Water Resources Research Center Brown Bag Webinar

APS Sustainable Water Strategies and Practices

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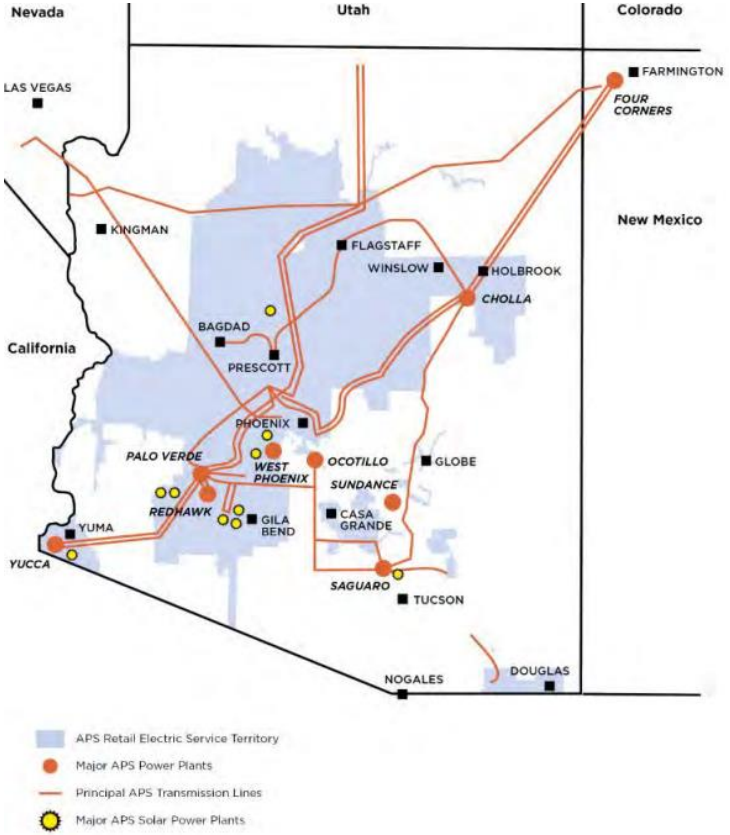
About APS

- Arizona Public Service is a principal subsidiary of Pinnacle West Capital Corporation
- APS was founded in 1884, originally as Phoenix Light and Fuel Company
- It is the largest electric utility in Arizona, operating nine power plants, in Arizona and New Mexico and serves 2.7 million Arizonans

APS Service Territory and Power Plants



APS Owned Generation Facilities (2020)	Net Capacity Owned MW	Net Ownership (%)
Palo Verde Generation Station Nuclear)	1146	29.1
Four Corners Power Plant (Coal)	970	63
Cholla Power Plant (Coal)	387	100.000
Redhawk Power Plant (Gas)	1088	100.000
West Phoenix (Gas)	997	100.000
Ocotillo (Gas)	620	100.000
Saguaro (Gas)	189	100.000
Sundance (Gas)	420	100.000
Yucca (Gas)	243	72
Douglas (Oil)	16	100.000
APS Renewable	245	100.000
Total Owned Generation	6321	

APS Renewable Portfolio 2020

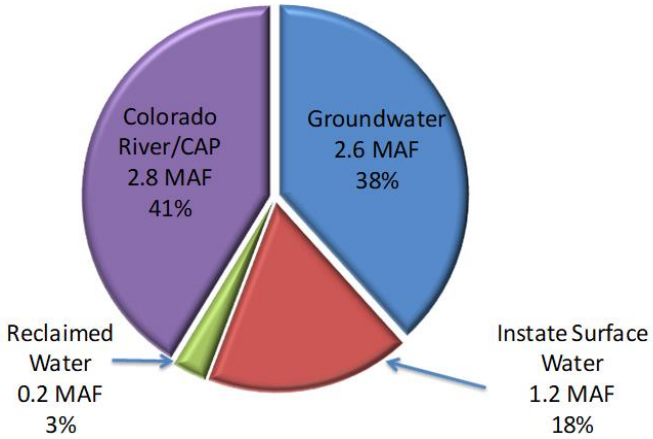
Renewable Portfolio 2020	
APS Owned	**Net Capacity (MW)**
AZ Sun (10 Facilities	170
Other APS Facilities	75
PPAs	
Solana	250
Other PV Solar PPAs	60
Wind PPAs (3 Facilities)	289
Geothermal	10
Biomass	14
Biogas	3
Distribited Energy	1085
Total Renewable Portfolio	1956

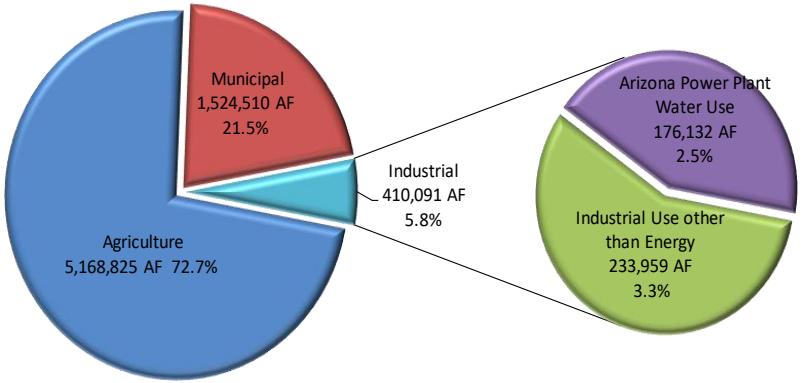
Why Are Sustainable Water Strategies and Practices Needed At APS and In Arizona?

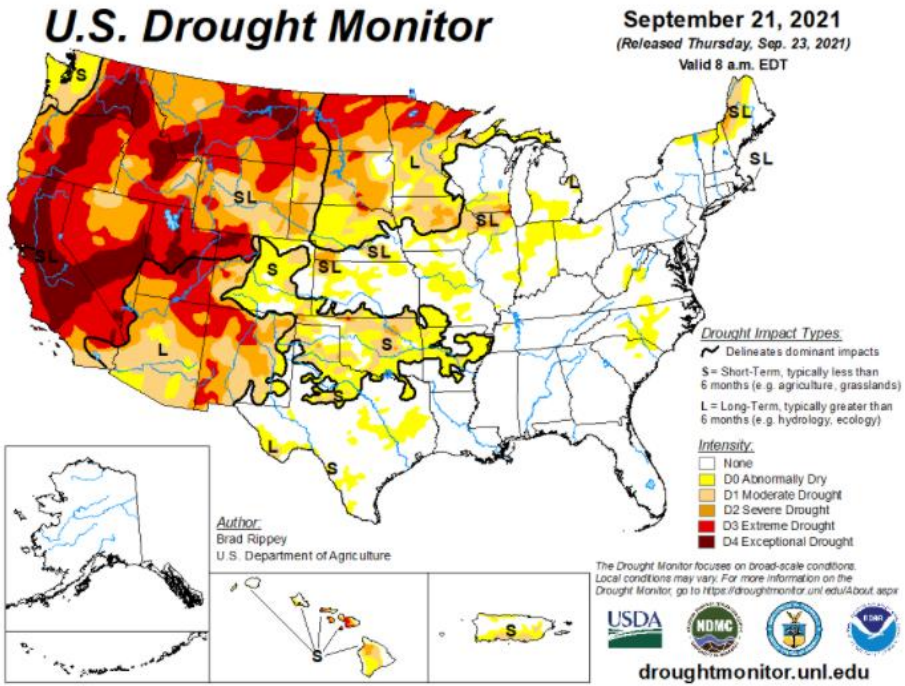
- All or portions of Arizona have been in some stage of drought condition for 21 consecutive years
- Colorado River Reservoir status is at historic low levels (38% of capacity)
- In-State reservoirs (Salt/Verde system) are at 70% of capacity, down from 81% one year ago, in spite of better than normal 2021 monsoon season
- First ever Tier 1 shortage declared on the Colorado River
- More pressure on non-renewable groundwater is likely as surface water is less available

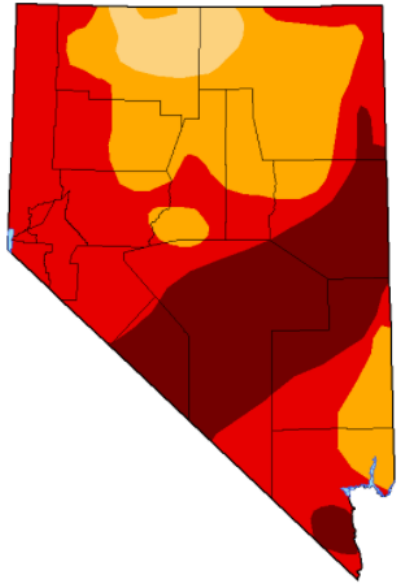
Arizona Water Supply and Demand

On average, approximately 7 MAF of water is used to meet statewide demand; 2.5% is used by power plants









Drought Intensity:

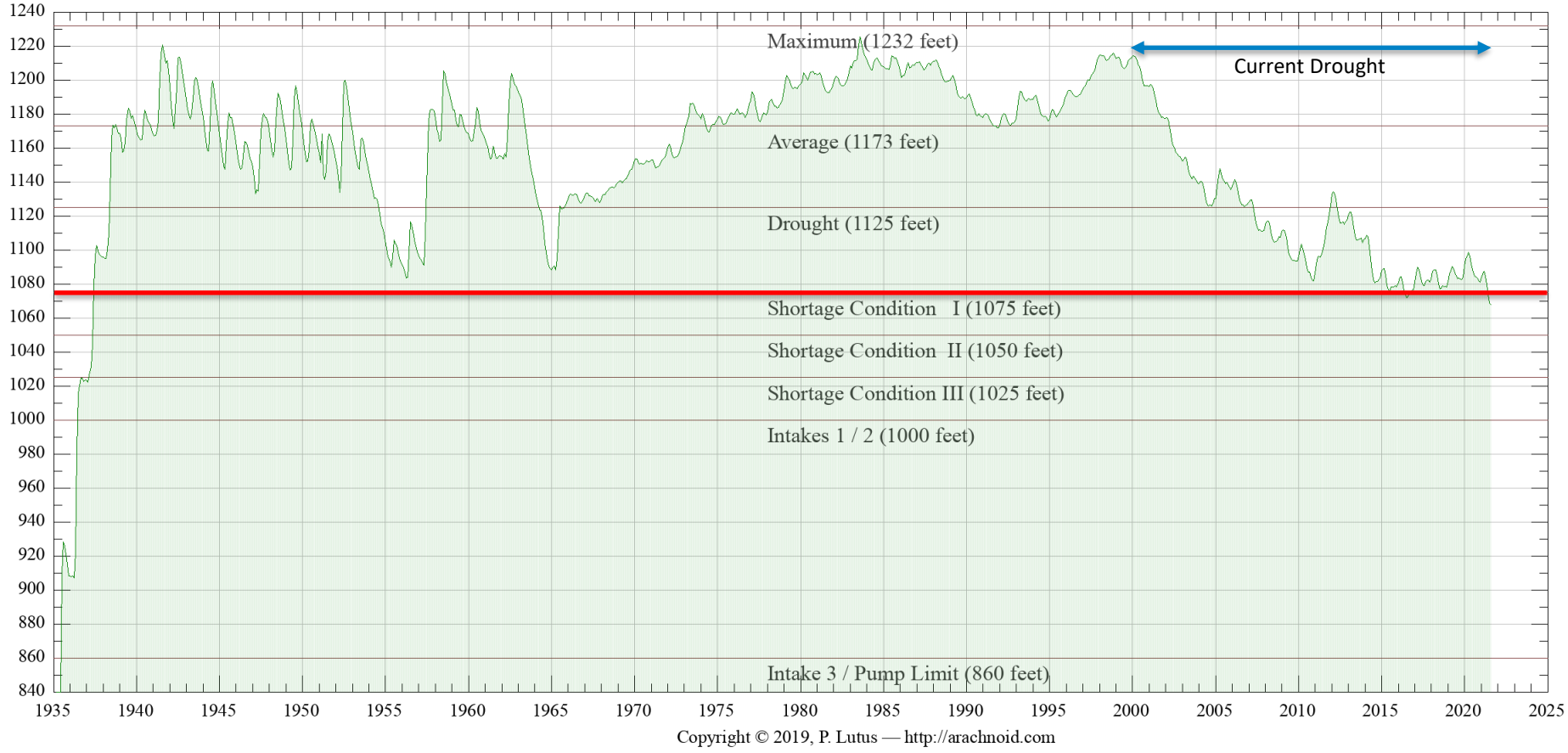
- D0 - Abnormally Dry
- D1 - Moderate Drought
- D2 - Severe Drought
- D3 - Extreme Drought
- D4 - Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Reservoir Storage (MAF) - As of September 14, 2021			
Reservoir	Current	Storage Last Year	Maximum
Lake Mead	9.009	10.332	26.120
Lake Powell	7.437	11.554	24.322
Fontenelle	0.237	0.276	0.345
Flaming Gorge	3.000	3.220	3.749
Blue Mesa	0.279	0.469	0.830
Morrow Point	0.111	0.111	0.117
Navajo	0.980	1.170	1.696

Lake Mead has dropped 1.323 MAF
In the last year

Lake Powell has dropped 4.117 MAF
In the last year



Lake Mead Water Level

WATER LEVEL

1,067.53

Feet MSL

Thursday, September 23, 2021
10:00:00 AM
Level is 161.47 feet
below full pool of 1,229.00

Share the level with your friends on Facebook

How low will it go?

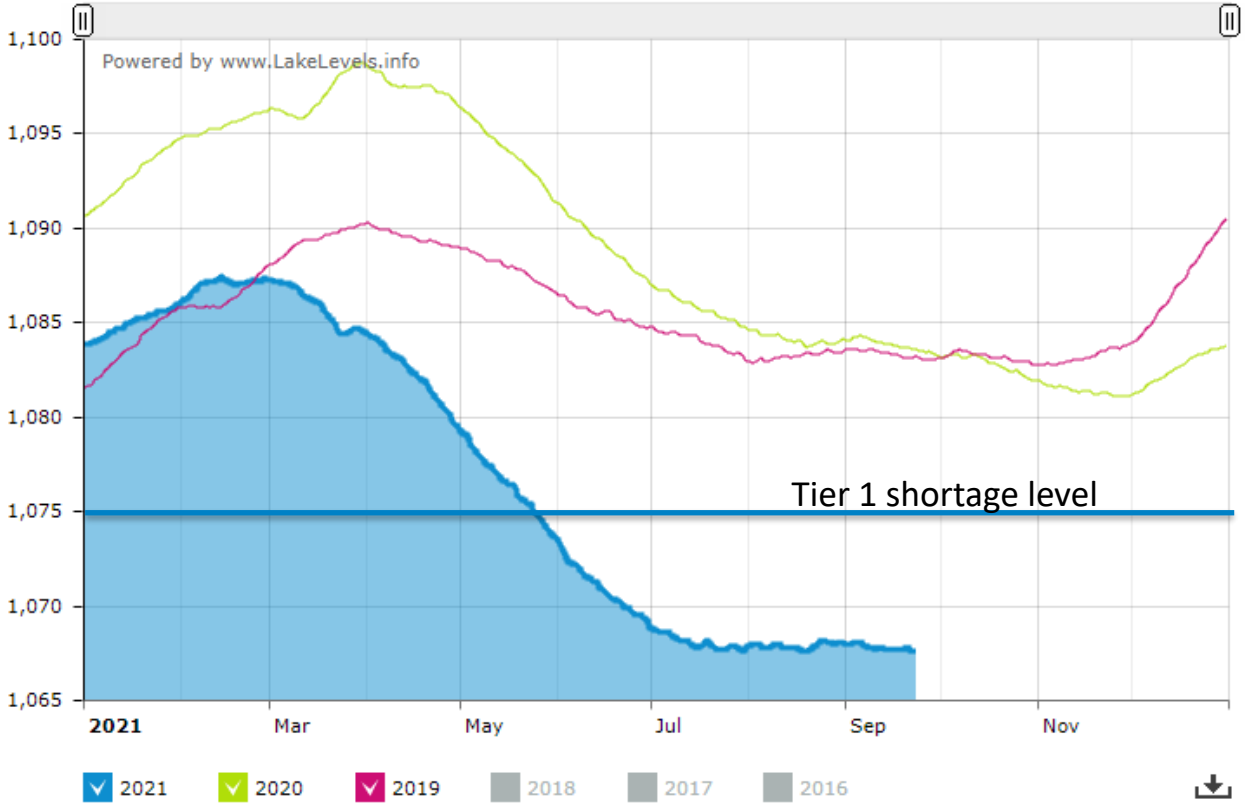
Get email notification of your specified level

Level Alert By Email

click here to sign up **IT'S FREE!**

Lake Level INFORMATION

Click for all lakes



Level Base: MSL
Full Pool: 1,229.00 feet
Winter Pool: 915.00 feet

Change Since Yesterday: ↓ 0.05 Feet
Level Controlled by:
Dam Name: Hoover (DOI BR)

What Does The Future Look Like?

- Probability that our climate will be hotter and dryer
- Extreme weather events are expected
- Droughts are likely to be longer and more impactful
- Shortage conditions on the Colorado River are likely to reach Tier 2 or Tier 3 levels, in spite of planning

Lake Mead in 2000 and 2021, Twenty-One Consecutive Years of Drought Has Impacted Water Supply

This is not news!

- The probability of a water constrained future, especially in the growing desert Southwest has been a reality for decades

- How have we planned for this contingency?

Arizona has planned well, but we are still facing shortages and challenges

- Colorado River Basin Project Act of 1968 - Arizona began importing Colorado River water through the Central Arizona Project Canal in the mid 1980's
- Arizona Groundwater Management Act of 1980
- Lower Basin Drought Contingency Plan – 2019
- Arizona Reconsultation Committee preparing for post-2026 Colorado River issues once the 2007 Guidelines expire

- Arizona municipalities and businesses have also made commitments to use water wisely

- Today, we will discuss what APS is doing to model sustainable water practices

APS Historical Focus on Water

- 1985 – Palo Verde NGS began generation as the only nuclear plant in the world to rely 100% on treated effluent for plant cooling water
  - APS (and partners) committed to a contract with the Sub-Regional Operating Group (Phoenix, Scottsdale, Tempe, Mesa, Glendale)
  - They had vision and were willing to risk what had never been done before, building a nuclear power plant in the desert
    - 91st Ave WWTP effluent purchase provides municipalities with operating revenue for growth
    - Palo Verde supplies the region with reliable, low-cost, carbon free power
    - Current contract extends through 2050; future license renewal could extend plant life for an additional 20 years

APS Historical Focus on Water (continued)

- Treated effluent use at Palo Verde is termed "Right water for the right use"
- Current effluent quality at the 91st Ave WWTP is sufficient to meet cooling water standards, therefore, expensive upgrades to produce higher quality effluent for other purposes is not required
- Frees up other freshwater supplies for growth in municipal and other areas
- Palo Verde remains the only zero liquid discharge nuclear plant, with no discharge of contaminants to the environment
- Palo Verde is the largest commercial power station in the United States

- 2009 – APS created new enterprise-wide Water Resource Management Department (WRM)
  - Primary focus on acquiring sustainable water supplies for nine power plants
  - Developed corporate water conservation strategies

APS Historical Focus On Water (continued)

- 2016 – APS implemented a Tier 1 metric to minimize use of non-renewable groundwater
  - Groundwater was chosen as it is the most at-risk, least sustainable of available water supplies
  - Then current drought conditions and potential future Colorado River shortages increased APS focus on water conservation

- 2020 – APS created a new Sustainability Department
  - Increased focus on water policy and strategy
    - Focus beyond power plants; more engagement in statewide and regional water issues
  - WRM continues as a separate organization with primary focus on direct power plant support

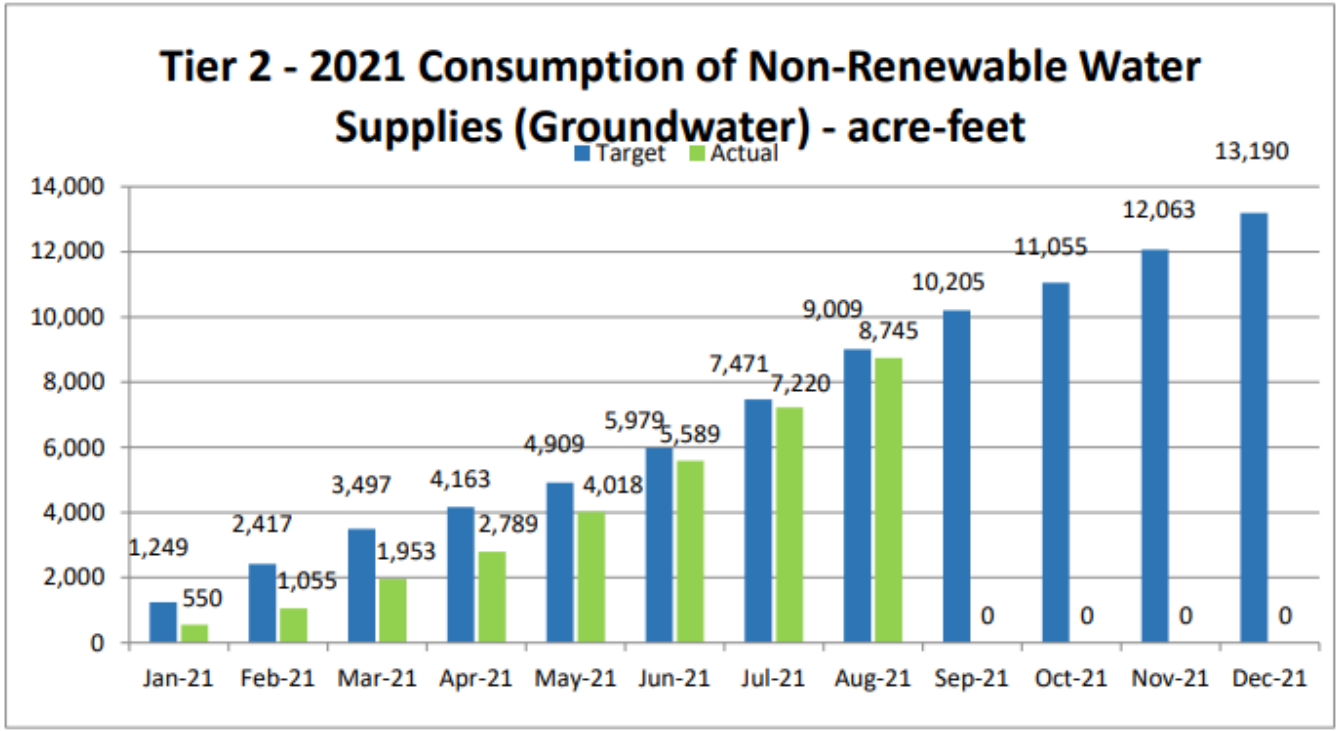
Are APS Power Plants At Risk During A Colorado River Shortage?

- Less than 1% of APS's Arizona fleet water comes from the Colorado River; only two APS power plants in Arizona use Colorado River water
- Yucca Power Plant
  - 5th/6th Priority water rights – lost in Tier 1 shortage
  - Groundwater sufficient to meet plant requirements
- Sundance Power Plant
  - Pinal County
  - GRIC Indian Priority CAP water
  - Relatively high priority
- The Four Corners Power Plant in New Mexico is reliant upon the San Juan River for cooling water
  - Four Corners is in the Upper Colorado River Basin, not impacted by lower basin shortages

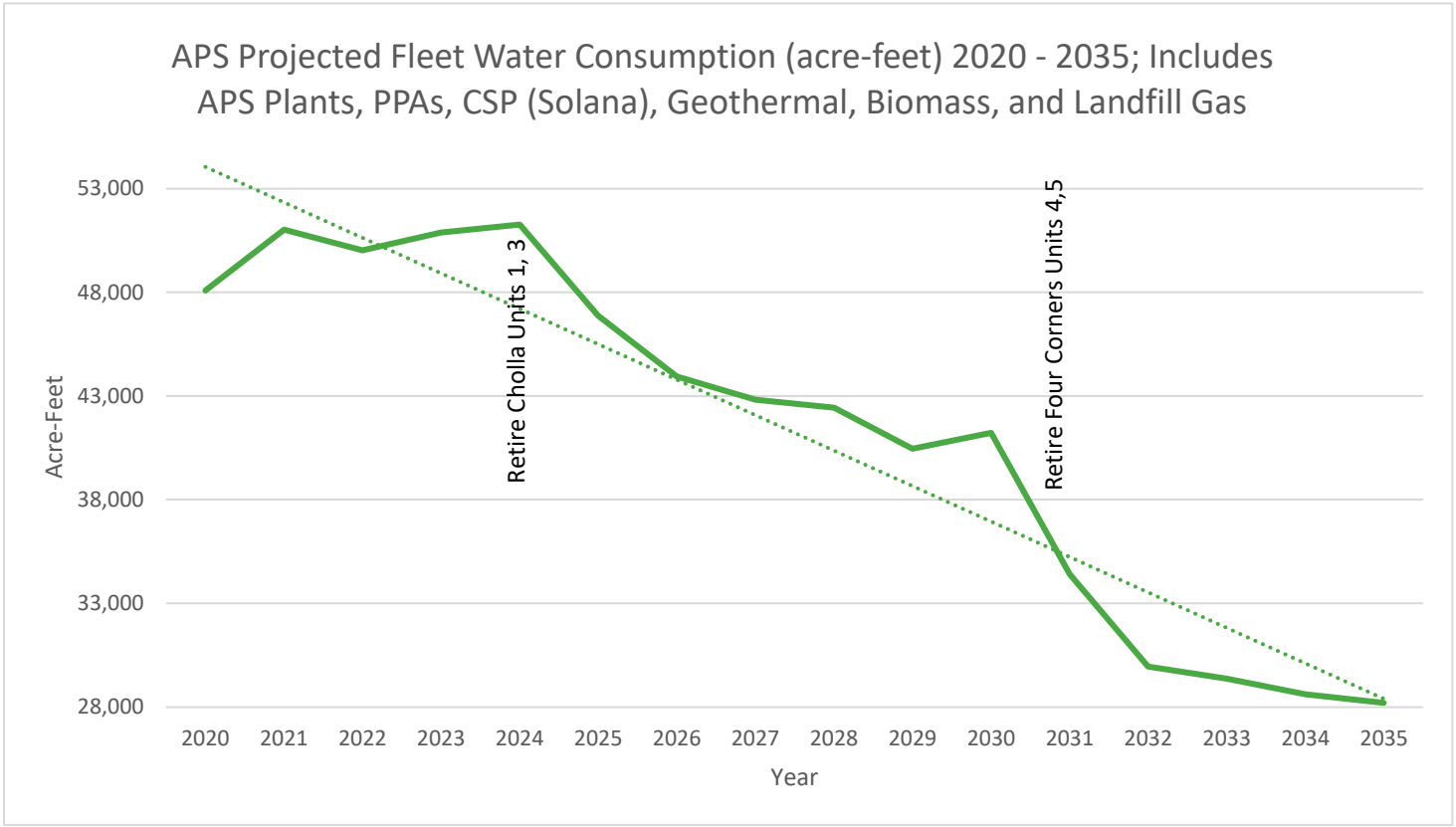
APS Sustainable Water Practices

- Reduce fleet water consumption
- Reduce fleet water intensity (gallons/MWh)
- Avoid water use by using more renewable energy (wind, PV solar)
- Increase energy efficiency programs – offering incentives to customers to use energy efficient lighting and equipment, thereby needing less power that would have consumed water
- Increase use of reclaimed water
- Retire older water intensive plants and replace with water efficient technologies (Ocotillo, hybrid cooling towers)
- Reduce reliance on non-renewable groundwater
- Reduce reliance on renewable but drought-impacted surface water

APS 2021 Goal – Reduce Groundwater By 31% From 2014 Reference year



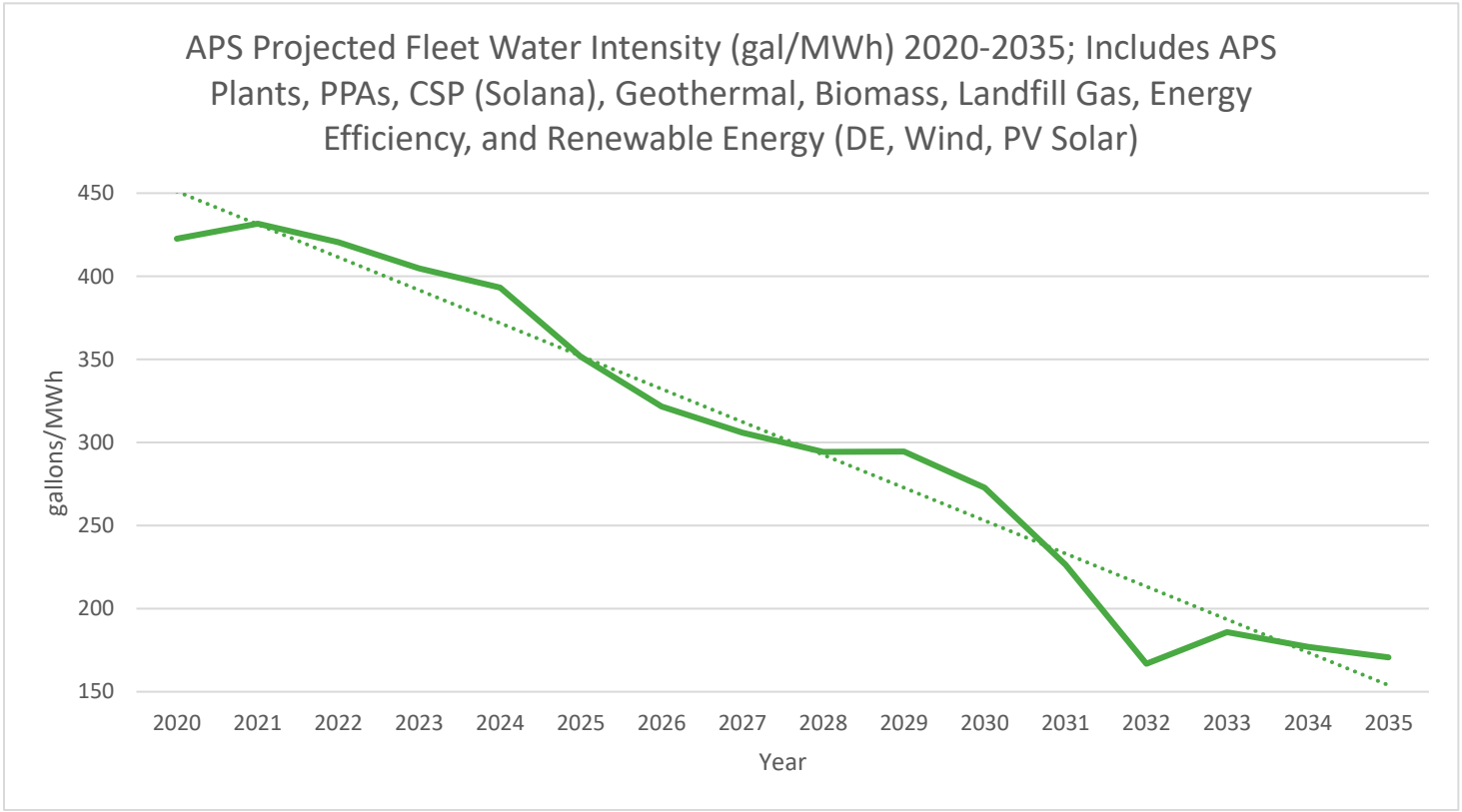
Water Consumption For Power Delivered To APS Customers Projected To Be Reduced By 41% Between 2020 and 2035



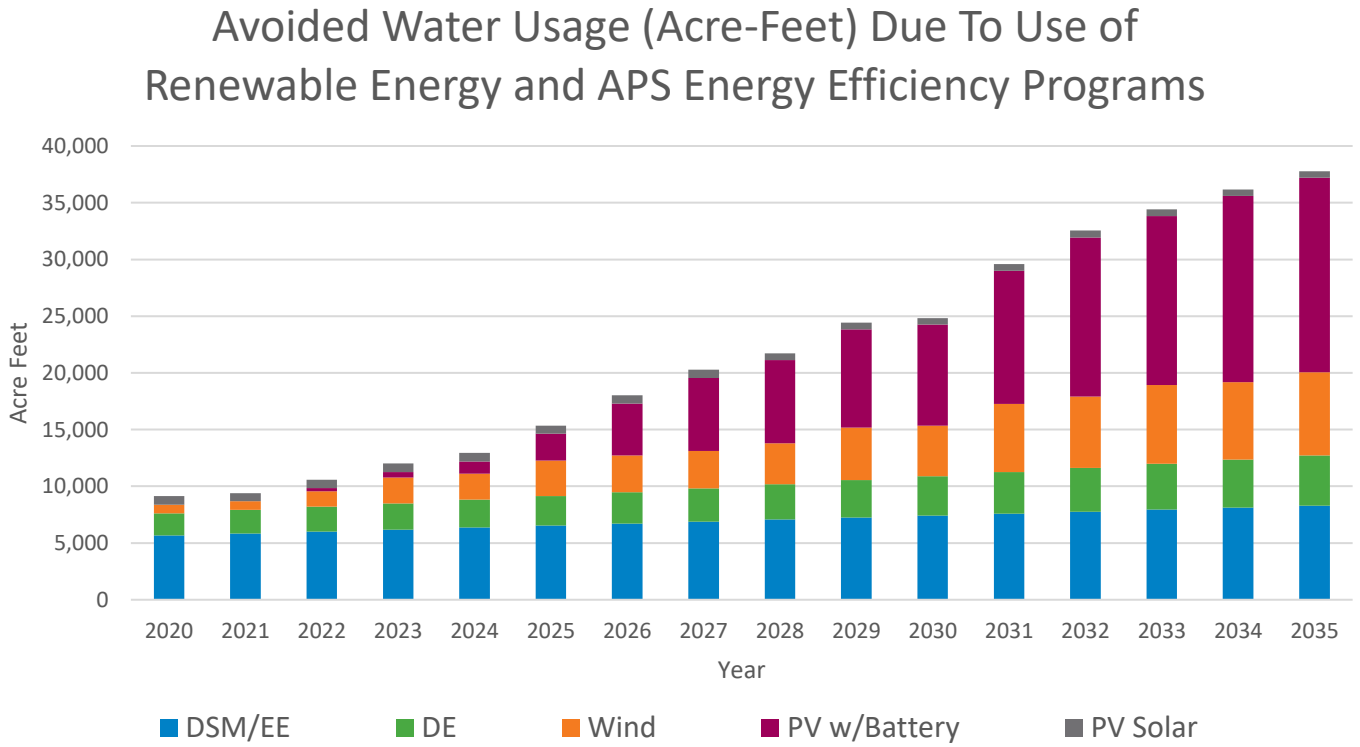
Ocotillo Modernization Project

- Replaced aging steam units with modern quick start combustion turbines
- Implementation of Hybrid (Wet/Dry) Cooling Technology
  - Reduced water intensity from approx. 900 gal/MWh to 140 gal/MWh
- Five Units were placed in-service in 2019

Water Intensity (gal/MWh) Of Power Delivered To APS Customers Projected To Be Reduced 60% by 2035



Avoided Water Usage Due To Increased Renewable Energy and Energy Efficiency

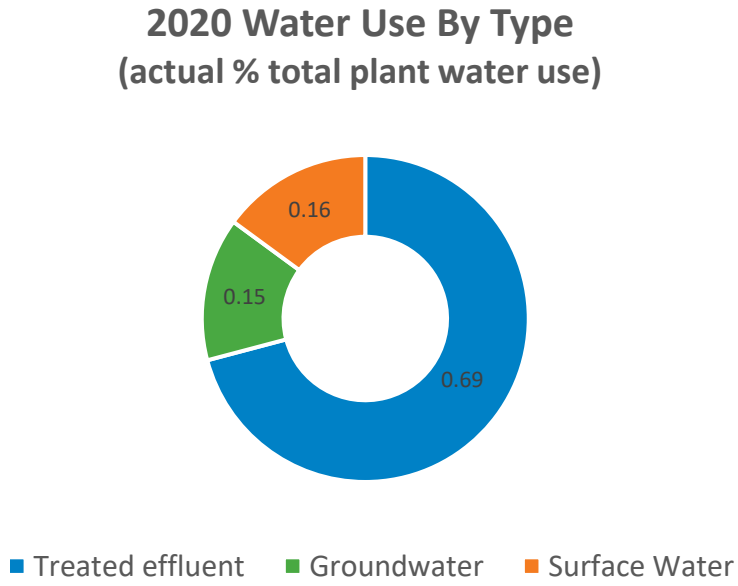


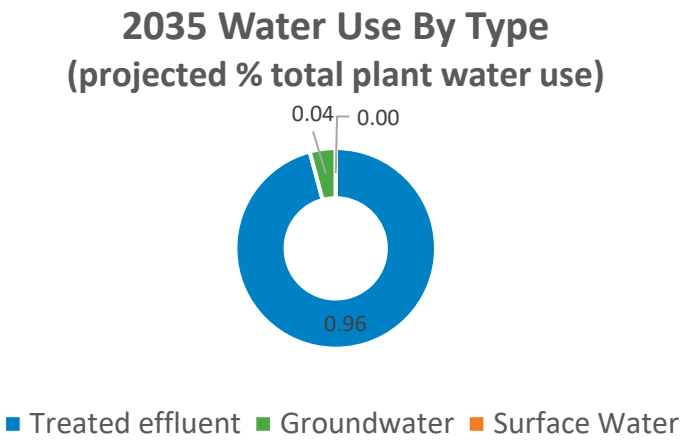
2035 Total % By Source	
PV w/Battery	45.4%
DSM/EE	22.0%
Wind	19.4%
DE	11.7%
PV Solar	1.5%

APS Uses Three Types of Water For Power Plant Cooling: Treated Effluent, Surface Water, and Groundwater

- Treated Effluent
  - In 2020, 69% of all APS fleet water consumed was effluent
    - Renewable – supply is municipal wastewater from wastewater treatment plants
    - Drought resistant – typical residential water cutback in drought is outdoor irrigation; interior use (portion sent to WWTPs) remains relatively constant
- Surface Water
  - In 2020, 16% of all APS fleet water consumed was surface water
    - Renewable – replenished by rainfall, snow and runoff
    - At risk of shortage during drought conditions
- Groundwater
  - In 2020, 15% of all APS fleet water consumed was groundwater
    - Non-renewable – can be pumped much faster than it can be recharged
    - Groundwater is Arizona's water savings account, should be reserved for drought contingency, when possible
    - APS announced a strategy to reduce reliance on groundwater in 2016
      - Current usage is 31% below 2014 consumption
      - By 2035, we project groundwater usage to be 80% below 2014

APS Water Use By Type During Resource Planning Period





Our Clean Energy Commitment

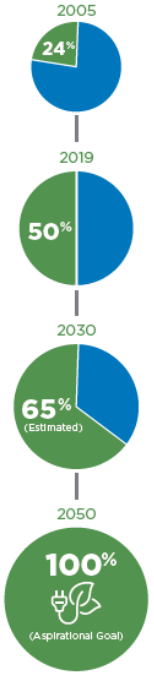
Our clean energy commitment consists of three parts:

- A **2050 goal** to provide 100 percent clean, **carbon-free electricity**
- A **2030 target** of achieving a resource mix that is **65 percent clean energy**, with 45 percent of our generation portfolio coming from renewable energy
- A commitment to **end our use of coal-fired generation by 2031**

Our Goal: 100 Percent Clean, Carbon-Free Electricity

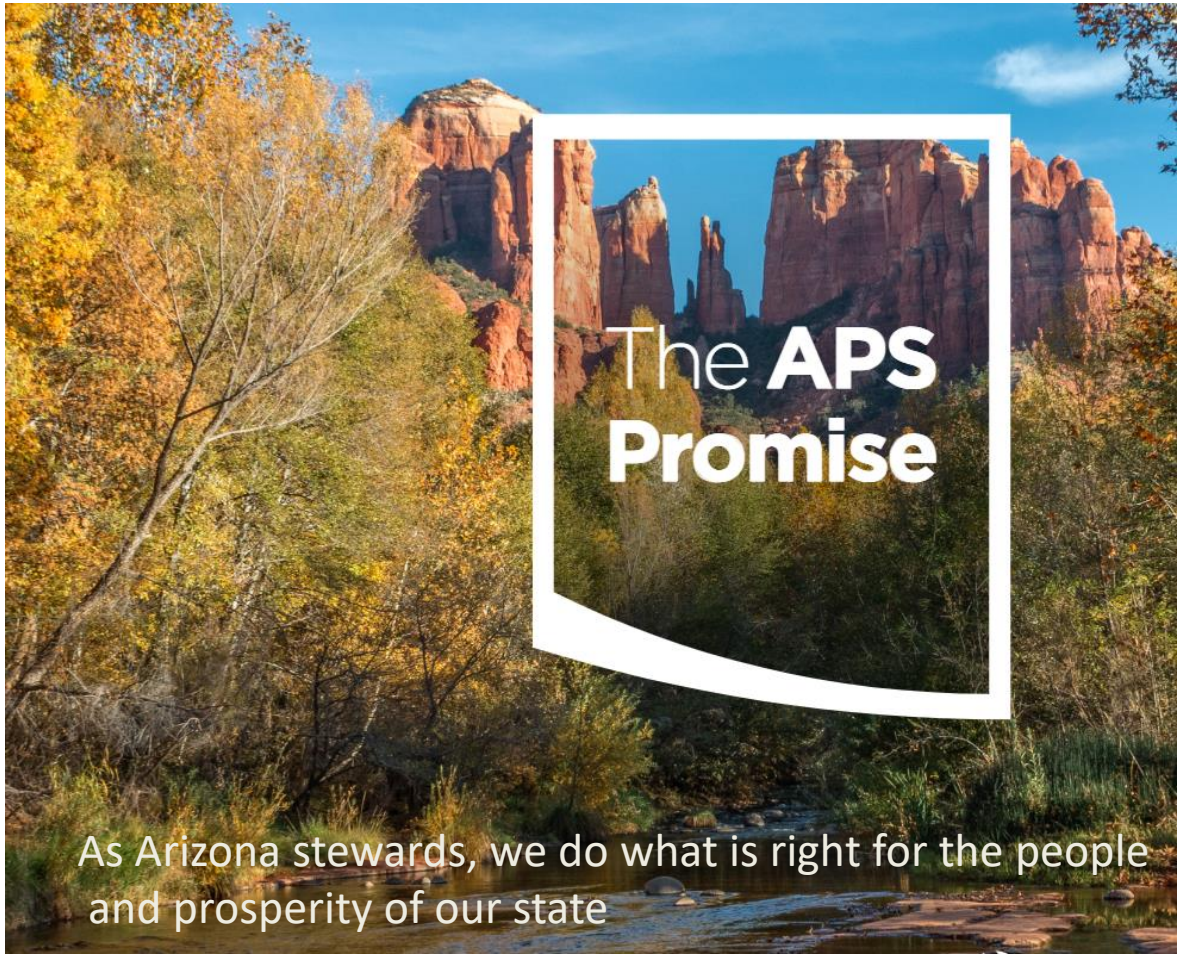
Our customers and stakeholders want clean energy, and we are listening. Working together, we are advancing Arizona's clean energy future. We plan to achieve a fully clean, carbon-free energy mix by 2050 to ensure Arizona remains a healthy and beautiful place to live and work. This goal is science-based and supports continued growth and economic development while maintaining affordable prices for our customers.

CLEAN ENERGY PATHWAY



Clean Energy Commitment Impacts On Water Consumption

- Increase reliance on photovoltaic solar power
  - Essentially no water required
- Increase reliance on wind generation
  - Essentially no water required
- Increase energy efficiency programs
  - Energy saved that would otherwise have required water for generation
- Continue to rely on carbon-free nuclear generation
- Cease coal generation by 2031
  - Cholla Power Plant to be retired in 2025 (9,080 AF of groundwater consumed in 2020)
  - Four Corners Power Plant to be retired in 2031 (16,871 AF of surface water consumed in 2020
  - Replacement power for these plants will come from more water efficient gas plants or renewable energy (wind, PV solar)
    - Cholla – 939 gal/MWh; Four Corners – 723 gal/MWh
    - Ocotillo – 140 gal/MWh; Redhawk – 279 gal/MWh
    - Wind, PV solar - 0 gal/MWh


The APS Promise
As Arizona stewards, we do what is right for the people and prosperity of our state