Testimony of Keith Hay,
Senior Director of Policy, Colorado Energy Office
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"Powered Up: State Utility Regulators on Challenges to Reliable, Affordable Electricity"

Good morning Chair Duncan, Ranking member DeGette, and members of the Committee. I am Keith Hay, Senior Director of Policy for the Colorado Energy Office. Thank you for the opportunity to share Colorado's story of how we are working to ensure reliable, affordable, low-carbon electricity for all Coloradans, and how federal action can further support the grid.

As I will describe in my comments, based on both our experience to date and deep analytical work, we believe that the most important steps that the federal government can take to advance reliability and resilience are supporting the development of new transmission, especially inter-regional transmission, siting reform to support renewable energy deployment, supporting reforms to help create a supportive legal and regulatory framework for geothermal energy development, and supporting energy efficiency investments and advanced building codes to reduce building energy use.

Since 2004, when Colorado voters approved the state's first renewable energy requirement, Colorado has been on a trajectory toward increasing renewable energy and today we are moving toward deep decarbonization of our electric system. In 2010, 68% of our electricity came from coal. In 2022, coal supplied just 36% of Colorado's electricity with gas providing 26% and renewables providing just under 40%.

In part, what has enabled this transition is the dramatic decline in the costs of wind, solar, and batteries; the increasing skill and experience of our utilities in effectively integrating renewables; and a supportive policy environment. Throughout this transition, the state has maintained a strong working partnership with our utilities, focused on the three pillars of affordability, reliability, and pollution reductions.

Colorado has adopted legislation directing our utilities to have approved resource plans to reduce greenhouse pollution by at least 80% by 2030 from a 2005 baseline. Today, all of the utilities subject to that requirement have approved plans and as a whole are projected to reduce greenhouse gas pollution by 84% to 87% below 2005 levels by 2030. Under those plans, the last coal plant in the state will retire by the end of 2030. As part of the state's overall energy planning framework, we have also passed legislation requiring utilities to submit annual resource adequacy reports to the Colorado Energy Office to ensure that we continue to provide reliable electric

service. We have been able to manage this transition while keeping average electrical rates below the national average.

As we look past 2030, the Energy Office is preparing to release a study, with modeling done by Ascend Analytics, which evaluates different pathways to the deep decarbonization of Colorado's electrical grid by 2040. As part of the study, we modeled a business as usual scenario and six different scenarios that reliably meet Colorado's projected 2040 load while achieving zero carbon pollution. These scenarios assume a 40% increase in demand over current levels driven not only by population growth, but also by significant vehicle electrification, shifting building and water heating to high efficiency electric appliances like heat pumps and heat pump hot water heater, and the electrification of oil and gas production in Colorado. I

The results of the analysis are very instructive. The modeling shows that under a business as usual approach, which is the lowest cost scenario to meet projected 2040 load, the Colorado grid achieves more than a 94% reduction in greenhouse pollution. It does this by adding significant amounts of wind, solar, and batteries, while retaining a gas generation fleet that is approximately the same size as the gas fleet in service in Colorado today. Over time, the levels of dispatch of gas units declines dramatically from current levels, but they continue to play a very important role in helping to ensure system reliability. By 2032, only one gas unit is projected to approach 20% capacity factor, and, by 2038, no unit is projected to have a capacity factor more than 11%. By 2040 gas provides less than 2% of electricity with wind, solar, and batteries providing roughly 70% of electricity and energy efficiency meeting roughly 9% of energy need. According to the modeling, this decline in the use of gas is driven by the economics of gas compared to wind and solar. What the results show is that, simply by simply minimizing costs to customers, our utilities will continue the state's transition to a lower carbon electrical grid.

To be clear, after over a century of reliance on fossil fuels to power the electric grid, there will be challenges with getting all the way to a zero carbon grid, especially when it comes to addressing the last few percent of carbon pollution. However, as the modeling in the study shows, with careful planning, Colorado can move to a nearly fully decarbonized grid by 2040.The study finds that across all of the scenarios most of Colorado's electricity comes from wind, solar, and storage. While wind, solar, and batteries play an important role, the modeling also shows that the lowest cost pathway to the transition includes flexible firm and dispatchable resources like geothermal, clean hydrogen, or gas with carbon capture along with adequate transmission to ensure power is available when and where it is needed.

The modeling finds that combustion turbines powered by clean hydrogen, which is among the lowest cost types of clean firm electricity as a result of federal incentives under the Inflation Reduction Act (IRA), and new forms of geothermal electricity generation, both play important roles. In addition, one of our large utilities is proposing to develop a gas plant with carbon capture and storage.

This analysis illustrates that we see no negative impact on the reliability of Colorado's electric grid from EPA's proposed clean power regulations. In fact, given the closure of all coal plants and the low dispatch rates for gas plants, we do not expect any plants in Colorado to meet the thresholds in EPA rules requiring use of clean hydrogen or carbon capture, but we do anticipate significant movement towards clean hydrogen, geothermal, and some investment in CCUS to meet state goals.

In addition to a business as usual scenario, the study includes the following scenarios:

Technology neutral

This scenario represents the economically optimal resource buildout to achieve a zero carbon grid by 2040. In this scenario, the model selected resources based on the most economical mix that is zero carbon and satisfies energy and capacity needs in each year after 2026. The model was allowed to select wind, solar, batteries, clean hydrogen, geothermal, gas with carbon capture and storage (CCS), small modular nuclear reactors, biomass, and demand response. The modeling shows that no new gas is added after 2029. Instead, the model selects clean hydrogen combustion turbines as firm capacity. In this scenario, the model adds 6,300 MW of wind between 2031 and 2040 along with roughly 5,000 MW of solar, more than 7,000 MW of batteries and more than 7,000 MW of hydrogen combustion turbines (both new and conversions). The model also adds almost 800 MW of geothermal. The model does not select gas with CCS or nuclear because of high costs. The NPV is $51.6 billion.

Wind, solar, battery only

This scenario assumes all new resources are wind, solar PV, and batteries only. To meet reliability, energy, and demand requirements, this scenario requires a buildout of more than 60 GW of new resources, including almost 17 GW of wind and 17 GW of solar, and more than 20 GW of batteries. As a result of the buildout, this scenario is the most expensive pathway to achieving a zero-carbon grid by 2040 with a NPV of $61 billion dollars. This scenario also has the highest level of exported energy, suggesting that if transmission or markets do not emerge that utilities could face higher levels of curtailment, which would likely create additional costs for customers.

Hydrogen limited

The Optimized 100 scenario adds roughly 7,000 MW of clean hydrogen combustion turbines because those units are forecasted to be the most cost-effective resources available from a cost/firm MW perspective. The Hydrogen Limited scenario examines what the next-best resource selections are if less hydrogen than expected is available. To reflect hydrogen not emerging, this scenario limits the amount of greenfield hydrogen CT buildout to 1,000 MW total (but keeps the 1,386 MW gas-hydrogen retrofit) with the remaining

capacity and energy needs served from the other available resources. To replace the hydrogen, this scenario adds almost double the amount of new capacity – roughly 24 GW in the OT100 compared to roughly 45 GW in this scenario. The majority of that is new wind, solar, and an additional 2,300 MW of 12-hours batteries and 2,800 MW of 100-hour iron air batteries. The NPV is $54.1billion.

High geothermal growth

This scenario reflects a pathway where geothermal technology is given additional policy support in Colorado. To reflect this support, the model is required to use geothermal to meet 2% of demand in 2034, 4% in 2036, 8% in 2038, and 10% in 2040. The first GW of new geothermal is hydrothermal-binary, the second is EGS-flash. Like other scenarios, the capacity expansion model performs an economic optimization to select the resources around the geothermal builds. This scenario has a NPV of roughly $54.7 billion.

Demand side focus

This scenario models a pathway to a carbon-free grid focused on meeting customer energy needs with distributed energy resources. As a result of the focus on smaller, customer-sited resources, this scenario yields higher peak loads but lower energy consumption for the model (ARS) to satisfy. While all scenarios assume some level of demand side resource contribution, this scenario assumes higher penetrations of distribution-level resources — roughly double that of the other scenarios. The NPV is $56.1 billion.

Small modular reactor focus

This scenario models the adoption and implementation of nuclear SMR technology in Colorado. The model builds 3,840 MW of nuclear SMRs from 2035-2040 (two 320 MW plants per year) to meet capacity and energy needs. Because of the cost of the SMR technology, this is the second-most expensive pathway to meeting a 100% reduction in carbon pollution in 2040. The NPV is$60.8 billion

In addition to supply-side resources, the study's modeling shows that reducing energy use in buildings, which is modeled as energy efficiency but includes a role for advanced building energy codes, plays an important role in meeting the decarbonization. Across all of the scenarios, energy efficiency meets roughly 9% of load, reducing GHG pollution and helping to cut consumer electricity costs.

Based on the study, Colorado is working on legislation this year that would update the existing electric utility clean energy planning framework. Building on the success of that framework, the updated legislation would require Colorado utilities starting in 2030 to have plans approved that show how they can achieve a carbon-free grid by

2040 while allowing the public utilities commission or utilities board to amend those plans to ensure that they result in reliable and affordable electricity.

Colorado will need three times the wind that is installed today and five times its current total amount of solar to provide affordable and reliable electricity in 2040. The ability to reach regions of high renewable potential and to transmit electricity between regions, allowing access to energy from diverse geographical areas, is important to meeting these targets and will become more important over time both due to the changing nature of generation and the increasing frequency of extreme weather events.

New transmission is especially important because Colorado is quite constrained in transmission capacity. In a recent analysis, the Department of Energy identified four "Qualified Paths" in the western U.S., in which transmission congestion is significant enough to pose a reliability risk. With three of those four qualified paths surrounding Colorado's borders: with Wyoming, Utah, and New Mexico. Accelerating the build out of interregional transmission is key to both minimizing costs to electricity consumers and increasing the reliability and resilience of the grid.

In addition to working on interregional transmission, Colorado is actively working to increase in-state transmission to reduce the time it takes to interconnect new resources and to align with the growth in wind and solar needed to achieve a carbon-free grid by 2040. Under an emerging model in Colorado, Xcel Energy, our state's largest utility, has received public utilities commission approval to build a new transmission network – a backbone – that will connect several of the best wind and solar resources in the state to the load centers along the Front Range, including Denver and Colorado Springs. The Colorado Electric Transmission Authority (CETA) is undertaking a transmission capacity expansion study that will take a long-run, holistic approach to identifying the need for additional transmission in Colorado, including through new transmission line construction, improvements to existing transmission lines, and connections to organized wholesale electricity markets. The study is considering the use of advanced transmission technologies and electricity storage as well as options for limiting land impacts, such as using existing rights-of-way, reconductoring existing transmission lines, and establishing new transmission corridors.

In addition to increasing in-state transmission, the state legislature has directed utilities to consider participation in regional electricity markets. Accelerating the build-out of interregional transmission is key to both minimizing costs to electricity consumers and increasing the reliability and resilience of the grid. We would urge federal action, both by FERC and through Congressional action, to support this deployment. For example, Colorado Sen. Hickenlooper and Rep. Scott Peters have introduced the Building Integrated Grids With Inter-Regional Energy Supply (BIG WIRES) Act, which would require each region to be able to transfer 30% of their peak load to neighboring regions.

Another important arena to help facilitate the development of new clean energy resources is permitting reform. Our modeling shows a need for significant expansion of supply to meet an anticipated 40% increase in electrical load by 2040. This will require tripling deployment of wind and quintupling solar over the next two decades. Our office is currently working with stakeholders on potential state legislation to streamline the state and local siting process for renewable energy, transmission, and energy storage within Colorado to allow infrastructure investment at the necessary pace and scale. We believe that similar action at the federal level will be important. Given the importance of geothermal electricity to Colorado, we would particularly urge federal action to grant similar categorical exclusions for geothermal as exists for oil and gas drilling.

Colorado is also evaluating the potential role of microgrids to help enhance reliability, especially in response to extreme weather events, including wildfires, which are a growing danger in Colorado. With support from the Bipartisan Infrastructure Law (BIL), our office is currently working on a microgrid roadmap to better understand the need, uses, and barriers to the development of microgrids to help provide resiliency and reliability, especially in response to wildfires and other extreme weather events. The Colorado Energy Office also administers programs that are supporting local communities and rural electric cooperatives in developing microgrids, including the Microgrids for Community Resilience (MCR) program, and Grid Hardening for Small and Rural Communities Program. These efforts are also supported by BIL funding.

In earlier comments to the Environmental Protection Agency, Will Toor, the Executive Director of the Energy Office, testified that Colorado does not expect that proposed EPA power plant rules would have any negative impact on the reliability of the state's electric grid. Rather, he clarified that based on Colorado's current electric utilities planning, the state's utilities will already be meeting EPA requirements. As I noted, all of the state's coal plants will be retired by the end of 2030, and the gas units will largely be operating at capacity factors below the thresholds required for conversion to hydrogen or addition of carbon capture in the proposed EPA rules. Finally, Director Toor observed that the technologies proposed in the EPA rules, including carbon capture and especially clean hydrogen, will be important to achieving a lower cost pathway to deep decarbonization of the electrical grid.

As reflected in my comments, Colorado is doing a lot to advance clean energy planning, but there are several areas where federal actions continue to play an important role in supporting reliability and resilience in Colorado. Many elements of the Bipartisan Infrastructure Law (BIL) and the Inflation Reduction Act (IRA) are extremely useful for enhancing grid reliability in Colorado. We appreciate the GRIP investments from the BIL that are flowing into Colorado. This includes three multi-state efforts led by Colorado utilities, Xcel Energy, Tri-State Generation and Transmission, and Holy Cross Energy, which focus on wildfire mitigation, analyzing the best approaches for electricity cooperatives to mitigate wildfires, and optimizing energy efficiency and resiliency. We are competing for additional funds to support transmission expansion. The clean electricity tax credits in the IRA are facilitating the

addition of many thousands of megawatts of wind and solar in our state, which are critical for resource adequacy. The 45V hydrogen production tax credits are important to enabling deployment of clean hydrogen in our state. We also find the BIL and IRA investments in building efficiency, through rebates, tax credits, and support for advanced building codes, to be important. In fact, as I noted above, the Ascend Analytics modeling found 9% of the total 2040 load being met by energy efficiency.

Thank you for the opportunity to testify.