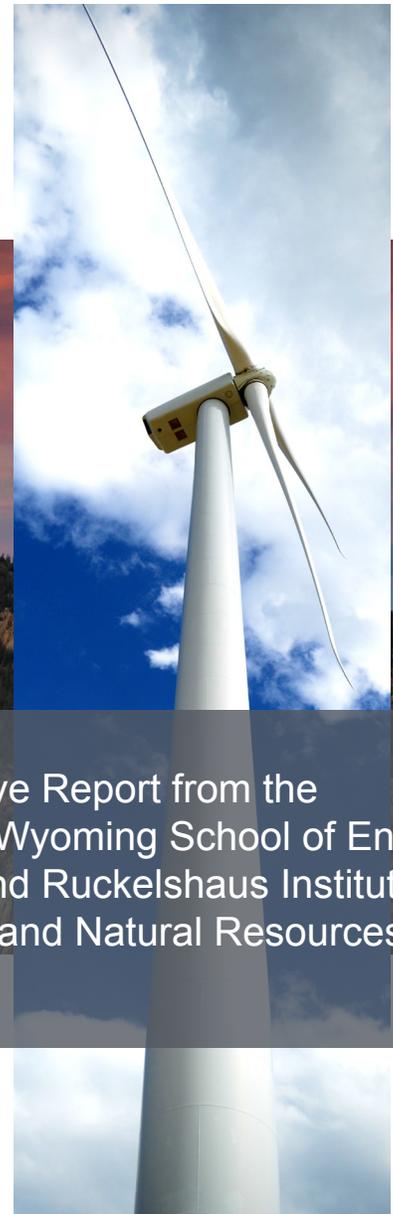
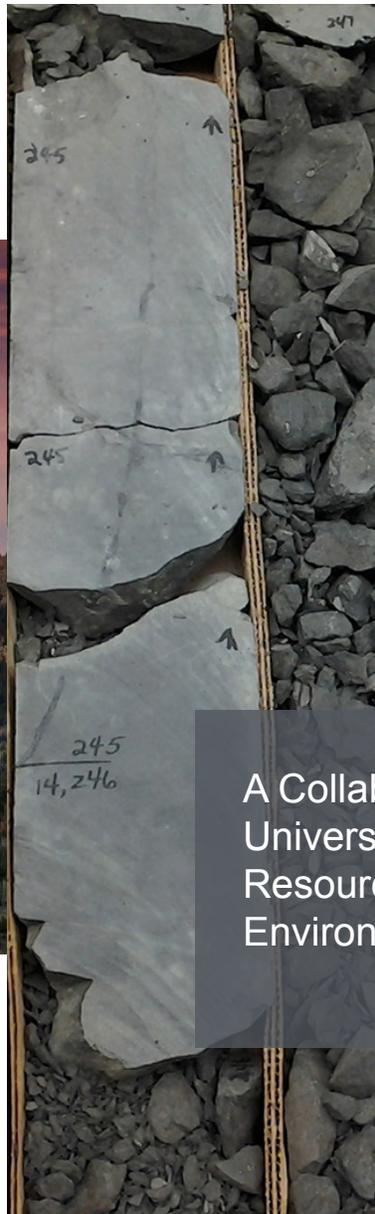


Social License for Wyoming's Energy Future: What Do Residents Want?

JESSICA WESTERN AND SELENA GERACE



A Collaborative Report from the
University of Wyoming School of Energy
Resources and Ruckelshaus Institute of
Environment and Natural Resources

Social License for Wyoming's Energy Future: What Do Residents Want?

By Jessica Western, Ph.D. | Research Associate, University of Wyoming Ruckelshaus Institute and Principal, Big Goose Creek Resolutions

and

Selena Gerace | Research Assistant, University of Wyoming School of Energy Resources

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Roger Coupal, Ph.D. | Community Development Specialist, UW Department of Agriculture & Applied Sciences

Tara Righetti, Esq. | Professor of Law, UW College of Law

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EXECUTIVE SUMMARY

This study explores the values, beliefs, and perceptions regarding Wyoming's energy economy. It also focuses on the future of our relationship to energy given the rapid changes in energy markets. The authors framed this study in terms of social license: a society's or a local community's acceptance or approval of a company's activities or operations.¹ We explored State of Wyoming residents' acceptance and approval regarding different energy futures. Our intention was to provide an understanding of what people in Wyoming envisage for the future of their energy economy in order to support decision making at all levels.

The study was a collaboration between the University of Wyoming's School of Energy Resources and Ruckelshaus Institute at the Haub School of Environment and Natural Resources. It was conducted over the course of two years and in two phases. The first phase surveyed Wyoming residents. We asked questions about their values and beliefs regarding different types of energy production, development, and technologies. The second phase was a Q-study. This approach assesses viewpoints of people who work on energy-related topics with the aim of better understanding the reasons behind Wyoming residents' values and beliefs about energy.

Wyoming residents support natural gas (83%), oil (71%), solar (69%), wind (66%), and coal (63%) energy production. Further, rather than opposing them, respondents indicated the need for more information regarding energy storage, uranium, nuclear energy, carbon capture and storage, and rare earth elements. Out of 14 values, respondents gave four the highest ranking, percentage-wise: aesthetic value (73%), biological diversity (73%), recreation value (63%), and economic value (60%), followed by community value (59%), future value (57%), and historic value (52%).

We received 60 pages of qualitative data where our respondents took the time to explain their reasons for supporting or opposing various energy types. This data provides a good indication of the trade-offs in residents' minds in relation to different energy types and the level of social license they provide for them. We used the last question—"Is there anything else you would like to tell us about Wyoming's energy future and what you would like to see happen or not happen in the next 20-30 years?"—to identify the statements we used in the second phase of the research, the Q-study.

This entailed a sorting exercise of statements and interviews exploring the reasons for the social license, or lack thereof, that we found in the survey. Three themes resulted from this Q-study, each representing a different emphasis useful in understanding trade-offs and interests.



Wyoming residents support natural gas (83%), oil (71%), solar (69%), wind (66%), and coal (63%) energy production.



¹ Neil Gunningham, et. al., *Social License and Environmental Protection: Why Businesses go Beyond Compliance*, 29 LAW & SOC. INQUIRY 307, 308 (2004), <http://scholarship.law.berkeley.edu/facpubs/675/>.

The first we called the “renewable theme,” where renewable energy is strongly supported as are developments in technology and non-energy types of income, such as information-based industries. The participants in this theme are motivated by concerns for climate change and other environmental factors, as well as the well-being of Wyoming workers and communities. For this reason, they support conventional energy as a bridge to renewable energy and non-energy types of industries.

In the second theme, what we call the “economic theme,” participants are motivated by concerns for Wyoming’s economy overall. This theme explored opinions of participants advocating for conventional energy, which they see as both part of Wyoming history and the strategic economic bridge toward other industries. Participants in this theme supported carbon capture and storage as a means to enhance oil recovery and to support coal operations, but also to reduce carbon in the atmosphere. In terms of enhancing the state’s economy, respondents considered it critical to pay attention to climate change. This theme was also more open to nuclear energy and strongly supported the development and use of new technologies.

The last theme, the “quality of life theme,” emphasized the importance of quality of life in Wyoming. Considerations related to jobs, job security, health insurance, wildlife, and reliable and cost-efficient energy delivery ranked highest in this theme. The quality of life theme did not favor any particular type of energy. The participants leaned toward different energy types in their interviews but not at the expense of a high quality of life. They raised concerns that the cost of transitioning from conventional to renewable energy would be passed on to vulnerable populations. This theme was the most positive about nuclear energy.



RENEWABLE THEME

- Most support for renewable energy
- Most support for information-based industries
- Motivated by climate change and other environmental factors



ECONOMIC THEME

- Motivated by concerns for Wyoming’s economy
- Support carbon capture & storage to enhance mineral recovery
- Open to new uses of technology



QUALITY OF LIFE THEME

- Emphasizes importance of jobs, job security, health insurance
- Strong considerations for reliable and cost-effective energy delivery

Overall, there is agreement across survey respondents and Q-study participants that:

1. Wyoming needs to use all the tools in its toolbox. There may be a small percentage of people who have strong preferences for a particular energy type but by far the majority want to look at all ways of boosting the energy economy and the economy in general.
2. In Wyoming, climate change is generally an accepted concept. Among the Q-study participants, there was strong disagreement that climate change is a “hoax.” The interviews and the comments in the survey indicate that far from rejecting climate change, Wyoming residents generally feel that using it to an economic advantage—and for many also an environmental one—may benefit the state.
3. Wyoming should pay attention to what customers outside its borders are willing to pay for and the reasons for those desires. Catering to those customers could improve Wyoming’s economy.
4. There is a high level of interest in developing technologies or recruiting industries with technology that can allow Wyoming’s energy economy to evolve into a more resilient and sustainable situation.
5. There is also a high level of interest in recruiting or developing non-energy related economic activities such as an information-based industry.
6. There is an interest in more information regarding nuclear energy and carbon sequestration. Because Wyoming residents want available all tools in the toolbox, they are not willing to throw out any ideas, but they need more information on these subjects before they will grant a higher level of social license.
7. There is need to decrease impacts on wildlife.
8. The retention and creation of jobs and job security is a top priority. Survey comments and Q-study interviews indicate a concern for workers, families, and communities that are connected to conventional energy sources that are either in decline, such as coal, or vulnerable, such as during a pandemic. Many mentioned the need for training programs and other job security measures.

The survey was conducted right before and the Q-study was conducted during the coronavirus outbreak. The pandemic has cast the weaknesses in Wyoming’s economy in an even starker light than before. However, the concern for Wyoming’s economy was as evident in the pre-pandemic survey as it was in the Q-study conducted during the pandemic.



In Wyoming, climate change is generally an accepted concept. Among the Q-study participants, there was strong disagreement that climate change is a “hoax.”

The results of this study suggest:

- **A comprehensive energy strategy for Wyoming:** The Wyoming public provides its leaders with the social license to activate an energy strategy in a manner that considers quality of life factors, improves the economy, and benefits the state’s environment. Although the state has pursued various avenues in the past towards energy planning, Q-participants believe a more comprehensive plan is still necessary. Judging from the responses in the Q-study, participants involved in Wyoming’s energy discourse want more risk taking, more support for new energy approaches, and a more outward-facing approach to new technologies, new ideas, and needs in other states. In all three themes frustration among Q-study participants was evident in the lack of action taken to develop a “comprehensive energy strategy,” as one participant called it, that supports all forms of energy, and that is developed in line with the preferences and demands of Wyoming residents **and** customers outside its borders, with goalposts. As long as this results in jobs and a continued strong energy identity for Wyoming, the survey indicates the public would be supportive.
- **We need to talk:** There is a need for more information to the Wyoming public about technologies and trade-offs. The trade-offs are reflected in the three resulting themes in this study; for example an increase in renewable energy but at what cost? Carbon capture and storage is to some extent supported by Q-participants but in the renewable theme questions are asked whether this will really reduce carbon dioxide levels or only boost oil production? The survey results also show that there is interest in technologies such as carbon capture and storage and even nuclear energy, but that the majority of the public is not familiar with these subjects enough to meaningfully evaluate the trade-offs. Providing more opportunities for information sharing and dialogue around these technologies and the trade-offs would likely boost the level of social license for them.
- **Wyoming values:** Although clearly energy and economy are closely tied in this state, and survey results show economic and community values ranking high, aesthetic and biological diversity values ranked highest in the survey. The beauty of Wyoming’s landscapes was often referenced as a reason to oppose wind energy. The importance of wildlife corridors was equally often referenced as a reason to oppose oil and gas activities. Respondents in both parts of the study made clear their passion for Wyoming’s natural amenities and attachment to place. When considering trade-offs, these values will be fundamental to any deliberations in Wyoming.
- **Change is gonna come:** Generally, energy production related to oil, coal, gas, and renewables is largely supported by the public with the public understanding that the current energy portfolio will change. Both survey and Q-study participants are concerned regarding the way external forces are changing Wyoming’s economic activities and income. The survey results indicate clearly that energy activities in Wyoming are not an “either/or” issue between conventional and renewable energy. Instead the survey responses indicate there is strong support for gas, oil, renewables, and coal in that order. The greater percentage of survey respondents and almost all Q-participants acknowledged that change was happening and Wyoming needs to prepare for the changes rather than “just let them happen to us” as one Q-participant put it.

INTRODUCTION

We conducted this research in 2019 and 2020 in response to the recent changes in worldwide energy markets and the impact those changes are having in Wyoming, a state which has long depended on energy industries for revenue and jobs. While Wyoming has long benefited from having rich supplies of energy resources, demand for those energy resources has shifted dramatically in recent years, and Wyoming and its residents are grappling with consequences of a new energy landscape.

A Shift in Wyoming’s Relationship to Energy

Wyoming has some of the most generous supplies of energy resources in the U.S., from coal in the Powder River Basin, to oil and natural gas fields across the state, to the wind that whips relentlessly through our great wide-open spaces. Thanks to an abundance of these resources, Wyoming has long been one of the leading energy-producing states, ranking as the top coal producing state since 1986 (producing about 40% of all coal mined in the U.S.), the eighth in crude oil production, and in the top ten of natural gas production. Energy-related mining and minerals extraction are the largest industry in Wyoming and energy related royalties, severance payments, and other taxes are a major source of revenue for the state,² typically accounting for about two-thirds of Wyoming’s annual revenue.^{3,4}

Wyoming natural gas production: 1978–2020

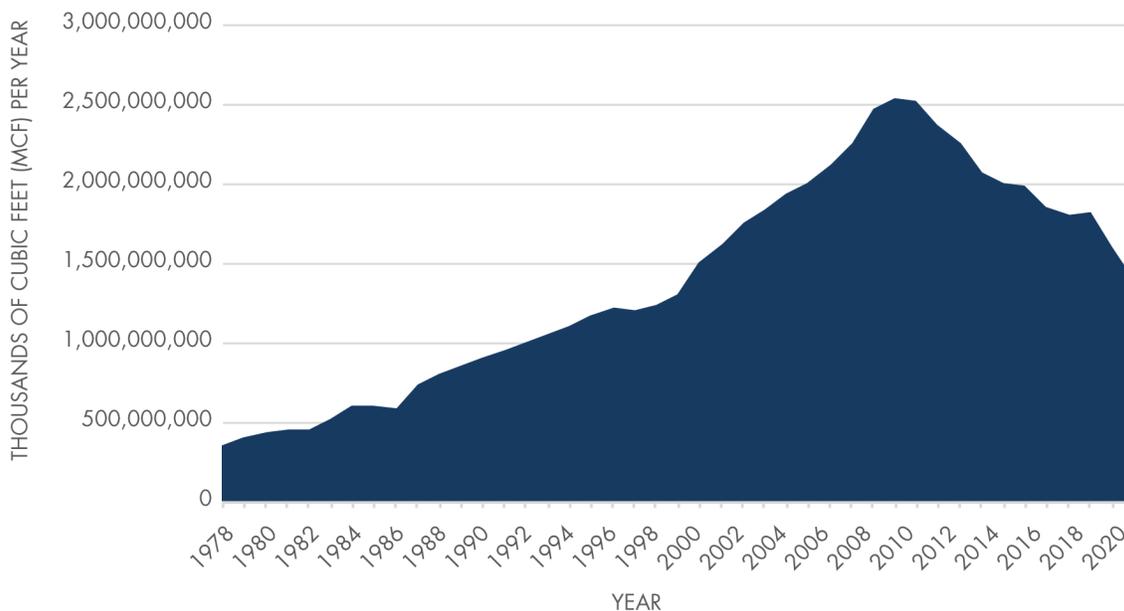


Figure 1. Wyoming natural gas production, 1978–2020 (Source: Wyoming Oil & Gas Conservation Commission with 2020 data predicted from the *October 2020 CREG Forecast*).

² U.S. Energy Information Administration. “Wyoming State Energy Profile.” Accessed October 2020. <https://www.eia.gov/state/print.php?sid=WY>

³ Wyoming Department of Administration & Information, Economic Analysis Division. “Special Reports and Presentations.” Accessed October 2020. <http://eadiv.state.wy.us/SpecialReports/SpecialRep.html>

⁴ State of Wyoming Legislative Service Office. “Budget Shortfall Introduction.” May 2020. https://wyoleg.gov/InterimCommittee/2020/03-202005265-0405262020_BudgetShortfallFINAL.pdf

Wyoming oil production: 1978–2020

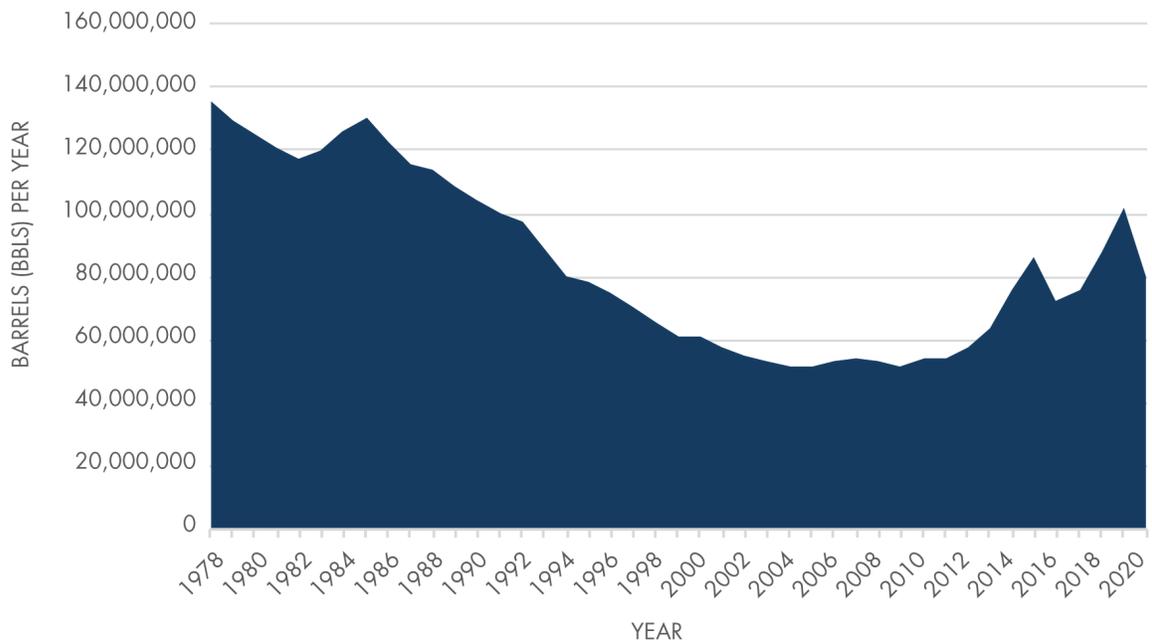


Figure 2. Wyoming oil production, 1978–2020 (Source: Wyoming Oil & Gas Conservation Commission with 2020 data predicted from the *October 2020 CREG Forecast*).

Wyoming coal production: 1978–2020

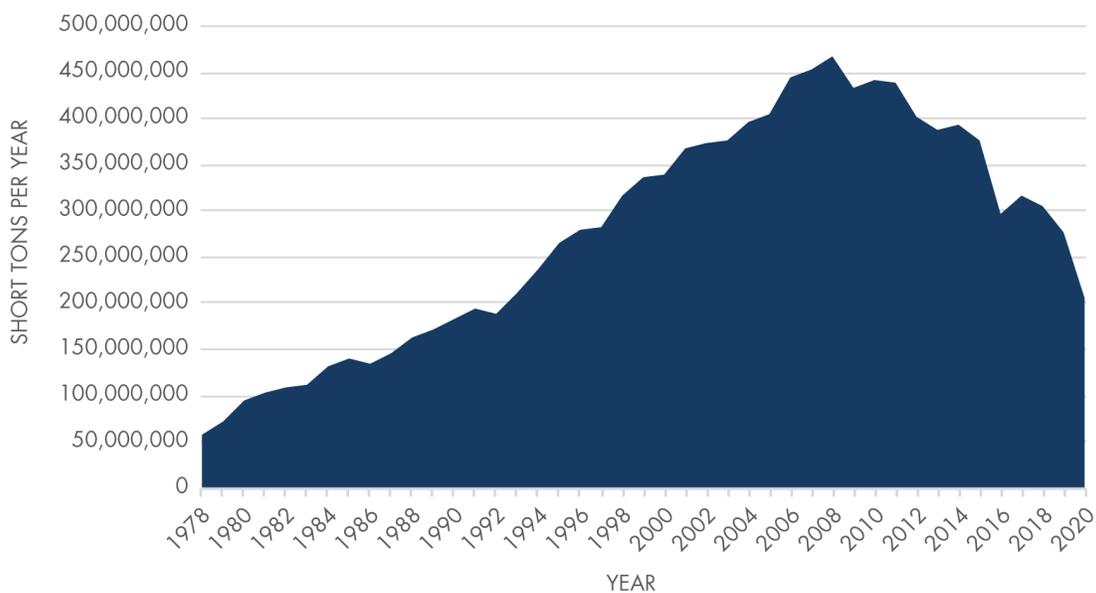


Figure 3. Wyoming coal production, 1978–2020 (Source: Wyoming Geologic Survey with 2020 data predicted from the *October 2020 CREG Forecast*).

The causes that led to all three of Wyoming’s core fossil fuel industries declining at the same time have been multifold—a combination of disruptive technologies, changes in public policy and public perceptions related to climate change, and most recently a global pandemic that continues to upend global economies.

Advancements in hydraulic fracturing (also known as “fracking”) caused extreme disruptions in energy economies. Fracking is the process of injecting water, sand, or chemicals into underground rock formations to fracture the rock and make it possible to remove the oil and/or natural gas in the pore space.⁵ While the technology has been around for decades, more recent advancements in fracking (along with horizontal drilling) have made it more effective and possible to extract oil and natural gas in places where it hadn’t been possible before.⁶ This fracking “boom” greatly bolstered the supply of oil and natural gas on the market, increasing competition and decreasing prices.⁷ The result has been a steady decrease in Wyoming’s production of natural gas beginning in 2010 and a sharp oil production decline in 2014-2015. Additionally, as natural gas became more abundant and cheaper, it began to outcompete coal for electricity generation, driving down demand for coal and thus decreasing Wyoming’s production of coal.

Motivated by concern over the environment and climate change, public perceptions of fossil fuels have also changed dramatically in the last ten years. Growing concerns about carbon emissions have led to greater demand for low-carbon energy sources, such as renewables. Public policy was implemented to encourage low-carbon energy, as well. Much of this was done at the state level. For example, California implemented its Low Carbon Fuel Standards (LCFS) in 2011, a program that sets requirements for reducing carbon emissions from transportation fuels.⁸ California also accelerated its Renewable Portfolio Standards (RPS) in 2015, mandating that 50% of electricity be generated by renewables by 2030.⁹ Other states have adopted similar policies aimed at significantly decreasing carbon dioxide and other greenhouse gases in the atmosphere.¹⁰



⁵ U.S. Geologic Survey. “What is hydraulic fracturing?” Accessed October 2020. https://www.usgs.gov/faqs/what-hydraulic-fracturing?qt-news_science_products=0#qt-news_science_products

⁶ U.S. Geologic Survey. “When did hydraulic fracturing become such a popular approach to oil and gas production?” Accessed October 2020. https://www.usgs.gov/faqs/when-did-hydraulic-fracturing-become-such-a-popular-approach-oil-and-gas-production?qt-news_science_products=0#qt-news_science_products

⁷ Blasi, Alessandro. “Witnessing the ongoing transformation of the oil and gas industry.” International Energy Agency. 2017. <https://www.iea.org/commentaries/witnessing-the-ongoing-transformation-of-the-oil-and-gas-industry>

⁸ California Air Resources Board. “LCFS Basics.” Accessed October 2020. <https://ww2.arb.ca.gov/resources/documents/lcfs-basics>

⁹ California Public Utilities Commission. “Renewables Portfolio Standard (RPS) Program.” Accessed October 2020. <https://www.cpuc.ca.gov/rps/>

¹⁰ National Conference of State Legislatures. “Greenhouse Gas Emission Reduction Targets and Market-based Policies.” Accessed October 2020. <https://www.ncsl.org/research/energy/greenhouse-gas-emissions-reduction-targets-and-market-based-policies.aspx>

These changes in both public perception and public policy have increased demand for renewables and encouraged their rapid development. As a result, both solar and wind technologies have become increasingly more efficient and their costs have decreased rapidly in recent years.¹¹ Today, electricity generated from wind is outcompeting both coal and natural gas,¹² further decreasing the demand for Wyoming's fossil resources.

Additionally, the global COVID-19 pandemic and subsequent economic recession has accelerated the decline in Wyoming's fossil fuel production. As people suddenly and dramatically reduced the amount that they travel (both by road and air), the demand for oil has plummeted in 2020.¹³ Similarly, electricity use has decreased significantly during global lock-down measures leading to further decreases in demand for both coal¹⁴ and natural gas.¹⁵

It is important to differentiate between short-term (not permanent changes in the markets) and long-term trends due to technology or regulation. While it is true that COVID had a major impact on oil and coal production in the state, those are expected to rebound somewhat to trend. Gas began to decline before COVID and the impacts on production due to COVID will not be seen until next year.

This Study: Social License for Wyoming's Energy Future

We initiated this study in the summer of 2019 to explore the values, beliefs, and perceptions that Wyoming residents hold regarding the future of Wyoming's energy economy. Wyoming's energy landscape has become increasingly complex for the reasons mentioned above, and our intention was to provide an understanding of what people in Wyoming envision for the future of their energy economy to support decision making at all levels. More specifically, this research was framed in the concept of social license.



It is important to differentiate between short-term (not permanent changes in the markets) and long-term trends due to technology or regulation.



¹¹ International Energy Agency. "Renewables." Accessed October 2020. <https://www.iea.org/fuels-and-technologies/renewables>

¹² Bloomberg New Energy Finance. "Scale-up of Solar and Wind Puts Existing Coal, Gas at Risk." Accessed October 2020. <https://about.bnef.com/blog/scale-up-of-solar-and-wind-puts-existing-coal-gas-at-risk/>

¹³ International Energy Agency. "Global Energy Review 2020: Oil." Accessed October 2020. <https://www.iea.org/reports/global-energy-review-2020/oil#abstract>

¹⁴ International Energy Agency. "Global Energy Review 2020: Coal." Accessed October 2020. <https://www.iea.org/reports/global-energy-review-2020/coal#abstract>

¹⁵ International Energy Agency. "The pandemic and a mild winter have delivered a historic shock to the global natural gas market." Accessed October 2020. <https://www.iea.org/news/the-pandemic-and-a-mild-winter-have-delivered-a-historic-shock-to-the-global-natural-gas-market>

A “social license to operate” is society’s or a local community’s acceptance or approval of a company’s activities or operations.¹⁶ In 2018, Stoellinger, Smutko, and Western published a peer-reviewed article regarding social license to operate oil and gas production on federal lands and the role of collaboration under the National Environmental Policy Act as a tool to obtain social license.¹⁷ That article explored incentives and disincentives for companies to obtain social license and described case histories where social license had been successfully achieved. In this study, the concept of social license is expanded to explore support from Wyoming residents for different types of energy production at the state level. Since energy production is inextricably linked to Wyoming’s economic well-being, cultural identity, and natural landscapes, we went further to explore the reasons for support or opposition to different forms of energy production. The results provide an understanding of the social license that exists among Wyoming residents for different types of energy economies and economic futures for Wyoming generally.

As noted above, a social license to operate generally confers community acceptance of a company’s operations and outlines “the demands on and expectations for a business enterprise that emerge from neighborhoods, environmental groups, community members, and other elements of the surrounding civil society.”¹⁸ A social license to operate is generally voluntary, often informal, and is granted by a community based on the opinions and views of stakeholders. In his book *The Social License: How to Keep your Organization Legitimate*, John Morrison notes that fifty years ago:

“the resource [extraction] sector secured its license to operate at the discretion of the government, in fact, we still do. And that’s called a legal license and permits and license are granted and we live up to the expectation and they are maintained. But in the world of globalization and in an increasing world of scrutiny and mobilization of local voices, if you don’t have the broad-based support of local people for what you want to do, then you won’t get your legal license.”¹⁹

When we began this research project in 2019, it was already abundantly clear that the people of Wyoming and their elected representatives would need to make difficult decisions, explore complex trade-offs, and generally take risks. An understanding of the social license that exists in Wyoming for taking those risks may support the decision making that is now even more necessary and relevant due to the COVID-19 pandemic and its consequences for Wyoming’s economy.

¹⁶ Neil Gunningham, et. al., *Social License and Environmental Protection: Why Businesses go Beyond Compliance*, 29 *LAW & SOC. INQUIRY* 307, 308 (2004), <http://scholarship.law.berkeley.edu/facpubs/675/>.

¹⁷ Temple Stoellinger, L. Steven Smutko, Jessica M. Western, *Collaboration Through NEPA to Achieve a Social License to Operate on Federal Public Lands* (2018), 39 *Pub. Land & Resources L. Rev.*

¹⁸ Brian F. Yates & Celesa L. Horvath, *Social License to Operate: How to Get it, and How to Keep it 1*, Pacific Energy Summit (Summit Working Papers, 2013), available at: http://www.nbr.org/downloads/pdfs/eta/PES_2013_summitpaper_Yates_Horvath.pdf.

¹⁹ John Morrison, *The Social License: How to Keep Your Organization Legitimate*, 159 (2014).

We started with an elicitation study where we interviewed individuals in the private, governmental, and non-governmental sectors who are intimately involved in Wyoming's energy industries. This elicitation study helped us design a survey, and the individuals involved in the elicitation study reviewed the survey instrument. The Wyoming Survey and Analysis Center at the University of Wyoming conducted the survey in late 2019 and early 2020. The survey provides an understanding of the values, beliefs, and preferences of Wyoming residents regarding energy issues and provides results that can be extrapolated to Wyoming's population. To explore the reasons behind the survey results, we conducted a Q-study, a methodology that allowed us to explore the Wyoming discourse regarding energy and the reasons behind the results we received from the survey. In this report we provide the reader with the methods of the survey and Q-study, the results, and our conclusions.

ELICITATION STUDY

The elicitation study provided us with an understanding of the questions to ask in the survey. During fall of 2019, we interviewed 10 key individuals who represented different interests in relation to Wyoming's energy economy. These individuals are active in various energy sectors, including utilities, University of Wyoming faculty, and State government officials. We asked these participants questions regarding what is important for Wyoming residents to consider in relation to changes in its energy economy, how to make these changes smoother, what are existing barriers to this transition, and what other factors needed to be considered. We also asked participants for the names of individuals they thought we should interview in the Q-study to follow the survey. Based on the results of this elicitation study, and additional research into Wyoming's energy economy, we designed the survey to explore preferences regarding different energy types, the reasons for respondents' preferences and beliefs regarding the future of Wyoming's energy economy. We also were able to create a list of individuals to invite to participate in the Q-study who elicitation study participants thought represented the various interests in Wyoming related to energy subjects.

SURVEY

Based on the results of the elicitation study described above, we designed the survey in fall of 2019. The random sample survey of Wyoming residents was designed to explore their values, beliefs, and preferences regarding energy issues. The survey was implemented late 2019 and early 2020 by the Wyoming Survey and Analysis Center.

Survey Methods

The survey instrument for this project was developed in collaboration with the Ruckelshaus Institute. Ruckelshaus Institute researchers provided WYSAC with a draft questionnaire designed to assess the public's opinions about the various energy related operations in Wyoming and the energy development future of the state. Once developed, the survey instrument was reviewed multiple times by researchers in the Ruckelshaus Institute. The finalized questionnaire was then programmed for online survey administration and simultaneously formatted into an 8-page scannable form.

The sampling frame for this survey included all Wyoming households with mailable addresses included in the Delivery Sequence File maintained by the USPS. A probability sample of 3,100 such addresses was drawn from that file for Wyoming. The sample was purchased from the Marketing Systems Group, a leading national vendor specializing in the generation of scientific samples.

All potential respondents were contacted via USPS invitation letter and survey packet. The survey used a mixed mode of data collection, where potential respondents were provided the option to complete the survey online or by using a paper version of the questionnaire sent in the mail.

On October 17, 2019, all households drawn into the sample were mailed a letter inviting them to complete the survey online. The letter provided the URL address of the survey and a unique access code. In an effort to secure a roughly equal gender split of the final sample, a quasi-random in-house selection of respondent was introduced, using the next birthday method: “To ensure a representative survey sample, we ask that the adult (18 years of age or older) in your household with the next birthday completes the survey.”

After about two weeks, all households who had not responded with completed surveys online were mailed a paper copy of the survey. The mailing included a cover/reminder letter and a postage paid return envelope. After another three weeks, all households that had not responded with completed surveys, were mailed a reminder letter. Finally, a replacement paper copy of the questionnaire was mailed to all households that had not responded with completed surveys by that time. This mailing went out on January 6, 2020. All mailings were sent First Class mail using physical stamps. Data collection was closed on January 27, 2020.

Response Rate and Data Analysis

A total of 522 completed surveys were received by close of data collection, resulting in a response rate of 18.8%. Of those, 181 were completed online and the remaining 341 were obtained via paper copies. This random sample yielded a margin of error of +/- 4.3 percentage points ($p < .05$). The sampling frame for this survey included all Wyoming households with mailable addresses maintained by the US Postal Services. As a result, this random sample reflects a natural distribution of survey data that closely matches the population in the state, see Table 1.

Table 1. Random-sampled survey responses by county.

County	Frequency	Percent	Valid %	Actual Pop. July 2019
Albany	35	7.0%	7.1%	6.7%
Big Horn	12	2.4%	2.4%	2.0%
Campbell	33	6.6%	6.7%	8.0%
Carbon	15	3.0%	3.0%	2.6%
Converse	5	1.0%	1.0%	2.4%
Crook	9	1.8%	1.8%	1.3%
Fremont	31	6.2%	6.3%	6.8%
Goshen	12	2.4%	2.4%	2.3%
Hot Springs	6	1.2%	1.2%	0.8%
Johnson	8	1.6%	1.6%	1.5%
Laramie	87	17.4%	17.6%	17.2%
Lincoln	18	3.6%	3.6%	3.4%
Natrona	63	12.6%	12.8%	13.8%

Niobrara	3	0.6%	0.6%	0.4%
Park	27	5.4%	5.5%	5.0%
Platte	11	2.2%	2.2%	1.5%
Sheridan	30	6.0%	6.1%	5.3%
Sublette	11	2.2%	2.2%	1.7%
Sweetwater	35	7.0%	7.1%	7.3%
Teton	16	3.2%	3.2%	4.1%
Uinta	14	2.8%	2.8%	3.5%
Washakie	9	1.8%	1.8%	1.3%
Weston	4	0.8%	0.8%	1.2%
Missing	28	5.6%		
	522	100.0%	100.0%	100.0%

In the course of data collection, the completed paper copies of the survey received in the mail were scanned into a database. At close of data collection, the datasets compiled within the two data collection platforms were exported into SPSS software and checked for consistency, missing data, etc., and then merged into a single dataset ready for analysis.

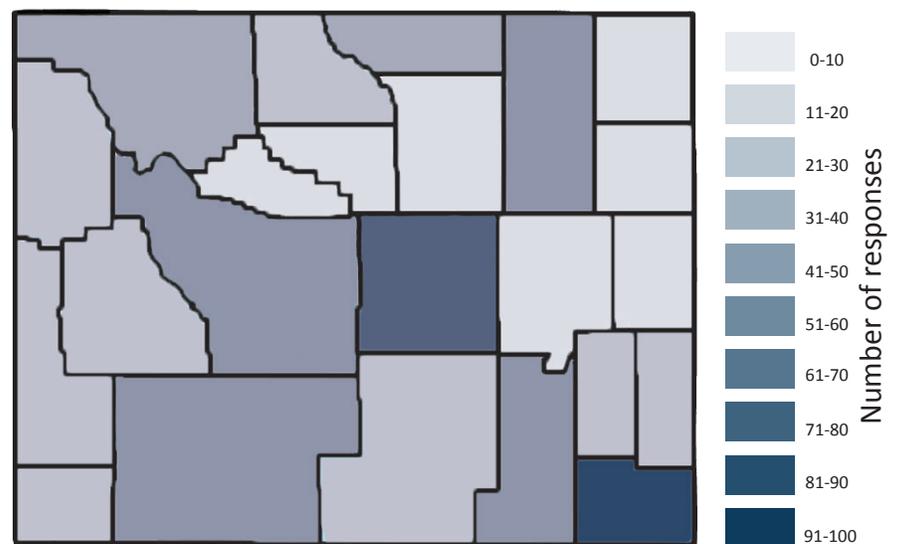


Figure 4. Visual distribution of random-sample survey responses by county. Responses were proportional to the proportion of Wyoming residents in each county.

SURVEY RESULTS

Types of Energy and Mineral Production

We asked Wyoming residents how much they support, oppose, or are neutral/not sure about the range of energy production types and other minerals or energy technologies in Wyoming.

The survey showed that, of the types of energy production in Wyoming, natural gas had the highest level of support, with 82.7% of residents supporting it. Oil was supported by almost 71.0% of residents. Coal was supported by 63.0% of residents in Wyoming, less than both solar (68.6%) and wind (65.5%). Most respondents reported being “not sure” about nuclear energy production (36.5%), followed by just over one-third (35.8%) of residents supporting it, while 27.2% opposed it. This suggests that, with the exception of nuclear, Wyoming residents are generally supportive of any type of energy production in the state.

Of the other minerals and technologies, uranium had relatively low support (43.7%), perhaps due to the fact that Wyoming produces very little uranium and the related labor intensity is also low. Rare earth minerals were shown to have even lower support at 34.2%. Energy storage had higher support (51.9%) than Carbon Capture Utilization and Storage (35.4%), but for all of these technologies, large proportions of residents reported being “neutral/not sure” about them, suggesting that there is a general lack of knowledge and information available about these technologies.

Twelve respondents filled in their ideas for energy production which included hydraulic, geothermal, waste-based, and cold-fusion types of energy.

Wyoming residents' support & opposition for types of energy production

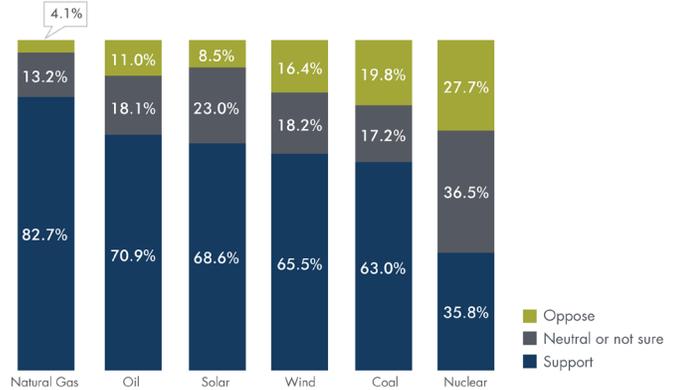


Figure 5. Percentage of Wyoming residents who support, oppose, or are neutral/not sure about different types of energy production in the state.

Wyoming residents' support & opposition for other minerals and technologies

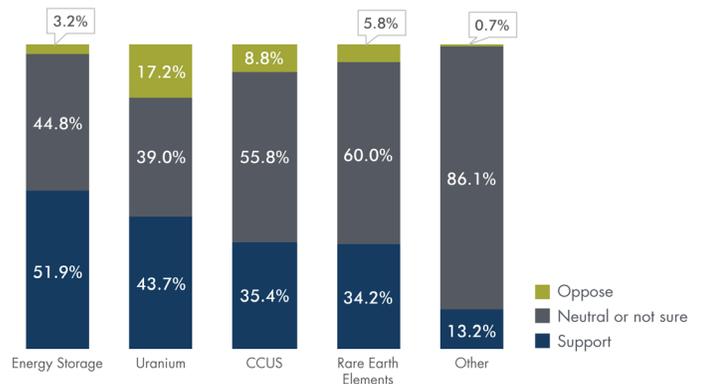


Figure 6. Percentage of Wyoming residents who support, oppose, or are neutral/not sure about other minerals and technologies in the state.

Amount of Energy Development

We asked Wyoming residents about the amount of fossil fuel energy development and the amount of renewable energy development they want to occur in Wyoming. Overwhelmingly, respondents reported wanting both to either increase or to stay at current levels.

Of all Wyoming residents, 58% reported wanting increases in fossil fuel energy operations (including coal, oil, and natural gas) and 16% wanted the current level of production to be maintained. Only 18% of residents said they think fossil fuel energy operations should be reduced.

When asked about the amount of renewable energy development, even more Wyoming residents (70%) said they want the amount to increase and fewer (only 9%) want the amount to be reduced. Another 13% indicated they are satisfied with the current amount of renewable energy in the state.

This broad support for both fossil fuels and renewables suggests that most Wyoming residents do not support one over the other. Rather, they believe that both can and should happen simultaneously in Wyoming.



Wyoming residents' opinions about the amount of fossil fuel development

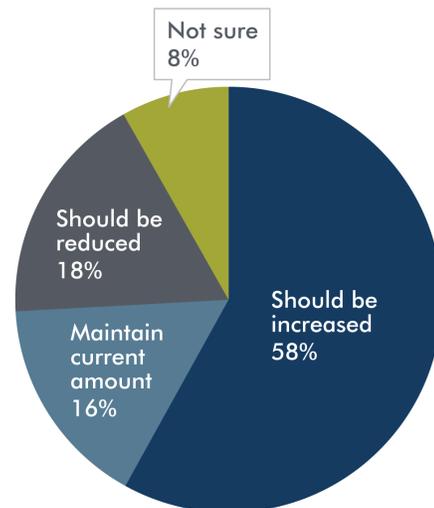


Figure 7. Wyoming residents' preferences about fossil fuel production in the state.

Wyoming residents' opinions about the amount of renewable development

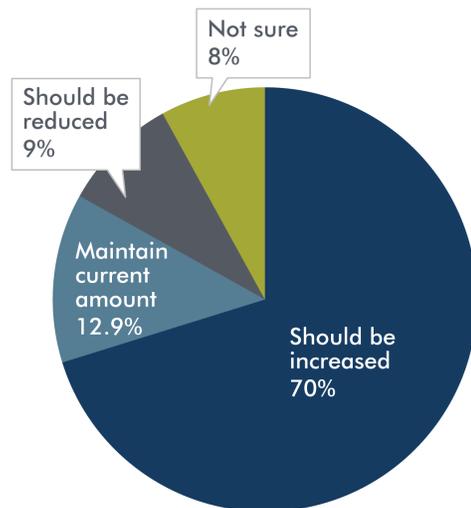
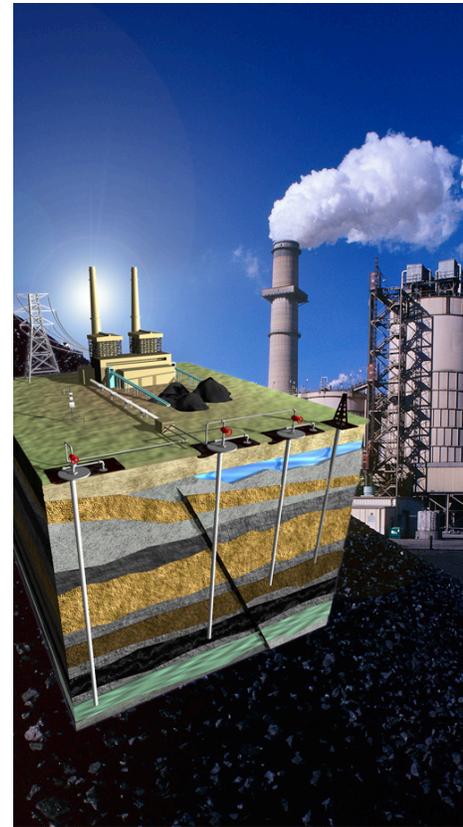


Figure 8. Wyoming residents' preferences about renewable energy development in the state.

Carbon Capture Technology

When asked about carbon capture and storage (CCS) and carbon capture, utilization, and storage (CCUS), more Wyoming residents reported they believe the technologies could have positive impact than those who thought it would have a negative impact overall. Among respondents, 37.8% think that CCS and CCUS are important to keep Wyoming fossil fuels competitive, and 30% think the technologies should be widely adopted as a means of reducing carbon emissions. Far fewer believe that CCS and CCUS are perpetuating fossil fuels instead of promoting renewables (12.9%), could have harmful side-effects (11.3%), or were too expensive to research or invest in (5.7%). Only 2.9% of Wyoming residents agreed with the statement that these technologies are not important and Wyoming should not adopt them.

However, a relatively large proportion of residents (32.2%) reported that they were not sure about CCS and CCUS. This lack of certainty about these technologies was reflected in our earlier survey question about general support or opposition for CCS and CCUS in which 55% of respondents reported being “neutral or not sure” about them. This further indicates that Wyoming residents have not yet formed an opinion about these technologies and suggests that more information is needed for them to be able to evaluate the benefits and risks related to CCS and CCUS.



Wyoming residents' opinions about CCS & CCUS

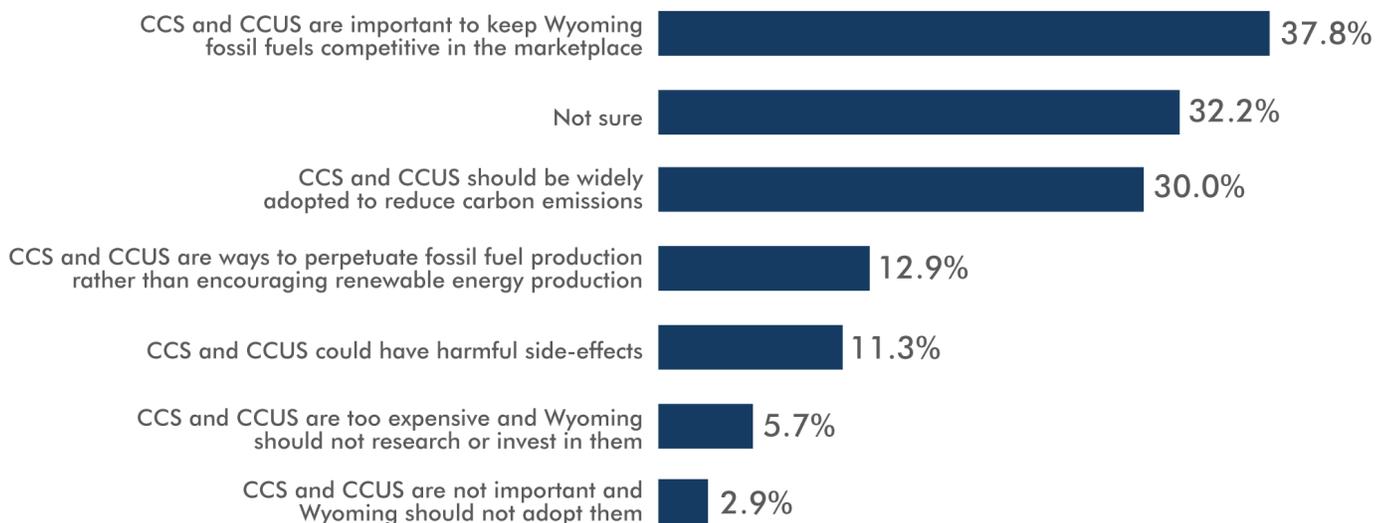


Figure 9. Percentage of Wyoming residents who agree with each statement about CCS and CCUS.

Values

We also asked Wyoming residents to tell us what they value most about Wyoming. They were asked to distribute 100 points among 14 values based on what is most important to them about Wyoming (Figure 10). For example, if a value was most important, they assigned it more points; if a value was not important, they didn't give it any points.

Wyoming residents' values

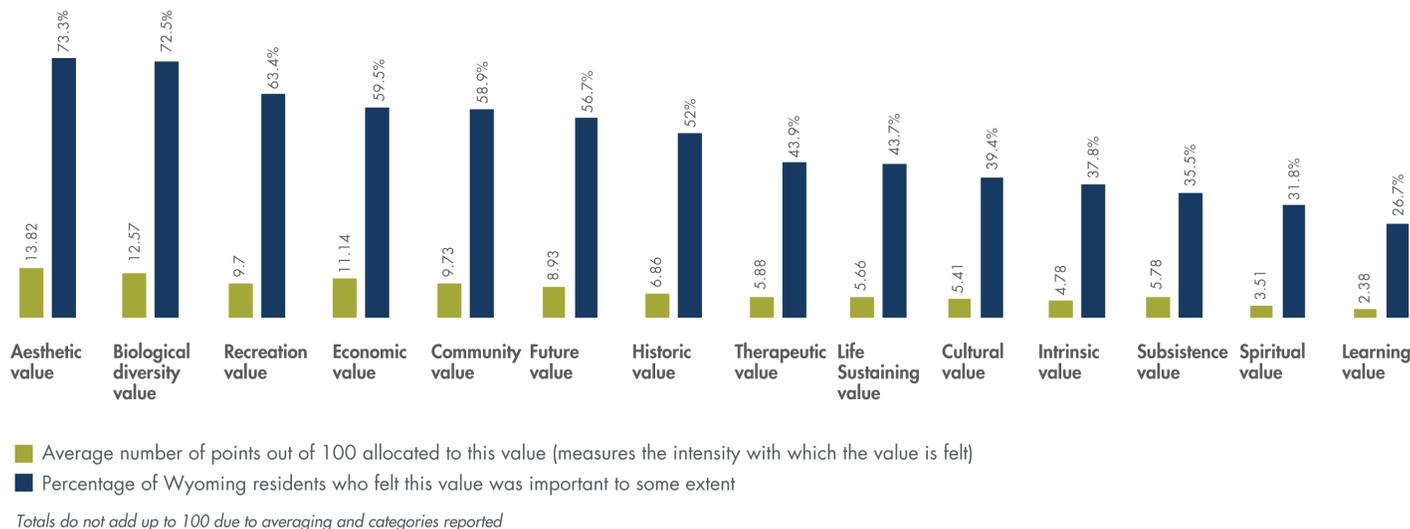


Figure 10. Points allocated to indicate which of fourteen values are most important to respondents.

The five values based on the definitions provided in the survey that the highest percentage of respondents reported as being most important to them are:

- 1. Aesthetics:** I value Wyoming because I enjoy the scenery, sights, sounds and smells, etc.
- 2. Biological diversity:** I value Wyoming because it provides places with a variety of fish, wildlife, plant life, etc.
- 3. Recreation:** I value Wyoming because it provides places for my favorite outdoor recreation activities.
- 4. Economic opportunity:** I value Wyoming because it provides economic opportunities related to minerals, tourism, hunting, manufacturing, energy production, and other sectors.
- 5. Community:** I value Wyoming because it is the location of my community and I wish to preserve that community and its health, security, and welfare.



The top three qualities that Wyoming residents value about Wyoming (aesthetics, biological diversity, and recreation) indicate a strong connection to the characteristics of the landscapes of Wyoming that make it unique—the natural beauty of its open spaces, mountains, and foothills; the wildlife and plant-life that inhabit the landscapes; and access to these places where residents can spend time and recreate. The high importance placed on these values also suggests a place-based identity that is stronger than a production or occupation-based one.

The other top two qualities (economic opportunity and community) show how strongly Wyoming residents value the social and economic structures that make it possible for people to prosper in the state. For people to be able to live in Wyoming, they need to be able to support themselves and their families, and they need thriving communities where they feel safe and supported.

Analysis of differences among demographic characteristics related to energy preferences are shown in Appendix B. Some differences that we found at min. 95% confidence levels regarding energy preferences and demographic information were:

- Respondents favored oil, gas and coal with increasing years in Wy.
- Respondents aged 25-44 supported oil and gas more.
- Respondents with less than 4-year College education supported oil, gas and coal more.
- Men favored uranium, nuclear and rare earth activities more. Women supported solar energy more than men.
- Respondents in higher income brackets supported CCUS, energy storage and rare earth activities more.



The top three qualities that Wyoming residents value about Wyoming indicate a strong connection to the characteristics of the landscapes of Wyoming that make it unique.

EXPLORING TRADE-OFFS: THE Q-STUDY

Following the survey described above, we conducted a Q-study involving interviews and a sorting exercise with 24 individuals who represent the diversity of interests in Wyoming related to energy issues.

Q-Study Methods

Q-methodology explains how participants view trade-offs in a particular situation, in this case current and possible future energy operations in Wyoming. Q-methodology is an interview-based social analysis protocol that provides statistically valid quantitative data identifying the main themes in a discourse, and qualitative data to explain the themes. For example, one Q-study discovered three fundamental perspectives among ranchers regarding range management and the role of government.²⁰ Armatas et al. conducted a Q-study in Wyoming to explore social-ecological vulnerabilities to water resources under climate change conditions and identified four distinct viewpoints: an environmental perspective, agricultural perspective, Native American perspective, and recreation perspective.²¹ The Q-methodology results in this report highlight the dominant perspectives key stakeholders hold regarding energy types and their trade-offs for Wyoming. It is a method that seeks to clarify the range of subjectivity in a discourse, and the reasons for the varieties of subjectivities within that range.

Q-studies are regarded as one of the most scientific interview protocols available because they are replicable and generate statistically valid results. Q-studies have been applied in a variety of public lands and natural resource planning contexts. For more information about the application of Q-study methods, see further Addams and Proops²² and McKeown and Thomas.²³ Q-study results can serve as both a starting point for collaborative dialogue and provide the sideboards for what conditions and objectives are acceptable.

For this study the first step was to invite the potential interviewees identified by participants in the elicitation study (See page 10). Although the survey was stratified by gender, the invitations to participate in this study were based on the individuals who were suggested to us in the elicitation study, and not stratified for gender. Invitations were sent by email to diverse stakeholders who are professionally involved in Wyoming's energy discourse. Follow-up telephone calls were made a maximum of three times to explore individuals' willingness to participate and to find a convenient time for them to be interviewed. We found the factors affecting participation, included: a) the interviews were conducted during summer months when some invitees were taking vacations, and (b) the interviews were conducted during the COVID-19 pandemic, which created an abnormal and often stressful situation for many balancing work and personal lives.

²⁰ Lien A., Svancara C., Vanasco W., Ruyle G. and L. Lopez-Hoffmn (2017). The Land Ethic of Ranchers: A Core Value Despite Divergent Views of Government. *Rangeland Ecology and Management* (2017) 70: 787-793.

²¹ Armatas C., T. Venn and A. Watson (2016). Understanding social ecological vulnerability with Q-methodology: a case study of water-based ecosystem services in Wyoming, USA. *Sustainability Science* (2017) 12: 105 - 121

²² Addams, H., and J. Proops (2000). *Social Discourse and Environmental Policy*. Northampton, MA, Edward Elgar Publishing Inc.

²³ McKeown B. and D. Thomas (2013). *Q Methodology*. Sage Publishing.



Table 2. Terminology used in this study.

Terminology	Description
Q-Methodology	A method used to quantitatively and qualitatively measure subjectivity within a discourse.
Discourse	A conversation regarding a particular topic or issue. In Q-methodology the data set and subject of analysis is the discourse rather than a population of people.
Q-Study	A study using Q-methodology.
Q-Sort	The placement of cards in the format featured in Figure 11. Each card contains a statement that represents an opinion within a discourse.
Q-Sample	The collection of statements on cards used in a Q-sort.
P-Sample	The participants in a Q-study. Each participant is a stakeholder who represents a particular voice within a discourse.
Factor Analysis	A statistical method that correlates Q-sort responses into groupings or factors. Each grouping of statements is mathematically unique from other groupings.
Factor	A statistically identified group of statements.
Theme	A main perspective within a discourse that is associated with a factor.
Variance	Variance is the percentage of the discourse that is explained by a theme, whereby all themes together provide an understanding of Wyoming’s energy economic discourse.

The resulting 24 interviews were conducted during August and September of 2020. Each interview took on average 45 minutes.

Next the Q-sample of statements was prepared. To prepare the Q-sample, the Ruckelshaus Institute used the language provided by respondents to the survey, specifically their answers to the open-ended question, “Is there anything else you would like to tell us about Wyoming’s energy future and what you would like to see happen and/or not see happen in the next 20-30 years?” As a result, the language used in this study is rooted in Wyoming’s energy discourse using statements taken directly from Wyoming residents.

Participants	Professional Field	Participants	Gender
8	Industry	15	Male
4	Government	9	Female
1	Agriculture		
6	Conservation		
2	University		
1	Recreation		
2	Utility		

Table 3. Q-study participant professional fields and gender.

From an initial list of 98 statements, which were allocated into 27 categories, 36 statements were selected (see Table 6) using the following criteria:

1. The final Q-sample needed to include statements from all 27 categories.
2. Each statement had to use as much as possible the original, place-based language (although some editing was sometimes necessary such as sentence structure for clarity).
3. Each statement had to be clear, while including the original complexity to reflect the trade-offs in residents' minds.

Once interviews were scheduled, each participant conducted the Q-sort exercise online before the interview. Figure 11 shows what a resulting Q-sort looks like. Participants were asked to place the 36 statements in the arrangement shown in Figure 11, from Strongly Agree (5) to Strongly Disagree (-5). In this exercise it is important in what column a statement is placed, not the row. A Q-sort reflects the amount of agreement or disagreement a participant attached to each statement. Each statement is identified in the Q-sort with a specific number. In Figure 11, the diagram of Q-sort exercise is shown with an example of the grid on which the participant has placed the 36 numbered statements. After completion, this is what a participant's Q-sort might look with each number representing to a different statement, and this is the data used for the quantitative analysis.

After each Q-sort exercise, interviews (see questions in Appendix C) were conducted to explore the deliberation process and the trade-offs involved for each participant in deciding where to allocate the statements in the Q-sort based on the format in Figure 11. Both the Q-sorts (quantitative data) and the interview (qualitative data) were used in the final analysis. This process reflects the internal deliberation a person goes through on any subject and captures the internal subjectivity of the participant and the context in which their deliberation takes place.

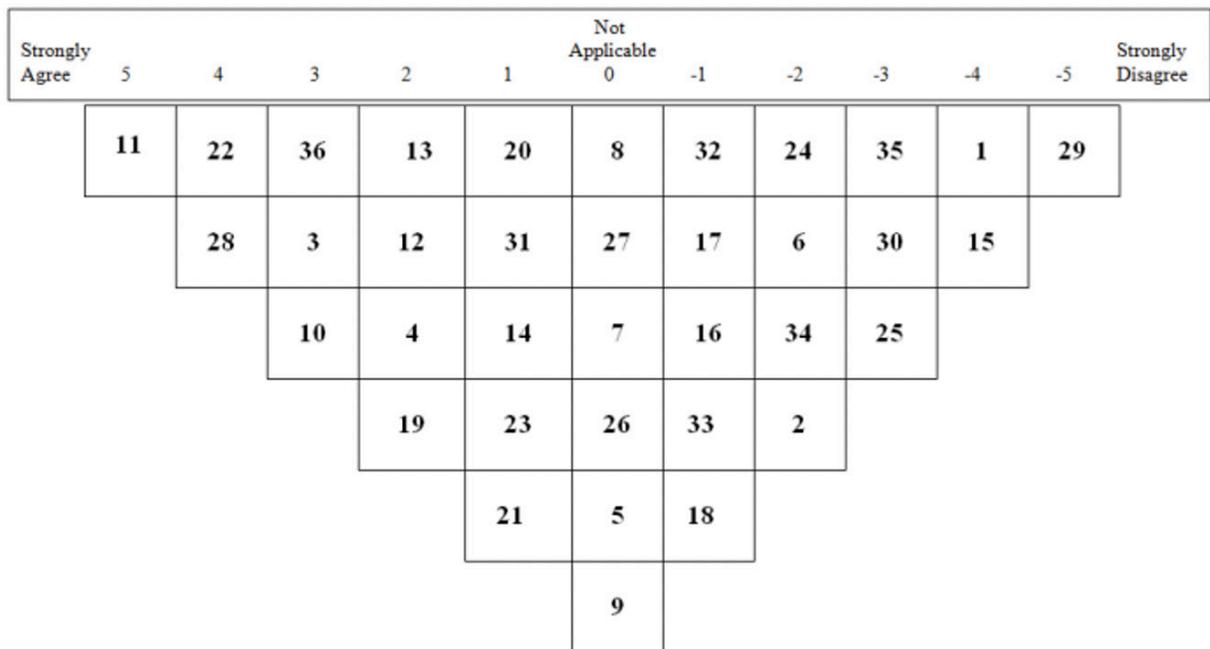


Figure 11. Diagram of Q-sort exercise showing grid on which participants must place 36 statements. This figure represents an example of how a participant's Q-sort might look after completion. Each number correlates to a different statement. The Q-sort reflects where the participant ranked each statement.

The purpose of the Q-study is to explore the main themes in a discourse. To be able to do this, we use principal components analysis to draw out statistically valid factors, where each factor represents a theme in a discourse. In this case the discourse addresses Wyoming’s energy future. To find these themes, the 24 resulting Q-sorts were loaded into PQMethod software, which uses principal components analysis to generate factors, or themes. The themes are derived from the numerical placement of the statements in each Q-sort on the continuum from -5 (strongly disagree) to 5 (strongly agree). Each theme resulting from PQMethod software is formed by a group of statements that correlate with each other. Resulting themes are also significantly different from each other.

Q-Study Results

Three themes resulted from the analysis, together explaining 68% of the variance (see Table 4) in the entire discourse. The three themes to some degree accept all energy types, and most types of energy and non-energy related economic diversification. Each theme however has a different emphasis: the first emphasizes renewable energy, the second emphasizes the economy, and the third emphasizes quality of life factors. Table 5 provides the main characteristics of each theme and Table 6 provides an overview of how each statement was ranked on average in each theme. Rankings run from strongly agree (5) to strongly disagree (-5).



Table 4. Statistical characteristics for themes regarding Wyoming’s energy future. Themes were derived through factor analysis from a ranked-order exercise and interviews of 24 participants across stakeholder groups throughout Wyoming, in summer and autumn 2020. Sorts represent the number of participants that loaded significantly ($p < 0.05$) onto a given theme. Composite reliability quantifies confidence in a perspective. Variance is the percentage of the discourse that is explained by a theme, whereby all themes together provide an understanding of Wyoming’s energy economic discourse. The lower the standard error, the more representative the sample is of Wyoming’s population.

	Eigenvalue	Sorts	Composite reliability	Variance explained (%)	Standard Error of Factor Z-scores
Renewables	10.56	14	0.98	42	0.132
Economic	4.32	8	0.97	19	0.174
Quality of Life	1.48	2	0.89	7	0.333

A Q-study forces participants to choose which statements they most agree and disagree with. It also forces participants to rank the remaining statements as best they can with this strict format. As a result, Q-methodology shows us the prioritization of the statements for each participant whereby the higher numbers indicate clear agreement or disagreement. The middle numbers are whatever the participant holds the statement to be, which may include neutrality, uncertainty, mild agreement, or mild disagreement. Therefore, we followed up each Q-sort exercise with an interview to find out what participants' reasons were for statement placement. The importance of the qualitative data is to help clarify this subjectivity.

The PQ-Method software used for the analysis provides a list of distinguishing statements whose rankings are statistically significant in each theme. The table in Appendix D reflects the distinguishing statements for each theme, that is, the statements that quantitatively emerged as unique to that theme.

When we then also look at the participants whose Q-sort contributed to a theme, both negatively and positively, we gain a picture of how the trade-offs are evaluated in a theme, and why. This has been summarized in Table 5.

It is also important to remember that “variance” (see Table 4) in this study refers to the amount of the discourse that can be explained by each theme, NOT that the theme is more or less dominating for Wyoming. The variance and these results describe a discourse, not a population of people. All three themes are relevant in this discourse.



“

A Q-study forces participants to choose which statements they most agree and disagree with.

Table 5. Characteristics of energy themes in the Wyoming discourse.

1. Renewable Theme	2. Economic Theme	3. Quality of Life Theme
<p>Renewable: Strongest support for renewable energy types.</p> <p>Conventional: Conditional support for conventional energy types.</p> <p>New technology: Supportive.</p> <p>Nuclear energy: Least support.</p> <p>Economic diversification: Supportive. The need for economic diversification is important in this theme. Proactive embracing of market realities in order to be less economically vulnerable.</p> <p>Climate Change: Clearly acknowledged and a factor driving choices. Climate change concerns in other states also seen as motivation to invest in new technologies.</p> <p>Concerns: In this theme the strongest support was evident for proactive planning to ensure a “soft landing” for communities and families affected by a transition away from conventional energy. Only theme supportive of taxing wealthier residents. Wary of carbon capture and storage as a way to perpetuate conventional energy activities they believe are in decline.</p>	<p>Renewable: Supportive of renewable energy types.</p> <p>Conventional: Strongest support for conventional energy types.</p> <p>New technology: Supportive.</p> <p>Nuclear energy: Mildly supportive.</p> <p>Economic diversification: Supportive. The need for economic diversification is important in this theme. Proactive embracing of market realities in order to be less economically vulnerable.</p> <p>Climate Change: Clearly acknowledged but not driving choices. Climate change concerns in other states seen as motivation to invest in new technologies.</p> <p>Concerns: Strongly supportive of energy and economic diversification, technological advances such as carbon capture and storage, and conventional energy as a bridge to renewable and nuclear energy activities. There is concern in this theme that Wyoming is moving too slowly to adapt to outside market-driven dynamics, at the cost of Wyoming’s economy.</p>	<p>Renewable: Conditionally supportive of renewable energy types.</p> <p>Conventional: Conditionally supportive of conventional energy types.</p> <p>New technology: Conditionally supportive.</p> <p>Nuclear energy: Conditionally supportive.</p> <p>Economic diversification: Conditionally supportive.</p> <p>Climate Change: Clearly acknowledged but not driving choices. Climate change concerns in other states acknowledged.</p> <p>Concerns: This theme is supportive of all energy types, technology, and economic diversification but seriously questions the trade-offs in terms of jobs, healthcare, communities, and wildlife. For example, in this theme, demands in other states due to climate change are acknowledged and there is concern for the costs to Wyoming of meeting those demands.</p>

Table 6. Three themes emerged from the principal components’ analysis, each representing a theme in the discourse regarding the future of Wyoming’s energy economy. Statements used to characterize and delineate perspectives that exist across stakeholders (n = 24) regarding Wyoming’s energy economy in 2020. Factor ranking indicate Q sorts that represents where participants ranked a statement along a scale from strongly agree (5) to strongly disagree (-5). The z-scores are untransformed values that form the basis for the factor rankings.

#	Statement	Renewable		Economic		Quality of Life	
		z-score	Factor ranking	z-score	Factor ranking	z-score	Factor ranking
1	Would like to see sustained growth of all energy industries in an environmentally sound way to benefit the entire state, it’s people and most of all, with the protection of its landscapes.	0.37	0	1.11	3	0.24	1
2	Carbon capture could help and I would like to see the universities evaluating that technology.	-0.39	-1	0.64	1	0.51	1
3	I don’t want Wyoming to be “used” and left with problems from industries that operate in energy development.	0.56	1	-0.25	-1	-0.33	-1
4	It is critical in the next 20-30 years to curb greenhouse emissions and to invest in developing and implementing technologies to reverse the adverse effects of man-made pollution on air, climate and water.	1.42	4	-0.19	0	-0.70	-2
5	Climate change is a hoax. It is equivalent to howling at the moon.	-1.89	-5	-1.70	-4	-2.07	-5
6	Coal and natural gas export should be developed and pipelines built for a significant income for Wyoming.	-1.27	-3	0.69	1	0.00	0
7	I would like to see economic diversification so one means of energy production does not stop our state dead in its tracks when that method phases out. And they will phase out. Everything has a shelf life.	0.98	3	1.76	5	-0.39	-1
8	We must diversify our private business streams such as expanded IT infrastructure, data centers, space-based telecommunications. We must attract more business and reduce resistance to change. We must be forward thinkers instead of reactionary thinkers.	0.99	3	1.03	2	-1.05	-3
9	We need to flex our energy muscles and not only provide clean, cheaper energy but also take some of the power from Washington, DC, by reducing reliance on Federal dollars (control) of this amazing state.	-1.29	-3	-0.82	-2	0.72	2

10	Extraction of coal and oil is a must. Wyoming banks on it! We need to keep it flowing.	-1.70	-4	0.57	1	0.21	0
11	We can't completely abandon fossil fuel products but climate and cultural realities will change the future of energy products. Wyoming would be wise to adjust to that reality now as opposed to later.	0.80	2	0.96	2	-0.84	-2
12	No one pays the least attention to the most important metric in the energy calculus: conservation. It's easy, it's cheap and it's on the shelf right now.	0.21	0	-1.05	-3	0.45	1
13	I would like Wyoming to continue to be a leader in hydrocarbon technology and production and move towards nuclear energy production.	-0.96	-2	0.42	1	0.27	1
14	More nuclear, coal, hydro, and gas. Less renewable.	-1.86	-4	-0.94	-2	0.72	2
15	The future of energy in Wyoming, America and the world is dependent on the equal development of nuclear energy, renewable energy along with the contained mining of sustainable fossil fuels.	-0.43	-1	1.60	4	-0.72	-2
16	Wyoming has an amazing opportunity in oil and gas development and the world is going to need them for a long time.	-1.23	-3	0.97	2	0.00	0
17	Wyoming is a prime state for wind and solar. My generation is a lost generation with regards to fossil fuel energy. We must now focus on the next generation. Hopefully it is not too late.	0.51	1	-0.79	-1	1.02	3
18	Change net metering laws to allow for more home generation of electricity.	0.68	1	-0.17	0	-1.74	-4
19	Each house could have a turbine or a solar panel so that these big wind farms are not needed.	-0.01	0	-1.26	-3	-1.74	-4
20	We need to build dams everywhere it's possible and get more hydro power and the other benefits of dams such as recreation and irrigation water.	-1.11	-2	-1.37	-4	-0.24	-1
21	Most forms of "green" energy need storage. This needs to be developed and encouraged with research funding at our universities and businesses.	0.54	1	0.15	0	0.18	0
22	We can succeed by using new technologies to capture and control emissions including the nuclear waste stream. Coal emissions can also be captured better. Wyoming should	-0.76	-2	1.38	3	0.51	1

	continue to help in the development of clean coal technology.						
23	Wyoming has an opportunity to develop, market and implement new technologies to advance current and new energy sources. We should use our university and any other ‘think tanks’ to be creative in our approach to our energy future,	0.74	2	1.42	3	1.87	4
24	I would like to see more involvement in nuclear power generation in Wyoming	-0.74	-2	-0.29	-1	0.84	2
25	I would like to see energy developed in Wyoming in a way that creates jobs and safe-guards displaced workers with job training and other appropriate safety nets.	0.96	2	0.78	2	1.95	5
26	The only thing we need to work on is better health care insurance so our young people can build a business and have a family in Wyoming.	-0.32	-1	-1.73	-5	1.05	3
27	We need implementation of energy programs that don’t change our state’s lands and aesthetic values.	0.19	0	-0.07	0	-1.11	-3
28	Wyoming State Legislature should legislate a meaningful renewable energy plan. The technology exists. We need renewable energy vision and commitment in Cheyenne.	1.58	4	-0.81	-1	-1.17	-3
29	Wind power still requires natural gas backup pipelines which then creates an environmental land footprint which is hard to rehabilitate when and if the wind energy plant is moved or terminated. Wind power is not efficient yet.	-0.65	-1	-0.64	-1	-0.06	0
30	State revenues are a concern as fossil fuel extraction fades. We're going to have to start taxing the people who can afford it, otherwise the state won't be able to function.	0.96	2	-0.91	-2	-0.21	0
31	Market trends that are driving a transition away from coal to natural gas and renewable are beyond our control. Adapt, change, and grow into the new markets that are emerging. This implies helping those communities who will be disrupted with the transition.	1.76	5	1.54	4	-0.45	-1
32	Wyoming needs to wean itself off coal and coal production. Natural gas should act as a bridge fuel in the coming decades to get us, the US, to sustainable and more environmentally-friendly forms of energy production.	0.62	1	-0.88	-2	1.17	3

33	Developing a new information-based economy is unrealistic. The related population growth would transform Wyoming into a Colorado or a Utah and would be met with resistance and strife.	-0.65	-1	-1.15	-3	0.93	2
34	Lessen impact on wildlife (i.e. migration corridors and breeding and birthing areas.) This goes for wind and solar as well as gas and oil.	1.02	3	-0.22	0	1.74	4
35	Responsible production/extraction but not at all cost. I would hope to see all wildlife continue to flourish.	0.46	0	0.18	1	-0.66	-1
36	Minimization of visual pollution regarding immense wind turbine fields There needs to be recycling advancements and tear-down strategies to recapture the land and visual expanses.	-0.12	0	0.04	0	-0.90	-2

Theme One: Renewable Emphasis

This theme clearly reflects the viewpoint that embraces renewable energy wholeheartedly and does not see conventional energy types as sustainable. Statements that ranked highest within this theme reflected grave concern regarding climate change, a desire for proactive measures by Wyoming’s legislature regarding renewable energy, and enthusiasm for the role that technology can play in addressing climate change as well as in economic diversification. This is the only theme that supports “taxing the people who can afford it” (statement 30), and the one theme that does not embrace carbon capture or other waste-capture methods as a solution. Responses within this theme strongly disagreed with the statement 22, “We can succeed by using new technologies to capture and control emissions including the nuclear waste stream. Coal emissions can also be captured better. Wyoming should continue to help in the development of clean coal technology.” As one respondent said: “I’m not opposed to carbon capture technology but not as a way to keep coal plants going.”



The statements that ranked lowest supported conventional energy. Participants in this theme disagreed with the need to reduce reliance on “Federal dollars (control)” (statement 9) and strongly disagreed with statement 5 that rejected climate change. Where the other two themes reflected mild to serious interest in nuclear energy, this theme regarded it with caution at minimum, and at most with outright rejection. As one cautious participant said, “Nuclear energy does have a role in renewable energy, but I’m more interested in small scale than large scale production.”

Participants in this theme were frustrated with the support for conventional energy, mentioning taxes on wind, tax breaks for drilling rigs, and zoning restrictions that make wind farms impossible. However, although participants in this theme did not support conventional energy types per se, participants in this theme did acknowledge the importance of these energy types in the short term to transition into renewable energy. In this theme the phrase “just transition” was often used to express a desire for a “soft landing” for communities and workers that will be affected by a transition away from conventional energy.

In this theme a similar frustration was expressed as in the economic theme below, that is, the perception that Wyoming is not acting proactively regarding its energy economy. Being proactive in this theme included support for household solar and wind. For example, one participant argued in favor of “removing the cap on net metering. It’s the least impactful energy in relation to viewsheds, wildlife, landscapes. It would simultaneously create so many jobs and small businesses around the state. We are one of the most limiting states for onsite solar. We could get all kinds of manufacturing opportunities related to rooftop solar. It would send a message to young tech-savvy people instead of the message that Wyoming rejects the future.” In the economic theme also, participants raised the desire to bring or keep young people in Wyoming.

It is important to note that one participant (the one person in this theme connected to conventional energy) in this theme ranked the statements almost the exact opposite of other participants: the statements that others placed positively, this person placed in the exact opposite location. This one participant who loaded negatively on the renewable theme expressed views often heard in Wyoming. This person was not persuaded that climate change is human-caused, nor that renewable energy types can take the place of conventional energy types. This person desired to see more innovation and investment go to conventional energy sources rather than renewables and was concerned that conventional energy is being “demonized while (they are) being so reliant on” it. This participant was concerned that regulatory agencies “are catering to an uninformed popular opinion” and are “propping up something that ultimately will not prove to be viable... We heavily subsidize wind and solar based on the current technologies of the last decade or more, but we could have those same resources be expended on technologies, say carbon capture, on fossil-based energy generation.”

This participant provides a perspective we heard more frequently in our survey comments, from individuals who are dependent on Wyoming’s energy economy but who are not decision makers or policy leaders. The analysis shows that this person is an important contributor to this theme through opposition. For example, this participant opposed subsidies for wind energy, while other participants opposed subsidies for conventional energy. And yet, in this theme, all participants argued for a “level playing field.”

Theme Two: Economic Emphasis

In this theme there is a more positive outlook regarding conventional energy, based on the history of oil, gas, and coal in our state. In this theme there is the belief that although markets now are increasingly tilting towards renewables, there is a significant role for conventional energy forms for some time to come, and they can continue to contribute meaningfully to Wyoming’s economy.

Here, too, there is a great interest in economic diversification beyond and within the energy sector. In this theme, one of the statements that participants most disagreed with was #5: “Climate change is a hoax. It is equivalent to howling at the moon.” Participants also strongly believe that technological advances will improve the storage and delivery of energy, decrease atmospheric carbon, and increase economic fortunes for Wyoming. Many participants in this theme believe that carbon capture and storage will decrease carbon levels in the atmosphere, and some feel it will also improve oil production and facilitate continuing use of coal for energy. Nuclear energy is viewed somewhat positively in this theme, as a way to emit less carbon.

The positive attitude in this theme towards conventional energy is based on the belief that it can continue to deliver economic benefits to Wyoming and the world, but with an understanding that there are limits to these



resources. The role of conventional energy for many of these participants is to create a bridge to a more diverse energy economy that includes renewables, while also diversifying the economy in general. Additionally, the decrease in market demand for conventional energy, especially coal, was acknowledged. Hence participants in this theme are interested in renewable energy and slightly interested in nuclear energy.

Participants in this theme strongly favor the creation of information-based industries as a way to diversify Wyoming's economy (statement 33). Participants in this theme most strongly disagreed with the statement that "The only thing we need to work on is better health care insurance so our young people can build a business and have a family in Wyoming" (statement 26). Although in the survey this statement was connected for some participants to Wyoming's energy fortunes, for the participants in this theme it was certainly not the "only" need, nor does it have "any role in our energy future."

The role of markets is emphasized in this theme. For example, one participant stated, "Whether you believe in climate change or not, climate change is real to a lot of customers so we better find products that they want." Another opportunity that was mentioned repeatedly in this theme is the desire to realize more value out of Wyoming's resources. The frustration we heard in the first theme emerged in this one as well. As one participant put it: "In a lot of ways we are like a third world country. Outside countries come in and mine our resources and ship them outside the state and all we get is the severance tax off of those. We don't really realize the benefits of those minerals. This (creation of more value) should have happened 40, 50, 100 years ago."

Another participant put it this way: "Wyoming is a net exporter of power, of energy. As such we are at the whim of those we export to. Whether it's electrons in the six-state compact, where the states dictate how the electrons are generated, whether it's the ports on the west coast for our coal getting out of here. Too often we have overlooked the fact that what happens outside of Wyoming has a direct impact to what happens inside of Wyoming relative to our export of power. And I would change our willingness to be so introverted and accept the fact that things that happen outside of our border...because we are reliant on those outside of our border to buy our raw product or our electrons, we have to do it in a manner that the client wants and I think we have missed an opportunity to accept that and be more cognizant of what's going on outside of Wyoming." In this theme it was striking how participants often discussed the future of Wyoming's energy economy by first referring to the past when chances were missed. For example, "if we had done something 10 years ago, maybe now it's too late. In relation to coal 10 years ago, we were fighting climate change, weren't being proactive. If they could have been less in denial, at least hedge bets through risk management." The future in this theme is where the energy economy and Wyoming's economy is very diversified, new advances in technology are embraced, Wyoming is less reliant on resource exports, and more value is created within the state.

Theme Three: Quality of Life Emphasis

The most agreed with statements in this theme are concerned with quality of life issues: jobs, job training (statement 25), impacts on wildlife (34), and healthcare availability (26). In this theme there is a strong belief that advances in technology will reduce waste such as carbon and improve the energy economy. This theme also has the highest trust in the opportunities that nuclear energy could bring to the state.

The less disagreed with statements in this theme often reflected a lower priority to participants, rather than outright objection. One exception was statements supporting net metering. Participants in this theme felt that statement 18:



“Change net metering laws to allow for more home generation of electricity” and 19: “Each house could have a turbine or a solar panel so that these big wind farms are not needed” simplified a complex issue too much and did not accurately reflect what they felt were the real issues. As one participant said about these statements, “You have to have a level of knowledge to evaluate these statements. The general public doesn’t know really about net metering. The public doesn’t know the technologies, the trade-offs, the cost implications, or how the \$2.2 billion-dollar shortfall happened.” The statement participants in this theme most strongly disagreed with was, “Climate change is a hoax.”

An important concern in this theme centered around costs and who would be paying for changes in energy delivery. In this theme it was important to participants that consumers receive reliable energy at low cost, with a special concern for more vulnerable populations. Additionally, it is important to these participants that “Wyoming maintain its position as the nation’s energy leader.”

If quality of life issues are important in this theme, the views on how to achieve a good quality of life for residents in Wyoming differed. One participant expressed the desire to continue focusing on coal: “Wyoming does an excellent job at extraction and production, for example coal reclamation. Wyoming does environmentally safe extraction.” Additionally, this participant addressed the meaning of “energy transition” that “for others it means going from dirty systems to cleaner systems. For me it is about the impacts of transition costs and about reliability, from baseload to intermittent resources. What is the cost of those resources, what is the reliability of those resources? How to mesh intermittent energy with transmission grid not built for it, or designed?”

For another participant the future was more dependent on “a better reception across the board at legislative and regulatory levels of the opportunities to diversify Wyoming’s economy. It doesn’t have to be either/or. Wyoming’s energy economy can embrace all types of energy from fossil, thermal generation to renewable generation. All types of investment in Wyoming really requires support of all stakeholders, local, regional, state, and federal levels to ensure that these projects are successful in bringing value not only to the state but to all consumers across our nation. That level of support at all levels is critical to ensuring that these projects are not only developed but remain successful at bringing jobs and tax revenues at state and local levels. Without these investments we are experiencing a challenge in the economic involvement and recruitment of large industries and there’s an opportunity here for revenues and jobs for the state.” To recruit these industries, this participant felt it critical that the state needs business executives with a proven record in business expansion, recruitment, and retention.

Participants mildly agreed or disagreed with statements addressing an information economy, visual pollution related to wind turbine fields, economic diversification, and aesthetic values. The interviews indicated that this does not necessarily reflect agreement or disagreement but more that these issues are of less concern in this theme.

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An important concern in this theme centered around costs and who would be paying for changes in energy delivery.



Commonalities Among Themes

In this Q-study, there was consensus on eight statements across the three themes in the discourse. (see Table 7). All three themes reflected agreement regarding the need to lessen impacts on wildlife, the desire for an energy economy that safeguards jobs and displaced workers, and the need for energy storage development for renewable energy. The statements that all three themes generally disagreed with reflected disbelief in climate change and the need to build hydro-electric dams. Although Q-study participants acknowledged the importance of dams to agriculture and recreation, building more dams was questioned and building them “everywhere” was opposed by all. Two statements regarding wind energy were placed in the middle by all three themes: the need to minimize visual pollution and recycle materials, and that wind energy is inefficient.

Table 7. Consensus statements among the three themes.

No. Statement		Themes		
		1	2	3
	Statements disagreed with in all themes	Ranking between -5 and 5		
5	Climate change is a hoax. It is equivalent to howling at the moon.	-5	-4	-5
20	We need to build dams everywhere it’s possible and get more hydro power and the other benefits of dams such as recreation and irrigation water.	-2	-4	-1
Statements ranked in the middle for all themes				
21	Most forms of “green” energy need storage. This needs to be developed and encouraged with research funding at our universities and businesses.	1	0	0
29	Wind power still requires natural gas backup pipelines which then creates an environmental land footprint which is hard to rehabilitate when and if the wind energy plant is moved or terminated. Wind power is not efficient yet.	-1	1	0
36	Minimization of visual pollution regarding immense wind turbine fields. There needs to be recycling advancements and tear-down strategies to recapture the land and visual expanses.	0	0	-2
Statements agreed with in all themes				
23	Wyoming has an opportunity to develop, market and implement new technologies to advance current and new energy sources. We should use our university and any other “think tanks” to be creative in our approach to our energy future.	2	3	4
25	I would like to see energy developed in Wyoming in a way that creates jobs and safe-guards displaced workers with job training and other appropriate safety nets.	2	2	5
34	Lessen impact on wildlife (i.e. migration corridors and breeding and birthing areas). This goes for wind and solar as well as gas and oil.	3	0	4

Discussion of Themes

These three themes reflect different emphases on the same subject: directly, the participants were discussing the future of Wyoming's energy economy, and indirectly they were speaking to the future of Wyoming's economy generally. In the survey also, our 522 respondents connected Wyoming's energy economy to its future generally.

It is remarkable how much agreement emerged between the survey respondents and these themes. The 522 survey respondents represent a wide range of demographic characteristics, and yet energy is a subject relevant to most of them in some way: only 54 could not name some type of energy operation in proximity to where they lived. The 24 participants in the Q-study are individuals who are intimately involved in Wyoming's energy economy and are all in some way very active in this discourse at a leadership or policy level.

There is agreement across survey respondents and Q-study participants that:

1. Wyoming needs to use all the tools in its toolbox: there may be a small percentage of people who have strong preferences for a particular energy type, but by far the majority wants to look at all ways of boosting the energy economy and the economy in general.
2. The retention and creation of jobs and job security is a top priority. Survey comments and Q-study interviews indicate a concern for workers, families, and communities that are connected to conventional energy sources that are either in decline, such as coal, or vulnerable, such as during a pandemic. Many mentioned the need for training programs and other job security measures.
3. In Wyoming, climate change is generally an accepted concept. Among the Q-study participants, there was strong disagreement that climate change is a "hoax." The interviews and the comments in the survey indicate that far from rejecting climate change, Wyoming residents generally feel that using it to an economic advantage—and for many also an environmental one—will benefit the state.
4. Wyoming should pay attention to what customers outside its borders are willing to pay for and the reasons for those desires. Catering to those customers could improve Wyoming's economy.
5. There is a high level of interest in developing technologies or recruiting industries with technology that can allow Wyoming's energy economy to evolve into a more resilient and sustainable situation.
6. There is also a high level of interest in recruiting or developing non-energy related economic activities such as an information-based industry.
7. There is cautious support with an interest in more information for both nuclear energy and carbon sequestration. Because in Wyoming residents want all tools in the toolbox used, they are not willing to throw out any ideas, but they need more information on these subjects before they will grant a higher level of social license.
8. In the Q-study there was agreement on the need to decrease impacts on wildlife.



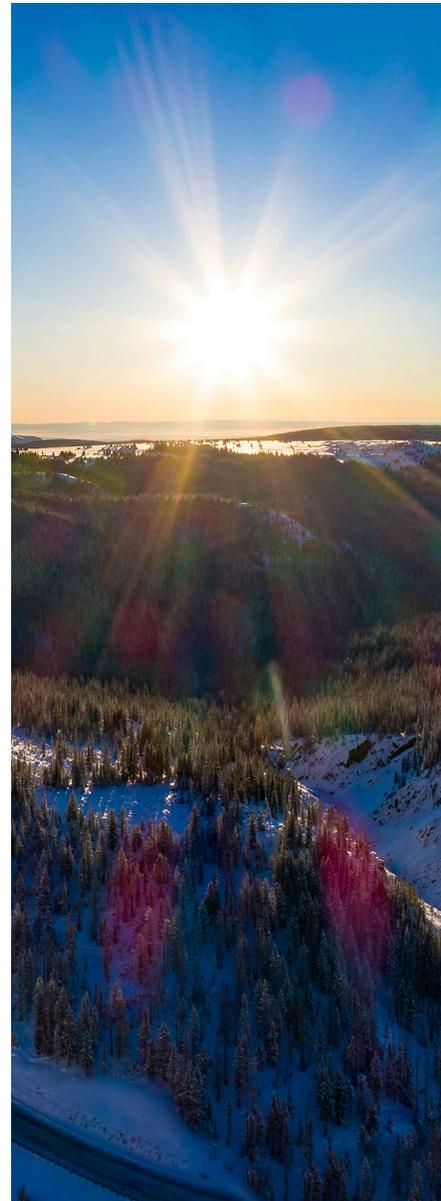
Three Approaches to Wyoming's Energy Future to Consider

Where the three themes and our survey respondents differ is in the approach to a more robust and resilient energy economy and economy in general. The Q-study provides clarification to what those differences are in the three themes.

The first theme sees renewable energy, with some limits, as key to that future. As we found in the survey's qualitative data, in this theme participants tied environmental health and economic health together. Climate change, wildlife, and resilient natural landscapes were a high priority for these participants. These participants integrated economic values to environmental ones, believing that climate change is a real threat and therefore our means of energy production must change. Decreasing conventional energy is seen as a given which the state should adjust to because in this theme the dangers of climate change outweigh the economic benefits. Tied to this are the economic benefits that can be gained from renewable energy and related activities. On the other hand, there is great concern for the well-being of Wyoming communities and workers so using conventional energy as an economic and community stepping stone to the future is still considered necessary. This theme prefers that Wyoming's leaders create an explicit plan to bolster the future of renewable energy and related technology, thereby improving the state's future.

The second theme reflects the survey respondents whose first priority is Wyoming's economy and jobs. Although climate change is considered a reality, of greater concern are the economic realities. Participants in this theme indicated that declining markets related to coal and to some extent oil were expected, but that the COVID-19 virus pandemic accelerated the speed of that decline and the weaknesses in our economy are now clear. As many said in this theme, paying attention to market demands outside of Wyoming is critical to the state's economic future, hence a preference to use conventional energy production as a strategic bridge to other economic activities that can provide jobs and a more resilient economy, including renewables, information-based industry, and nuclear energy. Many participants in this theme were advocates for conventional energy production, but ultimately their greatest concern was Wyoming's economy generally.

The third theme crystalized the values of the survey respondents who emphasized quality of life in Wyoming. Jobs, healthcare, wildlife, and affordable and consistent energy were prioritized in this theme. Preferences for energy types differed in this theme, but ultimately participants see energy production as a means to a good quality of life. Nuclear energy is supported in this theme as a possible consistent source of clean energy. New forms of technology including carbon capture and storage are also supported as a way of reducing carbon in the atmosphere and to support coal operations. In this theme, participants expressed frustration with the lack of support for renewable energy, hampering the state's ability to attract business acumen that could move Wyoming into a more economically solid position.



“

Wyoming's economy has historically been greatly impacted by energy.

Conclusion

The data from this survey and from the subsequent Q-study can be summed up in this quote from a survey participant: “Wyoming’s economy has historically been greatly impacted by energy. It should continue to grow, but also reduce impact to our environment, wildlife, and people. Wyoming has an opportunity to develop and market new technologies to advance current energy sources and research, and then implement new sources. We should use our university and any other ‘think tanks’ to be creative in our approach to our energy future, and then other states and nations may follow.”

This statement reflects the strong cultural and identity ties that Wyoming has as an “energy state,” as well as the importance of wildlife, landscape, and communities to Wyoming residents. We conducted this study to explore the extent to which there is social license for different types of energy production for the future. Our results indicate that there is social license for most energy types with the clear understanding that market forces are creating changes that Wyoming needs to quickly adapt to if the state is to be economically resilient. As the statement above indicates, Wyoming residents want to hold on to what they have and to create more. In order to create more, and improve economic stability, respondents and Q-study participants repeatedly mentioned the need for leadership. As one participant stressed in the economic emphasis theme, it is important for Wyoming “to create an energy plan, not just a renewable energy plan.”

Wyoming’s economy is closely tied to energy production, and the market demands for some types of energy are increasing while others are decreasing. At the same time, there are technological advances that can benefit both existing and future energy production. Tied into all of this are Wyoming’s natural amenities and the acknowledgement that the climate is changing. This study points to the following conclusions:

- **A comprehensive energy strategy for Wyoming:** The Wyoming public provides its leaders with the social license to activate an energy strategy in a manner that considers quality of life factors, improves the economy, and benefits the state’s environment. Judging from the responses in the Q-study, participants involved in Wyoming’s energy discourse want more risk taking, more support for new energy approaches, and a more outward-facing approach to new technologies, new ideas and needs in other states. In all three themes frustration among Q-study participants was evident in the lack of action taken to develop a “comprehensive energy strategy,” as one participant called it, that supports all forms of energy, and that is developed in line with the preferences and demands of Wyoming residents and customers outside its borders, with goalposts. As long as this results in jobs and a continued strong energy identity for Wyoming, the survey indicates the public would be supportive.
- **We need to talk:** There is a need for more information to the Wyoming public about technologies and trade-offs. The trade-offs are reflected in the three resulting themes in this study. For example, an increase in renewable energy but at what cost? Carbon capture and storage is to some extent supported by Q-participants, but in the renewable theme, questions are asked about whether this will really reduce carbon dioxide levels or only boost oil production. The survey results also show that there is interest in technologies such as carbon capture and storage and even nuclear energy, but that the majority of the public is not familiar with these subjects enough to meaningfully evaluate the trade-offs. Providing more opportunities for information sharing and dialogue around these technologies and the trade-offs would likely boost the level of social license for them.

- **Wyoming values:** Although clearly energy and economy are closely tied in this state, both the survey and the Q-study results emphasize the importance of aesthetic and biological diversity values to Wyoming residents. In the survey, these two values ranked highest. The beauty of Wyoming’s landscapes was often referenced as a reason to oppose wind energy. The importance of wildlife corridors was equally often referenced as a reason to oppose oil and gas activities. Respondents in both parts of the study made clear their passion for Wyoming’s natural amenities and attachment to place. When considering trade-offs, these are fundamental values to consider in Wyoming.
- **Change is gonna come:** Generally, energy production related to oil, coal, gas, and renewables are largely supported by the public with the understanding that the current energy portfolio will need to change. Both survey and Q-study participants are concerned regarding the way external forces are changing Wyoming’s economic activities and income. The survey results indicate clearly that energy activities in Wyoming are not an “either or” issue between conventional and renewable energy. Instead the responses indicate that there is strong support for gas, oil, renewables, and coal in that order. The greater percentage of survey respondents and almost all Q-participants acknowledged that change was happening and Wyoming needs to prepare for the changes rather than “just let them happen to us” as one Q-participant put it.



APPENDICES

APPENDIX A: SURVEY

APPENDIX B: ENERGY PREFERENCES ACROSS
DEMOGRAPHIC CHARACTERISTICS

APPENDIX C: Q-STUDY INTERVIEW QUESTIONS

APPENDIX D: Q-STUDY RESULTS

APPENDIX A: SURVEY



Draft

20. You have helped us understand what you think about Wyoming's future energy extraction and generation options. Please, tell us in your own words what you would like the role of:

a. fossil fuel energy extraction and generation in Wyoming's future to be.

b. renewable energy development and generation in Wyoming's future to be.

c. nuclear energy in Wyoming's future to be.

Is there anything else you would like to tell us about Wyoming's energy future and what you would like to see happen and/or not see happen in the next 20-30 years?

Your time and effort will help shape Wyoming's relationship to energy in the future. Thank you very much!

SURVEY OF PUBLIC VALUES AND PREFERENCES RELATING TO WYOMING'S ENERGY FUTURE

Thank you for taking the time to complete this survey. Your participation in this survey is voluntary. Refusal to participate will have no effect on any benefits to which you are otherwise entitled. Fill in bubbles completely using either pencil or pen (blue or black ink), but please do NOT use a felt-tip marker.

Mark Answers Like This [bubbles] NOT Like This [bubbles]

1. Does anyone in your household earn income directly from the energy-related operations (e.g. mining, production and transmission) in Wyoming?

- Yes Please describe the source of the income:
No
Not sure

2. Please check the types of energy operations that are within close proximity (within 100 miles) to the places you live, work, or recreate. (Mark all that apply.)

- Solar, Wind, Natural Gas, Hydroelectric Power, Bentonite, Oil, Coal, Energy Storage, Oil/Gas Pipeline, Rare Earth Elements, Carbon Capture Utilization & Storage, Uranium, Trona, Energy Transmission, Other (describe), Don't know/Not sure

3. Wyoming has abundant energy resources and various types of energy technologies and production. The following is a list of possible energy operations. How strongly do you favor or oppose each of these energy related activities?

Table with 7 columns: Activity, Strongly Favor, Favor, Neutral, Oppose, Strongly Oppose, Not sure. Rows include Wind, Coal, Uranium, Oil, Natural Gas, Solar, Nuclear Energy, Carbon Capture Utilization and Storage, Energy Storage, Rare Earth Elements, Other (describe).



Draft

4. Which one of the following statements regarding fossil fuel (coal, oil, and natural gas) energy operations in Wyoming best describes your opinion about that matter? (Please select one.)

- There is a need to increase the level of Wyoming's fossil fuel extraction and power generation.
- There is a need to increase the level of fossil fuel extraction and power generation, but only if combined with low-carbon technologies.
- The level of Wyoming's fossil fuel energy activities is appropriate.
- The level of Wyoming's fossil fuel energy activities should be reduced.
- There should not be any fossil fuel energy development in Wyoming.
- Don't know

5. Which one of the following statements regarding renewable (e.g. wind and solar) energy developments in Wyoming best describes your opinion about that matter? (Please select one.)

- There is a need to increase the level of Wyoming's renewable power generation.
- There is a need to increase the level of Wyoming's renewable power generation, but only if it avoids as much environmental conflicts as possible.
- The level of Wyoming's renewable power generation is appropriate.
- The level of Wyoming's renewable power generation should be reduced.
- There should not be any renewable power generation in Wyoming.
- Don't know

Carbon Capture and Storage (CCS) is the process of capturing carbon dioxide (usually from large point sources such as a coal- or natural gas-powered power plant), and securely storing the carbon dioxide, typically deep underground in a well-characterized geologic formation. Alternatively, Carbon Capture Utilization and Storage (CCUS) technologies typically involve the utilization of the captured carbon dioxide in an economically useful activity, such as enhanced oil recovery or in products. Both CCS and CCUS are proposed as solutions to ensure that Wyoming's fossil energy resources may continue to be used under a growing number of federal and state low-carbon energy mandates.

6. Which of the following statements reflect your opinion about CCS and CCUS in Wyoming? (Please mark all that apply.)

- CCS and CCUS are important to keep Wyoming fossil fuels competitive in the marketplace.
- CCS and CCUS should be widely adopted to reduce carbon emissions.
- CCS and CCUS are not important and Wyoming should not adopt them.
- CCS and CCUS are ways to perpetuate fossil fuel production rather than encouraging renewable energy production.
- CCS and CCUS are too expensive and Wyoming should not research or invest in them.
- CCS and CCUS could have harmful side-effects.
- Don't know/Not sure

We have a few questions about you:

11. In what community do you live or what community is closest to your home?

12. How long have you lived in (or near) this community?

YEARS (enter 1 for 1 year or less)

13. How long have you lived in Wyoming?

YEARS (enter 1 for 1 year or less)

14. Is the residence where you received this survey your primary residence?

- Yes
- No

15. What is your age?

YEARS

16. Are you:

- Male
- Female
- Other _____

17. What is the highest level of education you have completed?

- Less than high school diploma
- High school diploma or GED
- Technical/Vocational/Associates
- Some college no degree
- 4-year college degree
- Some graduate work
- One or more graduate degrees

18. What was your approximate annual household income before taxes in 2018?

- Less than \$10,000
- \$10,000 – 24,999
- \$25,000 – 49,999
- \$50,000 – 74,999
- \$75,000 – 99,999
- \$100,000 – 124,999
- \$125,000 – 149,999
- \$150,000 or more

19. Are you retired?

- Yes
- No **If no, what is your occupation?** _____



10. We have asked you many questions about energy activities in Wyoming. Now we would like to know in what ways is Wyoming important to you by offering you the following hypothetical scenario to consider.

Imagine that you could “spend” \$100 to ensure that the State of Wyoming is able to maintain its values. You may allocate or spend the \$100 in any way you like, but your total spending may not exceed \$100. You might spend all \$100 on one value (and \$0 on all others), or you might spend \$50 on one value, \$25 on another value, and \$25 on yet another value. Remember, the total dollars you spend should equal \$100.

(Reference to money is not made to actual money, your own or the State’s budget).

- \$ [][] [][] Aesthetic value (A) — I value Wyoming because I enjoy its scenery, sights, sounds, smells, etc.
\$ [][] [][] Biological diversity value (B) — I value Wyoming because it provides places with a variety of fish, wildlife, plant life, etc.
\$ [][] [][] Cultural value (C) — I value Wyoming because it is a place for me to continue and pass down the wisdom and knowledge, traditions, and way of life of my ancestors.
\$ [][] [][] Community value — I value Wyoming because it is the location of my community and I wish to preserve that community and its health, security and welfare.
\$ [][] [][] Economic value (E) — I value Wyoming because it provides economic opportunities related to minerals, tourism, hunting, manufacturing, energy production and other sectors.
\$ [][] [][] Future value (F) — I value Wyoming because I want future generations to know and experience the State as it is now.
\$ [][] [][] Historic value (H) — I value Wyoming because it has places and things of natural and human history that matter to me, others and/or the nation.
\$ [][] [][] Intrinsic value (I) — I value Wyoming in and of itself, whether people are present or not.
\$ [][] [][] Learning value (L) — I value Wyoming because we can learn about the environment through scientific observation and/or experimentation.
\$ [][] [][] Life Sustaining value (LS) — I value Wyoming because it helps produce, preserve, clean, and renew air, soil, and water.
\$ [][] [][] Recreation value (R) — I value Wyoming because it provides places for my favorite outdoor recreation activities.
\$ [][] [][] Spiritual value (S) — I value Wyoming because it has sacred, religious, or spiritually special places to me or because it contains places for which I feel reverence and respect for nature.
\$ [][] [][] Subsistence value (Sb) - I value Wyoming because it provides necessary food and supplies to sustain my life.
\$ [][] [][] Therapeutic value (T) — I value Wyoming because it contains places that make me feel better, physically and/or mentally.

\$ 1 0 0 Total Value Allocation

7. How strongly do you support or oppose, or are you neutral about development of wind and solar energy in Wyoming?

- Strongly support
Somewhat support
Neutral
Somewhat oppose
Strongly oppose

7a. Please indicate how strongly you agree or disagree with each of the following statements about wind and solar energy generation in Wyoming.

Table with 7 columns: Statement, Strongly agree, Agree, Neutral, Disagree, Strongly disagree, Don't know. Rows include: provide state and local revenue to Wyoming, support our country's energy needs, provide decarbonized energy, provide well-paying jobs in Wyoming, and I support wind and solar development for other reasons, please specify.

7b. Please indicate how strongly you agree or disagree with each of the following statements about wind and solar energy generation in Wyoming.

Table with 7 columns: Statement, Strongly agree, Agree, Neutral, Disagree, Strongly disagree, Don't know. Rows include: they have negative impacts on wildlife, energy delivery is inconsistent, they have negative impacts on recreational activities, they have negative impacts on environmental footprints, and I oppose wind and solar development for other reasons, please specify.



8. How strongly do you support or oppose, or are you neutral about oil and gas development in Wyoming?

- Strongly support
- Somewhat support
- Neutral
- Somewhat oppose
- Strongly oppose

8a. Please indicate how strongly you agree or disagree with each of the following statements about oil and gas energy generation in Wyoming.

I support oil and gas development because they...

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't know
provide reliable energy.	<input type="radio"/>					
provide state and local revenue to Wyoming.	<input type="radio"/>					
support our country's energy needs.	<input type="radio"/>					
provide well-paying jobs in Wyoming.	<input type="radio"/>					
I support oil and gas development for other reasons, please specify: _____						

8b. Please indicate how strongly you agree or disagree with each of the following statements about oil and gas energy generation in Wyoming.

I oppose oil and gas development because they...

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't know
have negative impacts on recreational activities.	<input type="radio"/>					
have negative impacts on wildlife, air and water quality.	<input type="radio"/>					
negatively impact climate change globally.	<input type="radio"/>					
I oppose oil and gas development for other reasons, please specify: _____						

9. How strongly do you support or oppose, or are you neutral about coal mining and coal-based power generation development in Wyoming?

- Strongly support
- Somewhat support
- Neutral
- Somewhat oppose
- Strongly oppose

9a. Please indicate how strongly you agree or disagree with each of the following statements about coal mining and coal-based power generation in Wyoming.

I support coal mining and coal-based power generation because they...

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't know
support our country's energy needs.	<input type="radio"/>					
provide well-paying jobs in Wyoming.	<input type="radio"/>					
provide state and local revenue in Wyoming.	<input type="radio"/>					
provide reliable energy.	<input type="radio"/>					
I support coal mining and coal-based development for other reasons, please specify: _____						

9b. Please indicate how strongly you agree or disagree with each of the following statements about coal mining and coal-based power generation in Wyoming.

I oppose coal mining and coal-based power generation because they...

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Don't know
have negative impacts on wildlife, air and water quality.	<input type="radio"/>					
have negative impacts on recreational activities.	<input type="radio"/>					
have negative impacts on climate change globally.	<input type="radio"/>					
I oppose coal mining and coal-based development for other reasons, please specify: _____						

APPENDIX B: ENERGY PREFERENCES ACROSS DEMOGRAPHIC CHARACTERISTICS

The survey results in the next five tables on the following pages show the differences in preferences for energy types or activities across respondents of different ages, levels of education and income, who have lived in Wyoming for different lengths of time, and men and women. The F-coefficient shows the level of difference between different demographic levels. Even if F-coefficients are not high, those presented here have a confidence level of 95% ($p < .05$). The higher the F-coefficient, the greater differences.

- Refers to the number of participants in this category.

Avg – Refers to the average score (from 1 Strong Agree to 5 Strongly Disagree, 3 (= Not Sure/Neutral)). The lower the score, the more agreement. The higher the score, the more opposition.

Table 8: Differences between age classes regarding energy preferences.

Average Level of Support for different Energy Activities based on Age											
Energy Type	18-34		35-54		55-74		75+		Total		F (p<.05)
	#	Avg	#	Avg	#	Avg	#	Avg	#	Avg	
Wind	41	2.20	113	2.37	259	2.14	76	2.51	489	2.26	
Coal	41	2.22	114	2.22	259	2.36	82	2.43	496	2.37	
Uranium	41	2.95	98	3.05	180	3.08	138	2.80	481	2.98	
Oil	71	2.25	97	2.38	187	2.13	142	1.84	497	2.11	
Gas	71	2.01	98	1.78	189	1.77	145	1.59	503	1.75	2.377
Solar	69	1.91	98	1.99	188	1.98	138	2.33	493	2.07	2.779
Nuclear	68	2.99	97	2.98	183	3.40	137	2.39	485	3.26	
CCUS	67	3.37	97	3.54	182	3.29	140	3.76	486	3.49	
Energy Storage	67	2.69	97	2.88	182	2.88	140	3.28	486	2.97	3.57
Rare Earth Minerals	67	3.40	97	3.34	181	3.45	140	3.65	485	3.48	

Table 9: Differences between lengths of Wyoming residencies regarding energy preferences.

Average Level of Support for different Energy Activities based on how long a survey participant has lived in Wyoming											
Energy Type	1-10		11-25		26-50		50+		Total		F (p<.05)
	#	Avg	#	Avg	#	Avg	#	Avg	#	Avg	
Wind	69	2.25	97	2.16	186	2.18	142	2.41	494	2.25	
Coal	71	2.62	99	2.75	186	2.29	145	2.14	501	2.38	4.872
Uranium	65	2.95	98	3.05	180	3.08	138	2.80	481	2.98	
Oil	71	2.25	97	2.38	187	2.13	142	1.84	497	2.11	4.593
Gas	71	2.01	98	1.78	189	1.77	145	1.59	503	1.75	3.442
Solar	69	1.91	98	1.99	188	1.98	138	2.33	493	2.07	
Nuclear	68	2.99	97	2.98	183	3.40	137	2.39	485	3.26	
CCUS	67	3.37	97	3.54	182	3.29	140	3.76	486	3.49	
Energy Storage	67	2.69	97	2.88	182	2.88	140	3.28	486	2.97	
Rare Earth Minerals	67	3.40	97	3.34	181	3.45	140	3.65	485	3.48	

Table 10: Differences between men and women regarding energy preferences.

Average Level of Support for different Energy Activities based on Gender							
Energy Type	Men		Women		Total		F (p<.05)
	#	Avg	#	Avg	#	Avg	
Wind	282	2.34	209	2.14	491	2.25	
Coal	287	2.28	210	2.51	497	2.38	
Uranium	274	2.61	205	3.43	479	2.96	33.319
Oil	283	2.01	210	2.21	493	2.10	
Gas	287	1.64	212	1.89	499	1.75	8.441
Solar	281	2.20	209	1.90	490	2.07	6.820
Nuclear	279	2.75	204	3.89	483	3.23	65.241
CCUS	276	3.25	208	3.76	484	3.47	8.902
Energy Storage	276	2.75	208	3.22	484	2.95	8.196
Rare Earth Minerals	275	3.08	208	3.95	483	3.46	27.696

Table 11: Differences between participants with different level of education regarding energy preferences.

Average Level of Support for different Energy Activities based on Level of Education											
Energy Type	Highschool/ GED or unfinished		Some College/ Assoc/Trade		Bachelors +		One or more graduate degrees		Total		F (p<.05)
	#	Avg	#	Avg	#	Avg	#	Avg	#	Avg	
Wind	84	2.43	185	2.30	134	2.17	94	2.13	497	2.25	
Coal	87	2.16	183	2.15	139	2.53	95	2.85	504	2.39	6.744
Uranium	79	3.18	181	2.99	131	2.89	94	2.90	485	2.98	
Oil	86	1.92	181	1.82	137	2.35	96	2.53	500	2.12	10.703
Gas	86	1.71	184	1.54	140	1.89	96	2.01	506	1.75	6.820
Solar	82	2.45	181	2.02	137	2.08	96	1.84	496	2.07	3.839
Nuclear	79	3.54	180	3.32	135	3.16	95	2.99	489	3.25	
CCUS	82	4.12	178	3.43	135	3.25	95	3.32	490	3.47	4.290
Energy Storage	82	3.24	180	2.86	135	2.99	93	2.86	490	2.96	
Rare Earth Minerals	81	3.84	179	3.26	135	3.49	94	3.54	489	3.47	

Table 12: Differences between participants with different level of income regarding energy preferences.

Average Level of Support for different Energy Activities based on Income											
Energy Type	\$ 0 - \$ 25 K		\$25 - \$ 75 K		\$ 75 – 100 K		\$ 100 K +		Total		F (p<.05)
	#	Avg	#	Avg	#	Avg	#	Avg	#	Avg	
Wind	71	2.00	164	2.13	85	2.38	134	2.44	454	2.25	
Coal	71	2.76	167	2.37	86	2.41	136	2.21	460	2.39	
Uranium	66	3.68	160	2.98	83	2.93	135	2.56	444	2.94	7.647
Oil	73	2.34	163	2.10	86	2.24	135	1.91	457	2.11	
Gas	72	1.96	167	2.10	86	2.24	135	1.91	457	2.11	
Solar	69	2.09	164	1.94	85	1.99	137	2.17	455	2.04	
Nuclear	68	3.82	159	3.39	86	3.13	134	2.75	447	3.21	7.862
CCUS	68	4.37	161	3.52	83	3.57	136	2.93	448	3.48	9.715
Energy Storage	69	3.62	160	3.08	83	2.99	136	2.40	448	2.94	8.118
Rare Earth Minerals	67	4.12	160	3.52	84	3.35	136	2.98	447	3.41	6.296

APPENDIX C: Q-STUDY INTERVIEW QUESTIONS

Wyoming Energy Future Interview Questions

About You:

1. What is your title?
2. How would you define your stakeholder type?
3. How are you involved in energy in Wyoming?
4. How long have you been involved in energy in Wyoming?

About the Q-sort:

5. What statements did you most agree with and why?
6. What statements did you most disagree with and why?
7. What statements wound up more in the middle section and why?
8. While deciding what statements you agreed or disagreed with, were there any trade-offs that were particularly difficult?
9. Considering that these statements represent the public discourse or conversation regarding energy production and its future role in Wyoming, do you feel your viewpoints and opinions are represented? Is there anything missing?

About Energy in Wyoming:

10. Generally, what would you change about energy production in Wyoming, if anything?
11. Why?
12. In Wyoming there is a running discussion about our “energy transition”. What does that phrase mean to you?
13. If we in the State of Wyoming are to be successful at your idea of an “energy transition”, what would that look like to you?
14. Right now, Wyoming’s economy is considerably dependent on energy production income. Would you like to see this continue or changed? How?
15. If you think of Wyoming’s counties and cities, what do they need to thrive in the future?
16. Is there anything you wish to add that I haven’t asked you about?

APPENDIX D: Q-STUDY RESULTS

Distinguishing statements for each theme. Average rankings of statements on spectrum of 5 (strongly agree) to -5 (strongly disagree). Scores are z-scores significant at $p < .05$. An asterisk indicates significance at $p < .01$.

#	Distinguishing Statements: Renewable Theme	Rank	Score
28	Wyoming State Legislature should legislate a meaningful renewable energy plan. The technology exists. We need renewable energy vision and commitment in Cheyenne.	4	1.58*
4	It is critical in the next 20-30 years to curb greenhouse emissions and to invest in developing and implementing technologies to reverse the adverse effects of man-made pollution on air, climate and water.	4	1.42*
34	Lessen impact on wildlife (i.e. migration corridors and breeding and birthing areas.) This goes for wind and solar as well as gas and oil.	3	1.02
7	I would like to see economic diversification so one means of energy production does not stop our state dead in its tracks when that method phases out. And they will phase out. Everything has a shelf life.	3	0.98*
30	State revenues are a concern as fossil fuel extraction fades. We're going to have to start taxing the people who can afford it, otherwise the state won't be able to function.	2	0.96*
23	Wyoming has an opportunity to develop, market and implement new technologies to advance current and new energy sources. We should use our university and any other 'think tanks' to be creative in our approach to our energy future,	2	0.74*
18	Change net metering laws to allow for more home generation of electricity.	1	0.68*
3	I don't want Wyoming to be "used" and left with problems from industries that operate in energy development.	1	0.56
19	Each house could have a turbine or a solar panel so that these big wind farms are not needed.	0	-0.01*
26	The only thing we need to work on is better health care insurance so our young people can build a business and have a family in Wyoming.	-1	0.32*
2	Carbon capture could help and I would like to see the universities evaluating that technology.	-1	-0.39
33	Developing a new information-based economy is unrealistic. The related population growth would transform Wyoming into a Colorado or a Utah and would be met with resistance and strife.	-1	-0.65
24	I would like to see more involvement in nuclear power generation in Wyoming	-2	-0.74

22	We can succeed by using new technologies to capture and control emissions including the nuclear waste stream. Coal emissions can also be captured better. Wyoming should continue to help in the development of clean coal technology.	-2	0.76*
13	I would like Wyoming to continue to be a leader in hydrocarbon technology and production and move towards nuclear energy production.	-2	-0.96*
16	Wyoming has an amazing opportunity in oil and gas development and the world is going to need them for a long time.	-3	-1.23*
6	Coal and natural gas export should be developed and pipelines built for a significant income for Wyoming.	-3	1.27*
9	We need to flex our energy muscles and not only provide clean, cheaper energy but also take some of the power from Washington, DC by reducing reliance on Federal dollars (control) of this amazing state.	-3	-1.29
10	Extraction of coal and oil is a must. Wyoming banks on it! We need to keep it flowing.	-4	-1.70*
14	More nuclear, coal, hydro, and gas. Less renewable.	-4	-1.86*

#	Distinguishing Statements: Economy Theme	Rank	Score
7	I would like to see economic diversification so one means of energy production does not stop our state dead in its tracks when that method phases out. And they will phase out. Everything has a shelf life.	5	1.76*
15	The future of energy in Wyoming, America and the world is dependent on the equal development of nuclear energy, renewable energy along with the contained mining of sustainable fossil fuels.	4	1.60*
22	We can succeed by using new technologies to capture and control emissions including the nuclear waste stream. Coal emissions can also be captured better. Wyoming should continue to help in the development of clean coal technology.	3	1.38
1	Would like to see sustained growth of all energy industries in an environmentally sound way to benefit the entire state, its's people and most of all, with the protection of its landscapes.	3	1.11
16	Wyoming has an amazing opportunity in oil and gas development and the world is going to need them for a long time.	2	0.97
18	Change net metering laws to allow for more home generation of electricity.	0	-0.17*
34	Lessen impact on wildlife (i.e. migration corridors and breeding and birthing areas.) This goes for wind and solar as well as gas and oil.	0	-0.22*
24	I would like to see more involvement in nuclear power generation in Wyoming	-1	-0.29
17	Wyoming is a prime state for wind and solar. My generation is a lost generation with regards to fossil fuel energy. We must now focus on the next generation. Hopefully it is not too late.	-1	-0.79*

9	We need to flex our energy muscles and not only provide clean, cheaper energy but also take some of the power from Washington, DC by reducing reliance on Federal dollars (control) of this amazing state.	-2	-0.82
32	Wyoming needs to wean itself off coal and coal production. Natural gas should act as a bridge fuel in the coming decades to get us, the US, to sustainable and more environmentally-friendly forms of energy production.	-2	-0.88*
14	More nuclear, coal, hydro, and gas. Less renewable.	-2	-0.94*
12	No one pays the least attention to the most important metric in the energy calculus: conservation. It's easy, it's cheap and it's on the shelf right now.	-3	-1.05*
33	Developing a new information-based economy is unrealistic. The related population growth would transform Wyoming into a Colorado or a Utah and would be met with resistance and strife.	-3	-1.15
26	The only thing we need to work on is better health care insurance so our young people can build a business and have a family in Wyoming.	-5	-1.73*

#	Distinguishing Statements: Quality of Life Theme	Rank	Z-score
25	I would like to see energy developed in Wyoming in a way that creates jobs and safe-guards displaced workers with job training and other appropriate safety nets.	5	1.95*
34	Lessen impact on wildlife (i.e. migration corridors and breeding and birthing areas.) This goes for wind and solar as well as gas and oil.	4	1.74
26	The only thing we need to work on is better health care insurance so our young people can build a business and have a family in Wyoming.	3	1.05*
33	Developing a new information-based economy is unrealistic. The related population growth would transform Wyoming into a Colorado or a Utah and would be met with resistance and strife.	2	0.93*
24	I would like to see more involvement in nuclear power generation in Wyoming	2	0.84*
9	We need to flex our energy muscles and not only provide clean, cheaper energy but also take some of the power from Washington, DC by reducing reliance on Federal dollars (control) of this amazing state.	2	0.72*
14	More nuclear, coal, hydro, and gas. Less renewable	2	0.72*
22	We can succeed by using new technologies to capture and control emissions including the nuclear waste stream. Coal emissions can also be captured better. Wyoming should continue to help in the development of clean coal technology.	1	0.51
16	Wyoming has an amazing opportunity in oil and gas development and the world is going to need them for a long time.	0	0.00

20	We need to build dams everywhere it's possible and get more hydro power and the other benefits of dams such as recreation and irrigation water.	-1	-0.24
7	I would like to see economic diversification so one means of energy production does not stop our state dead in its tracks when that method phases out. And they will phase out. Everything has a shelf life.	-1	-0.39*
31	Market trends that are driving a transition away from coal to natural gas and renewable are beyond our control. Adapt, change, and grow into the new markets that are emerging. This implies helping those communities who will be disrupted with the transition.	-1	-0.45*
35	Responsible production/extraction but not at all cost. I would hope to see all wildlife continue to flourish.	-1	-0.66
11	We can't completely abandon fossil fuel products but climate and cultural realities will change the future of energy products. Wyoming would be wise to adjust to that reality now as opposed to later.	-2	-0.84*
36	Minimization of visual pollution regarding immense wind turbine fields There needs to be recycling advancements and tear-down strategies to recapture the land and visual expanses.	-2	-.90
8	We must diversify our private business streams such as expanded IT infrastructure, data centers, space-based telecommunications. We must attract more business and reduce resistance to change. We must be forward thinkers instead of reactionary thinkers.	-3	-1.05*
27	We need implementation of energy programs that don't change our state's lands and aesthetic values.	-3	-1.11*
18	Change net metering laws to allow for more home generation of electricity.	-4	1.74*