Center for Energy Economics and Public Policy

An Assessment of Wyoming's Competitiveness to Attract New Wind Development, and the Potential Impacts such Development may bring the State

Summary Report

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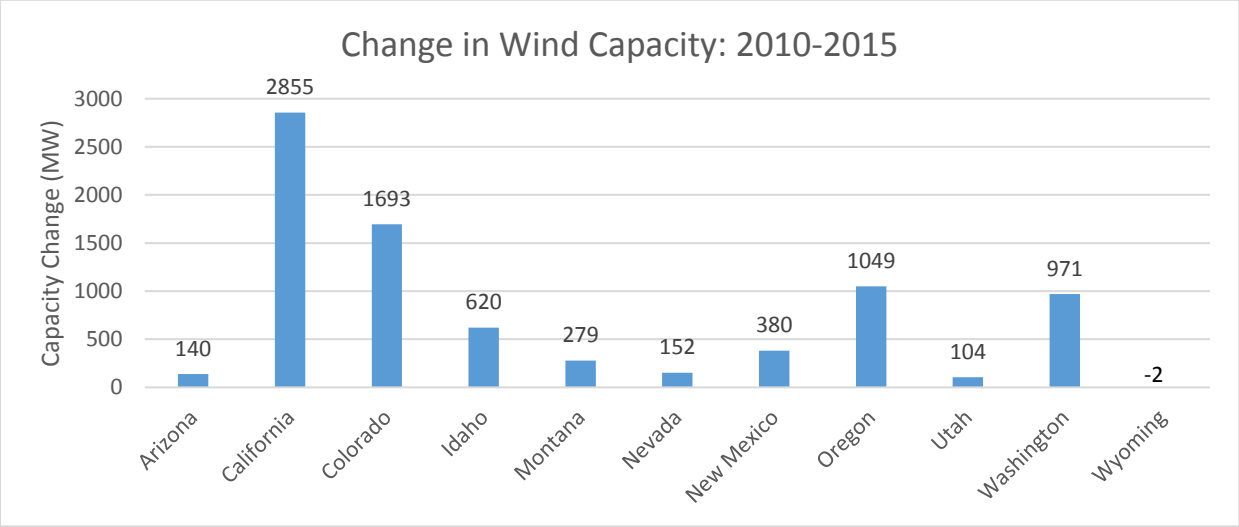
Summary Report

1. Wyoming Competitiveness to Attract Wind Development

The purpose of this report is to describe the determinants of, and to attempt to assess Wyoming's competitiveness to attract new wind development. The report also assesses the potential benefits of such development using a standard and well-accepted economic impact methodology. Wyoming has good wind resources that provide significant potential for expansion of wind generation development in the state. This opportunity comes at a critical time, as Wyoming is currently challenged by structural changes in its traditional energy sectors that have resulted in serious declines in state employment and tax revenues. Wind energy offers the potential to expand the state's economic base, provide jobs to displaced workers and much needed revenue to offset some of the current revenue shortfalls from traditional sectors, while creating more economic diversity in the state. This opportunity, however, has also led to some policy-makers considering taxation increases in the wind sector to create badly needed new revenue streams. Such decisions must be made with a clear understanding of Wyoming's real competitiveness and ability to attract new wind development, and how this could change if such policies are implemented. These issues are of special concern because any change in tax policy that unintentionally deters such development could be very costly, causing the state to potentially forego the income, employment and revenue benefits such expansion could provide. This report attempts to describe the possible tradeoffs such tax changes may incur, defining these in terms of potentially lost income, employment, and tax revenue so that policy-makers are well-informed as they face the hard decisions currently necessary to overcome the state's revenue challenges.

Figure ES-1: Wind development in Western Interconnect States since 2010.



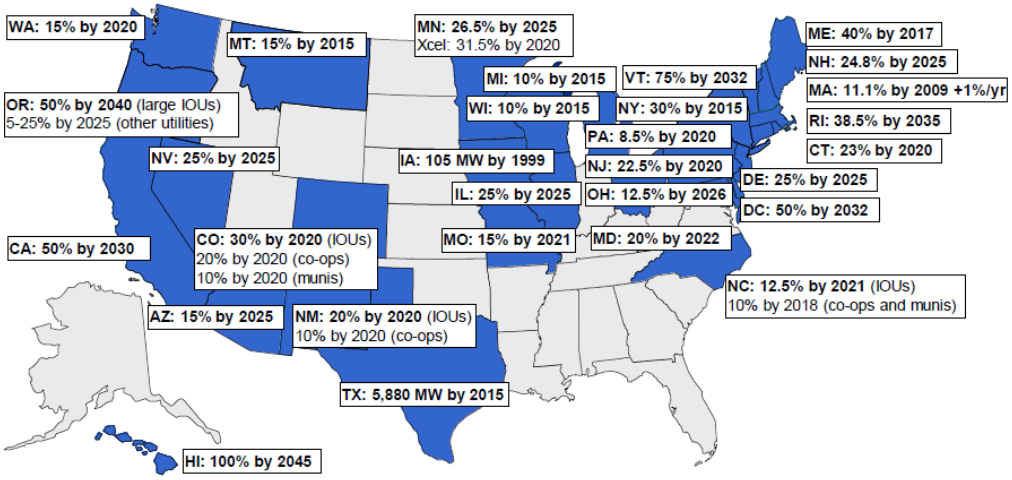
Source: U.S. Department of Energy

While Wyoming does have good potential wind resources to exploit, Wyoming's competitiveness to attract wind development may currently be challenged. Since 2010 no new wind generation capacity has been added to the state, and Wyoming is the only state in the western interconnection (the western electricity grid of the United States, of which Wyoming is a part) to have not seen any wind development in this period. Comparison of wind development on the western grid since 2010 across states is shown in

Figure ES-1. Wyoming's drought in wind development follows a period when wind development was quite robust during the years between 2008 and 2010, so less informed observers could be forgiven for not realizing this more recent change of fortune. This report concludes through a survey of the data that the lack of recent wind development in the state since 2010 has occurred for three reasons: available transmission capacity, Wyoming's policies regarding incentives to attract wind, and technological changes that have increased the benefits of developing wind elsewhere.

First, available transmission capacity to support new wind generation development in the state is currently quite limited. Several industry transmission planning reports and academic studies have discussed the need for greater transmission development if wind generation in Wyoming and the west is to be developed on much larger scales than seen today. The state of Wyoming has recognized this problem and in 2010 the Wyoming Infrastructure Authority (WIA) began a specific initiative to facilitate the development of new transmission. The process of developing transmission infrastructure though, is slowed by burdensome processes and regulations, and as of 2016 no new projects have yet been built. Overall, Wyoming continues to suffer from inadequate transmission access, and until this is rectified, Wyoming's competitiveness to attract large-scale wind development relative to other states that do not suffer this problem will be undermined.

Figure ES-2: Renewable Portfolio Standards in the United States, July 2016.



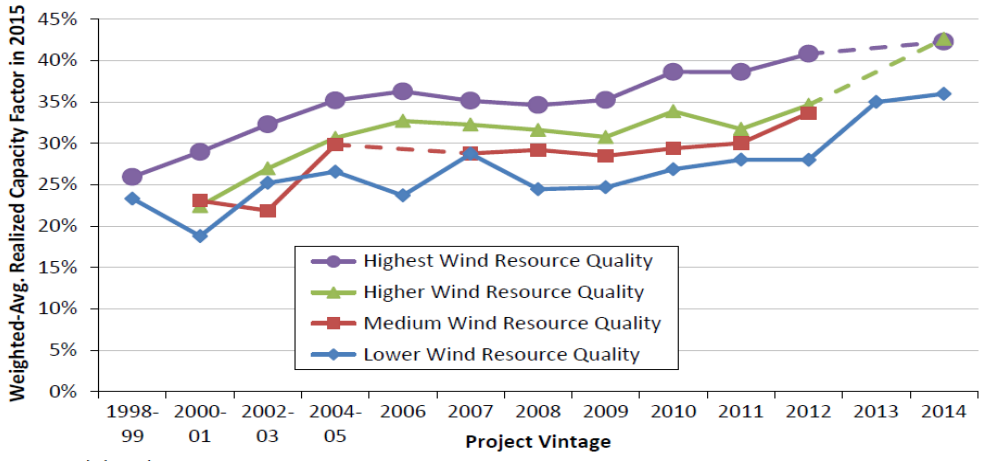
Source: Wind Technologies Report, 2015 (Wiser *et al.*, 2016)

Second, because other states also value the potential employment, income and revenue benefits wind development offers, Wyoming competes against other states on the country's western grid to attract activity. An analysis of the market incentives that other states provide suggests that Wyoming is among the least attractive states in this regard. While Wyoming's lack of a corporate income tax should be attractive to developers, Wyoming, is not unique in the west with respect to this advantage. Additionally, other states having an income tax often offer partial or even full tax exemptions, and/or tax credits to wind developers to offset these tax costs. Wyoming also does not offer a sales tax exemption for wind generation expenditures in the state, while several states in the west do. Given the capital intensity of wind development and the fact a significant portion of wind project costs occur in the construction phase, such an exemption is considered among the most important incentives for wind developers. Wyoming did have a sales tax exemption for wind equipment, however, this was ended in 2011. Wyoming also does not

offer any property tax exemptions, another renewable energy development incentive commonly found in other states.

Further, Wyoming is the only state in the country to provide a tax disincentive in the form of a wind generation tax. The tax, passed in 2010 and instituted in 2012, is currently assessed at $1/MWh of production. Wyoming's competitiveness to attract wind is also undermined by the fact that other states in the west have renewable portfolio standards (RPS), which have been shown to be effective in encouraging wind development. Figure ES-2 shows that Wyoming is one of only three states in the west lacking such a requirement, and patterns of development suggest this has also been a factor in Wyoming's recent inability to attract wind development. This report concludes that the lack of state tax and non-tax incentives have also contributed to the observed lack of wind development in the state since 2010.

Figure ES-3: 2015 Capacity Realized Factors by Quality of Wind Resource for Various Project Vintages.



Source: Wind Technologies Report, 2015 (Wiser *et al.*, 2016)

Third, ongoing changes in wind energy technology have benefited states with lesser wind resources to a greater degree than states with resources like Wyoming's. Figure ES-3 describes observed capacity factors over time by wind resource quality at new wind installations. As the figure shows, lower resource areas are closing the productivity gap with higher resource areas, and those places with wind resources in the second highest category have actually converged in observed capacity factor with the highest resource areas like Wyoming. These technological developments have resulted in an erosion of the natural resource advantage Wyoming has previously had with respect to wind generation productivity. Furthermore, as Wyoming's previous productivity advantage is reduced by technological change, the importance of other competitiveness factors increases. Concerns regarding transmission capacity and lack of state incentives become more important as the relative profitability of developing in Wyoming over other states declines.

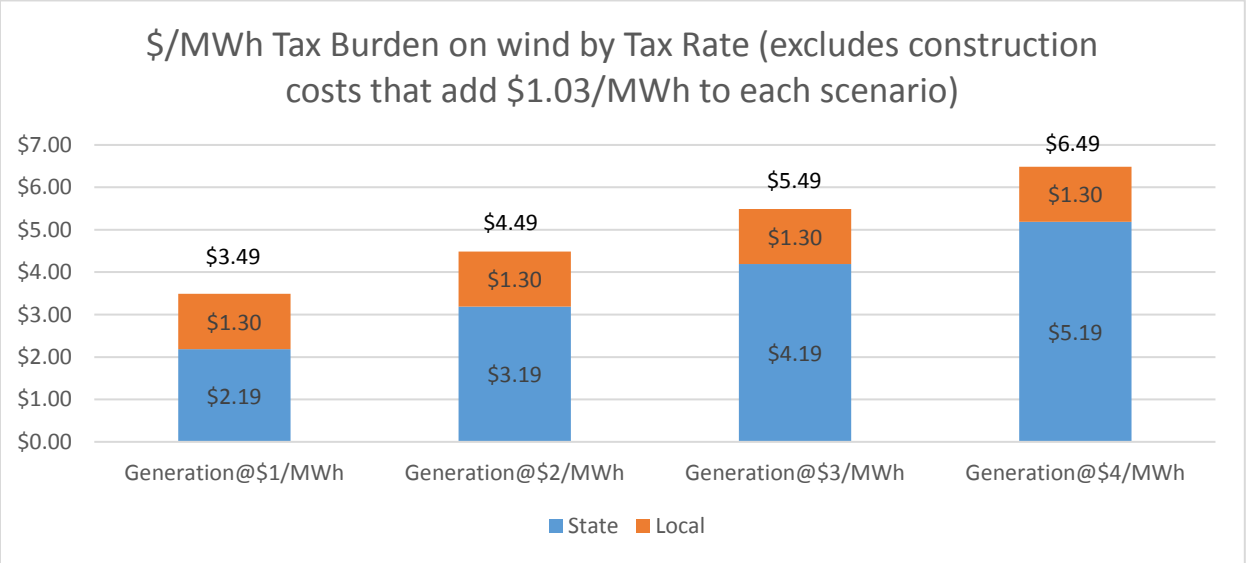
Recently, in response to the state's current revenue shortfall, some policy-makers have proposed increasing the levels of taxation on the wind industry in Wyoming. Two approaches have been suggested. The first proposes increasing the current $1/MWh tax on electricity generated from wind facilities. The second approach proposes the state impose a tax equal to a percentage of the federal production tax credits (PTCs) offered to wind developers. Both suggestions would further reduce Wyoming's competitiveness to attract wind development relative to states in the western region as no other state in the west is considering increases in taxation on the wind industry. With respect to the second option

regarding taxing federal production tax credits, this would increase the cost of financial capital to wind developers and likely have significant impacts on the ability of developers to attract financial partners needed to develop large wind projects. The report describes PTCs in the notes section at the end of this paper. Because the impact of such a tax decision is difficult to model (it requires specific knowledge of any wind developer's finances and ability to utilize the non-refundable tax credits currently offered by the federal government), it has not been considered here in this summary.

With respect to the option of increasing the existing wind tax, developers comparing states will often consider a simple metric of tax burden – the level of tax per unit of output sold in making location decisions. Using the modeled expenditures from five currently proposed wind developments in Wyoming, an estimation was made of the current level of taxation per unit of output new wind developers would face in Wyoming under current law and under three increased levels of generation tax. Figure ES-4 describes the current estimated level of total taxes per MWh any new project would face under (i) the existing and three proposed tax rates on generation, (ii) current sales and use taxes paid on operating expenditures, and (iii) existing property (ad valorem) taxes. As noted, these estimates are not derived from current taxes paid by existing facilities, but from the estimated taxes that would occur from new projects locating in Wyoming.[1]

Considering only operations and maintenance expenditures over the assumed 20-year life of a project, the estimated tax burden new wind producers would face ranges from $3.49/MWh to 6.49/MWh depending on the generation tax assumed. If sales and use taxes paid during construction are also included, taxes per MWh rise by $1.03/MWh, from $4.52/MWh to $7.52/MWh depending upon the size of the level of generation tax.

Figure ES-4: Estimated levels of taxation faced by New Wind development on a production basis.



[1] This estimate is somewhat lower than what would be estimated for existing wind facilities as developments in technology have reduced the expected overall operations and maintenance expenditures new facilities anticipate relative to older facilities.

Considering the $3.49/MWh total tax burden wind producers currently face based on operation expenditures, sales and use taxes account for $0.22/MWh, while $2.27/MWh accrues from the average property tax levy over the assumed 20-year life of the project, and $1/MWh is due to the generation tax. Total taxes paid are distributed to both state and local/county governments. Under the current generation tax level, $2.19/MWh (a 63% share) is paid to the state, and $1.30/MWh (a 37% share) to local governments. Because under proposed tax changes to the generation tax all additional tax levies on generation will flow only to the state, the state's share rises for each of the three new tax scenarios shown in the figure.

As shown, if the generation tax were increased in dollar increments from $2/MWh to $4/MWh, these increases would imply a significant increase in the total tax burden faced by wind producers – an increase of 29% for each $1 increase in the generation tax if only operations expenditures are considered. If the additional sales and use taxes paid by wind developers during construction are also included, the total tax burden rises from $4.52/MWh to $7.52/MWh, with each $1 increase in the generation tax representing a 22% increase in total taxes. Each new tax case represents a significant increase in the total tax burden wind developers would face, and would clearly have consequences with respect to Wyoming's competitiveness to attract such projects relative to other states. While this report cannot estimate the sensitivity of developer location decisions for each $1/MWh increase in tax burden, the economic and revenue impacts of a choice by developers not to locate in Wyoming can be estimated. The following sections briefly detail these findings.

2. Estimated Potential Benefits of New Wind Generation in Wyoming

In assessing the potential impact of new wind development, this report considers five projects currently proposed in Wyoming and estimates the potential employment, income and tax revenues they would create if built. The five projects include: 1) Chokecherry and Sierra Madre Wind Project (3,000 MW); 2) Pathfinder Wind Project (2,100 MW); 3) Invenergy Wind Project (120 MW); 4) Pioneer Wind Park (80 MW); and 5) Viridis Eolia Wind Project (840 MW).[2] The total "name-plate" capacity of these five proposed projects is 6,140 MW. Impacts estimated on income, employment and tax revenues include direct construction and operations; indirect service and support; and induced impacts due to the increased economic activity in the state. Economic impact estimates of wind development are typically divided into two parts. The first is the economic impact of installation of the turbines and the associated infrastructure for the wind project, and the second is the economic impacts of the operation and maintenance of the wind project once it begins production. Estimated Impacts are summarized in Table ES-1.

The expenditure data used to estimate the economic impact of both phases of a wind project in this analysis primarily came from two sources. The first was the National Renewable Energy Laboratory's 2015 Jobs and Economic Development Impact (JEDI) Land-Based Wind Model for Wyoming (NREL 6/28/2016). In order to account for economies of scale, a JEDI model was run for each project and the results aggregated into a total for the five projects rather than one JEDI model for the entire 6,140 MW of capacity. The expenditure data from the aggregated JEDI model was then integrated with expenditure data from the Chokecherry and Sierra Madre Wind Energy Project, Wyoming Industrial Development

[2] At the time this report was commissioned the Veridis Eolia project was planned as an 840 MW facility. The developers have recently updated the proposal and expanded the planned capacity to 1870 MW.

Information and Siting Act Section 109 Permit Application (PCW, May 2014) to estimate the expenditures in Wyoming from development and operation of the five projects.

Table ES-1: Estimated Economic Impacts of Proposed Projects if all projects were built

Construction Impacts	
Estimated Total Project Costs	$10.7 billion
Wyoming Expenditures (Total Direct Expenditures)	$2.4 billion
Non-resident labor expenditure	$366.5 million
Resident labor expenditure	$91.6 million
Non-labor construction expenditure	$1.5 billion
Sales and Use Tax Revenues	$441.9 million
Total Indirect and Induced Activity	$1.1 billion
Total Economic Activity: Construction Phase	**$3.5 billion**
Estimated Employment Generated	**22,216 job-years**
Labor Income Generated	**$1.3 billion**
Average per job income	**$58,858**
Operations/Maintenance Impacts (Annual)	
Total Operations and Maintenance Expenditures	$240.8 million
Wyoming O&M Expenditures (Total Direct Expenditures)	$129.8 million
O&M labor expenditure	$21.5 million
O&M Non-labor expenditure	$32.5 million
State-local government payments	$75.7 million
Total Indirect and Induced Activity	$49.5 million
Total Economic Activity: O&M Phase	**$179.3 million**
Estimated Employment Generated	**1,471 job-years**
Labor Income Generated	**$84.4 million**
Average per job income	**$57,381**
20-year O&M Direct Impacts	**$2.6 billion**
20-year O&M Indirect Impacts	**$1.0 billion**
20-year Estimated Employment Impact	**28,962 job-years**
20-year total Labor Income	**$1.7 billion**
Total 20 year Impacts (Construction + O&M)	
Total Direct Impacts	$5.0 billion
Total Indirect Impacts	$2.1 billion
Total New Economic Activity over 20 years	**$7.1 billion**
Total new Employment Generated over 20 years	**51,178 job-years**
Total new Labor Income Created in the state over 20 years	**$3.0 billion**

The economic impact of installation of the turbines and the associated infrastructure for the projects considered is due to the portion of total construction expenditures made in Wyoming. The total costs for all projects are estimated to be $10.7 billion, with $2.4 billion being spent in the state. Included in the $2.4 billion of direct in-state expenditures is $366.5 million of nonresident construction worker labor expense, $91.6 million in resident construction worker labor expense, $1.5 billion in non-labor construction expense, and $441.9 million in sales and use tax payments. When secondary economic impacts are

considered, the $2.4 billion of direct in-state expenditure is estimated to generate $3.5 billion of total economic impacts in the Wyoming economy. This economic activity is projected to generate 22,216 job-years of total employment and $1.3 billion of labor income during the length of the construction period for the projects. The average earnings per job for the construction of the wind projects are projected to be $58,858. The annual economic impact from construction of the wind projects would depend on the length of construction period, which is unknown at this point in time.

The second part of the impacts estimated from the five wind projects describes the potential economic impact from operation and maintenance of the wind facilities once built and operating. Excluding returns to capital, the annual direct O&M costs of operating the five projects is projected to be $240.8 million, of which $129.8 million would be spent in Wyoming. Included in the $129.8 million spent in Wyoming are: $21.5 million in annual O&M labor expense, $32.5 million in non-labor O&M expenditures, and $75.7 million in state-local government payments. When secondary economic impacts are considered, the $129.8 million of direct in-state expenditure is estimated to generate $179.3 million of total economic impacts annually in the Wyoming economy. This economic activity is projected to generate 1,471 job-years of total employment and $84.4 million of labor income annually. The average earnings per job for the operation of the wind projects would be $57,381. This economic impact would continue for the life of the projects. A 20-year life span is assumed, and the total economic impact estimated over the life of the projects is $2.6 billion in direct impacts, $3.6 billion in total economic impacts (an additional $1.0 billion in additional expenditures is created by indirect and induced impacts), 28,962 total job-years of employment, and $1.7 billion in total labor income.

Combining the impact of the two phases, the building and operation of all five facilities over their 20-year lifetime would be estimated to create $7.1 billion in new state economic activity, 51,178 job-years of new employment and $3.0 billion in new labor income.

3. State Revenue Impact of New Wind Facilities and the Potential Tradeoffs New Taxes may Cause

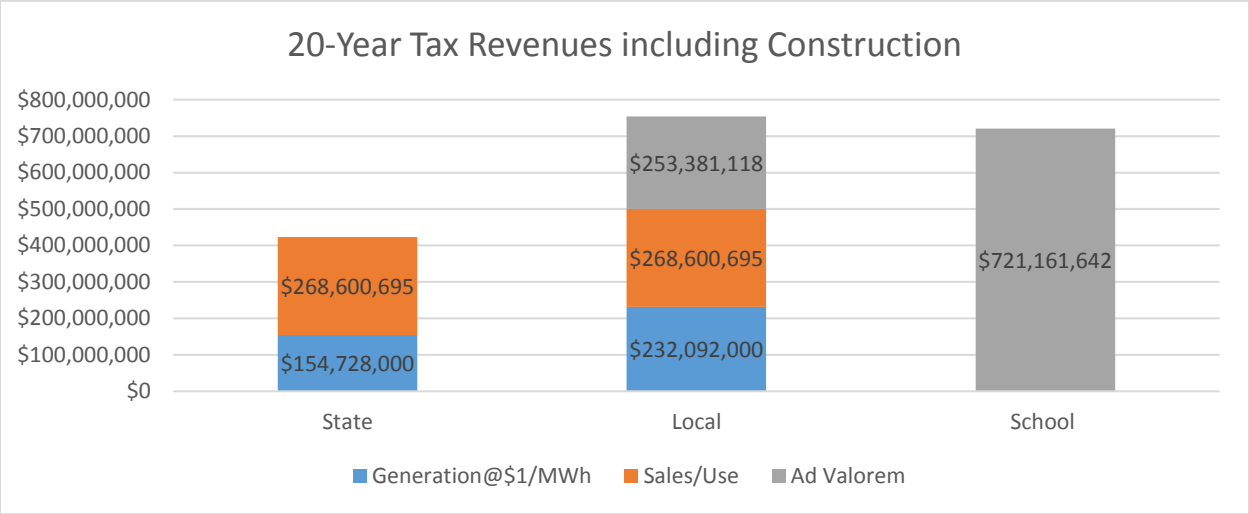
To estimate the total revenues accruing from the five projects previously listed, the models used to estimate economic impacts were used, along with existing and proposed tax laws (these estimates were also used to compute the tax burdens shown in Figure ES-4). The estimated tax revenues are presented in Table ES-2. Total tax revenues from both construction and operations over the 20-year life of the projects listed are estimated to be nearly $1.9 billion. 23% of these revenues are received from construction (approximately $442 million), with the remaining 77% ($1.457 billion) paid over the life of the projects. With respect to the distribution of these tax revenues, 22% of the revenue is received directly by the state from all sources, while an additional 38% is directed to the School Foundation account through the school-finance portion of the ad valorem (property) taxes paid. The remaining 40% of all revenues collected is distributed to local governments. Figure ES-5 describes the amounts estimated to be collected for each entity (state, local government or education), treating the school-funds collected as separate from the state revenues as these funds may only be used for school finance.[3]

[3] For property taxes, the average actual 2015 assessed valuation for the 21 wind farms in Wyoming from the LSO PowerPoint "Taxation of Wind, Coal, and Natural Gas" (revised) for the Joint Revenue Committee (May 11, 2016) was used to estimate each farm's potential assessed valuation. This is primarily based on a "Historical Cost Less

Table ES-2: Estimated Tax Revenues by Project and Total for Five Proposed Wind Facilities

	MW Capacity	Annual Generation Tax ($1/MWh)	O&M Sales and Use Tax	Annual Property Tax	Annual Total Tax	20-Year Total O&M-based Tax Revenue	Construction Sales and Use Tax
Chokecherry/ Sierra Madre	3,000	$10,500,000	$2,328,871	$23,808,048	$36,636,919	$711,738,381	$215,898,826
Pathfinder	2,100	$7,350,000	$1,630,210	$16,665,634	$25,645,843	$498,216,867	$151,129,178
Viridis Eolia	840	$2,940,000	$652,084	$6,666,253	$10,258,337	$199,286,747	$60,451,671
Invenergy	120	$420,000	$93,155	$952,322	$1,465,477	$28,469,535	$8,635,953
Pioneer	80	$280,000	$62,103	$634,881	$976,985	$18,979,690	$5,757,302
Total	**6,140**	**$21,490,000**	**$4,766,423**	**$48,727,138**	**$74,983,561**	**$1,456,691,220**	**$441,872,930**

Figure ES-5: Distribution of Tax Revenues



From Table ES-2 it is clear that the scale of the wind facility determines the share of potential revenues generated, with Pioneer Wind Park estimated to create only 1.3% of total tax revenues generated by the five facilities. Invenergy produces 2% of total tax revenues, Viridis Eolia creates 13.7% of potential revenues, while Pathfinder produces 34.2% of taxes on the wind sector. The Chokecherry and Sierra

Depreciation" approach, although there may also be "Capitalized Earnings" observations. While it may not be large, there is also some assessed valuation for the land component included in the value. Sales tax rates used the implied sales tax rate from JEDI (5.2%) which is close to the average 2015 sales tax rate for Wyoming (5.3%). Of the state's 4.0 percent rate, the state keeps 69% or 2.76%, about 50% of the 5.2% thus total sales taxes were split equally when the state vs. local government shares were computed. Some counties may assess 6% with the Specific Purpose Optional 1% that Wyoming allows, but this tends to come and go as capital projects are funded. Also, the actual distribution between the state and local government will depend on what Industrial Siting decides in terms of Impact Assistance Fund Payments. This consideration was not included in the modeling.

Madre project is anticipated to provide nearly half of the total tax income these five facilities create, at 48.9% due to the relative size of the project.[4]

The tax totals in Table ES-2 describe the potential revenue benefits existing wind development plans could generate for the state *if they are built*. These also define the *potential lost revenues if state decisions cause developers to reconsider their current projects*. To assess the potential tradeoff between the possible increases in revenues a tax increase could create relative to possible revenue losses if projects choose to cancel projects due to increased taxes, a comparison of potential tax benefits from a generation tax increase to $2/MWh through $4/MWh relative to the potential lost revenues if these tax increases cause project cancellations is presented in Figures ES-6 to ES-8.

Overall, if the generation tax were increased to $4/MWh, the maximum additional revenue that could be expected is $1.4 billion collected over 20 years. The potential loss in new revenues if such a tax increase resulted in the cancelation of currently proposed wind projects would be between $1.9 billion and $2.2 billion ($2.2 billion if the increased size of the Viridis Eolia project is included). Furthermore, revenue gains from any tax increase are very sensitive to which projects might cancel development plans.

Figure ES-6: Potential 20-Year Tax Revenue increases for possible new Generation Tax Levels

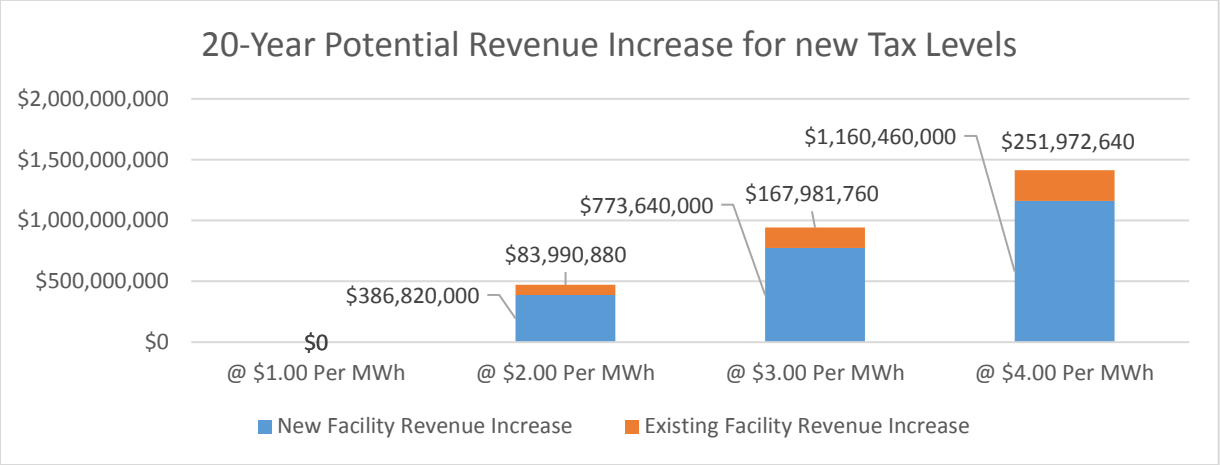


Figure ES-6 shows the potential revenue that increasing the generation tax could bring the state assuming a 20-year life of each project and assuming taxes are not charged until year 3, consistent with current tax rules. As can be seen these potential new revenues appear attractive, totaling over $471 million for a one dollar increase in the existing tax, $942 million at a $2/MWh increase, and $1.4 billion if a $4/MWh tax were assessed. Most of the benefits accrue from new projects, as existing facilities only account for 18% of the new revenues realized, thus for the majority of these benefits to be realized it must be the case that increased taxes do not deter facilities from developing in Wyoming.[5] It should also be noted that the revenues from existing facilities are potentially an optimistic estimate. The oldest existing facilities are

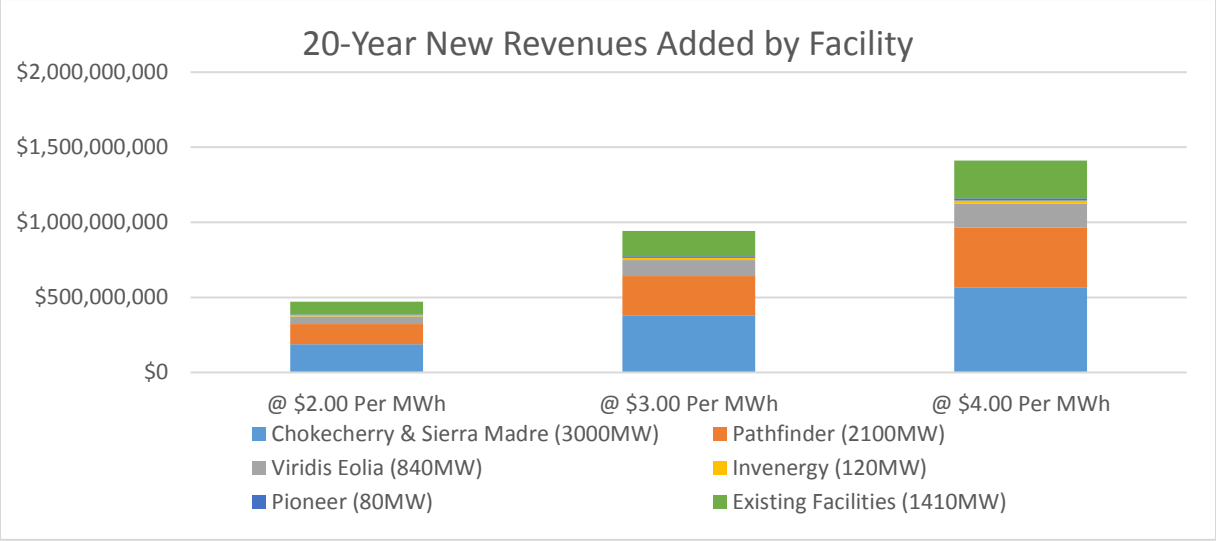
[4] As noted previously, the Viridis Eolia project has now been more than doubled in anticipated size and its share of total taxes paid would increase accordingly.

[5] Existing facility revenues were computed using a 34% capacity factor, the four-year average capacity factor across Wyoming facilities since 2012 using Wyoming Department of Revenue data. New facilities were assumed to have 40% capacity factors due to the use of newer technologies.

nearing 20 years old, and therefore the estimate assumes these facilities are rebuilt as necessary, though if taxes were increased it is also possible that developers would choose not replace these facilities.

Figure ES-7 breaks down the new tax revenues by project to further address the importance of particular projects continuing to develop for any potential tax revenue gains to be realized. The majority of new tax revenues occurring for an increase in a generation tax are realized only if the largest facilities continue to develop when higher taxes are imposed. The largest two projects, Chokecherry and Sierra Madre and Pathfinder, account for 68% of the total benefit possible from any increase in the generation tax being realized. Viridis Eolia accounts for 11.2% of potential revenues, and Pioneer Wind Park and Invenergy account together for only 2.7% of the potential gains.[6] Clearly, the benefits to increased tax rates on wind could be undermined if only the largest projects reconsider developing due to new tax changes.

Figure ES-7: Shares of Potential Tax Revenue Increases occurring by Project

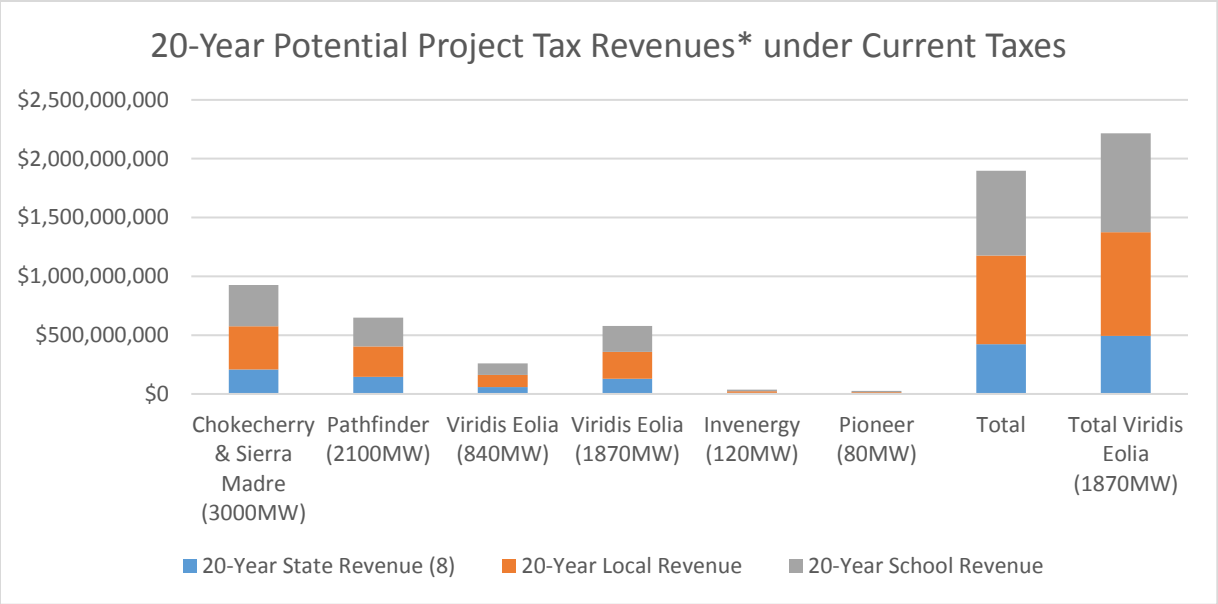


Evaluation of whether to institute a new tax increase should not occur without consideration of the potential costs of such a decision. Figure ES-8 shows the potential revenue losses that could occur if specific projects reconsider their decision to locate in Wyoming. These losses are computed assuming the current generation tax of $1/MWh is maintained since each project was planned while that tax was in place. Total potential tax revenues at current tax rates are almost $1.9 billion (over $2.2 billion including the larger capacity Viridis Eolia recently announced) assuming a 20-year life for each project. This total represents the maximum possible losses the state could experience if a decision to increase taxes caused all these projects to cancel their development plans. This is over four times the maximum benefits that could occur from a $1/MWh generation tax increase, two times the maximum increased revenues potentially occurring for a $2/MWh increase, and 34% more than the maximum revenues that might be expected from a $3/MWh increase in the generation tax.[7] As noted previously, the gains are most sensitive to the largest projects developing.

[6] At the newly announced size of 1870 MW, Viridis Eolia would account for 22% of potential revenue gains.

[7] Further, these differences are understated as they do not account for the time-value of money. Almost 25% of the tax revenues occurring if these projects proceed in Wyoming (those in figure ES-8) occur during construction, before the 20-year life of a project starts. Revenues from a generation tax increase occur annually and equally over

Figure ES-8: Potential Revenues by Project from all sources of Taxation



* These revenues also represent potential revenue losses if new taxes deter project developments.

4. Summary

Overall, the state stands to potentially lose significant economic activity and state revenues should the decision to raise generation taxes cause currently planned wind projects not to come to Wyoming. Overall, currently proposed projects could create $7.1 billion in new state economic activity, 51,178 job-years of new employment and $3.0 billion in new labor income over their 20-year lifetime. Additional state revenues could total over $1.9 billion over the same period assuming no new taxes are imposed. Potential losses are especially sensitive to how possible changes in tax structure affect the largest planned projects' decisions to locate in the state. In a worst case scenario, should the largest projects choose not to continue their development plans, the revenue losses experienced due to the new tax policy could result in a net decrease in realized state revenues relative to what would occur in the absence of such a change. This is without consideration of the economic benefits such projects bring through increased income and employment in the private sector. Furthermore, the impact of an increase in the state-wide generation tax resulting in project cancellations would be concentrated regionally in the counties where projects cancelled development.

While the sensitivity of currently planned projects to continue if tax changes are implemented cannot be known with certainty, the state does need to consider and attempt to determine the likelihood such policy changes could result in project cancellations before implementing such decisions. The state should also consider the fact that raising taxes will further reduce the state's competitiveness to attract future projects yet unknown, and that even the discussion of such tax changes may be reducing the chances such projects locate in Wyoming if talk of such tax changes results in additional project uncertainty that deters other wind development. Given such considerations and the potential benefits of wind generation

20-years. Assuming the state would prefer tax revenues sooner than later, the revenues shown in Figure ES-8 should be valued at more than those in Figures ES-6 and ES-7.

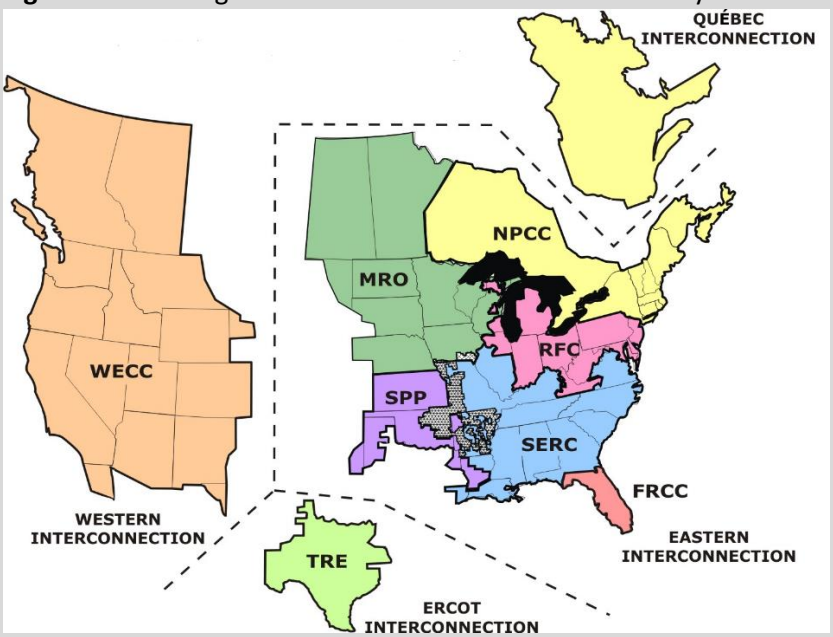
locating in Wyoming, serious consideration should be given to the possibility that attempting to raise revenue through new taxes on particular sectors such as wind generation could unintentionally result in less revenue actually received by the state than had no such increase been implemented.

Technical Notes:

1. A note on the States considered in this study in Assessing Wyoming's wind competitiveness

Several high wind-potential Midwestern states are geographically close to Wyoming and might seem natural comparators in the renewable generation market. They are not, however, due to the configuration of the North American power grid. As shown in Figure A1, in the United States there are three separate grids operating to the same technical specifications (alternating current, same voltage and frequency). Each of the three US grids, referred to as the western interconnection (which includes Wyoming), the eastern interconnection, and the ERCOT interconnection (primarily Texas) differ only in the phase of each system. If the waveform of the alternating electric current flowing through each interconnect were viewed on an oscilloscope, they would look like a sine waves, with a frequency of 60 Hz, implying they would alternate through 60 full cycles in one second. The phase of the system describes the timing of when the sine curve alternately reaches its peak and minimum. This timing is not coordinated across the three US interconnections. For this reason, power can only flow between interconnections if it is first converted to direct current before being transferred. Such conversion facilities are very costly to build and those that exist have limited capacity, thus there is relatively little power flow between the interconnections. Because of these operational barriers, almost all power generated in each interconnection can be used only in the interconnection in which it is produced. While significant wind potential exists in the states east of Montana, Wyoming, Colorado and New Mexico, the primary states competing with Wyoming in the renewable energy market are states in the western interconnection. This includes ten other states in total: Washington, Idaho, Montana, Oregon, Colorado, Utah, Nevada, California, Arizona and New Mexico.

Figure A1: Configuration of the North American Power System

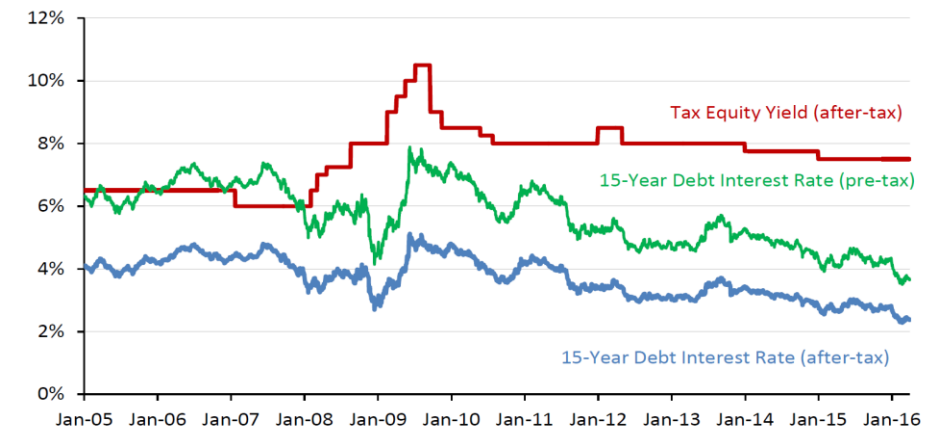


Source: North American Electricity Reliability Corp. (NERC)

2. A note on Federal Production Tax Credits (PTCs)

In December 2015, Congress extended the federal Production Tax credit (PTC) for five years (or if wind developers elect to do so, this can be converted into an Investment Tax Credit (ITC)). The current rate is $23/MWh, and this will now decrease in 20% annual increments to 80% of the current level in 2017, 60% in 2018, etc., before ending in 2021. The PTC allows wind development owners a non-refundable tax credit against federal taxes owed. This tax credit is paid for each MWh of electricity produced for 10-years after a facility is put in service, and the credit is inflation adjusted to maintain its value over time. Because developers often do not have a tax liability large enough to take advantage of the entire credit offered (it must be used for taxes – it is not a cash rebate), this has led to developers partnering with other firms that do have the tax liability to take full advantage of the PTC. This form of partnership in which the tax equity investor takes on ownership in the project offers an opportunity for wind developers to both utilize the tax credit more efficiently (without allowing potential credits to be unused if they do not have the tax liability to fully use it), and the ability to attract financing that might otherwise be difficult to obtain given the capital intensity of wind projects. Often developers do not have the financial resources to secure debt on the scale necessary to build the projects they would prefer, and therefore tax equity partnerships create the ability to secure the funding they might be otherwise unable to acquire.

Figure A2: Comparison of Wind Developer's Cost of Financial Capital with and without using PTCs



Source: Wind Technologies Report, 2015 (Wiser *et al.*, 2016)

Tax equity investors, however, are not numerous and they charge for their willingness to capitalize projects through negotiation. Developers are often forced to pay higher terms than the interest rates available for debt financing because they cannot access sufficient funds at these lower rates. As Figure A2 shows, the effective after-tax yield on tax equity, or the cost of capital wind developers face when using this form of financing is approximately twice the cost of 15-year debt.

Considerations to tax the production tax credit in Wyoming would be difficult to implement because of the nature of the PTC. It is not cash-in-hand as the tax credit is not refundable if not used. Secondly, if the tax credits available to offer a tax equity partner are reduced through such a tax policy change, this will increase the cost of tax-equity finance in Wyoming relative to other states, undermining the state's competitiveness to attract wind development. Further, at $23/MWh for example, a tax of, for example, 25% of the PTC would equate to a $5.75/MWh charge on the tax credit, which is significantly higher than the current tax rate on generation Wyoming charges.