2019 PRELIMINARY INTEGRATED RESOURCE PLAN

AUGUST 1, 2019

Contents

Executive Summary

This Preliminary Integrated Resource Plan (Preliminary IRP) summarizes the issues, trends and scenarios that will inform the final Integrated Resource Plan (IRP) to be filed by Arizona Public Service Company (APS) with the Arizona Corporation Commission (Commission) on April 1, 2020.

APS continues to address accelerating technology and energy trends that are influencing the industry while maintaining clean, reliable and affordable energy service for our 1.25 million customers across Arizona. These trends include:

- The growth of clean energy resources and advancing technologies on the energy grid such as energy storage
- Dynamic market conditions across the West driven primarily by growing renewable energy resources and energy policy direction
- Customer preferences for cleaner energy and choice in how and when they use energy in their homes and businesses

These trends are helping shape our near-term action plan for the next 2-3 years and ultimately our long-term resource planning and procurement strategy. Our top priorities include:

Increasing Clean Energy Resources

- Our diverse energy mix is already 50% carbon-free, and we intend to further increase our investments in carbon-free resources. Our near-term actions include competitive solicitations to procure clean energy resources such as solar, wind, energy storage, demand response and demand-side management (DSM) resources including energy efficiency that enable renewable additions and lead to a cleaner grid.
- We continue to reduce our carbon footprint and at the end of 2018, we achieved a 32% reduction in our carbon-emissions intensity from our 2005 baseline. Reductions are expected to continue as we add additional clean energy to our resource mix.
- Initially, we plan to issue a request for proposals (RFP) for up to 150 megawatts (MW) of APS-owned storage-ready solar resources to be in service by 2021 and another for up to 250 MW of wind resources to be in service as soon as possible, but no later than 2022. Both RFPs will have an option for commercial customer participation.
- We expect to have more than 100 MW of clean energy added to our system each year from ongoing private rooftop solar installations. We also have opportunities to develop flexible resources and absorb clean energy from the western energy market when the region is oversupplied with renewables.
- The continued operation of the Palo Verde Generating Station, the nation's largest carbon-free energy producer, is essential to any clean energy future for Arizona and the Southwest.
- With implementation of our near-term action plan, we expect our energy mix to increase to approximately 54% clean with more than 20% of our generation coming from renewable resources by 2022.

Reaffirming Our Commitment to 850 MW of Battery Energy Storage by 2025

- In February, APS announced an initiative to add 850 MW of battery energy storage to our portfolio by 2025. We remain committed to completing this initiative, but the timing and sequence of resource additions will depend on findings following the April 19 equipment failure at the McMicken battery energy storage facility.

- We have advised bidders participating in the RFPs for 200 MW of AZ Sun energy storage retrofits and 100 MW of large-scale solar with storage to stop work on their proposals until further notice. We are working diligently and methodically through an investigation to determine the root cause of the McMicken incident and identify potential lessons. The investigation results will inform our next steps, including any changes to design parameters that may be implemented for future batteries. We will notify participants when we make adjustments to the RFP schedule.

- We plan to move forward with the battery energy storage projects to be sourced by Purchase Power Agreements (PPAs), totaling 150 MW selected through the 2018 RFP, depending on the McMicken findings.

- With the revised battery project timelines, we will seek short-term wholesale market purchases from neighboring utilities, market participants and merchant-owned natural gas units and demand response projects in order to meet peaking capacity needs for the summers of 2020-2021. It is imperative that we follow this approach for reliability purposes, but purchases will be structured to avoid impacting longer-term resource planning strategies, consistent with our approach to adding carbon-free resources.

- We are developing an RFP for up to 50 MW of demand response to be released in the near future. This will also support reliability and add flexibility during peak demand on the system.

Enhancing Flexibility through Market Opportunities and Customer Participation

- The near-term action plan was developed with flexibility in mind to best manage population growth and economic activity (and resulting energy use and demand) expected in our service territory. The plan is flexible enough to provide sufficient resources to meet anticipated growth in energy demand, particularly from large, new sources such as data centers and rising transportation electrification, while minimizing the risk of adding capacity before it is required.

- We will focus on expanding the APS Rewards residential customer programs to manage peak demand on our system, encourage energy use when solar energy is abundant and provide savings to customers. The current Rewards programs cover smart thermostats, connected water heaters and energy storage.

- Participation in the western Energy Imbalance Market (EIM) will continue to be an effective tool for integrating the region's growing clean energy resources while creating savings for customers. To date, the EIM has delivered more than $102 million in gross benefits to APS customers since we joined the voluntary, real-time market in October 2016.

- We are in discussions with the EIM operator, California Independent System Operator (CAISO), and other EIM participants about the feasibility of a day-ahead market to achieve more cost savings and more efficient renewables integration across the region.

Overall, these steps will continue momentum toward a clean, reliable and affordable energy future for Arizona. The action plan integrates more clean energy into our diverse energy mix through planned RFPs — increasing our renewable energy resources to nearly 2,500 MW by 2021 — and our major commitment to energy storage. Strategic, short-term wholesale purchases of gas-fired power will support reliability and flexibility on our system. We will pursue market opportunities that enable our customers to benefit from the lowest-cost power available; including the region's expanding clean energy resources. Continued reductions in carbon intensity throughout our generation fleet, anchored by the nation's leading carbon-free energy producer, Palo Verde, and growing clean energy resources, augment our clean energy goals.

Our stakeholders are important in helping us identify opportunities and benefits of additional clean energy resources. Creating a sustainable energy future for our customers and Arizona takes collaboration and innovative thinking. The IRP is a public forum to outline our long-term planning process and near-term action plans, and we have enhanced collaboration through the IRP process by forming an initial IRP working group. This group included a diverse range of stakeholders who are engaged in our IRP process. Monthly working group meetings began in December 2018 to increase transparency into the IRP process and to exchange information and ideas about our existing resource modeling assumptions and planning. Additional public stakeholder forums will be held through the April 2020 Final IRP filing.

We appreciate the robust discussions so far in the process, and we look forward to developing the details of the near-term action plan and long-range plan with our stakeholders leading up to the filing of our IRP in April.

Introduction

As a company of 6,300 employees, we have one mission at APS: safely and efficiently deliver reliable energy to meet the changing needs of our customers. APS developed this Preliminary IRP with the purpose of maintaining reliable and affordable service for the 1.25 million customers we serve and building on the 50% clean energy portfolio we have today.

This commitment to clean energy will focus on developing a portfolio that includes renewables, nuclear, demand side management and energy efficiency, clean imports, fuel switching, electrification and energy storage. As the nation's largest producer of electricity, all of it carbon free, Palo Verde is the cornerstone of our current clean energy mix, as well as a significant provider of clean energy to the Southwest. The plant's continued operation is vital to a clean energy future for Arizona and the region, as a carbon-free and affordable resource, and as a large economic contributor to the local economy.

The uncertainty about our customers' changing energy needs only increases the further out we go in our planning horizon. That is why in this Preliminary IRP we concentrate on a near-term action plan of 2-3 years. This action plan is intended to be flexible enough to provide sufficient resources to meet the anticipated growth in energy demand, particularly from new, large sources, while minimizing risk of adding too much capacity before it is required. We will also address our long-term forecast and resource planning in the IRP to be filed in April 2020 with flexibility in mind as the electric industry continues to change rapidly.

APS continues to focus on the customer experience and developing programs that offer value and savings while addressing operational opportunities and challenges. These include reducing the amount of capacity that must be on hand to meet customers' peak energy needs by lowering that peak and shifting energy use to times when customers can take advantage of low-cost, abundant energy. New and innovative programs like APS Rewards[1] continue to be developed to put technology to use, invite customers to participate and realize bill savings for customers who make simple changes to their daily routine.

Part of our responsibility to the state is forecasting our customers' future energy needs. This is becoming increasingly difficult due to uncertainty in many areas. Those areas include the Commission's deliberations about retail competition, modernizing its energy rules and recent announcements of large data centers

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[1] The APS Rewards programs offer residential customers options to adopt home technologies and receive a bill credit for participating. Program descriptions can be found on page 28.

planning to locate in our service territory. Data centers traditionally consume significant amounts of energy, and they will drive additional resource needs over the next decade. We are working with those customers to make sure we meet their expectations for clean, reliable and affordable energy.

Additional uncertainty is created by potential energy rule updates; at times potential rules are in conflict with one another. Until APS has greater clarity on the future direction and timing of energy policy in the state, we will plan and source to the continuing obligation to serve our customers and ensure resource adequacy. By retaining flexibility in the sizing, timing and duration of new resource additions, we are best situated to respond to our customers' needs.

Increased Stakeholder Input

In preparation for filing this Preliminary IRP, APS began meeting monthly in December 2018 with the IRP working group, which was made up of a diverse group of stakeholders. The goals were to increase transparency into the resource planning process and enable an exchange of information and ideas about our existing resource modeling assumptions and planning process.

To support discussions within the IRP working group, APS retained Energy and Environmental Economics (E3), a consulting firm with wide-ranging expertise in the electric sector, to study how different clean energy policies and strategies impact our ability to maintain reliability and affordability. To facilitate this process, E3 developed a scenario-planning model that provides results consistent with the more detailed models run by APS to create its resource plan. This tool, designed to allow quick and iterative testing of a wide range of scenarios and sensitivities, has allowed APS and stakeholders to evaluate the potential implications of a variety of goals and policies. This process has yielded a number of valuable insights, and we anticipate that these points will be shared with the Commission and other stakeholders in future workshops addressing contemplated updates of various energy rules:

- APS and Arizona are experiencing continued population and load growth which will drive significant investment needs across all scenarios analyzed
- All modeled scenarios show that significant investment in new clean energy resources would be needed to sustain and increase substantial carbon reductions
- Scenarios with broadly-defined policies to encourage clean energy and carbon reductions provide more affordable and flexible options than more prescriptive targets for specific technologies (e.g., RPS) that narrow utilities' choices
- Palo Verde is critical to meeting future clean energy goals at low costs; replacing it with other resources would considerably increase customer costs and require substantial development time
- Scenarios with early retirement of Four Corners show significant carbon benefits, but would require large replacement investments in the next decade to maintain reliability
- Even in deep decarbonization scenarios, firm gas resources play a crucial reliability role but operate infrequently and at low capacity factors

APS thanks our working group participants for their dedication and constructive input to the planning process. Their feedback and engagement have helped identify near-term clean energy procurement opportunities, the priorities defined in our near-term action plan, and the next steps in preparing for the IRP.

In addition to the IRP working group meetings, we also held two publicly-noticed meetings with a broader group of stakeholders to share draft plans, generate discussion and address questions about our resource planning process. We look forward to continuing engagement with our stakeholders as we develop the IRP.

Regulatory Considerations

The Commission opened a docket (RU-00000A-18-0284) in August 2018 to evaluate proposed modernization of its energy rules for subjects including the Renewable Energy Standard and Tariff (REST), energy efficiency standards, net metering, interconnection of distributed generation (DG) facilities, electric vehicles (EVs), retail electric competition, forest bioenergy, baseload security and resource planning and procurement. We welcome the opportunity to collaborate in this process and encourage the Commission to take a comprehensive, holistic view of these policies so they may set the course for Arizona's affordable and sustainable energy future.

One set of rules under consideration, for retail electric competition, stands in direct opposition to successful implementation of many other policies, including the integrated resource planning and procurement process. A retail competitive electricity market in the state would undercut the ability of regulated utilities including APS to make long-term resource decisions, which over time would very likely lead to reduced resource capacity, shrinking diversity of resources and diminished reliability to meet customers' energy needs. Any move toward retail electric competition must consider how benefits of the current system, current innovations and clean energy policy initiatives would be impacted. We join others in encouraging the Commission to take the necessary time to ensure a full understanding of how a different market structure may impact Arizona consumers and the state's economy.

Broad electrification policies are important in developing a balanced approach to both increasing and utilizing excess energy, reducing greenhouse gas emissions and managing costs. With the continued cost reductions in battery storage technologies and increasing range of EVs including passenger cars, trucks, buses, airport equipment and others, the forecast for EV adoption is growing. Electrification policies that support the growth of EVs are important to reducing overall greenhouse gas emissions and improving air quality in Arizona. It will also be important for the policies to address infrastructure additions and upgrades required to enable the transition to electrification, as well as effectively manage the charging profiles of EVs so that utilities and customers can optimize electrification benefits, manage costs and take advantage of the overgeneration of renewable energy at certain times of day.

IRP Schedule

IRP Schedule	Start Date	End Date	Responsibility
Pre-Filing Workshops (optional)	8/1/2018	1/31/2019	LSEs, ACC
LSEs Files Preliminary Resource Plans (Preliminary IRP)	8/1/2019	8/1/2019	APS
APS Hosts Stakeholder Meetings	8/1/2019	4/1/2020	APS
Staff Reviews Preliminary IRPs	8/1/2019	9/1/2019	Staff
ACC Hosts Workshop on Preliminary IRPs	9/1/2019	10/1/2019	ACC
ACC Open Meeting - Review Preliminary IRPs	10/1/2019	11/15/2019	ACC
Pre-Filing Workshop on Final IRPs	12/1/2019	1/15/2020	ACC/LSEs
LSEs File Final IRPs	4/1/2020	4/1/2020	LSEs
Stakeholder Comments Due	7/1/2020	7/1/2020	Stakeholders
LSEs Response to Stakeholders Comments Due	7/1/2020	8/15/2020	LSEs
Staff Assessment and Proposed Order	7/1/2020	11/2/2020	Staff
ACC Holds Open Meeting on Final IRPs	1/15/2021	2/15/2021	ACC

Preliminary IRP Approach and Assumptions

The resources that are available to APS continue to change, as do options to reduce customer energy costs through opportunities such as participation in the western EIM and continued adoption of advanced technologies. We remain proactive in developing innovative and flexible programs to meet customer needs as evidenced in the action-plan section of this document.

APS continues to take an all-of-the-above approach to meeting customers' needs, with an eye on the resources needed to meet anticipated population growth and increasing economic activity in Arizona. One example is the major clean energy initiative we announced in February to add 850 MW of battery storage and at least 100 MW of new solar generation by 2025. The initiative will take advantage of the abundance of solar energy in the region by storing excess solar production for later use when customer demand peaks in the late afternoon and early evening as solar production wanes.

Energy storage is vital to Arizona's clean energy future, and we remain committed to the 2025 clean energy initiative. Yet guided by our priority on safety, we are awaiting the results from the ongoing investigation into the equipment failure at the McMicken battery energy storage system in Surprise on April 19. Findings from that investigation will help us learn what happened in this incident and apply those lessons to battery projects moving forward.

With battery project timelines facing adjustment, we will seek short-term wholesale market purchases from neighboring utilities, market participants and merchant-owned natural gas units and demand response projects in order to meet peaking capacity needs for the summers of 2020-2021. It is imperative that we follow this approach for reliability purposes during the period, but purchases will be structured to not impact longer-term resource planning strategies, consistent with our approach to adding carbon-free resources.

Regional Overview

The Southwest and APS will increasingly alternate between two energy extremes: periods in non-summer months characterized by overabundant energy supplies driven by increasing amounts of renewable energy resources; and tight capacity supply in the region during peak demand periods created by extreme summer heat and exacerbated by the limited role renewables can play in the late afternoon and early evening, when energy use peaks.

Energy overabundance in the Southwest largely results from extensive investment in renewable energy, required to meet renewable energy policy mandates. This investment has led to surplus energy production that exceeds customer demand in the non-summer months, when temperatures are typically mild and electricity demand is low. These well-intended policies create operating challenges and may cause unintended impacts on carbon reduction. Producing clean energy when customers are unable to use it or replacing nuclear generation, which is already carbon-free, with renewables does not lead to a decrease in carbon emissions. Both resources must be recognized for their ability to lower carbon emissions rather than as individual resources that can be traded off in a portfolio.

The situation also has impacted operation of baseload power plants due to minimum load conditions and having flexible resources available to meet quick-starting and fast-ramping requirements as the sunrises and sets. Certain baseload units are necessary year-round to help manage system voltage and system stability. Quick-starting, fast-ramping units are needed to meet customer demand as renewable resources fall off the system. As the region continues to increase renewable goals and by definition, renewable generation, the challenges placed on flexible and baseload resources will continue to intensify. The situation will improve somewhat as energy storage systems are deployed, but the timing, scale and efficacy of energy storage are yet to be determined.

For a number of years, the Southwest has been in a capacity-long position, meaning there has been more generation in the region than is required to meet typical reliability needs. However, this position has changed dramatically in the past several years. Due to moderate load growth and retirement of generating resources in the region, a rebalance is occurring, and the region will require capacity additions and infrastructure or face shortfalls, particularly in summer and high-demand scenarios as renewable generation falls off the system.

This challenge is quickly accelerating in California and has implications for the region. In the fallout from the 2000-2001 California energy crisis, the state constructed a resource adequacy program to ensure all load-serving entities provided sufficient resources to meet peak demand plus a planning reserve margin of 15%.[2] For many years, the resource adequacy conversation was relatively straightforward, but today it is changing due to policies that are focused more on energy than reliability. This has raised the alarm of system operators in California that recognize resource adequacy concerns are real and being challenged. To avoid similar concerns, it is important that Arizona address resource adequacy during all future planning scenarios. Planning for reliability is extremely important in Arizona and has broad implications for customers and economic development in the region.

Merchant generators and more specifically, natural gas facilities, have long served utilities as capacity providers. These facilities remain highly reliable sources of generation when the bulk electric system is facing high demand because they are available and dispatchable with high probability. Over the past several

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[2] APS currently manages system reliability through an industry-accepted methodology that establishes a loss-of-load-probability (LOLP) for the system. The concept of the LOLP method establishes the resource needs to maintain 100% system reliability with no more than one (1) event every 10 years (1 in 10).

years, regional merchant generation has either been acquired (purchased) by regional utilities for capacity purposes, or given the large-scale development of regional renewable resources, been displaced and removed from the market due to economics (reduced sales and corresponding margins). Simply put, the portfolio of available merchant generation in the region is substantially less than it has been historically, and, with no new merchant generation presently planned, securing short-term peaking (i.e., natural gas) merchant generation resources is becoming increasingly difficult. Ultimately, this condition has potential implications for reliability within the region, as well as, limiting options for APS to replace retiring and expiring generation resources.

This situation is creating challenges for APS and neighboring utilities that are required to maintain reliability through an appropriate planning reserve margin. Without existing generation or development of new replacement resources to meet peak system needs, available reserves are diminishing and energy prices are poised to increase dramatically during peak hours, translating to higher costs for customers. The decline in available, quick-starting and fast-ramping natural gas-fired capacity is a legitimate concern for resource adequacy in a region that experiences its highest system demand in the late afternoon and early evening during summer when renewable generation offers little capacity contribution.

Natural gas serves an essential “safety net” and bridge fuel to further the development of clean energy resources in the region. It will also support the development of a glide path out of coal generation as a reliable, cleaner alternative (which is discussed in the Action Plan Update). For those concerned about its carbon footprint, gas generation can be used sparingly and becomes the default generation resource when fully clean resources are not available to support the system and customer needs.

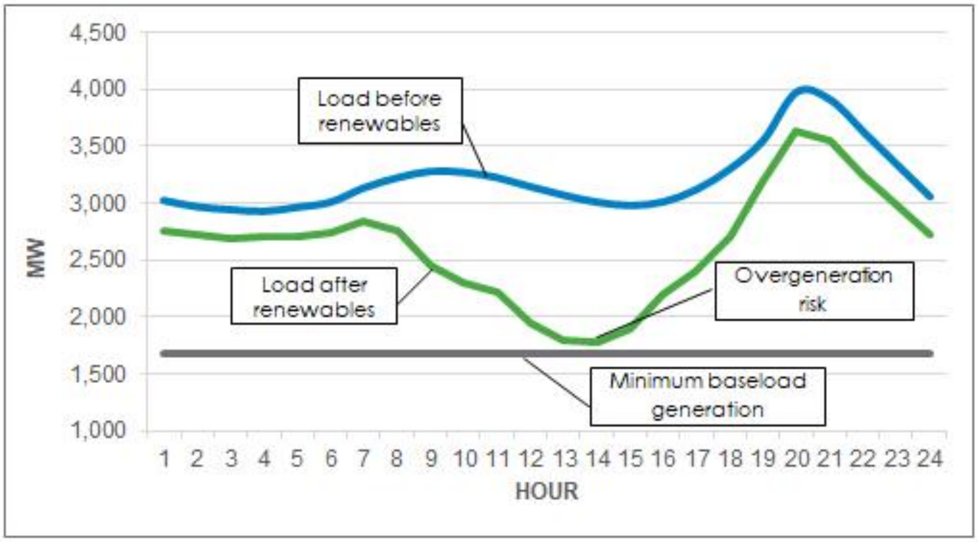
It is also becoming commonplace for California to have a surplus of renewable energy, which it either has to curtail or sell at negative prices. California’s focus on renewable energy mandates requires REC accounting mechanisms that lead to overproduction of renewable energy, whether or not customers can use it when such energy is produced. Nonetheless, when APS purchases excess renewable energy that would otherwise be curtailed, we are able to reduce fossil generation and its corresponding carbon emissions. The ability to count those market purchases toward our clean energy goals provides a meaningful way to reduce our costs of achieving those goals. We are in a unique position to benefit from solar overproduction in California, and with thoughtful and appropriate policy adoption, our customers can continue to benefit from the low and negative prices that California solar often produces.

A Flexible Approach to Peak Reliability

One of the primary resource planning needs for APS is having sufficient peaking capacity to reliably meet customer load requirements during the summer. With the state’s projected population growth and increased economic activity, coupled with contract roll-offs and plant retirements, there is a significant need for flexible resource additions.

Flexibility to meet varying system conditions, like those seen in the non-summer daily loads graph, will not benefit from a one-size-fits-all approach. A complementary suite of solutions combining clean energy resources with storage and firm resources such as natural gas will create the flexibility needed to maintain the reliability expected by our customers and regulators.

Non-Summer Daily Loads



These solutions will be influenced by the way customers manage their energy use through technology, rate and pricing signals, increasing transportation electrification, the types of resources implemented by utilities and regional market initiatives. For example, energy storage can be viewed as complementary to solar to absorb the excess energy produced midday and meet ramping requirements as the system peaks in the evening. Other forms of flexibility must be evaluated as well, such as renewables curtailment from utility and customer resources, demand response and natural gas.

The supply of natural gas is abundant, and gas prices are low by historical standards. Through the IRP planning horizon, natural gas prices are expected to stay low. This will lead to continued cost-effective operation of our existing gas fleet and offer cost-effective opportunities for future peaking resources to help keep customer rates low.

While APS will be diligently moving toward a clean future energy mix, natural gas resources will be essential to provide highly reliable service under any future scenario. In the case of coal retirements, the loss of firm generation can be partially replaced by natural gas, which will maintain reliability while significantly reducing carbon emissions. Additionally, having natural gas capacity in reserve will provide a cost-effective way to meet reliability requirements during the periods of limited renewable generation. For instance, when generation from renewable resources is limited due to consecutive days of cloudy weather, these units may operate at very low annual capacity factors and have little impact on our overall carbon emissions, but they are vitally important for reliability and affordability.

Load Forecast

Overview

APS projects that annual peak demand and energy needs will both increase at a compounded annual growth rate of 2.3% during the IRP planning period of 2020-2035. The growth over the planning period equates to approximately 3,000 MW of capacity needs and 12,800 GWh of energy requirements. The projected growth is primarily driven by three factors: population growth, economic growth and changing customer trends related to EVs and distributed generation.

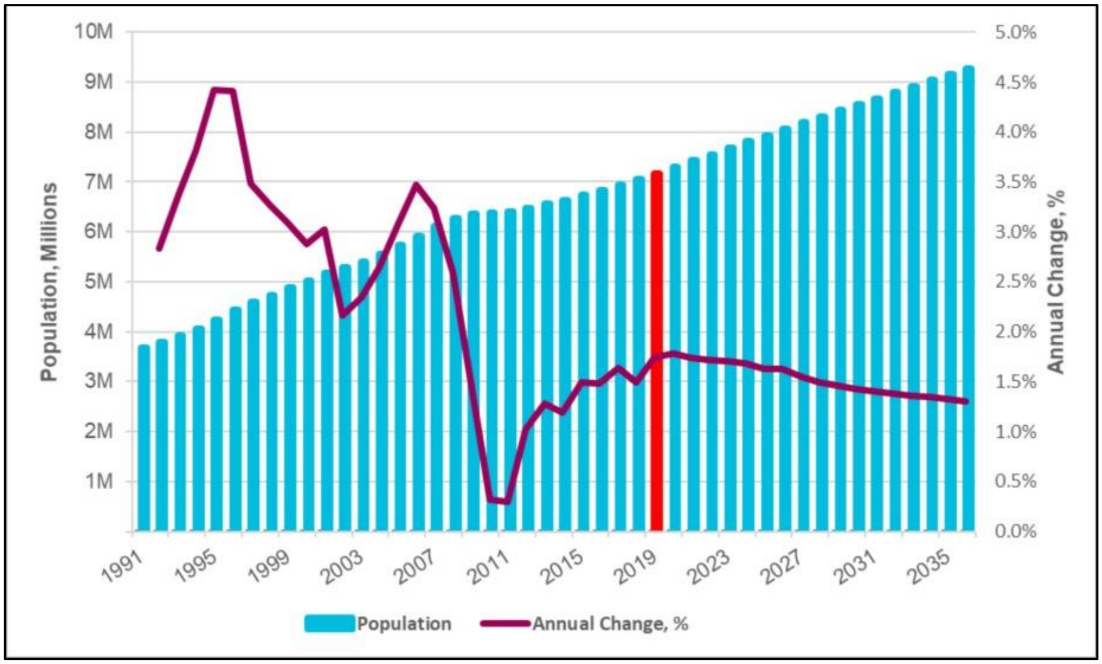
This estimate includes the effects of distributed generation and DSM/energy efficiency. We have engaged a third party to analyze DSM/energy efficiency impacts and we will update the Final IRP to incorporate the results of the study. Additional details regarding the study are provided in the Final IRP section of this report.

Growth Drivers

Population and Economic Activity

Population growth is the most influential variable in developing a load forecast, providing the basis for several other forecast components such as growth in households and residential customers. Population growth is also a key driver of increased economic activity in the state and the APS service territory.

Figure 1: Arizona Population Growth, 1991 – 2035



Prior to 2008, Arizona experienced strong population growth, driven by high migration rates. Population growth slowed during the recession, but has steadily risen since 2011 due to a return to higher levels of migration. We project that migration will remain near the current level through the planning period, resulting in an average annual population growth rate of 1.5%. While the projected growth is faster than the last decade, we do not expect that population growth will return to levels seen prior to the latest recession (Figure 1).

As a result of the population growth and higher levels of economic activity, we expect to add about 20,000-25,000 residential customers annually in the near term. For the 2020-2035 planning period, we anticipate adding 400,000 residential customers (2.0% annual growth, on average) and Metro Phoenix to add 250 million square feet of commercial and industrial (C&I) floor space (2.1% annual growth, on average). Growth in residential customers and C&I floor space are key drivers of peak and energy needs through the planning period.

Electric Vehicles

As part of the Preliminary IRP process, APS developed a scenario for adoption of EVs in Arizona and the impacts on our service territory. While EV adoption rates are currently relatively low, we expect the EV market share of new vehicles sold to steadily increase. APS has retained Navigant Consulting for an electric vehicle study to provide insight into EV adoption in our service territory and evaluate some of the infrastructure improvements required to support EV adoption. Findings from this study will be included in the Final IRP.

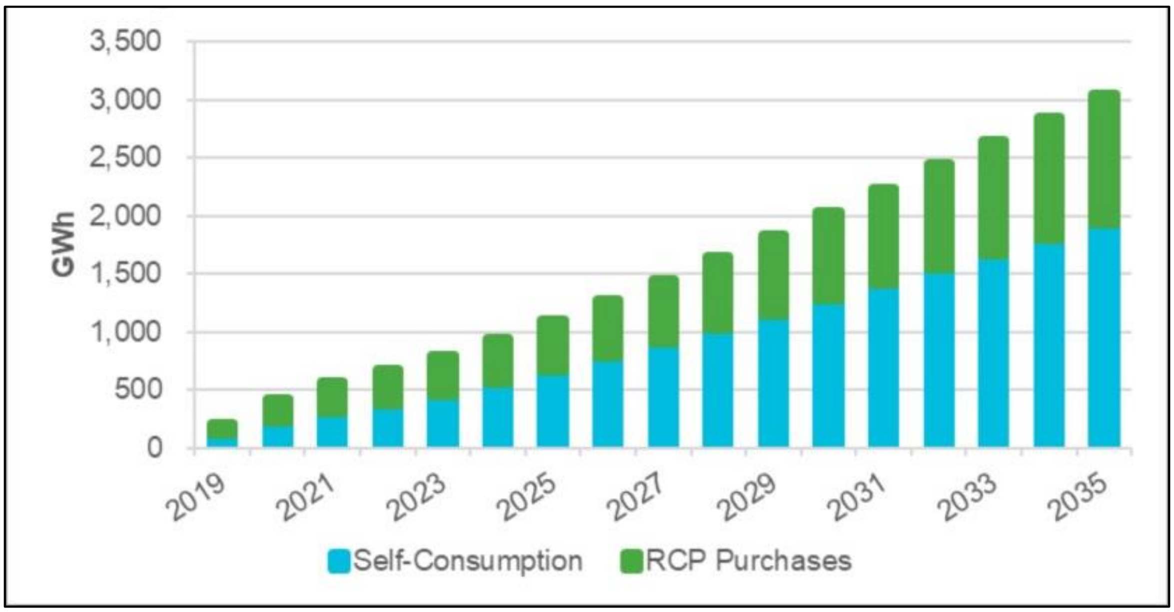
Distributed Generation/Rooftop Solar

Installation of private rooftop solar is expected to continue at a strong pace in our service territory. Nationally, APS ranks behind only the three California investor-owned utilities for most cumulative residential solar capacity installed and second behind San Diego Gas & Electric for cumulative residential solar installed per customer.[3]

APS expects the pace of DG installations to average more than 100 MW of capacity added annually. We will update the forecast for the near term and the long-term planning period in the Final IRP.

Figure 2 shows projected rooftop solar production, broken into self-consumption and Resource Comparison Proxy (RCP) purchases. Self-consumed production and excess generation (RCP purchases) offset future energy needs, but have little impact on capacity needs. Peak savings from additional DG are relatively small, as DG capacity contributions during peak are low, ultimately resulting in a peak hour shift to 6 p.m. through the planning period.

Figure 2: Additional Solar Production



Sources of Energy Growth

Population and economic growth, and the resulting increase in residential customers and C&I floor space, are the main drivers of energy growth in the near term. We also project energy gains from residential usage and EVs with an offset or reduction related to the RCP or rooftop solar purchases. C&I intensity is expected to decline, which partially offsets overall C&I growth or effectively reduces the net growth rate of the total C&I component.

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[3] 2018 SEPA Utility Solar Market Snapshot (July 2018).

Table 1. Sources of Energy Growth

Component	GWh
Residential Customers	5,216
C&I Floor Space	5,892
Residential Usage	813
C&I Intensity	(1,666)
Electric Vehicles	1,422
RCP Purchases	1,129
Total Growth	**12,806**

Residential usage is forecasted to increase based on the expectation that new homes are larger than the existing stock, increased saturation of electronics and a higher proportion of our customers living in the lower desert areas, where temperatures are generally higher than in other parts of our service territory.

Sales reductions from incremental DG and DSM programs are estimated and not large enough to offset the usage gains from these factors. Additional studies are currently underway to provide updated DSM estimates in the IRP. On the C&I side, intensity (use per square foot) is expected to decline due to additional DSM, DG and other efficiency gains.

Data Centers

Large data centers are attracted to the APS service territory because of our competitive rates, customer service, reliability and commitment to an increasingly cleaner energy mix. These are large, high load factor customers that will benefit communities and our existing customers. Several companies have recently announced that they will be locating in our service territory. They have not been factored into the load forecast in the Preliminary IRP, but as more details become known, they will be incorporated into the IRP load forecast.

Load Forecast Risks

Population and economic growth are the primary drivers of the forecasted energy growth and therefore pose the greatest risk to the forecast. Additional risks to the forecast include changes in residential usage and C&I intensity. These changes could be driven by several factors: the pace of new DG installations, higher or lower levels of DSM programs (which are being evaluated for the IRP in a DMS Opportunity Study), or new legislation on building codes or appliance standards. Finally, the pace of EV adoption is a key driver of growth that is uncertain at this point.

Existing Resources

Table 2 shows APS's existing resource mix, with the exception of small-scale solar projects. These resources are existing as of the end of 2018.

Table 2. Existing Resources[4]

Resource	MW
Nuclear	**1,146**
Coal	**1,672**
Natural Gas	**4,929**
APS Owned	3,469
PPAs	1,460
Total Microgrid	**32**
Renewables	**883**
Solar	564
APS Owned	239
PPAs	325
Wind (PPAs)	289
Other (PPAs)	30
Customer-Based	**1,947**
Energy Efficiency	1,032
Distributed Energy	876
Demand Response	39
Total Resources	**10,609**

Resource Needs

Future resources needed are developed by examining the difference between our current generating portfolio and the load forecast plus reserves as shown in Figure 3. Resource additions generally fall between two categories: clean resources that increase our carbon-free generation and peaking resources that meet peak demand and maintain reliability of the system. The IRP will further identify these resources based on the portfolio being evaluated. Figure 3 and Tables 3a-3c demonstrate a quickly growing need for resources in the 2020-2024 window for the near-term action plan. This window is the focus because decisions will be required to maintain system reliability. The 15-year resource needs and associated figures can be found in Appendix A.

[4] Does not include small-scale solar (Bagdad, schools and government, APS Solar Partner Program/Flagstaff Community Project and legacy solar).

Figure 3: Supply/Demand Gap (2020- 2024)

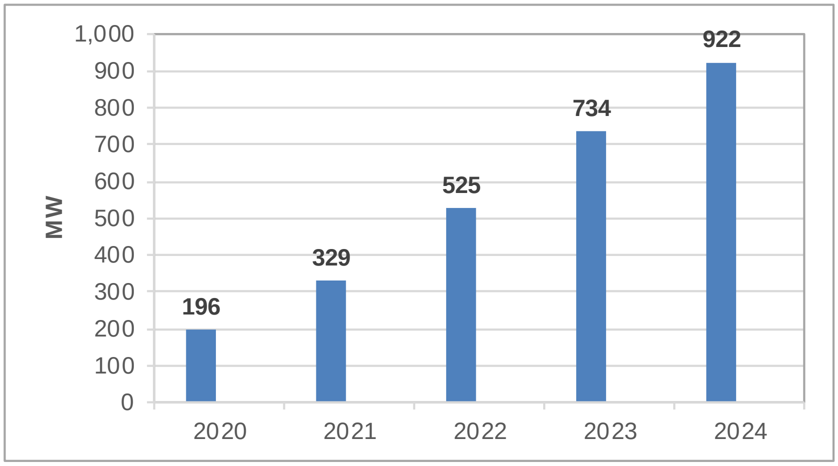


Table 3a. Preliminary IRP Load Growth Plan

	2020	2021	2022	2023	2024
Load Requirements					
APS Peak Demand After DSM & After DE	7,403	7,551	7,721	7,891	8,055
Reserv e Requirements	1,040	1,135	1,162	1,188	1,213
Total Load Requirements	**8,444**	**8,687**	**8,883**	**9,079**	**9,268**
Resources					
Total Existing Resources	8,247	8,358	8,358	8,345	8,345
Total Future Resources	196	329	525	734	922
Total Resources	**8,444**	**8,687**	**8,883**	**9,079**	**9,268**

Action Plan Window

Table 3b. Preliminary IRP 0.9% Load Growth Plan

	2020	2021	2022	2023	2024
Load Requirements					
APS Peak Demand After DSM & After DE	7,257	7,323	7,388	7,455	7,522
Reserv e Requirements	1,018	1,101	1,112	1,123	1,133
Total Load Requirements	**8,276**	**8,423**	**8,501**	**8,578**	**8,655**
Resources					
Total Existing Resources	8,247	8,358	8,358	8,345	8,345
Total Future Resources	28	65	142	232	310
Total Resources	**8,276**	**8,423**	**8,501**	**8,578**	**8,655**

Action Plan Window

Table 3c. Preliminary IRP 0% Load Growth Plan

	2020	2021	2022	2023	2024
Load Requirements					
APS Peak Demand After DSM & After DE	7,192	7,192	7,192	7,192	7,192
Reserve Requirements	1,009	1,081	1,083	1,083	1,084
Total Load Requirements	**8,201**	**8,274**	**8,275**	**8,276**	**8,276**
Resources					
Total Existing Resources	8,247	8,358	8,358	8,345	8,345
Total Future Resources	(46)	(84)	(83)	(70)	(69)
Total Resources	**8,201**	**8,274**	**8,275**	**8,276**	**8,276**

Action Plan Window

Technology Options

APS considers an expansive list of technologies during the planning process. These technologies fall within two buckets: currently deployed technology and deployment-ready technology.

Currently deployed technology consists of generation that we currently utilize for future planning purposes. This includes renewable energy resources, DSM, microgrids and gas-fired generation. Existing technologies have the benefit of proven reliability and performance on our system.

Deployment-ready technologies are defined as technologies that are both feasible for us to integrate and those that have reached a level of maturity and proven reliability to be considered for planning purposes.

Battery Energy Storage Systems

Since the 2017 IRP, battery storage has both matured and declined in cost to be competitive with other peak capacity resources on a large scale. We view battery storage as critical in integrating renewable resources on our system. All portfolios presented in the IRP will include stand-alone battery energy storage.

Benefits

- Shift energy to when it is needed the most
- Shave peak energy needs, potentially displacing gas burns
- Store negative-priced energy to maximize customer value
- Provide frequency regulation and other ancillary services
- Absorb excess energy on APS system from non-curtailable rooftop solar
- Reduce need for additional gas transportation and/or gas storage

Challenges

- Technology is still rapidly developing
- Minimal utility-scale operating experience
- Minimal utility-scale safety record
- Limited performance history
- Future decommissioning, disposal and recycling obligations, costs and prospective liabilities

Photovoltaic and Storage (PVS)

PVS will also benefit from lower battery prices. PVS facilities provide an opportunity to expand the solar footprint in Arizona by shifting solar energy to the peak energy use hours, maximizing value for our customers.

Benefits

- Allows peak needs to be met with renewable energy
- Increases the potential for additional renewables without creating over-generation challenges in the non-summer months
- Potential to provide ancillary services
- Necessary in order to develop and execute a robust carbon-free future

Challenges

- Ancillary services standard not yet developed
- Same challenges as battery energy storage systems

DSM and Distributed Energy Resources (non-supply side resources)

Private rooftop solar, battery storage, smart inverters, DSM, home energy management and smart appliances continue to evolve and are becoming increasingly compatible. With the new technology landscape rapidly changing, APS has enlisted Navigant to perform a DSM Opportunity Study that will ensure an accurate modeling and depiction of DSM for future portfolios and will include a discussion of the following topics:

- Increasing penetration of connected/smart devices that provide increased potential for real-time energy management, load shifting and automated demand response
- Increased baseline efficiency levels due to increased building codes, appliance standards and other market effects
- New emerging energy technologies such as customer-sited battery storage that provide new opportunities for storage, shifting and managing loads
- Increased value in strategic electrification technologies that can help balance loads on the grid, reduce air emissions and take advantage of excess midday solar generation
- The need to manage new loads on the grid from increased adoption of EVs and other electric transportation

- A forecast of future potential DSM costs and energy savings/load management opportunities, including total technical potential, cost-effective economic potential and likely achievable market potential

Solar

Solar configurations will be evaluated for the IRP based on economics and regulatory requirements. These may include solar PV fixed and single-axis tracking technologies.

Benefits

- Clean energy generation
- Ideal technology for Arizona
- Development costs continue to decline
- No fuel costs

Challenges

- Limited to daytime production
- Limited capacity value
- Requires quick-ramping resources to balance as sun sets

Wind

Wind turbines convert the wind's energy into electricity by using rotating blades to capture its kinetic energy. Older turbine technologies and Arizona's comparatively mild wind conditions limited deployment of large-scale wind systems in the past, but modernized technology is increasing wind's viability here and across the region. Turbines built today are generally taller, have larger rotor blades and use more advanced materials than previous models, increasing their capacity and efficiency. The planned RFP for up to 250 MW of wind resources gives APS an opportunity to evaluate the advanced technologies, their potential role in our cleaner energy mix and how Arizona wind now compares to neighboring states.

Benefits

- Clean energy generation
- Strategic siting may provide ability to better match peak needs

Challenges

- Variability and intermittency in production
- Limited wind opportunities in Arizona
- Inefficient use of transmission capacity

Natural Gas

While APS is diligently moving toward a clean energy future, natural gas resources are essential to providing reliable service under any future scenario. In the case of coal retirements, fuel switching, i.e., replacing coal energy with natural gas energy, will contribute to a cleaner future. Additionally, having natural gas capacity in reserve will provide a cost-effective way to meet reliability requirements during the periods of high demand

and limited renewable generation capacity contributions discussed above. These units may operate at very low annual capacity factors, which limits carbon emissions, but contributes greatly to our reliability needs.

Benefits

- Flexible, firm generation
- Provides system capacity and reliability
- Complements renewable generation
- Less carbon-intensive than coal and necessary for a transition from coal
- Low-cost fuel supply

Challenges

- Pipeline limitations
- Carbon emissions

Combined Cycle

Combined cycle natural gas-fired power plants deliver higher fuel efficiency by using residual heat in the gas turbine's exhaust stream. While less flexible than other resources, this technology is suitable for managing summertime peak demand and overall energy needs.

Combustion Turbine

Combustion turbine natural gas-fired power plants are composed of a compressor, combustion system (fuel injectors) and turbine. This flexible technology is well suited for managing peak demand and fast-ramping requirements.

Biomass[5]

Biomass facilities burn organic material that are plant- and animal-based and are considered a renewable source of energy. While there are many forms of biomass energy, APS will specifically consider forest biomass in the IRP as part of the ongoing Arizona wildfire conversation per Commission direction.

Benefits

- Considered carbon neutral
- Supports sustainable forest health

[5] In the two years since the Commission opened a docket to explore the role forest bioenergy could play in Arizona, a growing interest in managing forest resources has emerged throughout the state. To address wildfires impact on the loss of human life, personal property, forest acres, electric infrastructure and economic well-being, the Commission has held workshops and solicited stakeholder commentary to determine the feasibility of Arizona's regulated electric utilities developing an energy solution to this issue. To achieve the objective of improving forest health and safety of Arizona residents while utilizing the state's natural resources, APS continues to collaborate with a number of stakeholders and is actively participating in developing strategies to address forest biomass challenges.

Challenges

- More expensive than other renewable technologies
- Dependent upon a reliable long-term fuel supply

Preliminary Portfolios

APS evaluated a wide range of preliminary portfolios based on ongoing discussion with stakeholders and feedback from the Commission. With the majority of discussions centered on clean technology integration, we will select portfolios for the IRP that represent different paths to achieve a low-carbon future for our customers and Arizona. While the portfolios maintain similar objectives, the cost implications of each portfolio vary significantly for customers.

The IRP will begin with a reference case that fills the resource needs identified in Figure 3 using the least-cost method while meeting all current reliability (e.g., a 15% reserve requirement) and current regulatory requirements (e.g., the 15% Renewable Energy Standard and Tariff by 2025). This will serve as a reference point from which to measure all other portfolios and will provide cost implications of other resource portfolios.

In developing the framework for initial discussion for the IRP, we evaluated at a high level a wide range of portfolios using the model provided by E3 with input from the IRP working group. More specifically, we explored the following portfolios with focus on directional implications:

- Resource additions that meet current rules and regulations
- Resource additions that meet a 50% renewable portfolio standard target by 2030
- Resource additions that meet a 70% clean resource portfolio target by 2035
- Resource additions that reduce carbon by the same level as the 50% RPS case, by 2035, but doing so by focusing on affordability

While the results of exploring the portfolios mentioned above were directional in nature, they were extremely useful as part of the ongoing stakeholder workshop and will allow for more-focused portfolio discussions in the IRP. While the IRP will develop detailed results and implications, several themes resulted from the work developed in the workshop. More specifically, the key takeaways are:

- The more prescriptive/restrictive a portfolio is made, the more expensive that portfolio is for customers
- Clean energy technology will naturally be selected when portfolios focus on key objectives rather than providing parameters in which to achieve those objectives
- Decisions made in the near-term action plan window provide for future optionality, if properly designed. This maximizes planning and regulatory flexibility to adapt to the increasingly dynamic future of energy.

Final IRP

As required in Decision No. 76632, the additional portfolios will consider, but not be limited to, the following list:

Portfolios

- Analysis of a reasonable range of storage technologies and chemistries
- Include storage technologies as alternatives when considering upgrades to T&D, new build or capacity upgrades for existing resources
- The addition of fossil-fuel resources is no more than 20% of all resource additions
- At least one portfolio with 1,000 MW of energy storage technology
- At least 50% of clean energy resources, including at least 25 MW of biomass running at no less than 60% capacity factor
- At least 20% demand side management

Sensitivities

The ultimate list of portfolios presented in the IRP will be stressed by a set of key sensitivities. The purpose of the sensitivities is to evaluate the robustness of each portfolio and inform any final key considerations.

Load Growth

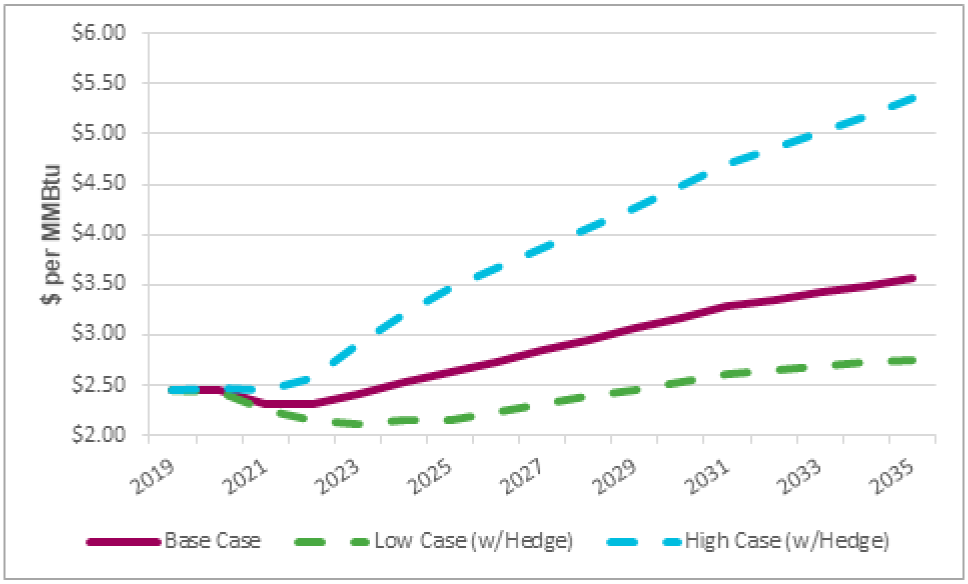
- High Load Growth
- No Load Growth
- Less than 1% Load Growth

Natural Gas Prices

Natural gas futures prices are based on the Henry Hub market in Louisiana. Due to fundamental shifts in natural gas exploration and excess gas produced as a byproduct of oil exploration, regional gas prices have been at very low levels. APS is uniquely positioned to take advantage of those low prices because of pipeline connections to west Texas (Permian) oil and gas fields, which provide a source of long-term, low-priced natural gas. In 2019, APS had the unique opportunity to purchase gas at negative prices, similar to the phenomenon seen in EIM midday, seasonal shoulder-period energy prices.

With Permian Basin natural gas trading at discount to Henry Hub and to ensure a wide range of gas price sensitivities, we will apply the Energy Information Administration (EIA) annual outlook high and low natural gas case sensitivities to the APS forward gas curve. Additionally, due to our hedging program, the additional reduction in potential volatility is applied to the forward curve for the first five years. The resulting forward curve with a range of sensitivities is shown in Figure 4.

Figure 4: Henry Hub Natural Gas Forward Price



One of the issues APS will need to address regarding natural gas is that the interstate pipeline capacity is becoming increasingly constrained. Patterns of natural gas use are also changing both here and in California. California has recently enacted legislation that is expected to significantly reduce natural gas usage over the next couple of decades. The timing of any such reductions could have implications for future natural gas infrastructure needs in the region as the same pipelines serve both Arizona and California. Absent any such regional legislation, gas pipeline capacity will evolve as a natural limiting factor on the future use of gas generation.

Carbon Prices

Carbon price sensitivities will include:

- Low: $0
- Base: California market price escalated at inflation, beginning 2025
- High: Carbon price escalation of 7.5% annually, beginning 2025

Technology Cost

The capital cost of technologies is based on information obtained through RFP and RFI solicitations, industry and vendor publications and utility announcements. For technologies that are still eligible for the production tax credit (PTC) and investment tax credit (ITC), these benefits are captured in any modeling, while applicable.

While capital costs are given, many factors contribute to the value a resource applies to the overall system. These include themes such as flexibility, fixed and variable O&M (including fuel costs) and capacity values. Capital cost assumptions are shown in Table 4. Any additional information available from internal or industry sources or RFPs will be incorporated as updates to the following estimates in the IRP.

Table 4: Resource Cost Assumptions[6]

Generation Resource Options	Capacity	Capital Cost ($/kW)	Book Life	Fixed O&M ($/kW-Yr.)	Variable O&M ($/MWh)	Typical Capacity Factor %
Renewables & Energy Storage						
PV - Single Axis Tracking	100 MW	$1,200	30 years	$17.43	-	Up to 35%
Battery Energy Storage System (4-hour Li-ion)	100 MW	$1,200	20 years	$24.00	-	Up to 16%
PVS - Single Axis Tracking + Battery Energy Storage System (3-hour Li-ion)	100 MW	$2,175	30 years	$36.50	-	Up to 34%
Wind	150 MW	$1,350	25 years	$34.73	-	Up to 50%
Geothermal	50 MW	$4,448	25 years	$131.68	-	80%
Nuclear						
Nuclear AP 1000 Hybrid	2,234 MW	$6,453	40 years	$111.25	$2.55	92%
Small Modular Reactor (SMR) - 12 Units	600 MW	$5,468	40 years	$76.72	$10.34	95%
Natural Gas						
Two 7FA.05, Evap. Inlet	431 MW	$696	32 years	$10.34	$2.16	10%
2X1 7F.05 CC Evap. Inlet, Air Cooled Condenser	710 MW	$1,341	32 years	$6.70	$1.78	35-50%
5X0 LMS100PA+ Chilled Inlet, Hybrid Cooled	521 MW	$1,475	32 years	$8.65	$2.62	10%
5X0 LMS100PA+ Chilled Inlet, Dry Cooled	431 MW	$1,778	32 years	$8.65	$2.62	10%
Six LM6000PC Sprint, Chilled Inlet	277 MW	$1,634	32 years	$11.95	$2.23	10%
Six Unit Wartsila 18V50	110 MW	$1,100	32 years	$25.08	$2.76	10%

[6] Values provided in 2021 dollars.

Future Studies to Inform the Final IRP

Integrated resource planning is a dynamic process that continuously assesses trends in customer preference, load growth, technology, markets, fuels and state and federal energy policy objectives. There is a body of work currently in progress regarding policy considerations that are not yet fully factored into the Preliminary IRP but may be addressed in the IRP.

DSM Opportunity Study

APS has been actively engaged in offering energy efficiency programs to our customers for decades and has achieved over 5,000 GWh of energy savings since the Commission's Energy Efficiency Standard was approved in 2010. A Market Potential Study performed for APS by ICF International in 2007 guided much of the program design. Although much of the savings identified in that study have been achieved, new technologies have emerged, and represent a new potential for energy savings. We engaged Navigant Consulting to perform a new market opportunity study to help guide future energy efficiency planning after the current standard expires at the end of 2020. Navigant plans to complete this study in the fall of 2019 and its results will be factored into the IRP.

Renewable Integration Cost

We have utilized third-party consultants in the past to assess the costs of integrating wind and solar energy into our system. Significant changes in the industry have occurred since those studies were performed, and we are in the process of scoping a new study and enlisting an energy consulting firm to update the costs. We are currently in the process of defining the parameters and identifying consultants to perform the study. It will incorporate new information regarding renewable dispatchability (or curtailment) to meet flexible needs, energy storage technologies, improved renewable forecast techniques, impacts of the western EIM and updated natural gas prices.

Electric Vehicle Study

As noted in the Load Forecast section, an electric vehicle forecast is included in the load forecast. With the current momentum and excitement surrounding the outlook for EV adoption, the critical role they may play in achieving a clean energy future for Arizona and the significant impact EV charging can potentially have on loads, APS has retained Navigant Consulting to perform an electric vehicle study. This study will provide insight into EV adoption in our service territory and evaluate some of the infrastructure improvements required to support EV adoption. Findings from this study will be factored into the IRP.

Regional Natural Gas Evaluation

Renewable generation in particular is causing utilities to change the way they consume natural gas. While some utilities (in California, for example) may end up reducing their annual gas consumption, they may not be reducing their peak hourly consumption due to ramping requirements in the evening when solar is in decline and the sun is setting but loads are still high. Energy storage also will shift daily gas consumption patterns. APS expects to continue adding renewable generation, energy storage and will ultimately retire coal units. Given these changes, we have retained a consultant to review regional trends to include in our future evaluations. The results of the study will be summarized and included in the IRP.

Action Plan Update

APS provides this update to the 2020-2024 action plan, which focuses on near-term developments and has higher certainty over the next 2-3 years. It also offers a view into potential resources needs and decisions through 2024. As more information becomes available, the action plan will be updated.

Continue Expansion of Renewable Resources

Investment In APS Solar Communities (formerly AZ Sun II)

Our proposal to expand rooftop solar installations for limited- and moderate-income Arizonans was approved by the Commission in August 2017. The program, under which APS owns and controls the generation, renewable energy credits and other program attributes, requires APS to invest from $10 million to $15 million annually from 2018-2020 in rooftop solar for single-family and multifamily homes, allocating at least 65% of annual program expenditures to residential installations. Although the program focuses primarily on single-family homes, it is also available to multifamily housing, Title I schools, nonprofits aiding limited-income groups and government entities serving rural communities located in our service territory.

APS is collaborating with Arizona-based solar installers to equip qualifying customer homes with solar systems. Participating residential customers will receive a monthly credit on their energy bill for 20 years. The solar systems will be installed primarily on single-family homes with west- and southwest-facing roofs, which offer the greatest potential to generate energy during the late afternoon and early evening hours, when customers use the most electricity.

Innovation of Customer-Side Resources with Advanced Grid Technologies

Resource needs have changed dramatically, and APS is offering programs that help customers enjoy energy savings when those savings have the greatest resource value, with emphasis on load shifting and reducing peak load. The following programs focus on customer participation and simplicity by aligning technologies, rates and operational needs of the grid.

Take Charge AZ

EVs can help Arizona achieve an increasingly clean energy mix—and cleaner air. Drivers are expected to have over 130 EV models to choose from by 2022, but barriers to adoption still exist. APS seeks to make driving EVs convenient for participating customers by reducing range anxiety through access to more charging infrastructure.

The APS Take Charge AZ pilot programs offer free EV charging equipment, including installation and maintenance, to businesses, government agencies, nonprofits and multifamily communities. Participants pay electric costs that come from using the equipment and are encouraged to charge EVs when solar energy is abundant and energy prices are lower.

Take Charge AZ comprises several new EV pilot programs that include charging infrastructure programs for fleets, workplaces, highways and multifamily housing and boosts Level 3 DC fast-charging infrastructure. We are exploring innovative strategies to own and operate the DC fast-charging stations while collaborating with local business customers to provide the best possible location siting and to encourage off-peak charging with varied per-minute rates.

DSM Implementation Plan

The 2018 and 2019 DSM plans continue APS's plan to reshape DSM to better align with changing resource needs based on the time of day when energy savings have the greatest resource value and greater emphasis on load shifting and reducing peak load. Among other measures, the plans propose to continue the 2017 Demand Response, Energy Storage, Load Management (DRESLM) program (see APS Rewards Programs) designed to support the deployment of residential load management, demand response and energy storage technologies that help residential customers shift energy use and manage peak demand — while reducing their energy costs at the same time.

APS Rewards Programs

In 2017, the Commission approved Decision Nos. 76314 and 76313, which authorized APS to implement demand response and load management programs that facilitate emerging energy storage technologies throughout our service territory. The increasing market penetration of rooftop solar is creating rapidly changing system load shapes and a need for more flexible resources as a backup for intermittent solar generation. Distributed energy resource opportunities that support load management, demand response and load shifting through the use of energy storage can help meet these flexible resource needs by limiting peak demand and shifting energy use away from peak periods and toward midday when rooftop solar production is highest. This provides both DSM benefits and allows better integration of unmanaged distributed solar generation on the grid. Some Rewards programs target feeders experiencing voltage issues or thermal constraints. APS operates all of the technologies deployed as part of the Rewards initiative to shift energy use, manage local peak demand, reduce system peaks, act as an excess solar energy sponge and achieve other grid operational benefits.

The Rewards Programs includes the following technologies, plus a platform to manage the devices:

- Storage Rewards and IFES (battery storage) – Residential and commercial-scale batteries (Storage Rewards), and intermediate feeder energy storage (IFES) deployed on targeted distribution feeders; APS can manage these devices as a fleet to reduce system peak, provide feeder congestion relief and support DR integration. Currently, the IFES program is on hold pending results from the McMicken investigation.

- Reserve Rewards (thermal storage) – Connected heat pump water heaters with 50-, 65- or 80-gallon capacity tanks are installed in homes on targeted distribution feeders; APS can operate devices as a fleet, to reduce system peak and provide solar sponging (load management benefits) by shifting water heating demand into the midday peak solar production period.

- Cool Rewards (demand response) – APS has enrolled more than 12,000 connected residential smart thermostats in Cool Rewards and operates them to provide demand response load reductions during summer system peak events. Demand response events are typically paired with home precooling prior to peak demand periods to maximize comfort and load shift/capacity reduction. Additionally, these smart thermostats assist customers year-round in optimizing energy and bill savings.

Future Resources

Request for Proposals (RFPs)

APS is pursuing a clean energy mix and the integration of renewables together with new technologies including energy storage that enhance the ability to meet peaking needs and manage excess energy production in midday. By utilizing energy storage to absorb over-generation or negatively priced energy in midday, we can add clean energy to the mix and meet customer peak energy needs in the evening.

In February, APS announced an initiative to add 850 MW of battery energy storage by 2025. We remain committed to completing this initiative, but the timing and sequence of resource additions will vary following the April 19 equipment failure at the McMicken battery energy storage facility.

We have advised bidders participating in the RFPs for 200 MW of AZ Sun energy storage retrofits and 100 MW of large-scale solar with storage to stop work on their proposals until further notice. Results of the McMicken investigation results will inform our next steps, including any changes to design parameters that may be implemented for future batteries. We will notify participants when we make adjustments to the RFP schedule.

We plan to move forward with the battery energy storage projects totaling 150 MW selected through the 2018 RFP, depending on the McMicken findings.[7]

We also announced plans to issue RFPs for up to 150 MW of APS-owned storage-ready solar resources to be in service by 2021 and another for up to 250 MW of wind resources to be in service as soon as possible, but no later than 2022. Both RFPs have an option for commercial customer participation.

Short-Term Summer Peaking Needs (DR and market purchases)

With the revised battery project timelines, APS plans to use existing generation in the region as a bridging strategy to meet the projected load plus reserve margin. These short-term purchases will ensure that we can meet summer reliability requirements and will be structured to not impact longer-term resource planning strategies. Currently, we expect the short-term needs will be met with wholesale market purchases from a combination of existing merchant natural gas units, neighboring utilities, wholesale market participants and an RFP for up to 50 MW of demand response that is being developed and will be released in the near future.

Transmission Resources

With 1.25 million customers across the state depending on APS for reliable and affordable electric service, APS relies on its network of transmission and distribution lines to safely deliver power. In planning the future development of our transmission infrastructure, we consider a broad range of technologies including generation, transmission and distribution resources and non-transmission alternatives to address the challenges of an increasing array of resource types and geographies.

The 2019-2028 Ten-Year Transmission System Plan[8] includes approximately 25 miles of 230 kV transmission lines, 1 mile of 115 kV transmission lines, 30 bulk transformers and five banks of 50 kV bus reactors. The total investment for the projects is estimated at approximately $390 million. Annual updates to the Ten-Year Transmission System Plan will address future needs as they develop.

MOD-030

APS recently announced on its OASIS website that it will use a new methodology for transmission system utilization. We will transition from a Rated System Path Methodology (MOD-029) to a Flowgate Methodology (MOD-030) for the calculation of Available Transfer Capability (ATC). This transition process will take approximately two years to complete and will result in more efficient use of and greater capacities for our transmission system, and may provide more flexibility in siting generation resources

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[7] APS July 29, 2019 News Release https://www.aps.com/en/ourcompany/news/latestnews/Pages/aps-to-request-proposals-for-new-solar-and-wind-resources.aspx

[8] Arizona Public Service Company 2019-2028 Ten-Year Transmission System Plan, Docket No. E-00000D-19-0007.

Table 5. Select Project Additions from APS 2019-2028 Ten-Year Transmission Plan

Project	Description	Construction Start Date	Construction End Date
Bagdad 115/69 kV Backup	Project will provide back-up service for AEPCO member loads in case of the loss of the Parker source. Additionally, the project will provide back-up service for APS to serve the Town of Bagdad loads in case of a loss of the 115 kV line from Prescott.	2019	2019
Freedom 230/69 kV Substation	The load demands in Goodyear and Buckeye areas are increasing and this substation will provide a new transmission source to maintain reliability of the local 69 kV system serving the area.	2019	2020
North Gila–Orchard 230 kV Line Circuit #1	Increases ability to import resources into the Yuma load pocket. The project will also be used to improve reliability, serve the need for electric energy, and provide continuity of service for the greater Yuma area by adding a transmission source in a new area of the Yuma system.	2019	2021

Reliability Coordinator

Pursuant to NERC's Rules of Procedure (ROP), NERC and the Regional Entities are required to ensure that all Balancing Authorities and Transmission Operator (TOP) entities each have the oversight of only one Reliability Coordinator (RC). The RC is responsible for maintaining the operating reliability of its area in real time and coordinating with its adjacent RC's wide-area view, which includes being situationally aware of activities in neighboring RC's that may have an impact on or within its RC area.

The current RC serving APS, Peak Reliability, announced that it is winding down operations at the end of 2019. After assessing all options, APS has chosen RC West as its new RC. RC West began operations on July 1, 2019 for California and northern Mexico entities, and APS will transition to RC West on November 1, 2019.

Extended Day Ahead Market (EDAM)

APS is currently participating in a feasibility assessment with the CAISO and other EIM participants to assess whether EIM participants can achieve net power cost savings and more efficient renewables integration through day-ahead unit commitment and scheduling. Once the assessment is complete, the discussion may transition to a broader EDAM public stakeholder process in the fall of 2019.

Key principles contemplated in developing EDAM include:

- Each balancing authority retains control over its transmission assets and its BA reliability responsibilities
- States and public power entities maintain control over integrated resource planning
- Resource adequacy procurement decisions remain with local regulatory authority

Coal Fleet

We continue to execute our strategy to stop coal use at our remaining Cholla units by spring 2025 and an overall commitment to exit coal by 2038. In assessing the exit strategy, APS continues to pursue solutions that strike a balance between providing customers reliable, reasonably priced power and managing coal generation's costs of environmental regulations and production. Coal plants deliver full capacity value during peak load times and operate at high capacity factors that deliver large quantities of energy to our customers. Removing those units from service can leave large gaps to fill for both capacity and energy so the transition must be mindful and gradual. While some of the energy will likely be filled with renewables and natural gas to support the renewables' variability, additional capacity resources will be needed to cost-effectively meet peak load requirements. Those capacity needs are likely to be met with a combination of gas and energy storage.

Navajo Generating Station

On February 13, 2017, the utility owners of the Navajo Generating Station voted to extend operation of the facility through the end of its lease in December 2019, provided an agreement was reached with the Navajo Nation. In November 2017, an agreement was finalized to allow the plant to remain operational until December 22, 2019. The Navajo Generating Station, and its coal resources, will no longer be a part of the APS generation portfolio beyond December 2019.

Source of Assumptions

Inputs	Source of Assumptions
Load Forecast:	Bureau of Labor Statistics; U.S. Census Bureau; Bureau of Economic Analysis; National Weather Service
Environmental Regulations:	Environmental Protection Agency; Arizona Department of Environmental Quality
Demand-Side Management:	Navigant Consulting, Energy Efficiency Standard
Renewable Energy:	Renewable Energy Standard, Market Data
Resource Costs:	Major Equipment Vendors, Market Data Acquired Through RFP and/or RFI Solicitations, Industry Organizations, Customer Data from Field Implementations
Integration Costs:	Consultant Integration Study (consultant to be identified)
Fuel Forecast:	Market, Fuel Contracts, EIA
Carbon Pricing:	Market

Acronyms

AAC	Arizona Administrative Code
AC	Air Conditioner
ACC	Arizona Corporation Commission
ACI	Activated Carbon Injection
ADEQ	Arizona Department of Environmental Quality
ADMS	Advanced Distribution Management System
ADWR	Arizona Department of Water Resources
AEO	Annual Energy Outlook
AF	Acre-Feet
AFB	Air Force Base
AFUDC	Allowance for Funds Used During Construction
AMA	Active Management Area
AMI	Advanced Metering Infrastructure
APP	Aquifer Protection Permit
APS	Arizona Public Service
ASU	Arizona State University
ATC	Available Transfer Capability
AZNMNV	Arizona-New Mexico-Nevada
BACT	Best Available Control Technology
BART	Best Available Retrofit Technology
BCF	Billion Cubic Feet
BESS	Battery Energy Storage System
BNEF	Bloomberg New Energy Finance
BTA	Biennial Transmission Assessment
Btu	British Thermal Unit
CAA	Clean Air Act
CAES	Compressed Air Energy Storage
CAFO	Concentrating Animal Feeding Operation
CAIDI	Customer Average Interruption Duration Index
CAISO	California Independent System Operator
CAP	Central Arizona Project
CC	Combined Cycle
CCR	Coal Combustion Residual
CCS	Carbon Capture & Sequestration
CDA	Conditional Demand Analysis
CEC	Certificate of Environmental Compatibility
CFI	Communicating Fault Indicators
CFL	Compact Fluorescent Lamp
CO	Carbon Monoxide
Commission	Arizona Corporation Commission
Company	Arizona Public Service
CPP	Clean Power Plan
CPP-RES	Critical Peak Pricing for Residential Customers
CRA	Congressional Review Act
CSP	Concentrating Solar Power
CT	Combustion Turbine
CWA	Clean Water Act
DA	Distribution Automation
DAM	Distribution Asset Monitoring
DE	Distributed Energy
DER	Distributed Energy Resources
DG	Distributed Generators
DMS	Distribution Management System
DR	Demand Response
DRESLM	Demand Response, Energy Storage and Load Management Program
DSCADA	Distribution Supervisory Control and Data Acquisition

DSM	Demand Side Management
EE	Energy Efficiency
EES	Energy Efficiency Standard
EGU	Electric Generating Units
EIA	Energy Information Administration
EIM	Energy Imbalance Market
EIS	Environmental Impact Statement
ELG	Effluent Limitations Guidelines
EMS	Energy Management System
EPA	Environmental Protection Agency
EPC	Engineer-Procure-Construct
EPRI	Electric Power Research Institute
ESA	Endangered Species Act
ESS	Energy Storage System
ECT-1R	Combined Advantage (9 am – 9 pm)
ECT-2	Combined Advantage (Noon – 7 pm)
ET-1	Time Advantage (9 am – 9 pm)
ET-2	Time Advantage (Noon – 7 pm)
ET-EV	Experimental Electric Vehicle Charging Rate Schedule
ET-SP	Time Advantage Super Peak
EV	Electric Vehicle
FERC	Federal Energy Regulatory Commission
FIP	Federal Implementation Plan
FGD	Flue Gas Desulfurization
FM	Fire Mitigation
FONSI	Finding of No Significant Impact
GHG	Greenhouse Gas
GRIC	Gila River Indian Community
GUAC	Groundwater Users Advisory Council
GWh	Gigawatt-Hours
HAPS	Hazardous Air Pollutants
Hg	Mercury
HRSG	Heat Recovery Steam Generator
HVAC	Heating, Ventilation, and Air Conditioning
IEEE	Institute of Electrical and Electronics Engineers
IGCC	Integrated Gasification Combined Cycle
IRP	Integrated Resource Plan
ITC	Investment Tax Credit
IVVC	Integrated Volt/VAR Control
kW	Kilowatt
kWh	Kilowatt-Hour
LAER	Lowest Achievable Emission Rate
LED	Light Emitting Diode
Li-on	Lithium-ion
LNB	Low NO_x Burners
LOLE	Loss of Load Expectation
MACT	Maximum Achievable Control Technology
MATS	Mercury and Air Toxics Standard
MCAQD	Maricopa County Air Quality Department
MCAS	Marine Corps Air Station
MER	Measurement and Evaluation Research
MMBtu	Million British Thermal Units
MW	Megawatt
MWh	Megawatt-Hour
NAAQS	National Ambient Air Quality Standards
NaS	Sodium-sulfur
NEI	Nuclear Energy Institute
NEPA	National Environmental Policy Act
NERC	North American Electric Reliability Corporation
NGS	Navajo Generating Station

NNSR	Nonattainment New Source Review
NOx	Nitrogen Oxide
NP	Network Protector
NPDES	National Pollution Discharge Elimination System
NPV	Net Present Value
NRC	Nuclear Regulatory Commission
NSPS	New Source Performance Standards
NSR	New Source Review
O&M	Operation & Maintenance
OMP	Ocotillo Modernization Project
OMS	Outage Management System
PAC	Program Administrator Costs Test
PC	Participant Cost Test
PCB	Polychlorinated Biphenyls
PM	Particulate Matter
PMUs	Phasor Measurement Units
PPA	Purchased Power Agreement
PPH	People Per Household
PSD	Prevention of Significant Deterioration
PTC	Production Tax Credit
PTR	Peak Time Rebate
PV	Photovoltaic
PVNGS	Palo Verde Nuclear Generating Station
PVS	Photovoltaic and Storage
PVWRF	Palo Verde Water Reclamation Facility
PWR	Pressurized Water Reactors
RCRA	Resource Conservation & Recovery Act
RE	Renewable Energy
RES	Renewable Energy Standard
RFP	Request for Proposal
RIM	Rate Impact Measure Test
RMR	Reliability Must Run
RPS	Renewable Portfolio Standard
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SAT	Single Axis Tracking
SCE	Southern California Edison Company
SCR	Selective Catalytic Reduction
SCT	Societal Benefit-Cost Test
SHM	Substation Health Monitoring
SIP	State Implementation Plan
SIS	Solar Innovation Study
SMR	Small Modular Reactors
SO_2	Sulfur Dioxide
SPP	Solar Partner Program
SRP	Salt River Project Agricultural Improvement and Power District
SRSG	Southwest Reserve Sharing Group
SWAT	Southwest Area Transmission
T&D	Transmission and Distribution
TRC	Total Resource Cost Test
TOU	Time of Use
USBR	United States Bureau of Reclamation
VAR	Volt-Ampere Reactive
VOC	Volatile Organic Compounds
WECC	Western Electricity Coordinating Council
WIIN	Water Infrastructure Improvements for the Nation
ZLD	Zero liquid discharge
Zn-Air	Zinc-Air

Appendix A – APS 15-Year Load Growth Plan

Table A-1. Preliminary IRP Load Growth Plan (15 Years)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Load Requirements																
APS Peak Demand After DSM & After DE	7,403	7,551	7,721	7,891	8,055	8,248	8,453	8,620	8,824	9,032	9,214	9,446	9,673	9,920	10,158	10,420
Reserve Requirements	1,040	1,135	1,162	1,188	1,213	1,243	1,274	1,300	1,332	1,364	1,392	1,428	1,463	1,501	1,538	1,578
Total Load Requirements	**8,444**	**8,687**	**8,883**	**9,079**	**9,268**	**9,490**	**9,728**	**9,920**	**10,156**	**10,396**	**10,606**	**10,874**	**11,136**	**11,421**	**11,696**	**11,999**
Resources																
Total Existing Resources	8,247	8,358	8,358	8,345	8,345	7,946	7,381	6,793	6,330	6,316	6,303	6,304	6,304	6,300	6,301	6,300
Total Future Needs	196	329	525	734	922	1,545	2,347	3,127	3,826	4,080	4,303	4,570	4,832	5,121	5,396	5,698
Total Resources	**8,444**	**8,687**	**8,883**	**9,079**	**9,268**	**9,490**	**9,728**	**9,920**	**10,156**	**10,396**	**10,606**	**10,874**	**11,136**	**11,421**	**11,696**	**11,999**

Figure A-1. Preliminary IRP Load Growth Plan (15 Years)

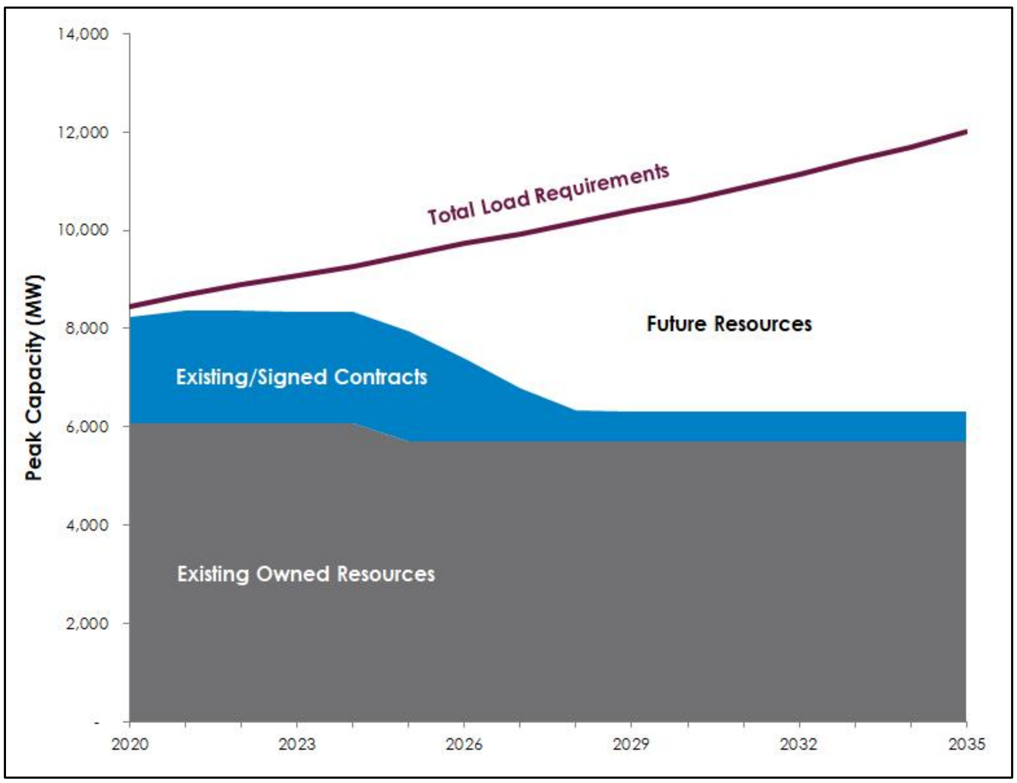


Table A-2. Preliminary IRP 0.9% Load Growth Plan (15 Years)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Load Requirements																
APS Peak Demand After DSM & After DE	7,257	7,323	7,388	7,455	7,522	7,590	7,658	7,727	7,797	7,867	7,937	8,009	8,081	8,154	8,227	8,301
Reserve Requirements	1,018	1,101	1,112	1,123	1,133	1,144	1,155	1,166	1,178	1,189	1,200	1,212	1,224	1,236	1,248	1,260
Total Load Requirements	**8,276**	**8,423**	**8,501**	**8,578**	**8,655**	**8,734**	**8,813**	**8,893**	**8,974**	**9,056**	**9,138**	**9,221**	**9,305**	**9,390**	**9,475**	**9,561**
Resources																
Total Existing Resources	8,247	8,358	8,358	8,345	8,345	7,946	7,381	6,793	6,330	6,316	6,303	6,304	6,304	6,300	6,301	6,300
Total Future Needs	28	65	142	232	310	788	1,432	2,100	2,644	2,739	2,834	2,917	3,001	3,089	3,175	3,261
Total Resources	**8,276**	**8,423**	**8,501**	**8,578**	**8,655**	**8,734**	**8,813**	**8,893**	**8,974**	**9,056**	**9,138**	**9,221**	**9,305**	**9,390**	**9,475**	**9,561**

Figure A-2. Preliminary IRP 0.9% Load Growth Plan (15 Years)

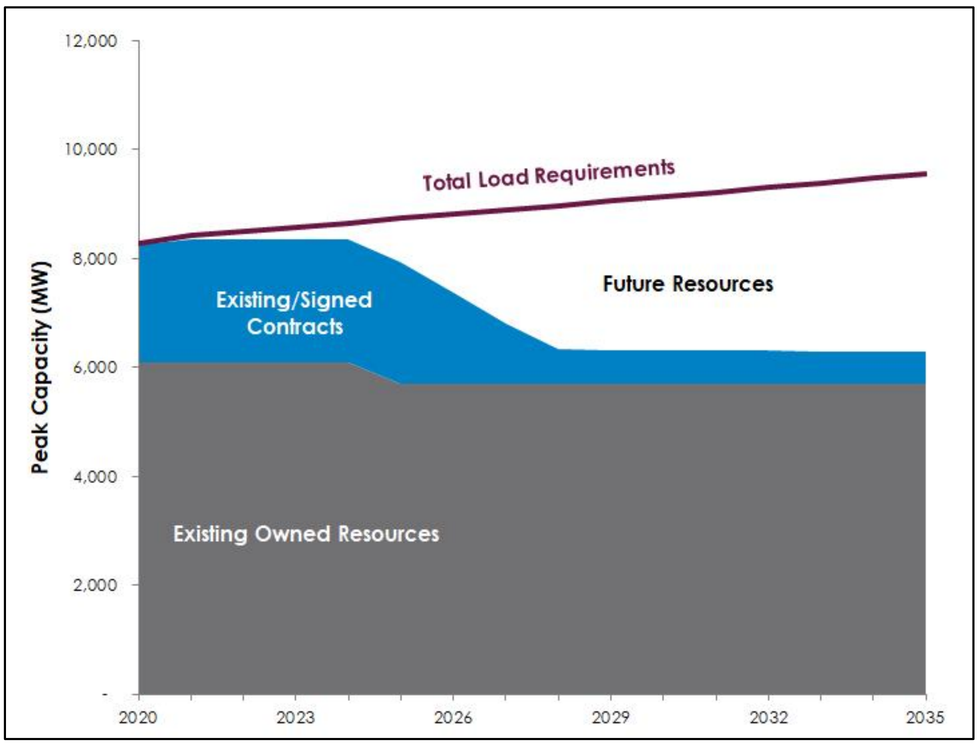
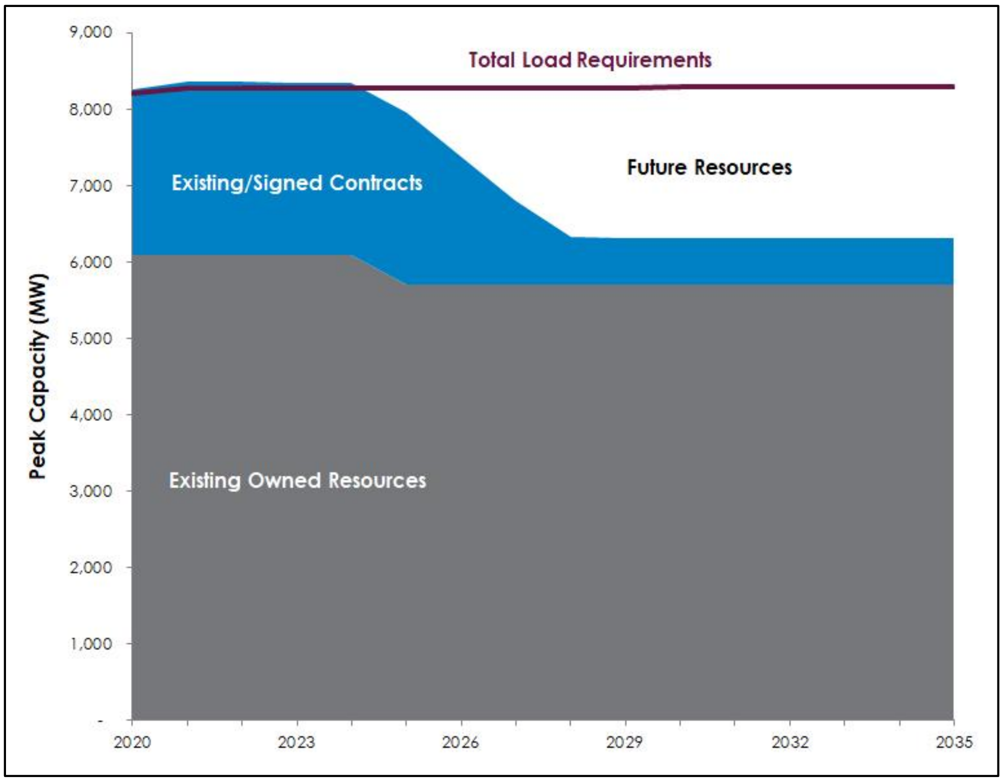


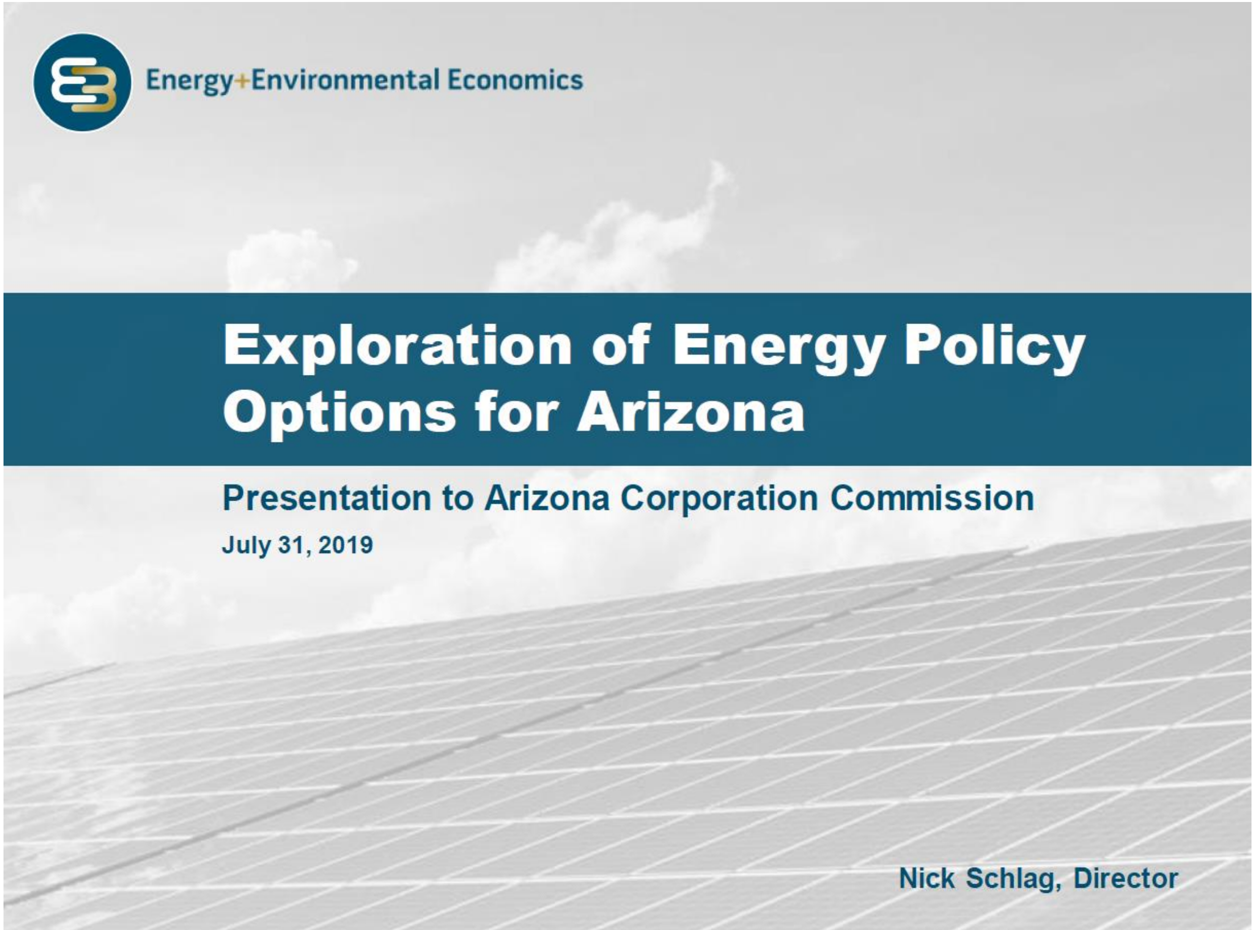
Table A-3. Preliminary IRP 0% Load Growth Plan (15 Years)

	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Load Requirements																
APS Peak Demand After DSM & After DE	7,192	7,192	7,192	7,192	7,192	7,192	7,192	7,192	7,192	7,192	7,192	7,192	7,192	7,192	7,192	7,192
Reserve Requirements	1,009	1,081	1,083	1,083	1,084	1,085	1,085	1,086	1,087	1,088	1,089	1,090	1,091	1,092	1,093	1,094
Total Load Requirements	**8,201**	**8,274**	**8,275**	**8,276**	**8,276**	**8,277**	**8,278**	**8,279**	**8,279**	**8,280**	**8,281**	**8,282**	**8,283**	**8,284**	**8,285**	**8,287**
Resources																
Total Existing Resources	8,247	8,358	8,358	8,345	8,345	7,946	7,381	6,793	6,330	6,316	6,303	6,304	6,304	6,300	6,301	6,300
Total Future Needs	(46)	(84)	(83)	(70)	(69)	331	897	1,486	1,949	1,964	1,978	1,978	1,979	1,984	1,985	1,986
Total Resources	**8,201**	**8,274**	**8,275**	**8,276**	**8,276**	**8,277**	**8,278**	**8,279**	**8,279**	**8,280**	**8,281**	**8,282**	**8,283**	**8,284**	**8,285**	**8,287**

Figure A-3. Preliminary IRP 0% Load Growth Plan (15 Years)

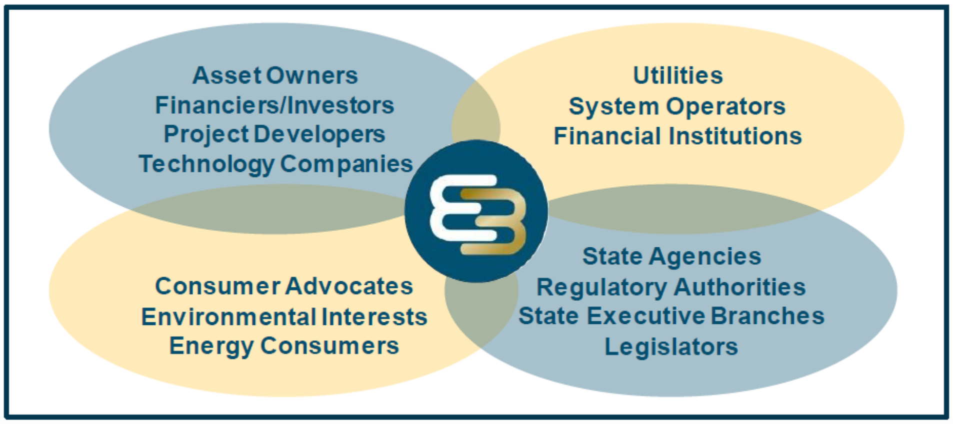


Appendix B – E3 Presentation to Arizona Corporation Commission



About E3

+ Founded in 1989, E3 is a leading energy consultancy with a unique 360-degree view of the industry
+ E3 operates at the nexus of energy, environment, and economics
+ Our team employs a unique combination of economic analysis, modeling acumen, and deep strategic insight to solve complex problems for a diverse client base



Key E3 resource planning studies

+ E3's resource planning studies focus on questions of how to meet aggressive carbon reduction and clean energy goals in the electric sector while maintaining reliability and managing costs

+ 2016 Power Supply Improvement Plan (HECO, 2016)
+ Pacific Northwest Low Carbon Scenario Analysis (PGP, 2017)
+ Ongoing IRP Support (CPUC, 2016-'19)
+ 2018 IRP Support (SMUD, 2018)
+ Deep Decarbonization in a High Renewables Future (CEC, 2018)
+ Upper Midwest 2019 IRP Support (Xcel, 2018-'19)
+ Resource Adequacy in the Pacific Northwest (Various utilities, 2019)
+ Resource Adequacy under Deep Decarbonization (Calpine, 2019)

Key findings common across E3 studies

1. Achieving a low-carbon grid is technically feasible and can be affordable, but eliminating carbon from the electricity sector entirely appears challenging and cost-prohibitive with current technologies

2. A technology-neutral policy focused on carbon reductions will enable utilities to meet clean energy goals more affordably than policies that establish goals for specific technologies

3. Even in a deeply decarbonized grid, natural gas resources will continue to play a crucial role in meeting reliability needs as “firm” resources, dispatchable on demand but rarely called upon

4. Openness and transparency have become foundational characteristics of successful resource planning efforts, and collaboration between utilities and stakeholders is a key step to enabling a clean energy transition

Energy+Environmental Economics 4

Building blocks for clean energy

+ **A technology-neutral approach to establishing future goals will provide optionality as opportunities for carbon reductions evolve, enabling utilities to choose the most affordable "building blocks"**

Building Block	Description
Nuclear	Maintain existing carbon-free generation
Renewables	Increase and diversify carbon-free generation
Fuel switching	Conversion from coal to gas (or other) generation
Clean imports	Utilize excess low-carbon electricity
Electrification	Electrify transportation sector and select building end uses
Energy storage	Load shifting/absorbing excess solar via energy storage
Demand management	Energy efficiency and other demand-side measures

Energy+Environmental Economics 5

Purpose of stakeholder engagement initiative

E3 has worked with APS to engage stakeholders in a transparent scenario analysis exercise based on detailed analytics, with the objective of enabling stakeholders to test the impacts of various resource portfolios and policies before APS files its preliminary 2019 IRP

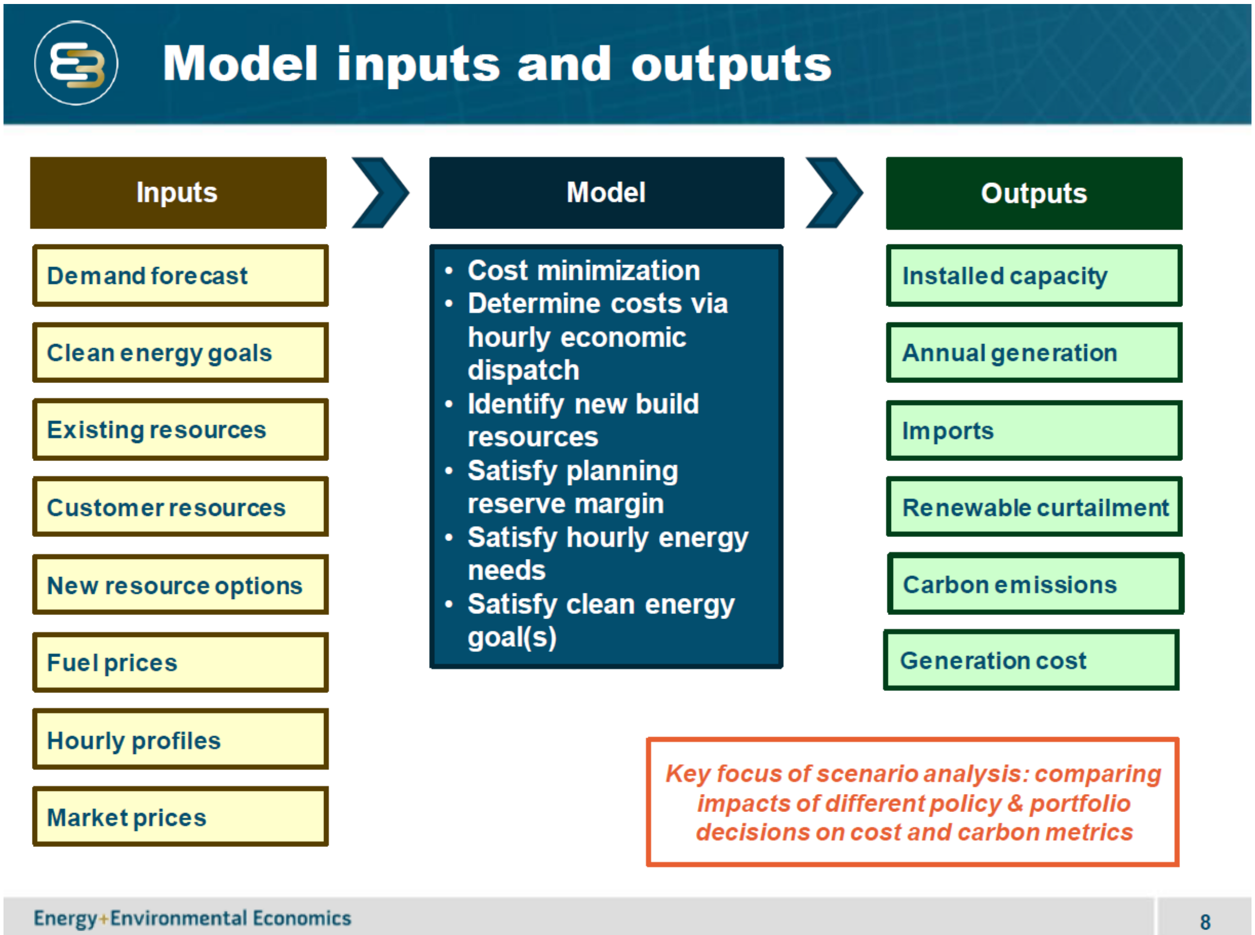
This initiative broadly encompassed three goals:

1. Develop an Excel-based tool that balances complexities of electric system modeling with time limitations and is directionally consistent with industry standard optimization models
2. Provide stakeholders with a more active means to participate in the portfolio planning process
3. Allow stakeholders to put forth a set of scenarios to study and directionally inform APS' development of its IRP

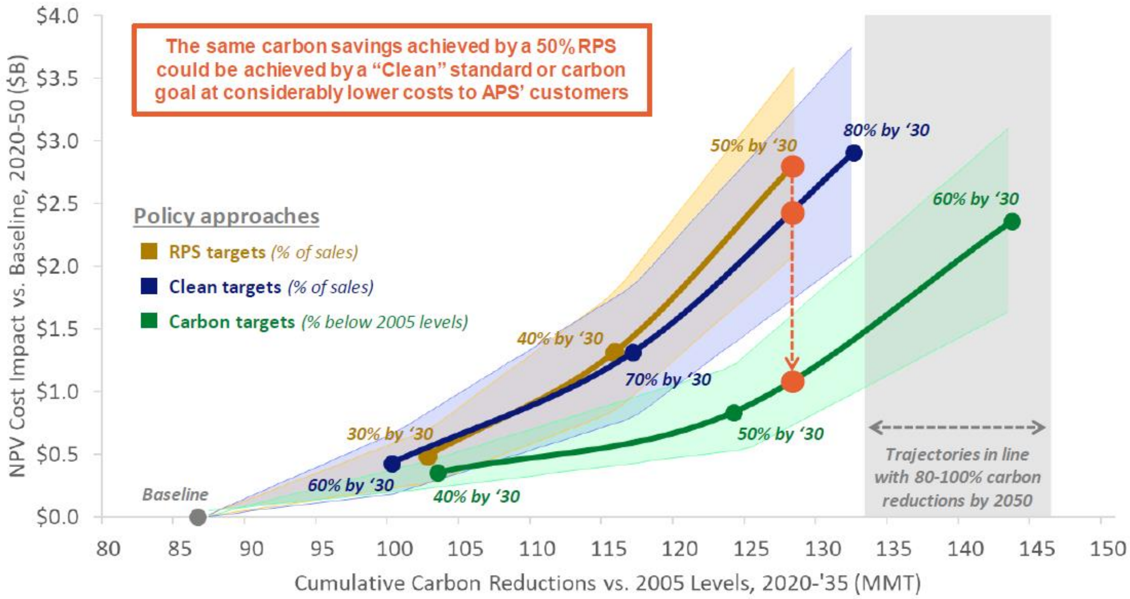
Energy+Environmental Economics 6

Four groups of scenarios explore different policy options

- **Scenarios modeled generally fall into four broad categories that affect the types of investments needed in each:**
  1. **Renewable Portfolio Standard (RPS):** portfolios designed to meet a kWh production quota for renewables, expressed as a percent of retail sales (30-50% RPS by 2030)
  2. **Clean Energy Standard:** portfolios designed to meet a kWh production quota for carbon-free resources (including nuclear & clean imports), expressed as a percent of retail sales (60-80% clean by 2030)
  3. **Carbon Target:** portfolios designed to meet a specific carbon goal (40-60% reductions by 2030)
  4. **Natural Gas Prohibition:** portfolios that prohibit investment in new natural gas infrastructure to meet future reliability needs
- **Stakeholders also designed a wide range of sensitivities to test assumptions on load growth, technology costs, and other key assumptions**


Model inputs and outputs
Inputs
Demand forecast
Clean energy goals
Existing resources
Customer resources
New resource options
Fuel prices
Hourly profiles
Market prices
Model
• Cost minimization
• Determine costs via hourly economic dispatch
• Identify new build resources
• Satisfy planning reserve margin
• Satisfy hourly energy needs
• Satisfy clean energy goal(s)
Outputs
Installed capacity
Annual generation
Imports
Renewable curtailment
Carbon emissions
Generation cost
Key focus of scenario analysis: comparing impacts of different policy & portfolio decisions on cost and carbon metrics
Energy+Environmental Economics
8

Estimating a range of cost & carbon impacts for APS



The expected cost impacts of a long-term prohibition on investment in new natural gas resources would result in significantly higher costs than any other scenario investigated, with an estimated NPV cost of $20-30 billion

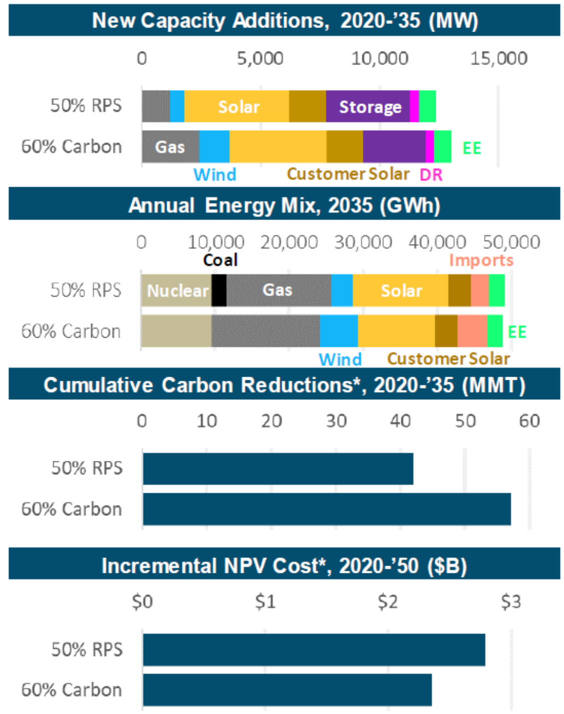
Contrasting standards: renewables & carbon

Both policies will encourage substantial investments in new clean energy resources…

…but a carbon-focused standard will lead to a more balanced & diverse generation mix…

…enabling achievement of greater carbon savings and a cleaner portfolio…

…while comparatively reducing costs for APS' customers



** Metrics measured relative to a least-cost portfolio of resources*

Energy+Environmental Economics 10

Key takeaways from analysis

1. APS and Arizona are experiencing continued population and load growth which could drive significant investment needs across all scenarios analyzed
2. All modeled scenarios show that significant investment in new clean resources would be needed to achieve substantial carbon reductions
3. Scenarios with broadly-defined policies to encourage clean energy and carbon reductions provide more affordable and flexible options than prescriptive targets for specific technologies that narrow utilities’ choices (e.g., RPS)
4. Palo Verde is critical to meeting future clean energy goals at low costs; replacing it with other resources would considerably increase customer costs and require substantial development time
5. Scenarios with early retirement of Four Corners show significant carbon benefits, but would require large replacement investments in the next decade to maintain reliability
6. Even in deep decarbonization scenarios, firm gas resources play a crucial reliability role but operate infrequently and at low capacity factors

Appendix C – IRP Working Group Disclaimer

Disclaimer / Context Language regarding IRP Working Group and E3's Work

1. E3's model is one of many that can be used to conduct resource planning analysis and we acknowledge that other models could yield different results. The E3 model was designed to be consistent with industry standards and is sound in its technical functionality.

2. There are a wide range of inputs that can be used for any model and those that were used for this process, while not necessarily endorsed by all members of the working team, were generally considered reasonable by a majority of the group. While the process allowed for multiple inputs (e.g. different technology prices) to be evaluated, it is acknowledged that different input values would in most cases yield different results.

3. The results of the scenarios evaluated by E3 were approximated costs and carbon emission levels intended to show the relative comparison of scenarios to each other. Point data should not be considered absolute or precise.

4. There is more analysis and study underway that will inform APS's Final IRP in April 2020. This includes the following studies:

    a. Natural gas market assessment
    b. Renewable integration cost assessment
    c. Electric vehicle penetration potential (APS service territory)
    d. DSM opportunity study
    e. Third-party evaluation of APS load forecasting methodology

    APS commits to a continued public and transparent process that includes the results from these studies, policy developments/direction from the Commission, and continued input from stakeholders to inform our Final IRP.