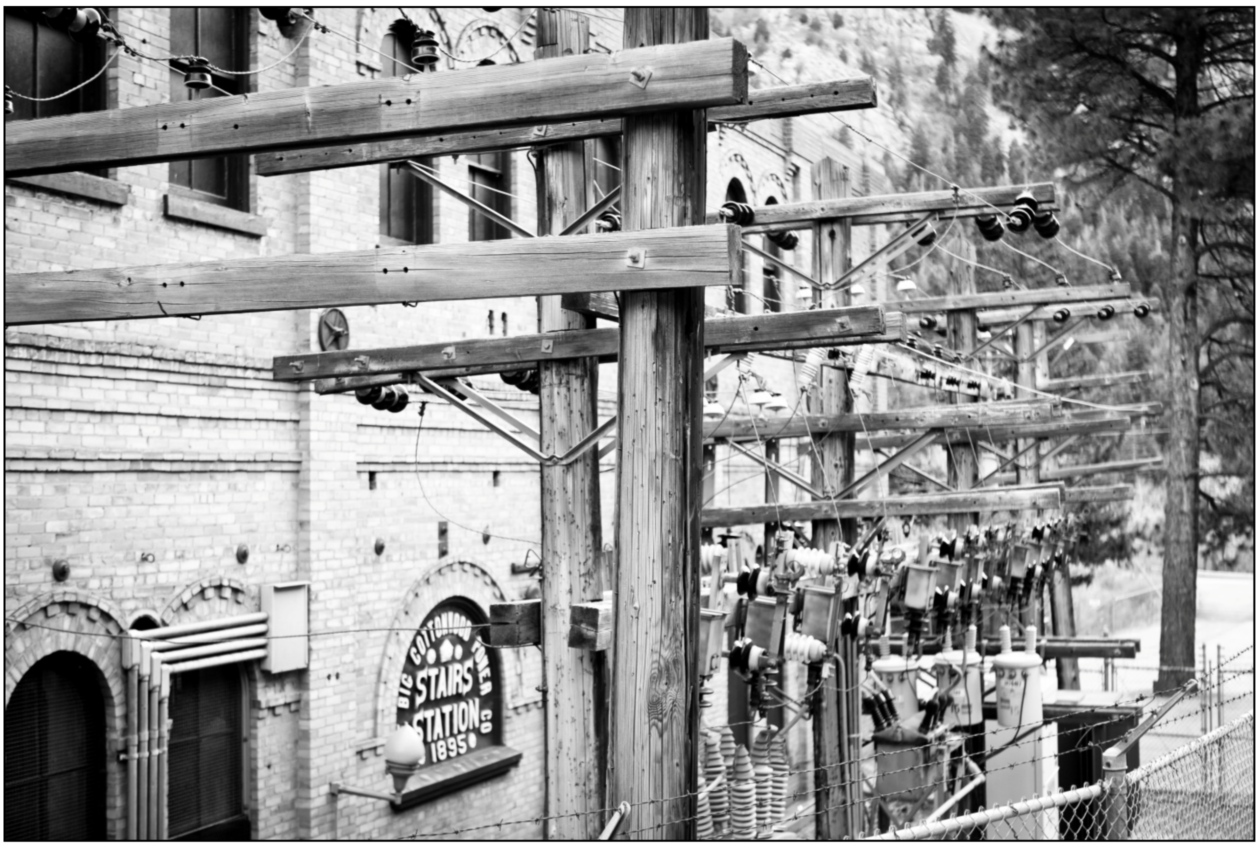
2013 Power Supply Assessment

Western Electricity Coordinating Council

September 23, 2013



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Introduction

The 2013 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 2014 through 2023. The members of the Loads and Resources Subcommittee (LRS) 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 Power Supply Assessment Policy."[1]

The PSA presents the results of the assessment that was conducted by the WECC staff during the second quarter of 2013. This assessment is based on data requested for the forecast period beginning in 2013 and submitted by WECC Balancing Authorities (BA) in the spring of 2013.

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) that are aggregated into the eight subregions reported in the PSA. The aggregation of zones into subregions is detailed in the North American Electric Reliability Corporation (NERC) Long Term Reliability Assessment – Methods and Assumptions (Methods and Assumptions) document[3] and in Table - 3 - Subregion Aggregation and Seasonal Margins.

Seasonal Planning Reserve Margins (PRM) are reported for each of the eight 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.[4] The calculated PRM is compared to subregional Building Block target reserve margins as this assessment's indicator of reserve adequacy. These subregional PRMs

[1] WECC Power Supply Assessment Policy.
http://www.wecc.biz/library/WECC%20Documents/Miscellaneous%20Operating%20and%20Planning%20Policies%20and%20Procedures/PSA%20Policy.pdf

[2] Additional information regarding the Promod Model can be found on page 13, and on the ABB/Ventyx website.
http://www.ventyx.com/en/enterprise/business-operations/business-products/promod-iv

[3] NERC Long Term Reliability Assessment – Methods and Assumptions.
http://www.wecc.biz/committees/StandingCommittees/PCC/LRS/Shared%20Documents/NERC%20Long%20Term%20Reliability%20Assessment%20(LTRA)%20Data%20Sheets/LTRA_Part_II.docx

[4] The PRM calculation indicates sufficient resources when the PRM is equal to or greater than the Building Block target reserve margin.

are reported in Tables 4 and 5, along with the associated Building Block target reserve margins.[5]

Executive Summary

A total of twelve cases are included in the 2013 PSA. Each case evaluates whether there are sufficient resources (e.g., existing generation, planned and potential additions, and transmission import capacity) in each of the eight 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 described in Tables 1 and 2 below.

Table 1 – Case Description

Case	Season	New Resources[6]	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 zonal results are aggregated to eight subregions to maintain load forecast confidentiality in years two and three of the forecast period as required by Exhibit B of the WECC Reliability Information Sharing Policy.[7] Datasheets containing aggregated demand, capacity, and transfers for all cases and for all subregions are available on the WECC website.[8]

[5] 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 resources 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.

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

[7] WECC Reliability Information Sharing Policy. http://www.wecc.biz/library/WECC%20Documents/Business%20and%20Governance%20Documents/Policies/Reliability%20Information%20Sharing%20Policy.pdf

[8] The datasheets used to calculate the PRMs for each case are located on the WECC website at: http://www.wecc.biz/committees/StandingCommittees/PCC/LRS/Shared%20Documents/Forms/AllItems.aspx?RootFolder=%2Fcommittees%2FStandingCommittees%2FPCC%2FLRS%2FShared%20Documents%2FNERC%20Long%20Term%20Reliability%20Assessment%20%28LTRA%29%20Data%20Sheets%2F2013%20Files&FolderCTID=0x012000FA4FA82A1BFBCC4492413F74844D464B&View={3D8A4591-23BB-4BCD-8C40-2E3B34AA2BBC}

The results of these studies indicate that by the summer of 2019 both the Canada and Mexico subregions could drop below the target margin when considering only Existing and under construction, Class 1, resources. In future years other subregions also drop below the target. However, when all reported resources (Existing, under construction, planned, and conceptual) are considered, all subregions are above the target margin throughout the study period.

The results of these studies indicate that by the summer of 2019 both the Canada and Mexico subregions could drop below the target margin when considering only Existing and under construction, Class 1, resources. In future years other subregions also drop below the target. However, when all reported resources (Existing, under construction, planned, and conceptual) are considered, all subregions are above the target margin throughout the study period.

The results of the winter cases indicate that the Canada subregion may be below the target margin as early as next winter when considering Existing and under construction resources only. When Class 2 resources are included in the studies the Canadian margin is greater that the target margin throughout the study period.

The results of the case studies 1 through 8 are tabulated in Tables 4 and 5 on pages 10 and 11.

Table 2 provides a description of the temperature sensitivities that were included in this year's assessment. Cases 9 and 10 are sensitivities that were created to examine a WECC-wide 1-in-20-year extreme temperature increase for both summer and winter. Cases 11 and 12 reflect 1-in-20 year extreme temperature peak demand increases for the summer in the Desert Southwest and Southern California, and a peak demand increase for the winter in Canada, the northwest US, and Northern California.

Table 2 – Temperature Sensitivity Cases

Temperature Sensitivities: Building Blocks			
Case	**Season**	**New Resources[9]**	**Temperature Definition**
9	Summer	Class 1 and 2	All Subregions 1-in-20 temperature adjustment
10	Winter	Class 1 and 2	All Subregions 1-in-20 temperature adjustment
11	Summer	Class 1 and 2	Desert Southwest/Southern California 1-in-20 temperature adjustment
12	Winter	Class 1 and 2	Canada/Northwest US/Northern California 1-in-20 temperature adjustment

[9] See footnote 6.

The results of the extreme temperature cases show that, in future years, WECC as a whole could drop below the Building Block Target margin. Although this type of interconnection-wide extreme temperature case is not an anticipated event, it does represent a scenario that would stress generation and the transmission system. The results also indicate that the Desert Southwest/Southern California subregion could drop below the target margin by the end of the study period.

The results of the case studies 9 through 12 are tabulated in Table 6 on page 12.

It is important to note that results indicating percentages below target reserve levels in later years of the assessment period are not forecasts of shortages. Rather, they are an indication that proposed resources need to progress through the regulatory approval process in a timely manner.

2013 Power Supply Assessment

Purpose

The 2013 WECC PSA evaluates and compares the Planning Reserve Margins (PRM) of subregions of the Western Interconnection with a Building Block target reserve margin. It identifies subregions within WECC that have the potential for electricity supply shortages based on reported existing and forecasted demand and existing and forecasted resource data, assumed non-contracted economic transfers, and transmission constraints among the subregions.

The purpose of this report is to present the results of the PSA that was conducted during the second quarter of 2013. The studies cover the summer period from 2014 through 2023 and the winter period from 2014/15 through 2023/24. The input data represent the Loads and Resources (L&R) data submitted in March 2013 by the individual BAs. The Promod modeling tool was used to produce the results for the assessment.

Methodology

For purposes of reliability assessments, the WECC Region is divided into the 19 zones. The zones are configured around demand centers and transmission hubs. The zones and their subregion are identified in Table 3 - Subregion Aggregation and Seasonal Margins on page 6.

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 39 BAs in WECC. These elements include:

- monthly and annual peak demand and energy forecasts;
- expected generation availability;
- annual energy for energy-limited resources;
- coincident hourly shaping data for loads and 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 several future years are readily available from BAs, the forecasts for future resources additions are more dynamic. Therefore, the certainty associated with the results decreases as one looks further into the future.

Case Descriptions

The common elements used in all of the cases included:

- existing generation as of December 31, 2012;
- 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 for all subregions are available on the WECC website.[11]

Building Block Target Reserve Margin

The Building Block target reserve margins were developed under the direction of the LRS 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.

Definitions and details of the Building Block target reserve margin elements are available in the Methods and Assumptions document.[12]

Separate Building Block target reserve margin values are developed 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

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[10] The term “additions” refers to both generation additions and retirements.

[11] See footnote 8.

[12] NERC Long Term Reliability Assessment – Methods and Assumptions. (See footnote 3)

not the requirements used by individual Load-Serving Entities or their regulators or local governing boards to evaluate their standards of 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 target reserve margin used for each subregion is shown in Table 3 below.

Table 3 – Subregion Aggregation and Seasonal Target Margins

Subregion	Zones in Subregion	Balancing Authorities in Subregion	Summer Margin	Winter Margin
Canada	Alberta, British Columbia	Alberta Electric System Operator, British Columbia Hydro and Power Authority	12.6%	13.9%
Northwest	Montana, Pacific Northwest	Avista Corporation, Bonneville Power Administration - Transmission, Tacoma Power , NaturEner Glacier Wind Energy, NaturEner West Wind, Northwestern Energy, 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, Western Area Power Administration - Upper Great Plains West, Constellation Energy Control and Dispatch	17.5%	19.2%
Basin	Idaho, No. Nevada, Utah	Idaho Power Company, Pacificorp - East, Sierra Pacific Power Company	13.7%	13.7%
Rockies	Colorado, Wyoming	Public Service Company of Colorado, Western Area Power Administration - Colorado-Missouri Region	14.5%	15.9%
Desert Southwest	Arizona, New Mexico, So. Nevada	Arizona Public Service Company, Arlington Valley, El Paso Electric Company, Gila River Maricopa Arizona, Griffith Energy, Harquahala Generating Maricopa Arizona, Nevada Power Company, Public Service Company of New Mexico, Salt River Project, Tucson Electric Power Company, Western Area Power Administration - Lower Colorado Region	13.6%	14.0%
Northern California	Northern CA, Balancing Authority of Northern California	California Independent System Operator, Balancing Authority of Northern California, Turlock Irrigation District	15.0%	12.1%
Southern California	Los Angeles Department of Water and Power, San Diego, Southern CA, Imperial Irrigation District	California Independent System Operator, Imperial Irrigation District, Los Angeles Department of Water and Power	15.2%	11.0%
Mexico	Comision Federal de Electricidad	Comision Federal de Electricidad	11.9%	10.7%
WECC Total			14.7%	14.5%

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[13] for this assessment reflect extractions of the monthly demands coincident with the WECC Region or subregion seasonal (summer and winter) peak maximum demands.

The non-firm demands include interruptible and load management demands as reported in the L&R 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

[13] See footnote 8.

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 apparent 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 is not included in this assessment. The L&R data request responses contain a list of existing generation as well as planned generation additions, changes, and retirements.[14] Below is a description of the generation resource classes.

- Existing Generation is generation that is available (in-service) as of December 31, 2012.
- New Generation is reported in four categories (reported as of December 31, 2012):
  - *Class 1:* Generation additions/retirements that were reported to be under active construction as of the reporting date of December 31, 2012 and are projected to be in-service/retired prior to January 2018. Class 1 also includes facilities or units that have a firm retirement date within 10 years 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 2020.

    This class includes resources that were expected to be in-service as early as Class 1 resources, but

    1) did not meet the test of being under construction; or
    2) have an estimated retirement date within 10 years.

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[14] A list of existing and planned generation is available on the WECC website at: http://www.wecc.biz/committees/StandingCommittees/PCC/LRS/Shared%20Documents/Forms/AllItems.aspx?RootFolder=%2Fcommittees%2FStandingCommittees%2FPCC%2FLRS%2FShared%20Documents%2FNERC%20Long%20Term%20Reliability%20Assessment%20%28LTRA%29%20Data%20Sheets%2F2013%20Files&FolderCTID=0x012000FA4FA82A1BFBCC4492413F74844D464B&View={3D8A4591-23BB-4BCD-8C40-2E3B34AA2BBC}

- *Class 3:* Generation additions/retirements that were reported and met the NERC criteria for Future-Planned Resources[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 Future Other or Conceptual Resources.[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 L&R 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 WECC 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 L&R 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

[15] Definition included in the NERC LTRA:. http://www.nerc.com/pa/RAPA/ra/Pages/default.aspx

[16] See footnote 15.

capability limits are presented on the zonal topology diagrams included in the Methods and Assumptions document.[17] The model allows transfers between the subregions only if excess capacity is available after the Building Block Reserve target 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 but are owned by an entity, or entities, located in another BA's geographic footprint, 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 defined subregions to meet their load requirements with internal generation and imports from other subregions or zones under the specified conditions. The LRS approved a set of study cases but recognized that the methodology used and the associated results are limited by the modeling tool and what resources are included in the studies. The LRS also recognizes that the 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.

Percentages highlighted in yellow indicate the years a subregion is below the Building Block margin. However, it is important to note that results indicating percentages below target reserve levels in later years of the assessment period are not forecasts of shortages. Rather, they are an indication that proposed resources need to progress through the regulatory approval process in a timely manner. In addition, WECC data providers should remain diligent in providing accurately categorized future demand and planned generation information. The results for cases 1 through 8 are listed in the summer and winter Planning Reserve Margin Tables 4 and 5.

[17] Diagrams included in the Long Term Reliability Assessment – Methods and Assumptions. (see footnote 3)

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

Table 4 – Summer Results

Planning Reserve Margin		Summer										
Subregion	Resources	Building Block Target	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Canada	Existing/Class 1	12.6%	20.9%	23.5%	22.1%	17.7%	13.7%	**11.4%**	**9.6%**	**8.1%**	**6.5%**	**5.0%**
	Existing/Class 1/Class 2		25.9%	31.2%	34.4%	33.1%	30.9%	30.3%	28.2%	26.4%	24.6%	22.8%
	Existing/Class 1/Class 2/Class 3		25.9%	31.2%	34.4%	33.1%	30.9%	30.3%	28.2%	26.4%	24.6%	22.8%
	Existing/Class 1/Class 2/Class 3/Class 4		27.0%	34.0%	39.1%	41.5%	47.3%	46.8%	46.7%	47.4%	45.2%	43.2%
Northwest US	Existing/Class 1	17.5%	40.1%	36.5%	32.2%	29.2%	24.9%	22.2%	18.9%	17.6%	17.6%	17.6%
	Existing/Class 1/Class 2		44.5%	45.3%	45.2%	44.6%	42.6%	41.2%	37.6%	35.9%	34.7%	31.8%
	Existing/Class 1/Class 2/Class 3		44.9%	45.3%	45.2%	44.6%	43.5%	41.9%	38.4%	36.0%	34.7%	31.9%
	Existing/Class 1/Class 2/Class 3/Class 4		44.9%	45.3%	45.2%	44.6%	43.6%	43.7%	40.1%	37.7%	36.4%	33.6%
Basin	Existing/Class 1	13.7%	13.8%	13.8%	14.1%	13.9%	13.8%	13.9%	13.8%	**12.1%**	**10.0%**	**6.4%**
	Existing/Class 1/Class 2		13.7%	13.9%	14.6%	14.2%	13.7%	13.8%	13.8%	13.8%	14.0%	**5.3%**
	Existing/Class 1/Class 2/Class 3		14.8%	15.3%	15.7%	15.3%	14.4%	14.2%	14.0%	13.7%	14.0%	**8.6%**
	Existing/Class 1/Class 2/Class 3/Class 4		14.8%	15.3%	20.3%	19.8%	18.9%	19.1%	22.1%	21.7%	21.9%	17.0%
Rockies	Existing/Class 1	14.5%	19.4%	17.1%	15.4%	14.6%	14.5%	14.5%	14.6%	14.6%	14.6%	**11.8%**
	Existing/Class 1/Class 2		21.2%	18.9%	20.6%	18.5%	14.9%	14.9%	14.8%	14.7%	14.6%	14.5%
	Existing/Class 1/Class 2/Class 3		21.2%	18.9%	20.6%	18.5%	14.9%	14.9%	14.8%	14.7%	14.6%	14.5%
	Existing/Class 1/Class 2/Class 3/Class 4		21.9%	19.7%	21.3%	19.2%	15.7%	15.6%	15.5%	15.6%	15.5%	15.4%
Desert Southwest	Existing/Class 1	13.6%	37.3%	32.5%	29.4%	25.1%	19.8%	14.4%	13.6%	13.6%	13.6%	13.7%
	Existing/Class 1/Class 2		37.0%	34.8%	35.6%	33.3%	30.0%	26.6%	22.5%	18.7%	14.3%	13.6%
	Existing/Class 1/Class 2/Class 3		38.0%	36.2%	36.9%	34.6%	31.3%	28.1%	24.2%	20.0%	15.5%	13.6%
	Existing/Class 1/Class 2/Class 3/Class 4		39.4%	44.4%	46.5%	44.6%	41.4%	38.6%	36.1%	32.0%	27.2%	25.5%
Northern California	Existing/Class 1	15.0%	15.2%	15.1%	15.1%	15.0%	15.1%	15.0%	15.1%	15.1%	15.0%	**12.9%**
	Existing/Class 1/Class 2		22.2%	22.3%	19.2%	19.5%	19.8%	19.3%	18.4%	17.6%	16.4%	16.3%
	Existing/Class 1/Class 2/Class 3		22.2%	22.3%	19.2%	19.5%	19.8%	19.3%	18.4%	17.6%	16.4%	16.3%
	Existing/Class 1/Class 2/Class 3/Class 4		22.4%	22.6%	19.6%	19.8%	20.9%	20.4%	19.6%	18.8%	17.5%	17.4%
Southern California	Existing/Class 1	15.2%	15.2%	15.2%	15.2%	15.3%	15.2%	15.2%	**10.8%**	**5.4%**	**-0.6%**	**-2.8%**
	Existing/Class 1/Class 2		19.1%	20.9%	21.1%	21.5%	21.6%	20.7%	19.6%	17.9%	16.0%	15.2%
	Existing/Class 1/Class 2/Class 3		18.2%	20.4%	20.3%	20.6%	20.8%	20.1%	19.3%	17.8%	16.2%	15.4%
	Existing/Class 1/Class 2/Class 3/Class 4		18.5%	21.7%	22.4%	24.3%	26.5%	28.1%	27.7%	26.2%	24.4%	23.5%
Mexico	Existing/Class 1	11.9%	12.1%	12.5%	12.0%	12.8%	12.6%	**9.8%**	**-7.6%**	**-10.1%**	**-12.6%**	**-15.0%**
	Existing/Class 1/Class 2		13.9%	12.3%	15.5%	16.2%	13.0%	12.7%	12.3%	12.7%	12.2%	**11.8%**
	Existing/Class 1/Class 2/Class 3		26.5%	18.4%	27.3%	27.8%	24.3%	20.9%	17.6%	14.4%	13.0%	**11.8%**
	Existing/Class 1/Class 2/Class 3/Class 4		26.5%	18.4%	27.3%	27.8%	45.5%	61.3%	56.9%	52.7%	50.2%	48.0%
WECC Total	Existing/Class 1	14.7%	30.2%	29.9%	25.7%	23.1%	20.9%	18.8%	18.0%	15.5%	**14.0%**	**12.3%**
	Existing/Class 1/Class 2		31.0%	31.8%	29.3%	27.4%	25.7%	23.9%	23.3%	20.7%	19.2%	17.3%
	Existing/Class 1/Class 2/Class 3		34.2%	36.0%	33.6%	32.1%	30.8%	29.2%	28.7%	26.0%	24.4%	22.5%
	Existing/Class 1/Class 2/Class 3/Class 4		35.0%	38.4%	37.1%	36.5%	37.2%	36.8%	37.3%	34.8%	33.1%	31.2%

The results of the summer PRM indicate a need, in some subregions and in later years, for additional resources beyond those already under active construction to meet the Building Block target reserve margin.[19]

[19] 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 resources 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.

Table 5 – Winter Results

Planning Reserve Margin		Winter										
Subregion	Resources	Building Block Target	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Canada	Existing/Class 1	13.9%	**11.5%**	14.4%	**12.2%**	**7.6%**	**3.3%**	**0.9%**	**1.9%**	**-0.1%**	**-0.7%**	**-0.9%**
	Existing/Class 1/Class 2		17.9%	21.4%	24.9%	23.8%	20.9%	19.5%	19.1%	17.6%	16.7%	16.3%
	Existing/Class 1/Class 2/Class 3		18.1%	26.0%	25.3%	25.9%	22.5%	19.5%	19.1%	17.6%	16.7%	16.3%
	Existing/Class 1/Class 2/Class 3/Class 4		20.2%	29.6%	30.5%	33.2%	36.6%	33.7%	35.0%	35.9%	34.7%	34.1%
Northwest US	Existing/Class 1	19.2%	33.5%	32.4%	30.5%	29.9%	29.3%	26.1%	23.7%	23.1%	21.4%	19.3%
	Existing/Class 1/Class 2		32.0%	34.4%	32.9%	33.4%	32.8%	30.6%	29.1%	27.8%	26.1%	23.9%
	Existing/Class 1/Class 2/Class 3		33.9%	34.5%	32.9%	33.4%	33.5%	31.4%	29.9%	28.2%	26.4%	24.3%
	Existing/Class 1/Class 2/Class 3/Class 4		34.0%	34.5%	32.9%	33.5%	33.6%	33.7%	32.2%	30.4%	28.7%	26.5%
Basin	Existing/Class 1	13.7%	22.4%	21.9%	19.2%	18.8%	18.4%	17.3%	14.0%	14.6%	13.9%	13.7%
	Existing/Class 1/Class 2		23.0%	22.5%	19.8%	19.3%	19.0%	17.8%	14.6%	15.2%	14.0%	13.8%
	Existing/Class 1/Class 2/Class 3		26.3%	25.0%	22.0%	22.1%	21.8%	19.8%	15.7%	16.3%	14.1%	13.9%
	Existing/Class 1/Class 2/Class 3/Class 4		26.3%	25.0%	27.4%	27.5%	28.1%	30.5%	26.2%	27.3%	25.5%	25.2%
Rockies	Existing/Class 1	15.9%	51.5%	44.0%	43.0%	33.3%	35.2%	36.1%	33.4%	33.4%	23.6%	22.2%
	Existing/Class 1/Class 2		53.8%	46.2%	49.9%	39.9%	40.0%	40.8%	38.1%	38.0%	28.6%	27.1%
	Existing/Class 1/Class 2/Class 3		60.0%	52.3%	56.0%	45.8%	45.7%	46.5%	44.6%	44.4%	34.9%	33.3%
	Existing/Class 1/Class 2/Class 3/Class 4		61.5%	53.8%	57.5%	47.3%	47.2%	47.9%	46.0%	46.2%	36.7%	35.1%
Desert Southwest	Existing/Class 1	14.0%	108.4%	106.6%	101.8%	95.9%	92.3%	90.8%	85.1%	78.2%	75.4%	70.8%
	Existing/Class 1/Class 2		108.2%	107.4%	103.2%	97.8%	94.1%	92.6%	87.4%	79.9%	77.8%	73.2%
	Existing/Class 1/Class 2/Class 3		108.6%	107.9%	103.6%	98.2%	94.5%	93.3%	88.5%	79.9%	78.1%	73.8%
	Existing/Class 1/Class 2/Class 3/Class 4		110.2%	115.4%	112.2%	107.5%	104.2%	103.9%	101.7%	93.3%	91.2%	87.5%
Northern California	Existing/Class 1	12.1%	35.9%	32.9%	31.9%	30.5%	29.4%	28.3%	26.9%	25.2%	23.5%	21.4%
	Existing/Class 1/Class 2		42.6%	41.5%	41.3%	40.8%	40.7%	40.1%	39.2%	37.8%	35.9%	33.8%
	Existing/Class 1/Class 2/Class 3		42.6%	41.5%	41.3%	40.8%	40.7%	40.1%	39.2%	37.8%	35.9%	33.8%
	Existing/Class 1/Class 2/Class 3/Class 4		43.0%	41.9%	41.8%	41.3%	42.4%	41.8%	40.8%	39.4%	37.6%	35.4%
Southern California	Existing/Class 1	11.0%	41.1%	38.9%	37.9%	34.8%	31.5%	29.7%	28.6%	26.2%	25.5%	23.9%
	Existing/Class 1/Class 2		45.0%	46.4%	48.0%	45.5%	42.8%	41.1%	40.2%	37.5%	36.7%	35.0%
	Existing/Class 1/Class 2/Class 3		45.0%	46.6%	48.0%	45.5%	42.8%	41.1%	40.2%	37.6%	36.7%	35.1%
	Existing/Class 1/Class 2/Class 3/Class 4		45.2%	48.2%	51.1%	51.0%	51.2%	52.8%	52.7%	49.9%	48.9%	47.1%
Mexico	Existing/Class 1	10.7%	64.3%	61.7%	40.4%	38.1%	26.1%	24.1%	24.7%	20.0%	18.2%	16.4%
	Existing/Class 1/Class 2		72.1%	69.4%	66.8%	64.2%	51.7%	49.4%	49.5%	44.5%	42.3%	40.1%
	Existing/Class 1/Class 2/Class 3		72.1%	69.4%	66.8%	64.2%	51.7%	49.4%	49.5%	44.5%	42.3%	40.1%
	Existing/Class 1/Class 2/Class 3/Class 4		72.1%	69.4%	66.8%	64.2%	87.0%	117.3%	116.3%	110.3%	107.1%	103.9%
WECC Total	Existing/Class 1	14.6%	34.0%	32.7%	30.0%	28.3%	26.1%	24.1%	22.6%	20.9%	18.8%	17.1%
	Existing/Class 1/Class 2		34.1%	33.7%	32.9%	32.0%	30.0%	28.3%	26.8%	25.1%	22.9%	21.2%
	Existing/Class 1/Class 2/Class 3		37.1%	37.6%	36.3%	35.8%	34.0%	32.1%	30.6%	28.7%	26.4%	24.7%
	Existing/Class 1/Class 2/Class 3/Class 4		37.8%	39.6%	39.5%	39.9%	40.3%	40.1%	39.5%	37.8%	35.4%	33.8%

Sufficient generation resources have been proposed such that all subregions meet the calculated Building Block target. Currently, some generation projects that are under construction are ahead of schedule and should be available sooner than reported. This would impact short term results. In addition, a significant number of proposed resources that are not under active construction are moving forward and are undergoing regulatory review, while others have not yet started the regulatory review process.

The results of the winter PRM indicate that the Canada subregion may be below the Building Block target as early as next winter. However, as previously noted, percentages below target reserve levels are not forecasts of shortages, but are indicators that proposed resources need to progress through the regulatory approval process in a timely manner.

Temperature Events

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 existing resources, resources under construction, and resources identified as Class 2.

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 2005-2012 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. Case 9 reflects a peak coincidental demand increases of 10 percent for the summer, and case 10 reflects a peak coincidental demand increases of 6 percent for the winter. This process is described in detail in the Temperature Adders section of the Methods and Assumptions document.[20]

Table 6 – Extreme Temperature Comparison

Planning Reserve Margin		Demand Adjustment	Seasonal Results										
Subregion	Resources		Building Block Target	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
WECC Total	Existing/Class 1/Class 2	All Subregions 1-20 Demand (Summer)	14.7%	21.4%	22.1%	19.7%	18.0%	16.4%	14.8%	**14.2%**	**11.8%**	**10.4%**	**8.7%**
WECC Total	Existing/Class 1/Class 2	All Subregions 1-20 Demand (Winter)	14.6%	27.7%	27.3%	26.6%	25.7%	23.8%	22.2%	20.7%	19.1%	17.0%	15.4%
Desert Southwest/Southern California	Existing/Class 1/Class 2	Desert Southwest/Southern California 1-20 Demand - Other Subegions 1-10 (Summer)	14.4%	25.3%	22.6%	22.9%	22.1%	20.7%	18.9%	16.6%	14.5%	14.5%	**13.6%**
Canada/Northwest US/ Northern California	Existing/Class 1/Class 2	Canada/Northwest US/Northern California 1-20 Demand - Other Subregions 1-10 (Winter)	15.7%	34.2%	35.5%	36.0%	35.6%	35.2%	35.1%	33.9%	32.3%	30.9%	28.8%

Using the same process described above, case 11 was created to test a 1-in-20 year extreme summer temperature peak demand increase for the Desert Southwest and Southern California. This case reflects an increase in demand of 4 percent. Case 12 reflects an increase in demand for a 1-in-20 year extreme winter Canada, the northwest US, and Northern California of 3.6 percent.

The results of the extreme temperature cases show that, in future years, WECC as a whole could drop below the Building Block Target margin. Although this type of interconnection-wide extreme temperature case is not an anticipated event, it does

[20] NERC Long Term Reliability Assessment – Methods and Assumptions. (see footnote 3)

represent a scenario that would stress generation and the transmission system. The results also indicate that the Desert Southwest/Southern California subregion could drop below the target margin by the end of the study period.

It should be noted that the decision of which resources to include in the various case studies can affect the timing of when potential deficits occur in the subregions. The case studies in this assessment only use resources that will be in-service prior to January 2018 for resources that are currently under construction (Class 1), or January 2020 for resources that are going through a regulatory review process, or are under construction, with an expected in-service date prior to January 2020 (Class 2). The LRS elected to limit the planned additions to this subset of resources due to a higher confidence that projects in Class 1 and Class 2 will be built. The LRS also realizes that limiting the resources to this subset can, and does, exclude many short lead-time approval and construction projects, such as wind, small-scale solar, or natural gas peaking units.

Study Caveats

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

1. The analysis is based on L&R data submitted in March 2013. The demand forecasts and reported resources for each BA were “locked” as of May 2013. 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. The LRS recognizes that the 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 West-wide coincidental peak demand. The model uses static hourly demand curves for each BA within WECC. These curves were created by averaging five years actual hourly

demand for each BA. Promod uses an algorithm and 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 hour 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 hour 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.