Pueblo Innovative Energy Solutions Advisory Committee (PIESAC) Study

December 15, 2023

Executive Summary

The Colorado Public Utilities Commission (CPUC) approved the Company's Phase I Colorado Clean Energy Plan (CEP) in 2022, creating a roadmap to deliver on our vision of becoming a net-zero energy provider by 2050. The Commission's decision, which is based on the revised settlement, will close or convert all of Xcel Energy's Colorado coal plants and deliver on our commitment to achieve 80% clean energy by 2030. In partnership with the Colorado Energy Office, Governor Jared Polis, Colorado legislators, and other important stakeholders, policies have evolved to provide a just economic and social transition for the communities impacted by coal retirements. However, action is required to bring these policies to life. Xcel Energy has a long track record of retiring coal generation without layoffs and working closely with impacted communities to better understand tangible impacts and partner to solve for the negative impacts in the future. Along with learned impacts from the community, Xcel Energy considers these additional factors:

- Comanche Unit 3, the last coal unit planned for retirement, will retire by Jan. 1, 2031, 39 years before its scheduled end of service.
- Beginning in 2031, Pueblo County may receive 10 years of payments from Xcel Energy–Colorado (valued based on property taxes) to account for the required acceleration of the Comanche 3 retirement date, unless incremental investment in the surrounding areas offsets this need pursuant to the Updated Settlement Agreement.
- Xcel Energy–Colorado will file a standalone Just Transition Resource Plan (JTP) in 2024 to seek approval from the CPUC for replacement electric generation for Comanche 3 and meet other resource needs, with a focus on reinvestment in the Pueblo community.

Xcel Energy is a national leader delivering renewable and clean energy to its customers. Xcel Energy–Colorado remains committed to a clean energy transition, empowering customer choice, and maintaining affordable energy costs for our customers.

Xcel Energy generates and delivers reliable and affordable electricity from an increasingly cleaner mix of energy sources. Across our eight-state service area, 53% of the power we provided in 2022 came from carbon-free sources: biomass, hydroelectric, nuclear plants, solar panels, and wind turbines. In Colorado specifically, 42% of the power we provided in 2022 came from carbon-free resources, and we reduced carbon emissions in the state by 51% from 2005 levels. The figures below show by fuel type the energy generated on our system(s) in 2022. The energy includes electricity produced at Xcel Energy power plants, purchased from others, and supplied through our renewable choice programs for participating customers (Windsource®, Renewable*Connect®, Solar*Rewards® and Solar*Rewards Community®).

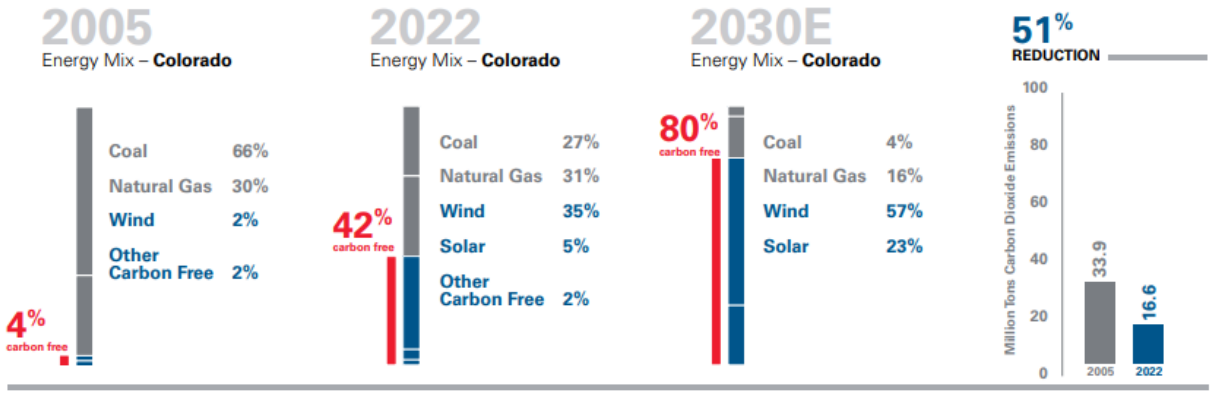

Figure 1: Energy Mix Xcel Energy-Colorado

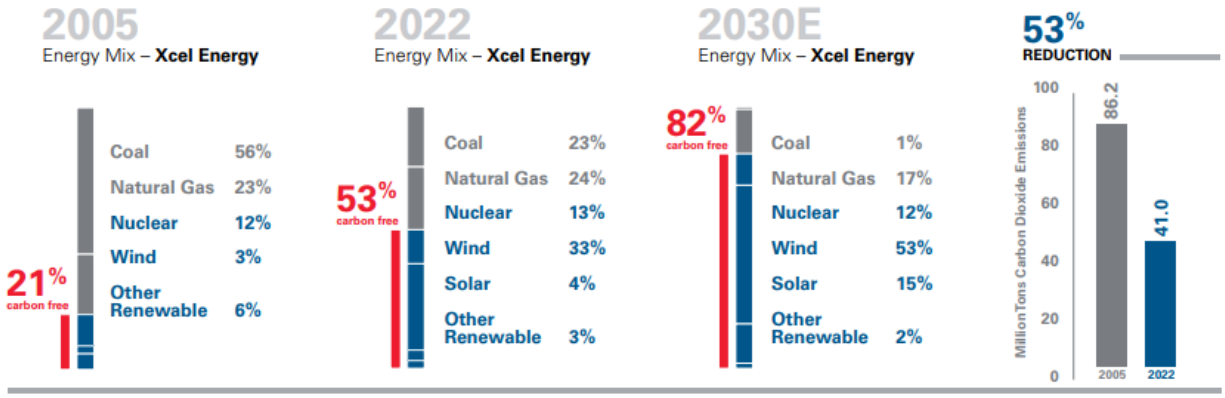

Figure 2: Energy Mix Xcel Energy Company Wide

Xcel Energy–Colorado has a long history of working with state policy makers. House Bill 19-1314, Just Transition Support for Coal-Related Jobs, was passed by the Colorado General Assembly in the 2019 Regular Session and signed by Governor Jared Polis. The bill:

- Recognizes coal has played, and continues to play, a significant role in the generation of electrical power in Colorado.

- Acknowledges that the transition away from coal could have significant negative economic and social effects on Coloradans with coal-related jobs and Colorado communities that rely on the coal industry as a major source of jobs, tax revenues, and economic activity.

- Declares that strong and comprehensive policies are needed so the state can fulfill its "moral commitment to assist the workers and communities that have powered Colorado for generations."

House Bill 19-1314 supported the Company's 2030 electric resource plan, filed at the CPUC in March 2021, and helped shape what was proposed and then settled on by the CPUC to justly transition communities impacted by coal plant closures in their community. Under the Updated Non-Unanimous Partial Settlement Agreement approved for Xcel Energy's Electric Resource Plan (ERP) and Clean Energy Plan,

Xcel Energy agreed to "conduct a study at an amount not to exceed $2 million to evaluate a variety of potential low-emission or carbon-free dispatchable resource options available for service and located at the site of Comanche Station or within Pueblo County that can contribute to the Company's continued efforts to reduce emissions."

In February 2023, the Company formally kicked off the Pueblo Generation Study in partnership with the Pueblo Innovation Energy Solutions Advisory Committee, a 12-member committee engaged in a yearlong study to better understand current energy generation options, a just transition for the community, future planned energy generation options, and the State of Colorado's public policy mandates.

This study captures the technical and operational analysis, considers current public policy in Colorado, feedback from the Pueblo community through many channels, economic and social impact to the Pueblo community, affordability for Xcel Energy's Colorado customers, and current availability of generation technology. Considering all factors, this study has put forth the following technology options as recommendations for consideration in the 2024 Just Transition Plan ERP. These technologies have been reviewed and deemed as potentially viable options that serve the needs of Xcel Energy and Colorado customers.

- Long Duration Energy Storage – 24+ hour
- Lithium-Ion Battery Storage – 4-hour minimum
- Compressed Air Energy Storage
- Thermal Energy Storage
- Clean Hydrogen as Primary Fuel

Xcel Energy also commits to working in partnership with the Pueblo community beyond the 2024 Just Transition Plan ERP. Based on the results of this study, the Company believes that further investment in Pueblo may be required beyond the energy generation technologies available within the proposed 2024 Just Transition Resource Acquisition Period and the pending outcome of the 2021 EPR-CEP acquisition. The economic impact study highlights possible generation replacement scenarios but is limited in its ability to fully capture the impacts of the early closure of Comanche Unit 3, barring anticipated further opportunities. However, in combination with the potential outcome of the ongoing 2021 ERP-CEP acquisition and further transmission system investment in the area, the goal of tax replacement and investment in the Pueblo community is not insurmountable – but it will take a sustained effort and series of investments. The Company also concludes that additional engagement and partnership is necessary and needs to be maintained for years to come to achieve a mutually desired outcome where Pueblo is thriving economically past the decommissioning of the Comanche Coal Plant.

The Company looks forward to working with the Pueblo community for many decades as Xcel Energy-Colorado and the State of Colorado continues toward 100% clean energy by 2050.

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Background

1.1 PIESAC

The vision of this study was to develop low-emission and carbon-free energy generation strategies and consider economic impacts through the development of a "Pueblo Innovative Energy Solutions Advisory Committee," or PIESAC. This initiative encourages increased focus and accountability in our utility system to support efforts to mitigate the impacts of the decommissioning of Comanche Unit 3 including supporting a just transition for the Pueblo community.

The purpose of the study was to evaluate available technologies that have low-emission and carbon-free resource options well suited for the existing resource base in the Pueblo area and which provides just transition benefits to the Pueblo area. The resources identified can inform bids into the Pueblo Just Transition Plan (JTP), which will commence in 2024 (solicitation in 2025) and identify resource portfolios to replace Comanche Unit 3 and meet other Xcel Energy resource needs through the end of 2031. The report's goals include minimizing the economic risks to the Company's employee base in Pueblo, and to the community itself, while also acknowledging the opportunities that investment in new technologies could create.

This is the first time a utility in the United States has both 1) proposed a community-specific resource plan and 2) established a community advisory committee to inform potential resource plan considerations prior to it being filed with the PUC (Public Utilities Commission). This innovative community engagement process is critical to achieving Xcel Energy's carbon free goals and supporting an important customer and community in Xcel Energy-Colorado's service territory.

The PIESAC charter was drafted in collaboration with the Advisory Committee. The agreed upon project charter is included in Appendix E in its entirety.

1.2 Comanche Closure

Comanche Unit 3 was put in service in 2010. The Settlement Agreement defines the retirement date of Comanche Unit 3 to be no later than January 1, 2031.

1.3 Resource Estimations

With the filing of the 2021 Electric Resource Plan and Clean Energy Plan, the Company intended to fill the resource needs of the PSCo system through the Resource Acquisition Period (RAP) of 2023 through 2030. However, as the retirement date of Comanche 3 shifted throughout the proceeding to an accelerated retirement date of January 1, 2031, a Settlement Agreement of involved parties developed the Pueblo Just Transition Plan. This plan is intended to accomplish the following goals:

- Present different portfolios, each of which may include resources with varying in-service dates and address the retirement date for Unit 3, which would be no later than January 1, 2031.
- Utilize a 90 percent emission reduction target, provided that the Company presents portfolios that do not reach the target and an informational least-cost plan.
- Fill all identified resource needs in 2029 and 2030 and extend the RAP of the JTP through the end of the year 2031.
- "Provide Company ownership of at least $690 million in capital investment or 500 MW of accredited capacity, whichever is triggered first, and a 50% target thereafter, provided that a showing of resource need is made in the first phase and any final approved plan in the second phase must be deemed a cost-effective resource plan consistent with Rule 3601 and Rule 3617".

- As part of the Updated Settlement, a $2 million study would be conducted to evaluate a variety of potential *dispatchable resource options* at the Comanche Station or within Pueblo County.

Figure 3 shows the Loads and Resources Table filed in the Supplemental Direct Testimony of Jack W. Ihle in Proceeding No. 23A-0046E Resource Adequacy Filing 2.0 PPA Extensions, expanded to include 2031. This same Loads and Resources Table was used as a baseline for the discussion in Phase II of the 2021 ERP and CEP as it was presented in the 120 Day Report with Preferred Plan resources included. The capacity deficits depicted in the Loads and Resources Table represent the amount of accredited capacity the Company would seek to acquire in the RAP of the Pueblo JTP.

Xcel Energy | Loads & Resources Table (MW)

OpCo: **PSCo**

Season: **Summer**

PSCo L&R Table (MW) for Summer Peak	2028	2029	2030	2031	
Coal	675	500	500	-	
Gas Steam	505	505	505	505	
Gas CC	1,914	1,914	1,914	1,914	
Gas CT	1,130	1,130	1,130	1,130	
Storage	412	412	412	412	
Biomass	-	-	-	-	
Hydro	13	13	13	13	
Solar	595	592	589	579	
Solar BTM	208	221	231	240	
Solar Community	193	193	206	218	
Wind	464	464	461	461	
TOTAL ACCREDITED CAPACITY	**6,109**	**5,943**	**5,960**	**5,471**	*A*
Native Load Forecast	7,136	7,247	7,374	7,502	
Demand Response	(679)	(725)	(767)	(767)	
FIRM OBLIGATION LOAD	**6,457**	**6,522**	**6,607**	**6,735**	*B*
Target Planning Reserve Margin %	*18.0%*	*18.0%*	*18.0%*	*18.0%*	
Target Planning Reserve Margin	1,162	1,174	1,189	1,212	
IREA & HCEA Backup Reserves	11	11	11	11	
TOTAL PLANNING RESERVE MARGIN TARGET	**1,173**	**1,185**	**1,200**	**1,223**	*C*
CAPACITY NEED	7,630	7,707	7,807	7,958	*B+C*
ACTUAL RESERVE MARGIN	(348)	(579)	(647)	(1,264)	*A-B*
CAPACITY POSITION: LONG/(SHORT)	**(1,521)**	**(1,764)**	**(1,847)**	**(2,487)**	*A-B-C*

Figure 3: Loads and Resources Table for Years 2028-2031

The capacity needs in 2028 – 2031 are driven mainly by the increased load forecast and the retirement of owned thermal generators and expiration of thermal PPA contracts. Figure 4 below shows the capacity of firm dispatchable generation that is being removed from the PSCo resource mix due to either retirement or contract expiration along with the last summer generating year for each resource.

Name	Final Summer Generating Year	Resource Type	Capacity (MW)
Hayden 2	2027	Coal	98
Cherokee 4	2027	Gas – Steam	310
Plains End I	2027	Gas	112
Plains End II	2027	Gas	109
Subtotal			***629***
Craig 2	2028	Coal	40
Hayden 1	2028	Coal	135
Subtotal			***175***
Comanche 3	2030	Coal	500
Fountain Valley 1-6	2031	Gas	236
Total			***1,540***

Figure 4: Firm Dispatchable Generation Retirements

Figure 4 shows that by the end of 2031, the PSCo system will see the retirement or expiration of 1,540 MW of firm dispatchable resources located across the state, highlighting a significant capacity need for the PSCo system. Therefore, as mentioned previously, the scope of the Pueblo JTP extends beyond just the replacement of Comanche 3's capacity. In the Phase I Commission Decision, it states "The Pueblo Just Transition solicitation is not geographically limited to the Pueblo area nor is the resource need limited to replacing Unit 3." (Decision No. C22-0459, 2022)

At the time of this writing, Phase II of the 2021 ERP and CEP is still awaiting a Commission decision regarding the Preferred Plan submitted by the Company in the 120-Day Report. The resources selected in Phase II will have a significant impact on the capacity needs presented in the table above, as well as the resource mix that should be considered when acquiring new generation assets. The Preferred Plan and resulting impacts are presented in Section 2.3 of this report.

1.4 Renewable Tax Policy

The technologies considered in this report were considered subject to the most current tax policy at the time of writing. Passed during the 2021 legislature, SB21-020 modified Colorado Revised Statutes (C.R.S Title 39, Article 4. Valuation of Public utilities) to ensure that clean energy resources and energy storage systems used to store electricity are assessed for valuation for the purpose of property taxation in a comparable manner to renewable energy facility property used to generate and deliver electricity.

For property taxation "renewable, clean energy resources, and storage" are valued using a rate per kilowatt of capacity applied to the capacity of the facility. Non-renewable property is included in the unit valuation of the entire utility. A unit valuation is based on both cost and income and is allocated among all the areas in which it operates. The result of these two different methodologies is that the amount of property tax per dollar of investment in renewable, clean energy resources and storage facilities is less than that of other non-renewable generation assets.

Property tax estimations were analyzed from each of the actual all-in cost of the technologies considered in this study. All technologies current Colorado tax law considers "renewable" will contribute

approximately the same annual property tax (~$1.7M) regardless of the installed cost of the asset. Advanced Nuclear and a Natural Gas fired Combined Cycle Turbine w/ Carbon Capture are the only two technologies considered that don't fall into that "renewable" category and thus yield higher annual property tax. Figure 5 below illustrates the potential property tax estimates for 500MW of each technology type considered for the Pueblo County region. These figures are not guaranteed, nor do they account for any federal, state, or other regulatory tax law changes that may occur.

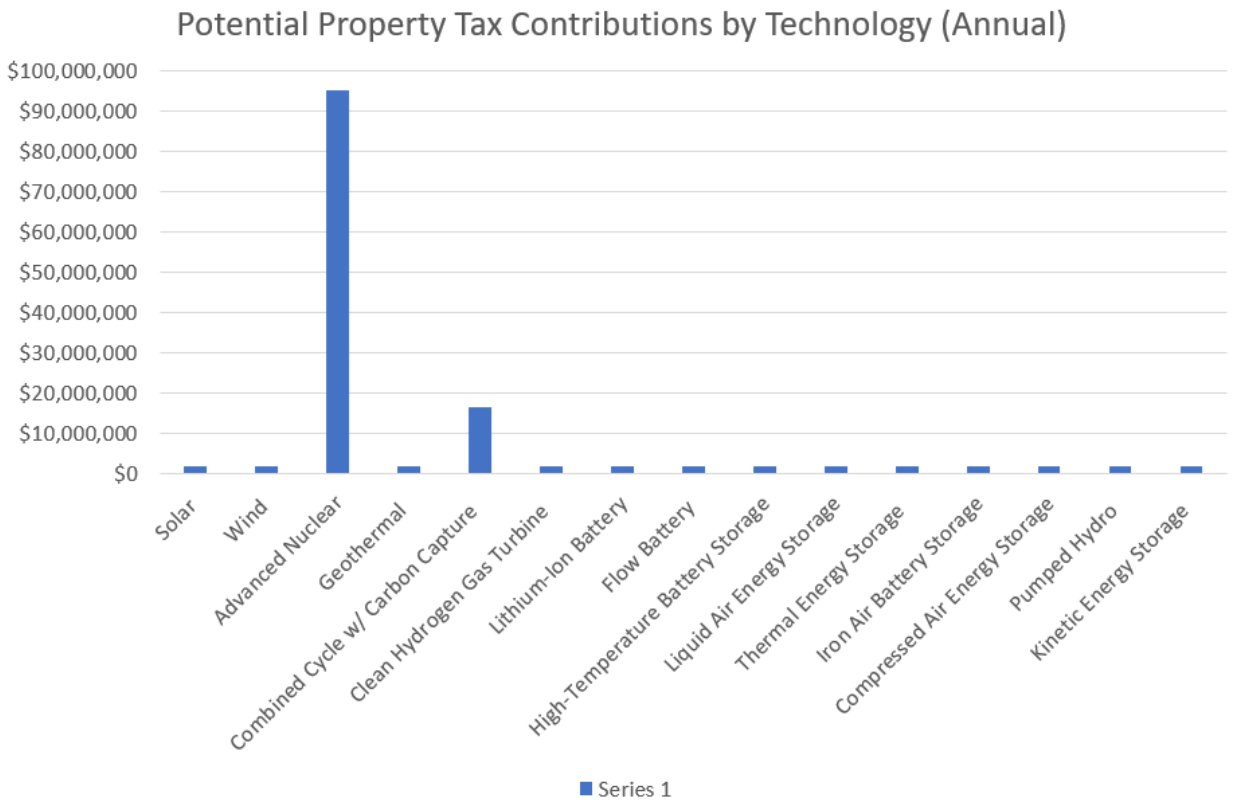

Figure 5: Potential Property Tax Contributions by Technology

1.5 Xcel Energy Policy

Xcel Energy and our industry are at the forefront of our nation's clean energy transition. Not only are we reducing greenhouse gas emissions from the energy we deliver, but we offer industry leading voluntary programs and resources for our customers and are helping other parts of the economy, such as transportation, to further reduce emissions. We're transitioning to cleaner sources of energy at a pace and scale designed to manage costs and other potential impacts, making sure that we maintain reliable, secure energy while keeping customer bills as low as possible.

And, we are doing it faster than the majority of others. We were the first major U.S. energy provider to set comprehensive environmental goals across all the ways our customers use energy—electricity, natural gas use for heating and transportation. Our vision is to provide energy service for customers with 80% clean electricity by 2030 (from 2005 levels) and 100% carbon free electricity by 2050. Along

with our 2050 carbon free goal on the electric system, we also announced a commitment toward net-zero emissions by 2050 on our natural gas system.

Just Transition Plan (2031)

2.1 Public Outreach & Engagement

Xcel Energy sought support related to public outreach that gave the community the opportunity to learn about, provide input on, and process the changes in coming years. Under the leadership of Xcel Energy-Colorado's community relations team, Tetra Tech was contracted to manage the outreach comprised of one-on-one informant interviews, focus groups, open houses, polling, online feedback forms, and a monitored hotline. The full public outreach and engagement report as prepared by Tetra Tech, reviewed and approved by Xcel Energy-Colorado, is included in Appendix B. The following sections highlight each of the different components in addition to high level observations.

2.1.1 One-on-One Interviews

One-on-One interviews were conducted from September 1, 2023, through September 29, 2023, with 19 individuals from a diverse number of sectors including:

- Business, Comanche Generating Station Staff, Education P-12, Education Higher, Economic Development, Environmental Justice, Government - State Legislators, Government - City of Pueblo, Government - Pueblo County, Government - State of CO, Labor/Workforce, Natural Resources, Public Health, and Workforce.

There are several high-level observations from the one-on-one interviews:

- Interview subjects are acutely aware of the role the Comanche Generating Station has played in the Pueblo community and are aware of the significant economic gap that will be left in the local economy when the station is retired.
- The subjects are also aware of the importance of the need to fill that gap in the replacement generation.
- There is disagreement on how to best fill the gap utilizing clean and renewable energy sources.
- Solar and wind ranked high between interview subjects, closely followed by (or tied with) small modular advanced nuclear and combined cycle natural gas with carbon capture.

2.1.2 Focus Groups

To solicit feedback from a diverse group of individuals, four different focus groups were held. Over 100 individuals were invited to participate, and the various focus groups were asked questions related to the retirement and replacement of Comanche Unit 3. Some of the key observations included:

• Community would like to expand partnership opportunities with Xcel Energy, specifically with respect to education (primary and secondary) and skilled workforce training.

• There is a need for additional education/communication with the community regarding Comanche Generating Station's (CGS) retirement, potential replacement generation options and the associated impacts.

• How to best approach filling the energy generation gap left by CGS' retirement is a divisive topic, but community perceives retirement as opportunity to "put Pueblo on the map" as a modern energy and technology hub.

• Xcel Energy is perceived as a strong partner to the Pueblo community in terms of leadership of and contribution to charitable causes.

2.1.3 Open House

Two open houses were conducted in collaboration with Tetra Tech. The open houses were held on Tuesday, Oct. 17, 2023, at CSU (Colorado State University) Pueblo Occhiato Student Center and Wednesday, Oct. 18, 2023, at St. Joseph's Church in Pueblo. The open houses attracted nearly 60 people, with many unique comments and questions. There were a couple of key observations from the open houses including:

• CGS is perceived as a provider of high-paying jobs, tax revenue, an economic multiplier effect, and as a significant polluter of air/water/soil.

• The jobs, revenue, and generation gaps that will be left by CGS's retirement, and the need to fill the gaps with similar quality, is well understood by the community.

• Which energy generation and storage options should be used to replace CGS elicited a variety of diverse viewpoints that included traditional clean energy sources and emerging technologies.

2.1.4 Online/hotline Feedback

Xcel Energy established a publicly accessible website in April 2024 that contained:

• Video recordings of the Advisory Committee meetings

• Slide Decks and other documents reviewed during Advisory Committee meetings

• An email address to collect public input

• A hotline to collect public input

The public website was routinely updated to include relevant information about the study progress and its findings. Written comments from stakeholders and any media inquiries received by individual Members of the Advisory Committee were forwarded to the Strategic Outreach & Advocacy team.

A link to the public website is included below:

https://co.my.xcelenergy.com/customersupport/s/projects/pueblo-energy-study

2.1.5 Polling

A poll of the general Pueblo community was conducted by Keating Research using a sample size of 500 among registered voters in Pueblo County. The 500 sample has a margin of error of + or - 4.4%. The poll was conducted the week of November 6, 2023. The full Polling Report is included in Appendix D.

2.2 Timeline

The Company will file the JTP no later than June 1, 2024. That will initiate the Phase I process which will take 10-12 months to complete. Following that, the Company will initiate Phase II where an RFP (Request for Proposals) is issued, and bids are received. This is expected to take another 10-12 months following the conclusion of Phase I.

2.3 Xcel Energy Requirements & Assumptions

Public Service Company of Colorado (PSCo) serves as the Balancing Authority for a sizable portion of Colorado and includes much of the Pueblo region. In addition to its Balancing Authority role, PSCo provides gas service to the Pueblo area, and also has electric generation assets in the area. PSCo is also the Transmission Operator for the region, governed by the PSCo Open Access Transmission Tariff (OATT), ratified by the Federal Energy Regulatory Commission (FERC).

Comanche Unit 3 is currently scheduled to retire no later than January 1, 2031. Per the PSCo OATT rules as of June 3, 2023, PSCO has three years from the date of retirement of a generating asset to bring in service the replacement generator(s). Therefore, the replacement generator(s) for PSCo's 500MW ownership share must be in service by January 1, 2034. This regulation is one of the key drivers for the replacement technologies being considered.

Another key driver in the replacement technologies being considered is the upcoming Commission Decision in the 2021 ERP and CEP. In the Company's updated preferred plan presented in the response comments filed after the 120-Day Report (Public Service Company of Colorado, 2023), the Company proposed the addition of approximately:

- 3,600 MW of wind resources,
- 1,500 MW of solar combined with storage resources,
- 1,100 MW of standalone solar resources,
- 600 MW of standalone storage resources; and,
- 600 MW of strategically located natural gas resources.

Figure 6 below shows the impact that the updated preferred plan of resources has on the Loads and Resources table should the Commission approve the plan.

Xcel Energy | Loads & Resources Table (MW)

OpCo: **PSCo**

Season: **Summer**

PSCo L&R Table (MW) for Summer Peak	2023	2024	2025	2026	2027	2028	2029	2030	2031	
Existing Resources	7,840	7,911	7,948	7,323	6,764	6,109	5,943	5,960	5,471	
Updated Preferred Plan Resources		-	-	472	1,367	1,598	1,731	1,697	1,744	
TOTAL ACCREDITED CAPACITY	**7,840**	**7,911**	**7,948**	**7,795**	**8,131**	**7,707**	**7,674**	**7,657**	**7,215**	*A*
Native Load Forecast	7,107	7,157	7,224	6,960	7,037	7,136	7,247	7,374	7,502	
Demand Response	(583)	(593)	(618)	(652)	(631)	(679)	(725)	(767)	(767)	
FIRM OBLIGATION LOAD	**6,524**	**6,564**	**6,606**	**6,308**	**6,406**	**6,457**	**6,522**	**6,607**	**6,735**	*B*
Target Planning Reserve Margin %	*19.3%*	*19.2%*	*19.2%*	*19.1%*	*18.0%*	*18.0%*	*18.0%*	*18.0%*	*18.0%*	
Target Planning Reserve Margin	1,259	1,260	1,268	1,205	1,153	1,162	1,174	1,189	1,212	
IREA & HCEA Backup Reserves	48	48	48	11	11	11	11	11	11	
TOTAL PLANNING RESERVE MARGIN TARGET	**1,307**	**1,308**	**1,316**	**1,216**	**1,164**	**1,173**	**1,185**	**1,200**	**1,223**	*C*
CAPACITY NEED	7,831	7,873	7,923	7,524	7,570	7,630	7,707	7,807	7,958	*B+C*
ACTUAL RESERVE MARGIN	1,316	1,347	1,342	1,487	1,725	1,250	1,152	1,050	480	*A-B*
Actual Reserve Margin %		*20.5%*	*20.3%*	*23.6%*	*26.9%*	*19.4%*	*17.7%*	*15.9%*	*7.1%*	
CAPACITY POSITION: LONG/(SHORT)	**9**	**39**	**26**	**271**	**561**	**77**	**(33)**	**(150)**	**(743)**	*A-B-C*

Figure 6: Loads and Resources Table (MW) for years 2024 - 2031

The following assumptions related to the updated preferred plan should be considered in the acquisition of resources during the JTP:

- Assuming the Commission accepts the Company's updated preferred plan, there is still a significant capacity shortfall in 2029, 2030, and 2031 that would need to be satisfied by the JTP.

- The capacity positions shown above are based on Phase II Loads and Resources data. By the time of filing the first phase of the JTP, the Company should have updated load forecasts and demand response forecasts, including an updated Effective Load Carrying Capacity (ELCC) and Planning Reserve Margin (PRM) study. These updated numbers will need to be used.

- The updated ELCC and PRM study will be critical to determining resource needs. As discussed in the 120-Day Report, the increased penetration of energy limited resources causes downward pressure on the accredited capacity that can be assigned to the next energy limited resource acquired. In the case of 4-hour standalone storage, the incremental ELCCs (Effective Load Carrying Capability) began to routinely fall below 20% (Public Service Company of Colorado, 2023). Incremental ELCCs of solar, wind, and storage resources will be needed to begin to determine the optimal mix of resources to fill the capacity needs of the system.

- The increase in energy limited resources should cause the Company to carefully consider the retirement dates of firm dispatchable resources when selecting resources to fill capacity needs. For example, Comanche 3 retires no later than January 1, 2031. In the Company's traditional view of resource acquisition, a project should come online before June 1, 2031, to contribute to the 2031 generating year and be included in the Summer Loads and Resources Table. If all resources selected for 2031 come online just before July 1, then there could still be a significant capacity shortfall in the winter months due to Comanche 3's retirement. Therefore, the Company will need to consider Winter and Summer adequacy in the selection of resources.

- Finally, with the 2021 ERP and CEP updated preferred plan, the Company has already begun the work of bringing generation projects into Pueblo County. The plan proposes the addition of five projects within Pueblo County that account for a combined name plate capacity of 1,260 MW of solar and 500 MW of battery storage. While the plan would begin to achieve some of the goals of the JTP, including replacing tax revenue and accredited capacity, they would increase the focus of the JTP on other resources to address community and Company needs. In this case, the further increased saturation of solar and lithium-ion battery storage coupled with the lack of wind in the region highlights why this report is so important and why alternative resources may be desirable.

2.4 Technical Study (Performed in Conjunction w/ 1898 & Co.)

To effectively study the different resource options viable in Pueblo County by 2031, Xcel Energy partnered with 1898 & Co., an industry leader in the energy space. The full Technical Study is included in Appendix A. The Technical Study was performed in three phases:

Phase 1 - Initial Evaluation of Generation & Storage Options

- Technologies were evaluated based on their dispatchability, the fuel availability in Pueblo or at Comanche for the resource, and the maturity of the technology - TRL (Technology Readiness Level).

Phase 2 - Technology Suitability

- Technologies were evaluated based on their suitability to the Pueblo County region and their ability to meet the Just Transition ERP requirements.

Phase 3 – Final Evaluation of Technologies

- Technologies were evaluated based on reliability & resiliency, environmental impacts, and customer affordability.

Figure 7 below demonstrates the outcome of the technical scoring matrix as performed by 1898 & Co. Each of the three categories (reliability & resiliency, environmental impacts, and customer affordability) were evenly weighted at 33.3%. The best/highest score a technology could receive for a category was 3.0. The category breakdowns are included in Appendix A. The five technology recommendations from 1898 & Co. include the following technology resources:

1. Long Duration Energy Storage – 24+ hour
2. Lithium-Ion Battery Storage – 4-hour minimum
3. Compressed Air Energy Storage (tie)
3. Thermal Energy Storage (tie)
5. Clean Hydrogen as Primary Fuel

	Long Duration Storage	Lithium-Ion Battery	Compressed Air Energy Storage	Thermal Energy Storage	Burn Hydrogen as Primary Fuel	High-Temp Battery Storage	Flow Battery	Liquid Air Energy Storage	Solar	Kinetic Energy Storage	CCGT with Carbon Capture*	Advanced Nuclear*
Customer Affordability	3.00	2.95	2.75	2.35	1.85	2.35	2.35	2.35	2.95	1.80	2.00	1.15
Environmental Impact	2.55	2.30	2.25	2.85	2.40	2.30	2.30	2.40	2.10	2.40	1.65	2.5
Reliability & Resiliency	2.20	2.20	2.30	2.10	2.80	2.20	2.20	2.10	1.50	2.20	2.60	2.6
Overall Score	**2.58**	**2.48**	**2.43**	**2.43**	**2.35**	**2.28**	**2.28**	**2.28**	**2.18**	**2.13**	**2.08**	**2.08**

**POST 2031 JUST TRANSITION CONSIDERATIONS*

Figure 7: 1898 & Co. Final Technical Scoring Matrix Outcome

2.5 Economic Impact

The Business Research Division (BRD) of the Leeds School of Business at the University of Colorado Boulder was contracted to analyze the net economic impacts of the early retirement of Comanche Unit 3 and the potential energy resources that may replace it. The purpose of the study was to provide third-party research examining the economic positive and negative effects of continuing to run the PSCo Comanche 3 coal generation and replacing it with green or carbon free resources (including storage). The analysis considered operating expenditures, capital expenditures, and decommissioning costs for the Comanche 3 unit as well as six different scenarios of replacement resources.

The six scenarios considered for the replacement of ~500MW of Comanche 3 generation are included in Figure 8 below. The ELCC values for each technology will be dictated by Xcel Energy Resource Planning as the JTP resource plan is filed in 2024. The six scenarios are an attempt to incorporate the technology recommendations from 1898 & Co. and demonstrate what the potential economic impacts of each scenario could be based on high level assumptions.

Scenarios Studied	
S1	Stand-Alone Compressed Air Energy Storage (CAES) (500MW)
S2	Simple Cycle Gas Turbine with Clean Hydrogen Fuel Blend (250 MW) + Medium Duration Energy Storage (350MW, 8-hr Duration)
S3	Stand-Alone Long Duration Energy Storage (500MW, 100-hr Duration)
S4	Advanced Nuclear (SMR) (462MW)
S5	Combined Cycle Gas Turbine with 100% Carbon Capture (500 MW)
S6	Simple Cycle Gas Turbines with Hydrogen Fuel (500 MW)

Figure 8: Six Resource Scenarios Considered by Leeds School of Business

The study extended through 2050 and assumes that decommissioning of the Comanche plant will begin in 2031. This period was selected to capture the near-term economic effects of each scenario, specifically on employment, gross domestic product (GDP), and disposable personal income. This study presents a net analysis of proposed changes to operations in Pueblo compared to the business-as-usual of Comanche operations without the early retirement. The economic changes evaluated in this report include the Comanche retirement (changes in capital and operating spending, decommissioning costs, and changes in taxes), and alternative energy resources.

A summary of the findings from each scenario are included below:

Scenario 1: Stand-Alone CAES (500 MW)
This scenario involves building a stand-alone compressed air energy storage solution. The construction costs of this solution are front-loaded, producing a positive economic impact from 2026-2031, but once construction and decommissioning end, and operations commence, the operating costs are below the comparative operations of Comanche, producing a probable negative economic impact. This makes this scenario have the second largest negative economic impact across GDP, employment, and disposable personal income (with Scenario 6 being the first) according to the model. On a nominal dollar basis, this scenario results in a total of $1.8 billion in GDP loss, $905 million in Pueblo County. Employment will be lower by an average of 338 jobs per year from 2026-2050 (209 in Pueblo County). Disposable personal income decreases a total of $1.2 billion across Colorado, or $621 million in Pueblo County over the 25-year horizon.

Scenario 2: SCGT w Hydrogen Fuel (250 MW) + Medium Duration Energy Storage (350MW, 8-hr Duration)
Scenario 2 includes building both a simple cycle gas turbine that uses hydrogen fuel, as well as a medium duration energy storage solution. This scenario results in larger construction costs and moderate operations costs, and the positive economic impacts from these costs have the potential to offset a majority of the negative impacts from the Comanche retirement and the smaller tax payments. On a nominal basis, GDP would increase by a total of $3.9 billion across Colorado because of this scenario, or $2.3 billion in Pueblo County. This is during the project time horizon of 2026-2050. Employment would increase by average of 608 jobs, or 336 inside of Pueblo County. Disposable personal income would increase by $2.2 billion on a nominal basis across Colorado, or by $965 million inside Pueblo County. This scenario has the second largest positive economic impact out of the six scenarios, only second to the small modular reactor in Scenario 4.

Scenario 3: Stand-Alone Long Duration Energy Storage (500MW, 100-hr Duration)
This scenario involves building a long duration energy storage solution. The economic impact of this scenario can be described as “middle-range” between the six scenarios, with moderate positive impacts from construction and operations. Colorado wide, the economic impact is still generally negative, but in Pueblo County, GDP has the possibility to remain unaffected. From 2026-2050, the total nominal impact on GDP of this scenario is negative $593 million, but in Pueblo County it is positive $0.7 million. Employment will be lower by an average of 160 jobs across the study time horizon (71 in Pueblo County). Disposable personal income will decrease by $602 million in Colorado as a result of this scenario, or $243 million in Pueblo County.

Scenario 4: SMR (462MW)
Given the costs of building a small molecular reactor, which is the project in Scenario 4, this scenario has the possibility of being the largest positive economic impact out of the six scenarios. The SMR scenario assumes that the technology will be available to Xcel and ready to be in service by 2035. This is also the only scenario where extra taxes paid by Xcel are expected to have a positive economic impact on the economic variables analyzed. Construction and operations also provide a large positive impact according to the model. The nominal impact on statewide GDP during the study time horizon is an $11.5 billion positive impact, of which about $9.1 billion would occur in Pueblo County, which would mean a 2.3% growth on the Pueblo County baseline GDP. This project would also result in an average of 1,637 jobs per year (1,243 in Pueblo County). Disposable personal income on a nominal basis would increase $5.9 billion across the state, or $4.1 billion in Pueblo County.

Scenario 5: CCGT with Carbon Capture (500 MW)
Scenario 5 models the economic impact of building a combined-cycle gas turbine with carbon-capture technologies. The economic gains from construction, decommissioning, and operations are not fully able to offset the losses from the Comanche retirement, but the negative impact is not as negative as Scenarios 1 and 6. According to the model, Colorado nominal GDP is projected to shrink by $265 million as a result of this scenario from 2026-2050. Pueblo County nominal GDP would shrink by $74 million. Employment would decrease by an average of 79 jobs statewide and 48 jobs in Pueblo County. Disposable personal income would decrease by $134 million across Colorado, or $108 million in Pueblo County.

Scenario 6: SCGT with Hydrogen Fuel (500 MW)
In Scenario 6, a stand-alone simple-cycle gas turbine with hydrogen fuel served by a hydrogen hub is built. The Hydrogen hub cost is not included. This scenario differs from Scenario 2 where both a SCGT and an energy storage solution are built in conjunction with each other. Given the small projected construction and operation costs associated with this scenario, it will have the largest negative economic impact out of the six scenarios. Nominal GDP statewide is projected to decrease by about $2.2 billion from 2026-2050, $1.1 billion in Pueblo County. The employment impact of this scenario would be lower employment by an average of 438 jobs across Colorado, and 273 in Pueblo County. Personal disposable income would decrease by $1.5 billion in Colorado on a nominal basis, or $786 million in Pueblo County.

Three of the technology scenarios are not possible within the bounds of the Just Transition Plan Resource Acquisition Period – S4, S5, and S6.

- S4 is not possible because Advanced Nuclear/SMRs take 10 years or more to develop, extending past the JTP resource acquisition period deadline, and there have been no SMRs (Small Modular Reactors) constructed in the United States.
- S5 is not possible because combined cycle gas turbines with 100% carbon capture systems have not been developed and are not anticipated to be available by 2031. The current industry standard is a 90% carbon capture rate.
- S6 is not possible by 2031 because it would require the development of a hydrogen hub and hydrogen pipeline to the Comanche site.

The full economic impact study performed by Leeds School of Business is included in Appendix C.

2.5.1 Economic Impact Study Assumptions

The following assumptions were made in relation to the data inputs to the CU LEEDS School of Business economic impact study model:

Scenario 1: Stand-Alone CAES (500MW):

Construction costs do not include Owner's costs* and do not account for technology learning curves. Construction and Operations and Maintenance (O&M) costs assume 2% escalation per year from 2023. Scenario 1 costs are based on estimates provided by Hydrostor for a 500 MW, 8-hour battery with hard rock geology.

*Owner's costs refer to expenses incurred by the Owner outside the Engineering, Procurement, and Construction (EPC) contract. These costs primarily consist of expenses related to project development, any land acquisition, and utility interconnection costs. Owner's development costs encompass project management, studies, permitting, legal, owner's engineering, and the owner's involvement in startup and commissioning. Costs incurred beyond the project boundary are also categorized as owner's costs.

Scenario 2: Simple Cycle Gas Turbine (SCGT) with Clean Hydrogen Fuel (250 MW) + Medium Duration Energy Storage (350MW, 8-hr Duration)

Construction costs do not include Owner's costs and do not account for technology learning curves. Construction and O&M costs assume 2% escalation per year from 2023. The medium duration construction cost is based on publicly available information for capital costs for lithium-ion at 8-hour duration. This assumes that medium duration technologies will compete directly with 8-hour lithium in the open market. The costs for the SCGT assume one 250 MW unit with a 10% capacity factor. The construction and O&M costs for the SCGT include the cost of hydrogen production with electrolyzers. The cost of energy to power the electrolyzers is not included.

Scenario 3: Stand-Alone Long Duration Energy Storage (500MW, 100-hr Duration)

Construction costs do not include Owner's costs and do not account for technology learning curves. Construction and O&M costs assume 2% escalation per year from 2023. The cost for 100-hour storage technology is based on publicly available information for capital costs for lithium-ion at 8-hour duration and information received from Xcel.

Scenario 4: Advanced Nuclear (Small Modular Reactors) (462MW)

Construction costs do not include Owner's costs and do not account for technology learning curves. Construction and O&M costs assume 2% escalation per year from 2023. It is assumed that an SMR would take 10 years to construct, and that it would have an operational lifespan of 60 years.

Scenario 5: Combined Cycle Gas Turbine (CCGT) with 100% Carbon Capture (500 MW)

Construction costs do not include Owner's costs and do not account for technology learning curves. Construction and O&M costs assume 2% escalation per year from 2023. The CCGT is assumed to be a 1x1 configuration with a 70% capacity factor. The cost to construct and operate the carbon capture

plant is included in the construction and O&M costs and is based on publicly available data for a 90% effective system (i.e., 90% of the carbon emitted is captured). This scenario assumes that 100% carbon capture technology will be available post-2031. Due to the absence of cost data for a 100% effective system, the costs for a 90% effective system were utilized.

Scenario 6: Simple Cycle Gas Turbine with Hydrogen Fuel (500 MW)

Construction costs do not include Owner's costs and do not account for technology learning curves. Construction and O&M costs assume 2% escalation per year from 2023. The costs for the SCGT assume two 250 MW units with a 10% capacity factor. Scenario 6 does not include the cost to produce or transport hydrogen. This scenario assumes that hydrogen would be procured from a hydrogen hub and transported via pipeline to the site.

2.6 Workforce Considerations

Xcel Energy is committed to the transition of its workforce from coal and into clean energy jobs. Comanche Generating Station Unit 3 workers are expected to be transitioned into jobs created by an approved replacement generation, other roles within Xcel Energy or through natural attrition. The Company has a long and successful history of transitioning its' workforce. Over the past 15 years, Xcel Energy has closed 19 units across their service territory and without any forced workforce reductions. Through a prescriptive methodology of workforce transition planning and guiding the workers through the transition, the Company will identify skill and worker transition support gaps, create transition pathways, design, and deploy training and other transition supports needed, and lead workers through the change.

Comanche workers are highly skilled, many have completed 2–4-year apprenticeships and already possess the skills necessary to operate and maintain a clean energy asset. The assets being considered require the same type of jobs and skills that Comanche has today, such as Engineers, Electricians, Operators, Mechanics, Instrument & Controls Technicians, and other Plant Support Staff and Management positions. Since Comanche workers already possess the foundational knowledge and skills needed, much of the upskilling that may be required to operate and maintain the new clean energy asset(s) can be done through on-the-job training and training specific to the new asset. Depending on the assets chosen, reskilling may require modification to existing or development of new apprenticeship programs.

In the coming years, Xcel Energy will leverage natural attrition and worker retirements to maintain safe and appropriate staffing levels leading up to the retirement of Comanche unit 3 and beyond. About two years before plant closure, transition conversations will be conducted with the Comanche employees to determine their desired job and transition support preferences. Based on the transition conversation outcomes and stakeholder feedback, skill and transition support gaps will be identified and solutioned. Transition pathways will be established, and training and transition supports deployed. Throughout, Xcel Energy will work in partnership with the International Brotherhood of Electrical Workers, Local 111 (IBEW 111), as all terms will need to be compliant with our collective bargaining agreement or negotiated.

To enable a workforce transition, Xcel Energy will continue to partner with the local Pueblo Community College and other education providers to leverage existing training or curriculum, or to build new. The community college may also be leveraged to provide training facilitation, facilities, and training materials. Additionally, continued partnerships with the local Workforce Centers, education providers, and Workforce Development Councils are highly valuable and will be leveraged to build a local diverse talent pipeline for on-going staffing needs and to ensure the long-term sustainably of these clean energy assets in the Pueblo community.

To further support coal plant employees in advance of the transition, representatives from the Company's Executive team and workforce representatives have and will continue to visit the closing coal plants on a regular basis. Plant visits have taken place about every several months either as added information is made available about our filings or as we progress in meeting key milestones in building the foundation for a workforce and community transition. These plant visits are an essential part of the Company's transition commitment, are key components of the change management plans, are an opportunity to have open dialogue with employees, provide regulatory and timeline updates, and discuss details of the plant retirement process.

The Company continues to work alongside the State in supporting a state-wide workforce and community transition plan. In 2019, the Colorado General Assembly passed House Bill 19-1314, which established the Office of Just Transition (OJT) in Colorado and through this bill, the formation of the Just Transition from Coal Advisory Committee (JTCAC). Holly Stanton, Sr. Manager of Strategic Workforce Planning, leads the workforce transition for Xcel Energy and was appointed by Governor Polis to hold one of the two "Utility Company" seats on the JTCAC. Earlier in the 2019 legislative cycle, Senate Bill 19-236 established the requirement to file a workforce transition plan with the Colorado Public Utilities Commission. Xcel Energy was the first company in the nation to file a workforce transition plan, which is also integrated with a community transition plan and Clean Energy Plan. As key milestones are met within future filings and Comanche closure nears, updated transition plans will be filed with the State. Xcel Energy also shares these plans with the OJT, IBEW 111, building trades, community leaders, and other key stakeholders to gather feedback and refine our plans prior to filing.

Post 2031 Just Transition

3.1 Technologies

Of all the technologies considered for this study, three stood out as options that would be best suited for consideration in the years after 2031. These three technologies include Advanced Nuclear (Small Modular Reactors), burning 100% clean hydrogen in a combustion turbine, and Combined Cycle burning Natural Gas with 100% Carbon Capture. Each of these different technologies are on different development/deploy-ability timelines and all present the most significant challenges to commercialization out of everything considered. These three technologies also offer positive community impacts on a much larger scale than most technology options considered. The sections below outline each technology and their associated challenges and benefits.

3.1.1 Small Modular Reactor (SMR)

Small modular reactor (SMR) technology was eliminated in Phase 2 Scoring due to inability to achieve the required JTP in-service year of 2031. Although SMR technology cannot replace Comanche Unit 3 by 2031, a deployment of this technology in Pueblo County could occur in the years after Comanche retires. Current estimated SMR development timelines span a minimum of 10 years or more. Figure 9 shows a projected SMR development timeline based on current regulations.

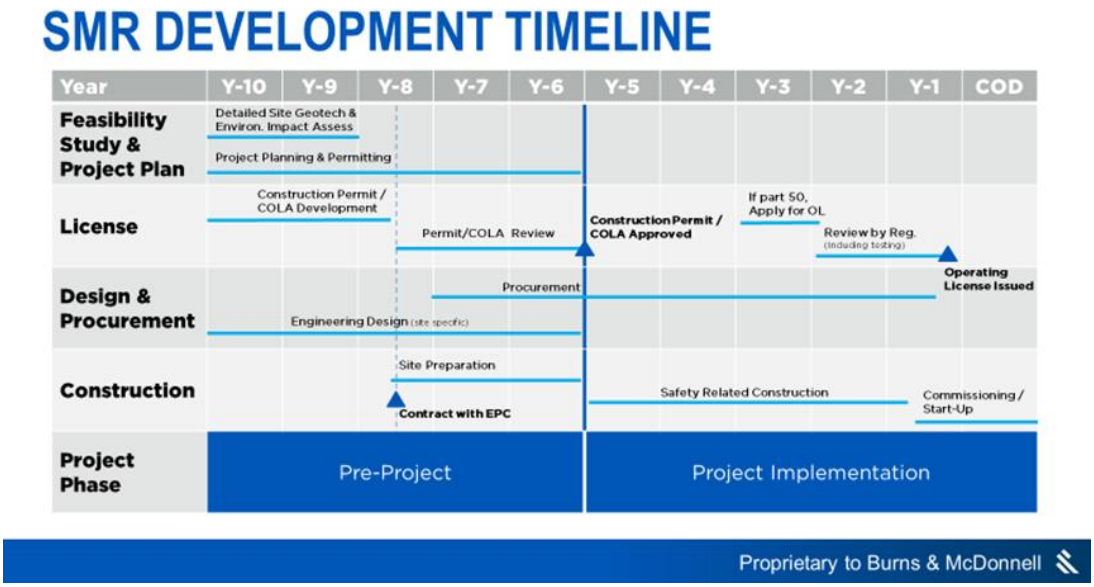

Figure 9: Burns and McDonnell - SMR Development Timeline

One SMR design, the NuScale US600 SMR, has received approval from the United States Nuclear Regulatory Commission (NRC).

In early 2023, the NRC issued its final rule certifying the NuScale standard design for an SMR in the Federal Register. This allows utilities to reference NuScale's design when applying for a combined operating license to build and operate a nuclear reactor (NRC, 2023). The Carbon Free Power Project, spearheaded by Utah Associated Municipal Power Systems (UAMPS) and using NuScale's design, was working on a combined operating license application to be submitted to the NRC in early 2024 at the time of this study.

The process to achieve the NRC final rule certification was extensive. The Carbon Free Power Project was first launched by UAMPS in 2015, and its projected commercial operations year of 2030 would mark a fifteen-year process to achieve operations of the first SMR in the United States. Important milestones achieved thus far for the Carbon Free Power Project are listed below (Nuscale, 2023):

- 2015 – UAMPS launched the Carbon Free Power Project.
- 2016 – Department of Energy (DOE) issued Early Site Permit to UAMPS for the Carbon Free Power Project.
- 2018 – NuScale SMR design certification application accepted by NRC.
- 2019 – Plant site selected; field work began.

- 2020 – Core boring work, meteorological tower installation, and surface seismic testing completed. Final technical review of NuScale design issued.
- 2022 – Geotechnical investigations completed, groundwater monitoring network established, onsite meteorological station is commissioned. The Nuclear Regulatory Commission voted to certify the design as “approved for public use.”

It was officially announced on November 8, 2023, that (UAMPS) and NuScale have mutually agreed to terminate the Carbon Free Power Project. This further casts uncertainty on the assumptions made around Advanced Small Nuclear technology throughout this study.

Other original equipment manufacturers (OEMs) have been awarded DOE grants to advance research into SMRs and are in various stages of development. The NRC currently lists GE-Hitachi Nuclear Energy and SMR, LLC, a subsidiary of Holtec International in pre-application phases, and Tennessee Valley Authority in a pre-application for construction permit phase (NRC U. , 2023).

Although the GE-Hitachi project does not have approval in the United States, it has met the milestone of signing a commercial contract in Ontario, Canada. This was signed with Ontario Power Generation, SNC-Lavalin, and Aecon in January 2023, for the development of a BWRX-300 SMR at OPG’s Darlington New Nuclear Project site (GE, 2023).

The Tennessee Valley Authority’s pre-application for construction is for their Clinch River Nuclear site in Roane County, Tennessee. This site was previously developed for a reactor project in the 1980s but restored after the project was terminated. Tennessee Valley Authority was granted an Early Site Permit from the NRC in 2016, approving the site for a nuclear power facility, independent of a specific design or construction permit (TVA, n.d.).The feasibility of an SMR at this site continues to be assessed by Tennessee Valley Authority.

An SMR in Pueblo County would create more than 200 full-time jobs, compensated at median salaries of greater than $85,000 per year. Although the timing of the closure of Comanche and a deployment of SMR in post-2031 do not align, there is still a possibility that the workforce displaced by the Comanche closure could utilize their background and skills in power plant operation in careers at the SMR facility. While all other technologies will result in a lesser tax base than that generated by Comanche from 2031-2040, an SMR will result in an increased tax base for Pueblo County.

3.1.2 Hydrogen Fueled Gas Turbines with Hydrogen Hub

Government funding through grants for hydrogen infrastructure development could be a major factor in the future of hydrogen fuel. The Bipartisan Infrastructure Law defines a regional clean hydrogen hub as “a network of clean hydrogen producers, potential clean hydrogen consumers, and connective infrastructure located in close proximity” (DOE, Regional Clean Hydrogen Hubs Notifications, 2023) . This Law provides up to $8 billion in funding for the Regional Clean Hydrogen Hubs Program, whose mission is to “establish six to 10 regional clean hydrogen hubs across America” (DOE, Regional Clean Hydrogen Hubs, 2023) . Grant applications were opened in September 2022 by the DOE’s Office of Clean Energy Demonstrations, with Full Applications due in April 2023. The DOE received 79 Concept Papers, or initial grant applications.

The state of Colorado was involved with one hydrogen hub application: the Western Inter-States Hydrogen Hub (WISHH), consisting of Colorado, New Mexico, Utah, and Wyoming. These states signed a Memorandum of Understanding to coordinate, develop, and manage a regional clean hydrogen hub in February 2022 and submitted a Concept Paper to the DOE on the matter. WISHH was one of 33 Concept Paper applicants who received a recommendation from the DOE and was "encouraged to submit full application" in December 2022. The full application was filed by WISHH in April 2023 for a $1.25 billion grant to establish infrastructure-based hydrogen economies, listing 8 planned projects with at least one in each state of WISHH (Robenblum & Cahill, 2023). Unfortunately, WISHH was not selected as one of the DOE funded hubs. Nevertheless, substantial concept development occurred through the WISHH submission process and Xcel Energy will continue to analyze opportunities to use this work to create an anchor for a Colorado clean hydrogen economy. These efforts will be a key consideration in the future availability of clean hydrogen in the region in the future.

A hydrogen power plant in Pueblo County would create opportunities for careers in power plant operations. A 500 MW CCGT or SCGT would require between 11 and 30 full-time employees, compensated at median salaries greater than $85,000 per year. A hydrogen power plant would also provide a dispatchable and reliable power generation source in Pueblo County that could utilize Xcel Energy's existing water rights and produce zero CO_2 emissions. With current legislation, hydrogen power plants fall into the category of renewable generation sites that are highly tax incentivized. In 2023, the tax base impacts to Pueblo County for a hydrogen power plant are estimated at less than $2,000,000 per year. Future tax legislation changes could result in different tax base impacts for this technology.

In the next decade, the DOE's selection for hydrogen hub funding, or other future infrastructure advancements for hydrogen, could increase the feasibility of hydrogen fueled power plants in Pueblo County – a non-CO2 emitting, job-creating technology.

3.1.3 Combined Cycle Gas Turbine (CCGT) with 100% Carbon Capture

CCGT with carbon capture was evaluated in the Technical Study as it stands today. As described in Section 5.2.4 of the Technical Study (included in Appendix A), there is only one operating power plant with carbon capture, utilization, and storage (CCUS) capabilities in 2023: the Boundary Dam Carbon Capture Project, a retrofitted coal-fired power plant that uses captured CO_2 for EOR (Enhanced Oil Recovery) in Saskatchewan, Canada. Another plant, the Petra Nova Project in Houston, Texas operated from 2017 until a suspension due to low oil prices in 2020, due to the pandemic.

The industry standard for carbon capture projects remains at capture of up to 90% of emissions. Based on current trends and state of technology, it was not projected that a 100% carbon capture project could be built by 2031 to meet the JTP requirements of the Comanche replacement. Therefore, the combined cycle with carbon capture technology evaluated in the Technical Study assumed up to 90% emissions capture.

Due to recent legislation and emission reduction goals set by Xcel Energy, commissioning new technologies that produce emissions has become rare, with carbon-emitting power plants only planned for a select few key areas of firm capacity need in the state. This was reflected in the scorecard, with an Environmental Impact subcategory score of 1.65 awarded to combined cycle with carbon capture, the worst of all technologies considered in the Technical Study.

The decade after 2031 could hold improvements in carbon capture efficiency. The grant programs, tax credits, and other incentives available through the Inflation Reduction Act and the Infrastructure Investment and Jobs Act could open the door for increased development of CCUS technology in the United States.

New CCUS projects announced in the United States indicate industry growth, and potential for technology maturity in the next decade.

The Tennessee Valley Authority (TVA), partnered with energy infrastructure firm TC Energy, announced plans for a feasibility study to retrofit two CCGTs (Combined Cycle Gas Turbine) (a 713 MW plant in Mississippi and a 1.1 GW plant in Kentucky) with carbon capture technology. The press release stated that these CCUS systems are targeting to capture more than 90% of carbon emissions (Patel, 2023) . The results of the year-long study will indicate whether further engineering and estimates will commence, or whether carbon capture is not an ideal option for these sites.

Duke Energy was awarded a grant from the Office of Clean Energy Demonstrations to conduct a front-end engineering study for adding CCUS to Duke Energy's Edwardsport Integrated Gasification Combined Cycle Plant in Indiana. The project has a target carbon capture efficiency of greater than 95% with an anticipated project start date of October 1, 2023 (OCED, 2013)

After a successful demonstration of their test facility in La Porte, Texas, NET Power is developing their first utility-scale project using their patented closed-loop gas fired turbine design: 300 MWe in Permian West Texas, with a projected COD (Commercial Operations Date) of 2026. Any CO_2 not recirculated in the cycle can be easily sequestered or sold to industry, according to NET Power (Netpower, 2023). NET Power's design is also under consideration for development by 8 Rivers at the Coyote Clean Power Project on Southern Ute Land (Power, 2023).

A CCGT with carbon capture would require a full operating staff, estimated between 20 and 25 full-time employees. These skilled operators and technicians would be compensated at median annual salaries between $80,000 and $120,000. Although the timing of the closure of Comanche and a potential deployment of a CCGT with carbon capture power plant in post-2031 do not align, there is still a possibility that the workforce displaced by the Comanche closure could utilize their background and skills in power plant operation in careers at the new facility. Furthermore, of the technologies considered in the Technical Study, combined cycle with carbon capture had the second highest tax base impact for Pueblo County, at an estimated $16.5 million per year.

If future combined cycle and carbon capture projects can demonstrate 100% carbon capture in the next decade, this technology could be a suitable and beneficial option for power plant development in Pueblo County while meeting Colorado's emissions reduction goals. As developing projects reach commercial operation, Xcel Energy can monitor design improvements and lessons learned, and potentially incorporate those efficiencies into combined cycle power plants in their fleet.

3.2 Policy for Advanced Technologies

The Federal Government and the State of Colorado have both advanced policies in the last three years that support advanced generation technology. These policies range from carbon free technology neutral policies to specific technology legislation and will be key to integrating new advanced carbon free

technologies in Pueblo. Moreover, policies for the development of long-lead time generation with low or zero emissions will need to evolve as the energy transition moves towards the carbon-free goals of the State of Colorado.

3.2.1 Federal Activities

Infrastructure Investment and Jobs Act (IIJA)

Signed into law in 2021, the IIJA provides $1.2 trillion in funding for United States infrastructure, including $73 billion in new funding for energy-related programs, including significant appropriations to the U.S. Department of Energy (DOE) for advanced clean technologies – energy storage, carbon capture utilization and sequestration, hydrogen, advanced nuclear, and others. Implementation of these programs must also include Community Benefit Plans and planning on how 40% of benefits from federal funding will flow to disadvantaged communities as written in President Biden's Justice40 initiative. Technology specific programs include:

Carbon Capture: Over $8 billion in grants for carbon capture were established through IIJA. These include programs for funding for products derived from anthropogenic carbon dioxide, design and projects for carbon dioxide transport, and direct air capture hubs.

Hydrogen: The IIJA provides $9.5 billion for clean hydrogen research, development, and demonstration programs. $8 billion of this is going to the newly established Office of Clean Energy Demonstrations for the Regional Clean H2 Hub Program. Clean hydrogen hubs will create networks of hydrogen producers, consumers, and local connective infrastructure to accelerate the use of hydrogen as a clean energy carrier that can deliver or store energy.

Long Duration Energy Storage (LDES): Multiple programs through the IIJA have opened to support development of LDES. This includes $505 million for energy storage demonstration projects, of which $355 million has been awarded, including up to $70 million for Xcel Energy's two demonstrations of Form Energy's 100-hour iron air battery. Additional programs include $150 million for the LDES Demonstration Initiative and Joint Program and $7 billion for the Carbon Reduction Program which is partially attributed to LDES solutions.

Nuclear: IIJA includes two main programs for nuclear energy. The First is $6 billion of investment for existing U.S. nuclear reactors that are projected to stop operations due to economic factors. The second program, Advanced Reactor Demonstration Program (ARDP) received $2.5 billion from the IIJA for the demonstration of advanced reactor technologies. ADRP so far will provide $160 million in funding to advanced reactors.

Geothermal: The IIJA included $84 million to fund four enhanced geothermal systems (EGS) pilot projects. These demonstrations have the goal to provide in field EGS data and spur further growth of geothermal energy. However overall, this program received considerably less funding than other technology areas.

Inflation Reduction Act (IRA)

In 2022 the federal government signed the IRA, H.R. 5376, into law. It is 800 pages of budgetary policy including extensive tax credits for new energy resources and $369 billion in energy and climate

spending. An analysis completed by the Rhodium Group indicates that the IRA puts America on track to reduce emissions 32-42% below 2005 levels by 2030 compared to 24-45% without it. Included in the bill are tax credits for clean energy resources:

Production Tax Credit (PTC): The IRA PTC; §45Y is a ten-year tax credit for projects that generate electricity with zero or negative greenhouse emissions, placed in service after 2024. The full credit gives 2.75 cents per kWh. Beyond the technology neutral PTC, there are also specific credits for clean hydrogen (§45V), zero emission nuclear (§45U), and for carbon oxide sequestration (§45Q).

Investment Tax Credit (ITC): The IRA technology neutral ITC creates a full credit of 30% for qualified projects that generate electricity with anticipated zero or negative greenhouse emissions rates placed in service after 2024. This ITC qualifies for energy storage and nuclear projects, and credits can be carried back 3 years.

Full Credits: Both PTC and ITC start with a lower base credit and based on different requirements and bonuses.

- Wage and apprenticeship requirements: both ITC and PTC are subject to an 80% reduction for projects that do not meet prevailing wage and apprenticeship requirements. Prevailing wage requires taxpayers to ensure that laborers and mechanics employed in the construction or repair of the facility are paid wages at rates not less than the prevailing rates for the locality as determined by the secretary of labor. Apprenticeship requirements require the taxpayer to ensure that an increasing percentage of labor hours be performed by "qualified apprentices" to participate in a registered apprenticeship program, up to 15% of labor hours for projects beginning construction after 2023.
- Domestic Content: 10% bonus credit is awarded to the PTC or ITC if steel and iron is 100% produced in the U.S. and if manufactured products are at least 40% sourced to the U.S.
- Energy Community: 10% bonus credit is awarded to the PTC or ITC if the project is built in an energy community; including brownfield sites or census tracts where a coal unit was retired after 2009.

3.2.2 Nuclear Regulatory Commission (NRC)

The Nuclear Regulatory Commission licenses and regulates the operation of U.S. commercial nuclear power plants. Currently operating nuclear power plants were licensed under a two-step process described in Title 10 of the Code of Federal Regulations (10 CFR) under Part 50. This process requires both a construction permit and an operating license. The NRC worked to improve regulatory efficiency and add greater predictability to the process by establishing an alternative licensing process, 10 CFR Part 52, in 1989.

Part 52 includes a combined license that provides a construction permit and an operating license with conditions for plant operation. Other licensing options under Part 52 include Early Site Permits, where applicants can obtain approval for a reactor site without specifying the design of the reactor(s) that could be built there, and certified standard plant designs, which can be used as pre-approved designs.

In either Part 50 or 52, NRC approval is necessary before a nuclear power plant can be built and operated. The NRC maintains oversight of the construction and operation of a facility throughout its

lifetime to ensure the plant complies with the agency's regulations for the protection of public health and safety, the common defense and security, and the environment.

Part 53 (not issued yet): The NRC proposes to establish an optional technology-inclusive regulatory framework for use by applicants for new commercial advanced nuclear reactors. The regulatory requirements developed in this rulemaking would use methods of evaluation, including risk-informed and performance-based methods, that are flexible and practicable for application to a variety of advanced reactor technologies. The draft proposed rule accommodates all reactor technologies and includes two distinct and self-contained licensing frameworks (Framework A and Framework B). The frameworks offer flexibility for the roles of risk assessment techniques and design approaches in establishing licensing basis information. (link to Part 53 rulemaking summary)

Per the NRC Planned Rulemaking Activities page, this is supposed to be published final in 2025.

3.2.3 State of Colorado Activities

Thermal Energy Bill (HB23-1252), Geothermal Grant Bill (HB23-1381) & Tax Credits that Advanced Decarbonization (HB23-1272): New legislation in Colorado creates both tax incentives and grant programs for the development and production of electricity from geothermal energy. This includes:

- Tax credits for 2024-2033 for 30-50% of expenditures to develop geothermal electricity. May not exceed $5M.
- A geothermal production tax credit of $.003 per kWh.
- A grant program for cost share for up to $500,000 for identification and exploration of suitable resources, and up to an additional $500,000 for confirmation through drilling and testing for geothermal electricity generation projects.

Hydrogen Bill (HB23-1281): Recent Colorado legislation created a two-tiered H2 Consumption tax credit $300-$1.00/ton depending on LCA and use. This bill also defines clean hydrogen and directs the PUC to study its potential to meet GHG (Green House Gas) targets. It defines what can be included in an H2 hub investment, including pipelines, electrolyzers, monitoring/controls, dedicated renewables, 3rd party purchases, and upgrades to turbines.

Net-zero by 2050 (SB23-16): Passed in 2023, SB23-16 sets that Colorado must strive to eliminate statewide greenhouse gas pollution by 100% by 2050 from 2005 levels. This legislation is in alignment with Xcel Energy's goal to deliver zero carbon electricity to customers by 2050.

SB19-181 & SB23-285: in 2019, SB19-181 changed the mission of the Colorado Oil & Gas Conservation Commission (COGCC) from "fostering" to "regulating" oil and gas in a manner protective of the public health, safety, welfare, wildlife, and the environment. SB23-285 changes the COGCC to the Energy and Carbon Management Commission (ECMC). This change also enables the agency to continue to regulate oil and gas and expand its responsibilities for emerging technologies such as carbon capture and sequestration, deep geothermal, and underground gas storage.

3.3 Post 2031 Technology Potential Economic Impact

Three scenarios evaluated by Leeds School of Business at the University of Colorado Boulder could not be constructed within JTP requirements. These three scenarios are depicted as Scenario 4 – Advanced Nuclear (462MW), Scenario 5 - Combined Cycle Gas Turbine with Carbon Capture (500 MW), and Scenario 6 - Simple Cycle Gas Turbines w/ 100% Hydrogen Fuel (500 MW). Scenarios 4, 5, and 6 were assumed to be in-service no sooner than December 31, 2035.

The assumptions and summary of Scenarios 4, 5, and 6 were included in Section 2.5.

The full economic impact study performed by Leeds School of Business is included in Appendix C. All six scenarios studied are included in the same report.

3.4 Timelines

This study focuses on generation options suitable for the forthcoming JTP with a resource acquisition period through the end of the year 2031, as well as longer term options for future resource acquisition processes.

Another resource planning cycle will commence in 2026, with a likely resource acquisition period into the mid-2030s. Some of the longer lead time generation types detailed in this study may be suitable for this 2026 resource planning cycle and resource planning cycles to follow the 2026 plan. The Company intends to continue to monitor technology developments and develop generically modeled resources based on these studies for inclusion in all of these resource planning cycles, as the need for low or zero emission dispatchable generation options is expected to continue and grow throughout the 2030s and beyond as PSCo continues to reduce emissions from its generation fleet and move towards its, and the State of Colorado's, goal of a carbon-free power sector.

3.5 Resource Estimations

Beyond the RAP of the JTP, PSCo's mix of resources will continue to evolve. The following figure shows the expected retirements or contract expirations through the year 2040.

Name	Final Summer Generating Year	Resource Type	Nameplate MW
Peetz Table	2032	Wind	199.5
Northern Colorado I	2034	Wind	151.8
Cedar Creek II	2035	Wind	250.80
Pena Station	2036	Solar	1.26
Hooper	2036	Solar	50
Limon I	2037	Wind	200
Limon II	2037	Wind	200
Sun Mountain	2037	Solar	200
Titan	2038	Solar	50

Colorado Green	2038	Wind	162
Valmont 7	2038	Gas	40
Valmont 8	2038	Gas	40
Limon III	2039	Wind	200.60
Golden West	2040	Wind	249.40
Manchief 11 + 12	2040	Gas	262
Total			***2,257.4***

Figure 10: Expected Retirements through 2040

While many of the resources listed above are Power Purchase Agreements and can be renegotiated or extended, it is still noteworthy that with the current contracts and plan in place, the Company will need to account for the loss of approximately 2,257 MW of nameplate capacity before the end of 2040. For reference, the previous Loads and Resources Table is presented below showing the years 2032 – 2040. Note that it includes the accredited capacity from Preferred Plan resources, which is simply an estimate of accredited capacity based on the last studied year (2031).

Xcel Energy | Loads & Resources Table (MW)

OpCo: **PSCo**

Season: **Summer**

PSCo L&R Table (MW) for Summer Peak	2032	2033	2034	2035	2036	2037	2038	2039	2040
Existing Resources	5,206	5,196	5,212	5,207	5,187	5,178	5,047	4,935	4,916
Updated Preferred Plan Resources	1,744	1,744	1,744	1,744	1,744	1,744	1,744	1,744	1,744
TOTAL ACCREDITED CAPACITY	**6,950**	**6,940**	**6,956**	**6,951**	**6,931**	**6,922**	**6,791**	**6,679**	**6,660**
Native Load Forecast	7,659	7,809	7,926	8,030	8,122	8,246	8,357	8,476	8,575
Demand Response	(767)	(767)	(767)	(767)	(767)	(767)	(767)	(767)	(767)
FIRM OBLIGATION LOAD	**6,892**	**7,042**	**7,159**	**7,263**	**7,355**	**7,479**	**7,590**	**7,709**	**7,808**
Target Planning Reserve Margin %	*18.0%*	*18.0%*	*18.0%*	*18.0%*	*18.0%*	*18.0%*	*18.0%*	*18.0%*	*18.0%*
Target Planning Reserve Margin	1,241	1,268	1,289	1,307	1,324	1,346	1,366	1,388	1,405
IREA & HCEA Backup Reserves	11	11	11	11	11	11	11	11	11
TOTAL PLANNING RESERVE MARGIN TARGET	**1,251**	**1,278**	**1,299**	**1,318**	**1,335**	**1,357**	**1,377**	**1,398**	**1,416**
CAPACITY NEED	8,144	8,320	8,459	8,581	8,690	8,836	8,967	9,107	9,225
ACTUAL RESERVE MARGIN	(1,686)	(1,846)	(1,947)	(2,056)	(2,168)	(2,301)	(2,543)	(2,774)	(2,892)
Actual Reserve Margin %	*0.8%*	*-1.4%*	*-2.8%*	*-4.3%*	*-5.8%*	*-7.4%*	*-10.5%*	*-13.4%*	*-14.7%*
CAPACITY POSITION: LONG/(SHORT)	**(1,194)**	**(1,380)**	**(1,502)**	**(1,630)**	**(1,759)**	**(1,914)**	**(2,176)**	**(2,429)**	**(2,564)**

Figure 11: Loads and Resource Table for years 2032 - 2040

Figure 11 is a picture of opportunity and flexibility. Future studies will allow the Company to make timely decisions on whether and how to incorporate other resources made possible by new developments in technology. As the Company continues to pursue its clean energy goals and the Company's resource mix continues to increase in weather dependent resources, the technologies presented in this study (and future improved iterations or newer developments) will become increasingly important. Technologies that can provide firm, dispatchable generation will be coveted, as they would provide more resource diversity and help make the final push to a zero-carbon future.

What's Next

The Company recognizes the need for continued engagement in dialogue and education efforts with the Pueblo community about the complexities of replacement generation for the Comanche Plant. As public engagement has shown, Pueblo views this transition as an opportunity to become a leader in the clean energy economy with a vibrant and thriving future for generations to come. The Company will continue to work with key stakeholders and the community to that end. The Company will also continue to engage with the Pueblo Innovative Energy Solution Advisory Committee at the Committee's discretion.

References

Colorado, T. P. (2022). Decision No. C22-0459 - Phase I Decision Addressing the Application for Approval of the 2021 Electric resource PLan and Clean Energy Plan and Approving in Part, the Updated Non-Unanimous Partial Settlement Agreement., (p. 42).

Decision No. C22-0459, Proceeding No. 21A-0141E (Public Utiliies Commission of the State of Colorado August 3, 2022).

DOE, U. (2023). *Regional Clean Hydrogen Hubs*. Retrieved September 2023, from https://www.energy.gov/oced/regional-clean-hydrogen-hubs

DOE, U. (2023). *Regional Clean Hydrogen Hubs Notifications*. Retrieved September 2023, from https://www.energy.gov/oced/regional-clean-hydrogen-hubs-notifications

GE. (2023, January 27). *GE Hitachi Signs Contract for the First North American Small Modular Reactor*. Retrieved September 2023, from https://www.ge.com/news/press-releases/ge-hitachi-signs-contract-for-the-first-north-american-small-modular-reactor

Netpower. (2023). *Technology*. Retrieved September 2023, from https://netpower.com/technology/

NRC. (2023, January 20). *NRC Certifies First US Small Modular Reactor Design*. Retrieved September 2023, from https://www.energy.gov/ne/articles/nrc-certifies-first-us-small-modular-reactor-design#:~:text=The%20company's%20power%20module%20becomes,down%20emissions%20across%20the%20country

NRC, U. (2023, August 30). *SMR Pre-Application Activities*. Retrieved September 2023, from https://www.nrc.gov/reactors/new-reactors/smr/licensing-activities/pre-application-activities.html

Nuscale. (2023). *Projects*. Retrieved September 2023, from https://www.nuscalepower.com/en/projects

OCED. (2013). *Carbon Capture Demonstration Projects Program FEED Studies*. Retrieved September 2023, from https://www.energy.gov/sites/default/files/2023-09/OCED%20Duke%20CCS%20Factsheet%209.27.23.pdf

Patel, S. (2023, September 21). *TVA Exploring Carbon Capture Feasibility for Two Gas-Fired Power Plants.* Retrieved September 2023, from Power: https://www.powermag.com/tva-exploring-carbon-capture-feasibility-for-two-gas-fired-power-plants/

Power, C. C. (2023). *Coyote Clean Power Project*. Retrieved September 2023, from https://coyote.energy/

Public Service Company of Colorado. (2023). *Response Comments of Public Service Company of Colordado on the 120-Day Report, Proceeding No. 21A-014E.*

Robenblum, A., & Cahill, C. (2023, April 10). *Western Interstate Hydrogen Hub Submits Application for US Department of Energy Funding Grant*. Retrieved September 2023, from https://drive.google.com/file/d/1qT9peZ2lBOsDRrw2mwN-tizdyMColGZZ/view

TVA. (n.d.). *Advanced Nuclear Solutions*. Retrieved September 2023, from https://www.tva.com/energy/technology-innovation/advanced-nuclear-solutions