



WECC

**Western Assessment of Resource Adequacy
Subregional Spotlight: Desert Southwest (DSW)**

January 29, 2021

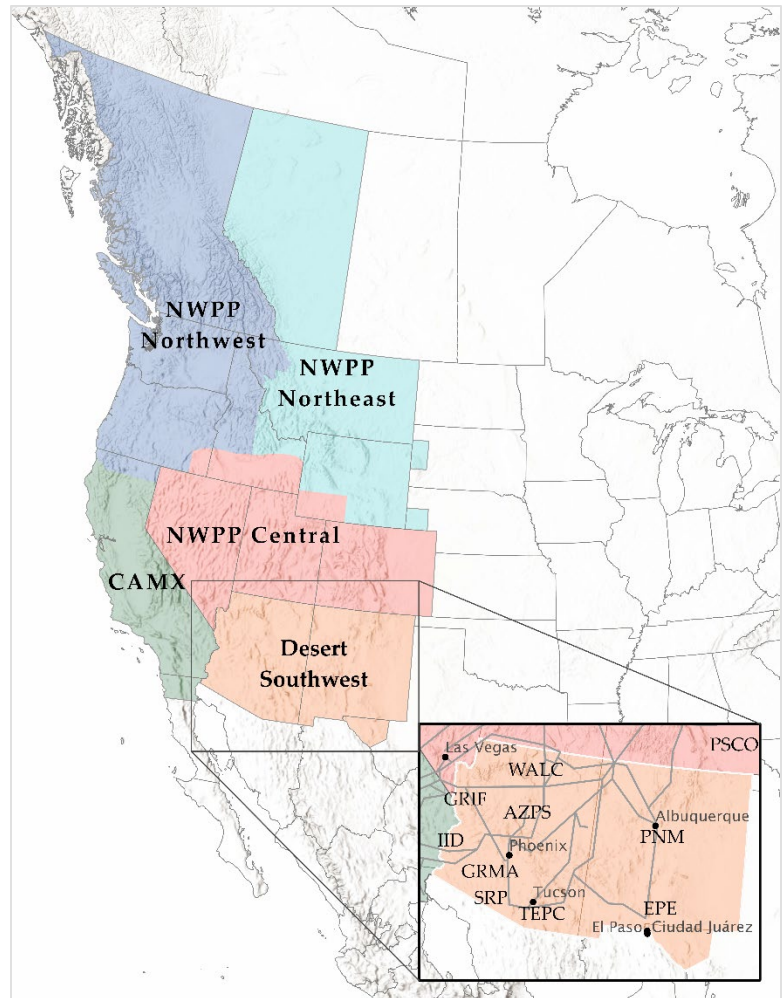
The Desert Southwest Subregion

WECC's Western Assessment of Resource Adequacy (Western Assessment)¹ divides the Western Interconnection into five subregions to account for geographic, operational, and system diversity (See Figure 1). As described in the assessment, each subregion faces unique resource adequacy challenges that require tailored solutions. The Western Assessment, released December 18, 2020, discussed resource adequacy at an interconnection-wide level. This subregional spotlight focuses on the Desert Southwest (DSW) subregion. The DSW subregion is a summer-peaking area that includes all of Arizona, most of New Mexico, and parts of Texas and California (Imperial Irrigation District).

This spotlight document covers six areas:

1. **Key Findings:** Highlighted takeaways specific to the subregion.
2. **Demand Analysis:** Assessment of peak demand and annual demand, as well as the variability in the subregional demand forecast.
3. **Resource Availability Analysis:** Description of the subregion's resource portfolio and expected changes over the 10-year study period, as well as the variability in the expected availability of each type of resource.
4. **Planning Reserve Margin Analysis:** Assessment of the planning reserve margins needed to maintain a one-day-in-ten-year (ODITY) threshold.
5. **External Assistance Analysis:** Assessment of the availability of excess resources in the other subregions, focused on time of need, and a discussion of potentially available assistance.

Figure 1: Desert Southwest Subregion



¹ The [Western Assessment](#) was released on December 18, 2020. The assessment contains an explanation of terms and WECC's methods and tools.

6. **Demand at Risk:** A study of the annual and peak day demand at risk before external assistance.

Key Findings

These findings, along with findings from the other subregions, are summarized in the Western Assessment document.

Demand

In 2021, the DSW subregion is expected to peak in early July at about 25,700 MW. However, there is a 5% probability that the subregion could peak as high as 29,100 MW, which equates to a 13% load forecast uncertainty. Overall, the DSW subregion should expect a 100% ramp, or 12,800 MW, from the lowest to the highest demand hour of the peak demand day.

Resource Availability

The expected availability of resources on the peak hour in 2021 is 29,300 MW. However, under low-availability conditions, the DSW subregion may only have 24,300 MW available to meet a 25,700 MW expected peak. Although there is only a 5% probability of this occurring, significant imports would be needed to meet demand under low-availability conditions. Because of their high penetration, baseload resources account for most of the variability (about 3,000 MW) as opposed to solar generation, which may vary by roughly 600 MW.

Planning Reserve Margin

For 2021, an annual planning reserve margin of 16% is enough to maintain the median resource adequacy ODITY threshold for the DSW subregion. However, in the months when variability in energy supply and demand is highest (March and December), a planning reserve margin near 27% may be needed to maintain the ODITY threshold. As more variable resources are added to the system, a larger planning reserve margin is needed to compensate for variability in the system and remain resource adequate.

Annual Demand at Risk

Hours at Risk

In 2021 and beyond, even with all planned resource additions, the DSW subregion needs external assistance to maintain resource adequacy. In 2021, in the Stand-alone EX scenario, the DSW subregion could experience as many as 415 hours in which the ODITY threshold of resource adequacy is not



maintained. Under the Stand-alone T1 and Stand-alone T2 scenarios, there are 283 hours with potential demand at risk.²

Even with all planned resource additions and importing excess energy from other subregions, the DSW subregion is at risk for unserved energy. In 2022, under the Imports EX and Imports T1 scenarios, there are 41 and 14 hours, respectively, in which the ODITY threshold is not met and load is at risk. The number of hours at risk increases for both scenarios between 2022 and 2024.

Energy at Risk

Energy at risk is the sum of all the demand at risk over the year. In 2021, the total energy at risk in the Stand-alone EX scenario is about 259 GWh. Spread over the 415 hours at risk in this scenario, this translates to about 624 MW of unserved demand per at-risk hour. This trend continues through 2024, with increasing levels of demand at risk each year.

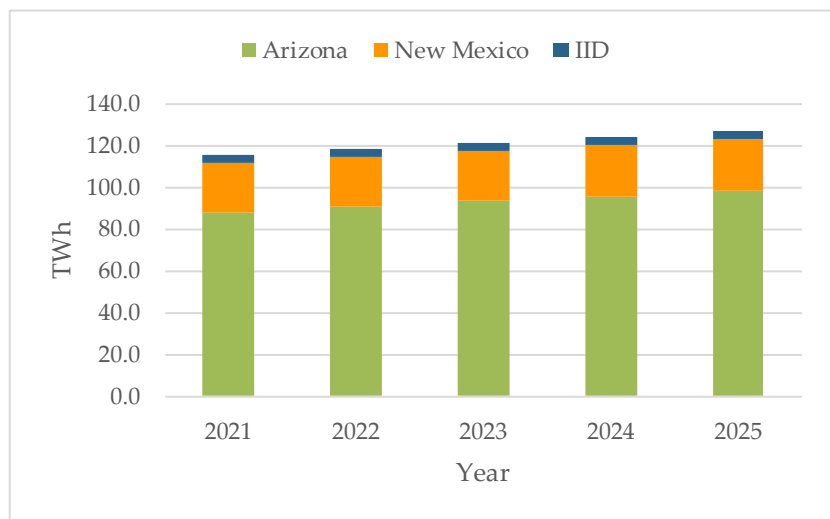
Demand Analysis

WECC examines three demand categories in its resource adequacy analysis: annual demand, peak day demand, and peak hour demand.

Annual Demand

From 2021 to 2025, annual demand in the DSW subregion is expected to increase from 115.3 TWh to 126.7 TWh. The Arizona area accounts for the largest part of the demand in the subregion, the rest consists of New Mexico and the Imperial Irrigation District (IID) (See Figure 2).³

Figure 2: Annual Demand



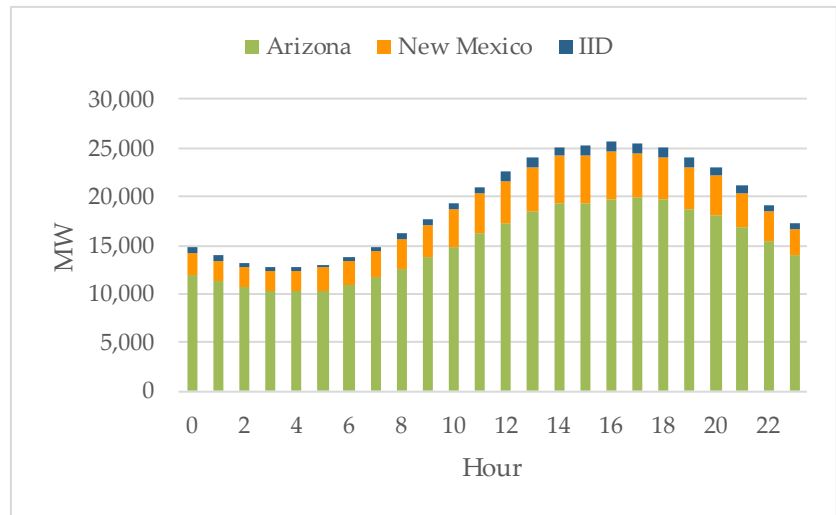
² A description of the scenarios is available in the [Western Assessment](#).

³ Demand information for El Paso Energy is included in the New Mexico analysis.

Peak Demand

In 2021, the DSW subregion's coincident peak demand hour is expected to be at 4:00 p.m. on the peak demand day. The lowest demand that day is expected to be at 4:00 a.m. (See Figure 3). Over the 12 hours from 4:00 a.m. to 4:00 p.m., demand is expected to increase more than 100%, from 12.7 GW to 25.6 GW, across the subregion. The Arizona area is expected to see a 9.7 GW (95%) ramp on the peak day, while the New Mexico area is expected to see a ramp of about 2.7 GW (131%). The IID area is expected to experience a 0.7 GW ramp, which is a 197% difference between the low demand and the high demand for the peak day.

Figure 3: Peak Day Demand—2021



Demand Variability

Variability in demand occurs every hour. Understanding how demand variability can affect resource adequacy allows planners to plan for the variability. Many factors drive demand variability, including weather, technology, policy, energy efficiency, and shifting demographics. Demand forecasts represented as a single number do not capture demand variability adequately. Instead, demand forecasts that provide a range of possible demand values allow resource adequacy analyses to account for demand variability across a probability distribution. As more demand or consumer-side programs, such as home batteries, electric vehicles, roof-top solar, or demand response programs are added to the interconnection, variability in demand will continue to grow. Increased variability means more uncertainty in demand forecasts, which may affect resource adequacy for the entire interconnection.

Figure 4: Peak Hour Demand Distribution Curve—2021

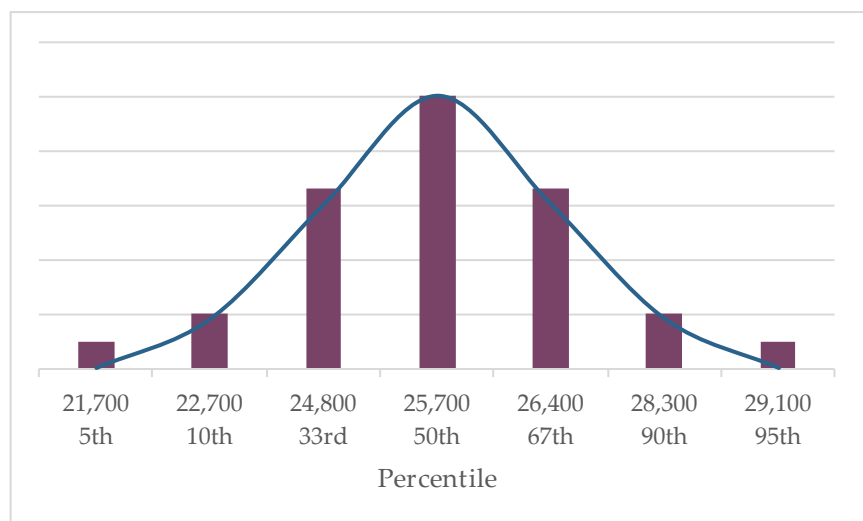
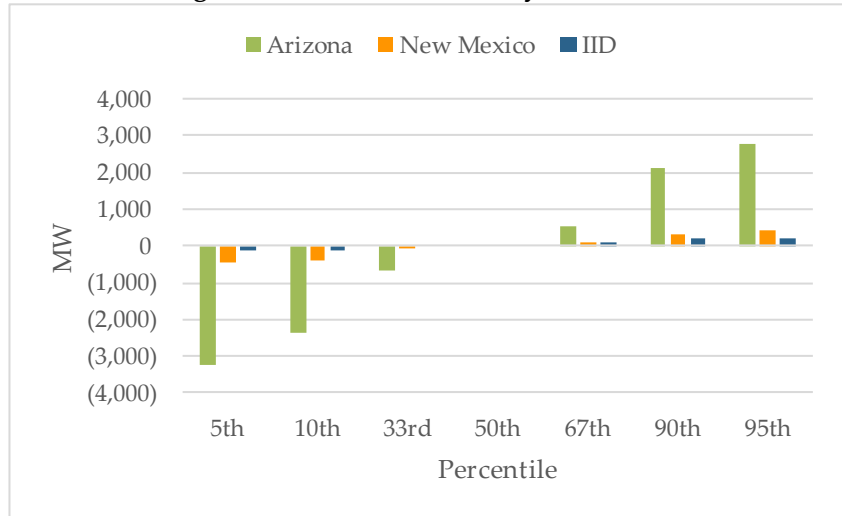


Figure 4 shows the degree of demand variability in the DSW subregion. On the peak hour of 2021, there is an equal probability that demand could be higher or lower than 25,700 MW. In an extreme scenario (a 5% probability of occurring), demand could increase from the forecast demand of 25,700 MW to 29,100 MW, which is 3,400 MW or 13% higher than expected. Likewise, there is a 10% possibility that demand could be 28,300 MW, or 2,600 MW higher than expected.

While all areas within the subregion have some degree of demand variability, the variability is not the same for all areas. Figure 5 shows the variability within the DSW

subregion, reported by area. The Arizona area has the largest and most variable demand in the subregion. Arizona demand ranges from about 3,200 MW below the expected demand to about 2,700 MW above it. The New Mexico and IID areas have much less variability in demand—less than 500 MW in the New Mexico area and less than 200 MW in the IID area.

Figure 5: Demand Variance by Area—2021



Resource Availability Analysis

WECC analyzes resource availability for both the peak hour and peak day. This assessment analyzes the amount of generation that is expected to be available from a resource, which varies greatly by resource type.

Peak Hour Availability

In 2021, available generation in the DSW subregion is expected to be about 28,700 MW (See Figure 6). The planned retirement of coal-fired and other baseload resources reduces this number to 27,800 MW by the end of 2025. However, Tier 1 and Tier 2 resource additions that are expected to be on-line by 2025 are predicted to increase the peak hour available generation to 29,500 MW.

Figure 6: Peak Demand Hour Availability by Tier



Table 1 shows the total megawatts each resource type is expected to contribute to resource availability during the peak hour over the next five years.

Table 1: Peak Demand Hour Availability by Type (MW)

	2021	2022	2023	2024	2025
Baseload	24,998	24,982	25,529	25,134	24,797
Hydro	2,547	2,447	2,547	2,547	2,547
Solar	1,384	1,809	1,769	1,769	1,769
Wind	431	425	448	448	448

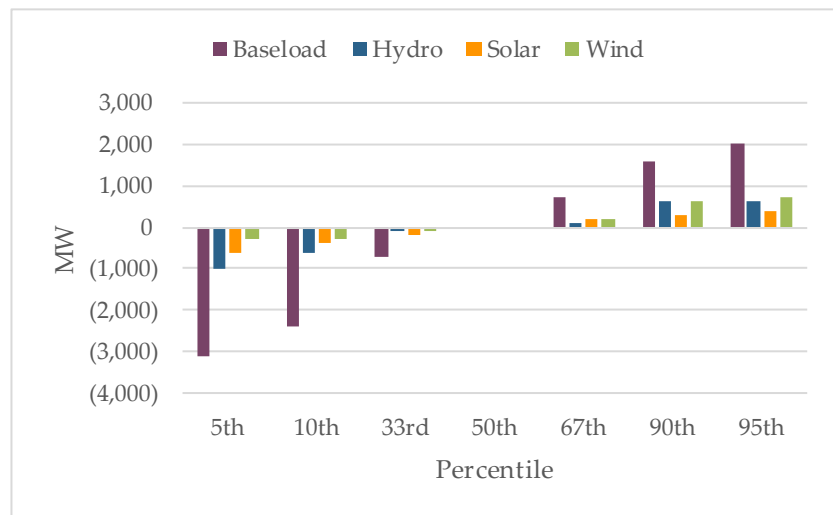
Baseload resources account for about 85% of the available generation in 2021 and remain relatively stable through 2025. The amount of available generation for the peak demand hour is expected to remain relatively stable over the next five years, but solar resources are expected to increase 35%. In future years, as more variable resources are added, the resource mix is expected to change and variability of the overall resource portfolio is expected to increase.

Variability by Resource Type

Figure 7 shows how resource availability varies by resource type across the DSW subregion. Under expected conditions, baseload resources can provide 25,000 MW; under low availability conditions, baseload resources could supply 3,100 MW less than expected, reducing availability to 21,900 MW. There is a 5% probability of the low availability conditions occurring.

Likewise, there are conditions under which baseload resources could produce 2,000 MW more than expected, increasing availability to 27,000 MW. Hydro generation has an expected availability of about 2,500 MW, but under low availability conditions, a 5% probability, hydro could supply 1,000 MW less than expected. This will reduce availability to 1,500 MW. Although solar generation is expected to have 1,400 MW of availability, that value can vary from a low availability of about 800 MW to a high of about 1,800 MW.

Figure 7: Resource Variance by Type—2021



Peak Day Availability

In addition to analyzing generation availability on the peak hour, WECC looks at generation availability on the peak day. Figure 8 shows the peak demand day for 2021 in the DSW subregion along with the expected resource availability by resource type. The DSW subregion depends largely on baseload resources, which create less variability throughout the day and decrease uncertainty in resource adequacy planning.

Resource Availability Variability

The DSW subregion's resource portfolio is less variable than other subregions, though, it is still subject to a range of availability based on the probability distribution across the subregion.

Figure 9 shows the expected variability of generation availability in the DSW subregion. The figure highlights the subregion's total generation availability at different levels of probability. In 2021, at least 29,300 MW of generation is expected to be available 50% of the time, while 50% of the time availability is expected to be less than 29,300 MW. Likewise, the figure shows that 33% of the time generation availability could be lower than 28,200 MW, 10% of the time the availability could be lower than 25,600 MW, and in extreme cases, 5% of the time, availability could be lower than 24,300 MW.

In rare cases in which generation availability could be extremely low, meeting demand while maintaining operating reserves may be difficult. Because resource availability differs across resource types, WECC analyzes the type of resources in a portfolio in addition to the generation capacity.

Figure 8: Peak Day Resource Type Availability—2021

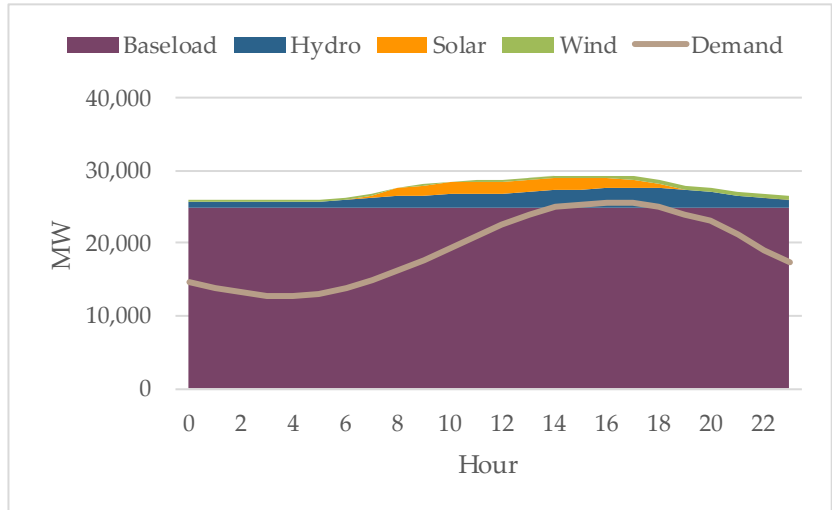


Figure 9: Peak Hour Availability Distribution Curve—2021

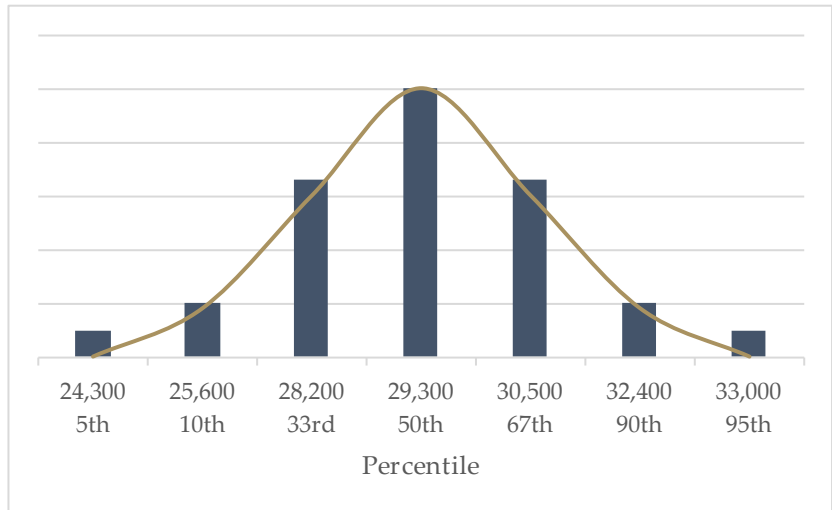
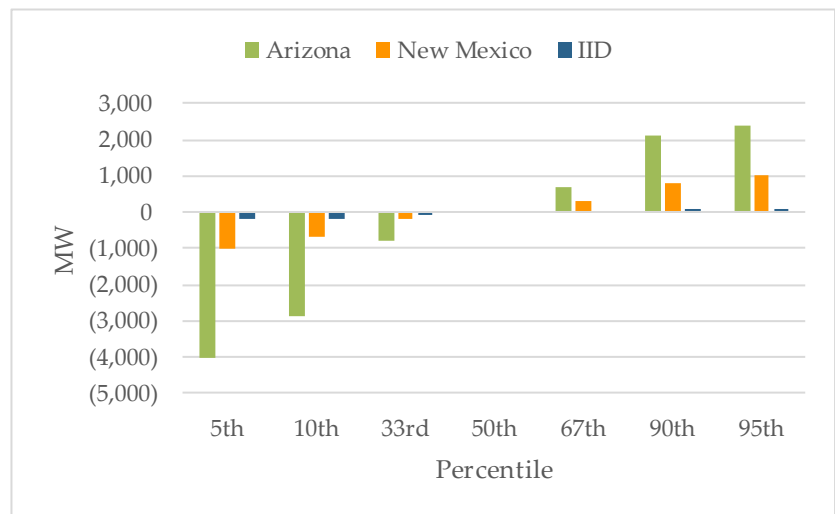


Figure 10 shows the differences in resource variability within the DSW subregion. The Arizona area has the greatest amount of variability in resource availability, ranging from about 4,000 MW less to about 2,400 MW more than expected, both cases with 5% probability. In the New Mexico area, resource availability could be up to 1,000 MW more than or less than expected. In the IID area there is little variability in resource availability. As more variable

resources are added, and more baseload resources are retired, resource variability will increase, which will affect resource availability within the subregion.

Figure 10: Resource Variance by Area



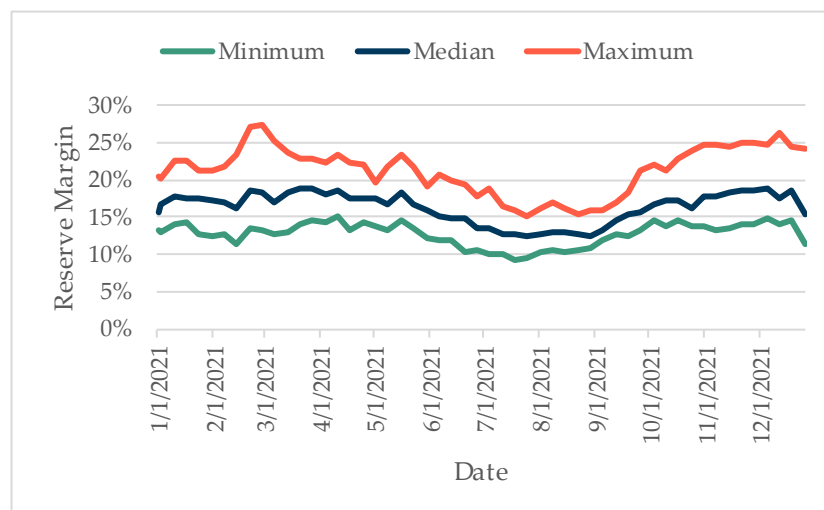
Planning Reserve Margin Analysis

The expected variability in both demand and resource availability emphasizes the importance of maintaining a planning reserve margin that accounts for variations in seasonal and hourly supply and demand. The planning reserve margins are calculated based on the stand-alone scenario and variances.

Reserve Margin—Percentage

Under different supply and demand scenarios, the planning reserve margin changes. When demand and resource variability are lower, a lower planning reserve margin is required to meet the ODITY threshold. Conversely, when demand and resource variability are greater, a higher planning reserve margin is required to meet the

Figure 11: Planning Reserve Margin Plot—Percent



margin is required to meet the ODITY threshold. The difference in conditions leads to a range of planning reserve margins. Figure 11 highlights the range of potential reserve margins necessary to cover demand and resource variability across the DSW subregion in 2021.

The planning reserve margin is calculated for every hour of the year. The figure shows the minimum, median, and maximum planning

reserve margin for each week of 2021. For example, the minimum planning reserve margin for the first week of January 2021 is 13%, while the median planning reserve margin for that week is 17%, and the maximum planning reserve margin for that week is 20%.

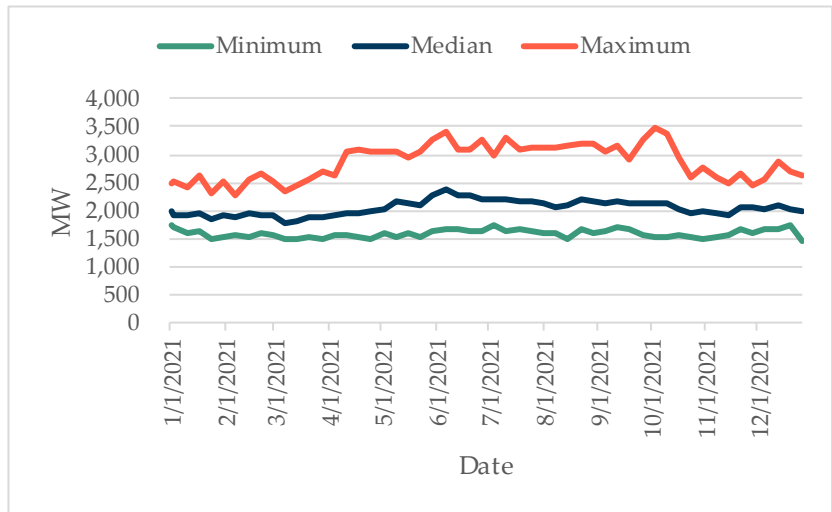
The planning reserve margin in 2021 ranges from 9% to 27% with the lowest value occurring in July and the highest value occurring in February. There are 5,928 hours in which the planning reserve margin is at or above 15%. This means, if a flat 15% reserve margin were applied to all hours of the year, almost 70% of the hours would not meet the ODITY threshold.



Reserve Margin as Megawatts

Figure 12 shows the planning reserve margin ranges for the DSW subregion in megawatts. For the entire subregion, the minimum planning reserve margin needed to maintain the ODITY threshold is relatively constant through the year at about 1,600 MW. It can range from a high of 1,900 MW in January to a low of 1,400 MW in December. The median planning reserve margin is also fairly stable and ranges from about 2,300 MW in the summer to 2,000 MW in the winter. The maximum planning reserve margin needed to meet the ODITY threshold ranges from a low of 2,300 MW in late February to a high of 3,500 MW in October.

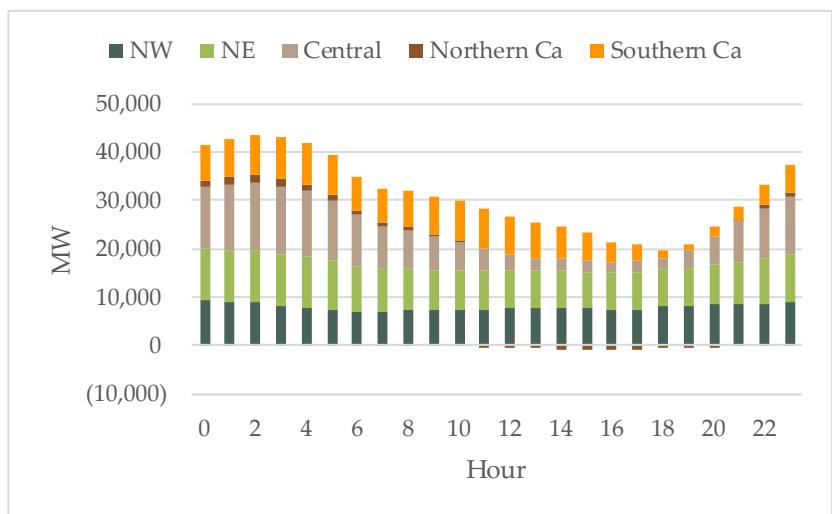
Figure 12: Planning Reserve Margin Plot—MW



External Assistance Analysis

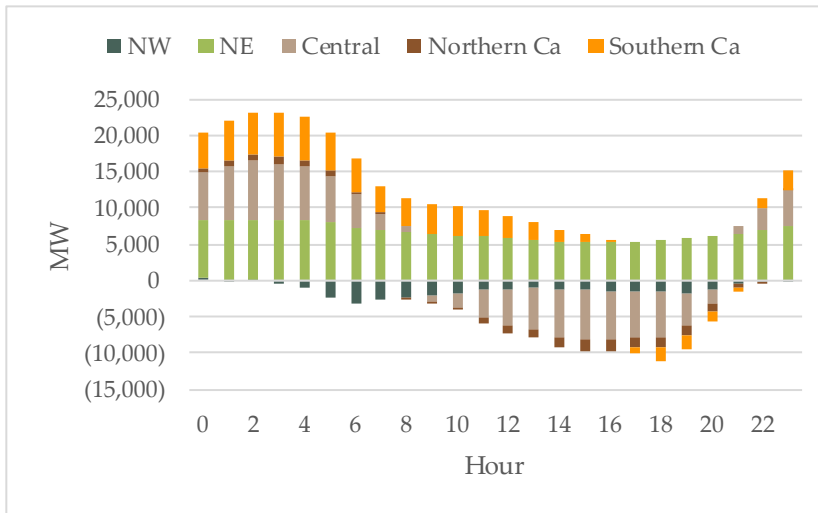
External assistance, or energy that is available to import from other subregions, can only be counted on when the energy and transmission are actually available. Figure 13 shows the potential imports available for the DSW subregion's peak demand day in mid-July, assuming expected demand and resource availability and Tier 2 resources are included. Under this scenario, all subregions outside DSW have resources available and could

Figure 13: Peak Day Expected Import Availability—2021



provide imports during the DSW's peak hour, which occurs at 4:00 p.m. However, if all the subregions experience low resource availability at the same time, the potential for them to provide imports is reduced by more than 75% from about 20 GW to about 5 GW (See Figure 14). If all the other subregions experience high demand and low resource availability at the same time, imports into the DSW subregion may not be available. This was the case in the California-Mexico (CAMX) subregion during

Figure 14: Peak Day Low Import Availability—2021



the August 2020 Heatwave Event, in which coincident high demand and low availability occurred across the Western Interconnection, vastly reducing available imports into the CAMX subregion. The probability of all subregions experiencing high demand and low availability at the same time is very low. However, as weather patterns and the resource mix continue to change, the likelihood of extreme demand and supply events stressing resource adequacy also increases.

Demand at Risk

Demand at risk is the amount of end-customer demand that may not be served, or is at risk of not being served, due to a deficiency of generation. WECC analyzes demand at risk on both the peak demand day and on an annual basis.

Peak Day Demand at Risk

Figure 15 shows expected supply, demand, and the planning reserve margin for the DSW subregion's peak demand day in early July 2021. Under expected demand and expected availability of resources on the peak day, the DSW subregion may experience some hours in which demand is at risk of not being served with internally available resources (Figure 16). During these hours, the DSW subregion may need imports from another region to maintain the ODITY threshold. On the peak hour of 2021, the DSW subregion has just over

Figure 15: Peak Day Condition Expectations—2021

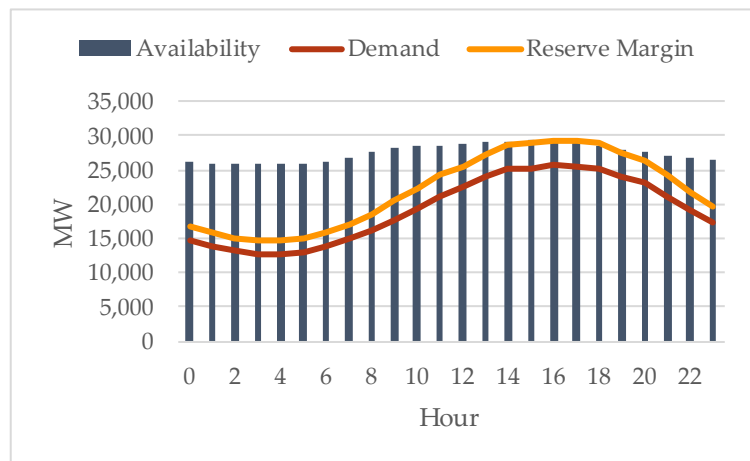
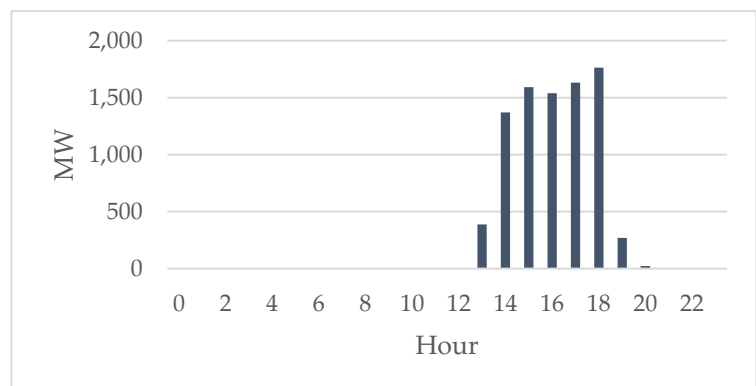


Figure 16: Peak Day Potential Demand at Risk—2021



1,500 MW of demand at risk of being unserved with Tier 1 and 2 resources, without imports from external areas. In fact, most afternoon hours of the peak day show demand at risk of not being served, with the greatest amount at risk of about 1,800 MW at 6:00 p.m. after solar resources have stopped generating. If resources fall short of expected availability, or if demand is higher than expected, demand may be at risk of not being served.

Annual Demand at Risk

Figure 17 shows the number of expected hours in 2021 through 2024 in which the ODITY threshold of resource adequacy is not met for each of the six scenarios studied. In 2021, in the Stand-alone EX scenario, the DSW subregion could experience over 400 hours in which the ODITY threshold of resource adequacy is not maintained. Under both the Stand-alone T1 and Stand-alone T2 scenarios, the number of hours with potential demand at risk is reduced to about 280. The assessment indicates that, as early as 2021, even with all planned resource additions, the DSW subregion will still rely on external assistance to maintain the ODITY threshold.

Figure 17: Potential Demand at Risk Hours



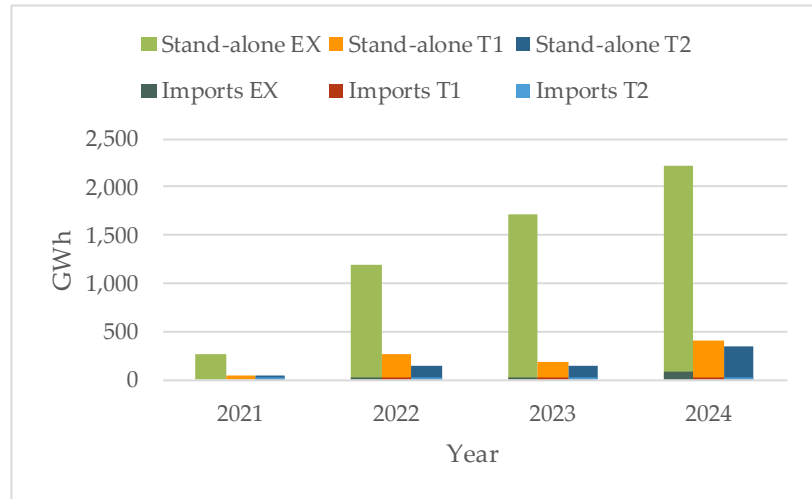
When imports are included on top of existing resources, there are 41 hours in 2022 in which the subregion may not maintain the ODITY threshold. This increases to 86 hours in 2024. When Tier 1 resource additions are included in the analysis, the number of hours in which the ODITY threshold is not met decreases to 14 hours in 2022, and to 22 hours in 2024. Adding all Tier 2 resources to the analysis reduces the hours at risk for unserved load to zero for all years studied.

Energy at Risk

In 2021, nearly 260 GWh of energy is at risk of not being served in the Stand-alone EX scenario (Figure 18). Spread over the 400 hours at risk in this scenario, this translates to about 650 MW of demand at risk per hour. This trend continues through 2024 with increasing levels of demand at risk each year for each of the stand-alone scenarios.

The assessment indicates that for the stand-alone scenarios, under all variations, additional or different types of resources above those planned to be added over the next four years are needed for the DSW subregion to remain resource adequate and avoid unserved demand.

Figure 18: Potential Demand at Risk GWh



Conclusion

As early as 2021, under expected conditions, the DSW subregion may experience some hours in which demand is at risk of not being served with internally available resources. When including imports from other subregions across the Western Interconnection, the DSW subregion can greatly reduce the hours in which the ODITY threshold is unmet. The assessment indicates that, to maintain the ODITY threshold, entities in the DSW subregion need to build the resources currently included in the construction queue. At times, the subregion will also depend on imports from other subregions to maintain resource adequacy. The growing variability in both supply and demand across the Western Interconnection increases the risk that imports may not be available to maintain the ODITY threshold. Therefore, the subregion should consider the degree to which it plans to rely on imports from other subregions and consider supplementing its own resources to remain resource adequate.

Appendix A

Announced and Expected Generation Retirements Used in the MAVRIC Model

Announced and Expected Generation Retirements (2020-2030)							
Subregion	State	Unit Name	Unit Number	Nameplate Capacity	Primary Fuel Type	Commission Date	Retirement Date
DSW	NM	Escalante	1	285.00	Bituminous Coal	12/1/1984	12/31/2020
DSW	NM	San Juan	1	369.00	Bituminous Coal	12/1/1976	6/30/2022
DSW	NM	San Juan	4	555.00	Bituminous Coal	4/1/1982	6/30/2022
DSW	NM	RGD	7	50.00	Natural Gas	6/1/1958	12/31/2022
DSW	TX	NWM	1	81.00	Natural Gas	5/1/1960	12/31/2022
DSW	TX	NWM	2	81.00	Natural Gas	6/1/1963	12/31/2022
DSW	AZ	Cholla	1	113.59	Bituminous Coal	5/1/1962	1/1/2025
DSW	AZ	Cholla	3	312.30	Bituminous Coal	5/1/1980	1/1/2025
DSW	TX	NWM	3	121.00	Natural Gas	3/1/1966	12/31/2026
DSW	TX	NWM 4 GT2	4	85.00	Natural Gas	6/1/1975	12/31/2026
DSW	TX	NWM 4 GT1	4	85.00	Natural Gas	6/1/1975	12/31/2026
DSW	TX	NWM 4 ST	4	120.00	Natural Gas	6/1/1975	12/31/2026
DSW	AZ	Iron Horse Solar	1	2.04	Sun	4/20/2017	4/20/2027
DSW	AZ	North Loop	1	27.00	Natural Gas	12/1/1972	12/31/2027
DSW	AZ	North Loop	2	27.00	Natural Gas	12/1/1972	12/31/2027
DSW	AZ	North Loop	3	27.00	Natural Gas	12/1/1972	12/31/2027
DSW	AZ	Springerville	1	424.80	Subbituminous Coal	6/1/1985	12/31/2027
DSW	TX	COP	1	87.00	Natural Gas	7/1/1980	12/31/2030