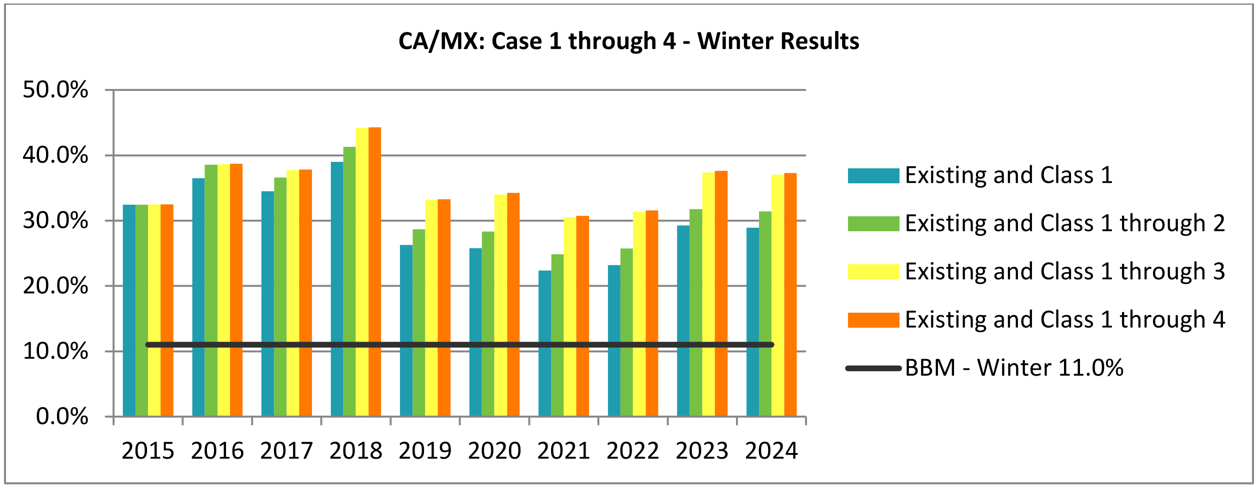

CA/MX: Case 1 – Existing/Class 1 Resources Winter Results	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Net Internal Demand	39,203	39,221	39,251	39,366	39,520	39,780	39,993	40,158	40,199	40,198
Anticipated Internal Capacity	54,531	57,132	57,233	57,608	57,608	57,258	57,207	57,207	57,207	57,207
Wind Expected On-Peak MW	569	569	569	569	569	569	569	569	569	569
Percentage of Wind Capacity	8.9%	8.9%	8.9%	8.9%	8.9%	8.9%	8.9%	8.9%	8.9%	8.9%
Solar Expected On-Peak MW	49	49	49	49	49	49	49	49	49	49
Percentage of Solar Capacity	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%	1.1%
Hydro Expected On-Peak MW	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150
Percentage of Hydro Capacity	25.8%	25.8%	25.8%	25.8%	25.8%	25.8%	25.8%	25.8%	25.8%	25.8%
Imports	2,651	2,549	2,559	2,439	1,925	2,330	2,142	2,450	2,460	2,142
Exports	3,167	3,181	3,078	3,120	5,317	5,260	6,287	6,537	7,228	7,309
Anticipated Resource Reserve Margin MW	12,716	14,319	13,548	15,350	10,393	10,270	8,937	9,323	7,755	7,622
Anticipated Resource Reserve Margin %	32.4%	36.5%	34.5%	39.0%	26.3%	25.8%	22.3%	23.2%	19.3%	19.0%

Summary of Assessment Results: Cases 9 and 10: 1-in-20 Temperature

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Table 3 - Case 9: 1-in-20 Temperature Summer Results

All Subregions: Case 9 Summer – Existing/Class 1 through 3 Resources	BBM	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
NWPP: Summer	16.43%	34.1%	33.4%	32.5%	29.9%	29.7%	29.5%	29.3%	28.6%	24.9%	25.7%
RMRG: Summer	13.90%	41.7%	58.3%	64.1%	60.1%	53.4%	48.9%	28.8%	13.9%	13.9%	13.9%
SRSG: Summer	15.17%	32.4%	39.2%	32.1%	29.2%	22.1%	18.3%	16.6%	15.8%	15.2%	15.2%
CA/MX: Summer	15.28%	15.3%	17.5%	18.7%	19.6%	21.6%	22.6%	22.7%	21.7%	21.7%	20.8%
WECC: Summer	15.65%	27.6%	30.1%	29.5%	28.1%	27.3%	26.6%	25.1%	23.4%	21.6%	21.7%

Table 4 - Case 10: 1-in-20 Temperature Winter Results

All Subregions: Case 10 Winter – Existing/Class 1 through 3 Resources	BBM	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
NWPP: Winter	17.93%	28.5%	29.1%	29.5%	29.6%	29.5%	29.2%	29.1%	29.0%	28.9%	28.8%
RMRG: Winter	15.95%	44.0%	52.5%	48.2%	45.3%	29.9%	27.8%	20.8%	17.2%	38.9%	36.1%
SRSG: Winter	16.06%	100.3%	95.5%	95.3%	89.3%	67.5%	55.1%	44.5%	35.9%	60.0%	59.4%
CA/MX: Winter	11.28%	32.5%	38.7%	37.7%	44.2%	33.2%	34.0%	30.5%	31.4%	37.4%	37.0%
WECC: Winter	15.60%	39.0%	41.1%	40.7%	41.7%	35.0%	33.5%	30.7%	29.6%	35.7%	35.3%

Appendix A – Zonal Topology Diagrams

Figure 1 - Summer Zonal Topology Diagram

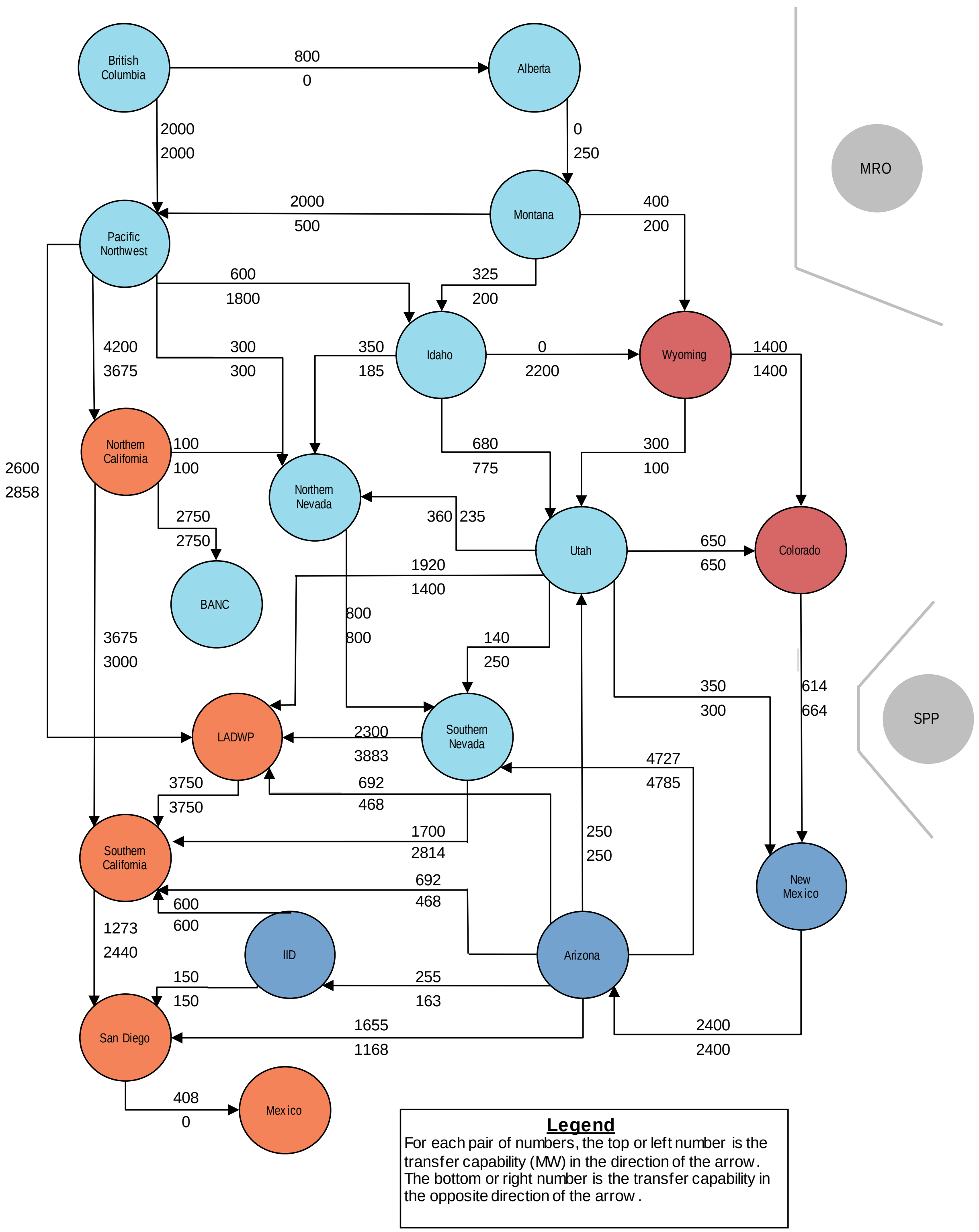

Figure 2 - Winter Zonal Topology Diagram