Memorandum

To: ISO Board of Governors

From: Neil Millar, Vice President, Infrastructure & Operation Planning

Date: May 5, 2022

Re: **Briefing on 2022 Summer Loads and Resources Assessment results**

This memorandum does not require ISO Board of Governors action.

INTRODUCTION

The ISO's 2022 Summer Loads and Resources Assessment presents the expected supply and demand conditions for the 2022 summer peak demand period. This annual assessment helps the ISO, industry participants, and other key stakeholders in planning and preparing grid operation for the upcoming summer season. This briefing provides the ISO Board of Governors with results and information on the following topics that are included in this year's assessment:

- Forecast of ISO peak demand for 2022;
- Discussion of current hydro conditions and expectations for the summer power supply;
- Generation additions and retirements;
- Assessment of capacity margins in the ISO system under diverse operating conditions and scenarios; and
- An update on the status of the Aliso Canyon gas storage facility.

The 2022 Assessment consists of a stochastic analysis for the summer season based on the ISO developed forecast of 2022 load based on recent history, and deterministic stack analysis focusing loads at the time of the net-peak in September when hydro and solar resources are in decline. The stack analysis is based on the California Energy Commission's most recent load forecast for September.

The 2022 Summer Loads and Resources Assessment report will be published on the ISO website following the ISO Board of Governors May meeting.

Summary

The overall probability of having to shed firm load during 2022 is reduced from 2021. The improved results are due to significant newly installed capacity since last summer. However, available capacity continues to be impacted by well below normal hydro conditions as California is in its third year of drought.

The ISO's 2022 load forecasts for peak demand and energy are based on twenty years of historical weather data, reduced from the 26 years used for the 2021 load forecasts. This makes comparing the stochastic results for 2022 to 2021 more challenging. Reducing the historical basis of the forecast was implemented to better reflect climate induced impacts on the load experienced in more recent years.

The ISO's greatest operational risk is during a widespread heat wave that results in low net imports due to high peak demands in its neighboring balancing authority areas. The risk increases in late summer concurrent with the diminishing effective load carrying capability of solar resources and the wane of hydro generation. ISO System Operations has procedures in place that can be used to manage varying levels of extreme scenarios throughout market activities. These would be used to the extent possible to avoid actual shedding of firm loads. Under extreme weather and events such as wildfires[1] that diminish larger amounts of supply[2], the ISO could still be faced with the necessity to shed firm load.

Major findings for the 2022 Assessment include:

- The ISO's forecast of 1-in-2 and 1-in-5 peak demand are relatively unchanged from 2021 and generally align with the latest Energy Commission forecast.
- The 1-in-10 demand is one percent higher than in 2021 and 4 percent higher than the Energy Commission's forecast reflecting the higher weighting placed on recent years in the ISO's projection of year ahead load levels.
- Hydro conditions are near record low levels.
- The net of resource additions and retirements is an increase of 7,556 MW from June 1, 2021 to June 1, 2022, with a net increase of dispatchable capacity of 3,206 MW, nearly all being battery storage resources.
- The risk associated with ongoing Aliso Canyon related gas restrictions remains the same as last summer and SoCalGas is expected to be able to meet the forecasted summer peak day gas demand.
- The 2022 Assessment, as with past assessments, is largely based on historical trends and risks, and does not fully take into account new and emerging risks. Climate change is driving more extreme conditions and limiting the ability to

[1] i.e. July 9th 2021 Bootleg fire impacted approximately 4,000 MW of import capability into California and reduced curtailed 3,000 MW of energy schedules into the CAISO.
[2] Wildfires and other potential adverse impacts to the transmission system are beyond the scope of this assessment.

incorporate assumptions that can be made about future conditions, particularly since past trends are not indicative of the future. Drought, wildfires and other climate change impacts put stress on the system beyond those of increased loads. Additionally, the transition from fossil fuel-based dispatchable resources to variable renewable energy resources has changed how the resource stack is evaluated to determine whether enough resources have been procured to meet system needs in the tightest conditions, and raises additional concerns with project delays affecting new resources reaching commercial operation.

Each of these findings is discussed in greater detail below.

Peak Demand Forecast

The load forecast for 2022 used a revised methodology from prior years. The historical weather period used to develop the forecast was shortened from the 26 years of weather history used in 2021 to the use of the most recent 20 years in 2022. This was done to provide a forecast that more explicitly accounts for the effects of climate change. The results of the forecast are that the 1-in-2[3] and the 1-in-5 summer peak demand forecasts are relatively unchanged from the 2021 forecast. The 2022 1-in-10 forecast increased 1 percent over the 2021 forecast. These results are presented in *Table 1*.

Table 1

2022 Peak Demand Forecast Comparison to 2021

	1-in-2	1-in-5	1-in-10
CAISO 2022 Forecast	45,866	47,850	51,469
CAISO 2021 Forecast	45,837	47,747	50,968
Difference (MW)	29	103	501
Difference (%)	0.1%	0.2%	1.0%

While the 1-in-5 load level remained about 4 percent above the 1-in-2 forecast, the 1-in-10 forecast is 12 percent above the 1-in-2 level.

Hydro Conditions

Energy supplies from California hydro facilities will be significantly lower than normal during 2022. California is in its third consecutive year of below normal precipitation statewide. The

[3] The 1-in-2 forecast is derived from the 50th percentile of the historical weather data from 24 weather stations across the ISO.

April 1, 2022 snow water content was 38 percent of normal, compared to the 2021 level of 60 percent of normal. Earlier than normal runoff reduced the snowpack in the first half of April, but additional precipitation occurring in the second half of April increased the snowpack somewhat. As of April 26 the snowpack was 29 percent of the April 1 average and 35 percent of average for April 26. Northwest River Forecast Center projections are used by the ISO as an indication of potential imports into California from the Northwest. The current April to September reservoir storage projection at The Dalles Dam on the Columbia River is 94 percent of average.

Available Generation

From June 1, 2021 to June 1, 2022, a total of 7,621 MW of new installed capacity is expected to be in commercial operation: 3,271 MW is dispatchable and 4,350 MW is non-dispatchable.[4] During the same period, 65 MW of generation capacity was retired, all dispatchable. The net of additions and retirements is an increase of 7,556 MW installed capacity, with a net increase of dispatchable capacity of 3,206 MW.

Of the new resource capacity coming online, 3,124 MW is from battery energy storage systems. While not providing new energy generation, battery energy storage enables surplus energy generated during periods of high solar production and energy generated during periods of lower energy prices to be stored and provided to meet system needs during the net peak period when solar production ramps down and is no longer available. Battery energy storage systems are able to provide system capacity, ancillary service and flexible capacity.

Assessment of Reserve Margins

The ISO developed a stochastic production simulation model employing the PLEXOS market simulation software to assess hourly operating conditions given the changing resource mix of higher penetration of variable renewable resources and fewer dispatchable conventional resources. The model runs 2,000 unique randomly generated scenarios of forecasted hourly load and renewable generation to assess the ISO's resource adequacy in system capacity, ancillary service, and flexible capacity on an hourly basis.

The 2022 Assessment uses loaded capacity, unloaded capacity, and unserved energy to characterize the capacity adequacy of the system. Loaded capacity is the generation capacity that is serving load. The unloaded capacity refers to any portion of online generation capacity that is not serving load and offline generation capacity that can come online in 20 minutes or less to serve load as well as curtailable demands such as demand response, interruptible pumping load, and aggregated participating load that can provide non-spinning reserve or demand reduction. The unloaded capacity includes operating reserves the system procures. The unloaded capacity margin is the excess of

[4] Non-dispatchable resources are technologies that are dependent on a variable fuel source and are modeled in PLEXOS as energy production profiles based on historical generation patterns. Non-dispatchable technologies include biofuels, geothermal, wind, solar, run-of-river hydro, and non-dispatchable natural gas.

the available resources, within 20 minutes or less, over the projected load expressed as a percentage on an hourly basis. Levels of unloaded capacity margin above the operating reserve requirement for any given hour (typically around six percent) signify that capacity is available beyond the requirement for operating reserves, which to the extent available, can be used during system contingencies. Unserved energy is the amount of energy load that is not served due to a shortage of system capacity and energy resources.

The 2022 model results are notably different than the 2021 results. The two most significant drivers of the differences are the addition of 7,556 MW of net new capacity and the revised methodology used to develop the 2022 demand forecasts. The load forecast process forecasts a range of potential summer peak demands based on the weather history fed into the forecast model. The revised forecast methodology for 2022 resulted in a distribution of the weather based forecasts that has greater numbers of load outcomes above the 1-in-5 forecast level and fewer below the 1-in-5 level.

Table 2 shows probabilities of an ISO system capacity shortfall from the 2022 model results and the 2021 base case results. The results in *Table 2* show an increase in the probability of low operating reserve levels over 2021 for the EEA 2 and EEA 3 ranges, but a decrease in the probability of unserved energy.

Table 2

Probabilities for System Capacity Shortages

2022		
System Capacity Shortfall	Shortfall Probability	Number of Shortfall Cases (out of 2,000)
Entering EEA 3 (Stage 2)	15.1%	301
EEA 3 - firm load used for contingency reserves (Stage 3)	7.7%	154
Unserved energy EEA 3 - firm load interruption	4.0%	80
2021		
System Capacity Shortfall	Shortfall Probability	Number of Shortfall Cases (out of 2,000)
Entering EEA 3 (Stage 2)	6.4%	128
EEA 3 - firm load used for contingency reserves (Stage 3)	4.8%	96
Unserved energy EEA 3 - firm load interruption	4.6%	91

While the additional capacity positively impacts the results, the revised forecast methodology results in increasing probability of low operating reserve levels even with the added capacity. However, to understand these results more fully, *Table 3* shows the levels the frequency and magnitude of unserved energy from the 2021 and 2022 assessments. Unserved energy is the amount of customer load that is unable to be

served due to a lack of resources at that time to serve the load. The results in *Table 3* show significant increase in system reliability.

Table 3

Comparison of Unserved Energy Results

	2021	2022	Percent Reduction (2021-2022)/2021
Total unserved energy MWH of all hours in 2,000 scenarios	1,085,168	177,394	**84%**
Number of hours of unserved energy in all 2,000 scenarios	645	190	**71%**
Percent of hours of unserved energy in all 2,000 scenarios	0.011%	0.003%	

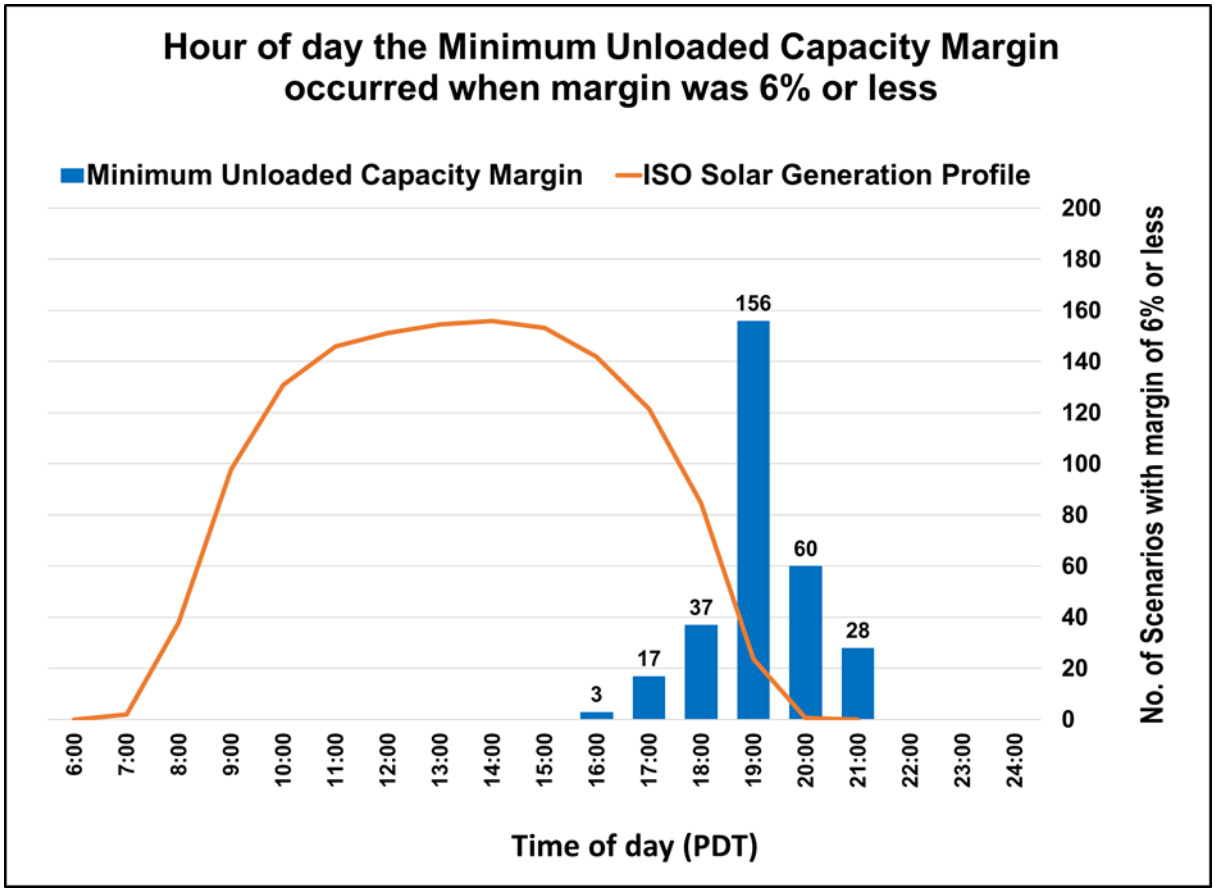
To put these two sets of data in context, *Table 2* shows that the higher loads in the load forecast range result in higher probabilities for experiencing conditions leading to reserve margins in the EEA 2 and EEA 3 range. However, the *Table 2* probabilities are based on the number of scenarios, but the 2022 model results show the number of hours at risk of actual load shedding is significantly reduced. This is demonstrated in the unserved energy results, that when reserves decline to the point that firm load needs to be shed, the actual amounts of load shed is significantly reduced from 2021 to 2022.

The timeframe of greatest operational risk is during the late summer if the ISO and the west experience a widespread heat wave that results in low net imports into the ISO due to high peak demands in its neighboring balancing authority areas, concurrent with the diminishing effective load carrying capability of solar resources and the wane of hydro generation.

The probabilities for operating in conditions that lead to an EEA 2 or EEA 3 are based on the minimum reserve margins within each of the model's 2,000 scenarios. The minimum reserve margin is used to show the likelihood of reaching various levels of low operating reserves for at least one hour over the summer period. *Figure* 1 shows the 2022 model results distribution for scenarios with a minimum reserve margin of 6% or less and the hours of the day that they occurred. The hours of solar generation anticipated during the 2022 summer peak day is shown to demonstrate that 81 percent of these low minimum reserve margins occurred during the hours ending 19:00 to 21:00 – hours of little to no production from solar resources. *Figure 1* demonstrates that resource adequacy levels are most challenged in the post-solar window, as reductions in the gas fleet have not yet been offset by sufficient new energy storage resources to compensate for the loss of capacity available in that window.

Figure 1

Hours of greatest risk
(Stage 2 / EEA 3)



Deterministic Stack Analysis

In a process of assessing adequate resource procurement targets and minimum resource needs under the California Public Utilities Commission (CPUC) RA program, the ISO performed a deterministic stack analysis. In addition to the stochastic modeling described above, the ISO deterministic stack analysis is included to provide an additional perspective on the amount of capacity the ISO is expecting to be available for summer 2022 and the level of reliability that is anticipated under various load levels and import conditions.

Figure 2 shows the result of the deterministic stack analysis for the month of September, 2022, at 8 pm, the month and hour of the greatest supply risk. Over 4,000 MW of net qualifying capacity has reached commercial operation date or expected to from June 1, 2021 to September 1, 2022. The NQC of the existing and new resources were reduced by 1,984 MW to account for the 8 pm time of day when solar generation is not available. The three bars of stacked resources portray three scenarios of progressively increasing resource

amounts. Moving from left to right, the first bar represents resources similar to the stochastic sensitivity case, where imports are limited to the average of the last six-years of RA imports[5] procured by the load serving entities to meet their collective RA obligations. The middle bar represents an increase in the RA import level to 8,500 MW, the highest amount procured for the month of September over the last 6 years. The bar on the right further increases the level of imports from the middle bar by assuming an additional 1,000 MW of non-RA economic imports during the peak period. As with the stochastic sensitivity results, *Figure 2* demonstrates the importance of imports above typical RA import levels for meeting 1-in-2 year load and higher peak demand conditions during late summer.

- The bar on the left shows that if the system is limited to imports of 5,990 MW the 15 percent planning reserve margin (PRM) associated with 1-in-2 load is able to be met in September with a narrow margin.

- The middle bar shows that if system imports reach 8,500 MW, approximately 2,500 MW greater than the typical RA procurement levels, the 17.5 percent PRM, reflecting 1-in-5 loads, can be met; however a 22.5 percent PRM would not be met.

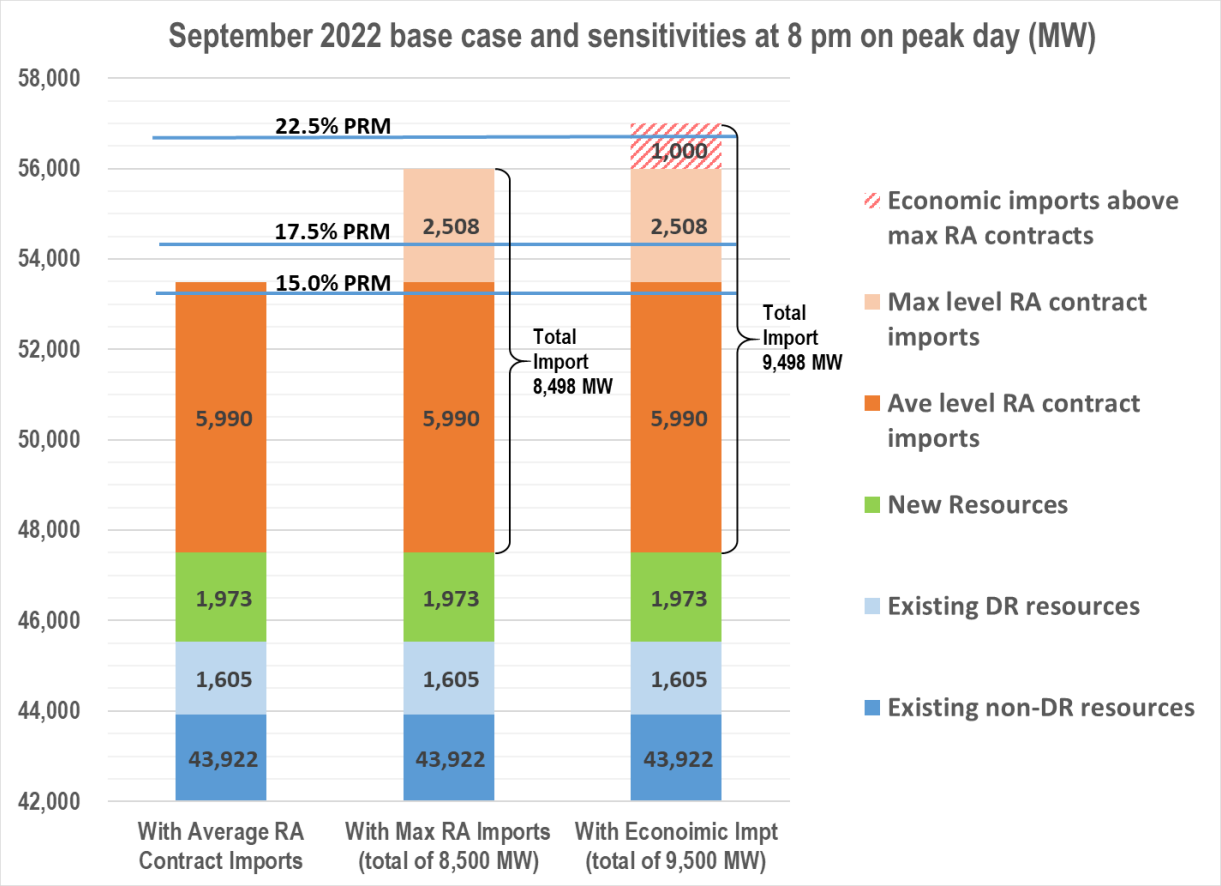
- The bar on the right demonstrates that loads equivalent to the day-ahead forecast for August 18, 2020, the day of the ISO 2020 summer peak, would meet a 22.5 percent PRM if imports reach the maximum over the last six years, a level of approximately 3,500 MW greater than the typical RA procurement levels.

[5] The 2015 – 2021 average of the total import capacity procured by all load serving entities to meet their RA obligation is 5,990 MW for the month of September.

Figure 2

ISO stack analysis for September 2022

(PRM levels based on CEC 1-in-2 load forecast plus planning reserve margin)



Status of the Aliso Canyon Gas Storage Operating Restrictions

On March 30, 2022, SoCalGas published its Summer 2022 Technical Assessment[6], which concluded that SoCalGas has sufficient capacity to serve the forecasted summer peak demand of 3.307 billion cubic feet per day (BCFD) under the "best case" supply scenario, with or without the use of Aliso Canyon, and under the "worst case" supply scenario with the use of Aliso Canyon. SoCalGas has insufficient capacity to serve the forecasted summer peak demand under the "worst case" supply scenario without the use of Aliso Canyon. Under the "worst case" supply scenario without the use of Aliso Canyon, the system capacity is 2.88 BCFD resulting in a partial curtailment of electric generating (EG) customers. Core and non-EG noncore customers are not impacted, however, as consistent with the Commission's July 23, 2019 Aliso Canyon Withdrawal

[6] https://efiling.energy.ca.gov/GetDocument.aspx?tn=242505&DocumentContentId=76010

Protocol, SoCalGas may use Aliso Canyon to maintain service to core and critical noncore customers.

The ISO analysis does not fully reflect more extreme climate induced load and supply uncertainties, and procurement delay risks.

Additional risks include:

- More extreme weather events beyond those projected from the most recent 20 years of historical data.
- Wildfire events that could limit key transfer paths or resources, and other potential transmission outages.
- The unexpected confluence of extreme heat, drought affecting fire risk, and smoke impacting solar production, and
- Project development delays such as those triggered by the recent Department of Commerce investigation of solar panel tariff issues.

These types of events tend to be managed in part by additional reliability measures beyond normal resource planning and market operation.

Preparation for Summer Operation

Producing this report and publicizing its results is one of many activities the ISO undertakes each year to prepare for summer system operations. Other activities include coordinating meetings on summer preparedness with the WECC, California Department of Forestry and Fire Protection (Cal Fire), natural gas providers, Transmission Operators and neighboring balancing areas. For 2022, the ISO engaged most of these entities in a tabletop exercise where participates walked through the ISO's Emergency Procedures. The exercise covered the change from the ISO's Alerts, Warnings and Emergencies to the NERC Energy Emergency Alerts (EEA's), communications protocols, recent policy changes, and contingency reserve management procedures. The ISO's ongoing coordination activities with these entities help to ensure everyone is prepared for the upcoming summer operational season.