

# SRP INTEGRATED SYSTEM PLAN STUDY PLAN

## APPENDIX – ASSUMPTIONS USED IN SCENARIOS, SENSITIVITIES AND STRATEGIC APPROACHES

This appendix details the assumptions underlying the key drivers outlined in the Integrated System Plan (ISP) Summary Study Plan document for the scenarios, sensitivities and strategic approaches that SRP will analyze. These assumptions were developed in collaboration with the ISP Advisory Group during the *Prepare* Phase of the ISP (November 2021–April 2022). SRP subsequently updated the assumptions in February 2023 to incorporate impacts from the Inflation Reduction Act of 2022. Additional details on these assumptions are included in the meeting materials from the *Advisory Modeling Subgroup Meeting 2: Inputs for the ISP Study Plan*, *Advisory Modeling Subgroup Meeting 3: Inputs for the ISP Study Plan – Part 2* and *Advisory Group Meeting 9: Continuing Forward*.<sup>1</sup>

### Scenarios

#### Current Trends

Key Drivers	Assumptions
<b>Economic Growth</b>	Economic load grows 1,645 MW by 2035 and residential and commercial load grows by 1,776 MW by 2035, driven by an average population growth of 1.5% per year. The resulting total load growth is 2.9% per year.
<b>Temperature Rise</b>	“RCP <sup>2</sup> 4.5” climate scenario from the Intergovernmental Panel on Climate Change (IPCC)
<b>Carbon Reduction Policy</b>	No federal or state policy beyond SRP’s 2035 Sustainability Goals (reduce the emissions intensity [CO <sub>2</sub> per MWh] by 65% from 2005 levels by 2035)
<b>Electrification</b>	500,000 electric vehicles by 2035; 83% residential electric heating adoption by 2035
<b>Distributed Generation</b>	1,300 MW distributed solar by 2035
<b>Energy Efficiency</b>	3,800 GWh total energy efficiency by 2035
<b>Renewable and Battery Storage Costs</b>	Midpoint between low cost (Strong Climate Policy Scenario) and high costs (Desert Contraction Scenario) (see below)
<b>Gas Resource Costs</b>	Energy Information Administration 2022 Annual Energy Outlook (AEO)
<b>Emerging Technology Availability</b>	Carbon capture and sequestration (CCS) available in 2035. 100% hydrogen and nuclear (small modular reactors) are not available by 2035.
<b>Emerging Technology Cost</b>	Gas with CCS costs are midpoint between low costs (Strong Climate Policy Scenario) and high costs (Desert Contraction Scenario) (see below). 100% hydrogen and nuclear are not available by 2035.

<sup>1</sup> <https://www.srpnet.com/grid-water-management/grid-management/integrated-system-plan>

<sup>2</sup> Representative Concentration Pathway- RPC



<b>Hydrogen Prices</b>	Green hydrogen forecast developed by E3 using electricity production from solar (blend between Arizona and Utah using Renewable and Battery Storage Costs above), hydrogen production using alkaline electrolyzers (blend between optimistic and conservative cost declines from California Energy Commission publication CEC-500-2019-055), hydrogen storage (using costs from Department of Energy project ST-001), and hydrogen transport (blend between AZ and UT transport costs, using Argonne’s Hydrogen Delivery Scenario Analysis Model (HDSAM) tool). \$3/kg hydrogen production tax credit from Inflation Reduction Act applied at 85% monetization.
<b>Gas Prices</b>	Energy Information Administration (EIA) 2021 AEO “Reference” case regionalized based on SRP’s gas supply
<b>Hydro Availability</b>	Hydro capacity and energy availability remain relatively constant at current drought conditions.
<b>Market Support</b>	Due to near-term capacity constraints, actions taken to contract maximum market capacity through 2032; afterwards 525 MW of market potential available.

## Desert Boom

Key Drivers	Assumptions
<b>Economic Growth</b>	Economic development load grows by 2,900 MW by 2035 and population grows by an average rate of 1.8% per year.
<b>Temperature Rise</b>	“RCP 8.5” climate scenario from the IPCC
<b>Carbon Reduction Policy</b>	<i>Same as Current Trends</i>
<b>Electrification</b>	600,000 electric vehicles by 2035; 86% residential electric heating adoption by 2035
<b>Distributed Generation</b>	1,800 MW distributed solar by 2035
<b>Energy Efficiency</b>	<i>Same as Current Trends</i>
<b>Renewable and Battery Storage Costs</b>	<i>Same as Current Trends</i>
<b>Gas Resource Costs</b>	<i>Same as Current Trends</i>
<b>Emerging Technology Availability</b>	<i>Same as Current Trends</i>
<b>Emerging Technology Cost</b>	<i>Same as Current Trends</i>
<b>Hydrogen Prices</b>	<i>Same as Current Trends</i>
<b>Gas Prices</b>	<i>Same as Current Trends</i>
<b>Hydro Availability</b>	<i>Same as Current Trends</i>
<b>Market Support</b>	<i>Same as Current Trends</i>

## Desert Contraction



Key Drivers	Assumptions
<b>Economic Growth</b>	Economic development load growth rate peaks in 2026 before declining, resulting in a total of 597 MW added by 2035 compared to 2022. Population growth rate follows a similar trend, peaking in 2027 before declining. This results in an average population growth rate of 0.4% per year between 2023 and 2035.
<b>Temperature Rise</b>	“RCP 8.5” climate scenario from the IPCC
<b>Carbon Reduction Policy</b>	<i>Same as Current Trends</i>
<b>Electrification</b>	<i>Same as Current Trends</i>
<b>Distributed Generation</b>	<i>Same as Current Trends</i>
<b>Energy Efficiency</b>	<i>Same as Current Trends</i>
<b>Renewable and Battery Storage Costs</b>	NREL 2022 ATB Market + Policy Conservative Scenario forecast. Inflation Reduction Act Investment Tax Credit (ITC) and Production Tax Credit (PTC) monetized at 80%. <sup>3</sup> Cost increases for solar (15%), wind (30%) and batteries (30%) added assuming existing supply chain challenges and trade friction worsen. <sup>4</sup>
<b>Gas Resource Costs</b>	<i>Same as Current Trends</i>
<b>Emerging Technology Availability</b>	<i>Same as Current Trends</i>
<b>Emerging Technology Cost</b>	Gas with CCS based on Energy Information Administration 2022 AEO +20%. 100% hydrogen and nuclear are not available by 2035.
<b>Hydrogen Prices</b>	Green hydrogen forecast developed by E3 using electricity production from UT solar (using Renewable and Battery Storage Costs above), hydrogen production using alkaline electrolyzers (conservative cost decline from California Energy Commission publication CEC-500-2019-055), hydrogen storage in UT (using costs from Department of Energy project ST-001) and hydrogen transport to AZ (using Argonne’s Hydrogen Delivery Scenario Analysis Model (HDSAM) tool). \$3/kg hydrogen production tax credit from Inflation Reduction Act applied at 80% monetization.
<b>Gas Prices</b>	<i>Same as Current Trends</i>
<b>Hydro Availability</b>	Glen Canyon Dam generation production is unavailable at the beginning of the study period (2025). Other hydrogeneration on the Colorado River and Salt River remain consistent with Current Trends assumptions.

<sup>3</sup> Includes the base credit and 5x multiplier for satisfying prevailing wage and apprenticeship requirements. Includes the Energy Community bonus (+10%) for Arizona wind built after the retirement of Coronado (and Springerville in the Minimum Coal strategic approach). 80% reflects uncertainty in cost to monetize tax credits (e.g., profit margin for tax equity investor or transfer entity, transaction costs) and to satisfy applicable requirements (e.g., prevailing wage). Assumed phase-out post-2045.

<sup>4</sup> A smaller increase is made to solar as NREL’s conservative scenario forecasts for solar already include adjustment to reflect trade frictions.



<b>Market Support</b>	Loss of Glen Canyon Dam and other hydrogeneration facilities in the West results in 0 MW of market support available. Existing market purchases currently contracted by SRP are honored.
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## Strong Climate Policy

Key Drivers	Assumptions
<b>Economic Growth</b>	<i>Same as Current Trends</i>
<b>Temperature Rise</b>	<i>Same as Current Trends</i>
<b>Carbon Reduction Policy</b>	Federal policy that requires a CO2 mass emissions (tons) reduction by 85% from 2005 level by 2035.
<b>Electrification</b>	Electric vehicle adoption consistent with reaching economy-wide net-zero emissions by 2050 (975,000 by 2035); 86% residential electric heating adoption by 2035
<b>Distributed Generation</b>	2,300 MW of distributed solar by 2035
<b>Energy Efficiency</b>	Federal codes, standards and incentives lead to higher energy efficiency growth, reaching 4,500 GWh total energy efficiency by 2035.
<b>Renewable and Battery Storage Costs</b>	NREL 2022 ATB Market + Policy Moderate Scenario forecast. Inflation Reduction Act ITC and PTC monetized at 90% <sup>5,6</sup> . All near-term supply chain impacts are fully resolved by 2025.
<b>Gas Resource Costs</b>	Energy Information Administration 2022 AEO
<b>Emerging Technology Availability</b>	Gas with CCS available in 2030, 100% green hydrogen available in 2034, and nuclear (small modular reactors) available in 2034
<b>Emerging Technology Cost</b>	Energy Information Administration 2022 AEO. Inflation Reduction Act ITC applied to nuclear and 100% hydrogen, and CCS tax credit applied to gas with CCS all at 90% monetization. <sup>4</sup> 100% hydrogen unit based on frame combustion turbine.
<b>Hydrogen Prices</b>	Green hydrogen forecast developed by E3 using electricity production from AZ solar (using Renewable and Battery Storage Costs above), hydrogen production using alkaline electrolyzers (optimistic cost decline from California Energy Commission publication CEC-500-2019-055), hydrogen storage in AZ (using costs from Department of Energy project ST-001) and hydrogen transport (using Argonne's Hydrogen Delivery Scenario Analysis Model (HDSAM) tool). \$3/kg hydrogen production tax credit from Inflation Reduction Act applied at 90% monetization.
<b>Gas Prices</b>	EIA 2021 AEO "Low Oil and Gas Supply" case regionalized based on SRP's gas supply
<b>Hydro Availability</b>	<i>Same as Current Trends</i>

<sup>5</sup> ITC and PTC include the base credit and 5x multiplier for satisfying wage and apprenticeship requirements. 90% reflects uncertainty in cost to monetize tax credits (e.g., profit margin for tax equity investor or transfer entity, transaction costs) and to satisfy applicable requirements (e.g., prevailing wage). Assumed phase-out post-2045.

<sup>6</sup> Includes the Energy Community bonus (+10%) for Arizona wind built after the retirement of Coronado (and Springerville in the Minimum Coal strategic approach).



<b>Market Support</b>	Favorable regional resource and load diversity allows for the potential for the wider region to carry slightly less total resource capacity while maintaining the same level of reliability. SRP assumes a regional coordination program and a regional diversity benefit and tests this assumption by reducing its Planning Reserve Margin requirement from 16% to 13%. Capacity (MW) market availability assumptions are consistent with Current Trends.
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## Sensitivities

Sensitivity	Assumptions
<b>High Demand Response</b>	Increased expansion in demand response over time, reaching 400 MW total Demand Response by 2035.
<b>High Energy Efficiency</b>	Federal codes, standards and incentives lead to higher energy efficiency growth, reaching 4,500 GWh total energy efficiency by 2035.
<b>High Distributed Generation</b>	Distributed solar and battery adoption reach 2,300 MW and 249 MW, respectively, by 2035.
<b>Increased Load Management</b>	Increased load flexibility through managed electric vehicle (EV) charging or other flexible loads. Modeled as a virtual battery addition with limitations on when it can charge or discharge.
<b>Regional Diversity</b>	Favorable regional resource and load diversity allows for the potential of a reduced loss of load probability on SRP's system. SRP tests this assumption by reducing the minimum Planning Reserve Margin requirement from 16% to 13%.
<b>High Gas Price</b>	EIA 2021 AEO "Low Oil and Gas Supply" case regionalized based on SRP's gas supply
<b>Low Gas Price</b>	EIA 2021 AEO "High Oil and Gas Supply" case regionalized based on SRP's gas supply
<b>Volatile Gas Price</b>	EIA 2021 AEO "Reference" gas regionalized based on SRP's gas supply, adjusted to reflect gas price volatility observed from 2000-2010
<b>High Technology Cost</b>	NREL 2022 ATB Market + Policy Conservative Scenario forecast. Inflation Reduction Act ITC and PTC monetized at 80%. <sup>7</sup> Cost increases for solar (15%), wind (30%), and batteries (30%) added assuming existing supply chain challenges and trade friction worsen. <sup>8</sup>
<b>Low Technology Cost</b>	NREL 2022 ATB Market + Policy Moderate Scenario forecast. Inflation Reduction Act ITC and PTC monetized at 90%. <sup>9</sup> All near-term supply chain impacts are fully resolved by 2025.

<sup>7</sup> Includes the base credit and 5x multiplier for satisfying prevailing wage and apprenticeship requirements. Includes the Energy Community bonus (+10%) for Arizona wind built after the retirement of Coronado (and Springerville in the Minimum Coal strategic approach). 80% reflects uncertainty in cost to monetize tax credits (e.g., profit margin for tax equity investor or transfer entity, transaction costs) and to satisfy applicable requirements (e.g., prevailing wage). Assumed phase-out post-2045.

<sup>8</sup> A smaller increase is made to solar as NREL's conservative scenario forecasts for solar already include adjustment to reflect trade frictions.

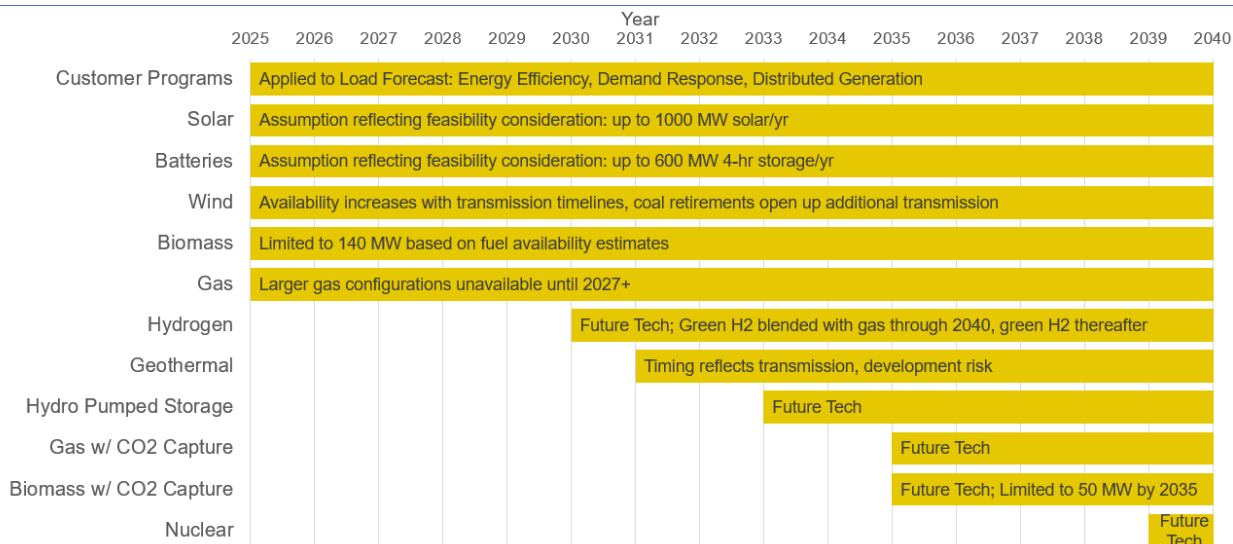
<sup>9</sup> Includes the base credit and 5x multiplier for satisfying wage and apprenticeship requirements for ITC and PTC. Includes the Energy Community bonus (+10%) for Arizona wind built after the retirement of Coronado (and Springerville in the Minimum Coal strategic approach). Monetization range reflects uncertainty in cost to monetize tax credits (e.g., profit margin for tax equity investor or transfer entity, transaction costs) and to satisfy applicable requirements (e.g., prevailing wage). Assumed phase-out post-2045.



## Strategic Approaches

### Tech Neutral

Key Drivers	Assumptions
<b>Technology Availability</b>	All resource technologies available, limits based on technical feasibility availability of new resources (chart below). Strong Climate Policy Scenario includes accelerated availability dates for CO2 capture (2030), 100% green H2 (2034), and nuclear (2034).



### No New Fossil

Key Drivers	Assumptions
<b>Technology Availability</b>	New gas and gas w/CO2 capture are removed as available resource technologies

### Minimum Coal

Key Drivers	Assumptions
<b>Technology Availability</b>	New gas and gas w/CO2 capture are removed as available resource technologies
<b>Coal Plant Operational Changes</b>	Evaluates impacts from Coronado Generating Station Units 1 and 2 and Springerville Generating Station Unit 4 operating seasonally beginning in 2025 (off-line for three months of the year during non-peak periods) and SRP fully exiting coal by 4/30/2034.



## Revision History

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Revision	Date	Description
0	August 2022	Original
1	March 2023	Updated to incorporate impacts from the Inflation Reduction Act into technology costs.
2	April 2023	Corrected understated High DG sensitivity assumption and economic growth assumption in the Desert Boom scenario.

