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Measuring the Economic Impacts of Wind Projects in Wyoming

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Measuring the Economic Impacts of Wind Projects in Wyoming

June 2022

Center for Business and Economic Analysis

The Center for Business and Economic Analysis (CBEA) at the University of Wyoming (UWyo) supports the economic growth and diversification of Wyoming's economy through applied economic and business analytics for communities, industries, and entrepreneurs who desire a prosperous Wyoming. The Center was established in 2019 as a unit within the College of Business. CBEA is a member of the Association for University Business and Economic Research.

Team

David Aadland, Director, Associate Professor, and Chair of the Department of Economics
Dr. David Aadland is the Director of the CBEA and an Associate Professor in the Department of Economics at UWyo. His research interests have been wide and varied over the years with papers written in the areas of macroeconomics, non-market valuation, applied econometrics, behavioral economics, agricultural economics, and statistics. His recent research has focused on interdisciplinary natural resource questions and the intersection of ecology, epidemiology, entomology, and economics. He holds a Ph.D. in Economics from the University of Oregon.

Christelle Khalaf, Associate Director
Dr. Christelle Khalaf is the Associate Director for CBEA. She has served as a member of the advisory panel on the Anchor Economy Initiative at the Federal Reserve Bank of Philadelphia in 2021, and as a member of the Ohio Economic Roundtable in 2020, which was convened by Governor DeWine and the Ohio Office of Budget and Management to discuss the state's economic outlook given the COVID-19 health pandemic. Khalaf is author or co-author of over 20 technical reports and briefs and has been quoted in several news media outlets, including NPR, HuffPost, and Energy News Network. She has published peer-reviewed papers in journals such as *Economic Development Quarterly*, *Economic Inquiry*, and *Journal of Labor Research*. Khalaf holds a Ph.D. in Economics from North Carolina State University and a Harvard Kennedy School Executive Certificate in Leading Economic Growth.

Srutakirti Mukherjee, Research Assistant
Srutakirti Mukherjee is a Ph.D. student in the Department of Economics at UWyo. Her areas of interest are conservation economics, natural resource and environmental economics, and energy economics. She holds a master's degree in Economics from the University of Calcutta, India.

Kiptia Lima, Research Assistant
Kiptia Lima is a second-year master's student in the Department of Economics at UWyo. She has a bachelor's and a master's degree from the University of Dhaka, Bangladesh. Her areas of interest are public goods provision, energy economics, behavioral economics, and labor economics. She is currently examining signaling in the job market as it pertains to gender and risk preferences.

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Correspondence: For additional information, contact ckhalaf@uwyo.edu.

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Executive Summary

This report details a comprehensive economic impact study for wind energy projects in the State of Wyoming, as conducted by the Center for Business and Economic Analysis (CBEA) at the University of Wyoming (UWyo), and as supported by UWyo's School of Energy Resources. To better comprehend the aggregate economic impacts of current and future scenarios of project deployment in the state, the CBEA research team conducted an economic impact analysis around three distinct deployment scenarios: a "low" scenario (2 gigawatts (GW)), a "moderate" scenario (4 GW), and an "aggressive" scenario (6 GW). These scenarios reflect deployment beyond what is currently installed. Our team also conducted a brief fiscal analysis, as well as a review of the permitting process for wind projects in the state, and compared that process across other states.

Key findings from our employment impact calculations indicated that, in our low scenario, these additional wind projects would support a total of 3,216 construction phase jobs, and 528 operations and maintenance (O&M) phase jobs over the life of the systems (i.e., roughly 20 years), assuming 100% Wyoming-based labor, but non-Wyoming manufactured turbines, blades, and towers. In our moderate scenario, we found that 6,432 construction phase jobs, and 1,056 O&M phase jobs, would be supported. Finally, our most aggressive scenario showed that 9,648 construction phase jobs, and 1,584 O&M phase jobs, would be supported. We note that these figures represent estimates reflecting current manufacturing market dynamics. However, Wyoming could see even larger employment impacts if additional in-state manufactured materials were utilized.

Moreover, we determined that these three deployment scenarios would bring sizeable economic impacts to the state. First, we calculated a total of roughly \$385M construction phase economic impacts to Wyoming in our low scenario, with an annual estimate of \$70M economic impacts over the life of the systems. In our moderate scenario, we calculated construction phase impacts at \$772M, with the annual O&M phase impact at almost \$140M. Our aggressive deployment scenario increased these totals to \$1.2B in the construction phase and \$210M annually in the O&M phase. The total economic impacts of these O&M scenarios, assuming a 20-year life of the wind projects, would be \$1.4B (low), \$2.8B (moderate), and \$4.2B (aggressive).

Further, wind energy can enhance tax revenues to geographies that would greatly benefit from such dollars. We determined that Wyoming could receive about \$30M in annual tax revenues in our low deployment scenario (or \$600M total over 20 years), \$60M in our moderate scenario (or \$1.2B total), and \$89M in our aggressive scenario (or \$1.8B total) from sales tax, generation tax, and property tax collections. Notably, the possible implementation of federal revenue-sharing of renewable fees, could bring Wyoming \$1M in annual federal royalties in our low deployment scenario (or \$20M total over 20 years), \$2M in our moderate scenario (or \$40M total), and \$3M in our aggressive scenario (or \$60M total), assuming half of the wind energy project deployment occurs on federal land.

Estimates presented in the report provide benchmarks for the economic and fiscal impacts of wind projects. However, they do not comprehensively quantify the benefits of these projects. To illustrate, wind power plants pay land leases and fees for the use of federal, state, and private land. Income received by private landowners creates ripple effects in the economy, similar to the economic impact from construction or operations. Fees from leases of state land contribute to Wyoming's fiscal revenue. Although we do not explicitly model these private and state land lease-related impacts, we note that they create economic benefits to the region beyond what is discussed in the report.

This analysis concludes with synthesizing takeaways on the permitting process for wind projects in the State of Wyoming, which has observable implications for the workforce, economic development, and the state's fiscal revenues. In sum, for projects with limited federal intervention, the permitting process can be completed within 12 months. However, this timeline is significantly extended once robust federal involvement is required.

In fact, across all Federal agencies, examining 1,276 Environmental Impact Statements published between January 2010 and December 2018, the average completion time, from Notice of Intent to Record of Decision, was 4.5 years (Council of Environmental Quality, 2020). This creates significant challenges for states with a large share of federal land. Permitting delays have been shown to lead to a series of adverse outcomes including investors abandoning development and an increase in the cost of electricity (Neupane, Adhikari, & Wiggin, 2022). Consequently, these delays negatively impact regional economic growth.

Effectively, only about 5 percent of total producing utility-scale wind energy capacity in the United States is generated from facilities on public lands (BLM, 2022). Here, in Wyoming, none of the projects constituting the 3.1 GW of wind capacity currently in place, are located on federal land. For context, Wyoming's potential wind capacity is estimated at 472 GW (Wind Energy Technologies Office, 2022). However, reaching this potential remains challenging, without significant commitment from federal agencies for a prompt streamlined permitting process, especially for a state with such a high concentration of federal lands.

1. Introduction

This report begins by reviewing the current state of wind energy development, both nationally and in the State of Wyoming, in Section 2. It then assesses the economic impact of the average proposed wind project in the state, as well as three different deployment scenarios: a "low" scenario (2 gigawatts (GW)), a "moderate" scenario (4 GW), and an "aggressive" scenario (6 GW), in Section 3. These scenarios reflect deployment beyond what is currently installed. To model the economic impact of wind projects, we use the National Renewable Energy Laboratory's (NREL) Jobs and Economic Development Impact (JEDI) model.

JEDI models utilize multipliers and consumption patterns derived from the IMpact Analysis for PLANning (IMPLAN) data. IMPLAN uses input-output (I-O) methodology to track the ripple effects created in the regional economy due to every initial dollar spent. This model is widely used to assess the economic impact of specific projects as well as the economic contribution of pertinent sectors. For example, IMPLAN has been used to (1) examine the adverse economic impacts of coal-fired power plant closures in Appalachian Ohio (Jolley et al., 2019), (2) measure the economic contribution of the commercial logging industry across all 50 states (Jolley et al., 2020), (3) quantify the economic impact of small colleges on their regions (Khalaf, Jolley, & Clouse, 2021), and (4) calculate the return-on-investment of free land as an economic development incentive in Cheyenne, Wyoming (Khalaf, 2021).

In the context of this report, the ripple effects captured by I-O models can be better understood using the activities of a wind developer as an example. When a wind developer purchases supplies from a local vendor, that local vendor provides wages to its employees and makes purchases from other vendors. In turn, these other vendors provide wages to their employees and make purchases from other vendors, and the cycle continues. Additionally, when employees of the developer in charge of operating the wind project spend their paychecks at local businesses, these local businesses provide wages to their employees, make purchases from other vendors, and so forth. As a result, the initial dollars spent will be circulated throughout the local economy several times. The impact of this initial spending on the regional economy can be estimated using economic multipliers.

In addition to the economic impact measured with jobs or value added, spending associated with wind activities will generate state and local government tax revenue from sales tax, generation tax, and property tax collections. Taken together, this tax revenue will benefit local schools, health systems, senior citizens, and many other aspects of Wyoming counties and communities. Section 4 presents results from calculating the potential tax revenues from wind energy deployment in Wyoming as well as an estimation of hypothetical revenue from federal revenue-sharing of renewable fees, if such a provision is implemented.

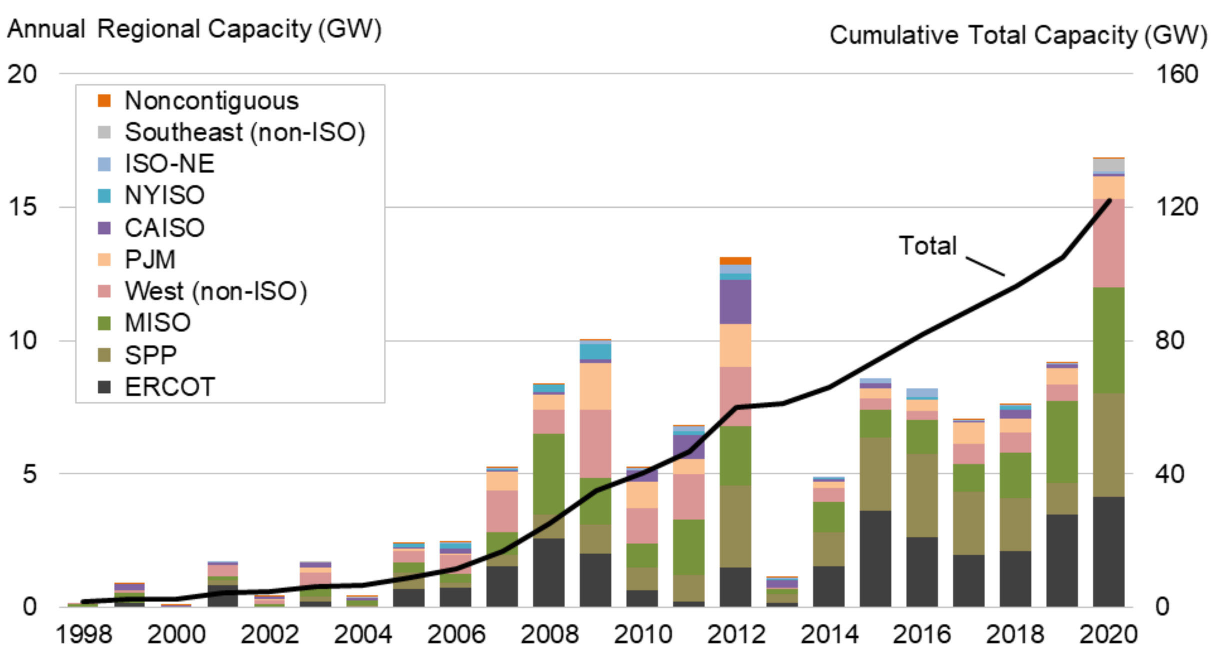
Finally, in Section 5, the CBEA provides synthesizing takeaways on the permitting process for wind projects in the State of Wyoming. The timeline for wind projects without significant federal intervention is contrasted with the timeline for projects with robust federal involvement. The findings suggest that the permitting process can be completed within 12 months for projects mainly involving state agencies compared to over four years for projects involving federal lands.

Wyoming's potential wind capacity is estimated at 472 GW (Wind Energy Technologies Office, 2022). However, currently, the state has a sparse 3.1 GW of wind capacity installed. Positioning the state and other similar regions, with a high concentration of federal lands, to reach their full wind energy deployment potential, requires significant commitment from federal agencies for a prompt streamlined permitting process.

2. Current State of Wind Development

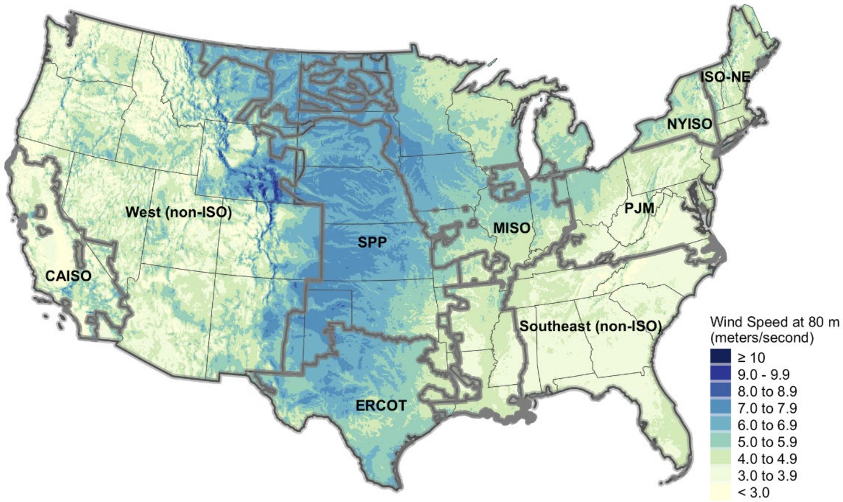
As of 2020, the U.S. had a cumulative wind capacity totaling 121,985 MW, with wind providing more than 10% of electricity in 16 states, and over 30% in Iowa, Kansas, Oklahoma, South Dakota, and North Dakota (Wiser et al., 2021). As shown in Figure 2.1., more than 70% of the new wind capacity installed in 2020 is located in the Electric Reliability Council of Texas (ERCOT), Midcontinent Independent System Operator (MISO), and Southwest Power Pool (SPP) regions. Regions covered by these independent system operators (ISO) are illustrated in Figure 2.2, as well as the average annual speed at 80 meters by ISO region.

Figure 2.1. National Installation Trends



Note: This figure from Wiser et al. (2021) illustrates national installation trends by ISO region.

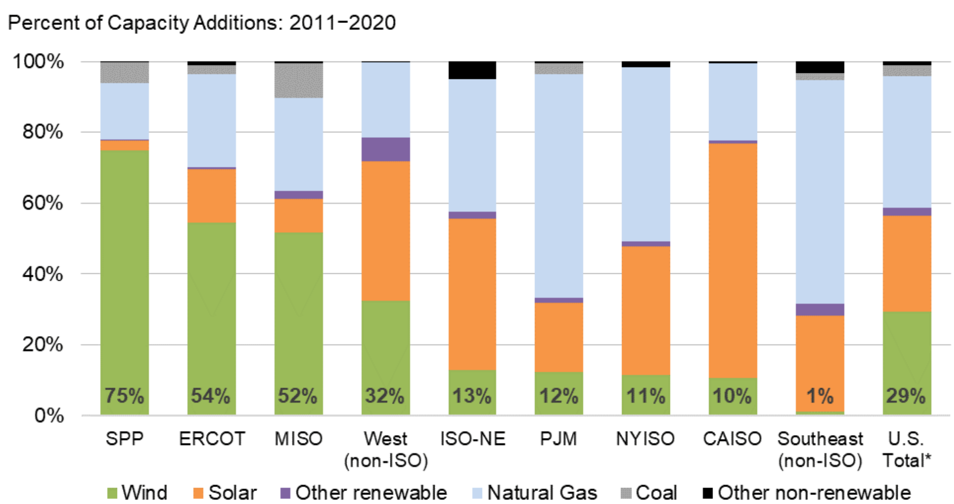
Figure 2.2. Average Annual Wind Speed at 80 Meters by Region



Note: This figure from Wiser et al. (2021) illustrates the average annual speed at 80 meters by ISO region.

While Figure 2.2. illustrates the states with substantial wind resources, Figure 2.3. illustrates additions over the 2011-2020 period by source and ISO region. The Midwest and Texas regions had the most wind capacity additions, which is consistent with the distribution of wind resources across the nation. In addition, the non-ISO regulated Western U.S. has seen significant wind additions, though to a lesser extent.

Figure 2.3. National Capacity Additions by Source and ISO Region



Note: This figure from Wiser et al. (2021) illustrates national capacity additions over the last decade by source and ISO region.

Focusing on Wyoming, Table 2.1. lists the top states for installed wind capacity as of the end of 2021 compared to the end of 2019. Wyoming's ranking increased from 17 to 14 and its wind capacity doubled during this time. Table 2.2 lists all operational wind projects in the state. As of the first quarter of 2022, Wyoming has 32 operational wind projects with a cumulative installed capacity of 3.1 GW, produced from 1,423 turbines.

Table 2.1. Top States for Installed Wind Capacity

Rank	State	2021 Cumulative Capacity (MW)	2019 Cumulative Capacity (MW)	Percent Change 2019 - 2021
1	Texas	35,969	28,871	25%
2	Iowa	12,219	10,201	20%
3	Oklahoma	10,994	8,173	35%
4	Kansas	8,245	6,128	35%
5	Illinois	6,997	5,350	31%
6	California	6,142	5,942	3%
7	Colorado	5,035	3,762	34%
8	Minnesota	4,591	3,843	19%
9	North Dakota	4,302	3,628	19%
10	New Mexico	4,001	1,953	105%
11	Oregon	3,842	3,423	12%
12	Indiana	3,468	2,317	50%
13	Washington	3,396	3,085	10%
14	**Wyoming**	**3,178**	**1,589**	**100%**
15	Michigan	3,159	2,188	44%

Note: This table lists installed wind capacity for the top 15 states in 2021. The data is available from the American Clean Power's 2021 Annual Market Report retrieved from https://cleanpower.org/market-report-2021/#:~:text=Texas%20led%20the%20country%20in,clean%20power%20capacity%20in%202021.

The largest is TB Flats I & II, at 503 MW and located on 44 square miles in Carbon County. Construction for this project began in June 2019 (PacifiCorp, 2019) and all 132 wind turbines were online by July 2021 (Fine, 2021). Notably, as evident in Table 2.2, 15 of the 32 projects are owned or will soon be repurchased by PacifiCorp, totaling 1,787 MW or over 56% of the state's wind capacity. Wyoming's wind power market seems to be dominated by utilities compared to the rest of the nation, where independent power producers own the majority of wind assets (Wiser et al., 2021).

Table 2.2. Operational Wind Projects in Wyoming

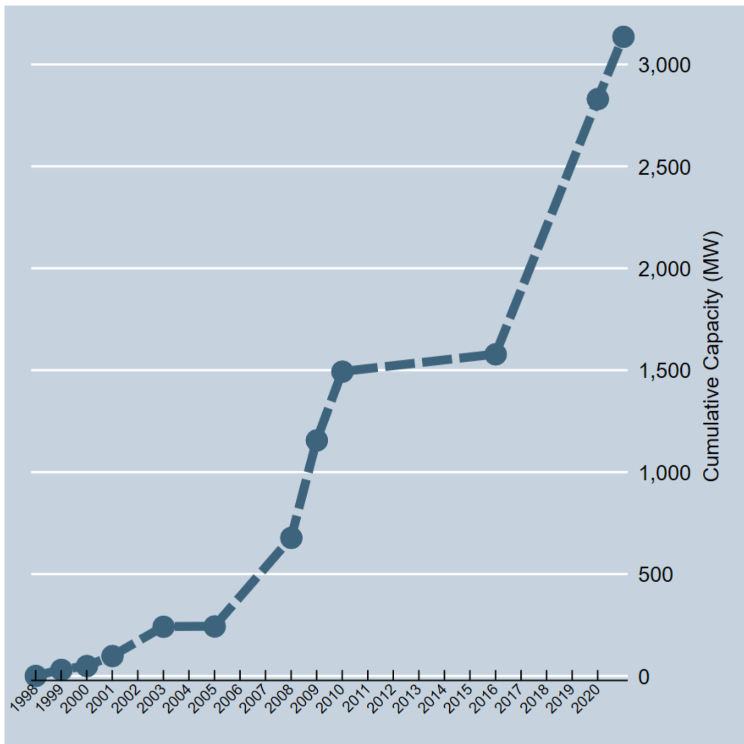
Project Name	Owner	County	Capacity	Number of Turbines
TB Flats I & II	PacifiCorp	Carbon	503 MW	132
Ekola Flats	PacifiCorp	Carbon	229 MW	58
Roundhouse	NextEra	Laramie	227 MW	82
Cedar Springs II	PacifiCorp	Converse	202 MW	73
Top of the World	Duke Energy	Converse	200 MW	110
Cedar Springs I	NextEra	Converse	199 MW	72
Seven Mile Hill I & II	PacifiCorp	Carbon	145 MW	79
Evanston (Wyoming Wind Energy Center)	TransAlta Renewables	Uinta	144 MW	80
Dunlap	PacifiCorp	Carbon	137 MW	74
Cedar Springs III	NextEra	Converse	133 MW	48
High Plains	PacifiCorp	Albany	122 MW	66
Glenrock	PacifiCorp	Converse	119 MW	66
Rolling Hills	PacifiCorp	Converse	116 MW	66
Campbell Hill	Duke Energy	Converse	99 MW	66
Pioneer Wind Park	sPower	Converse	85 MW	46
Mountain Wind II	Clearway	Uinta	80 MW	38
Mountain Wind I	Clearway	Uinta	61 MW	29
Corriedale Wind Energy Project	Cheyenne Light 38% (Black Hills Power 62%)	Laramie	59 MW	21
Rock River I	PacifiCorp *	Carbon	49 MW	49
Glenrock III	PacifiCorp	Converse	46 MW	26
Silver Sage	Duke Energy	Laramie	42 MW	20
Foote Creek I Repower	PacifiCorp	Carbon	41 MW	13
McFadden Ridge	PacifiCorp	Albany	35 MW	19
Happy Jack	Duke Energy	Laramie	29 MW	14
Foote Creek 3	PacifiCorp *	Carbon	25 MW	33
Foote Creek 4	PacifiCorp *	Carbon	17 MW	29
Casper Wind Farm	Chevron	Natrona	17 MW	11
Medicine Bow	Skyline Renewables	Carbon	6 MW	9
Air Force	Air Force	Laramie	2 MW	1
F.E. Warren Air Force Base	Air Force	Laramie	1 MW	2
Foote Creek Rim II	PacifiCorp *	Carbon	1 MW	2
BLM-JCI	BLM	Carbon	0.1 MW	1

Note: This table lists operational wind projects in Wyoming using data from The U.S. Wind Turbine Database retrieved from https://eerscmap.usgs.gov/uswtdb/, coupled with information on ownership from the Wyoming Public Service Commission retrieved from https://wyoleg.gov/InterimCommittee/2022/07-202206292-010622CorpsComgenerationfacilities.pdf and through conversations with industry experts. * PacifiCorp has application before the Public Service Commission to buy and repower project.

The first wind project in the state became operational in 1998. In the decade that followed, capacity slowly increased to reach 678 MW. By 2021, the state's wind capacity had more than doubled mainly due to a record increase of over 1.2 GW in 2020. Below, Figure 2.4.

illustrates the cumulative total capacity in the state over time. While Wyoming had 1.3 MW of capacity in 1998, by the end of 2021, it had over 3.1 GW of wind capacity, about 19% of the state's total generation.

Figure 2.4. Wind Deployment in Wyoming Over Time



Note: This figure illustrates cumulative capacity from wind projects in Wyoming using data from The U.S. Wind Turbine Database retrieved from https://eerscmap.usgs.gov/uswtdb/.

Currently, multiple projects of varying capacities are at different phases of the permitting process. The construction of the largest wind project in the U.S. is already underway, which would add about 3 GW of new energy capacity in Wyoming. In addition, over 2.4 GW has already been approved by local and state authorities. Further, there are proposed projects and expansions being considered that would continue to grow the state's wind capacity. <Table 2.3>

Table 2.3. Projects Under Development or in the Queue

Project Name	County	Capacity	Phase	Expected Operational Year
Rail Tie	Albany	504 MW	Permitting	2023
Uinta Wind Energy Project	Uinta	221 MW	Permitting	2023
Rock Creek Wind	Albany & Carbon	590 MW	Permitting	2024
Boswell Springs Project	Albany	332 MW	Permitting	2024
Anticline Wind Energy Project	Natrona	175 MW	Permitting	2024
Chokecherry and Sierra Madre	Carbon	3,000 MW	Under Construction	2026
Two Rivers and Lucky Star Wind Project	Albany & Carbon	780 MW	Advanced Development	2026
Expansion of Foote Creek 3 & 4	Carbon		On PSC Docket	
Expansion of Rock River I	Carbon		On PSC Docket	

Note: This table lists wind projects that are under development or in the queue in Wyoming using data from various sources (BluEarth Renewables, 2022; Innergex, 2021; PacifiCorp, 2019; S&P Global, 2019; Uinta County Herald, 2018; Western Area Power Administration, 2022; Wyoming Department of Environmental Quality, 2022; WY Public Service Commission (PSC), 2022).

3. Economic Impact Analysis

Economic impact analyses are a widely accepted approach used to better comprehend the effect of an event or industry, such as the exogenous shock from the new construction of wind projects to local and state economies. These analyses typically use input-output (IO) methodologies to re-create inter-industry linkages and calculate the impact on a regional economy. Economic impact analyses have been commonly used in prior literature and reports in various disciplines and for different industries alike, from agriculture to forestry, and many others. In this report, we calculated the economic impacts from the construction and operation of a hypothetical wind project in Wyoming, as well as the impacts of three deployment scenarios over the next 5 years. These impacts were calculated at the state level, though the bulk of the impact will be felt at the county level.

Modeling the economic impact of a project requires the examination of three distinct types of effects. An exogenous increase in economic activity in a given geographic area creates a ripple effect in the economy of that area. In this case, the project will require several construction jobs. These jobs, and their associated compensation and output, are what we refer to as the direct effect. Beyond this initial effect, there will also be an increase in the demand for intermediate goods needed in construction, which is what we call the indirect effect. Further, the additional income of workers within the construction industry is going to lead to added economic activity in terms of buying goods and services, which, in turn, creates new economic activity in a region. Individuals' spending will induce more spending. We call this last wave of impacts the induced effects. The total impact of the project is the sum of direct, indirect, and induced effects, as illustrated in Figure 3.1. Beyond the direct, indirect, and induced effects, Table 3.1 displays a list of additional economic impact analysis terminology that is used in this report.

Figure 3.1. Types of Economic Impacts

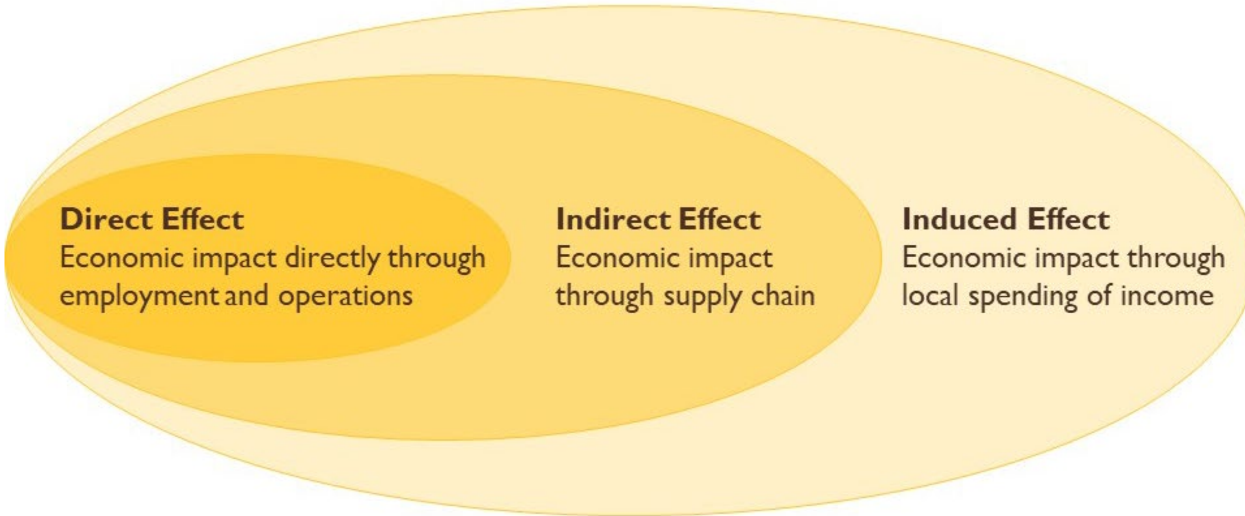


Table 3.1. Economic Impact Analysis Terminology

Variable	Definition
Jobs	Jobs refer to an industry-specific mix of full-time, part-time, and seasonal jobs. Expressed as full-time equivalents (FTE).
Earnings	Earnings refer to all forms of employment income, including employee compensation (i.e., wages, salaries, and benefits) and proprietor income.
Value Added	Value added is the difference between an industry's total output and the cost of its intermediate inputs; it is a measure of the contribution to GDP.
Output	Output is the value of production by industry in a calendar year. It can also be described as annual revenues plus net inventory change. It is often referred to as the total economic impact.
Multipliers	Multipliers describe how, for a given change in a particular industry, a resulting change will occur in the overall economy. For instance, employment multipliers describe the total jobs generated as a result of 1 job in the target industry.

To model the economic impact of wind projects, we use the National Renewable Energy Laboratory's (NREL) Jobs and Economic Development Impact (JEDI) model. The JEDI models are a series of tools developed by NREL that allow researchers to estimate the economic impacts of constructing and operating power generation facilities at the state level. For this report, we utilized the JEDI land-based wind model, which contains 14 aggregated industry sectors, as the central tool to estimate the number of wind industry jobs and economic impacts to the State of Wyoming.

JEDI requires assumptions on what products are locally manufactured, as well as what percent of materials and labor are purchased locally. In this report, we assume 100% of labor originates in Wyoming. Regarding materials, we use two distinct scenarios reflecting 1) a case where *none* of the turbines, blades, and towers are manufactured in Wyoming, and 2) a case where *all* the materials are manufactured in the state. We use these scenarios for both construction and O&M phases. We also assume that all other costs, e.g. permitting or concrete, are spent locally at the rate of 100%. Finally, the last set of required JEDI inputs centers on tax information. Wyoming has no property and sales tax exemptions in place. In Section 4, we discuss tax impacts in more detail.

Average Wind Project

The average capacity of proposed projects in the state ranges from 221 MW to 3,000 MW, with a median of 547 MW, calculated using the list of projects under development or in various phases of the permitting process, shown in Table 2.2. As such, we model the economic impacts of a hypothetical 500 MW project in the State of Wyoming. This type of project will have significant short-term impacts for the duration of the construction phase (usually over 12-24 months) and relatively more modest long-term impacts (usually over 20 years).

Construction Phase

Table 3.2. presents the economic impacts during the construction phase for an average wind project. We also present additional impacts (highlighted in grey) representing estimates if all materials used on this project were manufactured in Wyoming. The direct construction jobs

supported on this project are expected to equal 211 jobs, with a total job impact of 804 jobs, taking into account the indirect and induced impacts. However, if all materials were produced in the state, the total job impact would reach 3,088 jobs. In addition to jobs, Table 3.2. displays earnings, output, and value added. For this hypothetical 500 MW project, the direct value added is $29M, with a total value added of about $96M, taking into account the indirect and induced effects. If all materials were produced in the state, the total value added would reach $314 million.

Table 3.2. Construction Phase Impacts for a 500 MW wind project in Wyoming

	Jobs	Earnings	Output	Value Added
Direct Impact	211	$28,659,350	$31,684,767	$29,067,113
Indirect Impact	418	$29,305,722	$110,038,870	$51,074,729
Additional Indirect Impact (if local manufacturing)	1,918	$115,446,770	$673,489,871	$185,785,480
Induced Impact	175	$7,899,622	$28,511,268	$16,231,185
Additional Induced Impact (if local manufacturing)	366	$15,663,206	$56,531,897	$32,183,368
Total Impacts (no local manufacturing)	804	$65,864,695	$170,234,904	$96,373,027
Total Impacts (with local manufacturing)	3,088	$196,974,671	$900,256,672	$314,341,875

Note: This table lists direct, indirect, induced, and total impacts associated with the construction of a 500 MW wind project in Wyoming. Rows highlighted in grey reflect estimates that account for the impact of using locally manufactured materials.

Operation Phase

Table 3.3. presents the economic impacts during the operation phase for the average wind project. We also present additional impacts (highlighted in grey) representing estimates if all replacement materials used on this project were manufactured in Wyoming. The direct construction jobs supported on this project are expected to equal 14 jobs, with a total job impact

of 133 jobs, taking into account the indirect and induced impacts. However, if all materials were produced in the state, the total job impact would reach 189 jobs. In addition to jobs, Table 3.3. displays earnings, output, and value added. For this hypothetical 500 MW project, the direct value added is about $1M, with a total value added of about $17M, taking into account the indirect and induced effects. If all replacement materials were produced in the state, the total value added would reach $25 million.

Table 3.3. Operation Phase Impacts for a 500 MW wind project in Wyoming

	Jobs	Earnings	Output	Value Added
Direct Impact	14	$917,263	$917,263	$917,263
Indirect Impact	93	$4,165,636	$21,894,794	$14,172,348
Additional Indirect Impact (if local manufacturing)	45	$3,671,897	$16,697,604	$6,809,438
Induced Impact	25	$1,184,815	$4,275,895	$2,434,054
Additional Induced Impact (if local manufacturing)	11	$497,910	$1,797,183	$1,023,187
Total Impacts (no local manufacturing)	133	$6,267,714	$27,087,952	$17,523,665
Total Impacts (with local manufacturing)	189	$10,437,520	$45,582,739	$25,356,289

Note: This table lists direct, indirect, induced, and total impacts associated with the operation of a 500 MW wind project in Wyoming. Rows highlighted in grey reflect estimates that account for the impact of using locally manufactured materials.

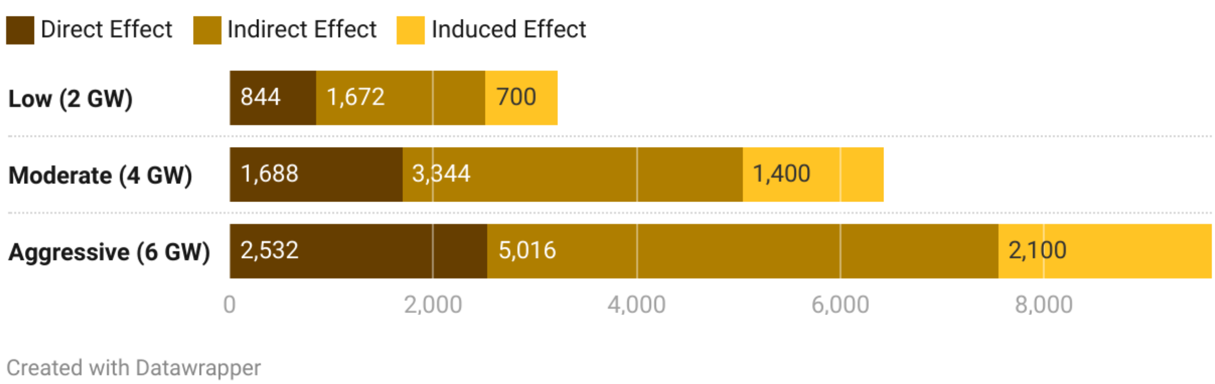
Projected Installation Scenarios

In this section, we model the economic impact of three distinct deployment scenarios: a "low" scenario (2 gigawatts (GW)), a "moderate" scenario (4 GW), and an "aggressive" scenario (6 GW). These scenarios are consistent with the expected capacity of projects currently under development or in the queue, as seen in Table 2.2. For all three scenarios, we assume 100% of labor originates in Wyoming but regarding materials, we model the case where none of the turbines, blades, and towers are manufactured in the state. Therefore, when interpreting economic impacts, it is important to remember that the realized economic impacts will be lower if some of the workers reside outside the state and larger if some of the blades are manufactured in the state.

Construction Phase

Figure 3.2. presents the economic impacts in terms of employment during the construction phase across our three scenarios. In our low scenario, at 2 GW, the direct construction jobs supported amount to 844 jobs, with a total job impact of 3,216 jobs, taking into account the indirect and induced impacts. In our moderate scenario (4 GW), we anticipate 1,688 direct construction jobs in Wyoming, with a total of 6,432 jobs including the indirect and induced impacts. Finally, the most aggressive scenario, at 6 GW deployed, sees 2,532 direct construction-related wind jobs, with a total of 9,648 jobs if we accommodate for the multiplier effect.

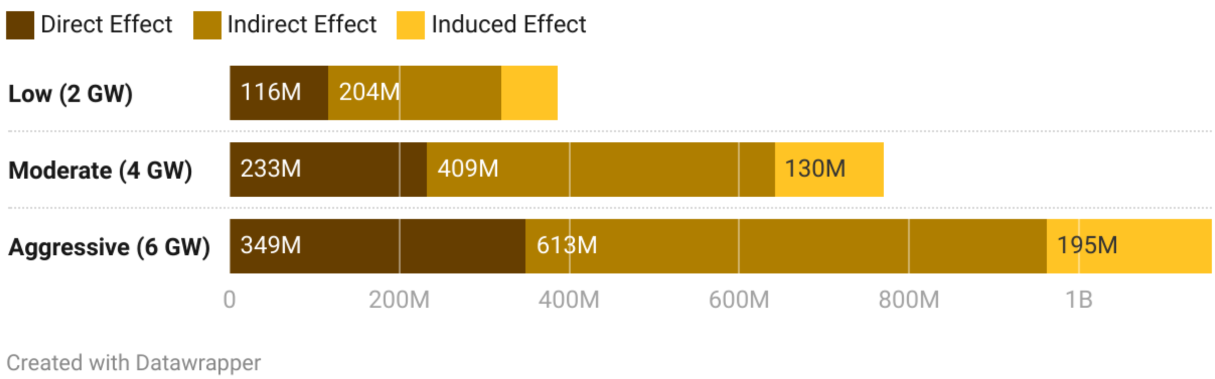
Figure 3.2. Construction Phase Employment Impacts



Note: This figure illustrates direct, indirect, and induced employment impacts associated with three wind deployment scenarios in Wyoming.

Next, Figure 3.3. displays the value added construction phase economic impacts of our low, moderate, and aggressive scenarios. In our low scenario, at 2 GW, the direct value added is \$116M, with a total value added of about \$385M, taking into account the indirect and induced effects. In our moderate scenario (4 GW), the direct value added is \$233M, with a total value added of over \$772M. Finally, the most aggressive scenario, at 6 GW deployed, sees a direct value added of \$349M, with a total value added of about \$1.2B.

Figure 3.3. Construction Phase Value Added Impacts

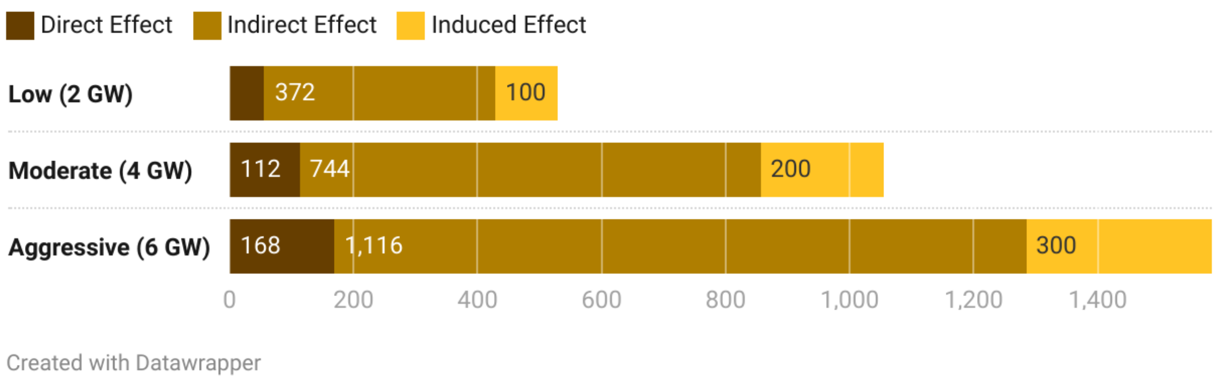


Note: This figure illustrates value-added impacts associated with three wind deployment scenarios in Wyoming.

Operations Phase

Next, Figure 3.4. presents the economic impacts in terms of employment during the O&M phase across our three scenarios. In our low scenario, at 2 GW, the direct jobs supported are estimated at 56 jobs, with a total job impact of 528, taking into account the indirect and induced impacts. In our moderate scenario (4 GW), we anticipate 112 direct jobs in Wyoming, with a total of 1,056 jobs including the indirect and induced impacts. Finally, the most aggressive scenario, at 6 GW deployed, sees 168 direct wind jobs, with a total of 1,584 jobs if we accommodate for the multiplier effect.

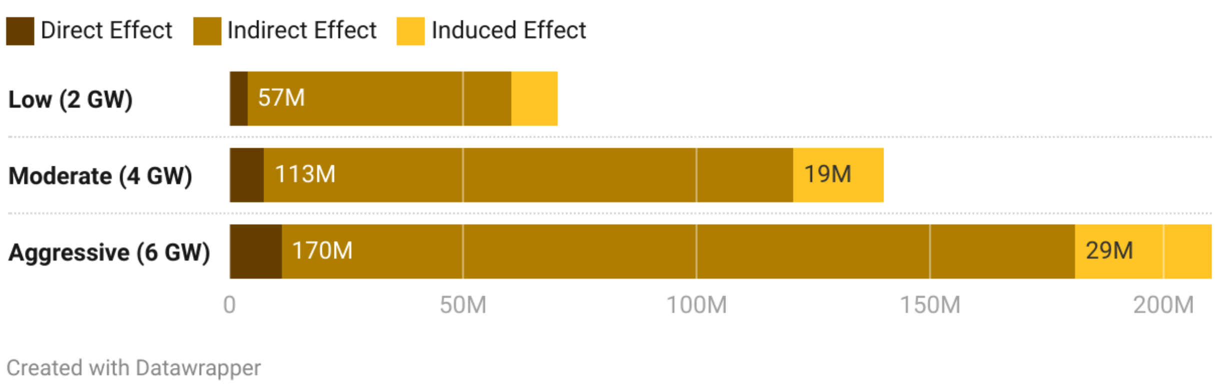
Figure 3.4. O&M Phase Employment Impacts



Note: This figure illustrates employment effects associated with wind deployment scenarios in Wyoming.

Figure 3.5. displays the value added economic impacts of our three scenarios. In our low scenario, at 2 GW, the direct value added is $3.7M, with a total value added of about over $70M. In our moderate scenario (4 GW), the direct value added is $7.3M, with a total value added of about $140M. Finally, the most aggressive scenario, at 6 GW deployed, sees a direct value added of $11M, with a total value added of $210M. Given that most wind energy projects are operational for a minimum of 20 years, the total economic impact over 20 years, would be $1.4B in the low scenario, $2.8B in the moderate scenario, and $4.2B in the aggressive scenario.

Figure 3.5. O&M Phase Value Added Impacts



Note: This figure illustrates value-added impacts associated with wind deployment scenarios in Wyoming.

4. Tax Impacts

Wyoming is one of nine U.S. states that does not levy an income tax. Thus, Wyoming's largest sources of revenue are sales and use taxes, severance taxes, mineral royalties, and property taxes. Severance taxes are paid by extractive industries to the State of Wyoming in return for removing, extracting, severing, or producing any mineral, while mineral royalties are paid to federal and state governments in return for leasing public land.

Wyoming has one of the lowest property tax rates in the U.S. Tax rates or mill levies are set by the various political entities with the legal power to levy taxes, including counties, school districts, cities, towns, and special taxing districts (such as water and sewer districts and cemetery districts) (Wyoming Department of Revenue, 2022). To illustrate, a wind project with an estimated market value of $100M, would be assessed at 11.5%, the industrial assessment rate. If this project is located in Laramie County, District 109, where the total tax rate is 67.34 mills, the taxes collected would equal $774,410.

However, the tax that impacts wind developers the most is the sales tax as wind development is highly capital intensive, and sales tax requirements can significantly increase a project's total capital expenditure (Godby, Taylor, & Coupal, 2018). Wyoming eliminated its previous sales tax exemption on wind development in 2010 and, currently, 105 local tax jurisdictions are collecting an average local tax of 1.5% (local governments are allowed to levy sales tax of up to 2%), in addition to the 4% statewide sales and use tax.

In addition, Wyoming levies a wind generation tax of $1/megawatt hour (MWh) (Wyoming Legislative Service Office, 2019). It is imposed on each MWh of electricity produced, at the point of interconnection with an electric transmission line. Taxes are not collected for the first 3 years of electricity production. Facilities owned and operated by the state, federal, or county governments are exempt from the tax, as is electricity produced for personal consumption.

Given the above, we calculated the potential tax revenues generated during the operation phase of wind projects. Table 4.1. shows that our three wind deployment scenarios would result in annual tax revenues ranging from about $30M in the low scenario (for a 20-year total of about $600M), to about $60M in the moderate scenario (total of $1.2B), and $89M in the aggressive scenario (total of $1.8B). As seen in Table 4.1., the median wind project, at 500 MW, can contribute over $7M annually in sales tax, generation tax, and property tax. Taken together, this tax revenue will benefit local schools, health systems, senior citizens, and many other aspects of Wyoming counties and communities.

Table 4.1. Potential Tax Revenues from Wind Energy Deployment in Wyoming

	500 MW	2 GW	4 GW	6 GW
Statewide Sales Tax (4%)	$600,017	$2,400,069	$4,800,137	$7,200,206
Local Sales Tax (2%)	$300,009	$1,200,034	$2,400,069	$3,600,103
Generation Tax	$1,533,000	$6,132,000	$12,264,000	$18,396,000
Property Tax (Mill Levy = 62.86)	$5,047,897	$20,191,590	$40,383,179	$60,574,769
Total	$7,480,923	$29,923,693	$59,847,385	$89,771,078

Note: This table estimates potential tax revenue from wind energy deployment in Wyoming from three different sources: sales tax, generation tax, and property tax.

Further, wind power plants pay land leases and fees for the use of federal, state, and private land. Income received by private landowners creates ripple effects in the economy, similar to the economic impact from construction discussed in Section 3. Fees from leases of state land contribute to Wyoming's fiscal revenue. Although we do not explicitly model these private and state land lease-related impacts, we note that they create economic benefits to the region beyond what is discussed in the report.

Concerning the fees paid by wind developers for the use of BLM lands, they are currently retained by the US Treasury. However, H.R. 3326, the Public Land Renewable Energy Development Act of 2021, introduced into the House of Representatives in May 2021, proposes federal revenue-sharing of renewable fees, which is line with the federal revenue-sharing of mineral fees. The provision postulates that instead of the Treasury retaining the entirety of the fees, it would retain only 25% and then deposit 25% in a Renewable Energy Resource Conservation Fund, which would be established by the same legislation to restore and protect affected wildlife (Public Land Renewable Energy Development Act, 2021). The state where the revenue is derived would also receive 25%. The remaining 25% would be paid to the one or more counties within the boundaries of which the revenue is derived.

If this bill becomes law, wind energy projects on federal land would provide significant additional fiscal revenue to states. To illustrate, we calculate hypothetical returns from federal revenue-sharing of wind energy fees in Wyoming for the average wind project (500 MW). We assume the project will require 30,000 acres of public land, based on each turbine producing 2 MW and needing 120 acres.

Based on a Right-of-Way authorization date of June 1, 2022, and a commercial operation date of June 1, 2025, Table 4.2 lists the yearly cost and its two components, acreage rent and MW fee. While BLM adjusts acreage rent yearly to keep up with price changes, we use the per acre rental rate for wind energy authorization on public land for 2022. As such, the amounts listed in Table 4.2, are all expressed in 2022 dollars.

Once this 500 MW project is operational, the State of Wyoming would expect to receive $260,275 in the form of federal royalties while local communities would receive an additional $260,275. Over the lifetime of the project, estimated at 20 years, the state would expect to receive $5,147,713 in federal mineral royalties while local communities would receive an additional $5,147,713.

Table 4.2. Federal Wind Energy Fees from a 500 MW project in Wyoming

Year	Acreage Rent	MW Fee	Total Rent
2022	$20,550	$0	$20,550
2023	$41,100	$0	$41,100
2024	$41,100	$0	$41,100
2025	$41,100	$125,000	$166,100
2026	$41,100	$500,000	$541,100
2027	$41,100	$1,000,000	$1,041,100
2028	$41,100	$1,000,000	$1,041,100
2029	$41,100	$1,000,000	$1,041,100
2030	$41,100	$1,000,000	$1,041,100
2031	$41,100	$1,000,000	$1,041,100
2032	$41,100	$1,000,000	$1,041,100
2033	$41,100	$1,000,000	$1,041,100
2034	$41,100	$1,000,000	$1,041,100
2035	$41,100	$1,000,000	$1,041,100
2036	$41,100	$1,000,000	$1,041,100
2037	$41,100	$1,000,000	$1,041,100
2038	$41,100	$1,000,000	$1,041,100
2039	$41,100	$1,000,000	$1,041,100
2040	$41,100	$1,000,000	$1,041,100
2041	$41,100	$1,000,000	$1,041,100
2042	$41,100	$1,000,000	$1,041,100
2043	$41,100	$1,000,000	$1,041,100
2044	$41,100	$1,000,000	$1,041,100
2045	$41,100	$1,000,000	$1,041,100
Total	$965,850	$19,625,000	**$20,590,850**

Note: This table estimates the amount of rent and fees collected by the Federal Government from a 500 MW project on federal land in Wyoming.

Assuming half of the wind energy project deployment occurs on federal land, we can estimate Wyoming's share of federal royalties, under the three deployment scenarios (2 GW, 4 GW, and 6 GW). Notably, the possible implementation of federal revenue-sharing of renewable fees, could bring Wyoming $1M in annual federal royalties in our low deployment scenario (or $20M total over 20 years), $2M in our moderate scenario (or $40M total), and $3M in our aggressive scenario (or $60M total).

5. Permitting Process

Wind Energy Projects in Wyoming

Federal, state, and local authorities' role in the permitting process for wind projects depends on the size of the project and the type of land on which the development will occur. In fact, site selection is the first step for these projects, where determinants, such as the permitting schedule and site-specific concerns, play a key role in location decisions (Wyoming Renewable Energy Coordination Committee, 2022). Therefore, the site selection phase includes screening for technical factors regarding the physical suitability of the land as well as any critical issues that might impact the permitting process, e.g. land use, zoning, wildlife, migration corridors, surface and groundwater, vegetation, habitat management areas.

At the local level, counties and municipalities are the regulatory authorities. All wind facilities larger than 0.5 MW must obtain a permit from any county in which the facility is located. Facilities must also obtain permits for any enlargements. Applications for permits are submitted to the board of county commissioners and must meet a set of permitting requirements that can be found in Wyoming Statute § 18-5-501 et seq.[1] Mainly, developers must certify that steps were taken to notify all landowners within one mile and all towns located within 20 miles. Moreover, developers must certify that notification of the proposed wind facility will be published in the newspaper at least 20 days before a public hearing (which must be held by the county commissioners to hear public comment).

In addition, the statute states that the base of any tower must be at least 110% of the maximum height of the tower away from any property line or public road. Towers must be at least 1,000 feet from a residential dwelling or occupied structure, one-quarter mile from any

[1] Wyoming statute 18, article 5 can be retrieved from https://wyoleg.gov/statutes/compress/title18.pdf.

platted subdivision, and at least one-half mile from any city limits. These rules may be waived with permission from residents or owners located closer than the minimum distance.

Once the board of county commissioners receives an application, it determines if it is complete within 30 days. If the application is deficient, the applicant will have 30 additional days to provide the additional information. After the application is determined complete, the board will hold a public hearing within 60 days. After the hearing, the board has 45 days to render a decision. If denied, the decision can be appealed. In addition, after the application is determined complete, instead of a hearing, the board can refer the application to the Wyoming Industrial Siting Council, within 30 days, if the board finds there are potentially significant adverse environmental, social, or economic issues that the board does not have the expertise to consider or authority to address.

Wyoming has 23 counties and 99 incorporated municipalities. Eleven counties have adopted wind energy development regulations: Albany, Campbell, Carbon, Converse, Crook, Goshen, Laramie, Lincoln, Natrona, Sweetwater, and Uinta. Table 5.1. lists key aspects of the local permitting process. In addition to wind permits, proposed projects often require additional construction related licensing from local officials for road maintenance, grading/erosion and sediment control, and stormwater (Wyoming Renewable Energy Coordination Committee, 2022). However, these permits are common and promptly issued.

Figure 5.1. Eleven Wyoming Counties have adopted wind energy regulations

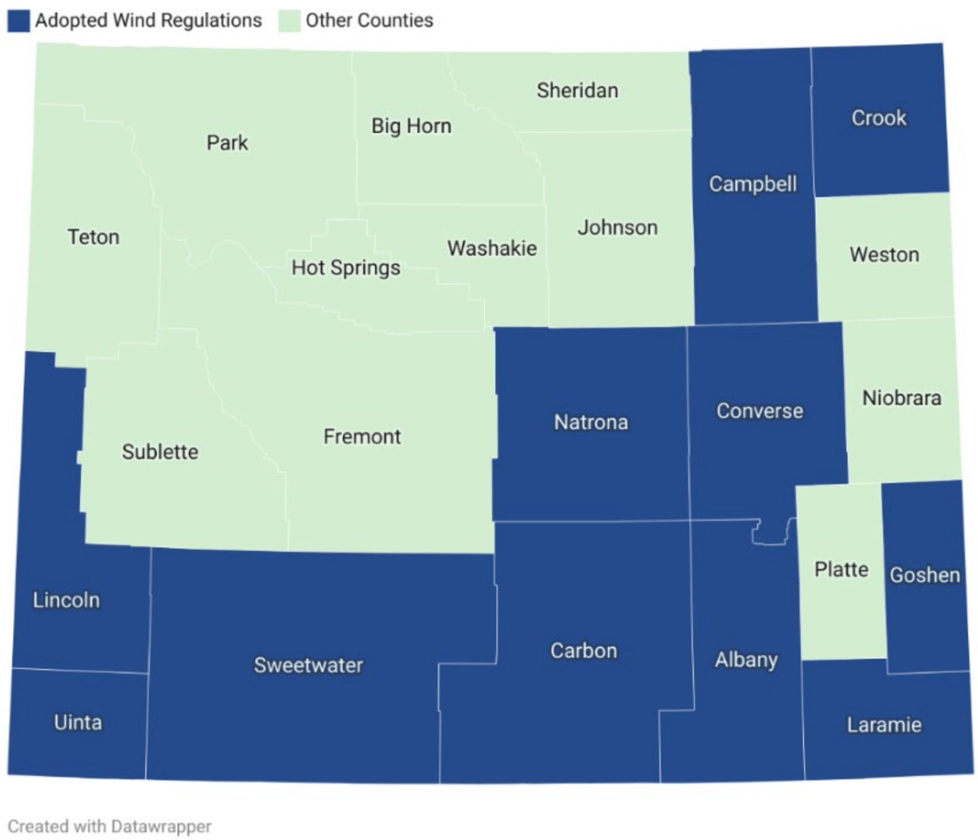


Table 5.1. Local Permitting Process for Wind Energy Development by Wyoming County

County	Permits	Fees	Time Frame
Albany	Wind Energy Conversion System (WECS) project permit	$300 per turbine; $100 notice fee for filing a development proposal; fees associated with notifying adjacent property owners (property owners within a 5-mile radius of the project's exterior boundary).	3–4 months
Campbell	WECS Project Permit	$200 per turbine.	3–4 months
Carbon	Commercial WECS Conditional Use Permit	$100 application, fee per number of wind turbines, and cost of public notice charges.	3–5 months
Converse	Wind Energy Permit	$5,000 or $250 per wind turbine, whichever is greater.	3–5 months
Crook	Permit Pursuant to the Crook County Wind Energy Facility Resolution	$2,000 per wind turbine. A process and building permit fee may be applicable.	4–5 months
Goshen	WECS Use Permit	$5,000 or $250 per wind turbine, whichever is greater.	4–5 months
Laramie	Site Plan and Wind Energy Permit		
Lincoln	Commercial Wind Permit		
Natrona	WECS Project Conditional Use Permit	$300 application fee.	2 months
Sweetwater	Commercial WECS Facility Permit		
Uinta	Wind Energy Facility Land Use Certificate	$500 fee to cover administrative costs, $1000 plus $100 per tower.	3–6 months

Note: This table lists the eleven Wyoming counties that have adopted regulations specific to wind energy development (Wyoming Renewable Energy Coordination Committee, 2022).

At the state level, the siting and permitting of wind energy developments in the State of Wyoming involves several state agencies, including the Wyoming Public Service Commission (PSC), Wyoming Department of Environmental Quality (WDEQ), Wyoming State Preservation Office (SHPO), Wyoming Game and Fish Department (WGFD), Wyoming Department of Transportation (WYDOT), Wyoming Office of State Lands and Investment (OSLI), and the Wyoming Department of State Parks and Cultural Resources (WYSPCR).

In Wyoming, commercial wind projects consisting of 20 or more turbines, meet the definition of an "industrial facility," and are therefore under the jurisdiction of the state, which requires them to obtain a Wyoming Industrial Development Information and Siting Act (WISA) permit from the Industrial Siting Council (ISC). Table 5.2. lists the different permits required by state agency and the associated timeline.

Empirically, when examining the timeline from application submission to approval using the publicly available information through WDEQ, we find that the average wait time is 4 months. The earliest available wind project application for viewing is from June 2003 and the newest is from December 2021. We note that the duration from submission to approval has been increasing over time, with earlier projects (prior to 2010) approved in about 3 months while newer projects have recently been approved in about 5 months (Roundhouse Wind Energy Project and Rock Creek Wind) or even 7 months (Rail Tie Wind Project). This might reflect the need for more robust evaluations as these projects have been increasing in footprint over time and are more likely to involve federal agencies in their plans.

Table 5.2. State Permitting Process for Wind Energy Development in Wyoming

Agency	Permits	Time Frame
Department of Environmental Quality (WDEQ)	1. WISA permit 2. Section 401 Water Quality Certification 3. Construction General Permit if project disturbs 1 or more acres *Stormwater Pollution Prevention Plan if the project disturbs 5 or more acres* 4. Permits to Construct Water and Sewer System might be needed if the project will include on-site facilities 5. Consultation with WDEQ for compliance with Construction General Emission Standards *Permit required if the project includes the construction and operation of a batch plant or a stationary emergency generator* 6. Permits for mining and extraction of aggregate if needed for concrete and roads	2–5 months
Public Service Commission	1. Certificate of Public Convenience and Necessity, for regulated public utilities	6–12 months
State Engineer's Office	1. Water use permits	several months
Office of State Lands and Investments (OSLI)	OSLI is involved if the project is located on Wyoming state trust land. 1. Wind Energy Lease 2. Survey Authorization Form 3. Temporary Use Permit for the installation and monitoring of Meteorological (MET) towers	4–12 months
Department of Transportation	1. Permits required for the installation of associated electric transmission facilities on state highway 2. Permits are required for vehicles and loads that exceed the statutory limits 3. Registration of MET Towers	2 months
Game and Fish Department	1. Monitoring Plan Development 2. Special Use Permit to allow special uses of Wildlife Habitat Management Areas when such use does not interfere with the purpose for which the lands and/or waters were acquired or are administered	24 months
Department of State Parks and Cultural Resources	1. Provides easements if roadways or transmission lines are crossing a state park property	

Note: This table lists the state permits required by Wyoming agency (Wyoming Renewable Energy Coordination Committee, 2022).

At the federal level, the needed permits will depend on funding and location. The National Environmental Policy Act (NEPA) permitting is required if the project is partially or fully located on federal land. In addition, the construction and operation of a wind project with a gen-tie connection to a transmission line owned at least in part by the Western Area Power Administration (WAPA) triggers NEPA compliance. Similarly, NEPA is triggered if the project is federally funded.

The National Environmental Policy Act (NEPA) requires an environmental impact assessment when federal actions are expected to significantly impact the quality of the human environment. If a project requires an environmental impact statement (EIS), the timeframe would be approximately 24 months while the timeframe for an environmental assessment, often required for projects without significant impacts, would be approximately 6 to 12 months.[2] In sum, NEPA permitting is a lengthy process requiring collaboration among multiple federal and state agencies as well as tribal authorities when warranted.

In fact, across all Federal agencies, examining 1,276 EIS published between January 2010 and December 2018, the average completion time, from Notice of Intent to Record of Decision, was 4.5 years (Council of Environmental Quality, 2020). A federal coal lease modification in Colorado had the fastest turnaround with less than 4 months while a highway bypass in North Carolina had the longest turnaround with more than 24 years. In Wyoming, similarly, the average is 4 years, with a natural gas pipeline system expansion having the fastest

[2] A wind energy project would require an EIS if the proposed action included the addition of new generation resources greater than 50 average MW while an EA would be required if the proposed action would generate equal to or less than 50 average MW (Wyoming Renewable Energy Coordination Committee, 2022).

turnaround at a little over a year and a natural gas development project having the slowest turnaround at over 10 years.

If a wind project is owned by the Federal government, it requires no state or local permitting. Otherwise, state and local permitting is required. Further, projects located on land under the U.S. Forest Service jurisdiction require site testing and feasibility permit and a permit for the construction and operation of a wind energy facility from that agency (Wyoming Renewable Energy Coordination Committee, 2022).

Other federal agencies often require additional reviews, which can significantly increase timelines. To illustrate, agricultural lands impacted by a renewable energy project might require the involvement of the Natural Resources Conservation Service (NRCS) and Farm Services Agency to ensure the project is not in violation of the Farmland Protection Policy Act. Applications to these agencies are processed within 45 days. While the U.S. Environmental Protection Agency delegates authority to the state as it pertains to the Clean Water Act, it reviews applications relating to stormwater runoff within 7 days. The U.S. Army Corps of Engineers (USACE) provide permits regulating impacts to aquatic resources and discharges of dredged or fill material as well as permits for construction, expansion, modification, or improvement of linear transportation projects. The Fish and Wildlife Service, Federal Aviation Administration, and Federal Communications Commission are among the many agencies that are often involved in the federal permitting process for wind energy projects.

In sum, for projects with limited federal intervention, the permitting process can be limited to 12 months. However, this timeline is significantly extended once federal involvement is required. This creates significant challenges for states with a large share of federal land: about 50% of Wyoming land is owned by the federal government. Permitting delays have been shown to lead to a series of adverse outcomes including investors abandoning development and an increase in the cost of electricity (Neupane, Adhikari, & Wiggin, 2022). Consequently, these delays negatively impact regional economic growth.

Effectively, only about 5 percent of total producing utility-scale wind energy capacity in the United States is generated from facilities on public lands (BLM, 2022). Here, in Wyoming, none of the projects constituting the 3.1 GW of wind capacity currently in place, are located on federal land. To benchmark, Wyoming's potential wind capacity is estimated at 472 GW (Wind Energy Technologies Office, 2022). However, reaching this potential remains challenging, without significant commitment from federal agencies to a prompt streamlined permitting process, especially for a state with such a high concentration of federal lands.

Wind Energy Projects in Other States

The permitting process across the nation varies widely, with the majority of states enabling local authorities as the primary government tasked with siting decisions. However, some states leave the siting decisions entirely up to state regulators. To illustrate, in Texas, the state with the most installed wind capacity, all siting is left to local government discretion, with only state-level rules for decommissioning wind projects (National Conference of State Legislators, 2020). In contrast, the West Virginia Public Service Commission has the sole authority to regulate all generation of electrical energy for service to the public.

Some states instead use a hybrid approach that involves approvals from both state and local government regulators. For example, in Colorado, upon the Public Utilities Commission (PUC) issuing a certificate for new facility construction, a project developer still needs to obtain local permits. Similarly, Wyoming uses a hybrid approach where state law requires project developers to obtain local approval prior to constructing a wind energy facility greater than 0.5

MW. In addition, large wind facilities, including those with 20 turbines or more, must obtain a permit from the state Industrial Siting Council. As of September 2020, 22 states favored leaving siting regulations to local government discretion, 4 states (Connecticut, Maryland, North Carolina, and West Virginia) designate the state regulators as the primary authority, and 22 states have opted for a hybrid approach.[3] Table 5.4. lists elements of the permitting process in Wyoming and neighboring states as well as their installed capacity.

In general, suggested techniques to streamline the permitting process have often centered around more information transparency by providing guides, objective standards, and criteria for evaluation (King, Schiavinato, & Case, 2016). Checklists can facilitate timely approvals of submitted applications. In addition, centralized services or a "one-stop" process can significantly minimize coordination time across agencies. However, these suggestions are not sufficient to rein in permitting timelines which can deter new investments.

Several initiatives have focused recently on streamlining the permitting process for major infrastructure projects in the nation. To illustrate, as it pertains to offshore wind permitting, the Bureau of Ocean Energy Management and the Bureau of Safety and Environmental Enforcement signed a Memorandum of Agreement in 2021 to clarify their roles and responsibilities as well as promote the efficient use of resources for renewable energy production (Bureau of Safety and Environmental Enforcement, 2021). More broadly, the bipartisan infrastructure bill contained several provisions designed to streamline the federal environmental permitting process and it included reauthorization for the Federal Permitting Improvement Steering Council. As these

[3] Louisiana and Mississippi are the only two states without wind specific permitting ordinances.

initiatives continue to produce plans to improve permitting, specifically as they pertain to onshore wind, we offer a series of suggestions in Section 6 that might inform these efforts.

Table 5.4. Permitting Process in Neighboring States

State	Authority	Local Process	State Process	Installed Capacity
Texas	Local	Zoning and siting are left to local governments.		33,133 MW
Kansas	Local	Local governments have the authority to regulate wind siting through the state's planning and zoning laws.		7,016 MW
Colorado	Hybrid	Local authorities have 120 days to issue a final decision on a siting application.	The PUC must also issue a certificate before the construction of new facilities. The commission process requires that relevant local permits be obtained prior to issuing a certificate.	4,692 MW
North Dakota	Hybrid	Projects must still comply with local regulations related to zoning and land use.	The North Dakota Public Service Commission has jurisdiction over siting wind energy facilities greater than 0.5 MW.	3,989 MW
Oregon	Hybrid	Siting for wind generating facilities, less than 50 MW, is generally regulated by local governments.	Oregon's Energy Facility Siting Council has jurisdiction over siting decisions for wind generation facilities 50 MW or greater.	3,737 MW
Wyoming	Hybrid	State law requires project developers to obtain local approval prior to constructing a wind energy facility greater than 500 kW.	Large wind facilities, including those with 20 turbines or more, must obtain a permit from the state Industrial Siting Council.	2,738 MW
New Mexico	Local	Local governments regulate wind power siting through zoning and land use regulations.	The location of electricity generating projects over 300 MW must be reviewed and approved by the Public Regulation Commission.	2,723 MW
Nebraska	Hybrid	Local governments have the authority to include considerations for the	Generally, energy generation projects must be approved by the Power Review Board.	2,531 MW

State	Authority	Local Process	State Process	Installed Capacity
		encouragement of wind energy in their zoning regulations and ordinances.		
South Dakota	Local	Local governments have authority over facilities less than 100 MW.	Any construction of a wind facility > 5 MW must give notice to the PUC of the facility's location, size, and method of interconnection. No person may begin construction of a wind energy facility 100+ MW without first obtaining a permit from the PUC. The PUC must make a final determination regarding a wind energy permit within 9 months of the permit application filing date.	2,305 MW
Idaho	Local	Local governments, through city councils or county commissions, have siting authority.		973 MW
Montana	Local	Local governments control zoning and land use decisions.		880 MW
Utah	Local	Zoning and siting are left to local governments.		391 MW

Note: This table lists elements of the permitting process in Wyoming and neighboring states using data from the National Conference of State Legislators (2020) as well as their installed capacity using data from the Nebraska Department of Environment and Energy retrieved from https://neo.ne.gov/programs/stats/inf/205.htm.

6. Discussion

In accordance with the Energy Act of 2020, the Department of Interior and the Bureau of Land Management (BLM) are engaged in efforts to enhance infrastructure permitting coordination and facilitate environmental reviews to support the national goal of 25 GW of solar, wind, and geothermal energy on America's public lands between 2021 and 2025 and a carbon pollution-free power sector by 2035 (Bureau of Land Management, 2022). Western public lands are positioned to play a key role as they provide the largest share of vast contiguous land. Specifically, Wyoming will benefit from a regional Renewable Energy Coordination Office that will be established to support program work across a four-state region.

Against this backdrop, it seems that federal permitting, which is the longest portion of a permitting timeline for renewables projects, is the focus of streamlining efforts, although it remains too early to judge the success of such initiatives. In fiscal year 2021, BLM authorized 12 projects (11 solar and 1 geothermal) on public land, for a total capacity of 2,890 MW (Bureau of Land Management, 2022). BLM has set plans to increase its year-over-year permitting, which has been mainly driven by staff prioritizing renewable energy projects and increased staffing. The agency expects to authorize 6,000 MW in 2022, about 7,000 MW in 2023, over 13,000 MW in 2024, and about 7,000 MW in 2025. However, these projections only include 1,000 MW of wind in 2022 and a little over 1,000 MW of wind in 2023.

While recent efforts to streamline permitting are ongoing, effectively, for projects with limited federal intervention, the permitting process can be completed within 12 months, a significantly shorter timeline that the one for projects requiring extensive federal involvement. The average completion time for project permitting on federal land is over four years. This creates significant challenges for states with a large share of federal land. Permitting delays have been shown to lead to a series of adverse outcomes including investors abandoning development and an increase in the cost of electricity (Neupane, Adhikari, & Wiggin, 2022).

The current federal permitting process creates a disincentive for companies, whereas they are incentivized to avoid locating their wind projects on federal land. This disproportionately penalizes western states, and is reflected in the gap between Wyoming's installed wind capacity (3.1 GW) and its potential (472 GW). Table 6.1 list the cumulative installed capacity for the top 15 states, as well as their potential. In addition, it calculates the share of installed capacity relative to potential and lists the share of federal land by state.

Table 6.1. Top States for Installed Wind Capacity

Rank	State	2021 Cumulative Capacity (MW)	Potential Capacity (MW)	Share Installed of Potential Capacity	Share of Federal Land
1	Texas	35,969	1,347,992	3%	1.9%
2	Iowa	12,219	279,568	4%	0.3%
3	Oklahoma	10,994	359,434	3%	1.5%
4	Kansas	8,245	506,182	2%	0.5%
5	Illinois	6,997	191,349	4%	1.2%
6	California	6,142	303,376	2%	45.4%
7	Colorado	5,035	395,378	1%	36.2%
8	Minnesota	4,591	182,826	3%	6.8%
9	North Dakota	4,302	296,084	1%	3.9%
10	New Mexico	4,001	652,575	1%	31.7%
11	Oregon	3,842	297,334	1%	52.3%
12	Indiana	3,468	191,349	2%	1.7%
13	Washington	3,396	174,223	2%	28.6%
14	**Wyoming**	**3,178**	**472,418**	**1%**	**46.7%**
15	Michigan	3,159	81,311	4%	10.0%

Note: Data used in this table is available from the American Clean Power's 2021 Annual Market Report retrieved from https://cleanpower.org/market-report-2021/#:~:text=Texas%20led%20the%20country%20in,clean%20power%20capacity%20in%202021, the Congressional Research Service retrieved from https://sgp.fas.org/crs/misc/R42346.pdf, and the Wind Energy Technologies Office retrieved from https://windexchange.energy.gov/maps-data/321.

For these 15 states, the average share of installed capacity relative to their potential is 2% while the average share of federal land is 18%. Although we are not claiming causality, Table 6.1 suggests a negative association between the share of federal land within a state and the share of installed capacity relative to a state's potential. For states with below average share of federal land (highlighted in yellow), the average share of installed capacity is 3% while for state with a higher than average share of federal land (highlighted in green), the average share of installed capacity is 2 percentage points lower, at 1%.

The challenging permitting process for wind projects on federal lands in the State of Wyoming has observable implications for the workforce, economic development, and the state's fiscal revenues. Wind projects are essential to the state's diversification efforts and its pursuit of economic development. In fact, over the next five years, the state can experience a temporary employment boost in the form of 3,216 to 9,648 construction phase jobs, depending on the level of wind energy deployment in the state. This economic activity can range from $385M to $1.2B in terms of value added over the construction period.

Further, wind energy deployment can support between 528 to 1,584 annual operations and maintenance (O&M) jobs, between $70M to $210M annual value-added, and between $30M to $90M annual tax revenue in the form of sales, generation, and property taxes. These annual impacts would continue for the life of the systems (i.e., roughly 20 years). Note that these figures represent estimates reflecting current manufacturing market dynamics. However, Wyoming could see even larger employment impacts if additional in-state manufactured materials were utilized.

These estimates are consistent with other studies across the nation. To illustrate, the deployment of 7.5 GW of utility-scale solar in Ohio was estimated to support more than 54,000 construction jobs and generate up to $67.5 million in local tax revenues annually (Michaud et al., 2020). In Illinois, 3 GW of wind energy were estimated to have created approximately 19,047 full-time equivalent jobs during construction periods with a total payroll of over $1.1 billion, as well as 814 permanent jobs in rural Illinois areas with a total annual payroll of nearly $48 million in addition to roughly $28.5 million in annual property taxes for local economies as well as $13 million annually in extra income for Illinois landowners who lease their land to wind farm developers (Loomis et al., 2016). Large renewable energy facilities (e.g., solar and wind farms) have proven their ability to create jobs, tax revenues, and a multitude of other positive economic and environmental outcomes, which has made them a viable economic development strategy for rural areas (Khalaf, Michaud, & Jolley, 2022).

Estimates presented in the report provide benchmarks for the economic and fiscal impacts of wind projects. However, they do not comprehensively quantify the benefits of these projects. To illustrate, wind power plants pay land leases and fees for the use of federal, state, and private land. Income received by private landowners creates ripple effects in the economy, similar to the economic impact from construction or operations. Fees from leases of state land contribute to Wyoming's fiscal revenue. Although we do not explicitly model these private and state land lease-related impacts, we note that they create economic benefits to the region beyond what is discussed in the report.

Notably, fees paid by wind developers for the use of BLM lands, are currently retained by the US Treasury. If there was legislation in place to implement federal revenue-sharing of renewable fees, wind energy projects on federal land would provide significant additional fiscal revenue to states. Assuming half of the wind energy project deployment occurs on federal land, Wyoming can collect $1M in annual federal royalties in our low deployment scenario (or $20M total over 20 years), $2M in our moderate scenario (or $40M total), and $3M in our aggressive scenario (or $60M total). These royalties would be divided equally between the state and the county where the project is located.

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