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Colorado Faces Economic, Technological, and Even Geopolitical Barriers

to Meeting Its Aggressive Greenhouse Gas Emission Reduction Goals

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ABOUT THE MIKE A. LEPRINO FELLOWSHIP

The Mike A. Leprino Free Enterprise Fellowship was established by Laura Leprino and Matthew Leprino in honor of the late Mike A. Leprino, who was a pillar in the Denver community. The son of Italian immigrants, he was a banker, developer and community servant. Some of the greatest treasures and neighborhoods in our state were built and funded by Mike. He gave back relentlessly to his state and country, something that he also instilled in each of his children. No greater defender of free enterprise and the American dream, Mike is someone who from humble beginnings built an enviable legacy in Colorado. Thanks to Mike A. Leprino's legacy, we can all take a lesson in hard work, the entrepreneurial spirit, and the power of free enterprise. The Mike A. Leprino Fellowship will focus on issues reflected in the values and accomplishments of this former pillar of the community.

ABOUT THE AUTHOR

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Ms. Lim was also a consultant at Deloitte and Touche LLP in its litigation support services group in Chicago, Illinois. She received her Juris Doctor from DePaul University College of Law in Chicago, Illinois and her Bachelor of Arts from the University of Illinois, Urbana-Champaign. Ms. Lim clerked for Federal District Court Judge Rebecca Pallmeyer (now Chief Judge) in the Northern District of Illinois and for Illinois Attorney General Jim Ryan.

ABOUT COMMON SENSE INSTITUTE

Common Sense Institute is a non-partisan research organization dedicated to the protection and promotion of Colorado's economy. CSI is at the forefront of important discussions concerning the future of free enterprise in Colorado and aims to have an impact on the issues that matter most to Coloradans.

CSI's mission is to examine the fiscal impacts of policies, initiatives, and proposed laws so that Coloradans are educated and informed on issues impacting their lives. CSI employs rigorous research techniques and dynamic modeling to evaluate the potential impact of these measures on the Colorado economy and individual opportunity.

Common Sense Institute was founded in 2010 originally as Common Sense Policy Roundtable. CSI's founders were a concerned group of business and community leaders who observed that divisive partisanship was overwhelming policymaking and believed that sound economic analysis could help Coloradans make fact-based and *common sense* decisions.

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"So that the record of history is absolutely crystal clear, that there is no alternative way so far discovered of improving the lot of the ordinary people that can hold a candle to the productive activities that are unleashed by the free-enterprise system." — Milton Friedman

Key Points:

- Governor Polis has declared that Colorado will rely on 100% renewable electricity by 2040, a goal that surpasses even that of President Biden, although achieving such targets will not come without economic and social cost. The challenge is significant, and, by most measurements, the state is behind in meeting its targets.
- While it's important to keep a line of sight on how to reach our climate goals, no one has the exact path to net zero. We should keep in mind the importance of flexibility as first movers in this energy transition and make reasonable, attainable interim targets towards meeting goals.
- Obstacles to transitioning to 100% renewable energy include improved battery technology and the availability of material inputs to battery production. The United States is making improvements in battery technology but unfortunately finds itself reliant on imports from countries like China which control many key materials used in batteries.
- Technology will be integral to meeting Colorado's goals, but new technology must be viewed in the context of the energy system developments.
- Much of the discourse surrounding energy policy is still focused on binary arguments about whether climate change exists or whether it is caused by human activity or naturally occurring. Effective public policy should focus on progress that balances expediently reducing harm with cost effectiveness.
- Economic growth and environmental protection are not mutually exclusive. In fact, economic growth provides the means to protect and care for the environment. Cheap and reliable energy is a vital contributor to that growth.
- Energy is critical to the future of the quality of human life globally, economic opportunity, and climate change, and yet it is a highly regulated monopoly sectors, granting consumers very little choice.

Introduction

In July 2017, Colorado joined the U.S. Climate Alliance, a coalition of states and U.S. territories that are committed to upholding the objectives of the 2015 Paris Agreement on climate change. In the 2019 legislative session, the Colorado General Assembly passed fourteen pieces of climate legislation, including House Bill 19-1261, the "Climate Action Plan to Reduce Pollution," which included targets to reduce statewide greenhouse gas emissions to 26% by 2025, 50% by 2030, and 90% by 2050 below baseline 2005 levels.[i]

Governor Jared Polis directed state agencies to develop a plan to meet those targets and subsequently issued the "Greenhouse Gas Pollution Reduction Roadmap" (Roadmap) in January 2021.[ii] The Roadmap builds upon actions the state

had already undertaken to reduce greenhouse gas pollution and detailed policies that would help the state achieve its aggressive emissions-reduction targets. The roadmap outlines some key steps regarding actions to:

- Continue the swift transition away from coal to renewable electricity;
- Achieve large reductions in methane pollution from oil and gas development;
- Accelerate the shift to electric cars, trucks and buses;
- Make changes to transportation planning and investment and land use planning to encourage alternatives to driving;
- Increase building efficiency and electrification; and
- Reduce methane waste from landfills, wastewater, and other sources.

Furthermore, Governor Polis has declared that Colorado will rely on 100% renewable electricity by 2040, a goal that surpasses even that of President Biden.[iii] Achieving such targets will not come without economic and social cost.

The 2005 baseline emissions from which reductions will be calculated was established at nearly 139.2 MMT of CO_2 equivalent. The state's targets require emissions to be cut by 36.4 MMT of CO_2 equivalent by 2025, an additional 33.6 MMT by 2030, and another 56 MMT by 2050.[iv]

Thirteen other pieces of legislation passed in 2019 and implementation is in various stages of regulatory action. The chart on the following page shows the laws and regulations directed by HB19-1261 and other climate related policy.

Laws and Regulations Directed by HB19-1261 and Other Climate-related Legislation

PUC	AQCC	DOLA	CDOT	CEOS	CDA	CDLE	CSFS	COGCC	CDPHE	Governor Office	State & Local Laws
SB21-246	SB21-264	HB21-1009	HB21-1303	HB21-1105	SB21-235	HB21-1290	HB21-1180	Mission Change 200–600	SB20-204	FY23 Budget	HB21-1117
HB21-1238	HB21-1286	HB21-1253	SB21-260	SB21-230		HB21-1149		Mill Levy Increase	SB20-204		HB21-1162
HB21-1269	HB21-1266	HB21-1271	TSA Planning	SB21-231		HB19-1314		Mission Change 800/900/1200			HB21-1189
SB21-072	ZEV rule	Clean Energy Grant	SB19-239	HB19-1198				Permit Fee Increase			HB21-1141
SB21-103	Methane rules										HB21-1052
SB21-261	Reg. 22										SB21-020
SB21-272	Reg. 11 updates										SB21-293
HB21-1324	SB19-096										HB21-1284
EV rate rules	SB19-181										HB19-1231
Utility CEPs											HB19-1260
SB19-077											HB19-1159
SB19-236											
HB19-1003											

As the state continues to regulate and legislate in favor of accelerated goals, by most measures, the state is behind on meeting its targets. Whether more aggressive policy actions are warranted or if innovation and technology will rally to meet the challenge is still to be determined. However, a measured and realistic approach to meeting the state's energy and emissions goals is of the highest importance going forward. Policies should carefully weigh the global benefits against the costs to Coloradans.

Overregulation is one of the top challenges of the oil and gas industry nationwide. But even more harmful than overregulation is the instability of policy at both the federal and state levels. As seen recently at the federal level, regulation and policy created in one administration are rolled back in another, swinging the industry from one extreme to another. The instability of the regulatory environment hinders growth and investment and creates disincentives to innovation and business formation. The instability also manifests as public distrust which impacts policy debates and community support for energy resource development. When policy is perceived as the binary ideological choices of political actors rather than as necessary actions for public benefit, it undermines public trust and creates an uncertain environment.

Even as oil prices spike to levels not seen since 2008, U.S. oil producers remain reluctant to increase U.S. energy production. While the message recently from the Biden Administration has been encouraging of increased production, it likely does not represent a wholesale change in its view that the industry must be abandoned in favor or renewables. The mixed messages and ever-changing regulatory environment mean that gas prices will continue to remain high for the foreseeable future even as the Administration makes efforts to increase domestic production.

This Is a Global Challenge

Countries have debated how to address climate change for decades. The most important international agreements have been the Kyoto Protocol and the Paris Climate Agreement (Agreement). The Agreement was reached in December 2015 under the Obama Administration. In 2017, President Trump withdrew the United States, only for the United States to rejoin in 2021 under President Biden. As a signatory to the Paris Agreement, the United States joined 195 countries in a common effort to combat climate change by setting emission reduction pledges. The parties to the Agreement agree to take actions to meet the target of holding the rise in global temperature "well below" 2° Celsius (3.6°F) above pre-industrial levels, and preferably limiting the increase to 1.5°C (2.7°F).[v] It also aims to reach global net zero emissions (carbon neutrality) by 2050.

Much of the controversy surrounding the Paris Agreement concerns which countries are most responsible for climate change, and therefore, how to curb emissions. In the context of this debate, major climate agreements have evolved their approaches to pursuing reduced emissions. The 2005 Kyoto Protocol required only developed countries to reduce emissions, whereas the 2015 Paris Agreement

recognized that climate change is a global problem and called on all countries to set emissions targets.

Although the United States has emitted the most greenhouse gases historically, China and India are now among the world's top annual emitters.[vi] Increasing emissions from China and India, along with the rest of the developing world, overwhelm the small reductions in GhG emissions achieved by the United States and European countries.

Between 2005 and 2020, annual global CO_2 emissions increased by 5.8 gigatons—a 20% increase. China accounted for 92% of that increase. During the same period, the U.S. led the world in cutting CO_2 emissions by 24% while China's emissions rose 84%.[vii] Despite President Xi Jinping's pledge that China will be carbon neutral by 2060, it is clear by China's actions that it is not honoring that pledge. In 2020, China built over three times as much new coal power capacity as all other countries in the world combined. Additionally, 163 gigawatts of new coal power projects were permitted in China in 2020, which is over five times more than that initiated in the rest of the world combined.[viii]

The United States is committed to decarbonizing. U.S. emissions are still below pre-pandemic levels and about 20% lower than in 2005.[ix] Though some of the reduction in emissions is due to slow economic growth related to COVID-19, the downward trajectory is evident. Yet largely due to China's substantial growth in in emissions, even if all countries fulfill their latest Paris Agreement pledges, global emissions growth will likely result in the world missing the Paris 2°C target by 0.4 to 0.5 degrees. The United Nations Environmental Program recently released a "gap report" which calls the global efforts "highly insufficient to bridge the gap."[x]

Further, China is planning to spend nearly $1 trillion on infrastructure projects around the world as part of its so-called "New Silk Road."[xi] In addition to increasing China's geopolitical influence, many of these projects are associated with high greenhouse gas emissions that will hinder overall reductions in global emissions for decades.

Other challenges exist to the transition to renewable energy. Wind and solar power are intermittent sources, making stored power a necessity to ensure access to power when the wind is not blowing and the sun is not shining. Storing large amounts of power has historically been difficult or impractical, expensive, and technologically challenging. Additionally, material inputs to battery construction are mined in countries outside of the United States and complicated by supply chain issues.

The scale and scope of this challenge should not be underestimated. Currently, minerals like copper, lithium, cobalt, and nickel are required inputs to manufacture batteries. They are extremely expensive and difficult to extract in ways that are not harmful to the environment. Additionally, many of the mining operations are

outside of the United States and utilize substandard work conditions, often including child and forced labor.[xii]

China is dominating the global advanced battery supply chain, and as the United States pushes toward a clean energy revolution and increased mandates for electric vehicles, China has increased its dominance of the mining and processing of raw materials needed as inputs to solar and wind power generation systems and batteries used in electric vehicles. China is the leading supplier of rare-earth minerals and often wields its dominance like a cudgel. For example, in 2010, China cut Japan off from rare-earth exports as part of a dispute in the South China Sea. The United States and Japan took the issue to the World Trade Organization and, though the WTO forced China to resume exports to Japan in that case, China continues to control the supply of these minerals and uses its position to restrict exports when trade tensions increase.

Overreliance on China to supply these critical ingredients is also a national security concern. The Department of Defense recently described the critical supply chain issue:

> China dominates the global advanced battery supply chain…. Even materials and components manufactured domestically often have reliance on China-produced precursors or are fragile suppliers and single point failures within the supply chain. As electrification is expected to accelerate dramatically by 2030, reliance on China will grow and China's relative cell dominance is projected to remain stable.[xiii]

Amid these security concerns, in January, the Biden Administration effectively canceled two long-standing mineral leases at the Twin Metals mine in northeastern Minnesota which contain the world's largest undeveloped deposits of cobalt and nickel, which are rare-earth minerals needed to meet our energy goals.[xiv] The underground copper, nickel, cobalt, and platinum mines were leased for 56 years and used state-of-the-art precision methods of extraction. Canceling the leases will not reduce demand; it will only serve to increase our reliance on foreign suppliers, which has doubled over the past two decades. Furthermore, U.S. mining techniques and environmental controls produce these strategic materials in a safer and environmentally sound manner that are not shared by foreign suppliers.
The World Bank estimates that, to meet the growing need for electrification, production of battery minerals, including cobalt and nickel, must increase by 450% over its 2018 level by 2050.[xv] Any mineral supply shortage will impact the speed and scale at which clean energy technology can be deployed. The shuttering of these mines makes no sense as we race towards widespread electrification, particularly in our transportation sector considering our accelerated goals for electric vehicles. The issue is also one for Colorado to contemplate as the state pursues its own aggressive targets that exceed President Biden's goals. Colorado ranks 24th among all states in total CO_2 emissions, according to the U.S. Energy Information Administration.[xvi] If the state were to meet its emissions goals, the

reduction would amount to just over 2.1% of current U.S. emissions and only .3% of global emissions.

The discourse surrounding climate change, and solutions to it, are often grounded in emotion and often people are stuck in the binary arguments of old: climate change does or does not exist and climate change is caused by humans or naturally occurring. Often your choice will signal a moral failing to the opposing side and at that moment, discourse ends. It becomes impossible to find a solution because of disagreement on first principles.

Altogether the divisiveness in climate discourse harms our public policy making because it uses fear to garner acceptance of extreme policy interventions. Doomsday predictions and sensationalist headlines are par for the course when it comes to environmental discussions. Headlines take the worst-case scenarios and sensationalize them as our likely futures. Such apocalyptic rhetoric is harmful to the energy and environmental policy conversation. It further divides an already polarized public, suppresses respectful and honest discussion, and impedes sober and rational policymaking. Despite this, it is possible that we can build a future that both is sustainable and provides a high standard of living for everyone.

Climate change has become so polarized and politicized that rational policymaking is difficult to achieve. A desire to address the harmful effects of climate change should not be taken as a blank check for implementing policy choices. Actions should be taken; however, our goal should be to continuously move toward rapid decarbonization without sacrificing resilience and affordability for Colorado families and businesses.

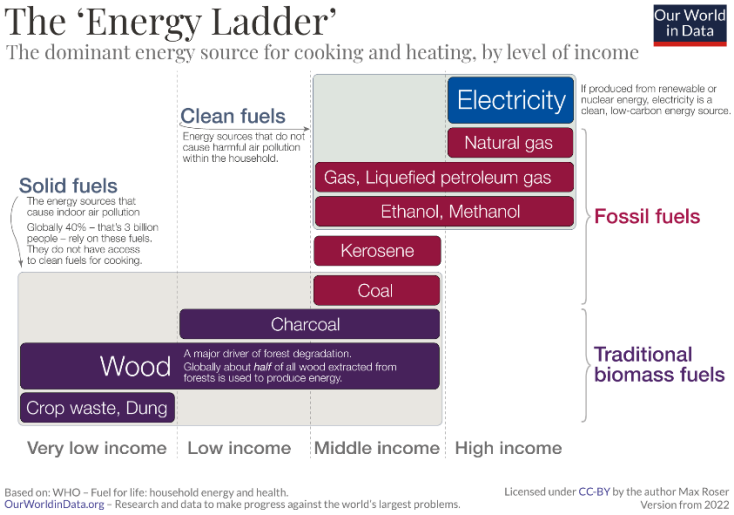
The effort needed to achieve net-zero greenhouse gas (GhG) targets is extremely challenging and seems nearly impossible on Colorado's current policy timetable. Future policy discussions aimed at achieving net-zero emissions will require much more honesty, realism, and an appreciation for economic, global developmental, and national security needs.

Western Climate Goals Keep the Rest of the World in Poverty

Cheap, reliable energy is the key to economic growth, security, and broad-based prosperity. Access to cheap and reliable energy is key to bringing large amounts of people out of poverty.

Western energy policies are out of touch with the rest of the world. Most of the world does not live like the western world. There are nearly 7.5 billion people in the world, and, according to the World Bank, 1.1 billion of them do not have any access to electricity.[xvii] About 2.9 billion use solid fuels such as wood, charcoal, coal, and dung for cooking and heating. Burning these fuels over open fires or simple stoves creates toxic particulate matter which affects both the lungs and heart. The lack of electricity and cleaner fuels is one of the biggest health threats to individuals living in poor countries. Indoor pollution from particulate matter causes harmful health

effects such as increased risk of chronic obstructive pulmonary disease (COPD) and of acute respiratory infections in children (the leading cause of death among children under 5 years of age in developing countries). Evidence also exists of associations with low birth weight, increased infant and perinatal mortality, pulmonary tuberculosis, nasopharyngeal and laryngeal cancer, cataracts, and, specifically to coal, lung cancer.[xviii] Estimates of annual deaths caused by indoor air pollution range from 2 million to 5 million people.[xix] A disproportionate number of these deaths are women and children who are primarily responsible for cooking in these societies.



Economic development is the key to overcoming energy poverty across the globe. Given the serious hardship faced by the world's poor due to the lack of energy, energy policies should focus on increasing access to cheap and reliable energy. Energy is essential for economic development and prosperity. Economic development brings more opportunities, which means better outcomes for billions of people who currently have no access to cheap and reliable energy. Rather than support policies that bring cheaper and more reliable energy to these parts of the world, our policies actually keep people living in poverty.

Take sub-Saharan Africa, for example, where 2/3 of the population live without electricity and more than 85% in rural areas lack access. Together, the countries account for less than 2% of global CO_2 emissions. Increasing their access to electricity would improve people's health, education, and improve quality of life across the continent. A lack of affordable and reliable electricity is among the top constraints on business and job growth in Africa.

President Obama's ambitious program, Power Africa, sought to provide universal access to power in sub-Saharan Africa by 2030. It was estimated that more than $300 billion in private and public capital would be needed, of which $7 billion in financial support over five years would come from U.S. agencies. However, because the United States had a competing goal of reducing global CO_2 emissions, the

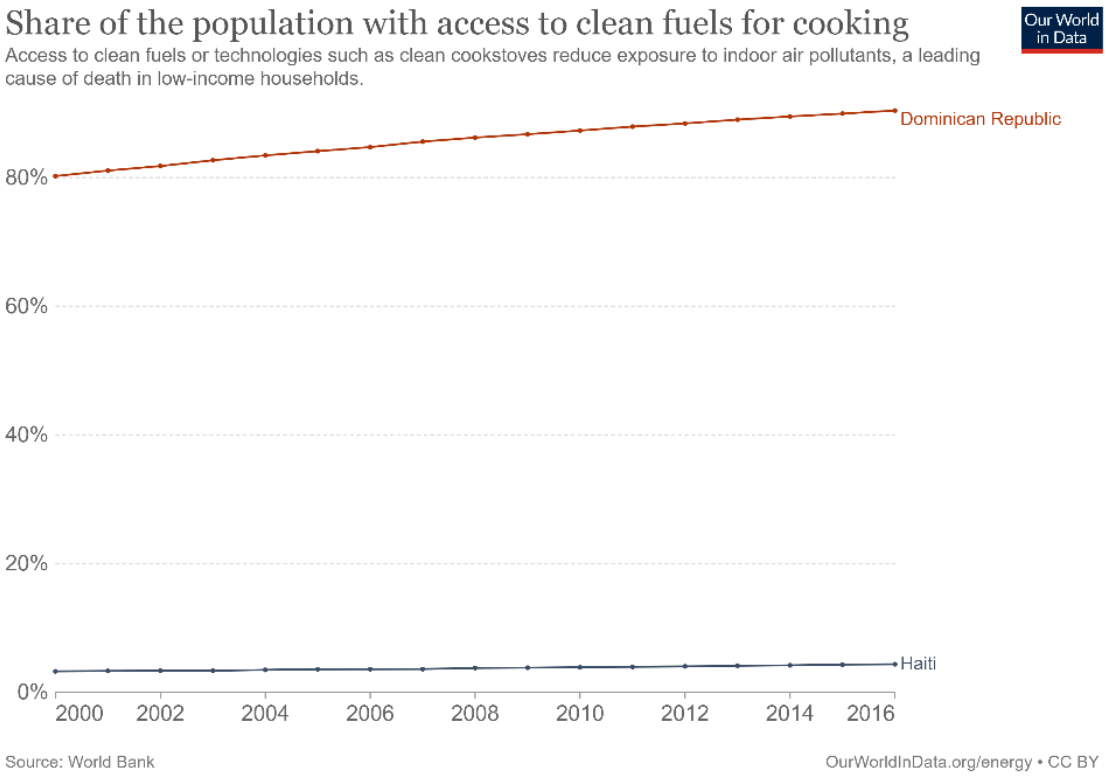
leading U.S. organization tasked with investing in poor countries, the Overseas Private Investment Company (OPIC), self-imposed a carbon emissions ceiling on its own portfolio. Collectively, African nations are among the lowest contributors of CO_2 emissions in the world at about 3% of total world emissions.[xx] The International Energy Agency (IEA) estimated that achieving universal access would increase energy-related CO_2 emissions by 2030 by less than 1%. The Center for Global Development estimated that more than 60 million additional people in Africa would gain access to electricity if OPIC were allowed to invest in natural gas projects and not just renewables.[xxi]

Richer countries are more resilient because they have the economic wherewithal to adapt. For poor nations, creating infrastructure for modern energy, sewage, and flood water management are higher priorities than decarbonization.

Consider tropical storms and hurricanes, for example. Haiti is the poorest country in the Western Hemisphere—nearly 60% of the population lives under the national poverty line.[xxii] In 2008, Haiti experienced four consecutive storms—Fay, Gustav, Hanna, and Ike—which included massive rainfall that produced flooding throughout large parts of the country. Gonaïves, the fourth largest city, was particularly hard-hit by the four storms. Across the country, they killed 793 people, left 310 missing, injured 593, destroyed nearly 23,000 homes, and damaged another 84,625.[xxiii] More than 150,000 people were displaced. The flooding wiped out 70% of Haiti's crops, leaving millions at the risk of starvation in the months that followed. Damages were assessed at approximately $1 billion.

The storms of 2008 devastated the poor country on the island of Hispaniola. The country's economic growth and social progress continue to be adversely affected by the lack of reliable energy.[xxiv] Only 1/3 of the population is connected to the electricity grid, up to 50% of those connections are illegal, and service through the grid is unreliable. Most Haitians are still using wood for fuel, either by burning the wood directly or turning it into charcoal, which has caused massive deforestation on the island. Cooking, or, in other words, surviving, is the number one reason for the deforestation and contributes significantly to indoor pollution, a leading cause of death in low-income households. With no other feasible and cheap energy alternative, Haitians have eliminated anywhere from 70% to 98% of their tree cover, causing widespread soil erosion and leaving denuded mountain slopes vulnerable to flooding, mudslides, and landslides. Haiti's energy poverty has contributed to its deforestation and the loss of nearly all its trees have amplified natural disaster impacts. Furthermore, the lack of economic development means there are no resources to prepare for or respond to natural disasters which continue to plague the country.

Compare Haiti's 2008 hurricane experience with that of its island neighbor, the Dominican Republic, which was much more resilient. In the 1970s, the Dominican Republic launched programs to harness its hydroelectric power potential and import propane and natural gas for cooking. Now, all its fuels are imported and its forests are intact. The difference today is stark.



In order to reduce the use of biomass for fuel, people will need access to reliable, inexpensive, cleaner energy sources. One of the bridge fuels to cleaner burning energy is liquified petroleum gas (LPG) which is made from oil. The switch from biomass to LPG may even be beneficial to the environment. Researchers in India introduced LPG to rural communities in the Himalayas where there had been significant forest degradation due to harvesting of wood for fuel which was the main source of energy.[xxv] They found that, in addition to improving the living conditions of the local people, the switch to LPG has had positive effects on the regeneration of the surrounding forests.

And we have seen throughout the history of humanity, that energy, specifically, the advent of fossil fuels, changed the entire world.

The Energy Transition

Electricity is necessary for a modern society to operate. Electricity is taken for granted in our everyday life, but electricity is a necessary input to the production of many of the goods and services a modern economy requires.

Over the course of history, as populations expand and living standards rise, ever-increasing quantities of energy have been necessary to sustain rising numbers in population and improved standards of living. With this increase in demand, sources of energy have changed and evolved. Just as we are now undergoing a transition

away from hydrocarbons, the world has undergone many energy transitions. We have transitioned from wood to coal to crude oil and natural gas. Throughout a transition, older forms of energy use persist alongside new ones. For example, during the Industrial Revolution, the industrialized world's primary energy source transitioned from wood to coal.

An energy transition requires overcoming complex technical, scientific, and public policy challenges. Accelerating a transition is fraught with risk and can cause unanticipated economic and societal consequences. Deployment of wind and solar energy continues to be limited despite direct financial incentives and mandates from the U.S. government over the last 30 years, starting under the George H. W. Bush Administration. Between 2005 and 2015, federal government expenditure on tax incentives and grants alone was over $50 billion.[xxvi] Growth in the solar and wind power industries was supported by a combination of federal spending on supply-side incentives (tax incentives, credit support, and research and development) and demand mandates by both federal and state governments. In addition to the federal government's investment in solar and wind, strong government support has resulted in meaningful growth of the industry. Yet today, these two technologies produce just 4% of our primary energy requirements.[xxvii] On the other hand, oil and gas continue to generate a large amount of revenue for the federal government. Between 2005 and 2014, oil and gas leasing income averaged $11 billion per year.[xxviii]

While setting individual state targets can be important, reducing carbon emissions is a global challenge. Even if the developed world achieves net zero, unless there is a corresponding reduction in carbon emissions in the developing world, the impact will be relatively small. Some estimate that the impact would be no more than 20% less in 2050 against a business-as-usual scenario.[xxix] Policies that push for a rapid energy transition in the developing world will lead to lower rates of economic growth.

Even prior to Russia's invasion of Ukraine, Europe's energy crisis at the end of 2021 was a cautionary tale about the race to decarbonization. In the summer of 2021, Europeans were bracing themselves for a cold and expensive winter due to rising energy costs that increased fuel bills and the prices of many everyday purchases. European household gas and electricity bills climbed to unprecedented levels.[xxx] As the economy reopened from the pandemic, an increase in electricity demand followed while natural gas stockpiles were low. Demand for natural gas in Asia also increased as commercial and industrial activity resumed. Gas importers prioritized Asian markets over European ones due to the higher price paid in Asia. China diverted much of the gas that would have gone to Europe, signaling that gas should be secured at any price to keep China's industry running. Europe was hard-pressed to replenish its natural gas stockpiles. The U.K. experienced a particularly bad year for wind while accelerating its phasing out of coal. On February 3, 2022, millions of UK consumers were told they faced price hikes of about £2,000/year (roughly $2,600/year).[xxxi]

The surge in energy prices has brought the European Union's climate policies under scrutiny. Though it should seem obvious that the race to renewables has left most of Europe beholden to imported oil from Russia, climate advocates argue that the real issue is that the transition was not fast enough. However, that argument does not represent a realistic view. Due to the energy crisis, now exacerbated by the Russia–Ukraine conflict, coal is burning throughout Europe because the natural gas supply is limited and expensive.[xxxii]

The continent imports over 40% of its gas from Russia. It consumes nearly five times as much oil as it produces, and Russia produces nearly four times as much oil as it consumes. European governments' commitments to an accelerated decarbonization of the global economy left them even more reliant on Russian natural gas. Germany, for example, decommissioned half of its nuclear plants ahead of schedule in December 2021, only to turn to burning more coal once Russia invaded Ukraine.[xxxiii] Belgium, on the other hand, citing the need for energy sovereignty, announced it was extending the lives of two if its nuclear plants.[xxxiv] We are seeing that the real existential threat to world order is a mismanaged and unrealistic exit from fossil fuels in favor of renewables. As Energy Secretary Jennifer Granholm recently said, "The future of energy security, the future of economic security, the future of national security, the future of climate security—these are all inextricably bound together."[xxxv] The U.S. transition to cleaner energy must balance all these factors and an overemphasis on one over another will have vast geopolitical and economic consequences.

Net Zero or Bust…but Not Like That

In our race to decarbonization, low-carbon technologies available to replace fossil fuels are wind, solar, hydroelectric, and nuclear. Nuclear power is an abundant, carbon-free source of base-load power and its usage can make a large contribution to the mitigation of climate change and air pollution. In all IPCC 1.5°C scenarios, nuclear power plays an important role in limiting global warming. In contrast to wind and solar, nuclear can operate at full capacity nearly uninterrupted and can provide a continuous source of reliable energy.

As such, nuclear should be considered as an attractive option for decarbonization. Yet, its use continues to be shunned in many communities due to concerns about its safety, waste disposal, and high initial costs and time commitments.

Nuclear is currently 20% of the electricity we produce in the United States and 52% of our carbon-free energy, making it the largest domestic source of clean energy. Nuclear power plants operated at full capacity more than 92% of the time in 2020.[xxxvi] Nuclear plants are 1.5 to 2 times more reliable than natural gas and coal plants and about 2.5 to 3.5 times more reliable than wind and solar plants. In the United States, nuclear energy is helping, alongside renewables, to decarbonize the electric grid. There are currently 94 commercial reactors helping to power homes and businesses in 28 U.S. states. Illinois has the most reactors of any state (11) and gets more than 50% of its power from nuclear sources, as do South Carolina

(55.8%) and New Hampshire (60.8%). The top 10 nuclear-producing states have an average carbon intensity approximately 30% lower than the national average, and states with some nuclear generation have emissions intensity 24% lower than states without it.[xxxvii]

A realistic view of decarbonization should include nuclear power as an option. However, as we recently saw in Pueblo, Colorado, nuclear power is a long way away from winning over public opinion.[xxxviii] When studying potential alternatives to the closing of the Comanche Generating Station, county commissioners expressed an interest in nuclear technology as the only carbon neutral way to replace the jobs, energy, and tax base provided by the Comanche power plant. The 750-megawatt Comanche 3 unit, beset by failures due to equipment defects, poor maintenance, and human error, is the state's single largest source of CO_2 emissions and, as such, a target for closure by environmentalists. When the plant was originally proposed in 2004, Comanche 3 was expected to operate until 2070. Though it was originally proposed at a cost of $680 million, the cost ballooned to $784 million. In late 2021, Xcel reached an agreement with the PUC to close the power plant in 2035, ahead of its 2040 amended closure date based on its accelerated renewable energy target.

The nuclear power proposal faced significant backlash from the community and county commissioners stopped pursuing the option. However, because nuclear energy offers an efficient and reliable energy option and has rigorous safety standards in place, it should be part of any accelerated clean energy plan. Excluding, limiting, or restricting nuclear puts enormous pressure on renewable technology to always perform reliably when its performance is only intermittent. Progress on nuclear technologies which make nuclear power generation more efficient and attractive continues. Because barriers are difficult to overcome, we should look to the federal government to lead the way in prioritizing nuclear power as they have done through grants to explore next-generation nuclear technology with Bill Gates and others.

There Is No Free Market

America has a free-market economy built on the ideal of competition. The idea of rewarded effort dominated American industrialization in the nineteenth century as pioneers forged westward, building a society deep-rooted in individualism and personal freedom that evolved from the rigors of frontier conditions.

Adam Smith's explained in his seminal work, *The Wealth of Nations*, that, within the system of natural liberty, "three duties of great importance" attach to government. The first two duties were national defense and the administration of justice, the third was that the sovereign is charged with "erecting and maintaining certain public works and certain public institutions which it can never be for the interest of any individual, or small number of individuals, to erect and maintain; because the profit could never repay the expense to any individual or small number of individuals, though it may frequently do much more than repay it to a great society."

In 1877, in the Supreme Court case of *Munn v. Illinois,* we see the foundations of utility regulation. *Munn* concerned grain elevators in Chicago, a railroad hub and shipping midpoint. Bushels of grain were shipped from the west to the east by train or boat and privately owned grain elevators were found alongside railroads and harbors. The state legislature set a maximum rate for grain storage and private grain elevator owner Munn set rates higher than those allowed by state law. Munn sued, arguing that the state illegally deprived owners of their property rights guaranteed by the Fourteenth Amendment.

The Court upheld the state regulations and held that states have the power to regulate certain private companies "clothed with the public interest" and thereby so critical to the functioning of society that government has the right to oversee the prices charged to ensure that essential services provided to the public are done in a reasonable manner. Thus, the principle of the "regulatory compact" between regulators and privately owned utility companies was born.

The regulatory compact is essentially an exchange of rights and obligations. The utility is granted an exclusive franchise to operate in a service area with a captive customer base, and in return, it has a duty to serve all customers within the service area. The utility can charge rates that cover its reasonable cost of service and afford investors the opportunity to earn a reasonable rate of return on their investment. The rates are overseen by a regulatory agency that balances protecting ratepayers from monopoly pricing and protecting the investors' rights to earn reasonable returns.

Shortly after grain elevators, this was applied to railroads and then to other sectors of the economy that deliver a public service such as electricity, telecommunications, and other utilities. These for-profit industries, in providing a public service, are given market dominance in exchange for government oversight. While competition is usually seen as a force that regulates prices, other factors come into play. Consider early electricity infrastructure. Once alternating current power became the dominant technology for generating and distributing electricity, competing electric light companies sprung up all over the United States. Multiple sets of power lines were strung through cities, each owned by different companies trying to capture and service business.

The duplicative infrastructure was a waste of resources and money. As more demand is served through a single wire, the average cost goes down. Once a power line is erected, the marginal cost of serving an additional household with the same line is very low. The more households are served through that single wire, the lower each individual's costs will be because the capital cost is spread out over more customers. It is also cheaper to build high-capacity power lines that serve a lot of demand rather than a large number of low-capacity lines. At the time, steam turbine power was also cheaper to generate in a small number of large power plants than in a large number of small power plants.

This concept was best demonstrated by Chicago businessman Samuel Insull, who founded Commonwealth Edison, the utility that still provides Chicagoans their power today. Insull convinced the Chicago government to provide Commonwealth Edison an exclusive license to provide electricity service in Chicago. In exchange, the city could regulate the prices that Commonwealth Edison charged through a public utility commission.

The regulatory compact, under which for-profit electric utilities are monopolies which provide electricity service in specific locations in exchange for being regulated by states or cities, became the dominant form of providing electricity service in the United States by the early part of the twentieth century. This enduring agreement still is more or less intact today.

Clearly, this arrangement is nothing like a free market. Under a free market system, where businesses compete for consumers, firms are incentivized to offer the best value propositions. Competing for customers makes businesses better, cheaper, and more innovative. On the other hand, utilities are legally protected from competition, charge rates approved by the government, and receive guaranteed returns. Their customers are captive and cannot purchase services elsewhere.

Utilities make profits not primarily by selling electricity, but by making investments and receiving returns on them. Historically, if they could make more power plants and power lines, they could make more money. When the regulatory compact was established, it made perfect sense—the demand for power was rising and expanding. The need to electrify the country was paramount.

This was, of course, true during the westward expansion. In Colorado, the history of public utilities began with the railroad boom of the 1870s.[xxxix] In 1885, there were electric streetlights in Denver and a telephone line from Denver to Pueblo. The state legislature brought these services under state regulatory control in 1913 and established the Public Utilities Commission (PUC). Created by state statute, the PUC consists of three members appointed by the Governor with the consent of the Senate. The members serve rotating terms and no more than two members can be affiliated with the same political party.

The stated mission of the PUC is "effectively regulating utilities and facilities so that the people of Colorado receive safe, reliable, and reasonably-priced services consistent with the economic, environmental and social values of our state."[xl]

The PUC's advocacy, under its historical role as an enforcer of the regulatory compact, was always based on the reasonable rate a ratepayer should pay for electricity. This made sense when electricity usage was growing and expanding. In this era, when energy-efficiency is generally a universally accepted virtue, utilities sell less product and, therefore, make less money. Encouraging more efficiency reduces a utility company's potential to recover costs. The PUC of today has to balance not only a reasonable rate, but also the emission profiles of utilities'

investments under our net-zero goals as well as community benefits and environmental and social justice. How these goals are balanced and applied has a direct impact on the rates captive consumers pay for their electricity.

A key question for policy makers is how to support rapid decarbonization while maintaining reliability and affordability for consumers. Ideas often support some type of carbon pricing as an effective and market-based solution to decarbonization.

Carbon Pricing. Carbon pricing, also called a "polluters pay" model, is a market-based solution that discourages the use of CO_2 by assigning a monetary value to carbon which provides an incentive to reduce carbon emissions. The best-designed carbon prices provide three key benefits: they preserve the environment, promote funding in clean technologies, and boost revenue. Because carbon pricing influences the behavior of businesses, investors, and consumers across the economy, it incentivizes emission reductions across all sectors and fosters innovation without inordinate pressure on the power sector to decarbonize first. Additionally, since carbon pricing is a market-based strategy, it establishes clear economic signals that do not favor certain energy resources over others or mandated requirements which may be out of sync with effective practices. There are two types of carbon pricing:

> **Carbon Tax.** A carbon tax is a fee that fossil fuel–burning corporations pay as a result of government regulation with a goal of mirroring the actual cost that burning carbon creates. George Shultz and James Baker proposed a carbon tax in 2017 that would rest on four pillars: First, create a gradually increasing carbon tax. Second, return the tax proceeds to the American people in the form of dividends. Third, establish border carbon adjustments that protect American competitiveness and encourage other countries to follow suit. And fourth, roll back government regulations once such a system is in place[xli] Such a proposal would encourage the private sector to innovate and provide the predictability that would incentivize capital investment. Such a policy would work but would have to be undertaken at the federal level. While several states have sought to implement a carbon tax at the state level, without the reduction in regulations at both the state and federal level, as well as no corresponding tax in other states, such a carbon tax would only serve to make the state less competitive.
>
> **Cap & Trade.** A cap-and-trade system (also known as an emissions trading system or ETS) sets the quantity of emissions reductions and lets the market determine the price. A cap puts a maximum tolerable level of emissions and requires that companies which go beyond the limit pay. Trading gives a company a strong incentive to reduce emissions in the most cost-effective manner but also allows for greater flexibility. Again, states have sought to implement a statewide cap and trade program with varying results.

Disruption in deregulated markets. Potential for disruption in the retail electricity market occurred last year when Tesla was approved to become an electricity retailer in Texas. According to the paperwork filed with the Texas PUC,

Tesla Energy Ventures plans to sell electricity drawn from the grid to customers and from its battery storage products. Tesla could sell kilowatts that are either drawn from the grid or pulled from Tesla-made home batteries when the grid goes down. Tesla could also let individual Texans with solar panels earn money by sharing their excess power with the grid. That's something that currently only large commercial customers can do easily.

Tesla said in the filing it made with the PUC that it plans to drum up business among existing Tesla customers, targeting them through its mobile app and website. The company is well positioned to tap into a loyal customer base interested in moving past fossil fuels. On top of that, after the February winter storm that caused widespread blackouts, Texans installed more than 1 gigawatt of personal solar panels, according to federal energy data—that trails only Arizona and California. With new solar panels and Tesla's Powerwall batteries controlled by Tesla-managed algorithms, Texas homes could conceivably use Tesla to become their own power plants operating on an interconnected grid.

Colorado's Transition Priorities

Our public policy decisions when it comes to net-zero goals all impact the rates we pay as captive consumers of energy. Investments in new projects or increases in customer rates made by utilities must be approved by the PUC. Particularly illustrative is Xcel Energy's (Xcel) proposed rate hike that is under review by the PUC currently.

As Colorado utilities implement climate and clean energy policy goals, some of which are already prescribed statutorily, Coloradans will see corresponding increases in their monthly utility bills. The extents of these increases are not fully known, as the PUC process for approving future investments which are the bases of future rate increases is still in process. However, as Xcel customers have seen with the outcome of the last resource plan 4 years ago, they can expect more rate increases based on upcoming investment.

Xcel's rate increase request includes a total natural-gas rate increase of $188.6M over the next 3 years. This would gradually increase the average consumer's monthly bill by $4.16 in the first year, an additional $1.83 in 2023, and an additional $2.15 in 2024. If approved, these rate increases will take effect in November 2022. A separate request for an increase of electric rates by $182M would raise the average customer's monthly bill by roughly $5.24. If approved, these rates will take effect in April 2022. Lastly, Xcel is seeking to recoup costs of $550 million associated with a snowstorm and freezing temperatures on President's Day 2021. If approved, monthly bills will increase by $7.08 for most residential customers for two years.

Colorado's Power Pathway (approved)
Colorado's Power Pathway, a regional transmission project, will add 560 miles of high-capacity transmission lines and new substations across eastern Colorado which

will transmit wind and solar electricity to the Front Range from rural areas. Amidst opposition, the massive project was approved in February 2022 after months of hearings. The $1.7 billion project supports Xcel's $8 billion plan to shutter all but one of Colorado's coal power plants by 2028 and replace them with wind and solar power in support of meeting the state's mandated goal of reducing carbon emissions by 80% by 2030.

Electronic Vehicles (EVs)
In 2019, the largest source of carbon emissions was the transportation sector, followed by electricity generation, oil and gas production, and fossil methane use in the residential, commercial, and industrial sectors.[xlii] By 2020, transportation displaced electricity generation as the largest source of pollution and passenger vehicles contributed the most to the state's emissions.
"To accelerate the electrification of cars, buses, trucks, and other vehicles in Colorado, the state set a goal of 940,000 electric vehicles on the road by 2030 (nearly 60% of all Colorado vehicles)—Governor Jared Polis issued an Executive Order Supporting a Transition to Zero Emission Vehicles in January 2019."[xliii] In order to meet targets, the governor's roadmap contemplates that nearly 100% of all light-duty vehicles on the road should be electric and that zero-emissions trucks should constitute 100% of the market share of new sales by 2050.

While rising costs of raw materials will drive up battery costs, U.S. automakers such as Ford have invested billions to build their own battery plants in the United States in an effort to manufacture competitively priced electric cars. In addition, Ford is looking to develop alternatives to cobalt like lithium iron phosphate as forecasters predict a nickel and cobalt shortage by 2030.

Even if we have a sufficient supply of ethically and environmentally sourced minerals the accelerated transition to electric vehicles still faces significant challenges. There are challenges around the need for new transmission and distribution systems for electric vehicle charging. The $1 trillion infrastructure bill invests $7.5 billion, $5 billion of which is dedicated to building out a national network of 500,000 EV chargers to support longer range trips.

The federal subsidizing of the purchase of EVs beginning in 2009, overwhelmingly subsidized individuals who did not really need the subsidy. Colorado had its own state income tax credit of $4,000 for qualifying purchase. However, an analysis in 2019 of the credit by the Congressional Research Service found that nearly 80% who claimed the federal subsidy had annual incomes of $100,000 or more, about half of those sales took place in California.[xliv] The tax credit phases out once a manufacturer has sold 200,000 qualifying vehicles. Tesla and GM reached that threshold in 2018.

Because electric vehicles don't use gas, their owners do not pay these gas taxes. As the EV market grows in the years ahead, policy makers should ensure EV drivers pay to support the nation's transportation system equitably.

Smart Meters (approved)
Smart Meters are being installed in homes with the goal of installing 1.6 million new smart meters by the end of 2023. These meters read household energy usage in real time and will enable Xcel to implement time of use rates which charge more at peak demand times and less during low-use periods. The PUC approved the $419 million installation costs, to be passed on to the consumers, as well as the time-of-use (TOU) rate schedule for Xcel.

The new Xcel rates will include three sets of charges for different time periods:

Peak period	Monday through Friday, 3pm–7pm	13.9 cents/kWh in the summer	8.7 cents/kWh in the winter
Shoulder period	Monday through Friday, 1pm–3pm	9.5 cents/kWh in summer	6.9 cents/kWh in winter
Off-peak	All other times, plus weekends and holidays	5.1 cents/kWh, all seasons	

Traditionally, as demand for electricity increases throughout the day, the cost of generating that electricity is high as well. TOU assumes that customers will be incentivized to shift more of their energy consumption to the time periods when the cost of generating electricity is cheaper. TOU also assumes that there will be reductions in load as a result of changes in customer behavior in response to price signals which would help reduce CO2 emissions.

The Smart Meter builds upon Xcel's earlier implementation of its SmartCityGrid pilot program in Boulder, Colorado. In 2008, Xcel estimated the costs of the project for ratepayers to be $15 million, the rest of the project's $85 million price tag to be borne by investment partners. Within a year, Xcel's expenses were $44.5 million. In 2013, the PUC allowed Xcel to recover $27.9 million from their Colorado ratepayers, denying the remaining $16.6 million.

Other investor-owned utilities (IOUs) in the United States have adopted TOU rates with mixed outcomes. In 2015, the California Public Utility Commission mandated the state's three IUOs to transition to default TOUs by 2019. The IOUs implemented opt-in pilots in 2016 and then default pilots in 2018 which included over half a million consumers. One of the main arguments of adopting TOU rates is the idea that customers will change their energy use based on TOU price signals. Yet consumer groups in California found that the pilot result showed that load reductions do not mitigate increased monthly bills.[xlv]

Although customers in the aggregate did exhibit statistically significant peak load reductions of about 3–6%, the load reductions were so small and did not result in statistically significant bill reductions for most customer groups. Even for sub-groups where reduced bills due to changes in behavior were statistically significant, the reductions were but a small portion of the structural bill increase. For example, a 5% peak load reduction might reduce the bill by about 5%, but if the monthly bill increase is $20, the resulting behavioral change decreases the bill by only $1. The

analysis found that the TOU rates benefited 10–15% of customers in the pilot. There was no bill change for 50% of PG&E customers and 40–50% of SCE customers, and bill increases for 30–40% of customers.

With the advent of smart thermostats, there is much more potential for consumers to be able to take advantage of TOU strategies. With highly accurate and programmable electric thermostats, consumers can take advantage of the TOU rates to adjust their home temperature settings within 1 degree, which helps reduce energy use. The smart thermostats can use algorithms and sensors to analyze large amounts of heating and cooling data which are used to remember temperature choices and energy routines. Remote controls allow consumers to adjust via a smartphone or computer. The latest smart thermostats feature on-demand response and can reduce energy use at peak times of consumption, pricing, and carbon emissions. Smart thermostats assist in the change in behavior that is needed to reduce energy consumption and lower energy bills.

Even further, Google smart thermostats will allow users to make more sustainable choices by allowing owners to prioritize clean energy in their homes. Thermostats can automatically shift to clean sources of energy and cheaper energy rates. A premium service allows Google to purchase renewable energy credits on the consumer's behalf to offset fossil fuel electricity usage at home. Amazon has also entered the smart thermostat market and while both technology giants enter this aspect of the energy space, it will be interesting to see how consumers see the tradeoff between privacy and convenience.

Beneficial Electrification (statutory)
Beneficial electrification is the replacement of fossil fuel by electricity in buildings, transportation, and other sectors. In the case of buildings, cities like Berkley, New York, and San Francisco began banning gas powered appliances in new construction in an effort to reduce carbon emissions from homes. State legislatures across the United States began preemptively prohibiting similar type gas bans making the issue of electrification in homes a red state vs. blue state issue. A similar bill preempting a natural gas ban was introduced in Colorado (HB21-1034), but it died in committee.[xlvi] Governor Polis signed a compromise law SB21-246 which requires IOUs to file beneficial electrification plans with the PUC by July 1, 2022, and every three years. The act defines beneficial electrification as converting the energy source of a customer's end use from a non-electric fuel source to a high-efficiency electric source, or eschewing the use of non-electric fuel sources in new construction.

The bill prohibits the PUC from banning new gas hookups or requiring Coloradans to replace gas-fueled appliances and equipment from existing buildings. Colorado IOUs will need to develop plans to displace fossil fuel powered appliances and heating systems in favor of high efficiency electric alternatives like heat pumps and induction stoves in both new construction and existing buildings. The law allows for cost recovery for implementing approved beneficial electrification programs and the

PUC may consider incentive mechanisms to encourage utilities to invest in these programs.

Beneficial electrification is coming and Denver has already created an implementation plan for achieving 100% electrification in all new construction by 2030. Rather than banning natural gas hookups in new construction, the city is using its building code to meet requirements. Under the plan, all new homes would be free of natural gas infrastructure by 2024 and all new nonresidential buildings by 2027.

The plan defines a net-zero building or home as all electric, powered by renewable energy, highly energy-efficient, and able to provide demand flexibility for the grid through battery storage or equipment capable of receiving demand-response requests. However, since Xcel Energy does not plan to use 100% renewable energy by 2030, the city has called for new development to install rooftop solar to reach net zero or pay into a community solar fund.

The city is preparing a separate report on how it will implement electrification in existing buildings, but it will be much more challenging and more expensive for most existing natural gas customers. A Rocky Mountain Institute study found that costs can vary substantially depending on individual homes' characteristics but that homes currently using natural gas heating are more expensive to electrify.[xlvii] Demand flexibility that optimizes for TOU rates can reduce costs, but not usually significantly enough to favor electrification. RMI found that customers with existing gas service face higher upfront costs to retrofit to electric space and water heating than to install new gas devices, and either pay more for energy with electric devices—in the cases of colder climates in Chicago and Providence—or save too little in energy costs to make up the additional capital cost—in the cases of Houston and Oakland.

Policies addressing the electrification of existing homes should take into consideration the cost-effectiveness of switching, particularly as we continue the transition to a low-carbon grid. At present, electric heating technology is too expensive for many Coloradans to afford—an air-source residential heat pump costs $6,000, on average, and the average electric water heater costs half that amount.[xlviii] Electrification of large buildings would be even more difficult to achieve. According to an analysis conducted by CSI last year, large-building electrification is prohibitively expensive for many Colorado buildings, impossible for others, and unable to reduce the built environment's emissions until 2030.[xlix]

Microgrids (under review)
In 2020, Xcel proposed deploying seven microgrids across the state of Colorado at a cost of $23.4 million to its ratepayers.[l] A controversial topic within the utility space, a microgrid is a local energy grid with control capability, meaning it can disconnect from the traditional grid and operate autonomously. Numerous benefits stem from its ability to disconnect from the grid such as ensuring critical services such as hospitals can continue running during power outages. Additionally,

microgrids can serve remote communities with no other source of reliability electricity. Microgrids are not necessarily 100% renewable; some rely on fossil fuels for part of their resilience.

We Are Building the Plane While Flying It

Building the new, reimagined grid while powering the priorities set by the legislature and governor is the challenge of our lifetime. Many targets rely on the supply side of the equation, but it is important to realize that many of the assumptions also rely on reductions on demand side. However, we are simultaneously electrifying our grid at the same time as we electrify our homes, cars, and the rest of our lives which poses a challenge to grid reliability. While it's important to keep a line of sight on how to reach our goals, no one has the exact path to net-zero emissions. As more consumers demand clean energy from renewable sources, we will be more reliant on the grid than we ever have been. Consumers deserve to know that the investments made today will help meet the energy demand of the future. We should keep in mind the importance of flexibility as first movers in this transition and make interim targets that are attainable. Meaningful progress should be defined realistically. The energy transition from coal to renewables should consider the role of natural gas and even the potential role of nuclear power. Communication with consumers is key in this transition, as they should be involved in the tradeoffs that will come in this accelerated transition.

Additionally, as our world becomes "smarter," we must be more vigilant in our cybersecurity efforts not only at the infrastructure level but on the individual level as well. Cyber threats to our energy systems are rising and malicious actors can shut down our energy infrastructure and disrupt our energy supplies, economy, and everyday life. Increasingly we must be prepared and ensure resiliency from cyber-attacks lest we become victims of bad actors using our energy as a powerful leverage.

Conclusion

We are at a revolutionary time in energy policy, and it is only with innovation that we will be able to achieve our ambitious goals. Our desire for change cannot obscure the on-the-ground reality of how important energy is to our economy and the need to assure a robust supply of reliable and affordable energy. While frustrating, we must resist the call for more extreme cuts and instead create and foster an economic climate that will release innovation and drive solutions that empower companies and individuals.

Economic growth and environmental protection are not mutually exclusive. In fact, economic growth provides the means to protect and care for the environment, and affordable energy is a vital contributor to that growth. Allowing price signals to drive innovation, investment, and decision making will spur economic growth, create jobs, and save money for the taxpayer. When risks and rewards are properly aligned, economically viable ideas will flourish.

And while there is unprecedented investment in infrastructure at the federal level, pursuing aggressive targets that bear no impactful consequence on the overall climate goals only serves to slow the economy, handcuff innovation, and increase costs for the individual and families. Governments should allow market forces to decarbonize our economy, not mandates and regulations which choose winners and losers and depress innovation. Throughout human history, energy transitions have occurred while heavily dependent on legacy energy sources. It is clear that we must transition from fossil fuels to renewable energy at some point, and we should do so expediently. The question is: how expensive does it have to be?

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