Modeling Economic & Environmental Impacts of Wind Development in Arizona

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Sustainable Energy Solutions

The Western Wind & Solar Integration Study and the MAPS model

The Western Wind & Solar Integration Study, performed by the National Renewable Energy Laboratory (NREL), General Electric Energy (GE), and other partners, used a Multi-Area Production Simulation (MAPS) model to evaluate the impacts on the western electric grid of integrating wind up to 30% penetration. The study evaluated three scenarios of wind development: (1. In Area) each state in the study footprint met its electric load with wind developed in the same state; (2. Mega Project) the entire study footprint was optimized for least capital cost of energy delivery, using construction costs for wind development and the transmission lines that would be required; and (3. Local Priority) wind generating capacity built in the same state in which it would serve electric load was given a 10% reduction in capital construction cost, in order to account for some of the local economic impacts.

Using WWSIS MAPS data, this study quantified the cost to serve load for all of the transmission areas in Arizona for each scenario. At 10 and 20% wind integration, the cost of serving Arizona load was lower when using in-state wind resources (In Area scenario) than it was when importing most of the wind energy from out of state (Mega Project Scenario). At 30% wind integration, the Mega Project scenario resulted in slightly lower operating costs.

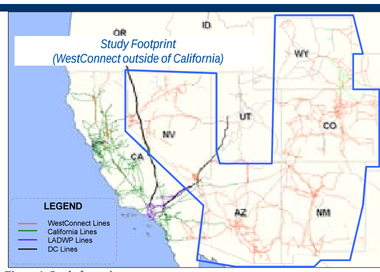


Figure 1. Study footprint

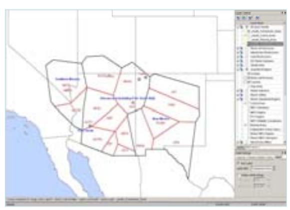


Figure 2. Transmission areas in MAPS

The JEDI model

The Jobs and Economic Development Impacts (JEDI) Model quantifies the direct, indirect, and induced impacts of a specified investment in wind energy development. The impacts for each phase of a 1000-MW wind development in Arizona are shown in the figure below (2008). This study quantified the total economic impact for the 20-year life of the wind development scenarios examined in the Western Wind & Solar Integration Study.

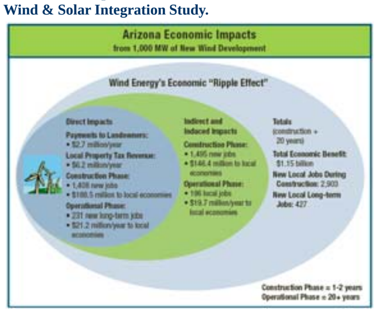


Figure 3. Example JEDI results. Source: NREL.

Quantifying local economic impacts over the life of a wind project as a per-MWh benefit

By dividing the total (20-year) economic impact of the wind development in each scenario by the total quantity of energy that the wind capacity would produce in that time frame, this study quantified the dollar value of economic impact that the project would generate on a per-MWh basis. That is, the dollar value represented the quantity of local economic impact on Arizona that would accompany each MWh of wind generated by an in-state wind development.

By attributing this benefit only to the wind generating capacity located in Arizona for the In Area, Local Priority, and Mega Project scenarios, this study showed the relative benefit to Arizona of developing in-state versus importing wind energy from out of state (Table 1).

Table 1. Economic impacts of each of the WWSIS 30% scenarios.

Economic impacts of 30% wind development spread across 20 year generation			
Scenario	In Area	Local Priority	Mega Project
MW in AZ	11220	7710	1890
Arizona economic benefit per MWh wind used	$30.58	$21.02	$5.15

Combining WWSIS and JEDI economic impacts

This study quantified the difference in operating cost between the WWSIS wind-development scenarios and the no-wind scenario per MWh of wind introduced as the *operating cost savings per MWh*. By adding this to the *local economic impact per MWh*, this study estimated the net economic benefit to Arizona of each wind development scenario. While the operating cost savings at 30% wind integration were highest in the Mega Project scenario, the local economic impacts of in-state development in the In Area and Local Priority scenarios more than offset this difference in operating cost. The Local Priority scenario yielded the greatest *net benefit* to the state at any wind integration percentage.

Table 2. Total cost of energy to serve Arizona load in each of the 30% wind development scenarios (2009$)

	In Area		Local Priority		Mega Project	
Scenario	Total Cost	$/MWh	Total Cost	$/MWh	Total Cost	$/MWh
30% Wind	$6.21 Billion	$62.44	$6.21 Billion	$62.48	$6.11 Billion	$61.44
				No Wind	$8.05 Billion	$80.92

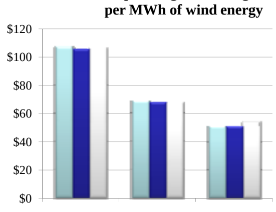


Figure 4. WWSIS scenario operating cost savings/MWh wind

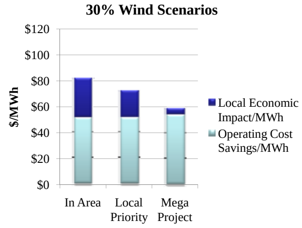


Figure 5. WWSIS 30% wind scenario net economic impacts/MWh wind

Quantifying & monetizing environmental impacts

The total emissions for all of the electricity generation in Arizona were quantified by the WWSIS for each scenario. By calculating the average emissions and water use per non-wind GWh used in Arizona, this study was able to estimate the emissions reductions and water savings that would result from wind integration rates of up to 30%. In addition, by assigning a mid-range market value to emissions permits and water, this study estimated the market value of these emissions reductions and water savings.

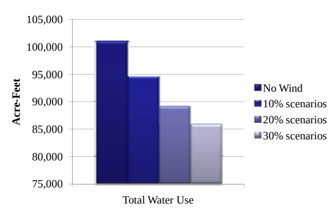


Figure 6. Water use of each scenario

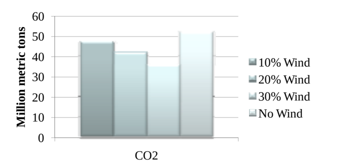


Figure 7. Carbon Dioxide emissions of each scenario

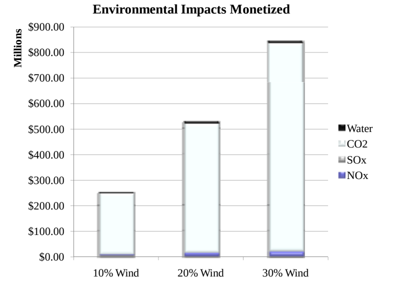
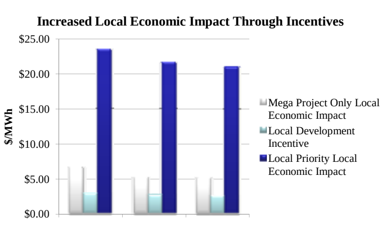


Figure 8. Monetized environmental impacts of each scenario



The WWSIS accounted for local economic impacts by reducing the capital cost of investment by 10% in their site selection algorithm for scenario development. This reduction resulted in cost-effective wind development in Arizona jumping from 1890 MW (Mega Project) to 7710 MW (Local Priority) for the 30% wind scenarios. The local economic impact on Arizona for these two scenarios is shown in Figure 9, compared with the cost of providing this 10% cost reduction as an incentive. This incentive, which works out to less that $4/MWh, increases the local economic impacts on Arizona by nearly $16/MWh.

Arizona Wind Development Policies

Dry Lake Wind Project, Navajo County, Arizona

POLICY GOALS:

1. Increase wind power development in Arizona
2. Attract wind developers through financial incentives
3. Maximize local economic development potential
4. Increase the viability / impact of tribal wind projects

Wind power development can be increased in Arizona through state policies such as the Renewable Energy Standard & Tariff and the streamlining of local development processes such as permitting across multiple jurisdictions.

Wind development can also be attracted to the state through the use of financial incentives. In addition to the property tax incentives that exist, the state could provide a production tax credit or production incentive, which even at $0.01/ KWh would render Arizona wind just as cost-effective to develop as any wind resource in the west. This would also allow Arizona to compete more readily with neighboring New Mexico, which offers such a production tax credit.

Wind Turbine Blade, Navajo County, Arizona

The local economic development potential of the wind projects that are built in the state can be maximized by increasing the supply chain in the state and the number of qualified workers for the wind industry. Incentives to manufacturers and workforce development programs would contribute to this goal.

Tribal wind development projects would have a greater local economic impact and would be more viable for tribal or external developers if federal tax credits and incentives were transferrable to tribes.

Source: USDOE Tribal Energy Program

Conclusions

Wind energy should be used as part of a strategy to meet Arizona's future electricity load. Arizona should pursue the development of in-state wind resources, even if it requires the creation of financial incentives to attract this development.

Wind energy offers the state significant economic and environmental benefits, and the cost of providing development incentives to make in-state wind more cost-effective is low in comparison to the quantity of economic impact on the state that is generated by the increased development that could result.

In addition to financial incentives to developers, other policy initiatives that should be explored include: policies to streamline the permitting and development process across the state's many jurisdictions; policies to increase the local economic impact of the development that does occur, such as increasing the availability of products, services and trained workers in the state; and policies to support the viability and impact of wind development projects owned by tribes or located on tribal land.

References

Lantz & Tegen (2008). Economic benefits, CO2 reductions, and water savings from 1000 MW of new wind power in Arizona. United States Department of Energy. Report DOE/GO-102008-2670. Golden. CO.

Wadsack, Karin (2009). The economic and environmental impacts of wind power development in Arizona. Thesis research presentation, Northern Arizona University.

Western Wind & Solar Integration Study. Multiple presentations and reports available at http://wind.nrel.gov/public/WWIS/