CAISO Balancing Authority
2022 Summer Outlook

May 18, 2021

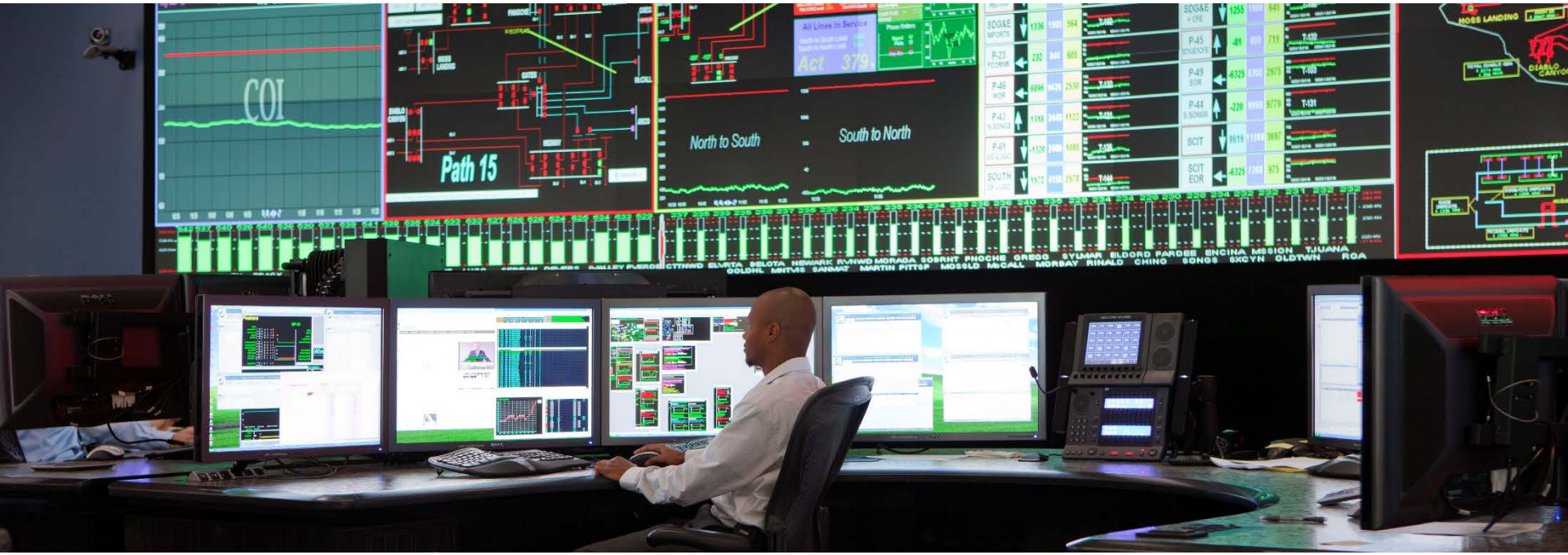
Agenda

- Welcome – John Phipps
- 2021 CAISO summer recap – Dave Delparte
- 2022 summer meteorological outlook – Jessica Taheri
- 2022 CAISO Summer Operations Assessment – Bob Emmert
- Cal Fire seasonal update Spring 2022
- SoCalGas update
- 2022 California utility updates
- BPA summer 2022 outlook
- Round table discussion

Market Sensitive Information

- Due to the diversity of the meeting participant roles and responsibilities, it is extremely important that market sensitive information is not shared.

- If you have any concerns about what information may or may not be safely shared, please consult your organization's legal counsel for advice.



2021 CAISO SUMMER RECAP

Dave Delparte, Director Real Time Operations

Summer 2021 Review

Overview

- California load conditions were moderate (not extreme)
- July 9th Bootleg Fire caused extreme supply condition

Role the WEIM had on reliability

- During July 9th WEIM performed well in directing supply where and when needed to avert load shed

Growth of storage

- ~ 1,000 MW last year ~ 4000 MW for start of Summer 2022

Recap of 2021 ISO System Peak on September 8

1-in-2 peak demand forecast was 45,837 MW

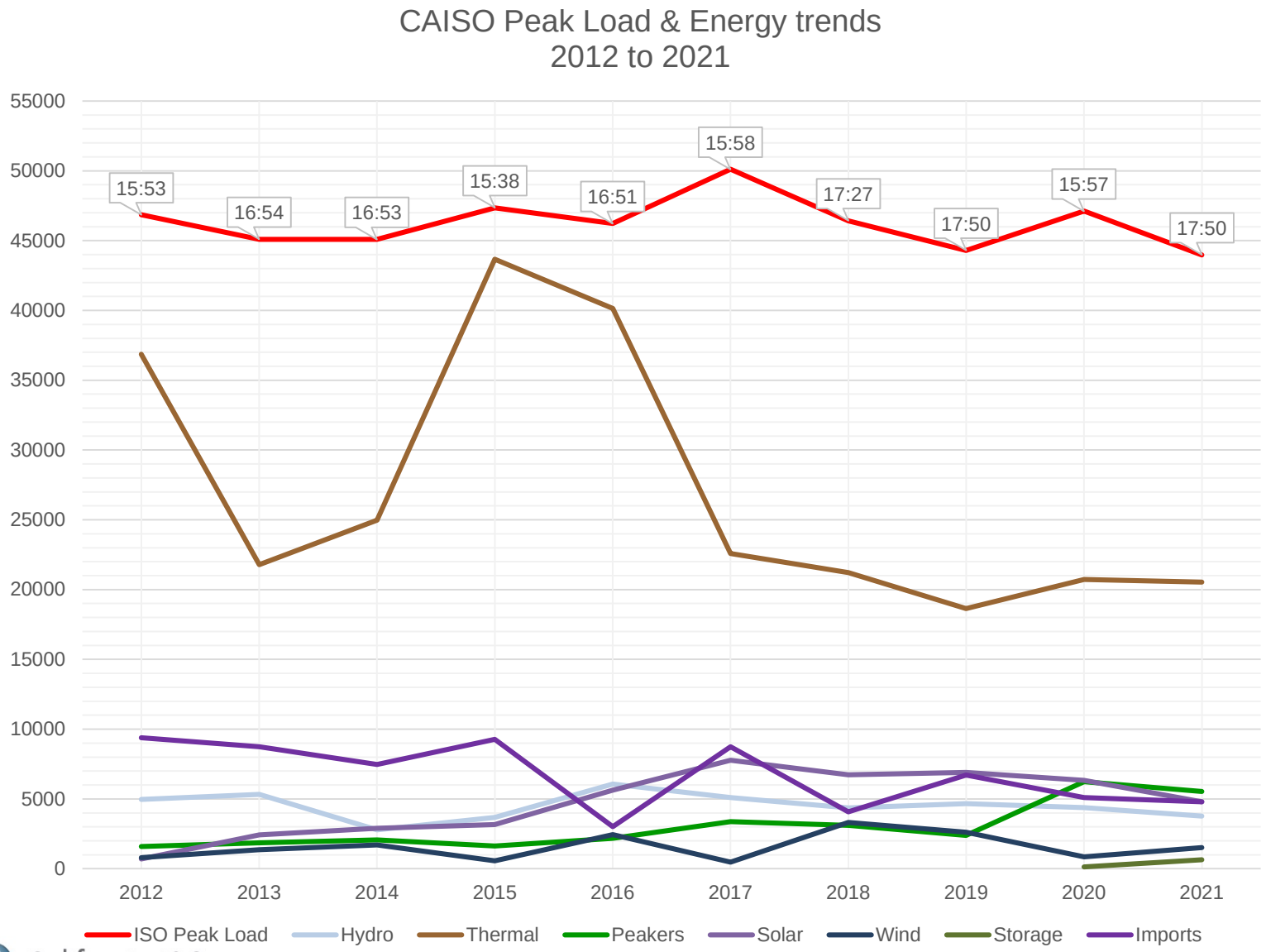
1-in-10 peak demand forecast was 50,968 MW

	MW's
ISO instantaneous Peak demand 9/8 @ 17:50	**43982**
Total Generation	**39174**
Hydro	3767
Thermal	20534
Peakers	5545
Solar	4790
Storage	653
Wind	1523
QF	2642
Imports (includes dynamics)	**4806**
Required OR	2546
Actual OR	**2967**

Below the 1-in-2 forecast

1875 MWs from EIM

CAISO BA historical resource mix at peak load



Managing peak load days

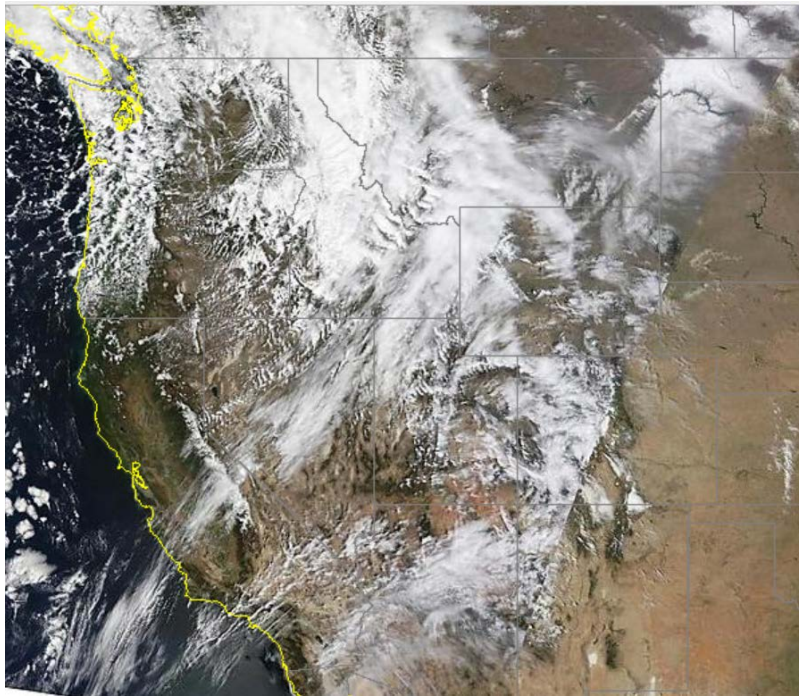
- Flex Alert – help reduce demand on high load days when resource supply may be insufficient
- Emergency declarations
  - AWE to EEA
- Manually commit Resource Adequacy (RA) resources outside of market
- Purchase energy as available on the interties
- Dispatch Reliability Demand Response Resources (RDRR)
- Capacity Payment Mechanism (CPM) – manually commit non-RA resources in the day ahead timeframe or actual operating day

2022 SUMMER METEOROLOGICAL OUTLOOK

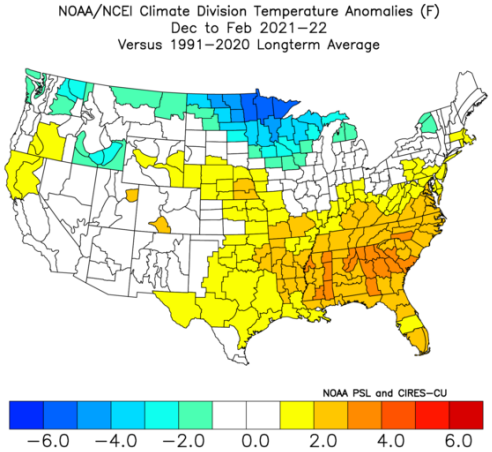
Jessica Taheri, Sr. Energy Meteorologist

Winter 2021 Overview

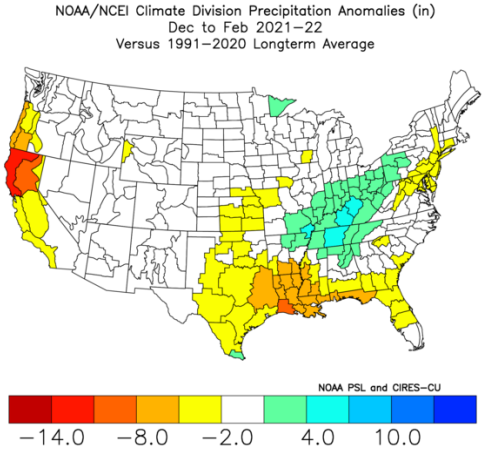
- Lower than normal precipitation across CA and south-central US
- Above normal temperatures across northern CA and southeastern US



Temperature

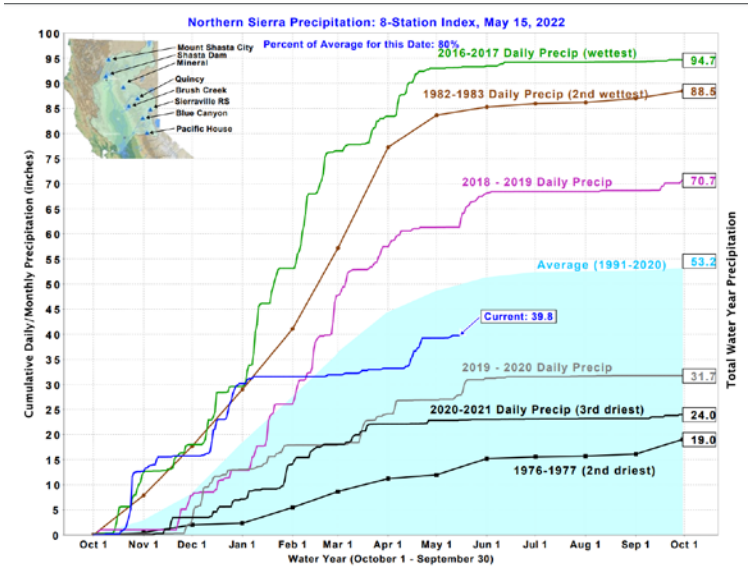


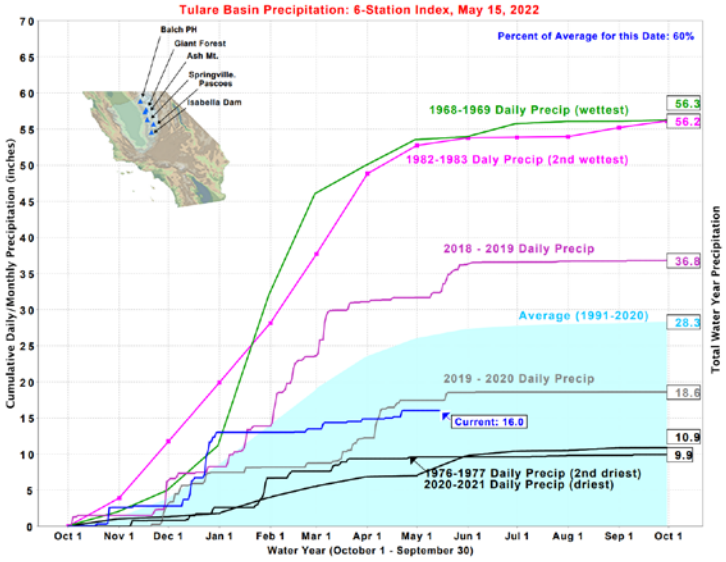
Precipitation

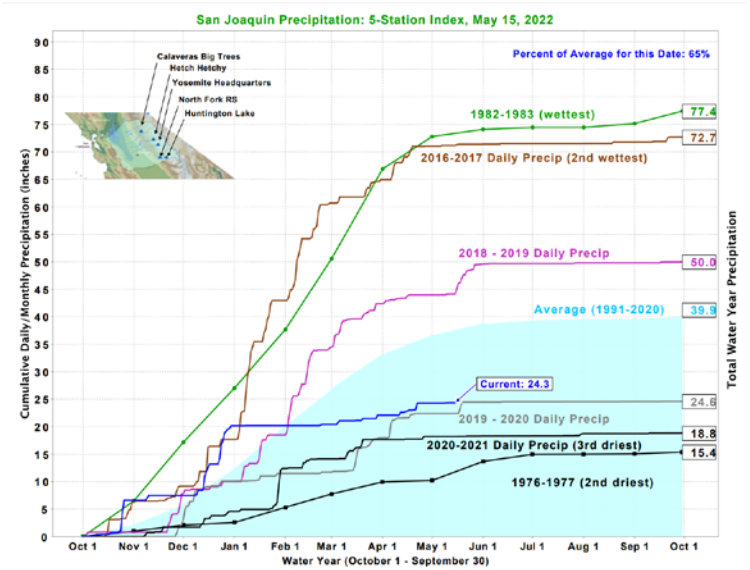


Precipitation

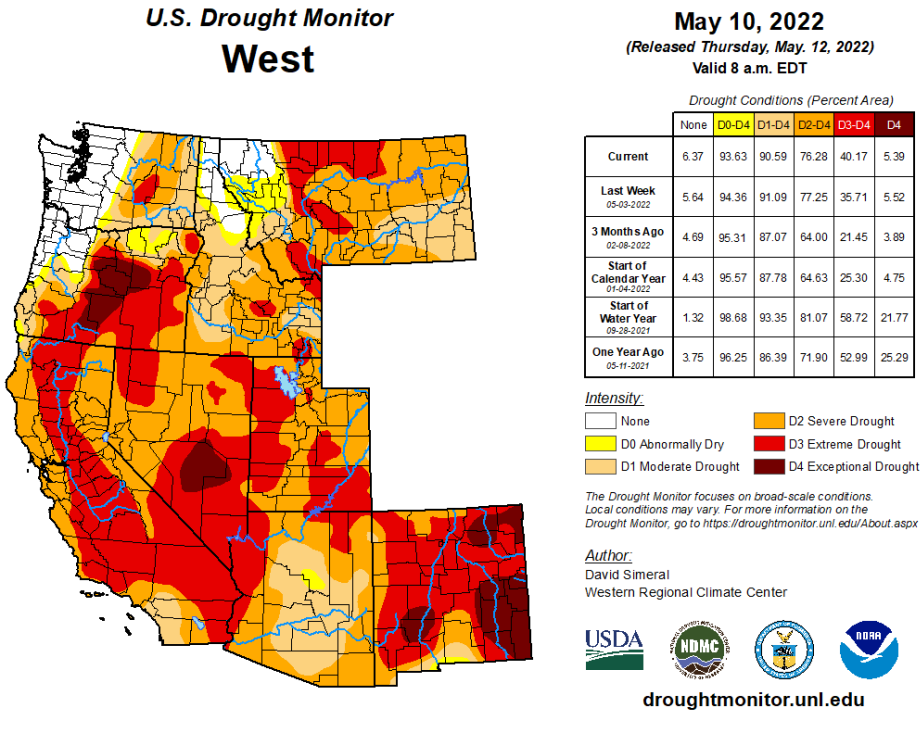
- Snowpack 24% of normal
- Cumulative Precipitation as May 15:
  - Northern Sierra Precipitation:
    - 80% of average
  - San Joaquin Sierra Precipitation:
    - 65% of average
  - Tulare Basin Precipitation:
    - 60% of Average
- Statewide :
  - 68% of normal

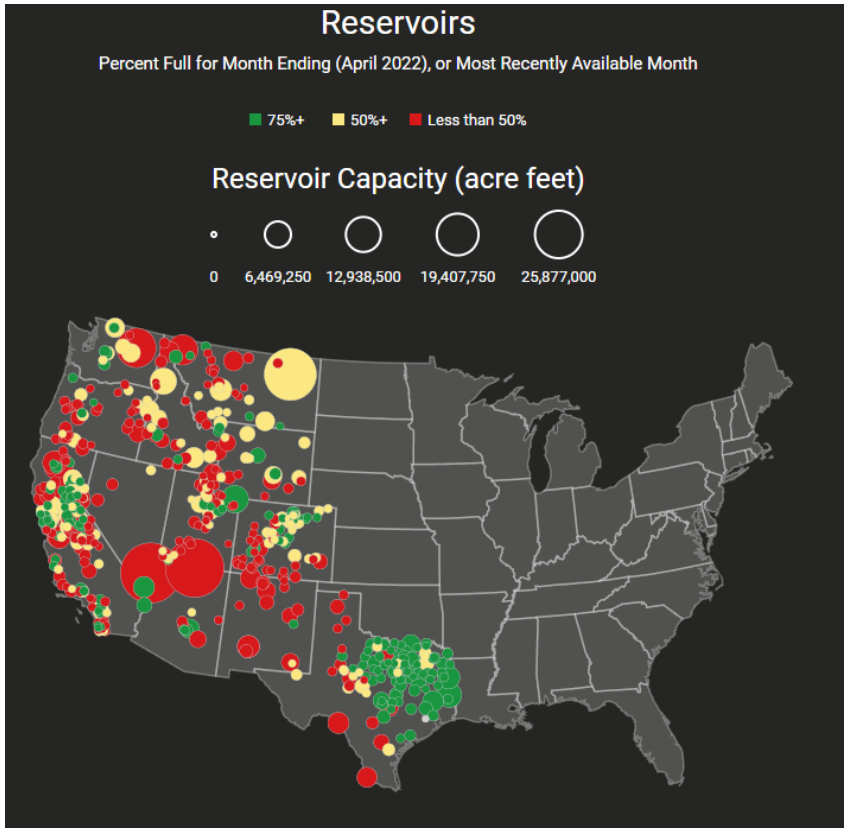




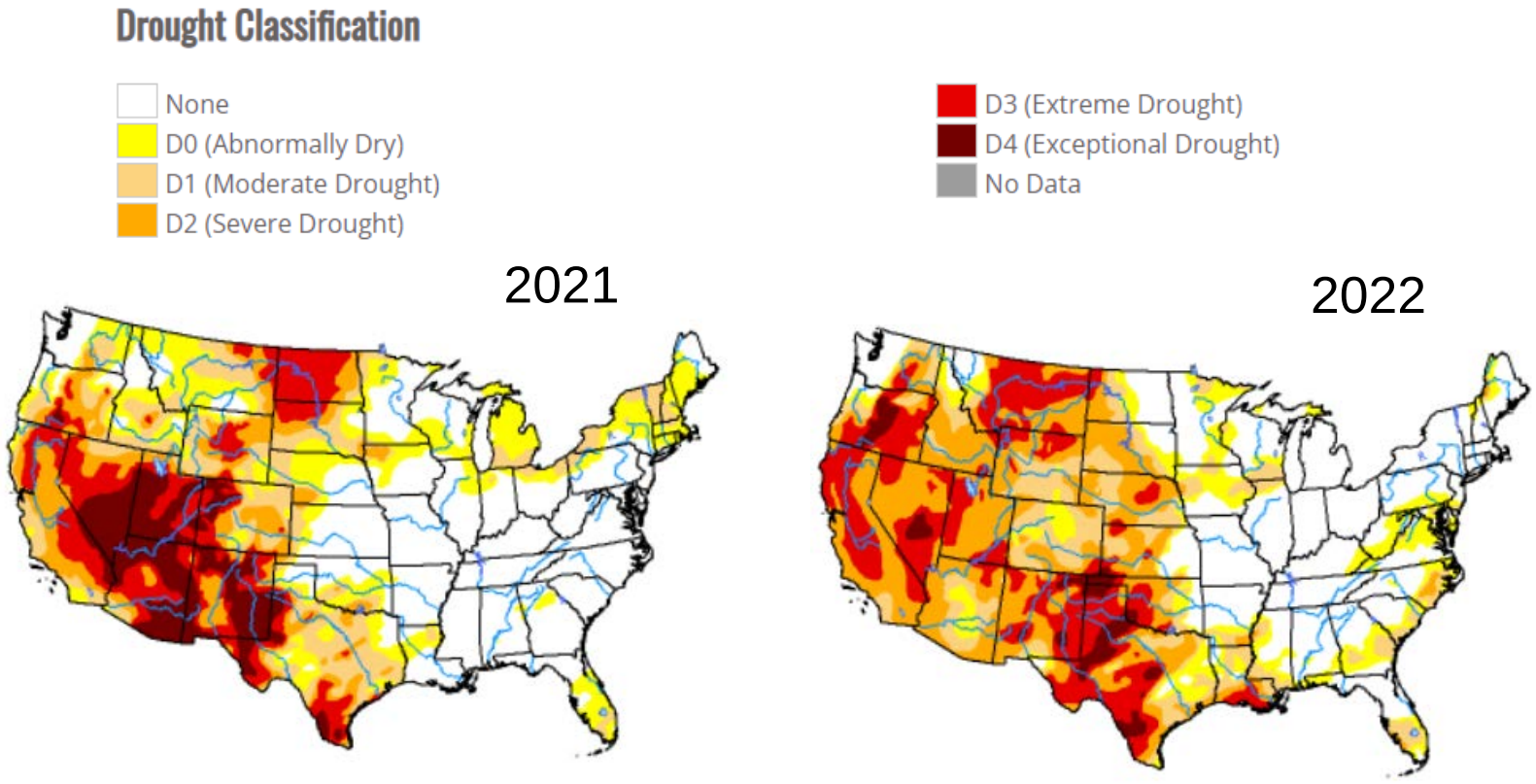


Drought present across nearly all of the western US leading to low reservoirs





Drought worsened over California and central US between 2021 and 2022

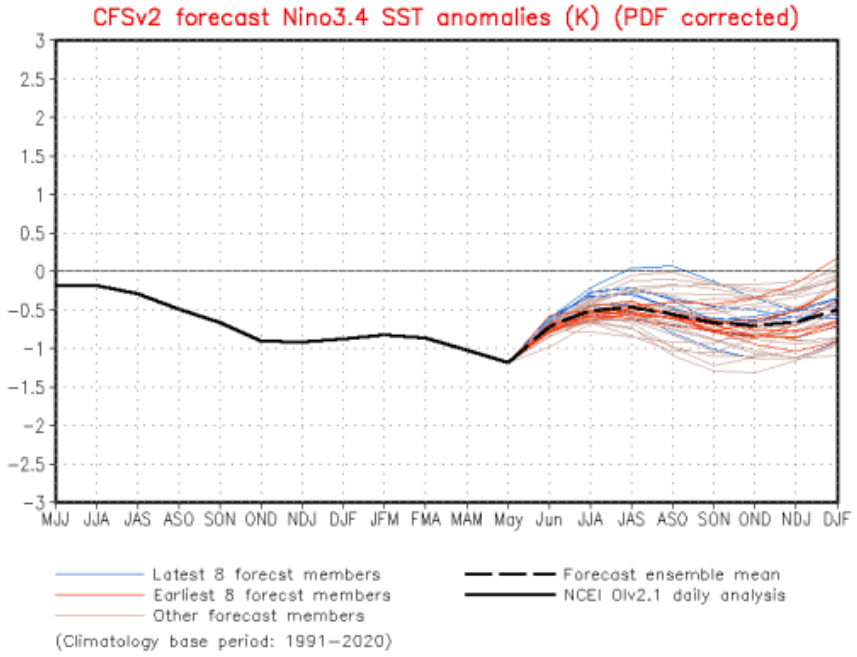


Maps as of April 13, 2022

INPUTS TO THE SUMMER FORECAST

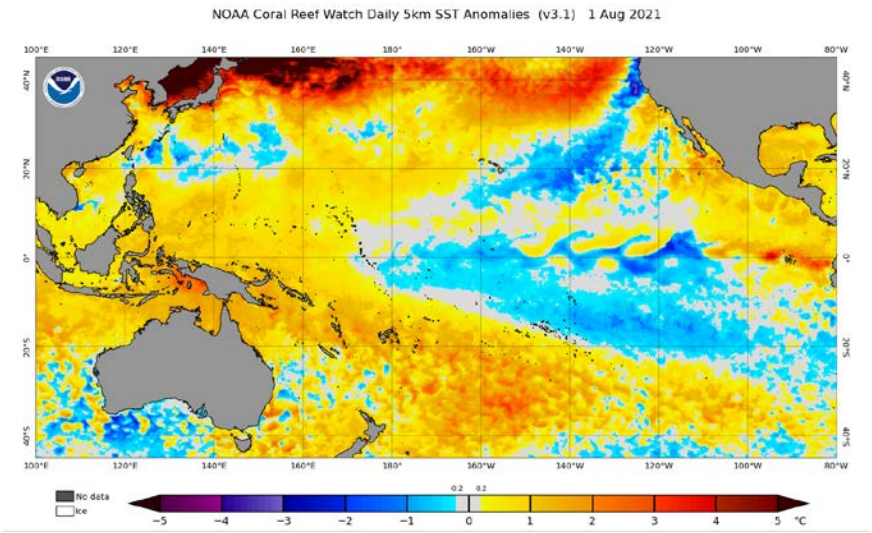
Synopsis:

- From the Climate Prediction Center (CPC):
  - Equatorial SSTs are below average across the Pacific
    - La Nina
  - 58% chance of La Nina through Summer
  - Historically, ENSO has little influence on west coast summer conditions

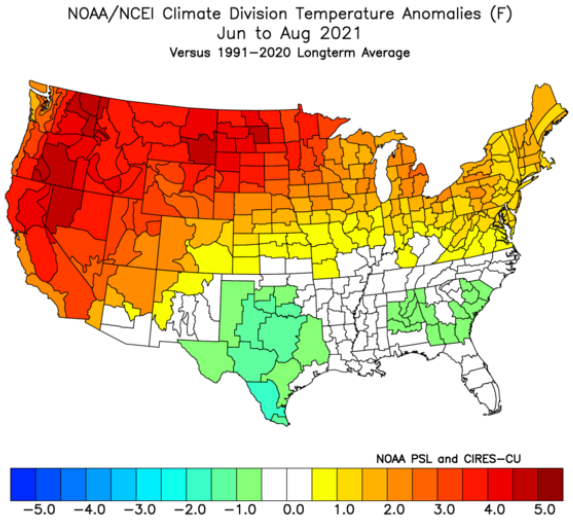


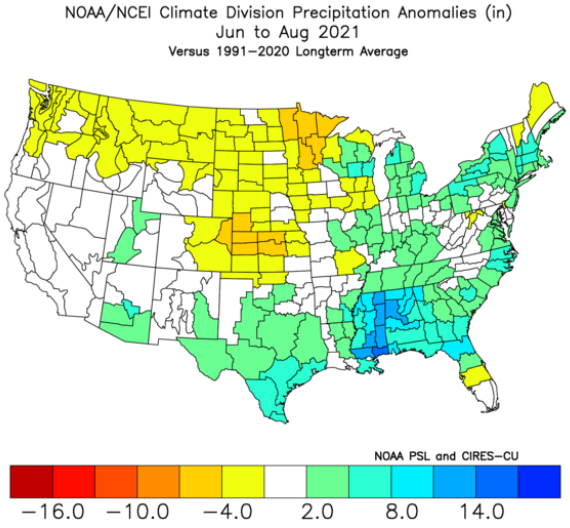
2021 Summer: Observations

- Strongest heat in August and September
- Above normal overnight temps all summer
- Early start to fire season and numerous high fire risk events throughout summer
- Above average monsoon rainfall

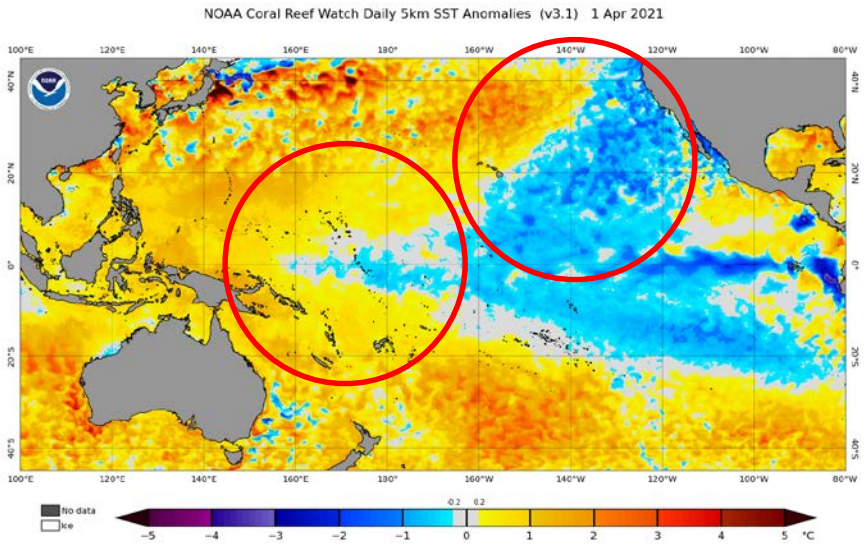


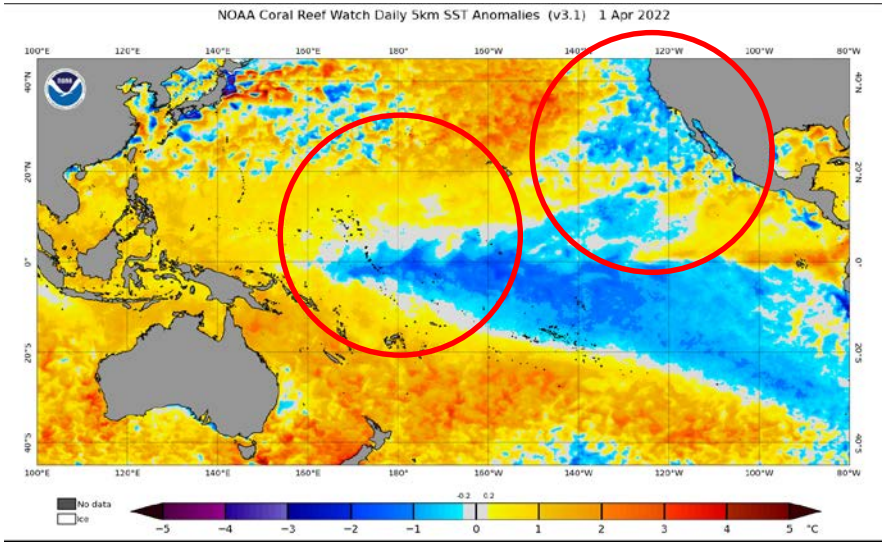
Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
2021	-1.0	-0.9	-0.8	-0.7	-0.5	-0.4	-0.4	-0.5	-0.7	-0.8	-1.0	-1.0





2021 Spring vs 2022



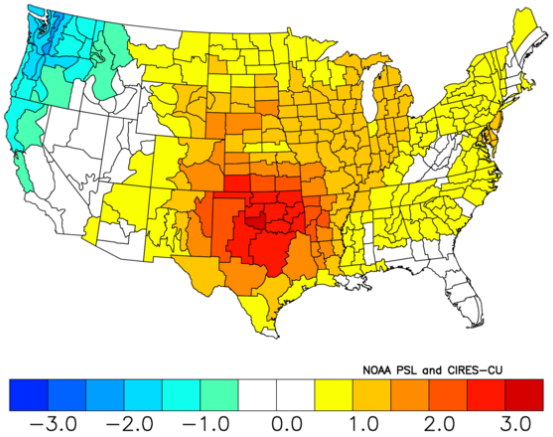


Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
2020	0.5	0.5	0.4	0.2	-0.1	-0.3	-0.4	-0.6	-0.9	-1.2	-1.3	-1.2
2021	-1.0	-0.9	-0.8	-0.7	-0.5	-0.4	-0.4	-0.5	-0.7	-0.8	-1.0	-1.0
2022	-1.0	-0.9										

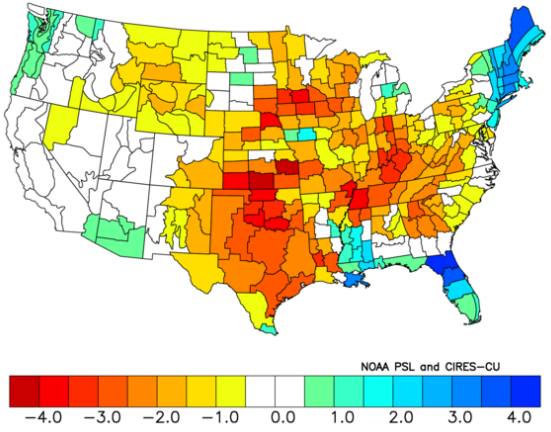
Analog years: 2008, 2011, 2012

- Years with similar SST, drought, El Nino patterns
- Also had strong drought throughout south-central US
- Can shift the ridge of heat further east and allow for more seasonable temps across coastal areas
- Drought persists

Temperature



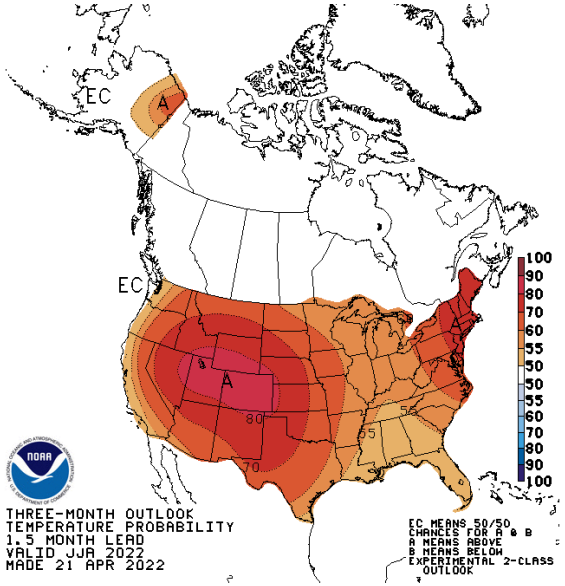
Precipitation

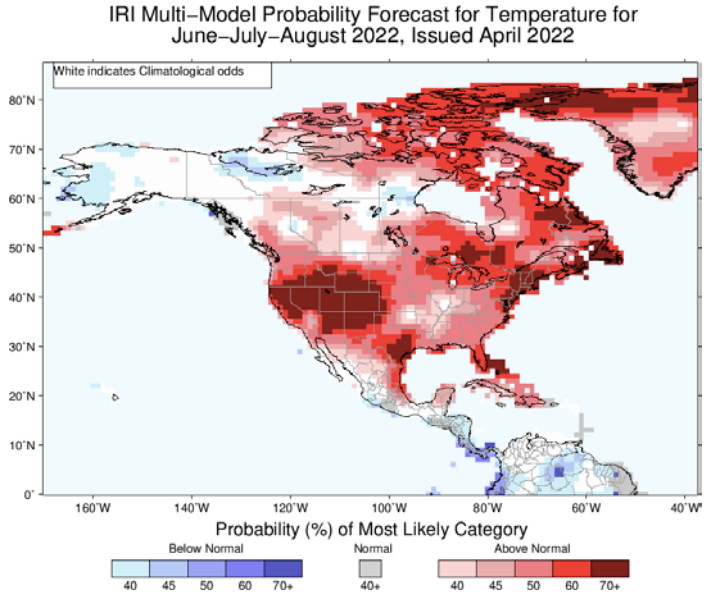


CALIFORNIA SUMMER FORECAST

Western Weather Outlook - Temperature
June 2022 – August 2022

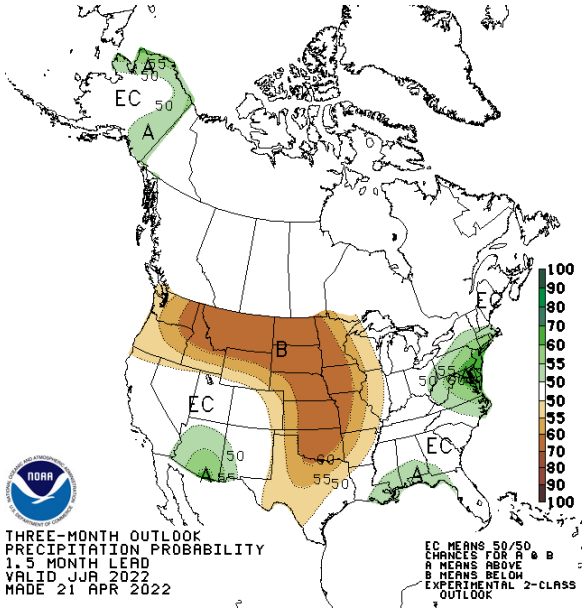
- **Temperature:**
  - The probability that the average temperature will be warmer than normal is 40% for the coast & Pacific Northwest and 70% the Interior
  - Potential for the interior heat to be strongest first half of summer, especially NorCal
  - Overall western US temperature above normal

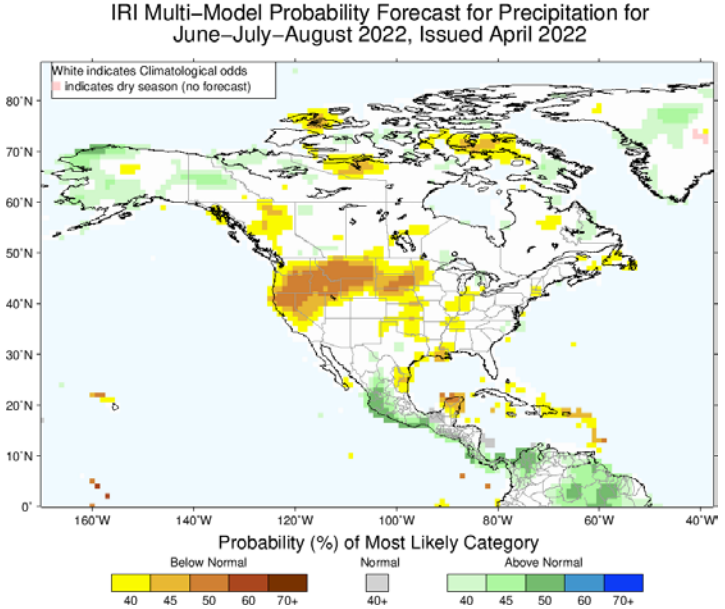




Western Weather Outlook - Precipitation
June 2022 – August 2022

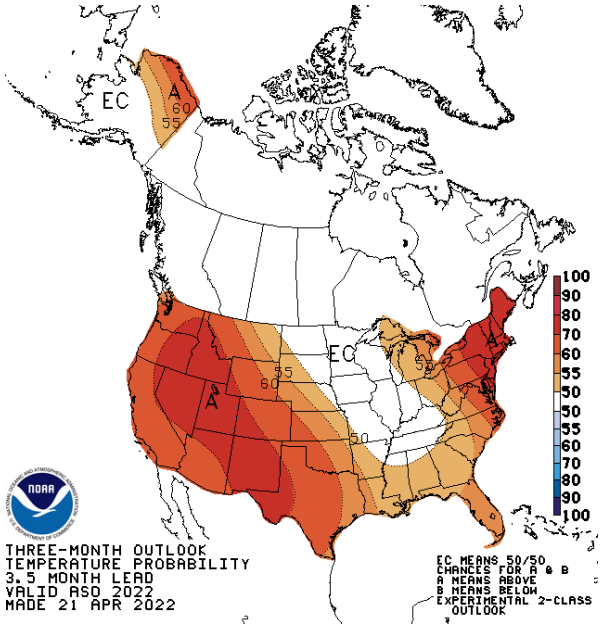
- **Precipitation:**
  - Current guidance suggests potential for above normal monsoon impacts for portions of the desert southwest
  - 60% chance for below normal summer rainfall for Pacific Northwest

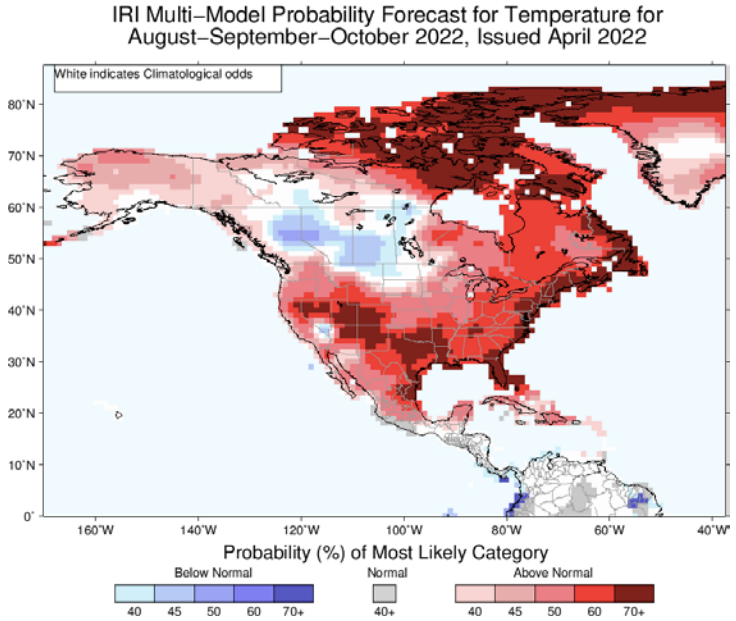




Western Weather Outlook - Temperature
September 2022 – October 2022

- **Temperature:**
  - Sept and Oct look similar to rest of summer with heat centered in central US
  - Monitoring potential for reduced offshore flow events state-wide

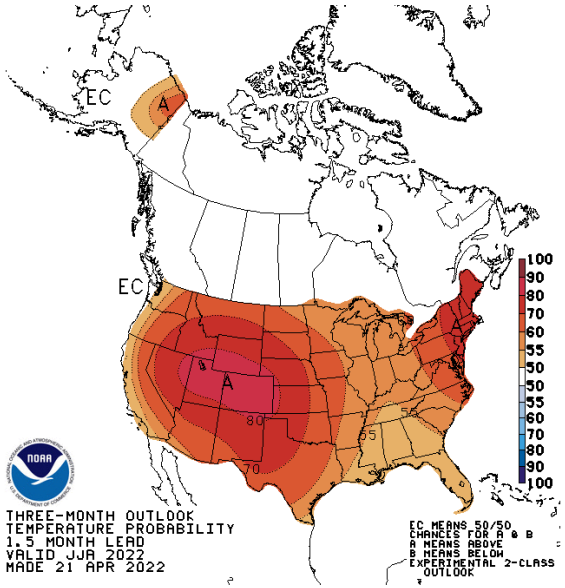


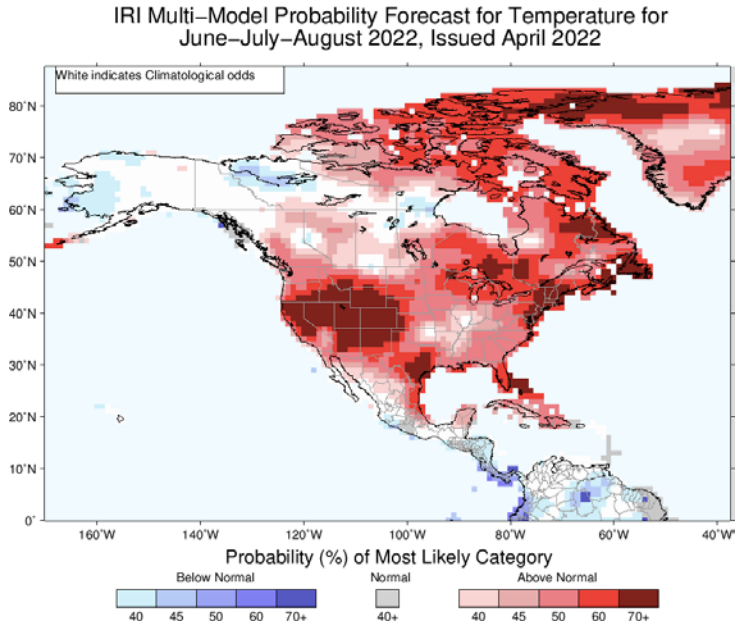


WESTERN US SUMMER FORECAST

Western Weather Outlook - Temperature
June 2022 – August 2022

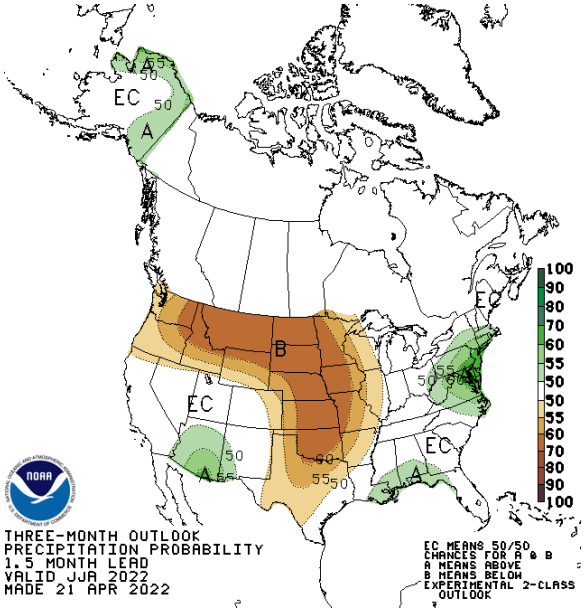
- **Temperature:**
  - Highest chances for interior western US to be most extreme
  - Heat strongest in Pac NW July – August
  - Heat strongest in Desert SW June - July

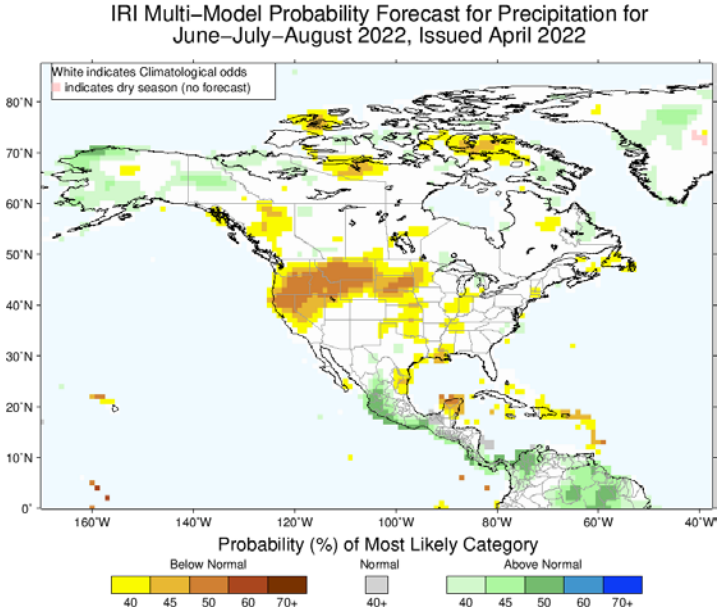




Western Weather Outlook - Precipitation
June 2022 – August 2022

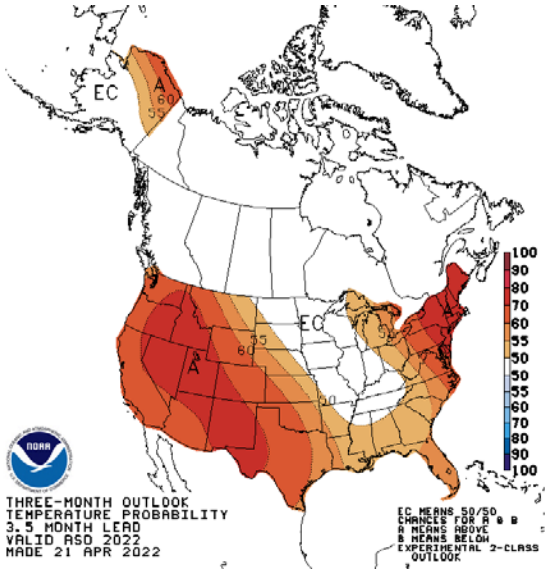
- **Precipitation:**
  - Below normal precipitation forecast for northern western US and the Plains
  - Above normal monsoon activity favored for Desert SW
    - Could lead to increased fire concerns with more frequent lightning

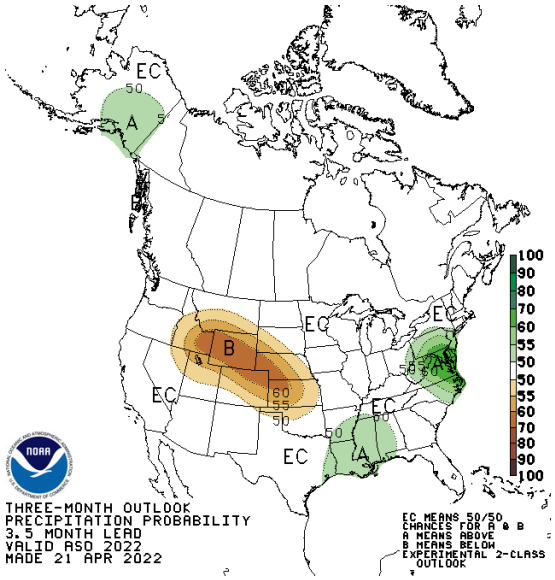




Western Weather Outlook
August – October 2022

- **Temperature:**
  - High confidence for interior west to see continued above normal temps
  - Highest risk shifts south into four corners region and Texas
- **Precipitation:**
  - Below normal for northern Rockies, no strong precip signals elsewhere





SUMMER ASSESSMENT 2022

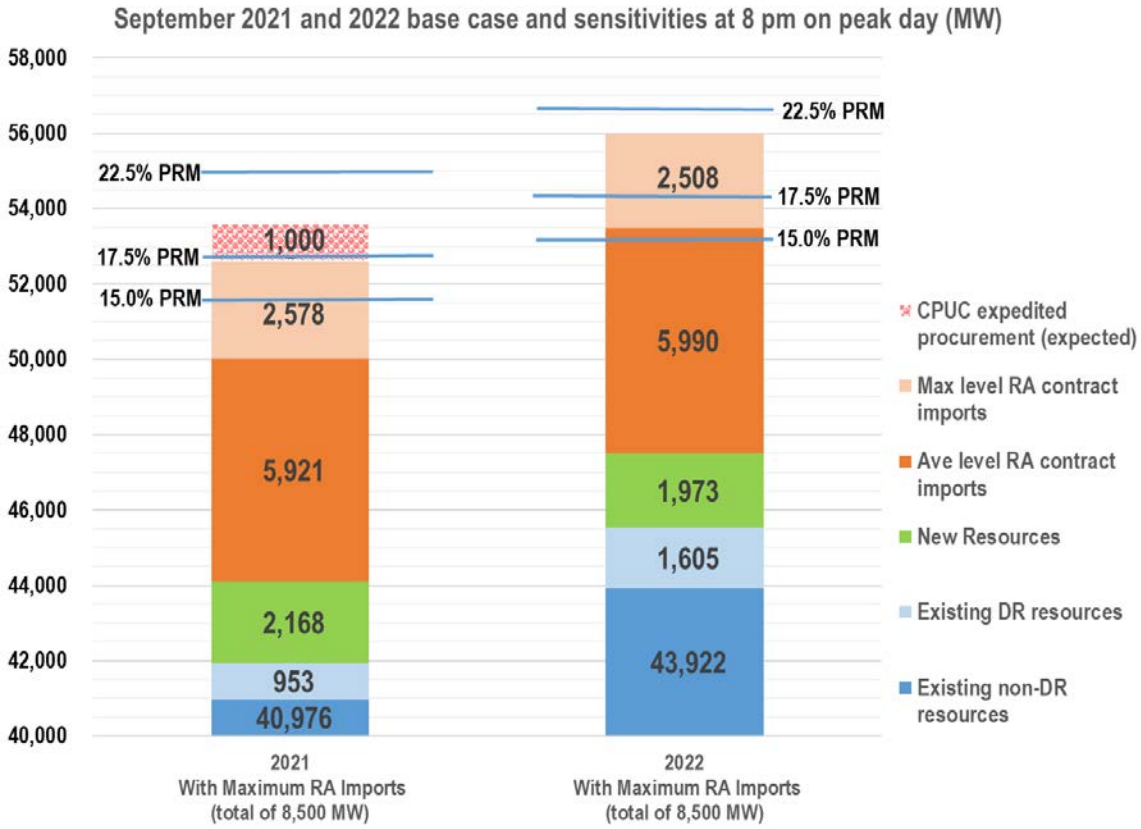
Bob Emmert, Sr. Manager, Interconnection Resources

The 2022 Summer Assessment provides the ISO's view of anticipated conditions in the summer ahead

- The analysis includes probabilistic results from a stochastic model and deterministic "stack analysis" results
  - Deterministic stack analysis of September when conditions can be most challenging due to declining solar and hydro
    - based on latest Energy Commission forecast
- The stochastic analysis relies on a production simulation model that runs 2,000 simulations modeling:
  - An ISO projection of 2022 load levels and a distribution of load scenarios using 20 years of historical weather data
  - Historical renewable resource generation profiles
  - Import limits to characterize declining availability of imports as ISO load levels increase
    - to simulate declining imports as temperatures increase in the ISO and across the west

The 2022 “stack analysis” demonstrates an improvement in supply conditions compared to 2021

- Load levels plus Planning Reserve Margins are based on CEC 1-in-2 load forecast
- Resource levels based on late April data



Observations:

- 2022 stack analysis shows marginally better supply than 2021
- Over 4,000 MW NQC was added from June 1 2021 to June 1, 2022
- The increase from September 1, 2021 to September 1, 2022 was 2,582 MW NQC
- This gain is offset by 1,005 MW higher load forecast for 2022 based on the latest CEC forecast

The ISO's stochastic model assumptions vary slightly from the stack analysis

- The ISO load forecast used the most recent 20 years of historical weather data versus 26 years of history used in 2021
  - 20 year historical weather period provides a forecast that more explicitly accounts for the effects of climate change.
  - Load forecast distribution contains larger population of high loads in 2022
  - The 2022 1-in-2 and 1-in-5 load forecasts are relatively unchanged from 2021 and generally aligns with the latest Energy Commission forecast
  - The 2022 1-in-10 load forecast is 1% higher that 2021 and 4% higher than the Energy Commission forecast
- Hydro: third year below normal – snowpack was 38% of average on April 1, compared to last year's 60% of average on April 1, 2021
  - The Northwest hydro reservoirs projected to be 94% of average
- Generation additions: 3,206 MW net increase in dispatchable capacity from June 1 2021 to June 1, 2022, largely battery energy storage

Stochastic model results

- Typically year to year results compare the number of samples (out of 2,000 drawn from the historical data) that experience at least an hour of shortfall and the depth of the shortfall
- Since the samples were drawn from a more recent and smaller number of years of historical data, comparisons to 2021 are now more nuanced
- Probabilities for EEA 2 and EEA 3 have increased for 2022 due to a larger population of high loads in the forecast distribution

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

- However, the probabilities for unserved energy has decreased, reflecting a lower probability for firm load shedding

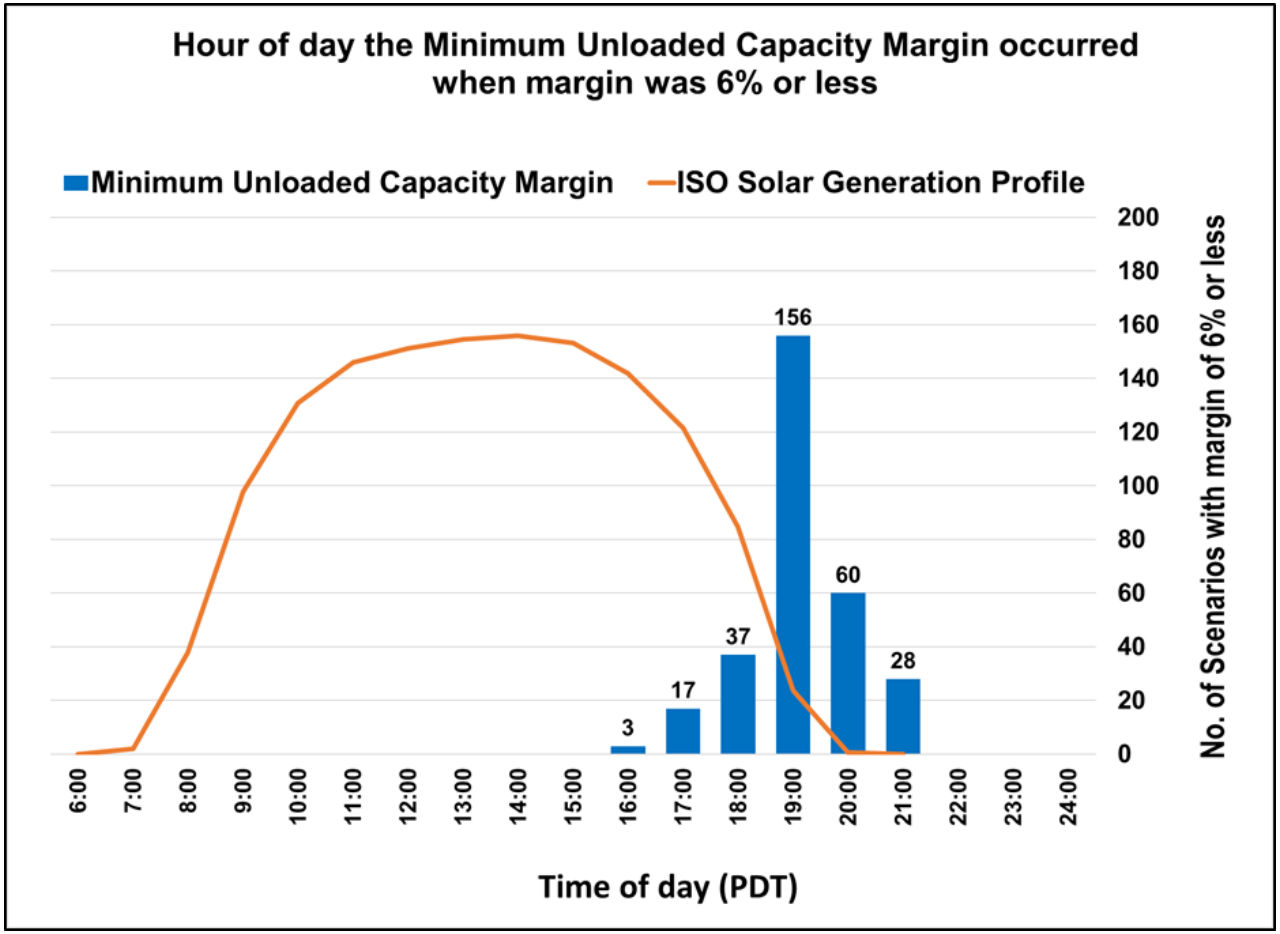
Stochastic model results (continued)

- The number of hours of risk and the amount of load shed at risk is significantly reduced in 2022 - despite the larger population of high loads in the forecast distribution increasing the number of scenarios that have at least one hour of operating reserves in the EEA 2 and EEA 3 range

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%	

The greatest risk of low reserve margins is when solar is unavailable



- 81% percent of the low minimum reserve margins occurred during the hours ending 19:00 to 21:00 – hours of little to no production from solar resources.

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

- 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

Conclusions

- Overall, 2022 capacity conditions are better compared to 2021 due to new resources (especially storage) despite load changes and hydro conditions
  - But the grid remains vulnerable to high loads and availability of imports during widespread heat events, especially in late summer
- While progress has been made in overcoming past supply shortfall conditions, additional resources are needed to ultimately achieve long term reliability margins
- Conventional planning techniques do not take into account growing risks of more extreme events, stemming from climate change, supply chain disruptions, etc. These pose additional risks not included in this analysis.

ROUND TABLE DISCUSSION