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GOING FOR THE GREEN

How Utah Can Thrive in the New Climate Economy

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INTRODUCTION

The "New Climate Economy" is an effort to tie economic strength to actions intended to reduce the impacts of climate change.[1] Such efforts are taking place around the world. In the U.S., innovations and other measures from corporations, along with new policies and investments from the federal government, provide states with a range of opportunities to capitalize on the transition to an economy that prioritizes climate-focused strategies.

This report focuses on those opportunities. The report analyzes job-creating opportunities by economic sector, explores opportunities from the federal government and corporations, and looks at ways Utah is seeking to bolster economic activity in rural parts of the state. Finally, the report notes what more Utah can do. The report seeks to build on past Utah efforts in this arena to help guide future efforts.[2]

KEY FINDINGS OF THIS REPORT

- Utah's per capita carbon dioxide emissions are 19th highest in the nation.
- Reaching the goal of cutting Utah's annual carbon dioxide emissions by three quarters over 30 years would require major shifts in how Utah addresses electric power generation, transportation, industry, commerce and home energy usage.
- Utah could leverage federal funds toward large clean energy projects, such as the pump-storage project in the Navajo Nation, the green hydrogen project in Millard County and carbon capture at Utah's coal-fueled power plants.
- Coal mining and coal-fueled electricity generation jobs represent about 5% of the direct employment in Utah's seven more coal-dependent counties. The State of Utah may need to support these counties in any transition from coal-fueled electricity generation. Utah should consider ramping up rural broadband, telework opportunities, tourism infrastructure, monetary support and targeted educational opportunities.
- Were there a cost on carbon, utility-scale solar would likely be the cheapest electricity in every county in Utah. Wind projects would also be more competitive across a wider geography.
- Utah's predominantly renewable-energy development through 2040 could create an estimated 39,000 construction jobs and 900 operations jobs, along with investment and tax revenue for local communities.
- Utah is already an innovator in renewable natural gas, geothermal energy, battery storage, and carbon capture and storage, which suggests that Utah is well-positioned to lead with those and other climate-focused strategies.
- Looking forward, there are multiple steps Utah can take toward becoming a leader in the new climate-focused economy, such as:
    - Creating a state commission and/or office dedicated to addressing climate challenges and climate-focused economic development, including the needs of rural areas and electricity transmission for Utah's renewable energy power sources.
    - Developing a technological solutions laboratory.
    - Creating a fund to support entrepreneurs seeking to create marketable clean energy innovations.
    - Encouraging clean transportation options.
    - Exploring more stringent building efficiency codes.
    - At the federal level, determining whether it makes sense for Utah to support approaches such as an agricultural producer carbon sequestration credits program and a carbon pricing mechanism.

The purpose of this report is not to determine which public and private efforts most effectively address climate change. Rather, the report recognizes that various efforts are currently underway, and that they represent both economic opportunities and challenges for Utah. As climate-focused policies, regulations and investment continue to expand, Utah has an opening to expand its economic prospects accordingly.

BACKGROUND

The recent extreme weather conditions across the state highlight the ways in which climate change might affect Utahns into the future. Climate change is happening, and experts have put forth targets and timelines for emissions reductions to help minimize its impacts. Most experts agree that a key feature, global warming, is mainly driven by human activity, and that arresting its progress depends on changes in human activity over time. They point to the importance of limiting global warming to 2.0 degrees Celsius above pre-industrial levels, or about 3.6 degrees Fahrenheit.[3] The planet has warmed about 0.8 degrees Celsius above pre-industrial levels so far – which of course is the average increase, with wide temperature fluctuations occurring across the globe. Climate changes are expected to affect Utah in various ways, both environmentally and economically.

Environmental concerns have already driven public policy and economic decisions, and will continue to do so. For instance, it is hard to imagine the rise of electric vehicles would have been so dramatic in recent years if the public and policymakers had not perceived them as helpful in addressing air quality and climate issues. It is hard to imagine that governments would have subsidized renewable energy so heavily if not for the perception that renewable resources help reduce greenhouse gas emissions.

Finally, it should be noted that addressing climate change in a meaningful way is a long-term proposition. Dramatic rhetoric about near-term projections might be bene-

BASIC DEFINITIONS

Weather – This refers to what is happening in the atmosphere at any given time; is it sunny or cloudy, hot or cold? A particular weather phenomenon may not indicate a change in climate, though scientists seek to understand extreme weather events and how they may relate to climate change.

Climate – This refers to the general weather that an area has throughout the year and over the years.

Greenhouse gases – These are gases that help the earth retain heat, resulting in a greenhouse effect, which contributes to global warming.

Global warming – This is the increase in temperature caused by greenhouse gases or otherwise.

Climate change – This is the result of a warming planet, which in turn results in sweeping changes to climates across the world and more volatile weather. While weather is inherently variable, the study of climate examines long-term trends, looking at averages, variances and distributions. These statistics help climate scientists understand that the trends toward higher temperatures represent a significant change, generally seen to be driven mostly by human activity. Sciences that study climate change – such as physics and chemistry – require a much higher level of certainty than other sciences. Nonetheless, as with other predictions and models used to guide public policy, there is no absolute certainty regarding the various, specific results of climate change.

GREENHOUSE GAS EMISSIONS

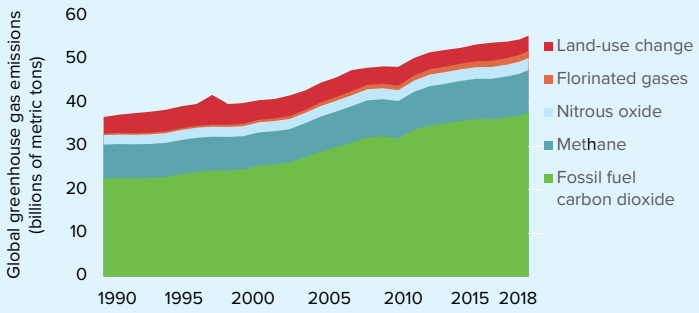
Even as public awareness of climate change has grown and policy interventions have expanded, emissions have been increasing globally – from about 37 gigatons of carbon dioxide (equivalent) in 1990 to about 55 gigatons by 2018.[a] (See Figure 1.) The increase is due predominantly to increases in China (from four gigatons to 14) – which is now far and away the largest emitter – and India (more than doubling to nearly four gigatons). The U.S. has decreased its emissions from a high of over seven gigatons in 2007 to under seven gigatons, though its total greenhouse gas emissions are even lower (at about six gigatons) when taking into account U.S. greenhouse gas emission sinks.[b] However, the U.S. and other developed countries have a larger share of historical greenhouse gases released into the atmosphere – often referred to as legacy pollution.

These greenhouse gas emissions are due to fossil fuel emissions, methane, nitrous oxides, fluorinated gases and land use changes.

Carbon dioxide is the most abundant of the four greenhouse gases – about 80% in total.[c] It is produced mainly from the burning of fossil fuels. Methane makes up about 10% of the greenhouse gases, from producing and transporting coal, natural gas and oil, as well as from livestock, agricultural practices, landfills and elsewhere. Nitrous oxide comprises about 7% of greenhouse gases, from agricultural, land use and industrial practices, as well as from the combustion of fossil fuels, from solid waste and from wastewater treatment. Fluorinated gases – or F-gases – account for about 3% of greenhouse gases, emitted from air conditioners, refrigeration and industrial processes.

Global greenhouse gases are on the increase.

Figure 1: Global greenhouse gas emissions from all sources



Note: These are carbon dioxide-equivalent emissions.

Source: U.N. Environment Programme.

Changes in land use may result in emissions, but there are other important aspects of the issue, such as considering land use change in agricultural production. For instance, while beef raised in Utah may have a relatively limited climate change impact from methane as well as nitrogen oxide from crops for the animal, beef raised in Brazil is often on land that was once rainforest, thus creating additional greenhouse issues such as burning the forest and eliminating the rainforest's carbon sink, which sequesters carbon dioxide. And Brazil is far-and-away the largest beef (and meat) exporter in the world.[d]

While the amount of greenhouse gas emissions is important, it is also important to consider their global warming potential – or GWP – which is the formula for comparing greenhouse gases with carbon dioxide. This formula is based upon how much heat specific emissions trap and how long they last in the atmosphere. Carbon dioxide has a global warming potential of 1 – since it is the baseline for comparison.[e] Methane has between 28 and 36 times more GWP than carbon dioxide because it has far more heat-trapping potential, though methane remains in the atmosphere for a relatively short time. Nitrous oxide has between 265 and 298 more GWP because it – like methane – has high heat-trapping potential, though it lasts in the atmosphere much longer than methane. Finally, F-gases are the worst of all the greenhouse gases because they trap the most heat and are the longest-lasting – potentially thousands of years; their GWP can be thousands to tens of thousands of times greater than carbon dioxide. While the amount of F-gases released into the atmosphere are microscopic compared to carbon dioxide, the high relative impact of these gases demands attention.

Sources:

a U.N. Environment Programme, Emissions Gap report, November 2019, p. 4, https://wedocs.unep.org/bitstream/handle/20.500.11822/30797/EGR2019.pdf?sequence=1&isAllowed=y.

b EPA, www.epa.gov/sites/production/files/2020-04/documents/us-ghg-inventory-2020-main-text.pdf.

c EPA, Overview of Greenhouse Gases, www.epa.gov/ghgemissions/overview-greenhouse-gases. And EPA, Understanding Global Warming Potentials, www.epa.gov/ghgemissions/understanding-global-warming-potentials.

d Katharina Buchholz, The Biggest Exporters of Beef in the World, Statista, April 27, 2021, www.statista.com/chart/19122/biggest-exporters-of-beef/.

e EPA, Overview of Greenhouse Gases, www.epa.gov/ghgemissions/overview-greenhouse-gases. And EPA, Understanding Global Warming Potentials, www.epa.gov/ghgemissions/understanding-global-warming-potentials.

ficial in spurring effective action, though it might also lead to poor public investments that offer little more than popular appeal. Addressing the human contributions to climate change is a long-term project demanding sustained efforts and ongoing technological innovation. It is a project to be measured in decades, not years.

ECONOMICS OF CLIMATE CHANGE

This report focuses on the costs and benefits of slowing down climate changes (or mitigation), as well as the costs and benefits of making adjustments to decrease impacts and find beneficial economic opportunities (or adaption).[4] These opportunities could come as investments from governments and businesses, and in the form of resources for communities negatively affected by a shift away from the use of fossil fuels.

But first, the report provides a brief overview of the costs of the damages from natural disasters, and the projected increase over time.

The Possible Costs – Damages

To the extent that climate change increases the frequency and intensity of natural disasters, costs increase along with them.[5] Take recent weather events to get a sense of the potential costs. The 2017 hurricane in Puerto Rico caused $90 billion in damage.[6] The 2018-2019 wildfires in California cost $40 billion. The 2019 flooding in the Midwest resulted in $10 billion in damage. In 2020, there were a record 22 weather and climate disaster events that surpassed at least $1 billion in damages – breaking the previous billion-dollar-event record of 16 in both 2011 and 2017.[7] In fact, for comparison, there were only 29 billion-dollar (inflation-adjusted) events in the decade of the 1980s, 53 in the 1990s and 63 in the 2000s, then jumping to 123 in the 2010s.[8]

The globe appears to be on pace for an increase in temperature of over six degrees Fahrenheit by the end of the century.[9] In the meantime, the change could result in damages that require a significant portion of the U.S. gross domestic product; one study suggested as much as 10% by 2100.[10] The question regarding climate change – and its associated costs – is not "Will it happen?" but "How significant will it be?"

Utah will play its part in paying its portion of the federal expenditures that are directed at these events. Along with the expenditures nationally, Utah will continue to have direct expenditures of its own.

The Possible Costs – Damages in Utah

To be clear, the following weather-related incidents affecting Utah are not meant provide evidence that climate change is happening or to be an exhaustive inventory. Rather, this is just a list of several recent ways that climate change is thought to have been affecting the state to understand potential future costs.

Temperature. As noted, temperatures have increased globally. Every year since 1980 has been above the 20th century average.[11] This increase may be driving more variability in weather, such as more common Arctic polar vortex occurrences and the freezing temperatures seen during 2021 in Texas. Like the globe (and the nation),[12] Utah is seeing an increase in average temperatures.[13] The Uintah Basin and the southeastern part of the state are seeing some of the most rapid increases.[14] One analysis put the eastern part of Utah and the contiguous areas in western Colorado as the U.S.'s largest hotspot – double the global average increase in temperature from 1895 through 2019, at more than 3.6 degrees Fahrenheit.[15] The Utah Climate Center at Utah State University suggests that Utah's overall temperature has been rising at about twice the global average during the past 40 years.[16]

Snowpack. Snowpack represents Utah's largest water "reservoirs," since about 80% of Utah's water supply comes from melting snowpack.[17] Research from Utah State University has found that Utah's annual snowpack has declined by 9% in the past half-century – in large part from rainfall replacing snow due to the shrinking number of below-freezing days (which has been reduced by six weeks).[18] Utah snowpack is expected to continue decreasing during this century.[19] This of course would have cost ramifications on water supply, but it would also affect recreation and tourism linked to Utah's snow, not to mention agriculture and energy production and development, which require significant amounts of water.

Drought. The West experienced its third-driest year on record in 2020.[20] The region ended the year with about three-quarters experiencing moderate to extreme drought and about one-quarter was extreme according to the United States Drought Monitor.[21] By mid-2021, nearly all of the West was in drought. The Colorado River's water flow has decreased by nearly 20% during the past century.[22] By some measures, the Colorado River Basin – covering half of Utah from the eastern part of the state through the south – has been in drought since 2000. The Department of the Interior states that the period from 2000 through 2015 was the driest 16-year period for the Basin in 100 years and one of the driest in 1,200 years.[23] On March 17, 2021, Utah Governor Cox declared a state of emergency given that 100% of the state was considered to be in at least moderate drought, and 80% was considered extreme. And in a Special Session in May, the Utah Legislature extended Utah's state of emergency due to drought.[24] By mid-2021, nearly all of the state has worsened to extreme or exceptional drought conditions.[25] This drought has resulted in reservoirs that are far below capacity. For instance, Lake Powell (in the Colorado River Basin) was near one-third of capacity by mid-2021.[26]

Fires. The Utah Department of Natural Resources says that soil moisture is at the lowest level since the state started recording it in 2006.[27] Soil moisture and fires are inextricably linked.

Fires are consuming more acres than in the past. In 2020, the U.S. saw the most acres burned in one year on record.[28] Megafires – or wildfires that burn more than 100,000 acres – are becoming more common. A California megafire in 2020 burned more than one

million acres – the first time a fire in the state passed that mark. And the fire season in the West has lengthened.[29] This increase in Western fires is linked to increased temperatures and drought, as well as forest management deficiencies and insects.[30] The main western culprit in terms of insects is the bark beetle.[31] Beetle outbreaks are occurring in part due to an increase in temperatures. These temperatures make many trees more vulnerable to the beetles and can help overall beetle populations thrive.[32] The Governor has projected that 2021 fire costs will be far higher than in previous years.[33] Implementing more effective forest management to help prevent fires will come with significant costs as well.

Health. Utah experiences episodic high particulate matter levels from fire smoke, ozone resulting from fires and higher temperatures, and dust from drought. [34] Furthermore, higher temperatures are an issue unto themselves. They result in an increase in disease-carrying insects as well as increasing rates for heat stroke and for cardiovascular, respiratory and other diseases.[35]

The Costs – Mitigation

In addition to climate change disaster damages, there are costs to help slow the increasing global temperatures. The costs might be in the form of regulation upon businesses or from governmental expenditures. For instance, recent proposals would more than double climate-related spending, providing tens of billions of dollars nationally for building clean energy projects, investing in innovation and other items.[36]

Here at home, the 2020 *Utah Roadmap*, for example, set a goal of reducing carbon dioxide emissions to 15 million metric tons annual by 2050 – from about 60 million today.[37] This would likely require adjustments to how Utah and Utahns address electric power generation, transportation, industry, commerce and home energy usage. There is a cost to all of these measures. The state and Utah companies could leverage federal funds for the required adjustments.

The Possible Benefits of Climate-Focused Investments

While the benefits of climate-focused investments could include the long-term slowing of climate change and its ramifications, this report focuses on the nearer-term economic benefits. The largest, near-term benefit to Utah from climate-focused economic strategies comes in the form of jobs.

In 2019, 2.4 million Americans held energy-efficiency jobs (in the new building sector and in retrofitting old buildings with more efficient windows, appliances and insulation), 266,000 worked in electric and alternative fuel vehicles, 248,000 worked on solar energy, 114,800 worked on wind energy, 108,000 worked in biofuels and 66,000 worked in battery storage.[38] (The counted jobs are those in which Americans spent at least 50% of their time on clean energy in these respective sectors.) Solar energy alone supports more jobs than all fossil fuel power generation combined.[39] While solar oper-

ations and maintenance do not require many jobs, there are a couple hundred thousand people constructing and installing solar across the nation.

In Utah's energy sector, energy efficiency created 32,500 jobs, solar totaled 7,400 jobs, and wind totaled about 500 jobs in 2019.[40] Utah trails only Vermont, Delaware, Wyoming, Rhode Island and Massachusetts in the percentage of energy efficiency, solar and wind jobs

MUST ECONOMIC GROWTH GO HAND IN HAND WITH FOSSIL FUELS?

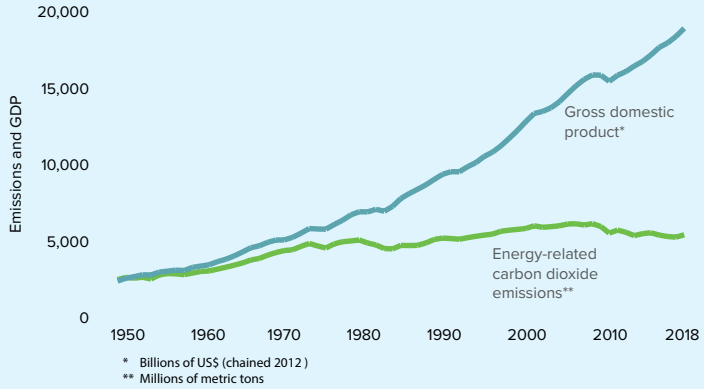
Adjustments toward a clean-energy future could depress gross domestic product. To avoid that, economists look toward decoupling developed economies from climate-focused measures, or more specifically separating per capita income from per capita greenhouse gas emissions.[a] In the United Kingdom between 1985 and 2016, gross domestic product per capita increased 71% while carbon dioxide emissions fell by 34% – representative of a decoupled economy. This was due in part to a shift toward services over goods, but it was also the result of advances in technology (such as solar and wind) and the enforcement of environmental regulations under the Climate Change Act of 2008. Criticisms of this decoupling equation suggest that the U.K.'s progress came mainly from the outsourcing of manufacturing and electrical generation, as well as the focus on gross domestic product over other economic indicators, such as employee wages.[b]

The U.S. has also seen evidence of decoupling over the past four or five decades, at least in terms of energy-related carbon dioxide emissions. (See Figure 2.) Much of the decoupling is due to a "declining carbon intensity" from a reduced reliance on coal by many energy providers in favor of natural gas.[c] The rise of fracking in particular has driven down natural gas prices, making coal less economical and leading to the shuttering of coal-fueled energy.[d]

For the most part, the Mountain States are experiencing decoupling.[e] Utah saw an increase in its gross domestic product of 40% between 2005 and 2017, with a decrease in carbon dioxide emissions of 13%. (See Figure 3.) Notably, Idaho is the only Mountain State with an increase in carbon dioxide emissions – one of only nine states with an increase over the period.

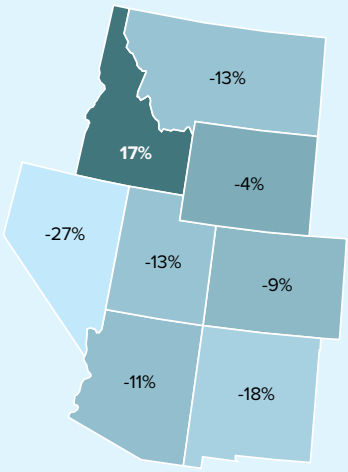
Economic growth leaves emissions in the dust.

Figure 2: U.S. GDP and Energy-Related Carbon Dioxide Emissions



In all of the Mountain States except Idaho, carbon dioxide emissions declined despite GDP growth.

Figure 3: Mountain State Carbon Dioxide Emissions



Source (both figures): Saha and Jaeger.

Sources:

a U.K. Office for National Statistics, The decoupling of economic growth from carbon emissions: UK evidence, October 21, 2019, www.ons.gov.uk/economy/nationalaccounts/uksectoraccounts/compendium/economicreview/october2019/thedecouplingofeconomicgrowthfromcarbonemissionsukevidence#.

b Saha and Jaeger, Op. Cit., p. 7.

c Ibid.

d See Reid Johnsen, Jacob LaRiviere and Hendrik Wolff, Fracking, Coal, and Air Quality, Journal of the Association of Environmental and Resource Economists, Vol. 6, No. 5, September 2019.

e Saha and Jaeger, Op. Cit., p. 9.

as a share of state employment – 2.5% of all jobs.[41] The rest of the Mountain States fall between 1.0 and 1.7% of all jobs.[42] Utah also saw the fifth-highest clean-energy job growth in the nation from 2018 to 2019 – a 4.7% increase in solar, wind and energy efficiency.[43]

Further, job growth in energy efficiency and power generation is expected to continue to far exceed U.S. growth, at least in the short-term.[44] Research suggests that $1 million in clean-energy spending results in about seven or eight full-time-equivalent jobs, whereas the same spending on fossil fuel generation results in only two or three jobs.[45] This is because fossil-fuel energy is more capital-intensive while clean energy is more labor-intensive.[46] Furthermore, wages in these jobs are between 8% and 19% higher than typical jobs in the U.S.[47]

The next section looks more carefully at clean energy jobs and opportunities for them in Utah, by economic sector.

ECONOMIC OPPORTUNITIES

In recent years, there have been some major advances in clean energy at the global level. For instance, 2020 saw the largest year-over-year increase in renewable power capacity since 1999 – a 45% increase over 2019.[48] And the increased pace is expected to continue through 2021 and 2022. Electric vehicle sales saw a similar increase from 2018 to 2019 – a whopping 40% – with the U.S. accounting for over 10% of global sales.

Some have suggested the need for recalibrated costs to zero-out the "green premium" – or the extra cost for products and services that have low or no greenhouse gas emissions.[49] To eliminate the cost differential, they suggest finding ways to either make "green" cheaper or to make the carbon-intensive items more expensive, such as with a cost on carbon. Putting a cost on carbon, however, is a large political hurdle.[50] On the other hand, the technological changes to make green purchases cheaper can benefit the economy in terms of increasing employment in clean-energy jobs across a variety of sectors: energy production, energy efficiency, transportation, industrial, natural resources and land. When considering green job expansion, any of these developments are likely to be at the cost of fossil-fuel jobs.

Energy Production Sector

The energy production sector accounts for about one-quarter of all greenhouse gas emissions – and some suggest that this sector holds the key to the quickest reduction in emissions.[51]

Coal. Coal was once king for electricity generation in the U.S. and internationally, but it is being replaced with lower-emission alternatives.[52]

Previous research from the Utah Foundation found that approximately 1,500 people work in Utah's five coal-fueled power plants.[53] One coal-fueled power plant closed in 2015, and with possible closures of the Bonanza (2030), Huntington (2036) and Hunter (2042)

power plants, this will mean a loss of jobs at the plants and a reduced local demand for coal from Utah's mines.[54] Approximately 1,000 people work in Utah's coal mines. Additionally, many trucking and other kinds of jobs support coal mining operations.

The economic benefit from coal mining and coal-fueled electricity generation is not inconsequential. While 2,500 jobs from plants and mines may not seem large in the context of state employment, coal-related operations are limited to six rural counties with numerous employees coming from a seventh. Total nonfarm employment in these counties is under 50,000. Accordingly, the coal mining and coal-fueled electricity generation jobs comprise more than 5% of the direct employment in those areas, with considerable indirect employment as well. In addition, coal-related jobs are also some of the best paying jobs available in the areas, and they bring in considerable tax revenues and natural resource royalties to these local economies.

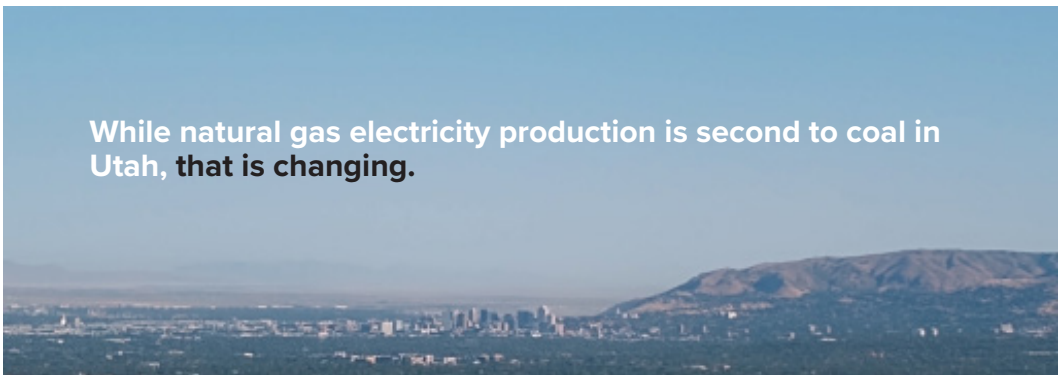
Productivity improvements resulted in increased coal production in the 20th century, particularly in the 1980s, while the number of coal mining jobs in Utah has decreased. Recent reductions in coal mine employment are due to a decrease in demand, the result of increased coal-fueled electricity generation regulation and low-priced natural gas electricity production.

Natural Gas. Natural gas electricity production surpassed coal nationally in 2015. This is due to decreased costs. Some estimates suggest that, in Utah, the cheapest electricity to develop and operate may be combined cycle natural gas (depending on market fluctuations with the price of gas).[55]

While natural gas electricity production is second to coal in Utah, that is changing. The coal-fueled power plant in Millard County (which sends most of its electricity to Southern California) is scheduled to close in 2025 upon its replacement with gas turbines – which are expected to be able to operate on a mixture of 70% natural gas and 30% hydrogen, and up to 100% hydrogen in the future.

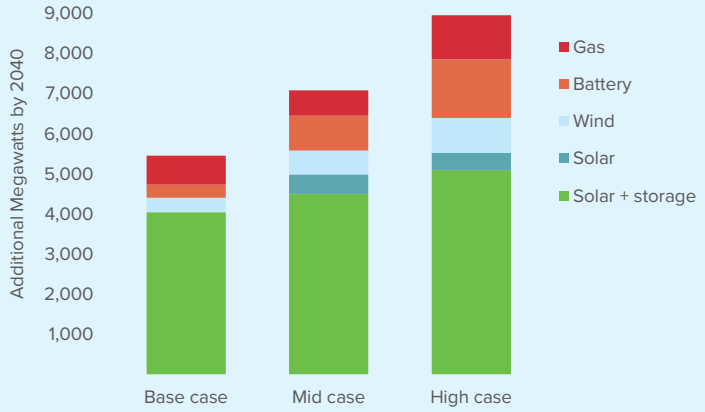
Natural gas was seen as a transition fuel from coal to renewables due to its reduced carbon intensity and carbon dioxide emissions. However, it is now clearly in the sights for reduction for its part in greenhouse gas emissions, due both to the carbon dioxide release from burning the fossil fuel and to the methane released from natural gas extraction operations and transmission.[56] As noted previously, fracking has played a major role in the reduction of natural gas costs, but it comes with its own environmental concerns.[57]

Utility-Scale Solar, Wind and Batteries. In the U.S., perhaps three-quarters of U.S. coal-fueled power plants cost more to operate than building and operating new solar and wind energy – and the cost of these renewables continues to decline every year.[58] Renewables are increasingly competitive across the U.S.[59] And were there a cost on carbon of $49 per ton, utility-scale solar could be the cheapest electricity in every county in Utah, beating out natural gas.[60] Wind is not far behind.



The future of Utah's energy leans heavily on renewables.

Figure 4: Cumulative Additions in Utah (MW)



Source: Energy Strategies.

Most U.S. planned capacity for 2021 is renewable, with 39% solar, 31% wind and 11% batteries.[61] This includes four solar projects in Utah. Further, PacifiCorp – which does business in Utah as Rocky Mountain Power – is considering new renewable projects in that include 1,243 megawatts of solar, including 682 megawatts of installed battery capacity and one 200-megawatt standalone battery.[62] These battery considerations follow the company's 2019 plan which for the first time ever included significant battery resources.[63]

As an alternative to lithium-battery utility-scale storage, Utah's Magnum Development's salt formations in Millard County are coming on the scene. The company currently bores into the salt formations for fuel storage, but has explored developing a battery-like compressed air energy storage system to generate electricity during peak demand or during times of low solar or wind electricity generation.[64] The area's existing electricity transmission lines make this an ideally-located project, which could spur additional renewable energy projects in the area.

Another type of utility-scale "battery" is pump storage, whereby a project sends water uphill when excess renewable electricity is generated, to be released back down during peak demand, using gravity to generate electricity. One such project – the first of its size in the U.S. – is being considered by the Navajo Nation in San Juan County.[65] This project would work with a large solar project on Navajo land as well as other renewables. The $3.6 billion pump storage project received preliminary approval from the federal government, which includes a transmission line to a transmission station over the border in Arizona that was previously used by a now-closed coal-fueled power plant.

About 80% of Utah's new electricity development through 2040 is expected to be solar and/or battery, with the rest being natural gas or wind.[66] (See Figure 4.) These solar and other projects cannot be placed just anywhere. However, the places that currently provide fossil fuel jobs often match locations with solid renewable energy potential.[67] Wind power has potential in several of Utah's fossil fuel employment hubs, while solar has potential in all of them – and, indeed, in every county in the state.[68]

In Millard County, the Intermountain Power Agency has fielded numerous, serious requests for renewable transmission, exceeding the total capacity of its transmission lines to Southern California.[69] This means a large number of jobs to the area, constrained only by transmission capacity. However, the planned TransWest Express Transmission Project from Wyoming to Nevada and beyond would allow for additional renewable capacity in the Millard County area, adding to the renewable generation coming from Wyoming wind projects.[70]

Utah's predominantly-renewable energy development through 2040 could create an estimated 39,000 construction jobs and 900 operations jobs, along with investment, tax revenue, increased spending and other jobs for local communities.[71]

Distributed Solar and Batteries. Rooftop solar plus batteries is an effective combination – capturing energy during peak generation for use at times of lower generation. One downside is that rooftop solar is more expensive than utility-scale projects. This

is not because of the cost of the panels but because of the labor costs – though this ultimately creates more jobs. Another issue is that they are less accessible to low- and moderate-income households. In response, several states have adopted policies to increase low- and moderate-income access in community solar programs.[72]

There are pressures against the future of ubiquitous rooftop solar in Utah. Rocky Mountain Power is looking to decrease the "value" of solar on roofs.[73] During 2016-2017, Rocky Mountain Power went before the Public Service Commission to reduce the export credit rate (the value of adding electricity back to the system) and add other fees that could have made this solar non-economical. The power company again went before the Commission in 2019-2020 to reduce the credit from between 5.5 and 6.0 cents (based upon time of year) to between 3.2 and 3.5 cents per kilowatt-hour, which arguably could have effectively eliminated Utah's rooftop solar residential market. The Commission opted to reduce the rate to around 5.5 cents per kilowatt-hour.

Other Renewables. The natural gas industry initially saw itself as part of the solution to climate change, but is now looking to pivot to still cleaner technologies, such as with renewable natural gas and green hydrogen.[74]

Utah is leading out as one of the states involved in the development of renewable natural gas.[75] The renewable gas is methane captured from farming and industrial practices. Due to the global warming potential of methane, capturing and burning it for electricity – or even simply capturing it and flaring it – is better from a greenhouse gas perspective. Many Utah companies are doing just that. Smithfield Foods in Millard County sends pig waste to a digester, captures the released methane, cleans it, and sends it to customers in Western states.[76] The Trans-Jordan landfill in Salt Lake County captures landfill methane to generate electricity on site, which is sold to Murray City power customers.[77] This is a simpler process than at Smithfield Foods because the methane does not need to be cleaned to the pipeline standard of natural gas. Wasatch Integrated Waste in Davis County separates organics, such as food waste and grass, processing them in an anerobic digestion which generates methane for use by Hill Airforce Base to produce electricity.[78] Also in Davis County, Alpro and the South Davis Sewer District use food waste digesters, capturing gas for the Dominion Energy system.[79] Nonetheless, it should be noted that all of this methane capture is ultimately a small share of overall natural gas usage.

Hydrogen development could be another boon to the state. Using hydrogen in a fuel cell to create electricity yields no harmful emissions. And burning hydrogen in a mixture with natural gas yields lower emissions than natural gas on its own. However, creating hydrogen itself is energy-intensive.

Green hydrogen, on the other hand, is the creation of hydrogen using renewable energy. As part of the Intermountain Power Plant gas-fueled power plant project, green hydrogen is expected to be an important fuel source in a mixture with natural gas. Magnum Development is looking to build green hydrogen infrastructure and storage near the power plant.[80] If so, that would likely spur the development of additional wind and solar energy in Millard County to create the green hydrogen. Further, existing natural gas pipelines to the plant and trucking via I-70 and I-15 could provide the means to ship green hydrogen across the West.[81] It should be noted that the electrolysis process requires significant water resources, though the project's owners procured the rights for needed water under the original coal-fueled power plant development.

Lastly, the U.S. produces more geothermal electricity than any other country.[82] While it is just a fraction of the overall energy produced, the U.S. Department of Energy suggests that generation of this "untapped energy giant" could be prompted to increase to nearly one-tenth of all electricity generation by 2050.[83] Much of the current production is happening in California, but Utah has been circulating water into the earth to generate

electricity from the Blundell Geothermal Power Plant in Beaver County since the 1980s. The University of Utah received a $140 million grant to develop a geothermal energy lab in Beaver County, which includes drilling two 8,000-foot-deep wells.[84] In terms of jobs, a benefit of geothermal is that it requires skills similar to those in the oil and gas sector.

Carbon Sequestration. Sequestering carbon dioxide emissions is another route being explored to reduce greenhouse gas emissions. Carbon capture and utilization is one such approach – capturing the carbon dioxide released when generating electricity and using that gas elsewhere. The question is what to do with this captured carbon dioxide. It can be used in oil extraction operations. But oil is, of course, another fossil fuel with its resultant carbon dioxide emissions. In terms of clean energy, entities could recycle carbon dioxide by converting it into algae biodiesel or using it to produce electricity or heat, for wastewater treatment or for animal feed. And Solid Carbon Products, a Utah company, is looking to supply Goodyear with the resources to make tires.[85]

While carbon capture is not economically viable at this time, foundations and governments are funding projects and research in an effort to make it so. The Musk Foundation, for example, sponsored carbon capture projects with $100 million in capital.[86] The federal government provides tax credits for carbon capture equal to $50 per metric ton of carbon dioxide, or credits of $35 per ton when captured and then used for recovering oil underground.[87] And Wyoming included a $10 million appropriation for carbon capture research during its 2021 legislative session.[88]

The Utah Legislature passed a bill for a high-cost infrastructure tax credit that can be used for carbon capture projects.[89] And in 2020, the University of Utah and the Utah Geological Survey received federal funds under the Carbon Utilization and Storage Partnership for carbon capture research, including for the state's coal-fueled power plants.[90] These funds tie in with the CarbonSAFE Rocky Mountains initiative to develop a commercial-scale carbon capture and sequestration project at the Hunter or Huntington coal-fueled power plants – among 16 carbon storage projects across the nation that are part of a cost-sharing research and development program.[91]

In addition to their methane capture systems, Alpro and the South Davis Sewer District are piloting a carbon capture concept by taking carbon dioxide from the digesters (half of the gas produced in the digesters is carbon dioxide) and running it through miles of piping that serve an algae farm where algae eats the carbon dioxide. The algae is then dried and sent to a plastics and rubber manufacturer that makes shoes with the material. Research suggests that the algae biofuels market is expanding.

Carbon dioxide can also be captured to benefit agriculture. Houweling Tomatoes in Juab County uses several sustainability measures, including capturing carbon dioxide from its heat and energy co-generation plant to grow tomatoes at its California location.[92]

Nuclear. What about nuclear? In terms of carbon dioxide emissions, many look toward nuclear as a viable alternative to fossil fuel electricity production. The Utah Associated Municipal Power Systems is looking to build 12 advanced small modular reactors at the federally-run Idaho National Laboratory. The U.S. Department of Energy is helping defer the project's financial risks, though the approach, if workable, would result in lower capital costs and overcome some of the other challenges with traditional nuclear power plants.[93] PacifiCorp is also planning a nuclear project at a retiring coal-fueled power plant site in Wyoming.[94]

Energy Efficiency Sector

The benefits of energy efficiency cannot be overstated; it would take 300 large, coal-fired power plants to generate the electricity saved in efficiency gains since 1990.[95] To

put that into context, there are only about 250 power plants in the U.S. (over one-third of which are small).[96] But there are many improvements yet to make. An expansion of energy efficiency with the electrification of building heating and appliances, industrial uses and transportation could cut energy use in half by 2050 and could cut greenhouse gas emissions even more. About one-third of that savings could come from buildings, one-fifth from industry, and about half from transportation.[97]

A focus on increasing energy efficiency would come with an enormous bump in employment, with insulation, electrification and high-efficiency products – both in existing buildings and new builds. As noted, the building-efficiency sector is the largest of the clean-energy employers. One estimate suggests that it would take 500,000 new full-time jobs 10 years to increase the energy efficiency in 40% of the homes and buildings across America.[98] With electrification, people employed in the fossil-fuel sector would lose jobs as existing capital wears out. However, Americans would see a savings on their energy bills, which could result in them spending that money in more labor-intensive areas – creating a demand for more jobs in other industries. And energy efficiency can benefit lower-income residents as heating and cooling costs comprise a larger share of their total household expenses.

Furthermore, these jobs are well distributed across the nation. Wherever there are homes and buildings, there is a need for energy-efficient construction and improvements.

In Utah, energy efficiency employs far more people than every other sector of the energy industry – 38% of the 38,000 total jobs.[99] (These are Utahns who spent at least 50% of their time working on energy efficiency.)

Electrification. Some researchers suggest that countries worldwide need to focus on electrification – from transportation to heating – while also increasing solar, wind, nuclear and other forms of electricity generation. The upside is that electrification is efficient. A full electrification across the U.S. would cut in half the BTUs – or energy – used now. This is because coal-fueled power plants lose about two-thirds of their energy as heat, natural gas power plants lose about half, and the typical internal combustion vehicle loses a whopping 80%.[100]

San Francisco has taken a step toward electrification with a ban on natural gas for new buildings.[101] But even with efficiencies, the cost remains a major hurdle.

Further, natural gas officials suggest that total electrification does not currently work everywhere, particularly in climates that see freezing winters like in Utah. Typical heat pumps that run off electricity are very efficient. But when outdoor temperatures reach below freezing, combined electric/gas systems are much more efficient (except compared to some new ductless systems). In these systems, a traditional gas furnace kicks in at below freezing temperature. These combined systems save about half on total gas usage. But they are more expensive upfront. In Utah, policymakers have allowed

utilities to collaborate, providing incentives that can help to overcome a portion of the costs; Rocky Mountain Power offers such rebates, and so does Dominion Energy.[102]

One natural gas official told the Utah Foundation, "We agree that we have to do everything we can do, but we have to do it smartly and not hurt lower-income households in the meantime."

Electrification (and its corresponding efficiency) could create tens of millions of U.S. jobs in the short-term while phasing out a fraction of that number of fossil-fuel jobs. The new jobs could come in the form of electricity supply, grid, residential and residential efficiency, commercial, transportation, industrial and other employment.[103]

Transportation Sector

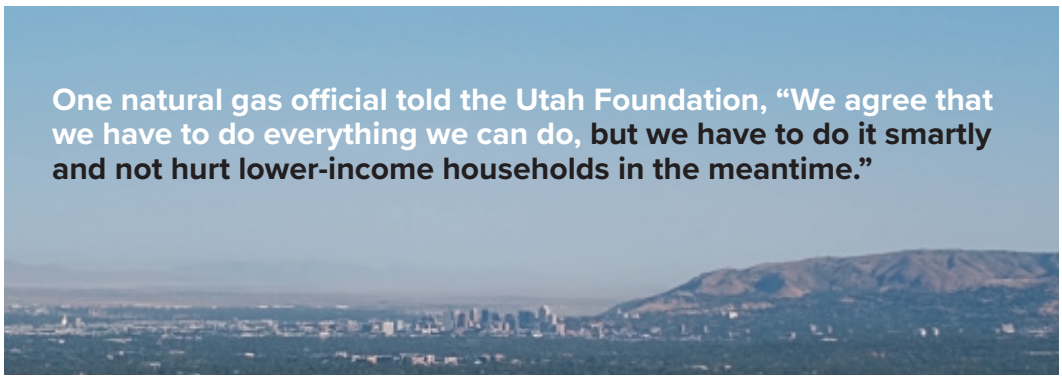
The transportation sector has the most emissions of any sector – about 29%.[104] Zero and low-emissions vehicles offer a path toward decreasing those emissions, even with more drivers on the road and regardless of whether the electricity comes from renewables.

Electric Vehicles. Since 2016, nearly every yearly forecast for electric vehicle growth has increased dramatically as costs for electric vehicles have dropped and consumer demand has increased commensurately. There were just one million electric vehicles on U.S. roads in 2015, but by June 2021 there were 12 million.[105] Nonetheless, in 2020, only 2% of U.S. auto sales were electric – far less than half the worldwide average (which is drawn up by Europe and China), though sales seem to have shot up in early 2021.[106] In Utah, 2020 sales surpassed the U.S. average, despite the state's decision to drop its electric vehicle tax credit in 2016.[107] These credits may help tip some consumers toward purchasing electric vehicles, but they still tend to have a relatively high sticker price. California seeks to help lower-income residents make the switch with a program that incentivizes them to swap out their internal combustion vehicles for a $9,500 electric vehicle rebate.[108]

Electric vehicles are already cheaper to operate and maintain than internal combustion vehicles. A new MIT study suggests that this savings makes the total cost of buying and driving electric vehicles comparable to internal combustion vehicles.[109] And analysts expect that electric vehicles will reach showroom-floor price parity with internal combustion vehicles during the mid- to late-2020s.[110] In part due to this price parity, Bloomberg New Energy Finance projects that half of all cars sold in the U.S. by the early 2030s will be electric.[111] In the meantime, more drivers will need to continue overcoming their range-anxiety – the very real concern of running out of battery power – though range is increasing, charging time is decreasing, and charging infrastructure is expanding.

Corporate America is embracing electric vehicles. Companies from Uber to JetBlue to FedEx (which is spending $2B on electrifying its fleet) have agreed to go carbon neutral by 2040.[112] Amazon is also reportedly focusing on carbon neutrality by 2040, in part with 100,000 electric delivery vehicles by 2024, which are already showing up

One natural gas official told the Utah Foundation, "We agree that we have to do everything we can do, but we have to do it smartly and not hurt lower-income households in the meantime."



to deliver packages to consumers' doorsteps.[113] Electrification of buses and even long-haul trucks is becoming more and more common.

The transition to electric should yield air quality benefits, as the Utah Foundation discussed in the recent report, *Driving Toward a Cleaner Future* (November 2019). Large fleet vehicles account for one-third to one-half of Utah's vehicle emissions, even though they account for only 3% of the vehicle miles traveled.[114] While alternative-fuel, heavy-duty fleet vehicles are more expensive than diesel and have large infrastructure costs, they offer large fuel and maintenance savings.[115]

Many auto manufacturers have set targets to sell only zero-tailpipe emission vehicles at some point during the next two decades, including Volvo by 2030, Audi by 2033, General Motors by 2035 (with 30 electric-vehicle models on the worldwide market by 2025), Jaguar Land Rover by 2036, Honda by 2040, and Mazda, Mitsubishi and Nissan by 2050, with many companies setting targets for half or more electric vehicle sales in the next 10 years.[116]

Increasing plug-in electric vehicles to 27 percent of the U.S. fleet by 2035 could generate around 50,000 additional net jobs per year and increase gross domestic product by more than $6 billion per year on average from 2015 to 2040.[117] While the electric vehicle transition may not benefit Utah in terms of manufacturing jobs – and maintaining them actually takes less work, possibly reducing service-center employment per-vehicle – increasing electric vehicle charging infrastructure could temporarily increase Utah employment.[118]

EV Charging Infrastructure. To support Americans' demand for electric cars now and into the future, there are roughly 42,000 charging stations across the country with about 102,000 individual charging outlets – more than triple the number in 2015.[119] But that will not be enough for the expected increase in demand over the decade – not to mention the electricity generation needed to power these vehicles. Additional government incentives may help to fill the gaps.[120]

Utah has about 1,700 public charging outlets and counting.[121] And the state is looking to further ramp up electric vehicle charging infrastructure, particularly in rural areas.[122] The Utah Legislature is helping with that. For instance, House Bill 259 from 2020 directs the Utah Department of Transportation with developing a plan for a statewide network.[123]

Road Usage Charges. A road usage charge (RUC) is imposed on drivers based on miles driven, often using GPS technology. RUCs are meant to make up for the deficiencies in motor fuel taxes, either as a funding source or as a fair means of charging drivers for road usage. RUCs are still in their infancy, though Utah lawmakers seem to have embraced them, particularly for electric vehicles.

While road usage charge programs are primarily meant to address the deficiencies of the motor vehicle fuel tax as a revenue generator, they can be crafted to address other policy objectives as well, such as improvements to traffic congestion and emissions.[124]

In Austria, Germany and Switzerland, a primary goal of RUCs on trucks is to encourage lower greenhouse gas emissions and air pollution. Therefore, the rates are higher for trucks with older, less efficient engines. For a full discussion of RUCs and their potential application, see the recent Utah Foundation report, *Measuring the Miles: Road Usage Charges in Utah* (March 2021).

Other. ASPIRE, an engineering research center at Utah State University, is studying roadway electrification.[125] This is useful for buses or shuttles that drive continuously and have a set route, but it may also have potential for the future of electric vehicle charging so that drivers can charge while on the road, greatly extending driving distance.

Lastly, while hydrogen fuel cell technology (where battery-like technology can be continuously powered with hydrogen and oxygen) is not yet widespread, significant uptake is possible. California has set a target of 200 hydrogen fueling stations and more than 47,000 hydrogen vehicles by 2025.[126]

Industrial Sector

A bipartisan amendment to a 2021 U.S. appropriations bill agreed to a goal of cutting hydrofluorocarbons to 15% of the 2011-2013 average emissions by 2036.[127] The U.S. Environmental Protection Agency (EPA) has already approved a list of substitute refrigerants and is preparing a plan to reduce hydrofluorocarbons. It will effectively create a cap-and-trade-type system. The EPA is also creating an enforcement strategy for some of the worst hydrofluorocarbons, including emissions tracking and third-party auditing.[128]

One study has estimated that phasing down hydrofluorocarbons and accelerating production of hydrofluorocarbon alternatives would create an additional 33,000 direct manufacturing jobs in the United States and an additional $12.5 billion in output per year beyond normal industry growth.[129] Phasing out hydrofluorocarbons, which have very high greenhouse gas potential, will allow for creation of many manufacturing jobs because alternatives will have to be created. Counting indirect and induced effects, it could create 150,000 additional jobs and $39 billion in additional output. There may be opportunities for Utah manufacturers to capture a portion of this economic activity.

Natural Resources Sector

Methane is a major concern for greenhouse gas emissions due to its far higher global warming potential than carbon dioxide. While methane is released into the atmosphere from numerous sources, an important proportion comes from the natural resources sector. The release occurs during coal mining (about 7% of total) and oil and gas operations (about 30% of total).[130] Of the oil and gas methane emissions, about half come from gas production, 20% come from oil production, and the remaining amounts come from processing, transmission, storage and distribution.[131]

Utah has more than 10,000 productive wells producing natural gas, not to mention abandoned wells that have not been properly plugged.[132] Utah and several other states have adopted regulations that require oil and gas companies to check for methane leaks on a regular basis and quickly fix them.[133] In 2016, the U.S. Environmental Protection Agency (EPA) adopted methane rules modeled after these rules. Though they were rolled back between 2017 and 2020 with deregulation, they may be restored.[134]

In the meantime, the EPA operates a voluntary methane reduction program. The program provides a list of dozens of recommended technologies to reduce methane emissions.[135] These recommendations come with estimated costs and payback periods to help incentivize adoption. A new study suggests that implementing underused mitigation measures in the oil and gas industry and otherwise could reduce global methane emissions by half within 10 years.[136] The study claims that half of these strategies have no net cost.

Oil and gas methane reductions could support Utah jobs. The reclamation of abandoned mines can be an important part of the transition for workers in affected communities. Notably, coal miners already have the required skills to perform such tasks and the work often lasts for several years at each location. Further, some are looking into using abandoned oil and gas wells for geothermal energy generation.

Land Sector

Agriculture is responsible for the equivalent of one-fifth of global greenhouse gas emissions. Land use change – like deforestation for the transition to agriculture – is a major part of the problem. Over the past 30 years, the world has lost nearly 700,000 square miles of forest – more than eight times the area of Utah.[137] Much of this is happening in places like Brazil, which is seeing rampant illegal deforestation of the Amazon.[138]

Land use change is not as much of an issue in the U.S. However, about 9% of total U.S. methane emissions are from manure management, and about 27% are from enteric fermentation – the latter primarily from bovine burps.[139] As a result, industrial animal agriculture – from meat and dairy – is responsible for 80% of agricultural greenhouse gas emissions.[140] This provides a great opportunity for targeted methane emission elimination. For instance, adding red algae to cow feed has been shown to nearly eliminate enteric fermentation methane.[141]

Some farms are trying complementary approaches. Agrivoltaics is the practice of putting solar panels on farmland.[142] This creates electricity, but can also provide the shade that helps some crops thrive while reducing water use.

In addition to agriculture, there is another land-use consideration: community development. Planning for growth is a high priority in Utah, particularly in relation to the impacts of transportation choices, land use decisions, and open space and emissions-related policies.

The Utah Foundation released an extensive report in 2019 on land use decision making, fiscal sustainability and quality of life in Utah. [143] The report looked toward promoting efficient land use, expanding transportation options, preserving green spaces and natural assets, preserving and improving community character and avoiding undue taxpayer subsidy of new growth. The report detailed the types of policies that Utahns suggest would most improve their overall quality of life: 1) promote production of quality, affordable housing; 2) build on policies and programs aimed at improving air quality; 3) invest in streetscapes and promote attractive, high-quality developments; and 4) invest in transportation infrastructure and programs to reduce traffic and improve the quality of roads and highways. All relate in varying degrees to greenhouse gas emissions reductions. For instance, efficient land use patterns, transit-oriented development, active transportation and improved street connectivity can all help to alleviate traffic congestion, reducing emissions.

OTHER ECONOMIC OPPORTUNITIES

Federal Government Regulation and Investment

Increased federal regulation and investment are coming. Regulations poses challenges, but Utah also will have opportunities to capitalize on it and new investment. One prominent observer has suggested that government spending on emission reduction research and development activities should quintuple.[144]

Federal efforts to support economic transition in coal communities is underway, with more possibly to come. For instance, the POWER (Partnerships for Opportunity and Workforce and Economic Revitalization) Initiative is "designated for communities and regions that can reasonably demonstrate how changes in the coal economy have resulted, and/or are anticipated to result in job losses and layoffs" related to coal mining and coal-fueled power plants.[145] Investments under the Initiative are expected to ultimately create more than 26,000 jobs, though these supports have so far been limited to the Appalachian region.[146]

Other federal legislation has been introduced as of this writing, with the aim of both incentivizing clean energy generally and supporting coal communities specifically.

Private Sector Investment

While various corporations have become more outspoken about the need for government intervention in encouraging a greener economy, some are also increasingly looking inward to ensure better environmental stewardship.[147]

The financial sector also appears to be steering away from carbon-intensive industries and toward the technical approaches that will help control climate change.[148] For instance, Breakthrough Energy Ventures is a $2 billion fund led by billionaires to invest in innovative practices to reduce climate change.[149] This is just a small part of the estimated $23 trillion in U.S. investments between now and 2030 that Utah governments and companies might look toward in progressing toward a lower-carbon economy.[150]

Investments in clean energy are quickly increasing. Due in large part to investments in wind and solar, clean energy investments in the U.S. passed $78 billion in 2019, an increase of 20% over the previous year.[151] And investment is rising faster than expected; estimates in 2015 for wind and solar projects by 2020 were one-half and one-third, respectively, of actual development.[152] It has been estimated that every doubling of solar production results in a decreased cost of 20%.[153] These lower costs then lead to more solar projects and higher production.

MEETING ECONOMIC CHALLENGES IN RURAL UTAH

Some of Utah's rural communities are falling behind the state's economic prosperity due to changes in fossil fuel production and consumption. Rural communities tend to be most affected by the closure of coal-fueled power plants and by the efficiencies in coal mining. The related jobs concentrated in rural communities are often relatively high-paying, do not necessarily require much more than a high school degree and often provide on-the-job training.[154]

There are ways to support rural communities through these changes. In its 2017 series on Utah's Coal Counties, the Utah Foundation explored various opportunities for economic development, with a focus on diversification. It found the need for diversification for the uses of coal (such as carbon fiber), diversification of electricity generation in relevant communities, and diversification of local economies (expansion of agriculture, tech jobs, manufacturing and tourism).[155] Subsequent reports have provided further direction along these lines.[156]

Broadband

To support rural diversification, the Governor's *One Utah* report suggests supporting "aggressive high-speed broadband deployment to rural Utah."[157] *Utah Rising* – a collaborative 2020 report authored by the Utah Foundation and others in response to the pandemic and resultant economic ramifications – discussed the importance of high-speed telecommunications access for all Utahns, allowing rural Utahns better economic opportunities. It suggested providing state grants for broadband infrastructure to provide last-mile access to underserved communities and households. It further suggested leveraging state and municipal highway and road construction to provide broadband providers the opportunity to install internet infrastructure at lower costs.[158]

State officials and civic leaders came together in the 2020 *Utah Leads Together* effort, which recommended that Utah "deliver high-speed reliable telecommunications access for all Utahns, in both unserved areas and underserved areas."[159] This would allow rural Utahns better opportunities to market agricultural goods worldwide, provide remote employment access, and allow for world-class health care and educational opportunities. Creating a solid broadband infrastructure also allows rural Utah to market its higher quality of life and proximity to outdoor amenities in attracting teleworkers that will use their salaries to build local economies.[160] During the 2021 Session, the Utah Legislature provided more than $10 million to support rural fiber, broadband and Wi-Fi.[161]

Telework

The Governor's *One Utah* report suggests that the state "evaluate and identify funding increases and expansion opportunities in rural investment programs that support remote work and entrepreneurialism."[162] The state should continue to support efforts to connect rural Utahns with telework opportunities. These include the Rural Workforce Network, a collaboration between the Salt Lake Chamber, the Economic Development Corporation of Utah and the Department of Workforce Services to provide more job opportunities for rural workers, including remote jobs. They also include the state government's own telework program to expand state job opportunities for rural Utahns through telework. Recent Utah Foundation research on telework found that some employees see telework as an opportunity to relocate to less-dense or rural settings.[163]

Rural connections are being fostered by such projects as the Rural Online Initiative, the Vernal Innovation Hub, and organizations such as Accelerant Business Solutions Provider, a Utah company that is focusing its efforts on sourcing employment in rural communities.[164] In partnership with the health care savings company HealthEquity, Accelerant established an "Opportunity Hub" pilot in Price, Utah, in late 2016.[165] Accelerant has now hired over

270 personnel.[166] The company plans to develop workspaces for urban companies looking to hire rural staff at Wasatch Front wages but with the expected benefit of lower turnover.[167]

Tourism

Utah Leads Together suggests that Utah "invest in and develop infrastructure such as trails, bike paths and other amenities that make Utah's unique vistas and landscapes more accessible to and enjoyable for Utah families and out-of-state visitors."[168] The Utah Conservation Corps does just that. Ramping up the Utah Conservation Corps program could help with unemployment and rural stimulation now, and rural tourism development in the future. Utah could expand the program or develop a larger program based on the AmeriCorps model.[169]

Utah Rising suggests identifying and investing in tourism infrastructure needed to help rural communities attract and handle more tourists. For instance, the increasing crowds, both in-state and from out of the state, on Utah's trail systems suggest it may be time to invest in expanding those systems.[170] Rural amenities can attract tourists as well as new residents.[171] A statewide recreation, arts and parks – or RAP – tax of 1/10 of 1% on the state sales tax could benefit recreational amenities in rural communities. A statewide RAP tax could bring in roughly $50 million per year.[172]

While a focus on tourism may not be ideal for some communities, the State of Utah Outdoor Recreation Vision from 2013 notes that "the best-performing communities were able to weather the economic cycles associated with extractive industries by sustaining a tourist economy and attracting new residents."[173] The state and successful communities need to show struggling rural communities that investments in the tourism economy – such as beautifying main streets and creating wayfinding signage – creates a halo effect, making a place more attractive for tech jobs, company relocations and employment expansions. Some coal communities are embracing this approach, like Helper and Price in Carbon County, and Castle Dale in Emery County. In Castle Dale, the official city website focuses exclusively on tourism. Its social media outreach is also tourism focused. While Castle Dale relies heavily on property tax revenue and incomes from the nearby Hunter Power Plant, as well as the Huntington Power Plant, the community is certainly recognizing the importance of economic diversification.[174]

Support

The state has numerous programs to support rural communities. The Governor's Office of Economic Opportunity provides tax credits and grants, such as the Rural County Grant program. The state could help with rural economic expansion by increasing support for the Rural County Grant program. Created in 2020, the program aims to address the economic development needs of rural counties, including: business recruitment and expansion; workforce training and development; and infrastructure, industrial building development and capital facilities improvements for business development.[175]

The Utah Department of Workforce Services has several programs which include grants and the allocation of federal monies, including the Navajo Revitalization Fund, the Uintah Basin Revitalization Fund, and the Permanent Community Impact Fund (which provides federal mineral lease funds and mineral bonus payments to rural communities).[176] These programs have provided tens of millions in grants, loans and other funding.

In addition, the Utah Coal Country Strike Team serves Carbon and Emery counties by looking to raise incomes by 10% while helping diversify the economy. The Strike Team pursues a four-fold strategy, including workforce training, housing revitalization, tourism infrastructure and economic development incentives. The Strike Team, with the support of the Utah Legislature, Schmidt Futures and the University of Utah, has

LEADING BY EXAMPLE

An important question in the climate change discussion is whether individual choices, household changes, city-wide measures, or even state policies that seek to reduce greenhouse gas emissions will ever be enough to make a dent in global greenhouse gas emissions. Really, a change to global warming would require more than a reliance on individual changes; policy action by states and nations are required. But do individual national policies even matter? Denmark, for instance, passed a climate act to reduce its emissions by 70% by 2030. While that goal is significant for any one nation, the question remains whether that reduction is significant on a global scale given that Denmark's population is less than one thousandth of the world-wide population. In fact, no one country – not even the U.S. or China – would be able to make all the needed greenhouse gas emission reductions on their own that are required globally.

Nonetheless, the Utah Roadmap suggests that Utah could be "leading by example."[a] This leadership can help show other communities and governments what is possible in developing global-scale solutions.

Utah is doing that in part, especially on the clean air front with its push toward cleaner vehicle fuels and wood-burning restrictions. These clean air steps can have corresponding benefits in terms of greenhouse gas emissions. But Utah's per capita carbon dioxide emissions are 19th highest in the nation, with 19 metric tons per person compared to the national average of 16 tons; this is due in large part to the carbon-intensity of the state's energy supply (from its reliance on coal) as opposed to just how much energy is used or how dependent the economy is on carbon dioxide emissions.[b] On the other hand, Utah had the 9th largest decrease in carbon dioxide emissions per person between 2005 and 2016.[c] Furthermore, given Utah's current reliance on coal, a shift toward other electricity sources will result in a large reduction in per capita greenhouse gas emissions.

The U.S. is also in a position to lead by example, with its wealth of resources, its leadership position in the world, and its standing as the world's second largest emitter of greenhouse gas emissions. Per capita, the U.S. leads the pack with more than 20 tons of greenhouse gas emissions per year (the 16 tons of carbon dioxide listed above, plus other emissions) – though Russia has been catching up with over 16 tons per capita, followed by Japan, China and the EU at around 10 tons, all of which are well above the global average of six tons per capita.[d] That leadership is important; climate researchers suggest that local and regional mitigation strategies are most effective when supported by national governments.[e]

Utah is uniquely positioned with renewable energy resources and a diversified economy to unroll climate interventions that also yield cleaner air and benefit communities struggling with economic transitions.

Sources:

a The Kem C. Gardner Policy Institute, The Utah Roadmap: Positive Solutions on Climate and Air Quality, January 31, 2020, p. 11, https://gardner.utah.edu/wp-content/uploads/TheUtahRoadmap-Feb2020.pdf.

b U.S. Energy Information Administration, Energy-Related Carbon Dioxide Emissions by State, 2005-2016, 2019, www.eia.gov/environment/emissions/state/analysis/.

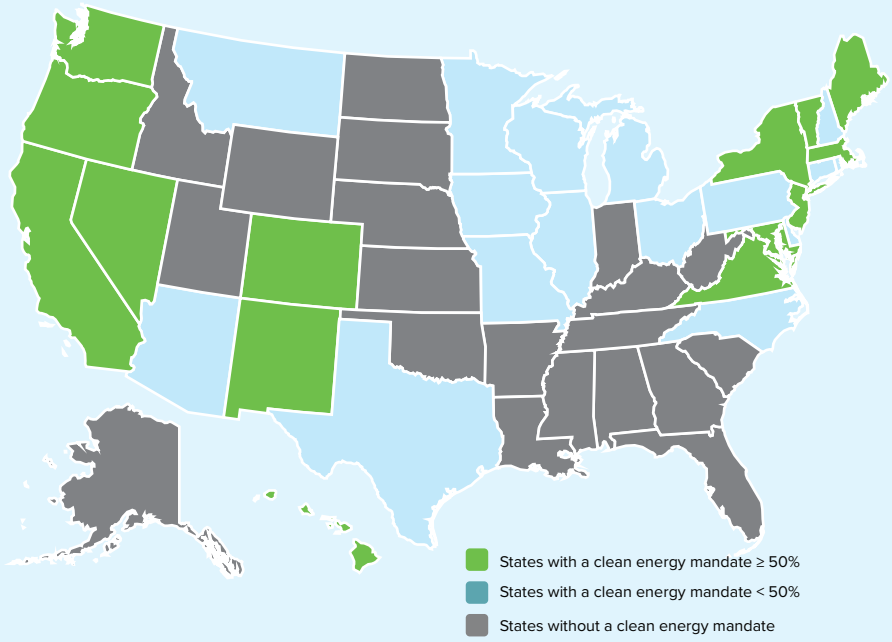
c U.S. Energy Information Administration, Energy-Related Carbon Dioxide Emissions by State, 2005-2016, 2019, www.eia.gov/environment/emissions/state/analysis/. Utah Foundation calculations and analysis.

d UN Emissions Gap report, https://wedocs.unep.org/bitstream/handle/20.500.11822/30797/EGR2019.pdf?sequence=1&isAllowed=y. (These emissions to not include land change emissions.)

e IPCC, 2018: Summary for Policymakers, p.19, www.ipcc.ch/sr15/chapter/spm/.

Utah is one of 20 states without a clean energy mandate.

Figure 5: U.S. States with Clean Energy Mandates, 2019



Source: Saha and Jaeger.

invested more than $1 million in Carbon and Emery counties to diversify the economy and help residents achieve a more economically stable future.[177]

Education

There are also opportunities for post-secondary education across the state. These opportunities are increasing with the expansion of online and distance learning. Further, the Utah Coal Country Strike Team's work plan includes workforce training by USU-E and the University of Utah.[178]

WHAT MORE CAN UTAH DO

Looking forward, there are multiple steps Utah can take toward becoming a national leader in the new climate-focused economy. The actions might include creating governmental structures and policies, supporting green infrastructure, and investing in innovation.

Creating a State Commission or Office Focused on Climate Change Challenges

Utah should consider creating a climate commission and/or office. Activities could include developing a state climate change plan – looking toward the *Utah Roadmap* for emissions reduction goals. It could work to ensure that the state prioritizes solutions that maximize economic and emissions benefits rather than simply following political popularity. It could also address emerging challenges such as the impacts of droughts.

While other states offer models, Utah itself convened the 2007 Blue Ribbon Advisory Council on Climate Change.[179] The experience of that entity could offer guidance. Additionally, a commission/office could draw insights from participants in the Utah Climate & Clean Air Compact, which includes leaders from business, government, faith and civic institutions.[180]

One consideration for a commission/office would be to determine whether Utah should impose a clean energy standard, with an eye toward economic costs and benefits, including the impacts of new technology investments. Utah is one of 20 states that lacks a clean energy mandate (though seven states without mandates have utilities with 100% decarbonization goals covering some portion of those states).[181] (See Figure 5.)

At the local level, there are 204 cities and counties that have clean-electricity mandates.[182] Some Utah cities are in that number.

A commission/office could support cities and counties in their efforts, such as recent Utah legislation fostering a governance agreement and rate structure that allows residents to opt in to 100% renewable power sources by 2030.[183] So far, 18 cities and three counties have expressed interest.[184] This would cover one-third of the customers in the Rocky Mountain Power service area.

A Community Opportunity Program. Within or in addition to a climate change commission/office, the state should consider creating a Utah community opportunity program to provide a clear link among federal funding, state investments and private investments in a climate-focused economy.

The rapid decline of a community's dominant industry can lead to dire fiscal conditions, including the inability to raise revenue, repay debt and provide basic public services.[185] A community opportunity program could seek to smooth the economic shift away from fossil fuel dependency through funding, re-training, economic development planning and other supports.[186]

Any such program might consider power-plant securitization to reach its goals. Securitization of coal-fueled power plants could include a monthly charge to ratepayers that could pay for a bond to reduce the cost of closing coal-fueled power plants (and can therefore reduce an obstacle to coal plant closures, namely utility concern over cost-recovery). Funds could be used to spur renewable energy development or provide rural community support.

The federal government could help amplify these efforts through infrastructure investments and tax credits, and by repurposing old energy sites for other economic uses.[187]

Utah Transmission Authority. Investment could also be spurred by the establishment of a Utah transmission authority.

New Mexico set up a transmission authority which sought to determine the amount of investment needed to develop a transmission infrastructure to access the states' wind and solar resources. The authority seeks the "opportunity for New Mexico to positively impact the environment while also growing the state's economy" through renewable energy transmission additions of roughly 1,000 miles at a cost of $11 billion.[188] It helps finance and develop these projects, directing private investment toward shovel-ready, utility-scale renewable energy projects.

Utah's transmission needs through 2040 seem comparably modest, with 291 miles of transmission at as much as $578 million under the high-need scenario as detailed under the 2021 Utah Transmission Study, with a possible $179 million for three more transmission developments.[189]

Some areas of the state are ripe for additional renewable energy development – such as the areas near existing or defunct power plants. A state-funded transmission authority in Utah could use private investment to unlock wind and solar power beyond these areas and across the state, reaching communities that are currently without transmission resources.

Another approach is one that the Texas legislature took in 2005. It fostered transmis-

sion development through renewable energy zones, leading to the development of major wind infrastructure and employment.[190]

Develop a Technological Solutions Laboratory and Invest in Innovation

Various experts argue that, in the long run, innovation will play a greater role in reducing emissions than will policy interventions, pointing to market-based technological innovations and their impacts on emissions. One such approach was included in the Governor's *One Utah* report: the creation of "a premier air quality/changing climate solutions laboratory."[191] The *Utah Roadmap* also points to the need to "fund a premier state-level air quality/changing climate research solutions laboratory to improve emissions inventories and the monitoring network, conduct research, advance new technologies, and convene entrepreneurs and experts to innovate."[192]

In line with the Utah Foundation's recent suggestion to "super-charge innovation" in other arenas, the state could invest in similar approaches around climate-change solutions.[193] A solutions laboratory could work toward the technical changes necessary to make "green" items cheaper, benefiting the economy in terms of increasing employment in clean-energy jobs. But unleashing market forces on the challenge could yield still greater economic achievements.

A key driver of Utah's success during the past 20 years has been the development of devices and products by entrepreneurs that flowered into major enterprises. In many cases, university research and technology transfer have played roles; a relatively small upfront investment, along with university collaboration, can open the way for creating a major employer in Utah with well-paid jobs and economic ripple effects. The state can play a key role in promoting innovation by supporting collaborative innovation between its own higher education institutions and private enterprises – in a way that learns from and improves upon the implementation of the Utah Science Technology and Research Initiative (USTAR).

Utah could develop a program that includes grants and university collaboration to support good ideas and develop already-proven concepts. For example, a company needing help with product R&D, materials or other support such as technology development, manufacturing processes, and automation, could receive a grant that would be transferred to a college or university department that has the specifically needed expertise among its professors and students. By helping the company with its needs, jobs are created and Utah's economy benefits. This approach also overcomes the challenge of commercializing new technologies emerging from universities, because a company would already be waiting for and needing the invention or product.

Utah could also create a program with a focus on small grants for projects to be executed within tight time frames. The funds would flow only when grant recipients met certain benchmarks at a certain time. Furthermore, Utah could create a 501(c)(3) that provides small grants and loans, where commercial loans are not feasible, and takes

equity positions in larger funding efforts. A nonprofit would be eligible for many more types of national grants and could take equity in companies — potentially providing funding for future generations of grants. A number of states have such programs. For instance, Oklahoma offers three stages of support: under $50,000 grants for proof of concept; $50,000 to $300,000 loans; and $300,000+ for equity positions.

Utah has a significant pool of academic and business talent regularly engaged in reviewing applications for federal grant programs. These experts could be complemented with out-of-state reviewers. Utah's new program could empanel academics to review proposals seeking small grants to demonstrate proof of concept for joint projects between Utah universities and entrepreneurs. For larger loans and grants, it could empanel business leaders in the relevant field to evaluate whether the product is viable or commercially ready, whether the applicants have the resources to pull it off and whether the available funding is adequate to the task.

Providing funding for qualifying companies to use university core facilities would allow those companies to expand their research capacity at a low cost. It would provide a funding stream to sustain and upgrade those facilities. It would also support related-facility personnel and support higher education institutions more broadly.

This aligns with a proposal from the Utah System of Higher Education for an Innovation District at the Point – or the south end of Salt Lake County – to "leverage the strengths of Utah's research universities and institutions of higher learning to create high quality Utah jobs and solve difficult Utah problems."[194] The idea is to bring together academia and industry on a combined campus for product commercialization. One part of this campus would be dedicated to air quality and climate change solutions, including a focusing on renewable energy and storage, transmission and public policy solutions.

Encouraging Clean Transportation Options

The high-profile concern around air quality allows for commensurate reductions in greenhouse gas emissions. This is especially true for vehicles as they are the largest overall emitter of greenhouse gases and are regular investments for consumers. In the Governor's *One Utah* report as part of the Sustainable Growth Promotion, one solution is to "deliver high profile sustainability projects," noting the following for transportation: continue converting state fleets to zero- and low-emission vehicles and utilizing Tier 3 fuels; encourage adoption of zero- and low-emission vehicles among private fleets with large impacts; continue investing in electric vehicle charging stations; and invest in multi-modal transportation options. [195]

While the state is participating in these projects, it could speed up progress and expand its world-class public transportation systems.

As the Utah Foundation found in a 2019 report, market forces will in the long run propel consumer uptake of electric passenger vehicles.[196] If the state were to use tax credits to encourage a more immediate market embrace, it would have to make an investment in sizable credits. However, the state might consider doing so on a short-term basis to limit the fiscal impacts and discourage fence-sitting.

In terms of tax credits, Utah may get a substantial air quality return on any such investment by continuing to focus incentives on heavy-duty fleet vehicles.[197] And due to the urgency of cleaning up Utah's air, replacing older diesel trucks with so-called "clean diesel" offers a potential target for more modest tax incentives. However, alternative fuel heavy-duty vehicle incentives would have a commensurate benefit in terms of greenhouse gas reductions.

The Utah Foundation report also suggested that the state could encourage the market's

embrace of alternative fuel vehicles by encouraging private actors to deploy alternative fuel infrastructure for customers, tenants, employees and visitors.[198] Furthermore, public and private sector stakeholders could mount public information campaigns to explain the growing availability of alternative fuel infrastructure and address any misplaced consumer fears.

Exploring More Stringent Building Energy Efficiency Codes

Utah saw the fastest population growth in the nation between 2010 and 2020.[199] There is little sign of that slowing down. With this population increase, Utah will need additional dwellings. This provides a good opportunity to build energy efficiency into the future – as opposed to relying on challenging retrofits down the road.

As noted in a previous Utah Foundation report, most of the thermodynamic standards in Utah's residential building code fall short of the latest standards in energy-efficient building as included in the International Efficiency Conservation Code.[200] The Utah Legislature has continued to allow lower standards than included in the 2018 Conservation Code.[201] Updating all requirements to the 2021 code would make new homes more energy-efficient.

While housing costs are an issue, the Utah Foundation analysis found that efficiency improvements would cost less than 1% of the cost of a new home, while residents would enjoy utility savings over time to counter these increases.[202]

In 2020, the Utah Legislature passed a bill directing the Office of Energy Development to create a home energy information pilot program.[203] Incorporating information from the Home Energy Rating System (HERS) index for new homes and the Home Energy Score (HES) for existing homes, this program looks to provide an estimate of energy usage, annual costs and emissions, as well as recommendations for improvement. However, for most homes, this information is difficult to obtain. Requiring a HERS, a HES or other home energy information on the Multiple Listing Service (the database that aggregates homes for sale) would give homebuyers the information needed to make an informed comparison.

Examining the Actions Utah Should Support at the Federal Level

Utah's congressional delegation helps to shape federal policies.[204] These elected officials will be responsible for determining whether Utah should support climate-focused policy approaches such as large increases in federal funding for green infrastructure. Beyond those unprecedented proposed investments, there are a couple of programs that hit close to home.

Agricultural Producer Carbon Sequestration Credits Program. The Growing Climate Solutions Act is an effort to authorize the Secretary of Agriculture "to develop a program to reduce barriers to entry for farmers, ranchers, and private forest landowners in certain private markets, and for other purposes."[205] That act would seek to encourage farmers to incorporate climate-friendly, carbon-reducing agriculture practices and techniques by opening up access to existing carbon credit markets. It would direct the U.S. Department of Agriculture to develop and run a certification program to help farmers adopt climate-friendly techniques, such as carbon sequestration, and monetize these solutions.

The legislation has bi-partisan support.[206] It passed the Senate in June 2021.[207]

Carbon Pricing Mechanism. There is not much likelihood at the federal level of a cap-and-trade type approach to pricing carbon in the near future, though it shows signs of working in Europe.[208] (At the state level, it has been used in California since 2013.[209])

Regardless, other carbon pricing mechanisms are being considered, often where revenues are used for incentives or economic development initiatives.

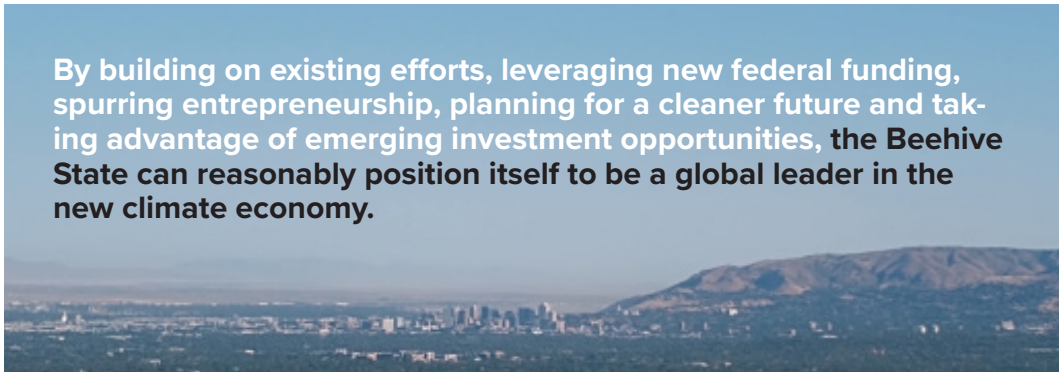
One such mechanism is carbon dividends, which has received some attention in Utah as of late, particularly in support of the Baker-Shultz Carbon Dividends Plan.[210] The idea is to charge a carbon fee to all users and then provide the proceeds back in the form of carbon dividends.[211] The plan calls for an economy-wide fee of $40 per ton on carbon dioxide emissions, increasing at 5% above inflation each year. These costs would increase costs to households. However, the proceeds from the cost on emissions would be provided back to households at an estimated annual amount of $2,000 for a family of four during the first year, increasing each year thereafter.

This plan would purportedly yield a 50% reduction in emissions over the course of 15 years. Proponents suggest that the plan would streamline regulations. They argue it would enable a rollback of EPA carbon dioxide regulation because the carbon price "would result in better reduction in emissions" and the Clean Energy Standard is "not efficient." They further argue it would "offer companies the certainty and flexibility they need to innovate and make long-term investments in a low-carbon future" instead of a patchwork of state-by-state regulations that are more subject to politics and change from year to year.[212] A gradually increasing carbon fee, they argue, would send strong market signals that encourage innovation and encourage longer-term investment.

Carbon-intensive exports to countries without comparable carbon pricing systems would receive rebates for carbon fees paid, while carbon-intensive imports from such countries will face fees on the carbon content of their products. Proponents suggest that a carbon fee with this type of border adjustment would help ensure that other countries follow suit, bringing trading partners on board with the plan. This is not seen as a state-level program, instead it is "solely focused on bi-partisan federal legislation," though one Utah legislator suggests that it is possible to "get Congress to act by first acting at the state level."[213]

Opponents of carbon dividend programs suggest that they create a new income-redistribution arrangement that collects taxes on fossil fuels and then sends those dollars to citizens in a political game of expanding the welfare state.[214] These opponents suggest that a carbon dividend would quickly become an entitlement, and that once the goals are reached under any such dividend, removing this entitlement would be politically impossible. Governor Cox's Energy Advisor and Executive Director of the Utah Office of Energy Development suggests that the inherent "punitive action" under carbon dividends (and any type of carbon tax) would not result in the aims of such a dividend and would unfairly hurt lower-income households, instead suggesting that innovation is the key to reducing greenhouse gas emissions.[215] However, at least one study suggests that, since lower-income households have a smaller carbon footprint, nearly all of these households would break even or come out ahead under these types of plans – in addition to reaping the benefits of expanded employment opportunities.[216]

Leadership. These climate focused policy innovations at the federal level deserve close consideration by Utah lawmakers. Whether the question is one of infrastructure



funding or policy levers, it is clear that the outcomes are critical to formulating Utah's new climate economic strategy. It is important, therefore, that the state play an active leadership role in those federal-level decisions.

CONCLUSION

A "New Climate Economy" is rolling out quickly, and with it are innovations, investments and opportunities that prioritize climate-focused strategies. Utah is already taking part in this new economy, but it lags behind the nation in terms of its per capita carbon dioxide emissions – even as the U.S. lags behind other industrialized nations and the world.

For 15 years, Utah has been looking toward climate change solutions, and the effort seems to have been re-prioritized with the *Utah Roadmap*'s goal of cutting emission in by about three-fourths over the next 30 years.

At the federal level, large new investments in Utah could play a part. For instance, Utah could leverage federal funds toward large clean energy projects, such as the pump-storage project in the Navajo Nation, the green hydrogen project in Millard County and carbon capture at Utah's coal-fueled power plants. The benefits of such investments are significant, as renewable-energy development alone is expected to create tens of thousands of Utah jobs in rural communities, spinning off new investment and tax revenue. To further bolster rural communities, Utah could consider ramping up rural broadband, telework opportunities, tourism infrastructure, monetary support and targeted educational opportunities.

Utah is already taking numerous steps toward a climate-focused economy, but there are additional approaches the state might consider. These include a commission/office dedicated to address climate challenges and climate-focused economic development across the state. Utah could look to speed up its clean transportation options and ensure that new homes have the efficiency that benefits homeowners and the planet. Utah could consider the development of a technological solutions laboratory and the creation of a fund that supports innovation in the state. The state could also consider supporting federal policies, such as an agricultural producer carbon sequestration credits program and a carbon pricing mechanism.

For Utah, the economic implications of climate-focused policy and investments are monumental. By building on existing efforts, leveraging new federal funding, spurring entrepreneurship, planning for a cleaner future and taking advantage of emerging investment opportunities, the Beehive State can reasonably position itself to be a global leader in the new climate economy. Along the way, we will realize environmental benefits, such as cleaner air, and a wider distribution of prosperity among our rural communities.

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