2015 Power Supply Assessment

WECC Staff

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Contents

Introduction

The 2015 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 2016 through 2025. 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 2015. The studies cover the summer period from 2016 through 2025 and the winter period from 2016/17 through 2025/26. The input data represent the Loads and Resources (LAR) data submitted in March 2015 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, GridView,[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 Gridview Model can be found on the ABB/Ventyx website. http://new.abb.com/enterprise-software/energy-portfolio-management/market-analysis/gridview
[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/ReliabilityAssessment
[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, their regulators, or local governing boards to evaluate 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	14.9%	16.1%
Rocky Mountain Reserve Group (RMRG)	Colorado, Eastern Wyoming	Public Service Company of Colorado, Western Area Power Administration - Colorado-Missouri Region	13.9%	11.9%

[8] LAR Methods and Assumptions: https://www.wecc.biz/ReliabilityAssessment

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	16.1%	12.3%
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%	13.5%
WECC Total			15.8%	14.7%

Case Descriptions

A total of 8 cases are included in the 2015 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, and by the category of certainty of new generation that is included in addition to existing resources. The cases are summarized in Table 2.

[9] See Generation Resources section on page 6 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

The common elements used in all of the cases include:

- existing generation as of December 31, 2014;
- 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]

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

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

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] The following is a description of the generation resource classes:

- Existing Generation is generation that is available (in-service) as of December 31, 2014.
- New Generation is reported in four classes (reported as of December 31, 2014):
    - Class 1: Generation additions/retirements that were reported to be under active construction as of the reporting date of December 31, 2014 and are projected to be in-service/retired prior to January 2020. 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 2022.

      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.

[12] PSA datasheets: https://www.wecc.biz/ReliabilityAssessment
[13] A detailed list is available in the PSA datasheets.
[14] The assessment period is from 2016 through 2025 for summer and from 2016/17 through 2025/26 for winter.

- 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. WECC's Transmission Expansion Planning Policy Committee (TEPPC) Data Work Group selected these two years 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.

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 all demand forecasts include transmission line; 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

[15] Definition included in the NERC Long-Term Reliability Assessment (LTRA): http://www.nerc.com/pa/RAPA/ra/Pages/default.aspx.
[16] Ibidem.

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 specific subregions may have adopted other tools, metrics and study assumptions that could result in different conclusions.

The results, as detailed in in the following sections show that throughout the ten-year study period, 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 2015. The demand forecasts and reported resources for each BA were "locked" as of May 2015. 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.

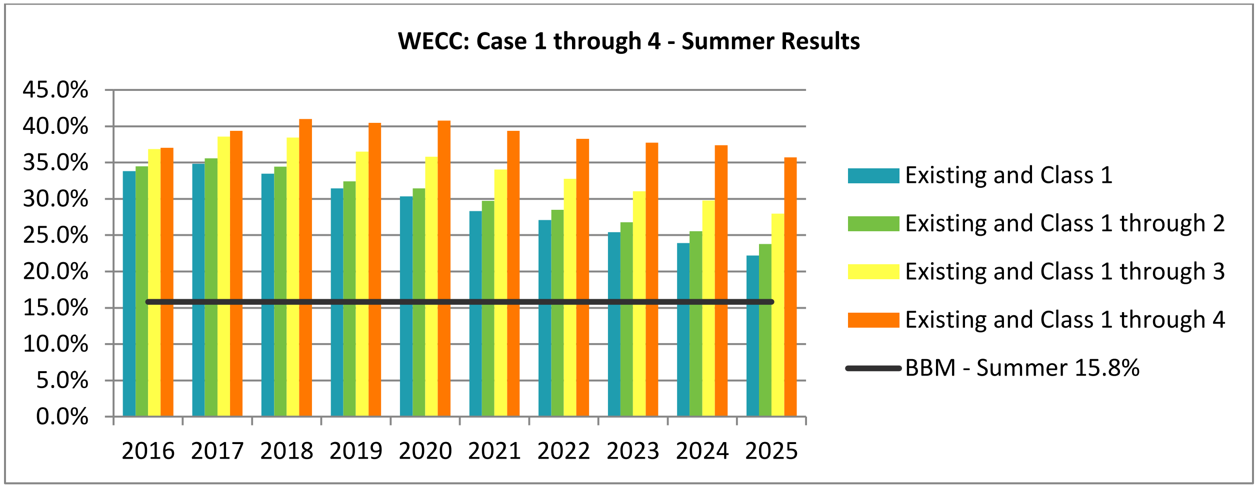
[17] LAR Methods and Assumptions: https://www.wecc.biz/ReliabilityAssessment

[18] Modeled remote resources are limited to Craig, Hayden, Hoover, Intermountain, Navajo, Palo Verde, and San Juan. No other adjustments are made for other joint plants or firm capacity purchases.

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. GridView 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 GridView 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. GridView 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 of actual hourly wind generation data. Solar resource energy curves were created using up to five years of actual hourly solar generation data.
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	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Net Internal Demand	151,243	152,317	154,558	157,197	159,045	160,399	161,395	162,987	164,933	166,572
Anticipated Internal Capacity	202,410	205,371	206,300	206,650	207,334	205,822	205,105	204,386	204,364	203,525
Wind Expected On-Peak MW	8,191	8,230	8,230	8,402	8,402	8,402	8,402	8,402	8,402	8,402
Percentage of Wind Capacity	32.2%	32.2%	32.2%	32.3%	32.3%	32.3%	32.3%	32.3%	32.3%	32.3%
Solar Expected On-Peak MW	3,209	3,547	3,956	4,412	4,412	4,412	4,412	4,412	4,412	4,412
Percentage of Solar Capacity	37.1%	37.1%	37.0%	36.9%	36.9%	36.9%	36.9%	36.9%	36.9%	36.9%
Hydro Expected On-Peak MW	43,077	43,101	43,114	43,127	43,336	43,336	43,336	43,336	43,336	43,336
Percentage of Hydro Capacity	60.4%	60.4%	60.4%	60.4%	60.2%	60.2%	60.2%	60.2%	60.2%	60.2%
Anticipated Resource Reserve Margin MW	27,271	28,988	27,322	24,616	23,160	20.080	18,209	15,647	13,372	10,635
Anticipated Resource Reserve Margin %	33.8%	34.8%	33.5%	31.5%	30.4%	28.3%	27.1%	25.4%	23.9%	22.2%

Summary of Assessment Results: WECC – Winter

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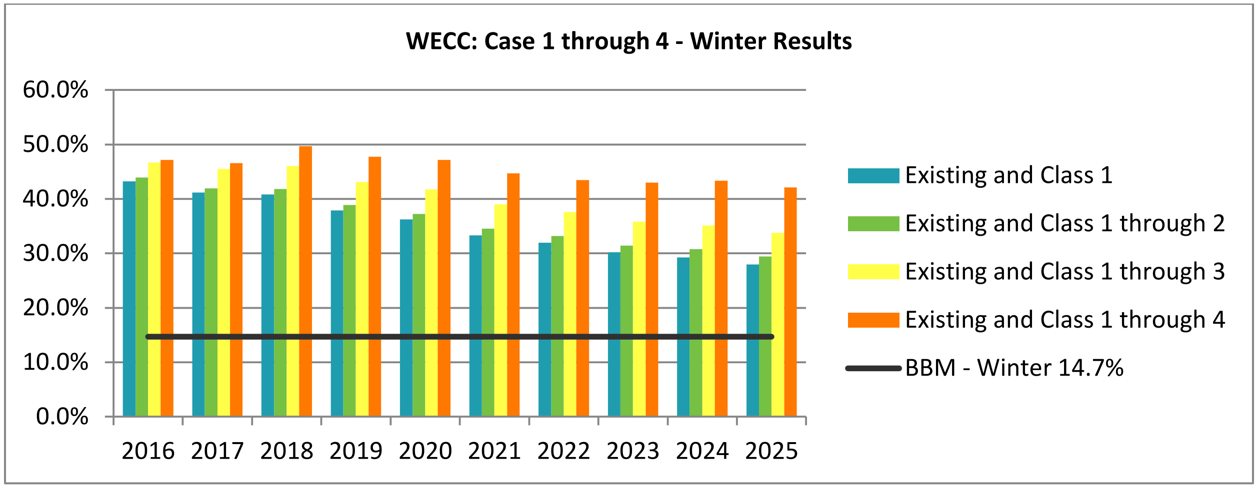

WECC: Case 1 – Existing/Class 1 Resources Winter Results	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Net Internal Demand	133,799	135,570	137,184	138,960	140,353	141,851	143,475	144,756	146,015	147,244
Anticipated Internal Capacity	191,799	191,382	193,215	191,639	191,191	189,094	189,296	188,491	188,719	188,390
Wind Expected On-Peak MW	5,428	5,465	5,465	5,507	5,507	5,507	5,506	5,506	5,506	5,506
Percentage of Wind Capacity	21.4%	21.4%	21.4%	21.2%	21.2%	21.2%	21.2%	21.2%	21.2%	21.2%
Solar Expected On-Peak MW	82	92	105	119	119	119	119	119	119	119
Percentage of Solar Capacity	0.9%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Hydro Expected On-Peak MW	37,841	37,864	37,876	37,888	38,035	38,035	38,035	38,305	38,035	38,035
Percentage of Hydro Capacity	53.1%	53.1%	53.1%	53.1%	52.8%	52.8%	52.8%	52.8%	52.8%	52.8%
Anticipated Resource Reserve Margin MW	38,183	35,883	35,865	32,252	30,206	26,391	24,730	22,456	21,240	19,501
Anticipated Resource Reserve Margin %	43.2%	41.2%	40.8%	37.9%	36.2%	33.3%	31.9%	30.2%	29.2%	27.9%

Summary of Assessment Results: NWPP – Summer

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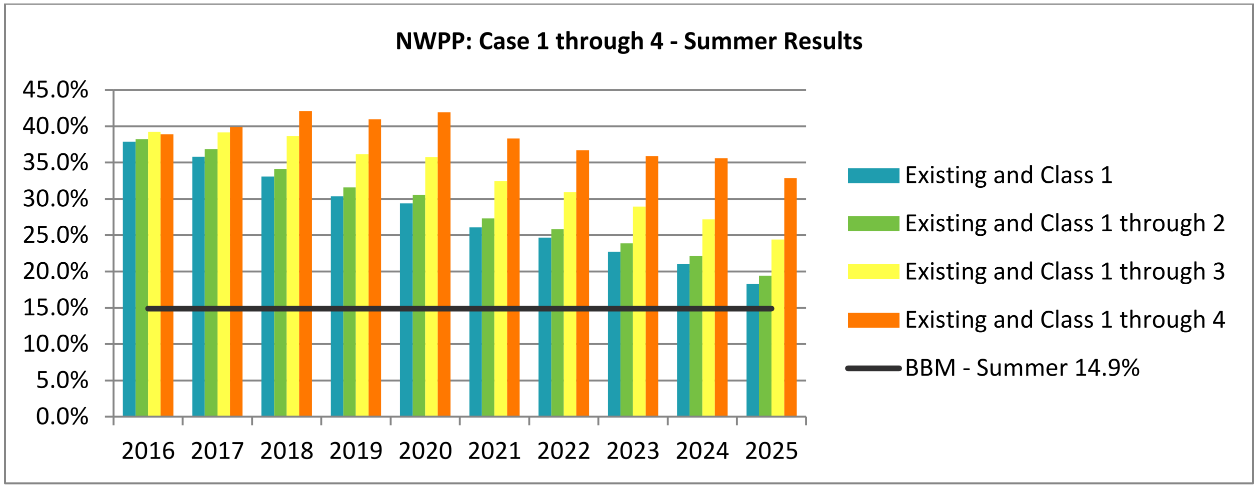

NWPP: Case 1 – Existing/Class 1 Resources Summer Results	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Net Internal Demand	68,340	69,568	70,811	72,044	72,969	73,781	74,549	75,278	76,049	76,862
Anticipated Internal Capacity	94,220	94,477	94,229	93,907	94,395	93,035	92,922	92,382	92,032	90,924
Wind Expected On-Peak MW	3,699	3,738	3,738	3,738	3,738	3,738	3,738	3,738	3,738	3,738
Percentage of Wind Capacity	30.5%	30.5%	30.5%	30.5%	30.5%	30.5%	30.5%	30.5%	30.5%	30.5%
Solar Expected On-Peak MW	199	199	199	199	199	199	199	199	199	199
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	37,452	37,474	37,486	37,499	37,499	37,499	37,499	37,499	37,499	37,499
Percentage of Hydro Capacity	69.6%	69.7%	69.7%	69.7%	69.7%	69.7%	69.7%	69.7%	69.7%	69.7%
Imports	1,501	1,501	1,501	1,501	1,501	1,501	1,501	1,501	1,926	2,326
Exports	0	0	0	0	0	0	0	150	975	1,600
Anticipated Resource Reserve Margin MW	15,698	14,543	12,867	11,129	10,554	8,261	7,265	5,888	4,652	2,610
Anticipated Resource Reserve Margin %	37.9%	35.8%	33.1%	30.3%	29.4%	26.1%	24.6%	22.7%	21.0%	18.3%

Summary of Assessment Results: NWPP – Winter

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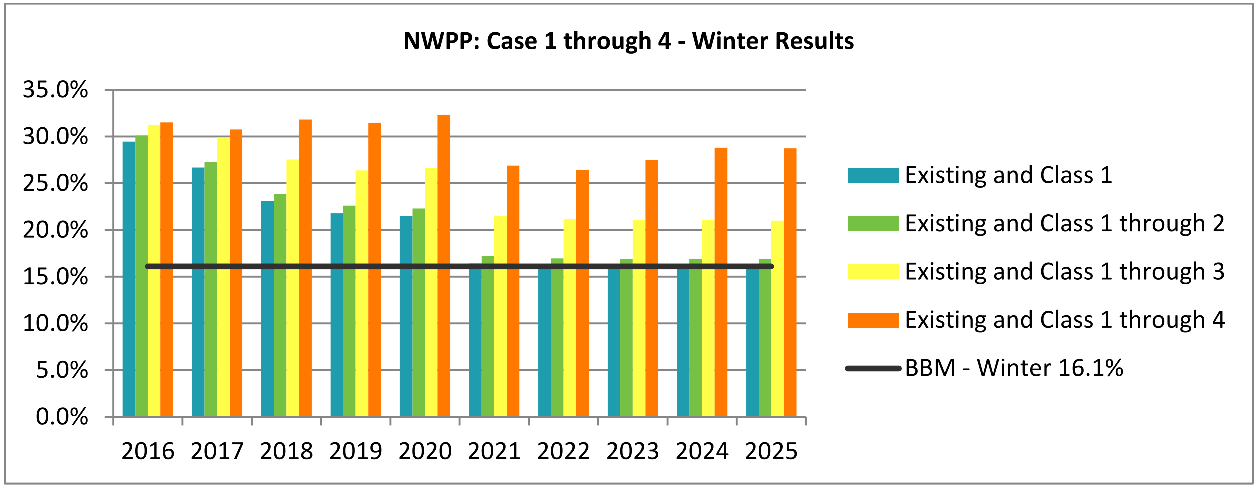

NWPP: Case 1 – Existing/Class 1 Resources Winter Results	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Net Internal Demand	71,145	72,526	73,668	74,851	75,588	76,401	77,294	77,985	78,703	79,402
Anticipated Internal Capacity	92,108	91,870	90,675	91,162	91,838	88,929	89.788	90,560	91,416	92,211
Wind Expected On-Peak MW	3,464	3,501	3,501	3,501	3,501	3,501	3,501	3,501	3,501	3,501
Percentage of Wind Capacity	28.5%	28.5%	28.5%	28.5%	28.5%	28.5%	28.5%	28.5%	28.5%	28.5%
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	34,360	34,380	34,392	34,404	34,404	34,404	34,404	34,404	34,404	34,404
Percentage of Hydro Capacity	63.9%	63.9%	63.9%	63.9%	63.9%	63.9%	63.9%	63.9%	63.9%	63.9%
Imports	1,501	1,501	1,501	1,501	1,501	1,501	2,151	2,951	2,851	5,176
Exports	0	0	0	0	0	0	0	0	0	0
Anticipated Resource Reserve Margin MW	9,508	7,677	5,147	4,260	4,081	228	50	20	42	25
Anticipated Resource Reserve Margin %	29.5%	26.7%	23.1%	21.8%	21.5%	16.4%	16.2%	16.1%	16.2%	16.1%

Summary of Assessment Results: RMRG – Summer

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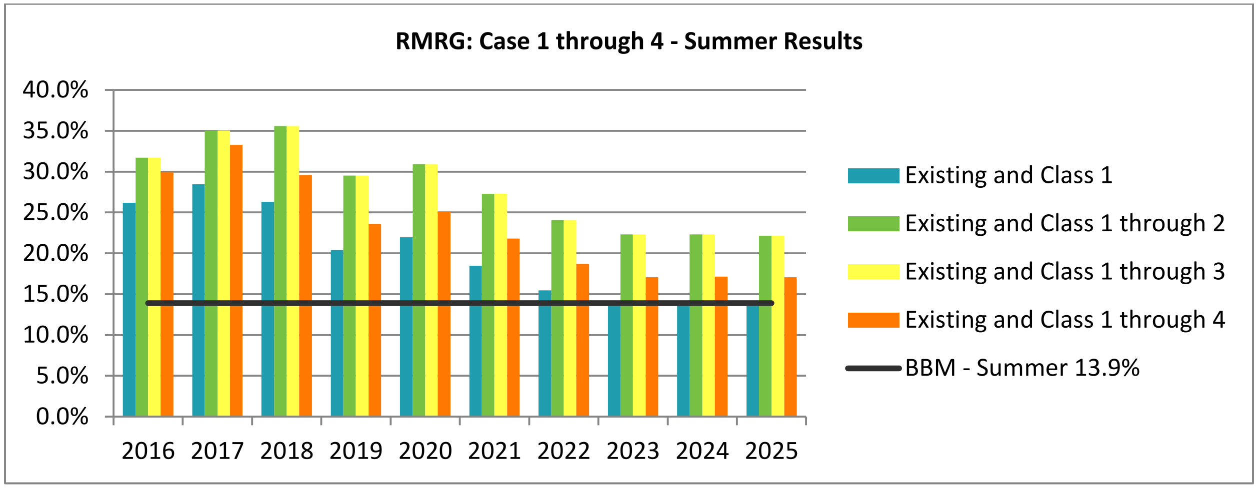

RMRG: Case 1 – Existing/Class 1 Resources Summer Results	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Net Internal Demand	12,055	12,171	12,417	12,667	12,830	13,129	13,414	13,736	13,932	14,194
Anticipated Internal Capacity	15,211	15,634	15,685	15,253	15,647	15,557	15,490	15,648	15,886	16,185
Wind Expected On-Peak MW	775	775	775	775	775	775	775	775	775	775
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	52	52	52	52	52	52	52	52	52	52
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	1,303	1,303	1,303	1,303	1,303	1,303	1,303	1,303	1,303	1,303
Percentage of Hydro Capacity	40.8%	40.8%	40.8%	40.8%	40.8%	40.8%	40.8%	40.8%	40.8%	40.8%
Imports	0	0	0	0	0	0	0	150	550	775
Exports	575	575	575	575	575	575	575	575	575	575
Anticipated Resource Reserve Margin MW	1,480	1,771	1,542	825	1,033	603	211	3	17	18
Anticipated Resource Reserve Margin %	26.2%	28.5%	26.3%	20.4%	22.0%	18.5%	15.5%	13.9%	14.0%	14.0%

Summary of Assessment Results: RMRG – Winter

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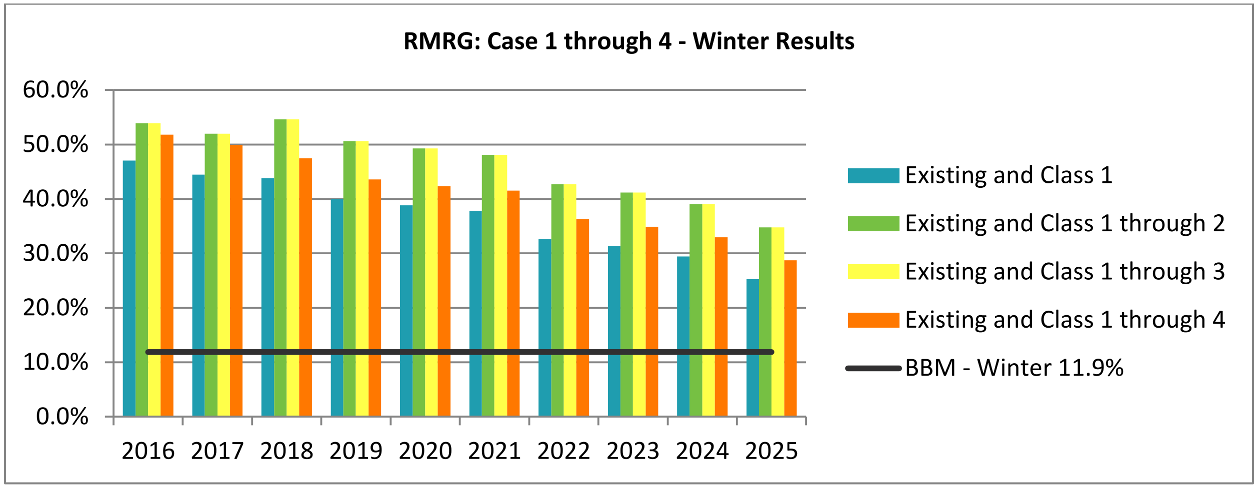

RMRG: Case 1 – Existing/Class 1 Resources Winter Results	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Net Internal Demand	10,162	10,350	10,419	10,618	10,826	11,013	11,267	11,494	11,737	11,883
Anticipated Internal Capacity	14,944	14,954	14,982	14,861	15,032	15,179	14,948	15,097	15,193	14,887
Wind Expected On-Peak MW	737	737	737	737	737	737	737	737	737	737
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	649	649	649	649	649	649	649	649	649	649
Percentage of Hydro Capacity	20.3%	20.3%	20.3%	20.3%	20.3%	20.3%	20.3%	20.3%	20.3%	20.3%
Imports	0	0	0	0	0	0	0	0	0	0
Exports	575	575	575	575	575	575	575	575	575	575
Anticipated Resource Reserve Margin MW	3,573	3,372	3,323	2,980	2,917	2,856	2,341	2,235	2,059	1,590
Anticipated Resource Reserve Margin %	47.1%	44.5%	43.8%	40.0%	38.8%	37.8%	32.7%	31.3%	29.4%	25.3%

Summary of Assessment Results: SRSG – Summer

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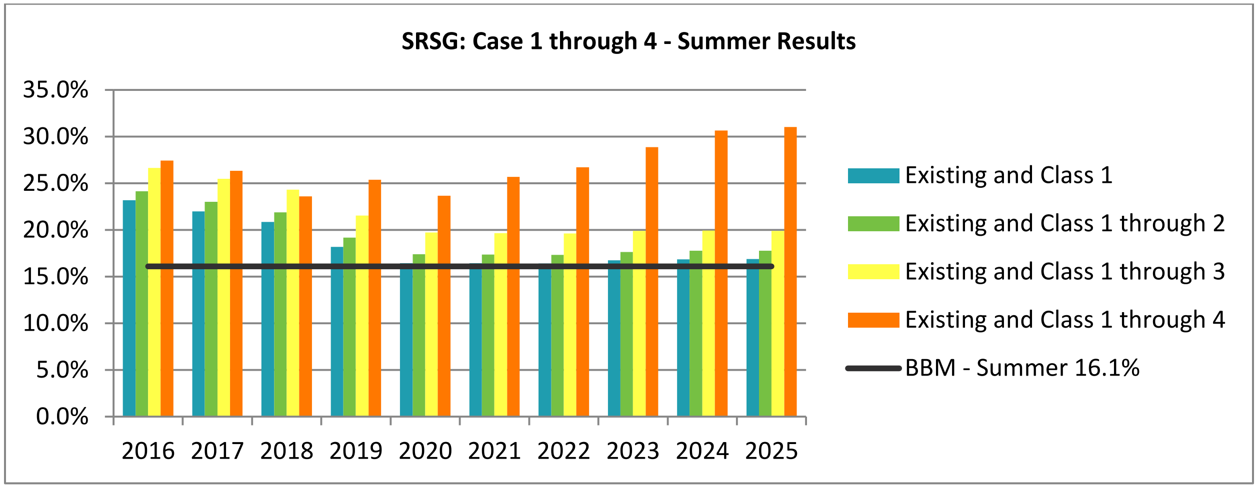

SRSG: Case 1 – Existing/Class 1 Resources Summer Results	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Net Internal Demand	23,297	23,486	24,047	24,514	25,058	25,516	25,734	26,209	26,763	27,377
Anticipated Internal Capacity	28,703	28,650	29,044	28,974	29,176	29,710	29,959	30,598	31,278	32,004
Wind Expected On-Peak MW	164	164	164	164	164	164	163	163	163	163
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	382	382	382	382	382	382	382	382	382	382
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	733	733	733	733	733	733	733	733	733	733
Percentage of Hydro Capacity	25.7%	25.7%	25.7%	25.7%	25.7%	25.7%	25.7%	25.7%	25.7%	25.7%
Imports	379	379	379	379	529	1,104	1,554	2,504	3,604	4,004
Exports	3,601	3,601	3,601	3,601	3,601	3,601	3,601	3,601	3,601	3,601
Anticipated Resource Reserve Margin MW	1,655	1,383	1,149	513	83	86	82	169	206	219
Anticipated Resource Reserve Margin %	23.2%	22.0%	20.9%	18.2%	16.4%	16.4%	16.4%	16.7%	16.9%	16.9%

Summary of Assessment Results: SRSG – Winter

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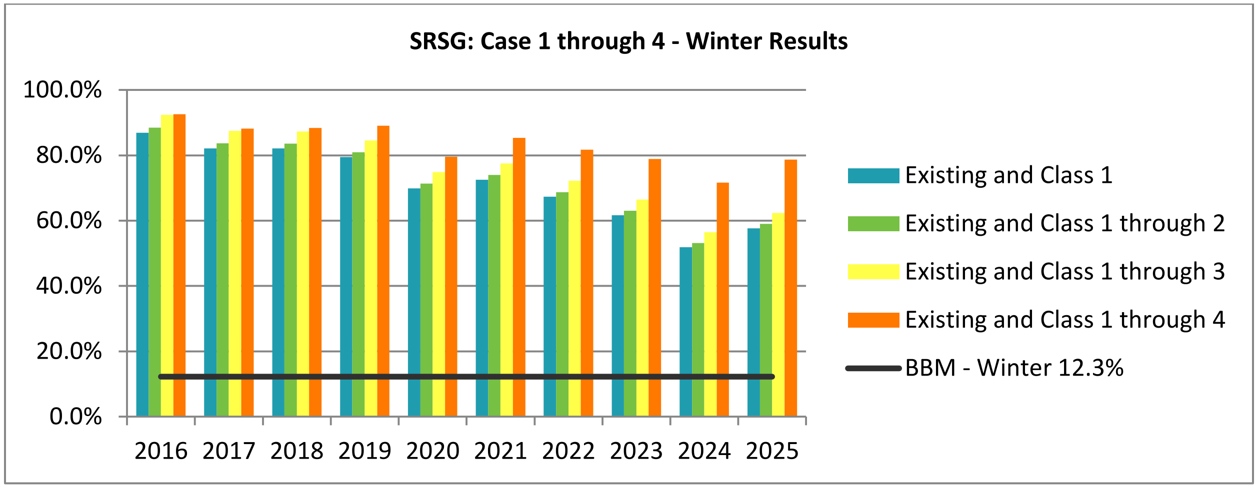

SRSG: Case 1 – Existing/Class 1 Resources Winter Results	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Net Internal Demand	15,017	15,383	15,753	16,051	16,296	16,348	16,693	17,242	17,644	17,570
Anticipated Internal Capacity	28,071	28,016	28,683	28,805	27,684	28,202	27,933	27,878	26,790	27,701
Wind Expected On-Peak MW	366	366	366	366	366	366	365	365	365	365
Percentage of Wind Capacity	43.8%	43.8%	43.8%	43.8%	43.8%	43.8%	43.7%	43.7%	43.7%	43.7%
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	448	448	448	448	448	448	448	448	448	448
Percentage of Hydro Capacity	15.7%	15.7%	15.7%	15.7%	15.7%	15.7%	15.7%	15.7%	15.7%	15.7%
Imports	379	379	379	379	379	379	379	379	379	379
Exports	3,601	3,601	3,601	3,601	3,601	3,601	3,601	3,601	3,601	3,601
Anticipated Resource Reserve Margin MW	11,207	10,741	10,992	10,780	9,384	9,844	9,187	8,515	6,975	7,970
Anticipated Resource Reserve Margin %	86.9%	82.1%	82.1%	79.5%	69.9%	725.%	67.3%	61.7%	51.8%	57.7%

Summary of Assessment Results: CA/MX – Summer

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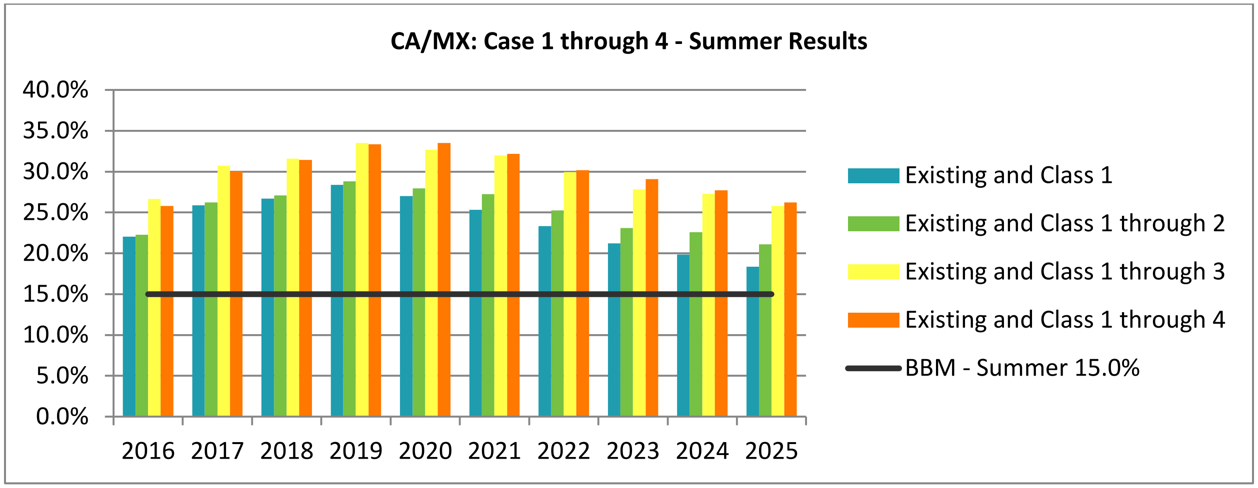

CA/MX: Case 1 – Existing/Class 1 Resources Summer Results	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Net Internal Demand	52,669	52,919	53,142	53,373	53,637	53,873	54,109	54,249	54,367	54,412
Anticipated Internal Capacity	64,276	66,611	67,342	68,516	68,117	67,521	66,734	65,758	65,169	64,412
Wind Expected On-Peak MW	3,553	3,553	3,553	3,725	3,725	3,725	3,725	3,725	3,725	3,725
Percentage of Wind Capacity	36.1%	36.1%	36.1%	36.1%	36.1%	36.1%	36.1%	36.1%	36.1%	36.1%
Solar Expected On-Peak MW	2,577	2,915	3,323	3,779	3,779	3,779	3,779	3,779	3,779	3,779
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	3,590	3,593	3,593	3,593	3,801	3,801	3,801	3,801	3,801	3,801
Percentage of Hydro Capacity	31.2%	31.2%	31.2%	31.2%	31.5%	31.5%	31.5%	31.5%	31.5%	31.5%
Imports	2,746	2,746	2,746	2,746	2,746	2,746	2,746	2,746	2,746	2,746
Exports	450	450	450	450	600	1,175	1,625	2,575	3,675	4,075
Anticipated Resource Reserve Margin MW	3,707	5,754	6,229	7,137	6,434	5,567	4,509	3,371	2,647	1,839
Anticipated Resource Reserve Margin %	22.0%	25.9%	26.7%	28.4%	27.0%	25.3%	23.3%	21.2%	19.9%	18.4%

Summary of Assessment Results: CA/MX – Winter

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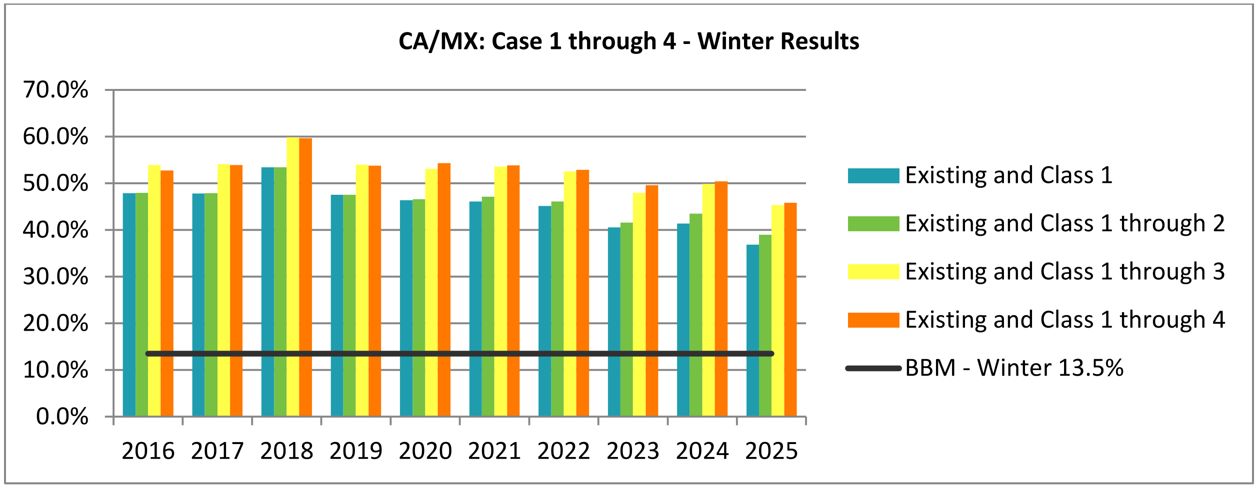
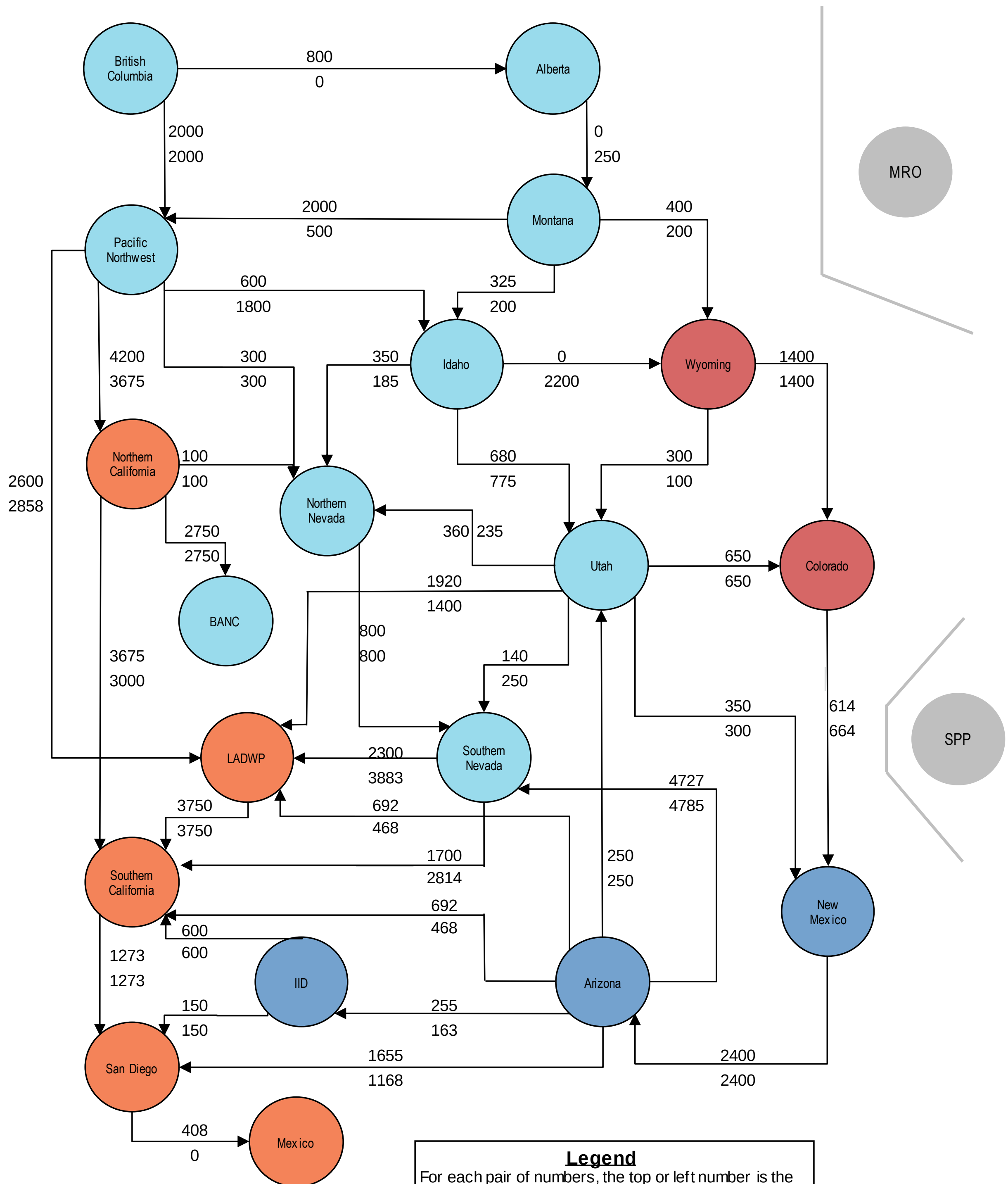


CA/MX: Case 1 – Existing/Class 1 Resources Winter Results	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Net Internal Demand	38,213	38,245	38,375	38,506	38,685	38,864	39,014	39,095	39,133	39,163
Anticipated Internal Capacity	56,527	56,542	58,875	56,811	56,636	56,783	56,627	54,956	55,320	53,592
Wind Expected On-Peak MW	862	862	862	904	904	904	904	904	904	904
Percentage of Wind Capacity	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%	8.8%
Solar Expected On-Peak MW	81	92	105	119	119	119	119	119	119	119
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	2,384	2,386	2,386	2,386	2,533	2,533	2,533	2,533	2,533	2,533
Percentage of Hydro Capacity	20.7%	20.7%	20.7%	20.7%	21.0%	21.0%	21.0%	21.0%	21.0%	21.0%
Imports	2,746	2,746	2,746	2,746	2,746	2,746	2,746	2,746	2,746	2,746
Exports	450	450	450	450	450	450	1,100	1,900	1,800	4,125
Anticipated Resource Reserve Margin MW	13,155	13,134	15,319	13,107	12,729	12,672	12,346	10,583	10,905	9,142
Anticipated Resource Reserve Margin %	47.9%	47.8%	53.4%	47.5%	46.4%	46.1%	45.1%	40.6%	41.4%	36.8%

Appendix A – Zonal Topology Diagrams

Figure 1 - Summer Zonal Topology Diagram



Legend

For each pair of numbers, the top or left number is the transfer capability (MW) in the direction of the arrow. The bottom or right number is the transfer capability in the opposite direction of the arrow.

Figure 2 - Winter Zonal Topology Diagram