

2030 Zero Carbon Plan

An illustration featuring two stylized wind turbines in shades of green and yellow. In the foreground, a light blue electric car is shown plugged into a charging station. The charging station is a white structure with a solar panel on its roof. The background is a dark blue grid pattern.

SMUD's flexible road map to eliminate carbon emissions from our power supply by 2030.





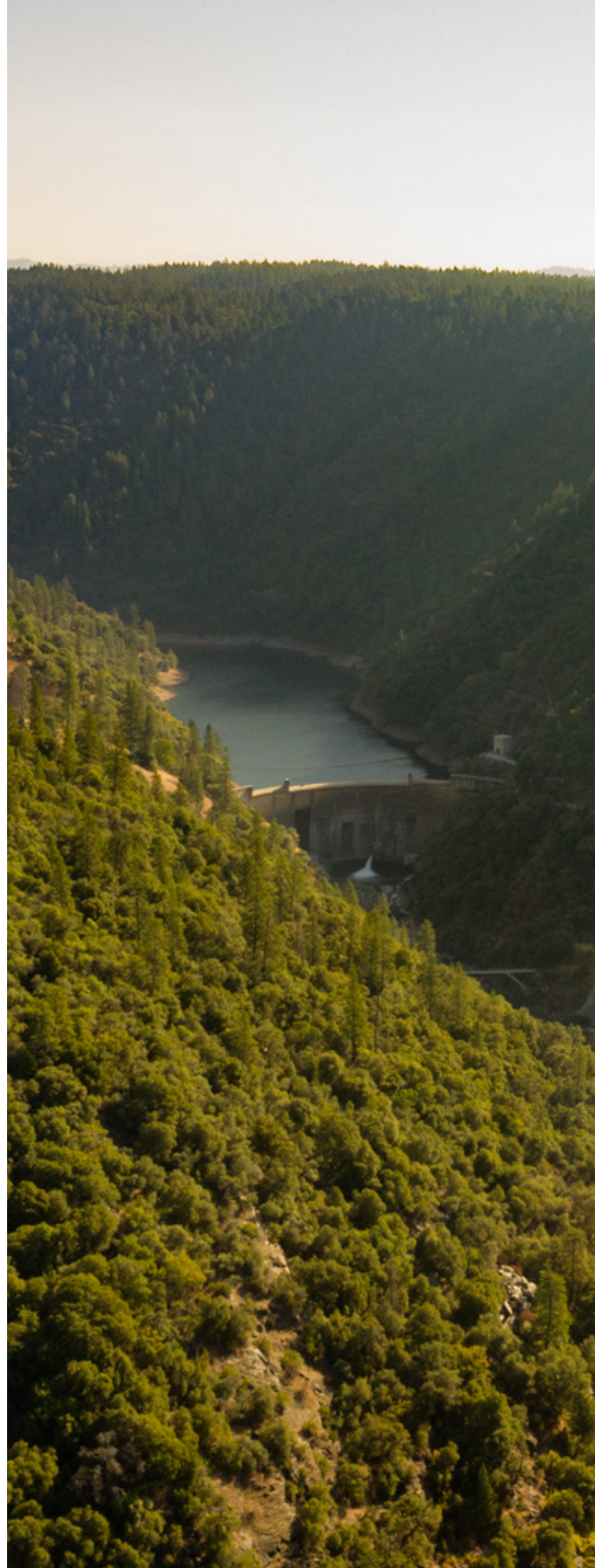
Executive Summary

SMUD's goal to eliminate carbon emissions from our power supply by 2030 is more ambitious than already aggressive state mandates and is ahead of virtually all other utilities in the United States. Our 2030 Zero Carbon Plan is a flexible road map to achieve our zero carbon goal while ensuring all customers and communities we serve reap the benefits of decarbonization.

For more than a half century, SMUD has focused on growing the amount of carbon-free electricity we provide to the Sacramento region. Construction of our Upper American River Project (UARP), a 688-MW hydroelectric system in the Sierra Nevada Mountains west of Lake Tahoe, began in 1957. Today, the UARP supplies 16% of our energy needs with low-cost, carbon-free electricity. With a range of other clean energy resources in our portfolio, SMUD's energy supply is on average 50% carbon-free today.

It's in our DNA to lead the way in carbon reduction. We've consistently set renewable energy and carbon reduction goals that are ahead of and more aggressive than state mandates. We set these aggressive goals because it's the right thing to do.

Having ambitious goals helped SMUD become the first large California utility to have at least 20% of our energy come from renewable sources. We have a long list of notable firsts: The world's first commercial-scale solar photovoltaic power plant in 1984, the original green power pricing program for our customers, the first utility in California to make time-based rates standard for all customers and the first solar-powered electric vehicle charging station in the western United States. But we recognize these are not enough.





Globally, 2016 and 2020 were the hottest years on record and California has witnessed first-hand the devastating impacts of carbon on our climate, with devastating wildfires, rising temperatures and decreased snowpack. In 2018, SMUD set one of the most aggressive carbon reduction targets in the country with the goal of achieving net zero emissions by 2040, five years ahead of California's 2045 net zero goal. In July 2020, our Board of Directors declared a climate emergency and adopted a resolution calling for SMUD to take significant and consequential actions to become carbon neutral (net zero carbon) by 2030. The Board also directed SMUD staff to report by March 31, 2021 on clear, actionable and measurable strategies and plans to reach SMUD's climate emergency goals. Rapidly advancing clean energy technology and a collaborative and inclusive approach to carbon reduction has allowed SMUD to set the even more ambitious goal of zero carbon by 2030, with the 2030 Zero Carbon Plan being our strategy to achieve that goal.

Eliminating carbon emissions will deliver far-reaching benefits. It's the right thing to do for the environment, air quality, our children and grandchildren and for equity in communities that have traditionally been left out of decisions and discussions about carbon emissions. This ambitious goal puts the Sacramento Region on the map as an example to follow and a region where innovative, climate-friendly businesses want to be.

We have a track record of setting game changing goals and achieving them. Our 2030 Zero Carbon Plan details how we'll get to zero without compromising reliability or affordability. It comes with a commitment to keep rate increases within the rate of inflation. While nine years is an aggressive timeline, we know the clean energy and clean technology sectors and customer preferences will change significantly between now and 2030, so flexibility is central to our Plan.

Going absolute zero carbon is a bold and ambitious goal -- one we believe we can and must achieve. We can't get there with today's technology and we can't get there alone. That's why innovation and partnership are key pillars of the Plan. Working in partnership with our customers and community, government agencies, community leaders and organizations, business leaders and the business community, legislators, regulators and others, we'll help align resources and programs for maximum impact in all communities. We know, for example, that widespread adoption of customer-owned distributed energy resources like electric vehicles and rooftop solar will be key to achieving zero carbon. Making these technologies accessible to all customers will be a central focus of our program development efforts over the coming years.



**Zero
carbon**
by **2030**

Our 2030 Zero Carbon Plan is our road map to eliminate carbon emissions from our electricity production by 2030 while maintaining a reliable and affordable service and partnering with our customers, communities and a wide range of stakeholders on this journey.

Our commitment to our customers and community

As a community-owned, not-for-profit utility, our customers and community are at the heart of all we do. By pursuing zero carbon, we're helping create a cleaner and healthier region for all.

Our goal of zero carbon by 2030 is anchored in our longstanding commitment to provide safe and reliable power with rates among the lowest in California. We won't compromise on this commitment.

Our customers, community and other partners are central to our vision and part of the solution to decarbonize our region. Their input and participation have helped us develop the 2030 Zero Carbon Plan. Ongoing communications and engagement with our customers and community will help ensure we continue to deeply understand their needs, which will be essential to enhance our programs to support zero carbon while meeting our customers' evolving preferences. Continuing to educate customers on the benefits of zero carbon and ways they can take action will also be critical to achieving our goal.

SMUD's zero carbon goal is best achieved by finding mutually beneficial solutions and we reaffirm our commitment to being inclusive, supporting regional innovation, clean tech jobs and attracting clean energy investments to the region through collaborative partnerships.

We have an opportunity to bring together a wide range of stakeholders — businesses, elected officials, community leaders and organizations, think tanks, academia, regulators, start-ups, native tribes, venture capitalists and others to align resources for maximum impact. We'll partner with others to develop technology, healthy ecosystems, find innovative sources of funding and develop new business models. We will also need to work closely with regulators with respect to climate-friendly policies and regulations that encourage electrification in the building and transportation sectors, which are currently the largest emitters of carbon/greenhouse gases in California.





SMUD is committed to achieving our zero carbon goal in an inclusive way that leaves no communities behind. For decades, SMUD has supported low-income customers with innovative programs to make energy efficiency and other technologies accessible. In 2016, SMUD introduced additional energy saving pilots which expanded our reach and helped thousands of income qualified customers adopt carbon reduction measures in their homes and reduce their overall energy bill burden. Measures included replacing gas appliances with electric appliances, installing rooftop solar systems, insulation, heating and cooling systems, and lighting and/or other weatherization improvements. We'll continue to re-examine our programs and pilots to tailor them to supporting our goal and our customers' needs in all segments.

Our Sustainable Communities Initiative helps bring environmental equity and economic vitality to all communities in our service area, with special attention given to historically underserved neighborhoods. We believe in the ability to make a greater collective community impact through partnerships. Through our Sustainable Communities Initiative, we collaborate with private industry, government agencies and nonprofits to invest in and implement programs that provide equitable access to indicators of sustainable community success, with a focus on social wellbeing, healthy environment, prosperous economy and mobility.

We're looking at other creative ways to support investment in underserved communities, including partnerships with financial institutions and other businesses and pursuing foundation and private investments to support decarbonization programs.

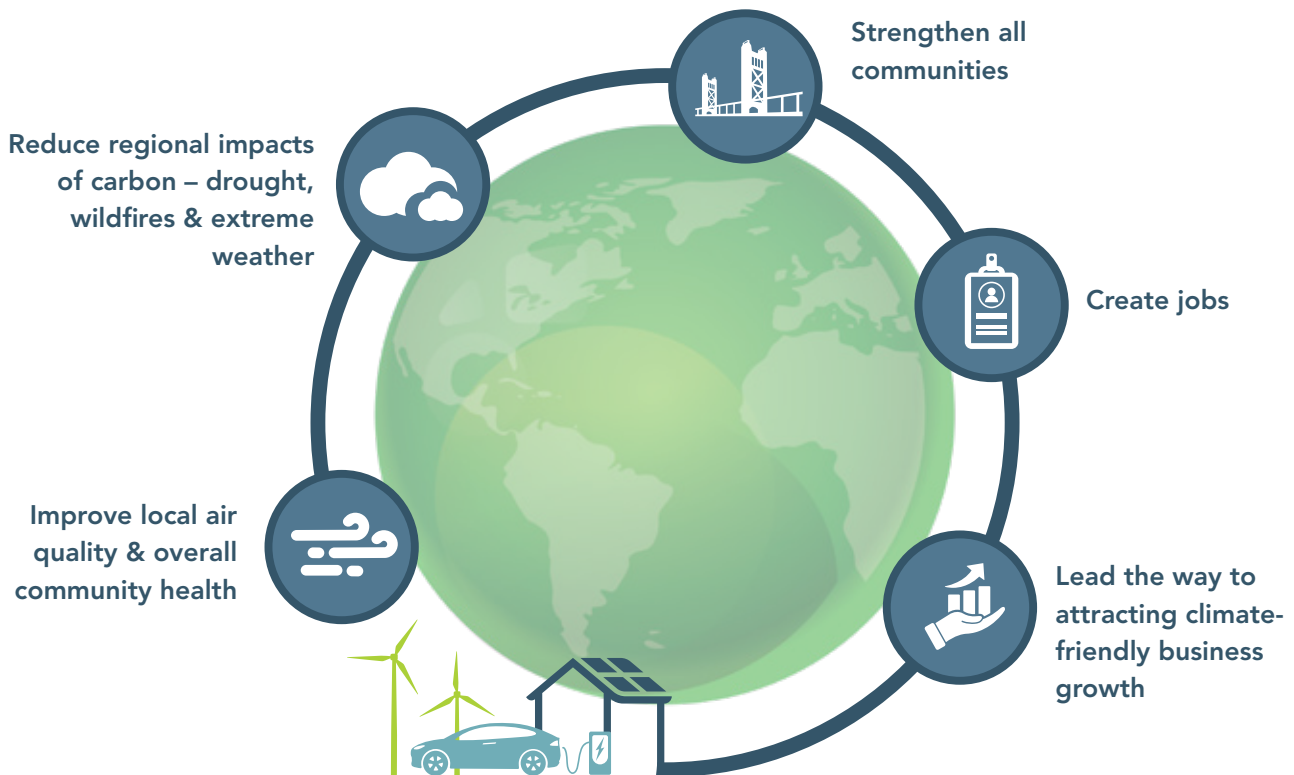
We'll continue working with our business customers to identify partnership opportunities to align resources, test technology, electrify buildings and transportation. Together, we'll develop tailored programs and pilots, while exploring co-development of new technologies and solutions. We plan to partner to seek funding for new initiatives that can help our region decarbonize faster and at lower cost.

Our commitment to our customers and community

Policy makers and regulators play an incredibly important role in shaping our zero carbon future. We plan to work collaboratively to promote cost-effective measures to reduce carbon emissions and support policy that encourages carbon reduction. We'll also work with government agencies to seek funding opportunities for new technologies and solutions that support SMUD's research and development efforts.

We have a history of partnering with our community and are excited to have broad support from our customers and community for our commitment to eliminating carbon from our power supply. We will build on what we're already doing – leading by example and engaging members of our community and industry – and together we can create and work toward a shared vision for the future. We'll continue to empower our communities to work with us to make sure Sacramento communities are livable, resilient and ready for a low-carbon future.

Community benefit



The road to zero: Four focus areas

Our 2030 Zero Carbon Plan is a road map with the flexibility needed to adjust to changing technology and customer preferences to completely eliminate the use of fossil fuels in our electricity production by 2030. With the clean energy technology in our power supply today, we expect to be able to reduce our carbon emissions by 90%, without compromising reliability or our low rates. Eliminating the last 10% will be more challenging and will require SMUD to take bold actions and pioneer new game-changing technologies.

To achieve zero carbon, we're focused on four main areas:

- **Natural gas generation repurposing.** Eliminating greenhouse gas emissions from our power plants is essential to reach our goal of zero carbon. We're focused on reimagining our existing generation portfolio to eliminate greenhouse gas emissions through retirement, re-tooling and using renewable fuels.
- **Proven clean technologies,** which are carbon-free technologies available today, including solar, wind and geothermal energy and battery storage. We'll significantly expand our investments in these technologies and adjust our plan as we progress in the other three areas.
- **New technologies and business models,** which are technologies that are either currently unknown or are not ready for large-scale adoption due to price, reliability or other factors. We'll launch pilot projects and programs to test and prove new and emerging technologies and develop paths for prioritizing technology adoption and scaling.
- **Financial impact and options.** We're focused on making sure achieving our zero carbon goal is possible at a reasonable cost that minimizes rate increases for our customers. We'll do that by identifying savings and pursuing partnerships and grants that support the Plan.





Figure 1. Priority areas of focus in SMUD’s 2030 Zero Carbon Plan

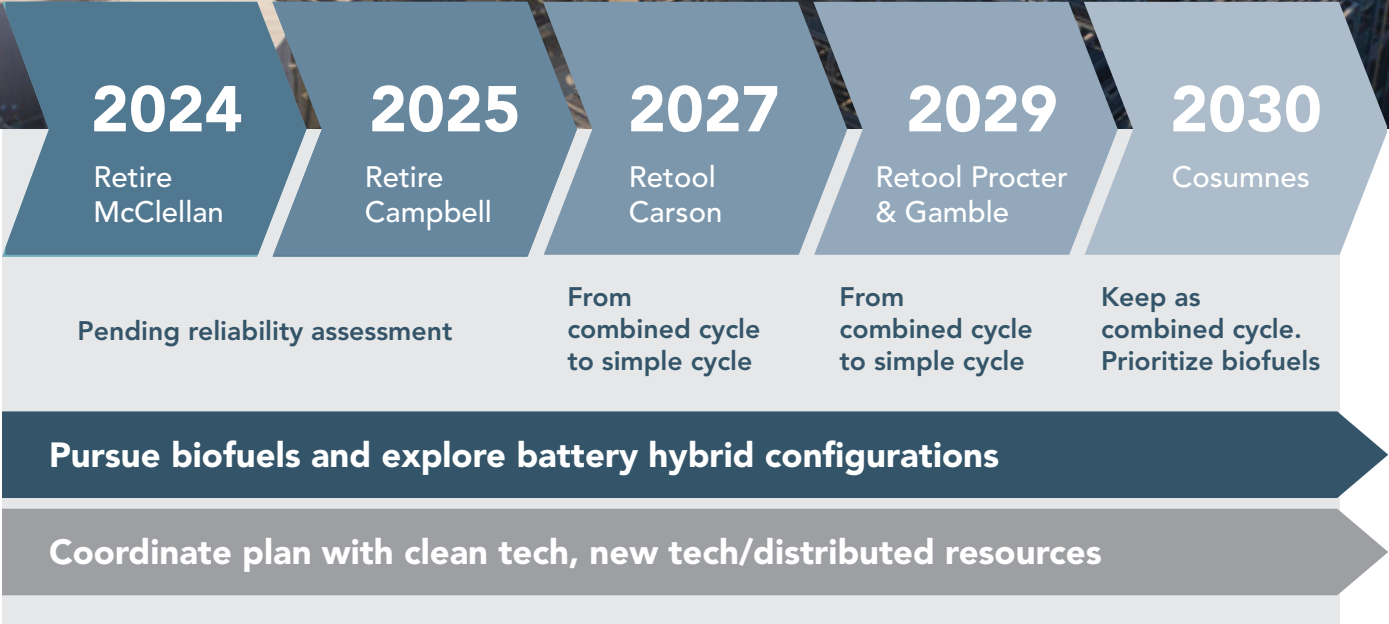
We’re committed to eliminating carbon emissions in our power supply while recognizing flexibility is needed to adapt as new technology emerges, costs decline and our customers adopt more distributed energy resources and other technology. While pursuing each of the four areas will be important through 2030, activities may accelerate or decline in individual areas based on overall progress and advancements in specific areas.



Natural gas generation repurposing

Our gas power plants provide low-cost, reliable energy. While recent investments mean SMUD’s Cosumnes Power Plant is the most efficient combined cycle gas plant in California, today our gas plants are our main source of greenhouse gas emissions, so retiring and/or refueling them is a significant part of how we’ll reach zero emissions. We looked at a variety of options in developing our 2030 Zero Carbon Plan.

We believe our gas power plants can continue to play a vital role to support reliability without emitting greenhouse gases. By retooling two of our plants from constant operations to become more flexible peaking units, we can drastically reduce their use and carbon emissions while maintaining most of their capacity. We’re targeting operating them on biofuels such as renewable gas from landfills, biodiesel or other renewable sources when they’ll need to operate for reliability.



Our Campbell and McClellan gas plants are located in areas already affected by air pollution. Modifying or retiring these plants will bring air quality benefits to these historically under-resourced communities because they’re located in areas of SMUD’s territory with some of the highest environmental sensitivity scores. Based on our studies to date, we believe we can retire McClellan in 2024 and Campbell in 2025 and replace them with proven clean technologies. Final decisions about the retirement of these plants will be based on additional reliability studies and discussions and engagement with the community.

Our Plan, which includes retiring two power plant and retooling other, will reduce our emissions and improve air quality in Sacramento. Table 2 is the summary of our plan to retire, retool and minimize the use of natural gas at our plants.



Table 2: Natural gas generation repurposing expected status in 2030*

Power Plant	Generator Type	Capacity (MW)	Fuel Source
Sacramento Power Authority at Campbell Soup		Retired*	
McClellan Gas Turbine		Retired*	
Central Valley Financing Authority at Carson Ice	Combustion Turbine	100	Biofuel**
	Steam Turbine	Retired*	
Sacramento Cogeneration Authority at Procter & Gamble	Combustion Turbine	150	Biofuel**
	Steam Turbine	Retired*	
SMUD Financing Authority at the Cosumnes Power Plant	Steam Turbine	207	Waste Heat
	Combustion Turbine	414	Biofuel**

*Final generator configurations are pending reliability assessment

**Final 2030 fuel mix is to be determined. Dependent on options available and may include one or more of the following: hydrogen, biogas, renewable natural gas, biofuels





Proven clean technologies

Proven clean technologies are the relatively mature zero emission technologies available in the market today and have demonstrated reliability and cost benefits. Along with reimagining our natural gas power plants, proven clean technologies are the foundation of this Plan and we expect they'll help reduce our carbon emissions by about 90% by 2030, far exceeding the regulatory and legislative mandates in place today.

Proven clean technologies include utility-scale wind, solar, batteries, hydroelectric power, biomass, geothermal, as well as customer-owned solar and battery storage. Our Zero Carbon Plan includes a significant increase in investments proven clean technology over the next nine years, by SMUD and our customers.



Utility-scale investments (2021-2030)

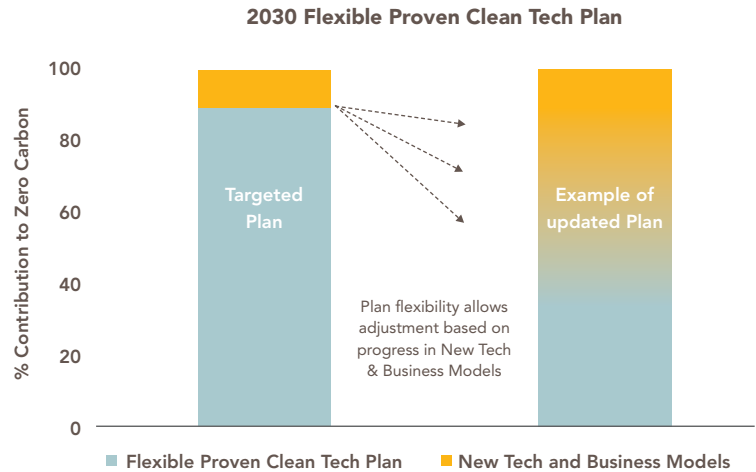
Local solar: 1,100 to 1,500 MW

Local battery storage: 700 to 1,100 MW

Wind (various locations): 300 to 500 MW

Geothermal (various locations): 100 to 220 MW

These utility-scale investment ranges are based on current and expected market conditions and costs for new technologies, recognizing market conditions can change quickly, impacting resource availability and costs. External market factors such as changes in California and western U.S. electricity market rules also play an important role in resource adoption, as do legislative and regulatory changes. If emerging technologies develop faster than expected, we will adjust our proven clean technology strategy accordingly. Similarly, if costs for new technologies decline slower than expected or if promising research areas don't yield the expected results, we may need to scale up our investments in other areas.



Customer-owned adoption of solar and storage (2021-2030)

Customer rooftop solar: 250 to 500 MW

Customer battery storage: 50 to 250 MW

We recognize our customers' investment in rooftop solar and battery technologies depend to a large extent on costs as well as overall customer sentiment about zero-carbon technologies. Investment estimates are based on today's forecast of probable adoption rates and the ranges reflect the uncertainty of costs associated with these systems over the next decade.

To safeguard reliability, it's also important that SMUD maintains a diverse resource portfolio that reflects different generation technologies and geographic diversity. So, our Plan includes intermittent renewable energy such as wind and solar as well as energy storage and geothermal resources that support reliability.



New technologies and business models

Emerging technologies play a critical role in our Plan, specifically to eliminate the remaining 10% of carbon emissions. We'll look to emerging distributed energy resource options and large-scale new technology innovations. This includes focusing on new applications for customer-owned distributed energy resources by assessing the attractiveness, costs and reliability of emerging technologies and business models. After launching and evaluating pilot programs and projects we will evaluate, prioritize and scale the technologies and programs we expect will have the largest impact reducing carbon in our 2030 resource mix, especially in terms of short duration generation capacity. To that end, we're focused on four main areas of technology:

- Electrification.
- Education and demand flexibility.
- Virtual power plants (VPP) and vehicle-to-grid technology (V2G).
- New grid-scale technologies.

Taken together, we expect customer-owned resources and SMUD customer-focused programs will contribute between 360 and 1,300 MW of capacity to our grid by 2030, depending on the rate of customer adoption and the success of the programs and technologies we develop.



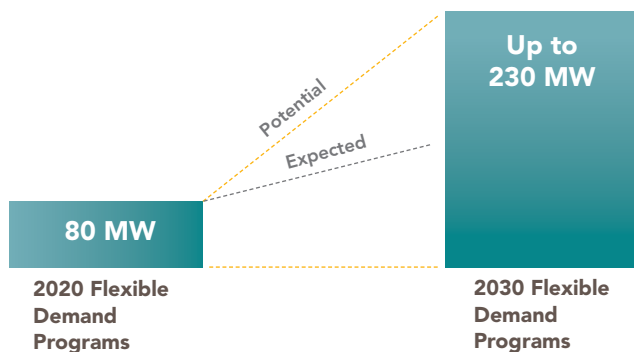
Electrification

Electrification of buildings and vehicles is a priority for SMUD today to support the decarbonization of these sectors, which are the largest carbon emitters in California. Our 2030 Zero Carbon Plan continues to prioritize electrification of transportation as well as new and existing buildings. In addition to piloting innovative electrification programs, we'll continue to engage under-resourced and low-income communities to achieve bill savings and ensure access to clean technologies. Examples of potential programs include:

- Electrifying multi-family homes, schools, commercial buildings, and under-resourced communities.
- New construction smart homes.
- Financing options.
- Turnkey EV charging solutions for residential and commercial properties.
- Incentives for used EVs.

Learnings from these pilot programs will help us identify the ones to scale. Pursuing external grants to help make these initiatives more affordable for all customers, we'll also advocate for regulatory changes and seek to collaborate regionally to accelerate the adoption of zero carbon technologies.

Education and load flexibility



We're on an important journey with our customers and it's important to help ensure our customers understand the actions they can take to help support decarbonizing our region. Through pilot programs aimed at flexible energy use, we can help customers reduce their energy usage and bills at times when the stress on our grid is the highest. These types of universal customer programs reduce carbon emissions without requiring customers to spend money on advanced technologies.

If successful, we'll scale our flexible demand programs as a lower cost alternative to large solutions such as utility-scale battery storage.

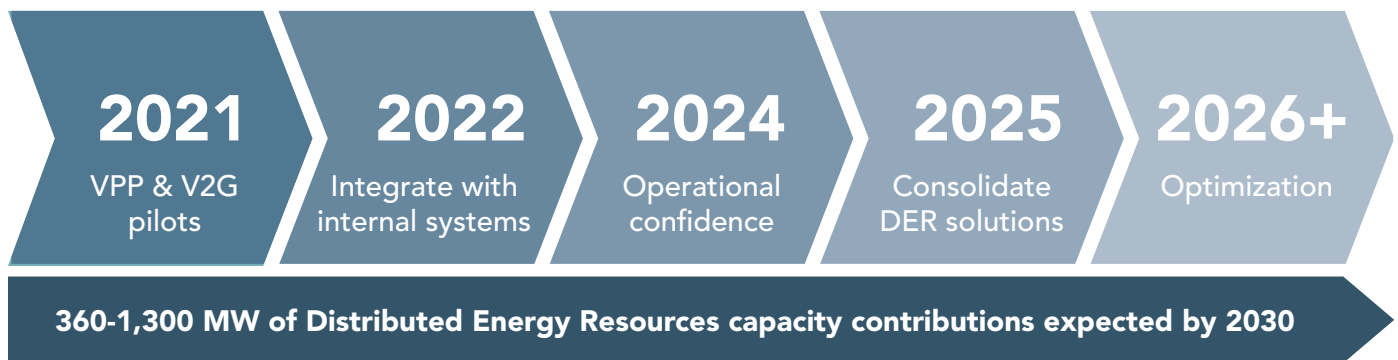
Customers will also have options to participate in programs that leverage the advanced and automation capabilities of their own devices, such as thermostats and electric vehicles, for deeper bill and carbon savings. We expect to develop about 165 MW of flexible load programs by 2030, but more could be possible as our programs continue to evolve to leverage advancing technology.



Virtual power plants (VPP) and vehicle-to-grid technology (V2G)

These programs seek to optimize the operation of our customers' equipment and distributed energy resources, balancing customer and grid needs to maximize benefits for both, while compensating customers for the energy they supply into SMUD's grid for use by other customers.

A virtual power plant consists of many small devices often owned by customers and located at their homes and businesses. When operated and managed together in a coordinated way, they can become an alternative to a conventional utility-scale power plant. VPPs can include electric vehicles, batteries, thermostats and electric water heaters. By aggregating their capacity and flexibility, a VPP can mimic a power plant and provide services that help reduce electric peak demand during hot summer days or cold winter nights, potentially reducing the need for SMUD to build or buy other resources freeing resources to more aggressively invest in renewable energy.



We will launch several VPP pilot programs between 2021 and 2024 to demonstrate and test their reliability, cost and value compared to alternative resources. This will inform selection of the best model for bringing VPPs to scale between 2025 and 2030. Our goal is to develop a flexible program where customers can bring a variety of devices that we use as one VPP to help reduce demand during key times of the year. Our approach will include working with third-party providers to jointly test VPP programs that can offer grid services such as resource adequacy and short-term energy.

Vehicle-to-grid technology is a key area of VPP innovation. Electric vehicle batteries can be connected to the grid to help stabilize the grid by either providing energy to the grid during periods of very high electric demand or by taking a portion of surplus renewable energy available on the electric grid to charge the grid-connected vehicle. We anticipate vehicle-to-grid advancements will offer some of the benefits of stationary battery storage without the added investment of a separate stationary battery.



New grid-scale technologies

While retiring and retooling our gas plants will drastically reduce emissions, the use of natural gas will not be completely eliminated unless we identify sufficient amounts of renewable fuels or develop alternative generation sources. Our initial studies indicate about half of our fuel needs after retooling can be met with renewable natural gas that we already have under contract. Additional fuel sources or technical advancements are necessary to close the remaining gap and fully eliminate our greenhouse gas emissions. We're looking at several options to address this:

- Biofuels and other clean fuels, including renewable natural gas, green hydrogen, biodiesel and ethanol.
- Long duration storage which could include technologies such as flow batteries, thermal storage and liquid air energy storage.
- Carbon capture and sequestration, including the Allam-Fetvedt cycle to assess the feasibility of this and similar technologies in the Sacramento region.
- Pumped storage hydro using our existing UARP dams and hydroelectric facilities.

This research and the ability to secure sufficient volumes of biofuels will allow us to scale up the most promising technologies. We'll continue to evaluate and seek innovative options as new technologies emerge.





Financial impacts and options

SMUD's rates are significantly lower than those of neighboring utilities and are among the lowest in California. We believe eliminating carbon emissions from our power supply by 2030 is achievable with rate increases that don't exceed the rate of inflation, which is consistent with California utility rate increases over the past 25 years. While these low rate increases are achievable, they will be challenging to achieve. We've identified the need for between \$50 and \$150 million in sustained and ongoing savings to help offset the costs of our Plan, which we'll deliver through operational savings and pursuing partnerships and grants. We expect to work closely with community organizations, industry partners, government agencies and regulators to jointly develop and finance innovative solutions and pave the way for cost reductions in new and emerging clean technologies.

Figure 2 shows a summary of estimated costs and operational savings for the 2030 Zero Carbon Plan.



The estimated costs and rate impacts discussed in this section represent one possible outcome based on our current expectations for market developments and costs. There are many factors that could cause the costs for achieving our zero carbon goals to go higher or lower than our initial estimates presented here. For example, if costs for technologies such as solar and battery storage decline faster or more significantly than expected, we may be able to accelerate the pace of our carbon reduction efforts without sacrificing affordability. Conversely, if costs are higher than expected or if some technologies fail to deliver on their projected potential, the overall pace and choices of technologies may need to be adjusted. We expect to revisit the 2030 Zero Carbon Plan regularly to adjust as necessary to these changing factors.

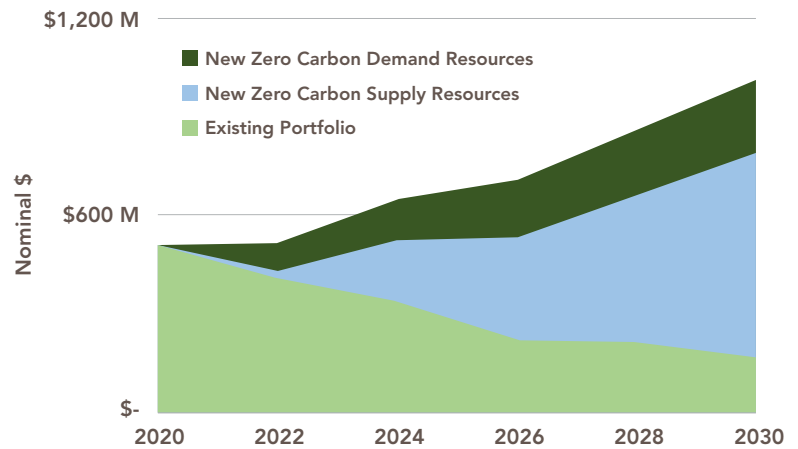


Figure 2. Cost of SMUD's electricity supply 2020-2030, including Zero Carbon Portfolio Costs



2030 Zero Carbon Action Plan

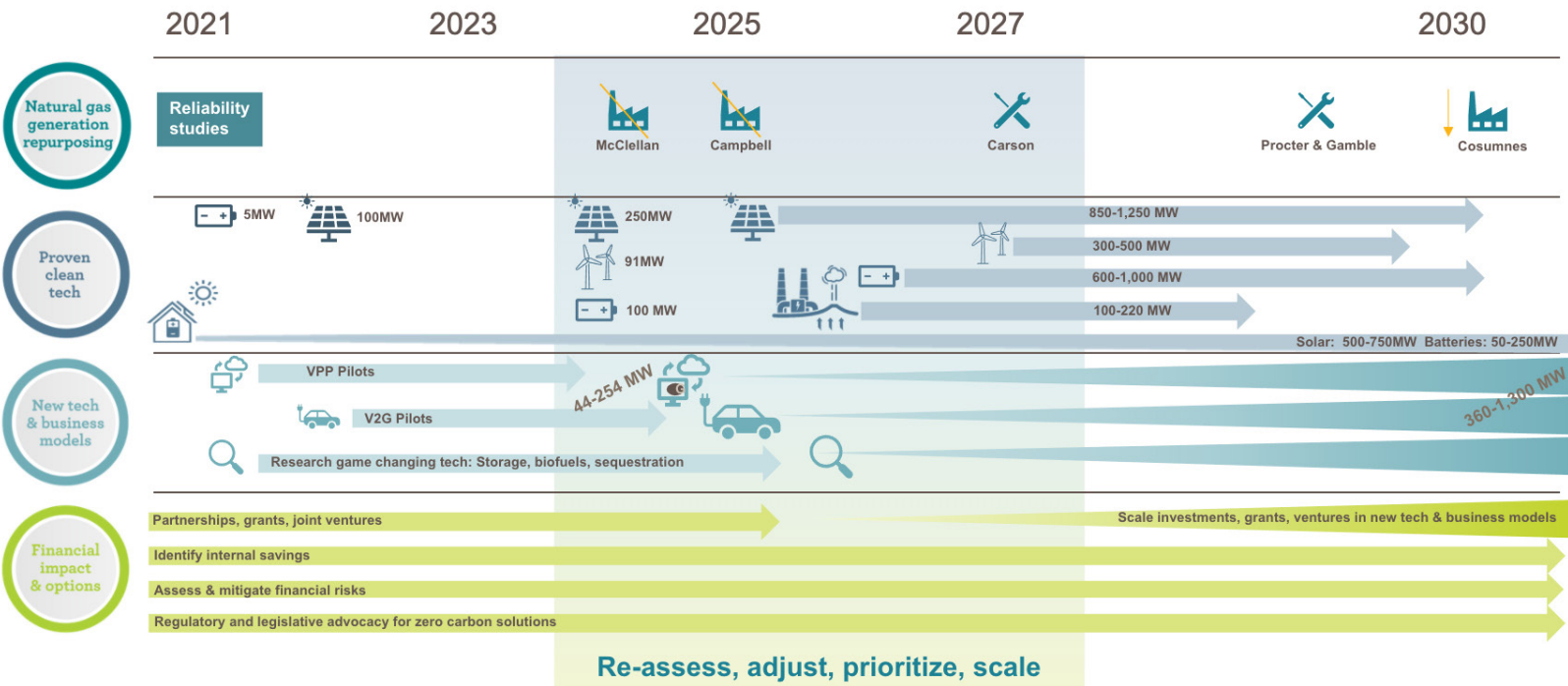
Our initial analysis indicates SMUD can reach zero carbon by 2030, while recognizing that there are a number of unknowns and risks and we'll adjust our Plan as technology, customer adoption and other factors change. While the specifics of our long-term activities to support decarbonization will be adjusted based on what we learn through the early implementation of our Plan and the results of our research and pilot programs, we have a number of priorities for the first year of the Plan as summarized in the table below.

Year 1 Zero Carbon Plan implementation priorities
<p>Implement plan for the Natural Gas Generator Repurposing Strategy, including</p> <ul style="list-style-type: none"> • Perform detailed studies of reliability, economics and environmental impacts of retiring McClellan and Campbell. • Research new utility-scale technologies, fuels and options.
<p>Implement plan for the Proven Clean Technology Strategy, including:</p> <ul style="list-style-type: none"> • Conduct locational analysis, system impact study and economic valuation and solicit counterparty offers. • Study strategic new technology options complementing the Natural Gas Generator Repurposing Strategy. • Explore delivery options for out-of-area renewables. • Develop and issue competitive solicitation for new proven clean technology projects.
<p>Implement plan for New Technology and Business Models Strategy, including:</p> <ul style="list-style-type: none"> • Perform information technology system upgrades to enable DERs and VPPs. • Include DERs in operations, distribution and grid planning processes. • Launch new customer-partner pilot programs for VPP Involving thermostats, EVs, rooftop solar and batteries. • Launch pilots for behavioral demand response "Flex Alert", EV managed charging and vehicle-to-grid demonstrations.
<p>Evaluate the 2030 Zero Carbon Plan for NERC reliability standards, system adequacy requirements, operational reliability requirements, and new reliability services contributions.</p>
<p>Assess system adequacy and reliability impacts, including:</p> <ul style="list-style-type: none"> • Evaluate operational reliability requirements to manage the variability of solar and wind generation. • Evaluate grid reliability services contribution from virtual power plants, distributed energy resources, demand response and load flexibility. • Perform detailed studies of sub-transmission system impacts from the re-tooling of the Carson plant.
<p>Set internal goals for operational efficiencies needed to manage risks to rate impacts.</p>
<p>Organize grant capture team to proactively seek opportunities for funding partnerships and research with manufacturers, vendors, government agencies, utilities and research institutions.</p>
<p>Engage government, agencies and policy makers</p> <ul style="list-style-type: none"> • Brief policymakers on the 2030 Zero Carbon Plan. • Advocate for and support electrification policies • Support cities' and county General Plans and Climate Action Plans • Connect with federal agencies and policy makers on climate action and our 2030 Zero Carbon Plan
<p>Identify new workforce skills needed to support zero carbon technologies.</p>
<p>Develop and implement a comprehensive regional communications, marketing, outreach and educational effort.</p>

2030 Zero Carbon Action Plan

Figure 3 also provides a high-level summary of the key elements and actions in our 2030 Zero Carbon Plan.

Figure 3: 2030 Zero Carbon Plan summary



We're pleased to release our draft 2030 Zero Carbon Plan for public comment. We'll use input from our customers, community and stakeholders to finalize our Zero Carbon Plan. Please submit written comments to smud.org/ZeroCarbon. You can also sign up for regular updates at smud.org/Board.





Powering forward.
Together.



smud.org/ZeroCarbon