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Introduction

For well over a century, Salt River Project (SRP) has been an engine of economic development in the state due, in large part, to a long-term focus on the reliable delivery of low-cost water and electricity. Our ability to sustain a high level of performance and customer satisfaction begins in our planning processes. For our power generation portfolio, that process is known as integrated resource planning.

An integrated resource plan, or IRP, is the result of a highly-structured and comprehensive analysis of a wide variety of new resource alternatives and different possible future scenarios. In our IRP work, we model various scenarios out up to 30 years into the future, though the focus of our conclusions as presented herein will be limited to the next 15 to 20 years.

A full IRP process is very time and resource intensive and undergoes a thorough review approximately every three years. However, the refinement of assumptions occurs on an ongoing basis to ensure that all resource decisions incorporate the latest information.

To develop the plan, SRP’s Resource Planning team synthesizes input received from many different sources, including many internal departments as well as external sources. The analysts use the information, which includes, among other things, technology updates, customer demand forecasts, fuel prices and pending regulatory changes, to determine which mix of generation resources best meets the company’s objectives.

This report represents a high-level overview of our IRP process, the important elements in that process, and the strategic conclusions reached as a result of the process. Our purpose in providing it is to ensure that our customers and other valued stakeholders have visibility of our work in this area, an understanding of the strategic resource direction, and why we think that direction is in the best interest of our customers and the communities we serve.

Stakeholder Engagement

A key feature of this most recent IRP process was the new approach we used for stakeholder engagement. SRP has always sought to be responsive to stakeholder comments and questions and has done so via individual meetings, direct responses over
phone and email, providing information on the SRP website, and various public forums. For this IRP, SRP hosted a series of stakeholder meetings that incorporated a diverse representation of SRP stakeholders, and allowed for interactive dialogue and sharing of perspectives between SRP and the stakeholder group. By using this process we were able to fully respond to questions and comments, and we even made some changes to our plan based on comments received. To ensure the best overall outcome for all involved, SRP engaged a third-party facilitator to help focus and balance the discussions.

Our stakeholder engagement meetings began in May 2014 and concluded at the end of September. The stakeholder process included three levels of engagement: the Strategic Initiatives Advisory Panel, the Stakeholder Forum, and one-on-one discussions with other key stakeholders. The first two levels are discussed further below. Our effort to reach out to all stakeholders is through the publishing of this document.

**Strategic Initiatives Advisory Panel**

The Strategic Initiatives Advisory Panel was designed as a collaborative working group representing the broad interests of SRP’s stakeholders. The panel was comprised of a diverse mix of experts in environmental policy, energy efficiency, the solar industry, and water policy, as well as representatives of large industrial, commercial, and residential customers; low income advocacy groups; and Native American interests. Panel members were invited as liaisons to the particular sector of stakeholders they served. Three working meetings were held in May and June 2014. At these meetings, presentations were made demonstrating the principles behind SRP’s scenario development, planning metrics and analytical results. SRP’s Resource Planning staff held numerous “make-up” meetings for Panel members with scheduling conflicts. This effort ensured that all had sufficient information and knowledge to participate in the discussions.

**Conclusions from the Advisory Panel**

Panel members concluded that the use and development of planning scenarios, the measures by which the resource plans are evaluated, and the types and mix of resources considered were sufficiently comprehensive. Panel members were also polled for consensus on eight principles which now form SRP’s Strategic Direction for resource plan development. The principles were actively discussed and modified to incorporate the Stakeholder feedback we received. This effort resulted in the following guidelines for future SRP generation development:

1. The four pillars of SRP’s Conservation and Stewardship ethic, which include affordability, reliability, greenhouse gas reductions, and responsible water management, offer a solid foundation for future initiatives that are consistent with big picture stakeholder values.
2. SRP’s integrated resource planning scenarios as presented, which include Regulation Escalation, Economic Transformation, and Global Stagnation, are sufficiently comprehensive in terms of scope and range of assumptions considered.

3. The measures by which SRP evaluates resource plan performance and likelihood of successful execution are clear and consistent with stakeholder expectations. These measures include Costs, Cost Stability, Reliability, Financial Flexibility, CO$_2$ Emissions, and Water Use.

4. The three future resource portfolios presented to the Advisory Panel are sufficiently comprehensive in terms of the types of resources considered and the alternative mixes of these resource types, recognizing these may change with future technology advances.

5. The principal elements of SRP’s recommended strategic resource direction are sensible and generally consistent with Advisory Panel expectations. The principal elements include:
   - Coal: A deliberate meaningful reduction in the amount of energy in SRP’s portfolio produced by coal generation.
   - Nuclear: Taking appropriate steps necessary to develop and preserve the option for new nuclear generation in the late 2020s – early 2030s.
   - Natural Gas: An increasing role for natural gas generation as a means to 1) partially meet increases in customer demand, 2) reduce SRP’s CO$_2$ emissions intensity, and 3) ensure reliability in a system with increasing levels of intermittent generation (such as wind and solar generation).
   - Renewables: Add a diverse mix of new renewable energy resources as a critical element to reduce SRP’s CO$_2$ emissions intensity.
   - Other: Other cost effective options, such as the electrification of transportation, will also be considered and implemented as a means of meeting SRP’s strategic objectives and reducing CO$_2$ emissions intensity.
   - Energy Efficiency: Promoting cost-effective energy efficiency and other load management options.
   - New Technology: Collaborate with others to encourage the development of and support for innovative application of new power generation, load management, and energy storage technologies through active participation in industry research and development organizations.
6. Transitioning from SRP’s current Sustainability Portfolio Principles (SPP) framework, after the current SPP goal sunsets in 2020 and has been met, to a long-term commitment to reducing SRP’s CO₂ emission intensity, is appropriate and acceptable with the following provisions:
   - SRP provides the transparency in reporting required to make sound comparisons of its sustainable resources to other electric utilities.
   - SRP continues to add new renewables to its portfolio and invest in cost-effective energy efficiency measures on both the customer and utility side of the system.
   - The achievement of the target follows a least cost discipline, accounting for the uncertainty in future cost projections. This discipline may mean utilizing other approaches to reducing emissions including, but not limited to, the replacement of coal energy with natural gas resources, new nuclear generation, water conservation, healthy forest initiatives, self-directed customer renewables, and efforts to aid in the reduction of CO₂ emissions from the transportation sector.

7. Interconnection standards should ensure that power quality and grid reliability are reasonable. Such standards may include intelligent inverters, real time adjustments, last mile communications, and distribution management systems.

8. SRP’s proposed principles for embracing a more open grid are appropriate and acceptable. The principles include:
   - Pursue investments, alternatives, and policies that embrace the opportunity for customers to choose customer generation resources.
   - Develop prices for customers that reflect the underlying economics of customer generation and promote good decision making.
   - Incentives associated with customer generation should be transparent and phase out with the maturity of a given technology.
   - Insulate those who currently have customer generation from pricing and policy changes for a reasonable period.

SRP is very appreciative of the effort and contribution made by the Advisory Panel. The comments and feedback received from the Panel directly impacted the eight principles which form SRP’s Strategic Direction. Moreover, the constructive dialogue that occurred over the course of the three meetings will influence future IRPs.

**Stakeholder Forum**

The second level of engagement involved a larger group of stakeholders. As with the Advisory Panel, efforts were made to keep a diverse and balanced approach in order to
best represent all stakeholders. The second group, the Stakeholder Forum, attended two meetings. The first were small group informational meetings, during which the Forum members received presentations similar to those shared with the Advisory Panel. There was also an in-depth discussion of the Strategic Direction from the Advisory Panel meetings. The small group setting provided the opportunity to discuss the information, ask questions, and make comment. Forum members were encouraged to comment and offer feedback on the resource planning process and issues.

The second meeting included the entire Forum in one venue. Forum members received a recap of the previous discussion points and the balance of time was given to the Forum to ask questions, provide comment and feedback on the planning process, SRP’s Strategic Direction and the Stakeholder/IRP process. Questions and responses were recorded for consideration in the current and future planning processes.

SRP’s primary objective of the stakeholder engagement process was achieved. The effort resulted in active and genuine communication which offered SRP a better understanding of stakeholders’ competing objectives, priorities, and viewpoints. Contributions from the Advisory Panel and Stakeholder Forum were, and will continue to be, an important part of the IRP process.
SRP’s Integrated Resource Plan

While SRP’s 2014 IRP includes some specificity regarding its near term plan, much of the focus is on the planning process and broader strategic conclusions. The dynamic nature of planning requires the flexibility within defined parameters. This framework is provided by the Strategic Direction. This IRP will provide the background and analysis for the first six points of the Strategic Direction listed above. Policy questions relating to customer owned generation and interconnection standards will be addressed via a separate process.

SRP Overview

SRP is the oldest multipurpose federal reclamation project in the United States. We have been serving central Arizona since 1903, nearly 10 years before Arizona became the 48th state.

Today SRP is one of the nation’s largest non-investor owned utilities. We provide electricity to more than 990,000 retail customers in a 2,900-square-mile service area that spans three Arizona counties, including most of the metropolitan Phoenix area. We are an integrated utility, which means we provide a full range of services including generation, transmission and distribution services, as well as metering and billing services.

SRP’s water business is one of the largest raw-water suppliers in Arizona. We deliver about 800,000 acre-feet\(^1\) of water annually to a 375-square-mile service area and manage a 13,000-square-mile watershed that includes an extensive system of reservoirs, wells, canals and irrigation laterals.

\(^1\) 1 acre-foot = 325,851 gallons of water or the amount needed for a family of five annually.
To meet the needs of nearly one million electricity customers today, SRP employs a very diverse portfolio of resources including those that burn coal and natural gas, nuclear generation, and a portfolio of sustainable energy options that includes hydroelectric generation, other renewable technologies, and conservation measures such as energy efficiency programs. Not only are the technologies diverse, but so are the locations as shown on Figure 1. SRP’s diverse resource portfolio is a core strength in preserving reliability and ensuring competitive prices, which have been a cornerstone for economic growth and the exceptional quality of life we enjoy in the Valley of the Sun for over a century.

**SRP’s Generation Resources**

Figure 2 shows SRP’s current resource mix from a capacity and an energy standpoint. The capacity chart demonstrates the relative contribution of each resource type to meeting peak summer demand. The energy chart illustrates the relative contribution of each resource type on an annual basis, i.e. considering every hour in the year rather than just the peak demand hour.

Today, a little over 50% of our customers’ annual energy needs are provided by coal-fired generation as shown on the energy chart. The remaining portion of our portfolio is met by nuclear, natural gas, sustainable and other resources\(^2\). The IRP is a structured process of considering what these charts could and should look like in the future.

**Resource Planning**

The resource decisions that have been made in the past have always reflected the best interests of our customers and the communities we serve. Today we have an exceptional quality of life in the Phoenix Metropolitan area. Resource Planning is fundamental in our ability to continue to provide reliable, competitively priced electricity that contribute to economic growth and affordable electricity for all of our customers.

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\(^2\) Represent short-term purchases and managing resource portfolios for districts within SRP’s balancing area.
The goal of SRP’s resource planning process is to develop a long-term resource strategy to meet our customers’ and other stakeholders’ expectations of low-cost, reliable power while demonstrating exemplary natural resource conservation and stewardship. The work is extensive and is conducted on a year-round basis. Numerous areas of SRP are involved in the collection, creation, and analysis of substantial amounts of quantitative and qualitative data that feed into the planning process. Moreover, SRP’s resource planning process deals with significant uncertainty in a structured and comprehensive manner.

Core Resource Principles
SRP has six Core Resource Principles that guide our planning process and decisions. The principles seek a balance among financial considerations, reliability, and environmental impacts while ultimately prioritizing customer satisfaction and valuing stakeholder input. We strive to understand the inherent tradeoffs among the principles and establish a plan that fully considers and balances all of them.

Establishing Key Metrics of Success
The Core Resource Principles serve to broadly guide our planning efforts; however, to evaluate the performance of different resource choices in light of these principles, we need to express the principles in terms of specific metrics. These metrics are necessary to inform strategic decision making and determine the merits of various resource portfolios. They are also designed to align with SRP’s Core Resource Principals, providing a way to evaluate progress towards meeting goals. These metrics include such measures as costs, cost stability, reliability, financial flexibility, CO₂ emissions, and water use.

The Planning Process
The purpose of the planning process is to determine which resource strategy will allow SRP to best meet projected demand in an uncertain future. To test different resource strategies, each resource portfolio is considered in light of different future scenarios. The performance of each individual resource portfolio is determined by the characteristics of the portfolio (what SRP can control) as well as what the future world looks like (what SRP can’t control). We measure the outcomes of the portfolios through our key planning metrics. The point of
testing each portfolio against different future scenarios is not necessarily to pick which portfolio among those tested is best, but to learn from the analysis so that we can craft a strategy that incorporates the strengths and mitigates the weaknesses of each.

There are five major steps involved in SRP’s planning process:

- **Drivers**
  - Identify the key drivers of change

- **Scenarios**
  - Imagine plausible futures in terms of the drivers

- **Portfolios**
  - Design alternative resource strategies (portfolios)

- **Results**
  - Model the portfolios under each scenario
  - Evaluate the portfolios using defined metrics

- **Direction**
  - Develop the best strategy

**Step 1: Key Driver Development**

There are numerous key drivers and assumptions that have a direct and/or indirect effect on SRP’s resource plans and on meeting our strategic planning goals. These planning drivers and assumptions are generally considered to be aspects that are beyond SRP’s direct control, but that significantly influence the decisions we make and the ultimate success of those decisions. And while there are a great many inputs and assumptions that go into the effort, the ones of most strategic importance include the following:

1. **Future Energy Consumption**: SRP’s forecasting department develops a range of customer energy demand projections. These projections cover a forecast horizon of 30 years and account for such issues as economic growth by sector, energy efficiency, customer-owned generation trends, changes in building codes and appliance standards, and changes in customer usage patterns.

2. **Cost of Fuel**: Producing electricity is largely a matter of converting the energy stored in fuel such as coal, oil, natural gas, and uranium to a form that is much more usable in residential, commercial, and industrial applications. This
conversion process has been at the heart of much of the economic growth and standard of living improvements for more than a century.

In Fiscal Year 2013, SRP’s fuel expense represented nearly 23% of corporate operating expenses. If one considers the fuel consumed in the wholesale electricity that we purchase from other companies, the figure is even greater. Therefore, the significance of fuel cost projections in our planning process can be readily appreciated.

Different fuel types have different characteristics in terms of relative price and price predictability. Nuclear fuel, i.e. uranium, is typically procured on a very long-term basis with stable pricing and is currently one of the lowest cost fuel sources around. Coal fuel has traditionally also been procured on a long-term basis, and thus has exhibited fairly stable pricing. Natural gas is the fuel subject to the highest degree of price uncertainty as most natural gas is procured on a short-term basis. Movements in natural gas prices are driven by the strength of the domestic economy, utilities moving away from coal-fired generation to natural gas-fired generation as a cleaner fuel source, environmental regulations, and advances in extraction technologies such as hydraulic fracturing, also known as “fracking.”

We also develop projections for wholesale electricity market prices. The wholesale market allows SRP to purchase electricity from other utilities or independent power producers when the price is below our own cost of producing electricity. SRP also sells electricity into the wholesale market when our customers aren’t consuming all of the electricity we are capable of producing. The proceeds from these sales directly reduce the costs which SRP needs to recover from our customers.

3. **Generation Costs:** The electric utility industry is highly capital intensive. The capital costs of most new generation projects are typically quoted in the hundreds of millions to billions of dollars. These costs are driven by raw materials costs such as steel, copper, and concrete; construction labor cost inflation; demand for new equipment; and technological advances. Each of these drivers is subject to inflationary pressure, therefore, new resources can be significantly more expensive than their predecessors.

When analyzing resource costs, is imperative to look at both the generation and fuel costs in total. For instance, nuclear resources have very high capital costs
with lower fuel costs as compared to a natural gas-fired plant. Technologies such as solar, wind, hydroelectric, and geothermal have no fuel costs, but they do have high capital costs.

4. **Environmental Regulations**: A resource portfolio must be in compliance with all applicable laws and regulations, as well as any targets set by SRP’s governing Board. This is straightforward relative to existing regulations, but can be challenging when trying to anticipate future regulations. The uncertainty associated with future regulations is that you do not always know what you will have to comply with or at what cost.

**Step 2: Scenario Development**

Scenario planning is one tool that SRP uses for long-term planning. The development of various scenarios tells us about different possible futures but is not intended to predict a precise outcome of events. The future scenarios consist largely of items that are beyond SRP’s control. This contrasts with the Portfolios that are developed in Step 3, where SRP does have control over investment decisions made. Testing various portfolios against different possible futures enables the development of comprehensive strategies.

Resource Planning develops internally consistent narratives of different possible futures that could occur and utilizes the key driver and assumption data to translate these narratives into quantitative modeling inputs. These narratives become our planning scenarios. Since there are an infinite number of future outcomes possible, our scenarios bookend a spectrum of the key driver assumptions while considering the interrelationships between those assumptions. The purpose is not to predict the future but to create a “proving grounds” for different resource strategies.

In our most recent IRP process, we developed three big picture scenarios, which are described in further detail.
1. **Regulation Escalation:** In this scenario, we see some similarities with today’s world that includes a recovering economy with moderate economic growth. Moreover, this future is characterized by a command-and-control theme where the Environmental Protection Agency takes the lead on environmental issues by focusing on coal resources and natural gas extraction techniques that drives higher costs.

2. **Economic Transformation:** This scenario begins with the assumption that the public and legislators are unified on addressing climate change and that the country’s economy strengthens considerably. With a strong focus on addressing carbon emissions, there are more incentives to move toward non-emitting resources and a strong economy present to support the changes needed.

3. **Global Stagnation:** The focus in this scenario is the impact of a slow economy. Without strong growth, it becomes difficult to advance environmental issues either through regulation or incentives. The nation must
first direct its efforts at improving the economy – such as job growth and economic stimulation.

To reiterate, the point of scenario planning to is test different resource strategies against an uncertain future using our three distinct scenarios. Our goal is not to predict the future but to use this planning process to identify the strengths and weaknesses of different resource strategies under each scenario. The insight gained from this exercise is paramount in developing a resource strategy.

**Step 3: Portfolio Development**

A resource portfolio is simply the mix of resource options used to either meet customer demand or to reduce customer demand. Resources used to meet customer demand are called supply-side resources and include different types of power plants including coal, nuclear, natural gas, hydroelectric, and renewable energy technologies. Options that serve to lower customer demand, such as price signal mechanisms, energy efficiency and customer-owned energy sources are broadly referred to as demand-side resources.

A portfolio can be represented in two different ways: from both a capacity and energy standpoint. Capacity represents the maximum amount of electricity that can be produced at any given moment. Energy represents the amount of energy that is actually produced over a defined period of time. One way to think about this is a like a water pipe. Capacity is the total amount of water that can flow through the pipe at one time, whereas energy measures the entire amount of water that has flowed through that pipe over the course of year.

From a resource planning perspective, capacity is what we look to in order to understand if we have enough resources to meet customer demand on the hottest day of the year. We look to energy to tell us how resources are being utilized over the course of a year, which drives metrics such as carbon emissions, water consumption, and fuel expenses.
What does a resource portfolio need to achieve?

1. **Dependable Power Supply:** A resource portfolio must meet customer demand every hour of every day. It must account for weather, customer count, the intermittency of wind and solar resources, and the possibility of unscheduled power plant repairs. Moreover, it must follow changes in demand as customers’ need for power changes.

2. **Cost Management:** The resource portfolio is at the core of SRP’s economics. This is true in terms of total costs, cost predictability, and financial flexibility. As a not-for-profit, public power entity, these ultimately play directly through to our customers’ economics. As such, the resource portfolio must prioritize cost management.

3. **Regulatory Compliance:** A portfolio must be in compliance with all applicable laws and regulations, as well as any targets set by SRP’s governing Board. This is straightforward relative to existing regulations, but can be challenging when trying to anticipate future regulations.

4. **Technical Feasibility:** The technologies considered need to be commercially viable; the new development timelines must be reasonable; and siting and permitting work must be achievable.

**Resource Portfolio Development**

Looking forward, SRP’s forecasting group develops long-term projections for both capacity and energy needs annually. A screening of new generation technologies and customer choice options is conducted so that resource planners have numerous alternatives from which to choose in meeting future capacity and energy requirements. In general, to be included in a resource planning strategy these resources have to be commercially proven technologies at a scale appropriate to our system requirements.

There is a multitude of resource combinations that could be chosen to develop a resource portfolio. For this reason, SRP starts with many resource portfolio options and narrows these options down to a top few that represent very distinct resource portfolios to be evaluated. This distinction is made in terms of capital and operating costs.

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3 SRP does partner with other industry organizations to perform research and development work on technologies that aren’t yet commercially viable to help create new options for the future.
costs, resource diversity, contribution on the hottest day of the year, environmental considerations and compliance with all applicable laws and regulations, as well as any targets set by SRP’s governing Board.

Note that a resource strategy doesn’t solely consider new resources, but also the future of existing resources. For example, how much, if any, generation from coal should be retired and when to reduce carbon emissions intensity and to avoid the costs of future environmental regulations on coal; will existing gas plants need to be modified to further compensate for the intermittency of wind and solar generation; will existing technologies become obsolete?

**Resource Tradeoffs**

In order to develop a long-term resource strategy that will meet our customers’ and other stakeholders’ expectations of low-cost, reliable power while demonstrating exemplary natural resource conservation and stewardship, specific decisions about resources have to be made and ultimately implemented. Inherent in these decisions are trade-offs arising from the characteristics of different resource types. Different resource types have different up-front capital costs, fuel and maintenance costs, environmental impacts, water usage, operational characteristics and asset lives.

**Usage Profile**

Power plants can be divided into three broad categories based upon their expected usage: baseload, intermediate, and peaking. Baseload resources are designed to produce power on a continual basis every hour of every day. These tend to have high capital costs but low fuel costs. Intermediate resources are designed to “follow the load.” This means that as the customer demand for electricity rises and falls throughout the day their output can be increased or decreased to match. Peaking resources also follow the load, but do so over a limited number of hours a year and are capable of being available very quickly.

Figure 9 represents a typical summer day for SRP. The shape of the graph represents the demand from customers for energy at each hour of the day. As illustrated, demand is lowest in the summer in the early morning hours when temperatures are lower and people are asleep.

In the summer our demand continues to increase as temperatures increase...
and air conditioners are turned on. As our customers use more electricity, SRP’s intermediate resources increase their production to meet the increasing needs. Once all of SRP’s intermediate resources are at full power we then look to our peaking resources to satisfy the remaining demand in the afternoon and evening when people return home from work and turn on the air conditioning.

Certain resources such as wind and solar do not fit within the framework of baseload, intermediate, and peaking. These are considered “intermittent resources.” These resources produce energy when the wind is blowing or the sun is shining. The output from these resources cannot be controlled to the same extent as traditional resources to match customer demand. As such, the other resources must help to compensate for the variability in the output of wind and solar.

**Capital Costs**
The production of electricity is a capital intensive business. In much the same way as operational characteristics differ across generation technologies so, too, do the capital costs of the various technologies. A capital cost is a broad term used that generally refers to the initial costs to construct the facilities necessary to generate power. They include the costs necessary to construct the power plant itself as well as costs for the fuel supply infrastructure (such as pipelines for gas units), transmission lines to connect the plant to where the energy is used, and water supply infrastructure.

**Operating Costs**
Each resource option also has associated operating costs that can differ across technologies and fuel types. Some costs vary based on facility usage. These costs include such things as fuel and consumables necessary to maintain the facilities. Additionally, there are fixed costs that are incurred regardless of how much the plant runs such as taxes, insurance, labor and other facility costs. Taken as a whole these costs are referred to as operating costs.

**Renewable and Sustainable Resources**
Renewable and sustainable resources have lower CO₂ emissions impact than conventional coal and natural gas-fired resources. Among these resources are wind, solar, biomass, hydro, landfill gas, and biomass generation. Historically, these resources have been more expensive than traditional sources of energy, and as a result, policies have been enacted to require utilities to procure specified amounts of renewable energy. Utilities in Arizona that are regulated by the Arizona Corporation Commission (ACC) are required to meet 15% of total sales from renewable resources by 2025. SRP is not subject to this ACC regulation; however, in 2004 our Board voluntarily adopted a set of Sustainable Portfolio Principles (SPP) requiring SRP to meet a portion of our sales through sustainable means including hydroelectric, wind, solar, energy efficiency,
geothermal and biomass resources. The Principles were modified in 2011 such that SRP’s goal is to meet 20% of our customer needs through sustainable sources by 2020. To date, SRP’s actual sustainable performance has exceeded its SPP target every year. Looking forward, SRP’s current plan is will meet the SPP target in 2020.

**Integrating Intermittent Resources**

Some renewable generation resources, such as solar photovoltaic and wind generation systems, are intermittent in nature. These resources only produce energy while the sun is shining or the wind is blowing. While SRP can forecast relatively well the amount of energy produced by these systems over a month or a year, it is much more difficult to forecast the energy production over a shorter time frame.

Figure 10 shows how a solar photovoltaic (PV) plant operates on a cloudy day measured in seconds. The black lines show solar PV output over the course of a day during daylight hours. The red area behind the black lines demonstrates the energy that would need to be provided from a traditional resource to provide continuous energy to our customers when the solar panels aren’t producing. By and large, the output from solar PV isn’t always this variable; however, this variability does occur from time to time and we need traditional resources available to compensate for it when it does happen.

Another matter associated with integrating large amounts of renewable generation is to understand the impact to SRP on the hottest days of the year. As it relates to solar PV as shown in Figure 11, the blue line shows customer demand over the course of a summer day with no solar resources added to SRP’s system. The dotted red lines show how demand is met by non-solar resources when solar PV is added to SRP’s system. For illustrative purposes the dotted red line
closest to the blue line shows how non-solar resources will meet customer demand if 500 megawatts (MW) of solar PV resources are added to SRP’s system.

The peak demand reduction for non-solar resources is reduced by about 250 MW and the peak demand has shifted to 7 p.m. This means that SRP must build enough non-solar resources to meet demand at 7 p.m. when solar resources are not generating electricity. If another 500 MW is added to SRP’s system as represented in the dotted red line furthest from the blue line, the peak demand reduction is effectively zero megawatts.

The implication is that there is a limit to how much solar can offset the need to add other more reliable types of generation. To the extent storage technologies, such as large batteries, become a competitive option, solar may be able to make a larger contribution.

Energy Efficiency, Price Signal-Based and Demand-Side Programs
SRP has numerous energy efficiency programs that allow customers to reduce their energy. These programs are designed to be cost effective, such that the incentives SRP pays to customers to take energy efficiency measures are lower than the overall benefits that SRP receives. The programs serve to reduce carbon and defer the need for new generation.

SRP has various price signal-based conservation programs that can result in reducing overall demand on our system at peak hours. These programs allow customers to be charged a lower rate for energy at times when SRP’s demand is low; however, when demand is high in the afternoon, customers are charged a higher rate.

As shown in Figure 12, these programs can have a significant impact in reducing SRP’s overall system peak. This reduction in peak system requirements helps diminish the need for new generating capacity on SRP’s system, and in so doing allows SRP to defer large capital expenditures in the future.
Three Portfolios to Evaluate
Based on the process and considerations outlined above, SRP has developed three distinct portfolios for consideration and evaluation.

- **Portfolio 1**: This portfolio can be viewed as more traditional in nature. It consists of a fairly well balanced portfolio of generation assets with natural gas-fired resources serving a larger share of total customer demand. The remaining new resource needs are met by solar generation. It is the heaviest fossil-fuel based portfolio strategy of the three as a result of having no planned coal power plant retirements and having the majority of new demand being met with natural gas-fired resources.

- **Portfolio 2**: This portfolio is perhaps the most moderate of the three, taking a somewhat middle-of-the-road approach to future resource expansion and treatment of our existing resources. The construction of a new nuclear power plant in the early 2030s is a distinguishing aspect of the portfolio, bringing with it a substantial amount of capital expenditures. This portfolio includes a moderate level of coal plant retirements. These coal plants are replaced by new nuclear, geothermal, and natural gas-fired resources.

- **Portfolio 3**: This portfolio represents the most significant departure from SRP’s current resource mix of all three of the portfolios. There are significant coal closures and additional repowering of other older SRP resources. The retirement of coal resources are replaced through large additions of geothermal, solar thermal, solar photovoltaic, and wind resources. Natural gas-fired resources are added in large part to support the level of renewable resources in the plan. Due to the high levels of intermittent renewable resources (wind and solar), a substantial amount of resources capable of turning on and off quickly are also added.

Resource Mix of Portfolios
While each scenario will have a slightly different resource mix when run through the various scenarios, due to the differences in loads in each scenario, Figure 13 is a representation as to how the various portfolios meet the energy
requirements under the Regulation Escalation scenario in 2034.

**Step 4: Evaluating the Portfolios**

The goal of the planning process is to determine which resource strategy will allow SRP to best meet future demand in an uncertain future. To test different portfolio strategies, each portfolio is considered in light of different future scenarios. The performance of each individual portfolio is determined by the characteristics of the portfolio as well as what the future world looks like. We measure the outcomes of the portfolios through our key planning metrics: costs, cost stability, reliability, financial flexibility, CO₂ emissions, and water use. We use natural gas fuel consumption as a way to measure cost stability. The point of testing each portfolio against different future outcomes is not necessarily to pick which portfolio among those tested is best, but to learn from the analysis so that we can craft a strategy that incorporates the strengths and mitigates the weaknesses of each.

**Comparing the Portfolios**

As referenced above each of the three portfolios have different characteristics that define them and thus each will perform differently in each scenario. Our goal in the IRP process is to measure how the portfolios perform under all three scenarios such that we are able to formulate a successful resource strategy based on the information garnered from the analysis.

**Portfolio Results: Capital Costs**

The electric utility industry is highly capital intensive. This means that in order to meet the long-term energy needs of our customers, we invest in assets that have significant construction or acquisition costs, but that provide value for 30 years, or longer. For an IRP, capital costs are typically tied to new power plants, transmission infrastructure, and pollution control equipment added to existing resources.

Capital costs are important from both an operational and a financial perspective. Investment in new assets is what allows SRP to meet our customers’ needs for around-the-clock reliability and to comply with environmental regulations. Wise capital investments also contribute to our ability to keep costs low and to maximize the value our customers receive from SRP’s system.

In the IRP process, capital costs are determined by four key factors:

1. **Customer Demand**: Growth in peak customer demand drives the need for additional resources.
2. **Asset Retirements**: Once existing assets reach the end of their useful lives, they are retired and replaced with new resources.
3. Environmental Regulations: Existing assets sometimes require additional pollution control equipment to keep pace with new environmental quality regulations. Furthermore, new assets in the future may be required to comply with more stringent environmental regulations than currently exist, which could raise the cost of those assets.

4. Technology Costs: The cost of new resources is tied to cost inflation and the development of new technologies.

While investing in capital assets is vital to maintaining long-term reliability and financial health, such investments do entail risk that needs to be managed wisely. Investment risk is closely tied to the four factors listed above.

1. Customer Demand: If demand growth is higher than expected, more expense will be required to meet that demand. If it is lower than expected, a utility can end up with surplus capacity.

2. Asset Retirements: New environmental regulations and technological advances can impact the useful life of remaining assets.

3. Environmental Regulations: Significant uncertainty exists relative to future environmental quality regulations and the costs associated with compliance with those regulations.

4. Technology Costs: While inflation rates are technology costs are forecasted, those forecasts are based on expectations and are not certain.

Our scenario planning process is critical to our ability to wisely plan capital investments and to manage the risks associated with them. In scenario planning we consider a wide range of customer demand forecasts, various possibilities for environmental regulations, and changes in technology costs. They key results from the process include relative cost and relative risk among the portfolios. These results are summarized in the following table for each portfolio.

<table>
<thead>
<tr>
<th>Capital Cost</th>
<th>Relative Cost</th>
<th>Risk Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portfolio 1</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Portfolio 2</td>
<td>High</td>
<td>Med</td>
</tr>
<tr>
<td>Portfolio 3</td>
<td>Med</td>
<td>Med</td>
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</table>

As noted in the key drivers above, capital expenditures can be driving the resource decisions involved in meeting future customer demand and by asset retirements. Portfolio 2 exhibits the highest capital costs as a result of both resource decisions, the inclusion of a capital intensive nuclear resource, and asset retirement assumptions in which coal assets are retired. Contrast this investment decision with Portfolio 1 with the lowest capital costs in which no nuclear resources are constructed and no coal assets
are retired. While the overall capital costs associated with Portfolio 1 may be low, this results in an increasing environmental cost risks in scenarios that have increased environmental regulations.

**Capital Cost Conclusions**

1. Additional demand drives the need for new assets. Cost effective means of reducing peak demand is important in helping to mitigate cost and cost risk.
2. Reducing carbon emission intensity will ultimately require the retirement of existing coal assets. Remaining useful life must be considered to minimize the economic consequences of doing so.
3. Nuclear generation drives high capital costs, but has zero emissions, low fuel costs, and is a reliable, proven technology. Must preserve the option for late ‘20s or early ‘30s.
4. A portfolio heavy in coal generation may reflect low fuel costs, but has capital cost risk associated with environmental regulations.

**Portfolio Results: Gas Burns**

Today, a key source of energy production for SRP is from natural gas-fired generation units. The amount of natural gas used to produce electricity on SRP’s system has been steadily growing as we have added natural gas combined-cycle and peaking facilities on our system. The total amount of natural gas burned on SRP’s system over the course of a year is referred to as “gas burns.”

Natural gas burns levels are important from an operational and financial perspective. Operationally, much of the new capacity recently added onto our system, and the majority of future capacity, produces power through the combustion of natural gas. In order for these units to be fully operational when demand requires them to be, it is imperative that SRP secures a reliable supply of natural gas for all hours of the year. Financially, natural gas can help contribute to a more diversified portfolio of resource options that can diversify risk. However, too much of a reliance upon natural gas can have impacts on price stability as natural gas prices have been quite volatile over the last two decades.

In the IRP process, natural gas burns are determined by three key factors:

1. Customer Demand: Growth in overall energy demand drives increases in fuel needs required to meet larger levels of energy demand.
2. Asset Retirements: If baseload coal assets are retired at the end of their useful lives, natural gas resources will be for replacement power.
3. Renewable Integration: Intermittent renewable energy facilities necessitate natural gas generation facilities capable of integrating their output into our system.

While the utilization of natural gas serves to maintain the reliability of SRP’s system, there is a risk associated with too much reliance upon natural gas as a fuel source. The use of natural gas as a fuel source needs to be evaluated in the overall operational and financial impacts to SRP. Natural gas risk is associated with the three factors outlined above.

1. Customer Demand: SRP must evaluate the amount of natural gas that it must purchase in the future. If demand is higher than expected the costs associated with the gas can be higher and the ability to transport the gas to SRP facilities may be impacted. If gas volume requirements are lower SRP may be in a position where it has purchased too much gas transportation capacity.

2. Asset Retirements: Emerging environmental regulations may necessitate the closure of a substantial amount of coal facilities. If natural gas becomes too large a portion of the overall resource mix, SRP may end up with too much exposure to the volatility of the natural gas market.

3. Renewable Integration: Because many of the most cost-effective renewable generation technologies today are intermittent in nature, natural gas resources that are capable of changing their output quickly are required.

The scenario planning process allows testing of the robustness of various natural gas burn values in different world futures. Here the scenarios can help to illustrate the relative risk as it relates to natural gas burns across the various portfolios. The process also allows SRP to stress test the range of risk across largely different customer demand and asset retirement assumptions that are embedded in the scenario planning process. The results of the process can be ranked and are summarized in the following table for each portfolio.

<table>
<thead>
<tr>
<th>Gas Burn</th>
<th>Relative Burns</th>
<th>Risk Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portfolio 1</td>
<td>Med</td>
<td>Med</td>
</tr>
<tr>
<td>Portfolio 2</td>
<td>Low</td>
<td>Low</td>
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<tr>
<td>Portfolio 3</td>
<td>High</td>
<td>High</td>
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As the table above illustrates, all three of the portfolios have high degree of range associated with their gas burn amounts and the associated risk. The importance of a diversified resource mix through the inclusion of nuclear becomes evident with Portfolio 2 maintaining the lowest relative gas burns across all scenarios. While Portfolio 1 sees no coal retirements, nearly all new generation is fired from natural gas resources,
driving an increase in gas burns. Portfolio three shows substantial gas price risk associated with coal retirements, meeting load growth, and the integration of large amounts of renewables, with not ability to minimize the burns through the inclusion of non-gas baseload resource.

**Gas Burn Conclusions**

1. Additional demand drives increases in natural gas usage on SRP’s system. Investment in cost effective sustainable resources such as renewable technologies and energy efficiency programs can help to reduce the increase in natural gas demand.
2. Natural gas generation will play an integral role in the reduction of SRP’s overall CO₂ intensity. Natural gas generation will largely replace any coal asset retirements at half the CO₂ intensity of coal resources and serve to efficiently integrate zero emitting renewable technologies into SRP’s system.
3. A resource portfolio mix too reliant on natural gas usage on SRP’s system can increase the price risk associated with natural gas fuel prices, creating unstable energy prices for our customers.
4. The overall volume of natural gas burns and thus the financial and reliability risk can be significantly minimized by the inclusion of a nuclear resource.

**Portfolio Results: CO₂ Intensity**

SRP measures the overall carbon intensity of our system as a key planning metric. This metric shows the total amount of CO₂ that is emitted per each unit of energy produced. This measure is similar to fuel efficiency ratings for automobiles. The fuel efficiency of your car, measured in miles per gallon, indicates how efficiently your car operates. Similarly, the CO₂ intensity metric measures how efficiently SRP is able to deliver power in relation to emitting CO₂.

Consistent with the core resource principle to practice exemplary environmental stewardship, SRP favors resource portfolios that look to reduce carbon intensity. Importantly, the carbon intensity metric allows SRP to account for growth on its system that has occurred throughout SRP’s history. The carbon intensity metric also helps measure our relative future carbon related environmental regulation risk.

In the IRP process, carbon intensity is determined by three key factors:

3. Load Growth: Load growth met with low or non-emitting technologies allow for a lower carbon intensity.

Changes from SRP’s current generation resource mix are required to lower SRP’s carbon intensity. In looking at how to reduce the CO₂ intensity SRP must look holistically at its system to determine the most efficient ways to reduce. The risks associated with reducing CO₂ intensity are related to the three factors that determine the intensity.

1. Coal Retirements: A portfolio heavy in coal generation may reflect low fuel costs, but has capital cost risk associated with environmental regulations.

2. Non-Emitting Resource Acquisitions: Coal retirements will reduce CO₂ intensity. To minimize SRP customers’ price risk for retiring coal plants, remaining useful life must be considered.

3. Load Growth: Higher coal retirements will drive the need for new assets. To mitigate natural gas price risk, nuclear and geothermal resources are viable options to replace coal.

Just as with the capital expenditures and gas burns, there are many implications to reducing SRP’s carbon intensity and the scenario planning process allows us to see these implications across a wide range of future world views. The chart below summarizes these results for each portfolio.

<table>
<thead>
<tr>
<th>CO₂ Intensity</th>
<th>Relative Intensity</th>
<th>Risk Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portfolio 1</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Portfolio 2</td>
<td>Med</td>
<td>Med</td>
</tr>
<tr>
<td>Portfolio 3</td>
<td>Low</td>
<td>Med</td>
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</table>

Portfolio 1 shows the smallest reduction in CO₂ intensity of all three portfolios. This is largely driven by no coal plant retirements. As a result, the CO₂ intensity remains high meaning that this portfolio has the greatest risk associated with future environmental regulations. Portfolio’s 2 and 3 see significant reductions in CO₂ intensity. Both portfolios show a “medium” risk, however the drivers of risk differ. Portfolio 2’s risk is driven by the inclusion of a nuclear resource that lowers the overall CO₂ intensity but has high capital cost exposure. Portfolio 3’s risks stems from the significant amount of coal energy that is displaced by natural gas facilities and intermittent renewables. This portfolio has highest natural gas production that increases natural gas price risk. The renewables have risks associated with integration and reliability.
**CO₂ Intensity Conclusions**

1. Reducing the CO₂ intensity of SRP’s system is an important aspect of minimizing long-term risk associated with future environmental regulations.
2. Retiring coal plants will significantly lower CO₂ intensity.
3. Reductions and retirements of coal assets can have an impact in gas price risk exposure. To mitigate gas price risk, nuclear and/or geothermal generation is a viable resource option to replace coal.
4. Higher intermittent renewable penetration levels on SRP’s system will lower SRP’s CO₂ intensity, but can affect the way in which SRP’s system operates and will require flexible modern natural gas-fired resources to ensure system reliability.

**Portfolio Results: Water Intensity**

Water intensity is similar to measuring the CO₂ intensity of our system, where the value represents the amount of gallons of water used to produce a megawatt-hour. This utilization of water can be for the creation of steam in the generating process as well as for the cooling process. Typically, nuclear and coal use the most water, followed by natural gas plants.

Consistent with the core resource principle to practice exemplary environmental stewardship, SRP favors resource portfolios that look to reduce water intensity. Just as with the CO₂ intensity metric, the water intensity metric allows SRP to account for growth on its system and helps to measure our relative future water related environmental risk.

In the IRP process, water intensity is determined by four key factors:

2. Resource Decisions: The choice of which resources to utilize to meet customer demand will have a large impact on overall water intensity.
3. Load Growth: Load growth met with lower water intensive generating technologies allow for lower water intensity.
4. Nuclear: Nuclear resources are the highest users of water out of all of our current resource options.

Changes from SRP’s current generation resource mix are required to lower SRP’s water intensity. In looking at how to reduce the water intensity SRP must look holistically at its system to determine the most efficient ways to reduce. The risks associated with reducing water intensity are related to the four factors that determine the intensity.
1. A portfolio heavy in coal generation may reflect low fuel costs, but risks associated with high water usage.

2. Coal retirements will reduce water intensity. To minimize SRP customers’ price risk for retiring coal plants, remaining useful life must be considered.

3. In contrast to carbon where nuclear can be beneficial to reduce price risk without emissions, with water nuclear increases the water intensity due to the high cooling requirements.

4. Acquiring new resources that are less water intensive, such as solar photovoltaic and wind technologies can reduce water intensity. Additionally, natural gas utilizing cooling technologies that minimize water usage can also help to reduce emissions. With regard to intermittent technologies there are reliability implications.

Just as with the capital expenditures and gas burns, there are many implications to reducing SRP’s water intensity and the scenario planning process allows us to see these implications across a wide range of future world views. The chart below summarizes these results for each portfolio.

<table>
<thead>
<tr>
<th>Water Intensity</th>
<th>Relative Intensity</th>
<th>Risk Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portfolio 1</td>
<td>Med</td>
<td>Med</td>
</tr>
<tr>
<td>Portfolio 2</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Portfolio 3</td>
<td>Low</td>
<td>Low</td>
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</table>

While portfolio 1 water intensity performance was poor, it exhibits a gradual trend downward trend with regard to water intensity. Portfolio 2 has the highest water usage of any of the portfolios driven nearly entirely by the inclusion of a nuclear resource. The impact of nuclear generation on the water intensity of the system is yet another aspect of nuclear generation that needs to be taken into consideration when planning to add this technology. Portfolio 3 performs the best of all portfolios driven by the overall reduction in coal seen in the portfolio and the inclusion of significant amounts of solar PV which uses minimal amounts of water.

**Water Intensity Conclusions**

1. Reducing the water intensity of SRP’s system is an important aspect of minimizing long-term risk associated with future environmental regulations and is aligned with SRP’s core resource principle to practice exemplary environmental stewardship.

2. Reductions and retirements of coal assets can have an impact in gas price risk exposure. To mitigate gas price risk, other generation technologies need to be incorporated.
3. Nuclear generation can have a large impact on water intensity.
4. Higher intermittent renewable penetration levels on SRP’s system will lower water intensity, but can affect the way in which SRP’s system operates and require flexible modern natural gas-fired resources to ensure system reliability.

**Portfolio Results: Total Costs**

The total costs of the IRP are meant to provide guidance as to what the real world implications could be for various resource decisions. The total costs are not mean to predict future retail electricity prices. For an IRP, the total costs generally represent the costs associated with meeting customer demand and include capital, fuel, operations and maintenance, renewable integration, taxes, decommissioning, energy efficiency, and gas transportation costs.

The metric of total IRP costs is important from a financial and reliability perspective. The costs that are incurred are a direct result of meeting our customers’ needs reliably. The total costs can vary widely between different growth and regulatory scenarios. These costs affect when and how much SRP is required issue new bonds and change prices. As a result, it is important that SRP make wise investment decisions to maximize the value of the energy we provide.

In the IRP process there are a multitude of drivers that can affect the total costs of any of the resource portfolios. Below are outlined the five largest:

1. **Customer Demand:** Growth in customer demand drives the need for additional resources and more fuel; changes in customer preferences can modify how and when customers use energy.
2. **Fuel Costs:** The future price of fuel is a key input to overall total costs.
3. **Asset Retirements:** Once existing assets reach the end of their useful lives, they are retired and replaced with new resources.
4. **Environmental Regulations:** Existing assets sometimes require additional pollution control equipment to keep pace with new environmental quality regulations. Furthermore, new assets in the future may be required to comply with more stringent environmental regulations than currently exist, which could raise the cost of those assets.
5. **Technology Costs:** The cost of new resources is tied to cost inflation and the development of new technologies.

The total costs as a result of meeting future customer demand are largely driven by portfolio investment decisions. The resource decisions that are made in the utility industry have long lived implications. Many of these investment decisions can have different cost outcomes as a result of what type of future world they eventually operate
in. Because the world is ever-changing, and with it the magnitude and timing of the key drivers above, there are significant risks associated with choosing a resource path. The risks associated with the key drivers are outlined below.

1. **Customer Demand:** If demand growth is higher than expected more resources and more fuel will be needed to meet that demand, increasing costs. If demand is lower than expected SRP could be in a situation where our facilities are overbuilt.

2. **Fuel Costs:** If the future price of fuel (natural gas, coal, nuclear) increases, those costs will be incurred in order to generate the energy required. Additionally, if the resource decisions result in an unbalanced portfolio, SRP could see more sizeable risk associated with certain fuels.

3. **Asset Retirements:** New environmental regulations and technological advancements can impact the remaining useful lives of assets. Assets forced to retire would need to be replaced, increasing costs.

4. **Environmental Regulations:** There is a wide range of uncertainty with regard to future environmental regulations. A decision to keep some assets online may be met with higher future costs as a result of future regulations or increase the costs associated with developing new generation assets.

5. **Technology Costs:** While these costs are largely driven by the inflation rate, global supply and demand disruptions for raw materials can swing and impact the cost expectations of future resources.

SRP’s scenario planning process allows us to stress test various portfolios across differing world futures in a way that allows us to see the impacts of the changing world. The scenarios allow us to see how these investment decisions affect the overall costs. The range of the total costs across the portfolios help to illustrate the risk of each portfolio.

<table>
<thead>
<tr>
<th>Total Costs</th>
<th>Relative Costs</th>
<th>Risk Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portfolio 1</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Portfolio 2</td>
<td>Med</td>
<td>Med</td>
</tr>
<tr>
<td>Portfolio 3</td>
<td>High</td>
<td>High</td>
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Portfolio 1 performs well for costs, showing the lowest total costs across all scenarios. This is largely a result of maintaining all of the existing coal resources throughout the planning horizon. By keeping the entire existing infrastructure online, Portfolio 1’s only capital expenditures are associated with generation facilities required to meet load growth. However the portfolio does have the broadest range of environmental cost risk as a result of keeping existing resources online.
Portfolio 2 has costs slightly higher than Portfolio 1. Again, capital expenditures continue to drive the differences here, as capital is necessary to replace the retired coal, construct a new nuclear facility, and meet future demand growth. While nuclear capital costs are high, the fuel cost risk range is muted due to lower gas burns.

As shown above, Portfolio 3 has the highest total costs. While this portfolio has lower overall capital expenditures as compared to Portfolio 2 with its inclusion of a nuclear resource, a significant amount of replacement capital investment is still required to replace retired resources. Portfolio 3 has a significant exposure to natural gas costs due to coal retirements.

**Total Cost Conclusions**

- Future demand drives the need for new capital investments. Cost effective means of reducing peak demand can help to mitigate cost and cost risk.
- A coal-heavy portfolio may minimize capital investment in the near term, but it results in significant cost risk exposure in the long term.
- The capital investment required to construct a new nuclear facility is sizeable; however the capital expenditures result in a more balanced portfolio with less exposure to fuel price fluctuations. Because of the long time-frame required for construction SRP should keep the preserve the option for a nuclear unit in the late ‘20s to early ‘30s.
- Reducing the carbon intensity of SRP’s system comes at a cost, but results in the reduction of environmental regulatory risk in the long-term.

**Step 5: Strategic Direction**

By going through this scenario planning process, we can identify certain resource strategies that respond well to uncertainty. Looking at the metrics helps show what tradeoffs are being made. We can see how the capital expenditures were moving in some opposite ways from the gas burns due to the nuclear resource. We also see that the lowest cost case is also our highest CO₂ case. Based upon the analysis of results and comparisons of the resource alternatives within each scenario a general resource strategy is developed.

The strategy below recognizes the tradeoffs that can occur between resource choices and recommends what is seen as the strongest strategy to move forward with. As part of the Stakeholder Initiatives Advisory Panel (SIAP) meetings, SRP reviewed and sought comment and input on SRP’s proposed strategic resource direction. The recommendations outlined below reflect the modifications from the SIAP. These recommendations were presented to SRP’s Board.

The principal elements of SRP’s recommended strategic resource direction include:
• Coal: A deliberate, meaningful reduction in the amount of energy in SRP’s portfolio produced by coal generation. This will diversify SRP’s resource energy mix as well as lowering our carbon and water intensity metrics. To minimize total cost, remaining useful life must be considered.

• Nuclear: Taking appropriate steps necessary to develop and preserve the option for new nuclear generation in the late 2020s-early 2030s. This will diversify SRP’s resource mix, mitigate fuel price fluctuations and lower carbon intensity. Preserving the option today, however, recognizes the high capital investment and long lead time required to build a new nuclear facility.

• Natural Gas: An increasing role for natural gas generation as a means to 1) partially meet increases in customer demand 2) reduce SRP’s carbon emissions intensity, and 3) ensure reliability in a system with increasing levels of intermittent generation, such as wind and solar generation. This will diversify SRP’s resource mix with a reliable, flexibly and relatively lower capital cost resource.

• Renewables: Add a diverse mix of new renewable energy resources as a critical element to reduce SRP’s carbon emissions intensity. Cost, contribution to peak demand and reliability considerations will be key factors in determining our renewable mix.

• Other: Other cost-effective options, such as the electrification of transportation and forest health initiatives will also be considered and implemented as a means of meeting SRP’s strategic objectives and reducing our carbon emissions intensity.

• Energy Efficiency: Promoting cost-effective energy efficiency and other load management options. These options can help lower SRP’s carbon and water intensity as well as lowering peak system requirements that reduce the need for new generating capacity on SRP’s system.

• New Technology: Collaborate with others to encourage the development of and support for innovative application of new power generation, load management, and energy storage technologies through active participation in industry research and development organizations. As new technologies become proven and commercially available, SRP will consider new technologies in future resource plans.

Summary
The purpose of the resource planning process is to determine which resource strategy will allow SRP to best meet projected demand in an uncertain future. SRP crafts different future scenarios (what SRP can’t control) to test the performance of each distinct resource portfolio examined (what SRP can control). The strengths and
weaknesses of each portfolio are determined by our key planning metrics. This effort allows us to craft a resource strategy that incorporates the strengths and mitigates the weaknesses of each portfolio to meet our customers’ and other stakeholders’ expectations of low-cost, reliable power while demonstrating exemplary natural resource conservation and stewardship.

Natural Resource Stewardship and Conservation

SRP’s Sustainable Portfolio Principles

SRP has a long history of natural resource stewardship. In 2004, the Sustainable Portfolio Principles (SPP) were first introduced, and SRP’s Board adopted a complementary goal that called for SRP to meet 2% of its retail energy requirements with sustainable resources by 2010. The SPP resources include hydroelectric, wind, solar, energy efficiency, geothermal and biomass. The primary goal of the SPP is to reduce emissions by the displacement of fossil fuel resources. As part of the 2004 SRP Board resolution, SRP management was asked to evaluate options for future direction of its Sustainable Portfolio. In 2006, SRP’s Board voluntarily adopted a proposal by SRP’s management requiring 15% of SRP’s energy production to be met with sustainable resources by 2025. As the cost of renewables continued to decline and stakeholder expectations increased, the Principles were modified in 2011 to not only increase the level of sustainable resources required from 15% to 20% but also to achieve the goal five years sooner—by 2020. In FY14, 12% of the energy for our retail customers came from sustainable resources. We are well on track to meet the SPP goal by 2020 and need to consider what conservation and stewardship goals for our resources should look like beyond 2020, once the current SPP goal has been met. For a variety of reasons, we believe that transitioning to a more explicit carbon intensity reduction is the best path.

Proposed Change

From the outset, SRP’s SPP recognized that the goal should not be to choose a specific resource technology (or technologies), but rather that the SPP should produce the maximum sustainable energy benefit. To this end, SRP has evaluated the merits of creating a long-term carbon dioxide (CO₂) intensity reduction goal, which would replace the current SPP goal. In meeting with our stakeholders, it was made known that the preference would be to replace the current goal only after the current one is met in 2020. This new metric would show the total amount of CO₂ that is emitted per each unit of energy produced. This measure is similar to fuel efficiency ratings for automobiles. The fuel efficiency of your car, measured in miles per gallon, indicates how efficiently your car operates. Similarly, the CO₂ intensity metric measures how efficiently SRP is able to deliver power in relation to emitting CO₂.
Why An Emissions Intensity Metric Is Better

1. **Flexibility is needed as the cost of certain renewables continues to drop**: Since the inception of the SPP in 2006, the price of solar PV and wind generation has declined significantly. While technological breakthroughs and cost projections are difficult to forecast, transitioning to an intensity standard will allow SRP the flexibility to adopt any technology that sees cost declines, which allows SRP to lower its CO\textsubscript{2} emissions intensity. In order to maximize value to our customers, we need the flexibility to choose the best options in light of technological advances and cost declines, which are inherently difficult to forecast.

2. **Renewed/strengthened political and regulatory interest in CO\textsubscript{2} emissions**: EPA has recently proposed its Clean Power Plan that directly addresses CO\textsubscript{2} emissions intensity in the United States.

3. **Accomplish more in a more cost effective manner**: Moving to a CO\textsubscript{2} intensity reduction goal would allow SRP to reduce emissions more and at a potentially lower cost than under a prescriptive sustainable resource requirement.

4. **More options available**: Part of the reason that we can reduce emissions more for a lower cost is the availability of power system options that aren’t included in the SPP. The best example of which would be efficiency improvements at our power plants and on our transmission and distribution systems (i.e. the “wires”). By improving the efficiency of those assets, we can deliver more electricity using less fuel, which naturally means fewer emissions. Other technologies in the future may forest health initiatives and the electrification of the transportation sector, e.g. supporting the growth of electric vehicles.

5. **Customer trends and preferences**: Preferences of some customers for renewable generation options have been changing. Along with a preference toward renewable energy, SRP has seen that many customers have their own internal goals and requirements. As we move forward, an emissions intensity standard will allow SRP to more effectively meet customer preferences as they develop.
SRP’s CO₂ Intensity Reduction Proposal

SRP’s specific proposal is to adopt an explicit long-term commitment to reduce CO₂ emissions intensity beginning in 2020 after the current SPP goal has been met. This CO₂ emissions intensity reduction from this commitment is contrasted against what would have otherwise been accomplished through a basic continuation of the current SPP goals. As can be readily observed, our goal is to accomplish more.

The commitment includes the following:

- Reduce CO₂ intensity by 40% over the next 30 years.
- Provide transparency in reporting required to make sound comparisons of its sustainable resources to other electric utilities.
- Continue to add new renewables to SRP’s portfolio and invest in cost-effective energy efficiency measures on both the customer and utility side of the system.
- The achievement of the target follows a least cost discipline, accounting for the uncertainty in future cost projections. This discipline may mean utilizing other approaches to reducing emissions including, but not limited to, the replacement of coal energy with natural gas resources, new nuclear generation, water conservation, healthy forest initiatives, self-directed customer renewables, and efforts to aid in the reduction of CO₂ emissions from the transportation sector.

Proposed EPA Carbon Rule

As we have seen with the recent release of the Environmental Protection Agency’s (EPA) proposed “Clean Power Plan,” there is a very significant regulatory focus on the reduction of CO₂ emissions intensity.

We are currently evaluating and commenting on the EPA proposal and its effect on SRP, our customers, and the state’s economy. We know that Arizona has one of the highest required emissions reductions of all the states. Fortunately, the planning work that we have been doing over the past several years has put us in a good position to quickly evaluate the proposed rule, to make comments to the EPA for consideration in the final rule, and to understand how our plans might need to change.
As this proposed rule was released towards the end of our planning process, and it will not be finalized for at least another year and the state’s implementation plan wouldn’t be finalized for at least another year after that, we will move forward with finalizing our current planning process with an understanding that the resource plan will need to be sufficiently flexible to incorporate potential carbon emission regulations.
Implementing the Strategic Direction

While the focus of this report is largely based on the “what” and “why” of SRP’s strategic direction, our stakeholders are also interested in what the direction might look like in terms of a specific resource mix. To be responsive to this interest, we offer this information as displayed and discussed below. We would emphasize that a key strength of a high-performing resource strategy is flexibility, i.e. the ability to adapt to changing circumstances in customer demand growth, usage patterns, fuel prices, technological development, and environmental regulations. Therefore, the pictures that follow can, and mostly likely, will change over time while remaining consistent with the overall strategy.

Projected Resource Mix

The projected changes in SRP’s energy mix over the next 15 years reflect a more diverse and less CO₂ intensive resource portfolio, as reflected in Figure 15. This additional diversity and lower CO₂ intensity directly results from a focus on the addition of new natural gas and sustainable resources.

For our coal resources, due to remaining useful life considerations, we would not expect to retire any existing coal resources prior to 2029. As we also have no plans on adding any coal resources on a long-term basis, coal energy as a percentage of total customer demand will continue to diminish as load grows such that coal will only be expected to provide 35% of annual energy by 2029. There are, of course, circumstances where some coal generation could be retired sooner than that as a result of environmental regulations.

Looking a little beyond 2029, we think that it is reasonable to expect that some of SRP’s existing coal fleet will be retired as a way of reducing carbon intensity and mitigating capital cost risk. The specific amounts, timing, and units would be dictated by a variety of factors; however, to meet our CO₂ intensity reduction commitment, as described in this document, a shutdown of roughly one third of the existing coal fleet is a reasonable assumption given current expectations.

Our current expectation for nuclear resources would be for no additions prior to 2030, though that could also change based on expectations for natural gas prices and compliance with CO₂ regulations. As with our coal resources, if we add no new nuclear resources, its contribution to our portfolio as a percentage of annual energy will diminish as customer demand increases.

Sustainable resources, including renewables, hydroelectric generation, and energy efficiency programs are expected to grow the most of any resource type in terms of
contribution to annual energy production. This is based on our strategic direction to reduce carbon intensity and also the significant decreases that we’ve seen in the cost of renewable generation. New utility-scale solar generation, in particular, is nearing cost competitiveness with energy produced by natural gas-fired generation at certain times of the year, recognizing, of course, that natural gas-fired generation is still required to provide energy when solar isn’t producing. SRP will continue to seek the best overall mix of these sustainable resources to the ultimate benefit of all our customers. This mix will be determined by customer cost impact, reliability, and overall risk reduction.

SRP has long relied on both short- and long-term **market purchases** to offset the need to build new generation. The amount of market purchases that our plan incorporates is based on extensive evaluations of excess regional capacity. In times of high regional surplus capacity, we can utilize a relatively higher level of market purchases. In time of diminished regional surplus capacity, we will plan to build new generation. In all cases, the focus is on resource adequacy and cost minimization.

**Demand reduction programs** such as time-of-day pricing programs, demand response programs, customer-owned generation, and energy efficiency measures. They are an important aspect in our efforts to mitigate the need to build new power generation resources. The drop-off in the contributions of these programs over the last five years of the plan is due to an expected shift in the peak demand hour and not a scaling back of the programs.

**Near Term Action Plan**

**Renewable and Energy Efficiency Investments**
Our resource plan will continue to add a diverse mix of renewable resources. As part of these additions SRP recently announced a 21-year solar PV power purchase agreement at a cost of $52.90/MWh. The 45-MW facility, known as the Sandstone Solar Power Plant, will be located near Florence, Ariz. and is expected to be online in 2015. SRP is looking to add another 55 MW of solar PV in 2020. By 2020, SRP plans to add 87 MW from existing geothermal resources located near the Salton Sea in California. This new geothermal generation is already under contract.

SRP will also pursue energy efficiency and peak reduction programs that help reduce CO₂ and water intensity as well as defer the need for new generation in a cost effective manner.
Natural Gas
To meet growing demand as well as increasing SRP’s resource flexibility that will support the integration of renewable generation like the Sandstone Solar Power Plant, SRP will begin adding 819 MW of combustion turbine capacity over the next 10 years. The next immediate step in this process is securing the permits necessary to construct the facilities.

Coal
SRP is looking to extend the life at the Navajo Generating Station (NGS) beyond 2019. It is important that NGS remain in operation for the Arizona economy, the Navajo and Hopi Tribes, as well as for the delivery of Colorado River water to central Arizona. Both the Los Angeles Department of Water Resources (LADWP) and NV Energy (NVE) have publically stated that they intend to exit ownership of NGS prior to 2020. The NGS participants are currently seeking the best way to facilitate this exit. Relative to LADWP’s ownership share, SRP may consider purchasing that share to facilitate an earlier exit by LADWP, as they have expressed an interest in doing.

Nuclear Generation
SRP continues to evaluate the efficacy of adding new nuclear generation onto our system. SRP will continue to maintain nuclear as an option through continued involvement in securing locations capable of siting a nuclear facility, conducting transmission line studies on the effects of integrating nuclear resources, remaining engaged with the current construction and siting processes underway in the United States, evaluating the economics of nuclear, and assessing water availability.

Research and Development
Since 2000, SRP has invested over $50 million in research and development through the Electric Power Research Institute and local universities. Each year, SRP establishes corporate R&D priorities. This research brings science, technology, and information solutions to address important issues facing SRP, while also aiding in building partnerships with utilities, local universities, and other stakeholders. The purpose of this exercise is to identify the areas in which SRP should focus its research efforts. The current list of corporate R&D priorities includes: manage and preserve water resources; manage and optimize SRP’s retail load; preserve existing power generation fleet; maintain and improve transmission and distribution system reliability and safety; study integration impacts and performance of renewable resources; and advance research on methods for reducing carbon emissions from SRP’s generation fleet.
Conclusion

SRP believes that the year and a half long process required to update its IRP and to engage stakeholders has resulted in a well-founded strategic direction that establishes the foundation for providing reliable and affordable electricity to our customers for many years into the future, and doing so in a way that exemplifies the wise stewardship and conservation of natural resources.