

# UC San Diego

## Capstone Papers

### Title

Beyond Boom and Bust: An emerging clean energy economy in Wyoming

### Permalink

<https://escholarship.org/uc/item/0zp872rt>

### Author

Moffit, Tim

### Publication Date

2021-06-01

# Beyond Boom and Bust: An emerging clean energy economy in Wyoming



Tim Moffit  
June 2021

Capstone Advisory Committee

Dr. Corey Gabriel, Executive Director of the MAS CSP program, Scripps Institution of  
Oceanography

---

Dr. Fonna Forman, Associate Professor of Political Science, UC San Diego

 \_\_\_\_\_ 6-11-21  \_\_\_\_\_

UC San Diego



SCRIPPS INSTITUTION OF  
OCEANOGRAPHY

## **Abstract**

While Wyoming is known for fossil fuel extraction, the state has the capacity to generate 1,653,856 GWh of wind per year. With the growing rate of greenhouse gas emissions and the cyclical Boom-Bust that the state faces, there is an opportunity for private sector investment and a state and federal government that can utilize the overgeneration capacity of wind in Wyoming for Bitcoin mining operations and Carbon Capture, Utilization and Storage. Currently, projects are under development, but the issue of overgenerated wind continues to exist. By harnessing the overgenerated wind for Bitcoin mining, Wyoming has the opportunity to redistribute the global hashrate, incentivize Bitcoin miners to move their operations to Wyoming, and stimulate job growth as a result. Carbon Capture, Utilization, and Storage could help propel Bitcoin mining operations as well as harness carbon to manufacture products across various industries. By assessing workforce characteristics and proposed federal policies, this research addresses the need for the implementation of the Endless Frontier Act with the inclusion of wind turbine and CCS development, workforce protection, and cryptocurrency incentives.

## **I. Introduction**

The combustion of fossil fuels is a dominant source of greenhouse gas emissions. According to the U.S. Energy Information Administration, the combustion of fossil fuels accounted for approximately 75.4 percent of U.S. greenhouse gas emissions in 2018, (U.S. EIA, 2020). While fossil fuels are the most commonly used energy source, they are not the most sustainable source of energy. While fossil fuels drive our economy and society toward technological advancement, they contribute to global warming, air pollution, ocean acidification, and many other environmental, social, and economic hindrances. Unlike fossil fuels, the use of renewable energy sources do not have known overwhelming negative externalities that make their continued mitigated use unsustainable with human existence and habitability of Earth. As such, harnessing the renewable energy potential around the nation could substantially enhance the U.S. economic standing and reputable status as a global superpower. The question that must be asked is not if transitioning is essential, but where the potential transition would take place.

The southeastern portion of Wyoming has the highest generation potential in the United States for wind energy, totalling at approximately 1,653,856 GWh potential, (OpenEI, 2021). More specifically, counties such as Carbon county and Laramie county have high potentials for wind energy generation. While wind development has occurred in the state and continues to do so, the federal and state level governments do not provide incentives for wind development to occur regularly. Many in the state's legislature rebuke the concept of abandoning fossil fuels for green energy, opting to continue conventional energy production practices by voting for wind generation tax increases and failing to implement a Renewable Portfolio Standard (RPS).

Because wind farm developments are still underway, transmission lines would transmit energy throughout the nation for power. However, the overgenerated wind energy could be utilized in mining Bitcoin rather than natural gas. This opportunity would allow Wyoming to provide economic stability and job security for the energy workers that otherwise fall into a pattern of a "boom-bust" cycle of fossil fuel extraction. This overgeneration of wind energy in Wyoming could provide Bitcoin miners with a more sustainable alternative to fossil fuels for their cryptocurrency mining. In essence, miners would be incentivized to mine Bitcoin in the state. Wyoming has an opportunity to stay ahead of Texas and Florida by investing not only in cryptocurrency and the technology that it operates on, (Blockchain) but also in the infrastructure necessary to transmit the wind potential that would allow for Bitcoin to operate on clean energy.

This research attempts to assess the wind potential in Wyoming, assess workforce statistics and the necessity to transition to green energy, Carbon Capture, Utilization and Storage development, and conduct a policy analysis. This research will then be able to provide a policy recommendation that will consider all of these factors and help propel our society toward a cleaner, more sustainable future.

## **I. Environmental and Social Impacts of fossil fuels**

There are various environmental and climate-related impacts as a result of fossil fuels. The most commonly discussed effects are derived from the combustion of coal, oil, and natural gas. Out of these fossil fuels, coal emits approximately 864 pounds of CO<sub>2</sub> per million British Thermal Units, (EIA, 2020). This number accounts for the four types of coal assessed by the U.S. Energy Information Administration; anthracite, bituminous, ignite, and subbituminous. Natural Gas accounts for nearly 117 pounds of CO<sub>2</sub> per million British Thermal Units, (EIA, 2020). Oil is responsible for, when combining diesel fuel, heating oil and gasoline, roughly 318.5 pounds of CO<sub>2</sub> per million British Thermal Units, (EIA, 2020).

As three of the highest utilized fuel sources in the United States, the carbon emissions associated with the combustion of these fuels are enormous. Through the release of these exorbitant greenhouse gases, global temperatures are expected to continue climbing leading to a plethora of environmental and social impacts including economic downturn, water and agricultural stress, and rising sea levels, (O'neill et al, 2017).

Climate change is a gradual climb toward irreversible consequences. Environmental and social impacts will not be deferred to the 2°C increase in global temperatures. Currently, the global surface temperature stands at 1.02°C, (NASA, 2021). As global temperatures rise and greenhouse gas levels continue to soar, obstacles such as coral reef degradation and the displacement of biodiversity will surely come to fruition, (O'neil et al, 2017). Higher levels of emitted greenhouse gases lead to more carbon being absorbed by the ocean, which leads to ocean acidification. This places stress on the coral reefs and marine life, and ultimately impacts fisheries and may contribute to economic stalemate and food insecurity. While this is not merely the only negative implication associated with rising global temperatures and greenhouse gases, it is an example of the domino effect.

While fossil fuels are not the only contributor to greenhouse gas emissions, they have a significant role in climate change. According to the United States Environmental

Protection Agency, (EPA), the combustion of fossil fuels for the purpose of electricity, heat, and transportation are the largest source of greenhouse gases, (EPA, 2021). NOAA explains that while the greenhouse gases allow for life to exist as it regulates the planetary temperature, the heat trapping gases continue to warm the planet as excessive levels enter the atmosphere, (NOAA, 2020).

Despite the negative hindrances that fossil fuels impart on our planet and society, they continue to be utilized in order to provide power to our utilities and propel our economy. As the impacts associated with fossil fuel combustion continue to worsen, it is essential to analyze the necessity of transitioning to renewable energy. Distinguishing Wyoming as a state that has an exorbitant amount of renewable energy potential is not only ideal, but essential to sustain our current way of life.

## **II. National Leader in Renewable Energy and Energy Efficiency**

Currently, the National Renewable Energy Laboratory (NREL) has indicated that the state is home to approximately 22 wind farms. One of the future wind development projects, the Transwest Express, LLC plans to build the nation's largest wind farm in Wyoming and carry the energy through transmission lines to the Hoover Dam in Nevada, where it will then be transmitted to southern California, (Transwest Express, 2021). Through the investment and chances taken to develop the necessary infrastructure, Wyoming will gain the capacity to provide wind energy to states across the country. While the Transwest Express would carry approximately 20,000 GWh per year of wind, there is still 1,633,856 GWh of overgeneration that would otherwise go wasted. Harnessing this excess energy for Bitcoin mining would clean up Bitcoin operations and help Wyoming become a beacon of clean energy cryptocurrency.

From the perspective of national reputation, Wyoming ranks in the bottom 10 states by the American Council for an Energy-Efficient Economy, (ACEEE),(Fiorino et al, 2019). Despite the potential of becoming a national leader in renewable technologies, Wyoming has not incentivized their industries to harness the wind in order to have ample energy production. Rather than providing economic benefits for companies that reduce their carbon footprint, the state legislature has taken strides toward discouraging the integration of renewable energy. The state legislature has regularly voted on increasing a wind production tax from \$1 per MWh to \$2 per MWh, (McKim, 2020). While this tax increase has not had enough support to be implemented, the possibility still exists. In addition, Wyoming has not implemented a Renewable Portfolio Standard (RPS), which would require a basic level of energy to come from renewable energy sources.

International examples of renewable energy leaders sit in Iceland. Cryptocurrency operations have begun taking advantage of the energy potential in Iceland due to the immense capability to supply power to the entire country on 100 percent geothermal energy, (Berger, 2019). Outside of the capital of Reykjavik, Iceland, a Bitcoin mining facility, Enigma, functions purely on geothermal energy. By using geothermal energy, blockchain technology in Iceland has minimal environmental impact. Wyoming has supported Bitcoin technology and even passed 13 crypto-friendly laws, making the state an ideal place to mine Bitcoin. However, rather than using wind energy, the state allows for excess natural gas to be used in powering the blockchain technologies. Wyoming has the inherent ability to develop a similar sustainable infrastructure to minimize blockchain-related environmental impacts through wind-powered energy. While the crypto-industry in Wyoming currently utilizes excess natural gas to provide power to Bitcoin operations, harnessing the overgenerated wind would allow for cleaner, more sustainable Bitcoin mining.

### **III. Wyoming's Wind Energy Potential**

While Wyoming holds the potential to produce 1,653,856 GWh/yr in wind energy, little effort has been made to uphold a standard of technological innovation. Wyoming has yet to develop a Renewable Portfolio Standard, (EIA, 2021). Despite the state's lack of renewable energy innovation, private industries have chosen to make use of the immense energy potential. Many private entities have begun construction of wind turbines and the associated technology necessary to carry the power throughout the state and elsewhere. For example, the Transwest Express, LLC has planned and begun implementation on the nation's largest wind farm that will ultimately carry power from Wyoming to California. The amount of wind energy that would be carried is approximately 20,000 GWh/yr, providing energy to four states. In other words, the amount of wind that could potentially be transmitted by means of the Transwest Express is slightly higher than the 18,798 GWh used for electricity in the entire population of Iceland in 2015, (Iceland, 2021). Wyoming's wind generation capacity has substantially increased. According to the Energy Information Administration (2021), Wyoming has doubled their output capacity to nearly 1,800 MWh.

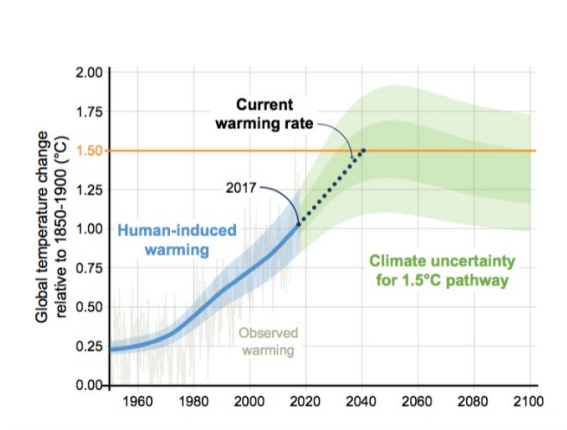
Along with the aforementioned Transwest Express project, the Rail Tie Wind Project will be providing wind power for Albany County as well as parts of Colorado, (Rail Tie Wind Project, 2021). While this project is still in its development phase, it will utilize existing transmission lines to transport the energy. Through this project alone, 504 MWh/yr of wind power will be produced, (Rail Tie Wind Project, 2021).

The production of wind energy holds such a high level of potential. Although the energy potential regarding wind is extremely high, Wyoming leads the nation in coal production. According to the Wyoming Mining Association (2019), the state mines

approximately 40 percent of the national coal and exports it to 26 different states. Unlike wind, coal is a finite resource that will inevitably deplete.

#### IV. Necessary Transition and Workforce Transformation

The energy workforce has propelled our society toward the technological advances that we have today. The United States, along with the rest of the world, has harnessed the power of fossil fuels in order to power our vehicles, provide utilities to homes and businesses, and a variety of other capacities. While the Environmental Protection Agency sites that fossil fuel combustion is the primary driver of U.S. greenhouse gases and drives anthropogenic climate change, the Intergovernmental Panel on Climate Change, (IPCC) explains that the current trajectory of emissions will raise global temperatures to 1.5°C by 2040, as seen in *Figure 1*. (IPCC, 2018).



**Figure 1.** IPCC Report indicating projected global temperature rise on the current trajectory. (IPCC, 2018)

Given that the scientific consensus indicates that fossil fuels have an adverse impact on our climate and the technology exists for wind energy and Carbon Capture, Utilization, and Storage (CCUS), an energy transition is not only ideal, but necessary.

The question of what will happen to the current energy workers is debated often by those in elected positions, but there has not been any comprehensive legislative protection for the energy sector workforce. Many of the manual laborers in the fossil fuel industry, (“Roustabouts”) are trained on the job. While this is not every case, the vast majority of roustabouts have little education, with the highest education level being high school (O\*Net, 2021). Fixed-term jobs, such as machinery operators, earn higher wages, but also require minimal education. The positions that require an education beyond high school are engineers and related fields of expertise, (BLS, 2013).

While transitioning would require a minimal amount of retraining for energy-sector employees, some workers will require more training than others. For example, career paths such as Petroleum Pump System Operators and Refinery Operators only



require a high school diploma and a year of on the job training for the position. Contrary to these positions, Roustabouts assist with many low-skilled, routine tasks such as maintaining equipment. Because of the extremely varied levels of training and skill sets, it is important to consider what skills transition to wind turbine energy and CCUS.

The prospect of the fossil fuel industry is steadily declining. According to Saha et al, (2021) 12,000 coal miners will be displaced annually between 2021 and 2030. Additionally, 34,000 oil and gas workers will face unemployment annually between 2021 and 2050. During the last few years, Wyoming has already experienced 6,000 mining jobs lost alone, (County17, 2021) with a population of 444,653 (WorldPopulation, 2021). As the resources deplete, it's necessary to find an alternative that provides stable employment with minimal to no environmental impact.

With the decline in fossil fuels, members of the associated workforce have spoken out on the anecdotal idea that their livelihoods have a high probability of looking much different in years to come. One worker, under the pseudonym Matt Craigan, explains that fossil fuel workers understand that transitioning to renewable energy is imminent, but want to ensure that they are able to transition as well, (Craigan, 2020). In addition, he elaborates on the need to diversify energy resources, as a complete transition to clean energy will require time to develop, (Craigan, 2020). Given that renewable energy technologies are not as readily accessible as fossil fuels, transitioning to renewable energy will require bridging the gap between fossil fuels and renewable energy, (Gooyert et al, 2021). This could be done through the carbon capture, utilization, and storage (CCUS) while renewable technology is under development.

As it stands, the fossil fuel industry understands the implications associated with fossil fuels and transitioning the entire workforce would require minimal retraining. Opportunities for retraining already exist in the state of Wyoming. In Wyoming, Laramie County Community College has implemented a Wind Energy program that prepares students for careers in the wind energy industry. According to the college's website, "Students will climb an operational wind turbine, visit a blade manufacturing plant, tour an electrical substation and tour a natural gas fired electrical generation station.," (LCCC, 2021). As it stands, many opportunities are currently available for fossil fuel workers to retrain into wind energy careers. With a workforce that understands and is willing to transition, providing training opportunities will accelerate the imminent renewable energy transition.

## **V. Blockchain Energy Consumption**

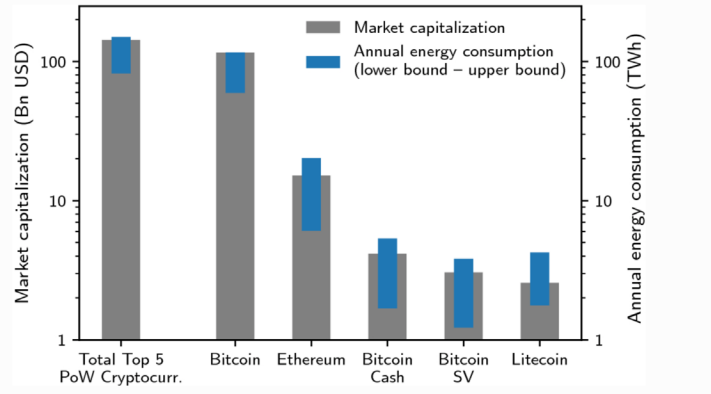
"Blockchain" is an electronic database, (i.e. ledger) that allows peer-to-peer interaction and transactions. This technology eliminates the need for a third party to mediate any transactions. Wyoming currently uses natural gas to power the Bitcoin

mining that occurs within the state. However, the overgeneration of wind energy in Wyoming provides an opportunity to provide a cheaper and more sustainable alternative to natural gas.

The energy consumption to mine an individual bitcoin is dependent on the length of proof-of-work, (Zhang et al, 2020). In order to better understand why proof of work dictates the level of energy consumption, it is necessary to understand the concept of proof-of-work. Proof-of-work is a verification system where crypto-miners essentially compete to solve an algorithm. The miner who solves the algorithm first has it verified by other competing miners. If the result was insufficient, they have to continue solving the problem; However, if it's correct the first miner gets the coins associated with the algorithm. Because there is only a set amount of bitcoins that have been created, the size of the block is constantly changing due to supply and demand. For instance, in May 2012, the size of a block was approximately 1.5 GW. Compared to 2012 sizes, May 2021 block sizes have grown to 334.07 GW (Statistica, 2021). These changes in block sizes is a result of the complexity of the algorithms and growing competition to solve them.

It is no secret that Bitcoin mining is extremely energy intensive. An individual bitcoin can utilize as much as 72,000 GWh of energy power, (Bradbury, 2020). While this is an average of mining a single bitcoin, Bradbury (2020) explains that due to a typical bitcoin algorithm taking ten minutes to solve and the typical processing unit being an Application-Specific Integrated Circuit (ASIC) the energy consumption can be as immense as 72,000 GWh. In addition, Bradbury (2020) explains that the bitcoin mining processes alone use up to 120 GW per second, which would require approximately 49,440 wind turbines to produce peak energy per second. In order to ensure that cryptocurrency has a sustainable future, it is crucial that it is mined in a manner that utilizes sustainable energy power, such as wind.

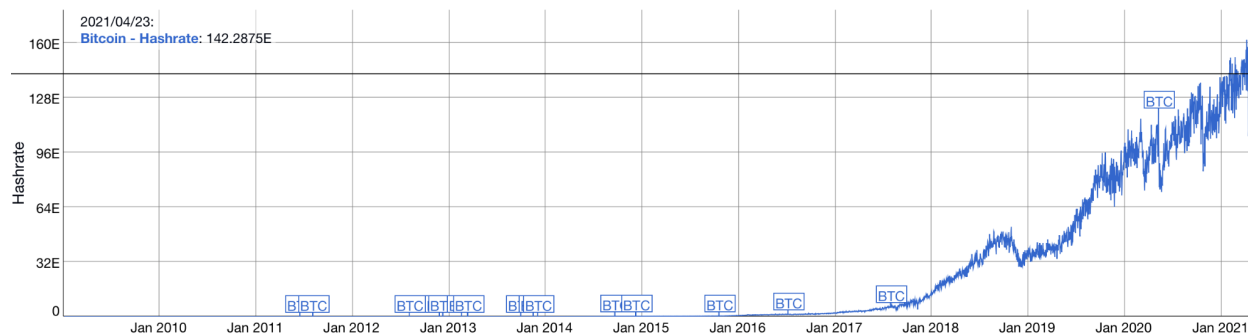
Blockchains are accessible by any given user and all activity can be monitored by all miners using it. This increases the difficulty of hacking the technology, as any nefarious activity will be verified as false and voided. This technology allows various cryptocurrencies to operate, yet requires large amounts of electricity to be powered. *Figure 2* shows the amount of energy consumed by each cryptocurrency. As displayed in the graph and explained by Sedlmeir et al (2020), Bitcoin may use up between “60 and 125 TWh per year.” This is equivalent to 60,000 and 125,000 GWh/yr. The energy consumed by Bitcoin alone can be compared to the annual energy consumption of countries such as Austria and Norway, (Sedlmeir et al, 2020). It is important to note that the carbon footprint of Bitcoin, while high, is still lower than gold. By using the overgeneration of wind for more sustainable Bitcoin mining, the footprint would continue to decrease.



**Figure 2.** Annual Energy Consumption by cryptocurrency (Sedlmeir et al, 2020)

In the realm of Bitcoin, each algorithm is intended to take approximately 10 minutes to solve, (Bradbury, 2021). Algorithms are completed as a result of hashing. The level of difficulty for each algorithm is dependent on the amount of miners attempting to solve the problem. In essence, as more individuals attempt to solve an algorithm, the more difficult it will be to solve. However, as time progresses, the algorithms become increasingly more complex. While the complexity of the algorithms is determined by the amount of miners attempting to solve it, the energy demand increases correspondingly. At the beginning of Bitcoin, there were only 21,000,000 created. As the remaining amount of bitcoins to be mined decreases, the complexity of the algorithms increases.

As Bitcoin has gained traction in the modern economy, the hash rate has sped up exorbitantly. In 2011, the average hashrate was close to 1TH/s. As of May 8, 2021, the hashrate reached 157.266EH/s. *Figure 3* shows the historical trend of increased hashrates for Bitcoin, (BitInfoCharts, 2021).



**Figure 3.** Progression of Bitcoin Hashrate (BitInfoCharts, 2021)

## VI. Blockchain, Wyoming, and China

As Bitcoin gains traction in the international realm, Wyoming has taken strides toward incentivizing miners to set up in the state. Wyoming has become a national

beacon of cryptocurrency as a result of implementing 13 cryptocurrency-friendly laws. While the state legislation is favorable toward Bitcoin miners, the energy consumption is not considered. Much of the energy required to power blockchains is done through excess natural gas. Great American Mining (2021) profits off of natural gas throughout the oil and gas industry, with the intention of providing power for bitcoin mining. As Bitcoin becomes increasingly prevalent in the world market, it will prove to be more sustainable by transitioning its power structure to renewable energy. With the least restrictive cryptocurrency laws in the U.S., Wyoming has an opportunity to use its overgeneration of wind to power the blockchain in the state.

By harnessing the power of wind energy and reducing the fossil fuel dependency of cryptocurrency, the economic stability as well as our national security will be preserved. Strengthening blockchain technology and Bitcoin in the U.S. is necessary to stay competitive with China. As blockchains are difficult to hack, U.S. assets would be well-protected if invested in Bitcoin. By investing in a clean and renewable energy system that powers blockchain and cryptocurrencies, the U.S. can be more secure in regards to trade disputes and economic sanctions. While fiat currency relies on government-backing, cryptocurrency is based on an electronic ledger that is difficult to alter and does not succumb to governmental oversight. Due to the decentralized nature of Bitcoin, the U.S. would benefit by having financial funding that can not be altered by other governments or entities. In essence, crypto currencies disentangle national finances from the international community.

It is important to mention that in recent years, China has begun cracking down on cryptocurrencies such as Bitcoin due to it forcing the local exchanges to shut down, (Kharpal, 2021). However, crypto trading has continued throughout China and exchanges have moved offshore, (Kharpal, 2021). It is important to note that the People's Bank of China has begun developing a national cryptocurrency, equivalent to Bitcoin that is controlled by the centralized government, (Kharpal, 2021). As such, this provides an opportunity for the United States to invest heavily in clean Bitcoin farms in order to redistribute the international hashrate. It is essential to ensure that the U.S. industries have a firm hold on Bitcoin as it is a currency that can not be impeded by international disputes. Up until recently, the power of economic sanctions were able to assist nations to reach an agreement on a variety of disputes. However, studies indicate that nations that have been sanctioned by the United States have begun turning to cryptocurrency as a way to continue economic growth while having international disputes, (Taskinsoy, 2019). For example, if China were to be sanctioned by the U.S., their economy would be hindered as a result. However, if Chinese industries had investments in Bitcoin, these investments would subsidize what is lost as a result of sanctions. In fact, research indicates that economic sanctions can hinder the economic standing of all nations involved, (Taskinsoy, 2019). Cryptocurrency can serve nations

as a means of economic protection due to its decentralized nature. As U.S. competitors begin harnessing the power of the blockchain, the U.S. will be forced to invest in research and development of blockchain technology.

Furthermore, Wharton School of the University of Pennsylvania has explained that China is leading the world in regards to blockchain technology altogether, (Wharton, 2019). According to the Wharton School of the University of Pennsylvania, China holds approximately 72% of the mining power for Bitcoin alone, (Wharton, 2019). While China has implemented regulations in order to reduce Bitcoin mining operations, the control is still maintained within their borders. On the other hand, the U.S. has a free market system, which allows for less governmental control of assets and serves as a perfect entry point for Bitcoin investments. By utilizing the overgeneration of wind, the international hashrate would subsequently be redistributed and lower overall emissions.

## **VII. Carbon Capture, Utilization, and Storage: The birth of a Low-Carbon Economy**

While an ideal scenario for the energy transition would focus on the complete elimination of fossil fuels, the U.S. economy is dependent on the industry. As a result, it is not feasible to immediately cease all fossil fuel use. Rather, investing economic resources into Carbon Capture, Utilization, and Storage (CCUS) could help the U.S. drastically reduce greenhouse gas emissions while opening up opportunities to use carbon to manufacture products.

CCUS is an optimal selection for reducing carbon emissions in Wyoming. The geological formations serve as assets that have the ability to sequester carbon before it enters the atmosphere. Furthermore, there is existing CO<sub>2</sub> pipeline infrastructure and power plants that are already sequestering carbon, (Bezdek, 2020). This developed infrastructure places Wyoming as a prime candidate for a low carbon economy. The CO<sub>2</sub> pipeline in Wyoming carries CO<sub>2</sub> throughout the state which would open the opportunity for the state to sell the carbon to private investors, who could reutilize it and stimulate the economy with carbon products. If additional federal funding opportunities were available, the infrastructure investment could make carbon transportation more efficient.

Uncertainty about the economic viability of CCUS still lingers, though there is a “business opportunity for American manufacturers,” (Saha et al, 2020). There have been commercial challenges, and very little global CCUS practices. There are less than 100 active CCS projects currently. Among those that are existing, most are in the U.S. The implementation of CCS technology can be harnessed by any industry that has a high CO<sub>2</sub> emission rate, such as cement, iron, and steel, (Saha et al, 2020). In

essence, many industries that have a history of excessive pollution rates now have the opportunity to reduce their environmental footprint.

The State of Wyoming has already requested the Department of Energy to conduct a study to determine the economic, employment, and environmental cost and benefits of CCS retrofitting technology. Based on the study, it was determined that retrofitting the existing infrastructure to capture carbon would reduce emissions by approximately 37%, (Leonardo Technologies, 2020). Furthermore, the study indicates that retrofitting CCS infrastructure and developing new CCS technologies would improve employment rates by 5 times the current rate, (Leonardo Technologies, 2020). While expenses may accrue, as any investment does, the benefits of CCS development proves to outweigh the costs.

Industries have already taken strides toward carbon-based products. The Department of Energy has contributed to a study that found that manufacturing captured carbon fibers to produce wind turbine blades increases the lifespan of the turbine (DOE, 2019). For states, such as Wyoming that rely heavily on fossil fuels for their economy, this method of reutilizing the captured carbon would stimulate private manufacturing of the wind energy industry and effectively fund large portions of the initial installation of wind projects.

Moreover, captured carbon has proven to be a competitive alternative to other pollutants such as plastic. For example, companies such as Lustir have begun manufacturing carbon products, to include carbon fiber straws and coasters. Another company, based out of Huntington Beach, California, manufactures foodware as well as fashion products, (Newlight Technologies, 2021). While many of the carbon-conscious companies that this research has discovered are not operating in Wyoming, they provide a guide for businesses to follow that could revitalize entire industries and bring additional jobs to the state.. As a result, Wyoming and states like it would have an opportunity to become national economic leaders as well as clean energy leaders.

### **VIII. Past Legislative Bills**

While the possibility of developing national CCS infrastructure, Bitcoin-incentivized policies, and wind turbine development exists, the federal legislature would need to implement policies to incentivize states to integrate the associated infrastructure and technology. Federal legislators have introduced bills that focused on energy transition and the associated work force. However, no substantial, comprehensive energy-related legislation has been passed and implemented into law. This section will focus on the analysis of proposed legislation that has failed to be implemented. More specifically, this analysis will provide evidence of shortcomings and vital gaps that would have helped these bills gain bipartisan support.

## **A. H.R. 1005: “Renewable Energy Jobs Act” (114th Congress)**

The Renewable Energy Jobs Act was proposed under the 114th Congress by Representative Raul Ruiz, (CA-36). The primary purpose of this bill was to provide economic incentives to States in order to develop renewable energy and energy efficient technologies and train the associated workforce for the necessary jobs. Some of the legislative gaps and barriers that this bill has include the regions of priority, ambiguity of funding, and lack of bipartisan support.

### **1. Regions of Priority**

If it were implemented, H.R. 1005 would have focused the allocation of grants toward states that have the most developed renewable energy infrastructure. Yates (2012) explains that the five highest renewable energy producing states are Washington, California, Oregon, Texas, and New York.

Moreover, while these states have the highest level of developed infrastructure, and may produce a sizable amount of renewable energy, other states have been identified as leaders in renewable energy potential. As the southeastern portion of Wyoming leads the nation in on-shore wind energy potential and has proven to have the ability to carry the energy to far-reaches of the U.S., providing federal assistance for development and retraining would have more long term benefits. Rather than focusing on states that already have invested in renewable technologies, this legislation may spark support from Wyoming if grants were allocated to those states with highest renewable energy potential.

### **2. Ambiguity of Funding**

The Renewable Energy Jobs Act specifies that the grants allocated to states are to be distributed by the Secretary of Labor. However, there is no clear indication of whether the funding comes from the Department of Labors standing budget or if additional funding is provided for the intended purpose. Without any specified plan as to where funding is coming from, partisan debates will likely continue.

Cooperation between both chambers of the federal legislature is needed in order to resolve the ambiguity of funding. While the House of Representatives is responsible for establishing the budget for each specific federal department, the Senate is required to pass legislation that would direct the guidelines and regulations that agencies must abide by. In order to implement a bill, such as the Renewable Energy Jobs Act, the source of funding would need to be established.

In order to ensure that funding for the Renewable Energy Jobs Act is secured, implementing the tenets of the bill into a bipartisan effort may prove to be more efficient.

For example, infusing the tenets into S. 1260 would incentivize bipartisan support and ensure that funding for renewable energy and energy efficiency are imminent.

### **3. Lack of Bipartisan Support**

The third, and possibly the most significant reason, H.R. 1005 did not get implemented was that there was a lack of bipartisan support. Many states that have joined the renewable energy revolution tend to be coastal states with large economies. Renewable energy and energy efficient technologies create a more sustainable energy supply that is economically cheaper than fossil fuels longterm. As such, it would be advantageous for states that have little to no renewable energy to begin research and development in this sector. The Biden administration has worked to promote bipartisan efforts on these developments. Rather than framing the energy transition as an ideological platform, the legislative body would be better off framing it as an economically-beneficial transition.

### **B. Green New Deal under a Biden Administration**

The Green New Deal has been fuel for political debates since its introduction. The resolution calls for a massive overhaul of our energy systems and transition to renewable energy, along with other greenhouse gas emitting activities. The legislation calls for 40-60 percent reduction in greenhouse gas emissions by 2030. Subsequently, it calls for the United States to achieve net-zero carbon emissions by 2050.

The Green New Deal has not been implemented, but the Biden Administration is focusing on portions of the bill in their climate agenda. For example, one of the primary tenets of the Green New Deal is to provide a fair and just transition for fossil fuel workers as they retrain into renewable energy and CCS technologies as well as providing an opportunity for these workers to earn a dignified, prosperous wage. Additionally, the Green New Deal has called for heavy investment in the corresponding infrastructure in order to lower greenhouse gas emissions and maximize energy efficiency.

Despite the effort by the Biden Administration, the Green New Deal sponsors are saying that the effort being made is simply not enough to achieve the overarching goals of the bill. However, it is crucial to mention that President Biden never endorsed the Green New Deal and is simply taking concepts and applying them to his legislative agenda. In order to fully understand the impact that the Green New Deal will have on our national emissions and economic prosperity, it is important to assess how a Biden Administration is focusing on it. President Biden may not have endorsed the bill, but has taken steps that parallel those of the Green New Deal.

### **1. Fair and Just Transition**



The Green New Deal calls for a fair and just transition away from fossil fuels for all associated workers and communities. While this is a significant inclusion in the legislation, it lacks the details as to how these workers will transition. As such, this bill sparks partisan debates that may likely be due to officials trying to appeal to their constituents. In order to pass the Green New Deal as a comprehensive piece of legislation, it is essential that details are outlined.

Under the current administration, President Biden has addressed the importance of transitioning to renewable energy and energy efficient technologies. Packaged as the American Jobs Plan, the administration is investing federal funding in order to build clean infrastructure. In addition, the American Jobs Plan provides retraining opportunities to energy workers in order to ensure that they have a smooth transition with an economically secure future.

## **2. Economic Prosperity**

As the Green New Deal promises economic prosperity, the Biden administration has taken similar steps to ensure this is more than just a concept; but rather an achievable plan. In a similar fashion to the Green New Deal, the American Jobs Plan promotes the need to allow workers to unionize. By allowing workers to unionize, wages will likely see an increase as well as more comprehensive healthcare options, (Walters et al, 2003). As a result of these guarantees, the American workforce will operate more effectively and efficiently.

In order to be prosperous, the access to adequate housing is essential. Under the American Jobs Act, \$213 billion will be invested in retrofitting housing communities with energy efficient technologies. The energy efficiency will bring down costs associated with housing as a result of less energy dependence. The areas that the Biden administration intends to invest most in are underprivileged communities, (Jaeger et al, 2021).

Along with housing, the American Jobs Plan intends to update schools, federal buildings, and other spaces in order to reduce greenhouse gas emissions. By opening the opportunity to upgrade the infrastructure and buildings, the opportunity for additional jobs is opened.

## **3. Sustainable Infrastructure**

As previously mentioned, the American Jobs Act has taken bold steps toward ensuring communities are sustainable and resilient to climate change. As such, the plan includes a proposal of \$100 billion that would be invested in clean energy power technologies. These technologies include but are not limited to the development of

transmission lines, the modernization of the electrical grid, and energy storage technology, (Jaeger et al, 2021).

By developing clean energy infrastructure, the dependence on fossil fuels will not only be reduced, but provide a sustainable future for generations to come. The aforementioned \$100 billion investment could assist in funding energy infrastructure projects across the country, leading to an increase in interstate energy cooperation and transmission. As such, the U.S. would become a more economically stable nation with a workforce that has job security without a “boom-bust” cycle looming around every corner.

Providing sustainable infrastructure not only fits into the ideal of the Green New Deal, but proves that aspects of the bill would work if implemented. Rather than depending on fossil fuels, the American Jobs Plan would provide a safe, economically and environmentally-stable energy production, U.S.-made manufacturing, and a thriving workforce.

## **X. SCALE Act**

The Storing CO<sub>2</sub> and Lowering Emissions (SCALE) Act is a bipartisan bill that was introduced earlier this year in the United States Senate. A large portion of this bill pertains to funding CO<sub>2</sub> storage transportation infrastructure.

### **A. Inclusion of Renewable Energy and economic stimulant**

Although a bipartisan cohort of legislators have joined together to reduce carbon emissions, the purpose of the bill should not be only to invest in CCUS. In order to reach a solution that satisfies the majority of Americans, it is vital that the integration of renewable energy is present in the legislation.

### **B. Funding of the SCALE Act**

As a bipartisan effort to mitigate carbon emissions by stimulating the economy and incorporating the fossil fuel industry on the road to renewable energy, the SCALE Act would effectively provide funding to various government agencies. For instance, the Environmental Protection Agency (EPA) would be granted funding in order to, “permitting Class VI CO<sub>2</sub> storage wells, and grants for states to establish their own Class VI permitting programs, to ensure rigorous and efficient permitting of CO<sub>2</sub> storage infrastructure,” (Coons, 2021). In essence, the EPA would oversee the implementation of carbon sequestration infrastructure.

According to Senator Coons (DE-D), the plan for CCUS follows, “the chicken or the egg,” train of thought, (Coons, 2021). By this, the infrastructure must be constructed and operational prior to carbon capture projects being committed. Similarly, carbon

capture projects must be established prior to investments being made toward CCS infrastructure.

### **C. Thinking Forward**

Ensuring that technological innovations have the potential to be expanded on is essential in order to have the possibility of economic growth. If enacted, the SCALE Act would need to ensure that investments in CCS technology allow enough caliber for future growth without any potential for economic hindrance, (Coons, 2021). By opening up grant opportunities to not only states, but local governments and private entities, the concern of emissions can be mitigated locally, state-wide, and nationally. Subsequently, this legislation is likely to achieve its goal of sparking innovation and stimulating economic growth by creating jobs.

Not only does the SCALE Act address reducing emissions while stimulating the economy, but the bipartisan nature of this bill addresses the consensus that it is essential to address climate change. The debate simply regards the means of addressing it. While this is only one facet of the climate change solution, it would result in a positive solution, while opening the door for discussions about renewable energy.

Additionally, the Biden Administration has championed the position that the Executive branch would promote CCS technology and provide funding opportunities for the necessary infrastructure to be developed. This method leads the way for the adaptation of other energy efficient and clean energy technologies.

## **XI. S.1260: The Endless Frontier Act**

The Endless Frontier Act is a bipartisan piece of legislation that aims to maintain technological competitiveness against China. Through this act, a Technology Directorate would be established through the national Science Foundation. The purpose of this bill would be to establish funding that would take strides toward enhancing the technology sector among many others in order to maintain competitiveness with China.

### **A. Bipartisan Support**

The Endless Frontier Act recently passed the Senate and will be referred to the House of Representatives. The salient features of the bill include \$100 billion funding to the National Science Foundation, in order to establish a Technology Directorate. With the support of both major political parties, the bill is almost imminent to pass Congress.

### **B. Integration of Green New Deal**

Due to the bipartisan support on this bill, infusing the tenets of the Green New Deal would ensure fair wages, comprehensive healthcare options, and retraining

opportunities for energy workers. Not only does the Biden agenda parallel these ideals, but integrating them into comprehensive policy will ensure that the ideals outlive this administration's term. This includes investing \$213 billion in older, low socioeconomic housing options for energy efficient retrofits.

### **C. Integration of the SCALE Act**

Integrating carbon capture and storage infrastructure into the Endless Frontier Act would ensure its passage into law. Because both bills are bipartisan and the Endless Frontier Act already passed the Senate, including the tenets of the SCALE Act would almost guarantee passage.

## **XII. IRS Reg Q**

IRS Reg Q is essentially a carbon credit. However, rather than getting a credit for reducing carbon emission output, the credit is given to facilities that sequester their carbon. While larger facilities are able to claim the credit, smaller companies have the ability to merge in order to claim the credit. However, the caveat regarding this credit is that repayment of the credit must be made if carbon is determined to have leaked within the first three years of sequestration.

If further implementation of this credit was attached to the Endless Frontier Act more companies would be incentivized to retrofit their existing equipment and install what is needed. However, it's imperative that the storage equipment is sufficiently installed and regulatory compliance is adhered to. This is essential in order to ensure that no carbon leakage comes to fruition; and should leakage occur, it is addressed immediately.

## **XIII. Policy Recommendations**

The U.S. energy systems act as a double-edged sword. While the technology and fossil fuels that our economy and livelihoods are dependent on have led our society to where it is today, the development and integration of renewable energy is essential to secure a habitable environment for future generations. As such, comprehensive energy policy must be implemented. Based off previous literature, this policy should include the following:

1. Economic feasibility
2. Inclusion of Wind and CCUS
3. Workforce transition considerations
  - a. Inclusion of retraining opportunities and economic stipends while retraining.

4. Economic incentives for U.S.-based crypto-companies that decarbonize their technological practices.
5. Provide federal grants for infrastructure development and renewable energy manufacturing.

Due to the strong bipartisan support and Senate passage of the Endless Frontier Act, this research recommends that this bill include provisions that provide funding for wind turbine development. By using the overgeneration of wind in Wyoming, the U.S. will remain competitive with China's energy sector. In addition, funding CCS technological development will reduce emissions and ensure that industries can harness the captured carbon for manufacturing purposes. More specifically, establishing the funding of \$213 billion that the Biden Administration proposed for low income community retrofits will help assist with lower emissions and improving economic prosperity.

Placing all of these facets under the Technology Directorate at the National Science Foundation would consolidate the responsibility and ensure equal oversight of technology programs. With the purpose of maintaining international competitiveness, this is essential for sufficient oversight. Because of the bipartisan support and the passage of the bill in the Senate, the inclusion of these aspects would guarantee renewable energy development, redistribution of global hashrate, and strong U.S. economic development.

Sources

Berger. (2019). *Exploring cryptocurrency and blockchain in Iceland*. Penn Today. <https://penntoday.upenn.edu/news/exploring-cryptocurrency-and-blockchain-iceland>.

Bezdek. (2020). *Wyoming Carbon Capture, Utilization, and Storage (CCUS) Study*. ResearchGate. [https://www.researchgate.net/publication/344256917\\_Wyoming\\_Carbon\\_Capture\\_Utilization\\_and\\_Storage\\_CCUS\\_Study/link/5f610fad92851c07896a0185/download](https://www.researchgate.net/publication/344256917_Wyoming_Carbon_Capture_Utilization_and_Storage_CCUS_Study/link/5f610fad92851c07896a0185/download)

*Bitcoin Hashrate Chart*. BitInfoCharts. (2021). <https://bitinfocharts.com/comparison/bitcoin-hashrate.html>.

Bradbury, D. (2020, April 22). *The Power It Takes to Create a Bitcoin*. The Balance. <https://www.thebalance.com/how-much-power-does-the-bitcoin-network-use-391280>.

*Carbon capture and storage in de-carbonising the Chinese economy*. Global CCS Institute. (2021). <https://www.globalccsinstitute.com/news-media/insights/carbon-capture-and-storage-in-de-carbonising-the-chinese-economy/>.

*Climate change impacts*. Climate change impacts | National Oceanic and Atmospheric Administration. (2019). <https://www.noaa.gov/education/resource-collections/climate/climate-change-impacts>.

Coons. (2021). *SCALE Act of 2021 (Storing CO2 and Lowering Emissions Act)*. [coons.senate.gov](https://www.coons.senate.gov). <https://www.coons.senate.gov/imo/media/doc/One%20Pager%20-%20SCALE%20Act%20-%20117.pdf>.

Craig. (2020, September 29). *Many fossil fuel workers like me want to transition to renewables – but we need support | Matt Craigan*. The Guardian. <https://www.theguardian.com/commentisfree/2020/sep/29/fossil-fuel-workers-transition-renewables-covid>.

*Critical grid infrastructure to connect the West*. TransWest Express Transmission Project: Delivering Wyoming Wind Energy. (2021). <http://www.transwestexpress.net/>.

Dahlman. (2020, August 14). *Climate Change: Annual greenhouse gas index: NOAA Climate.gov*. Climate Change: Annual greenhouse gas index | NOAA Climate.gov. <https://www.climate.gov/news-features/understanding-climate/climate-change-annual-greenhouse-gas-index>.

Denchak. (2019, November 4). *Fracking 101*. NRDC.  
<https://www.nrdc.org/stories/fracking-101>.

Deti, & Joyce. (2019). *2019 Wyoming Coal Overview*. Wyoming Mining Association. <https://www.wyoleg.gov/InterimCommittee/2019/09-2019082816-02UpdatedWMACoalOverview.pdf>.

*Energy*. (2021). <https://www.government.is/topics/business-and-industry/energy/>.

EPA. (2016). *What Climate Change Means for Wyoming*. Environmental Protection Agency.  
<https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/climate-change-wy.pdf>.

Fiorino, Weted, & Vecchi. (2019). *The Politics of Energy Efficiency: Explaining Policy Variations in the American States*.  
<https://www.ippapublicpolicy.org/file/paper/5d025e2838813.pdf>.

Frequently Asked Questions (FAQs) - U.S. Energy Information Administration (EIA). (2021). <https://www.eia.gov/tools/faqs/faq.php?id=73&t=11>.

*Frequently Asked Questions*. Intergovernmental Panel on Climate Change. (2018).  
[https://www.ipcc.ch/site/assets/uploads/sites/2/2018/12/SR15\\_FAQ\\_Low\\_Res.pdf](https://www.ipcc.ch/site/assets/uploads/sites/2/2018/12/SR15_FAQ_Low_Res.pdf).

Gooyert, & Gursan. (2020, November 17). *The systemic impact of a transition fuel: Does natural gas help or hinder the energy transition?* Renewable and Sustainable Energy Reviews.  
<https://reader.elsevier.com/reader/sd/pii/S1364032120308364?token=8D2BA3B2181E03D93AED75617E11CC5B8D9DB7088CA4AE6A653E5CAB57E7AE2BDB1964E95EDCAE0FAA8FD7D1C0780775&originRegion=us-east-1&originCreation=20210520052350>.

Lustir. (n.d.). <https://www.lustir.com/>.

McKim. (2020, June 8). *Proposal To Raise Wind Tax Dies Again In Committee*. Wyoming Public Media. <https://www.wyomingpublicmedia.org/post/proposal-raise-wind-tax-dies-again-committee#stream/0>.

NASA. (2021, January 22). *Global Surface Temperature*. NASA.  
<https://climate.nasa.gov/vital-signs/global-temperature/>.

Ocasio-Cortez. (2019). Congress.gov.  
<https://www.congress.gov/116/bills/hres109/BILLS-116hres109ih.pdf>.

*Optimized Carbon Fiber Composites in Wind Turbine Blade Design*. Energy.gov. (2019). <https://www.energy.gov/eere/wind/downloads/optimized-carbon-fiber-composites-wind-turbine-blade-design>.

*Resources Work: Careers in Mining, Oil, and Gas*. Bureau of Labor Statistics. (2013). <https://www.bls.gov/careeroutlook/2013/spring/art02.pdf>.

Ruiz, R. (2015, April 29). *H.R.1005 - 114th Congress (2015-2016): Renewable Energy Jobs Act*. Congress.gov. <https://www.congress.gov/bill/114th-congress/house-bill/1005?s=1&r=61>.

*S. 1260, Endless Frontier Act, with an Amendment in the Nature of a Substitute, the United States Innovation and Competition Act of 2021*. Congressional Budget Office. (2021, May 25). <https://www.cbo.gov/publication/57242>.

Saha, & Jaegar. (2020). *AMERICA'S NEW CLIMATE ECONOMY: A COMPREHENSIVE GUIDE TO THE ECONOMIC BENEFITS OF CLIMATE POLICY IN THE UNITED STATES*. World Resources Institute. <http://www.truevaluemetrics.org/DBpdfs/Initiatives/WRI/WRI-americas-new-climate-economy-2020.pdf>.

Sedlmeir, J., Buhl, H. U., Fridgen, G., & Keller, R. (2020, June 19). *The Energy Consumption of Blockchain Technology: Beyond Myth*. Business & Information Systems Engineering. <https://link.springer.com/article/10.1007/s12599-020-00656-x>.

*Summary Report for: 47-5071.00 - Roustabouts, Oil and Gas*. O\*NET OnLine. (2021). <https://www.onetonline.org/link/summary/47-5071.00>.

*Supporting Wind Energy in Texas*. Powering Texas. (2021, May 25). <https://poweringtexas.com/>.

Taskinsoy. (2019). *Blockchain: Moving Beyond Bitcoin into a Digitalized World*. ResearchGate.com. [https://www.researchgate.net/profile/John-Taskinsoy/publication/336616643\\_Blockchain\\_Moving\\_Beyond\\_Bitcoin\\_into\\_a\\_Digitalized\\_World/links/5da8a3224585159bc3d5ae5f/Blockchain-Moving-Beyond-Bitcoin-into-a-Digitalized-World.pdf](https://www.researchgate.net/profile/John-Taskinsoy/publication/336616643_Blockchain_Moving_Beyond_Bitcoin_into_a_Digitalized_World/links/5da8a3224585159bc3d5ae5f/Blockchain-Moving-Beyond-Bitcoin-into-a-Digitalized-World.pdf).

Technologies, L. (2020). *Wyoming Carbon Capture, Utilization, and Storage (CCUS) Study*. County 17. [https://county17.com/wp-content/uploads/sites/25/2020/09/eenews\\_DOE\\_CCUS\\_report.pdf](https://county17.com/wp-content/uploads/sites/25/2020/09/eenews_DOE_CCUS_report.pdf).



U.S. Bureau of Labor Statistics. (2021, March 31). *47-5071 Roustabouts, Oil and Gas*. U.S. Bureau of Labor Statistics.  
<https://www.bls.gov/oes/current/oes475071.htm>.

*U.S. Department of the Treasury*. Treasury Department and Internal Revenue Service Release Final Rule on Section 45Q Credit Regulations | U.S. Department of the Treasury. (2021). <https://home.treasury.gov/news/press-releases/sm1227>.

*U.S. Energy Information Administration - EIA - Independent Statistics and Analysis*. Where greenhouse gases come from - U.S. Energy Information Administration (EIA). (2021). <https://www.eia.gov/energyexplained/energy-and-the-environment/where-greenhouse-gases-come-from.php>.

The United States Government. (2021). *FACT SHEET: The American Jobs Plan*. The White House. <https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/31/fact-sheet-the-american-jobs-plan/>.

Unwin, J. (2019). *Top ten US states by wind energy capacity*. Power Technology. <https://www.power-technology.com/features/us-wind-energy-by-state/>.

*US Department of Energy and State of Wyoming Partner on Study Showing Potential*. governor.wyo. (2020). <https://governor.wyo.gov/media/news-releases/2020-news-releases/us-department-of-energy-and-state-of-wyoming-partner-on-study-showing-poten>.

Walters, & Mishel. (2003). *How unions help all workers*. Economic Policy Institute. [https://www.epi.org/publication/briefingpapers\\_bp143/](https://www.epi.org/publication/briefingpapers_bp143/).

*Wind Energy Program - LCCC: Laramie County Community College, Wyoming*. LCCC. (2021). <http://lccc.wy.edu/pathways/tradesTechnical/windEnergyProgram/index.aspx#prettyPhoto>.

The Wind Prospector. (2021). <https://maps.nrel.gov/wind-pro prospector/?aL=CxvzHk%255Bv%255D%3Dt&bL=clight&cE=0&IR=0&mC=42.93631775765237%2C-105.897216796875&zL=7>.

*Wyoming Loses 14,400 Energy Jobs In November Compared To 2019*. County 17. (2021, January 16). <https://county17.com/2021/01/16/wyoming-loses-14400-energy-jobs-in-november-compared-to-2019/>.

*Wyoming Population 2021*. Wyoming Population 2021 (Demographics, Maps, Graphs). (2021). <https://worldpopulationreview.com/states/wyoming-population>.

Yates, Y. (2019, September 9). *Top Ten U.S. States for Renewable Energy Installed Capacity*. Renewable Energy World.  
<https://www.renewableenergyworld.com/baseload/red-white-and-renewable-the-top-ten-u-s-states-for-alternative-energy/#gref>.

Zhang, R., & (Victor Chan, W. K. (2020). *Evaluation of Energy Consumption in Block-Chains with Proof of Work and Proof of Stake*. NASA/ADS.  
<https://ui.adsabs.harvard.edu/abs/2020JPhCS1584a2023Z/abstract>.