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Economic Development from Gigawatt-Scale Wind Deployment in Wyoming

Analysis Performed by NREL for the Wyoming Infrastructure Authority

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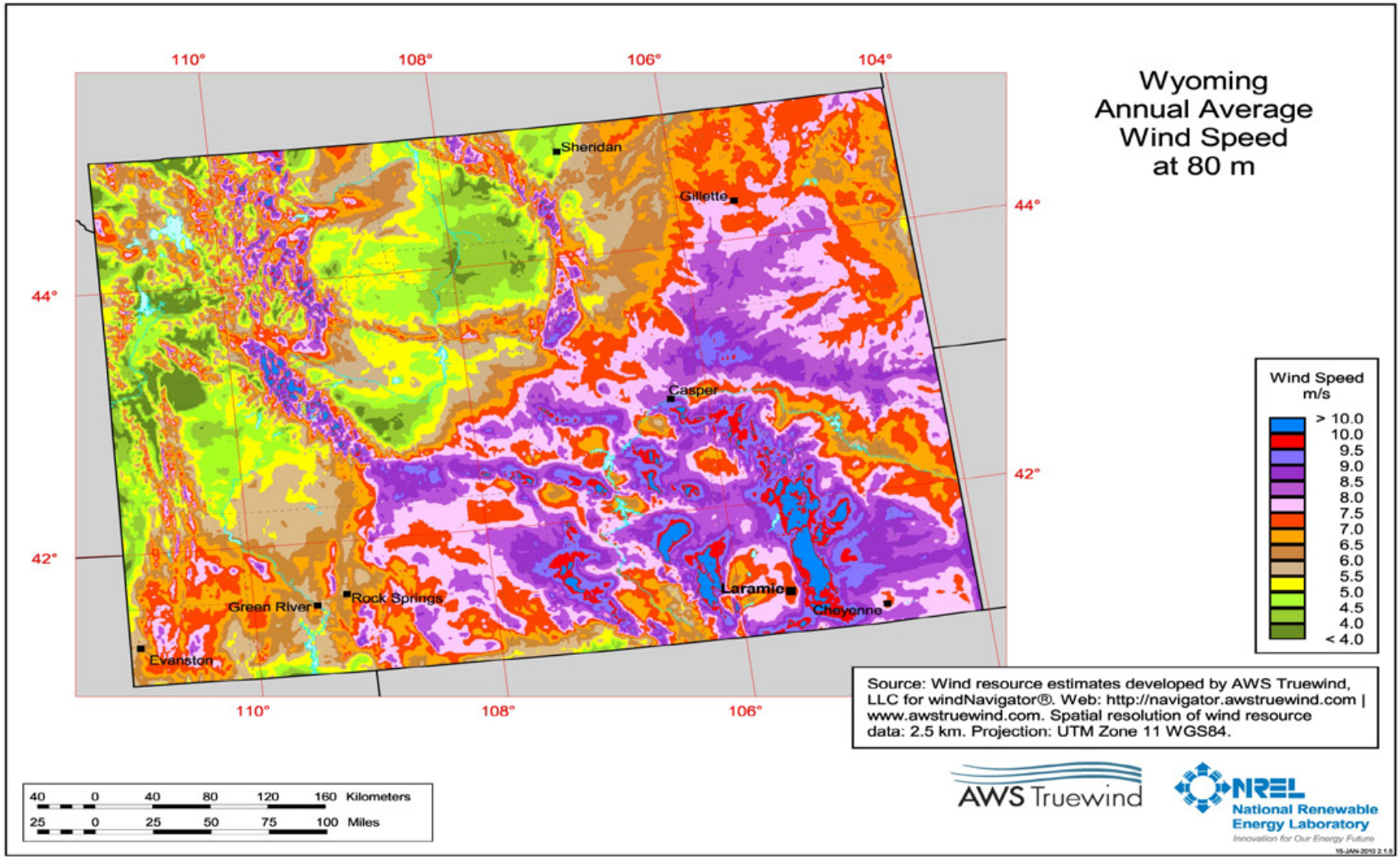
Presentation Overview

- Project context
- Definitions & caveats
- Deployment scenario
- Modeling inputs
- Results
- Conclusions

Photo by Pat Corkery, NREL/PIX16569

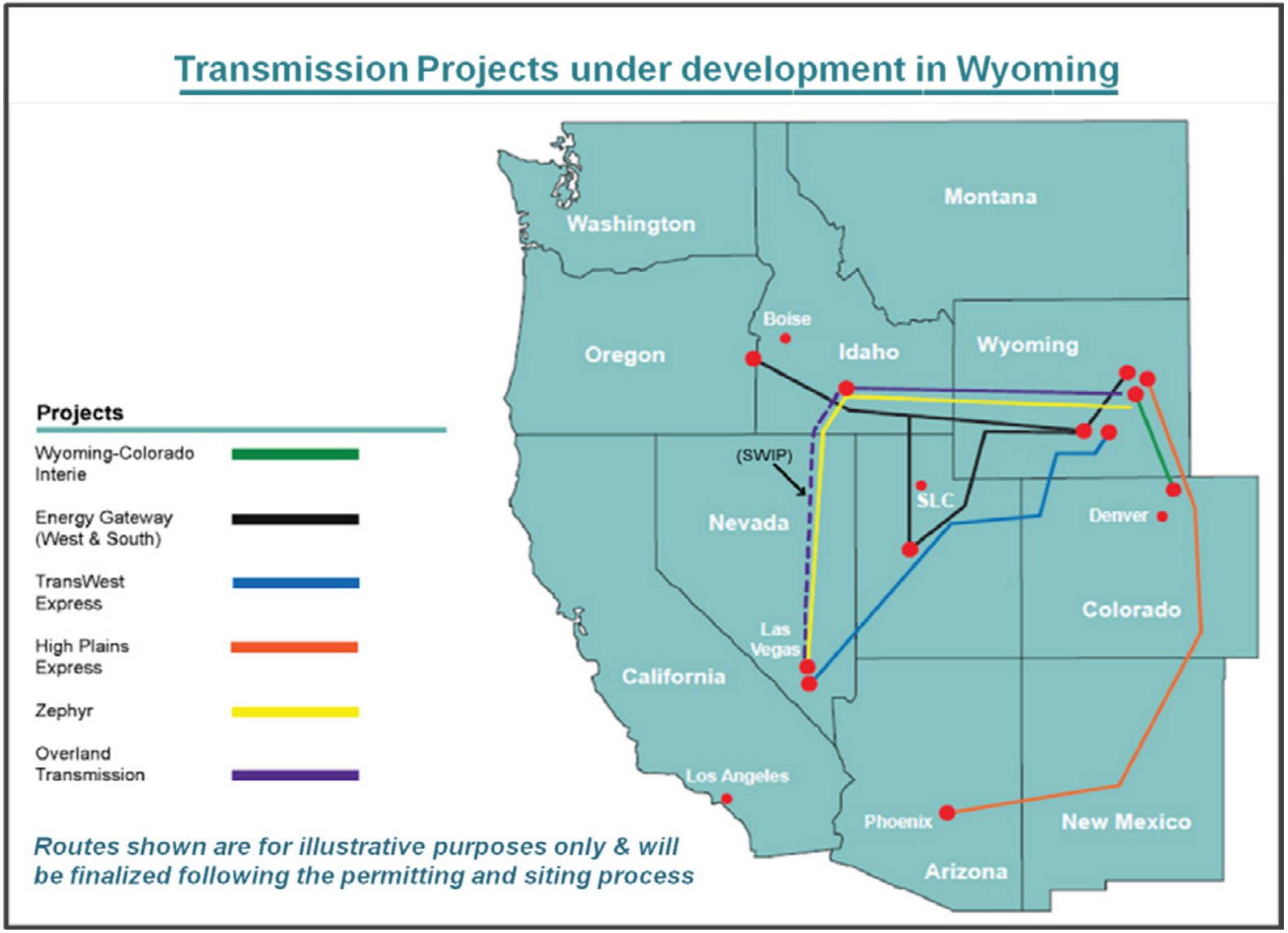
Wyoming Wind Resource



The Crux

Source: NASA (http://www.nasa.gov/)

Wyoming Transmission Projects



Source: WIA

Role and Scope of the NREL Study

- Building and siting new power generation and infrastructure, especially to serve out-of-state load, can be challenging.

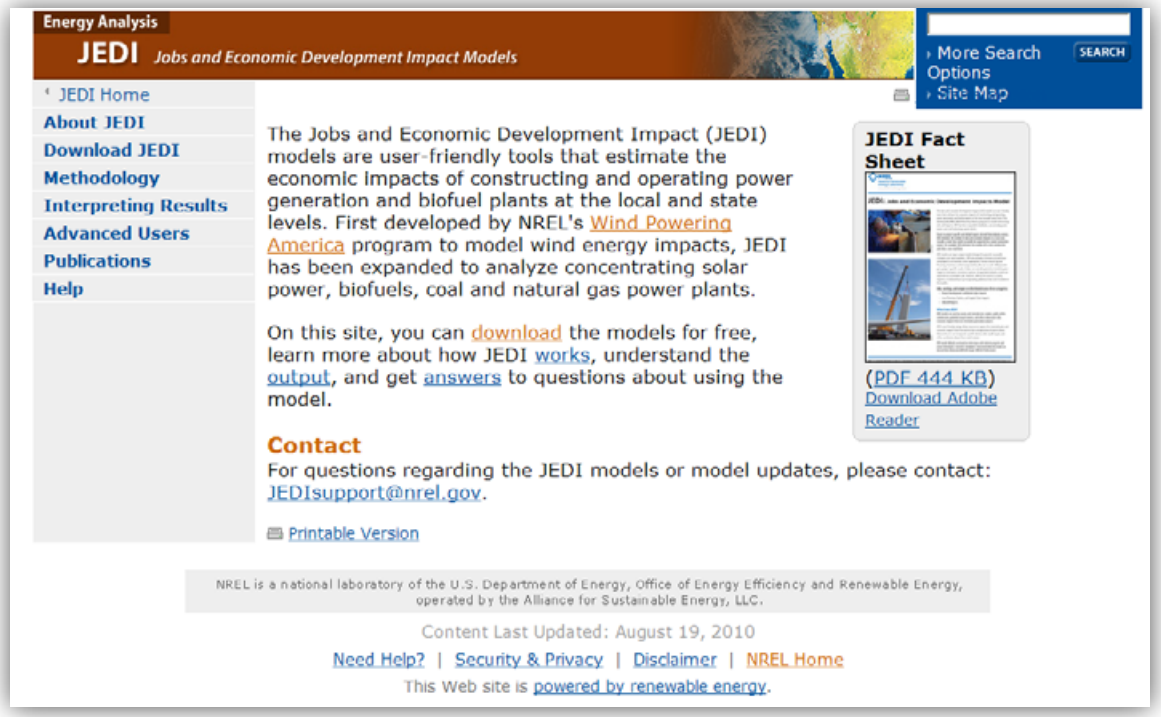
- Decisions are best made with a full understanding of how a given project (or set of projects) will affect Wyoming and its communities.

- Jobs and economic development are variables that are important to state policymakers, local policymakers, and residents.

- This study considers the question: What if?

  If deployment of new transmission allows for significant new power generation, what level of jobs and economic activity might result?

The JEDI Analysis Tools



JEDI is used by industry, government, academics, advocates, consultants, and others.

Currently public

- Utility-Scale Wind
- Natural Gas
- Coal
- Geothermal
- Ethanol
- Solar (CSP, PV)

In process

- Transmission
- Water
- Biopower
- Offshore, Small Wind

Jobs and Economic Development Impacts (JEDI) Model

Economic Development at Multiple Levels

Photo from Klaus Obel, NREL/PIX16082

1. On-site labor and professional services

Photo from Gamesa, NREL/PIX16001

2. Equipment production and supply chain

Photo from Ford Motor Company, NREL/PIX05556

3. Induced economic activity (household purchases due to injection of income)

JEDI Caveats

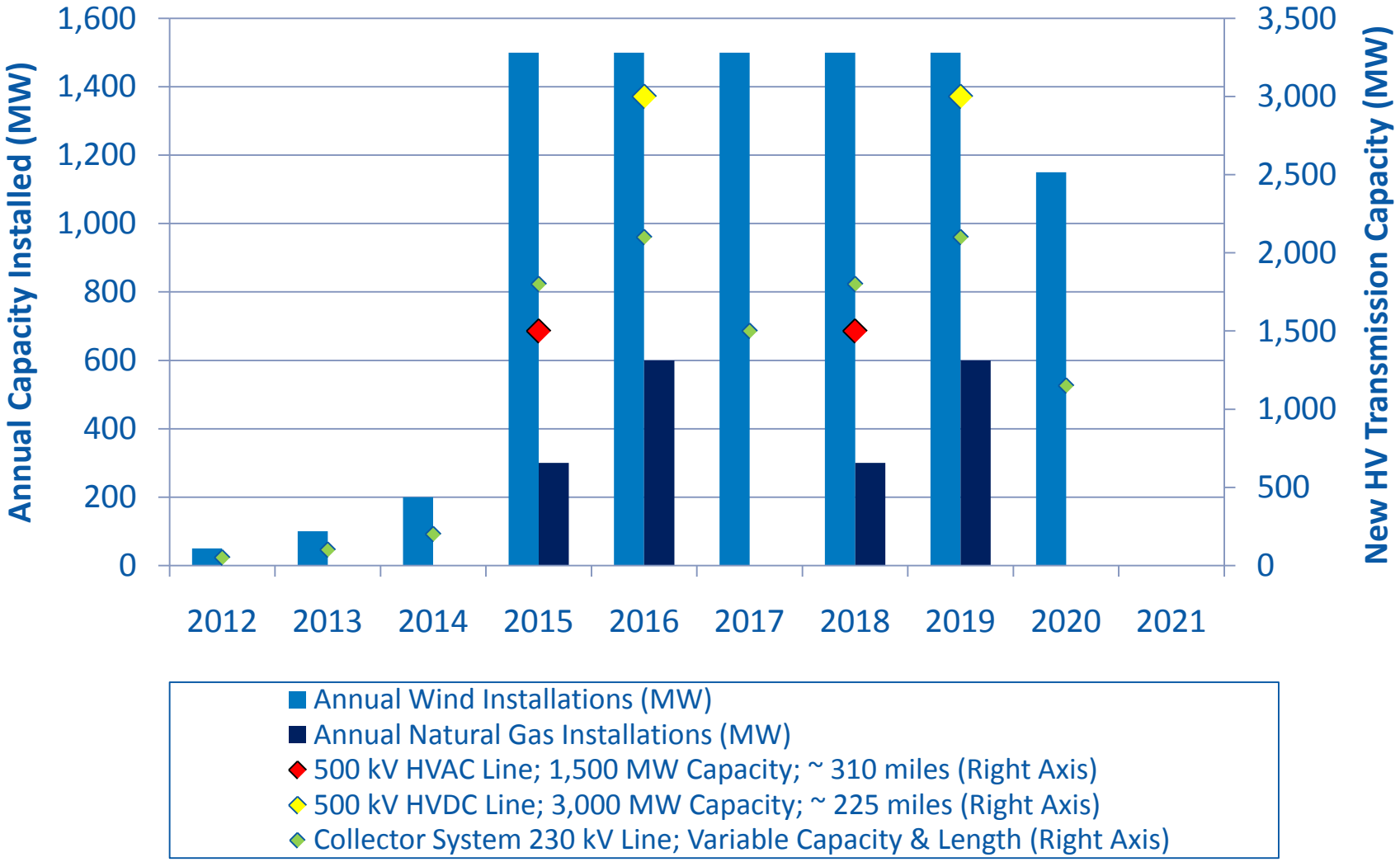
- Results are an estimate, not a precise forecast.
- Results are not a measure of project profitability or viability.
- Results report *gross jobs* as opposed to *net jobs.*
- Assumptions around local sourcing and procurement are fundamental in determining local economic activity.
  - Sensitivity scenarios are included in this analysis.
- Jobs are reported as Full-Time Equivalent (FTE) jobs.

Photo from First Wind, NREL/PIX16738

Infrastructure Portfolio for WIA

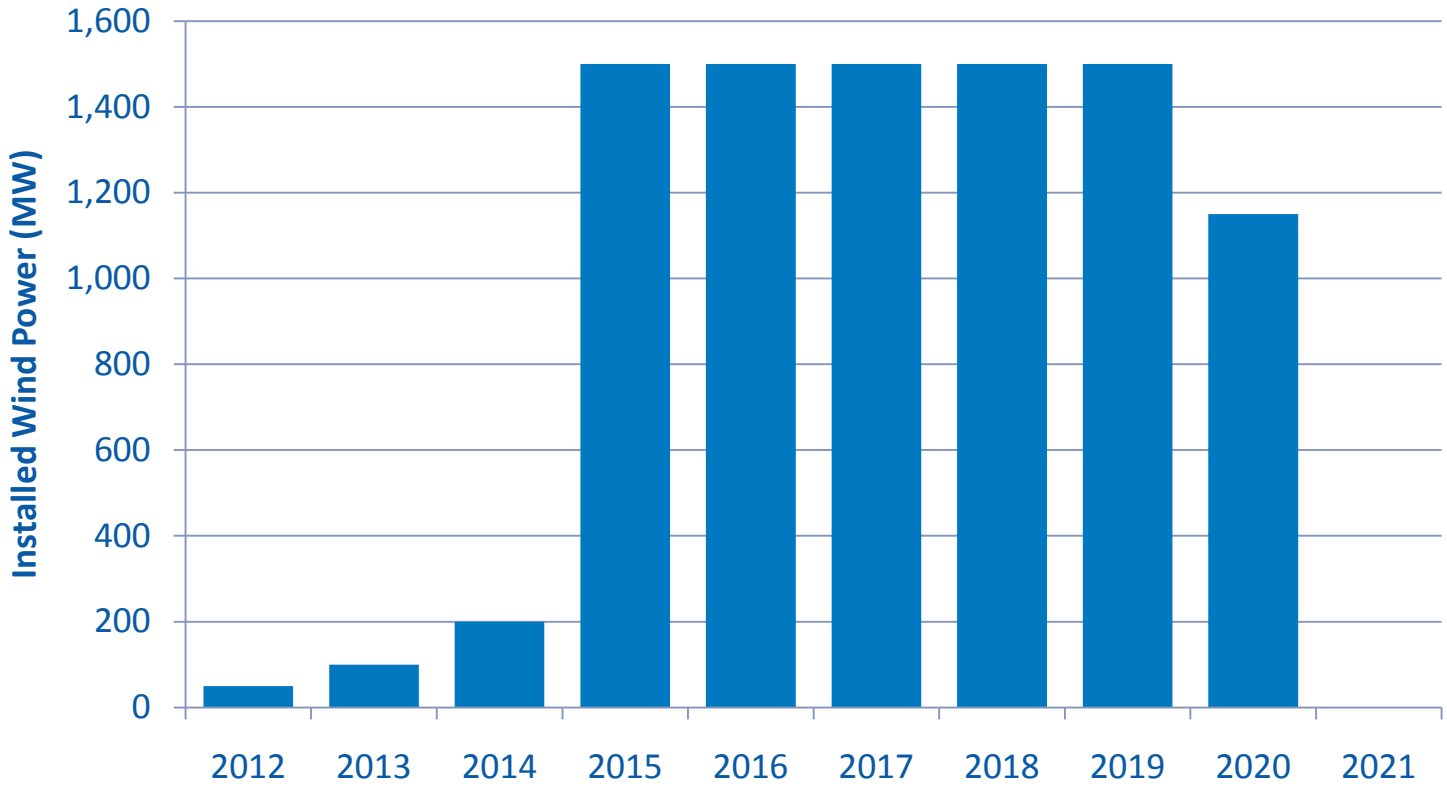
Infrastructure Type	*Units Installed*	*Total Installed Cost*	*Annual Operating Expenditures*
Wind Generation	9,000 MW	$18 billion	$225 million
Natural Gas Generation	1,800 MW	$2.3 billion	$42 million
500-kV HVDC Transmission Line	2	$2.2 billion	$60 million
500-kV HVAC Transmission Line	2	$1.3 billion	$35 million
230-kV HVAC Collector System	Multiple	$660 million	$17 million

Infrastructure Deployment (2012 – 2021)



Basic Inputs

Installed Cost	Annual O&M Cost	Land Lease ($/MW) (Annualized NPV)	Property Tax ($/MW) (Annualized NPV)
$2,000/kW	$25/kW	$6,025	$6,080



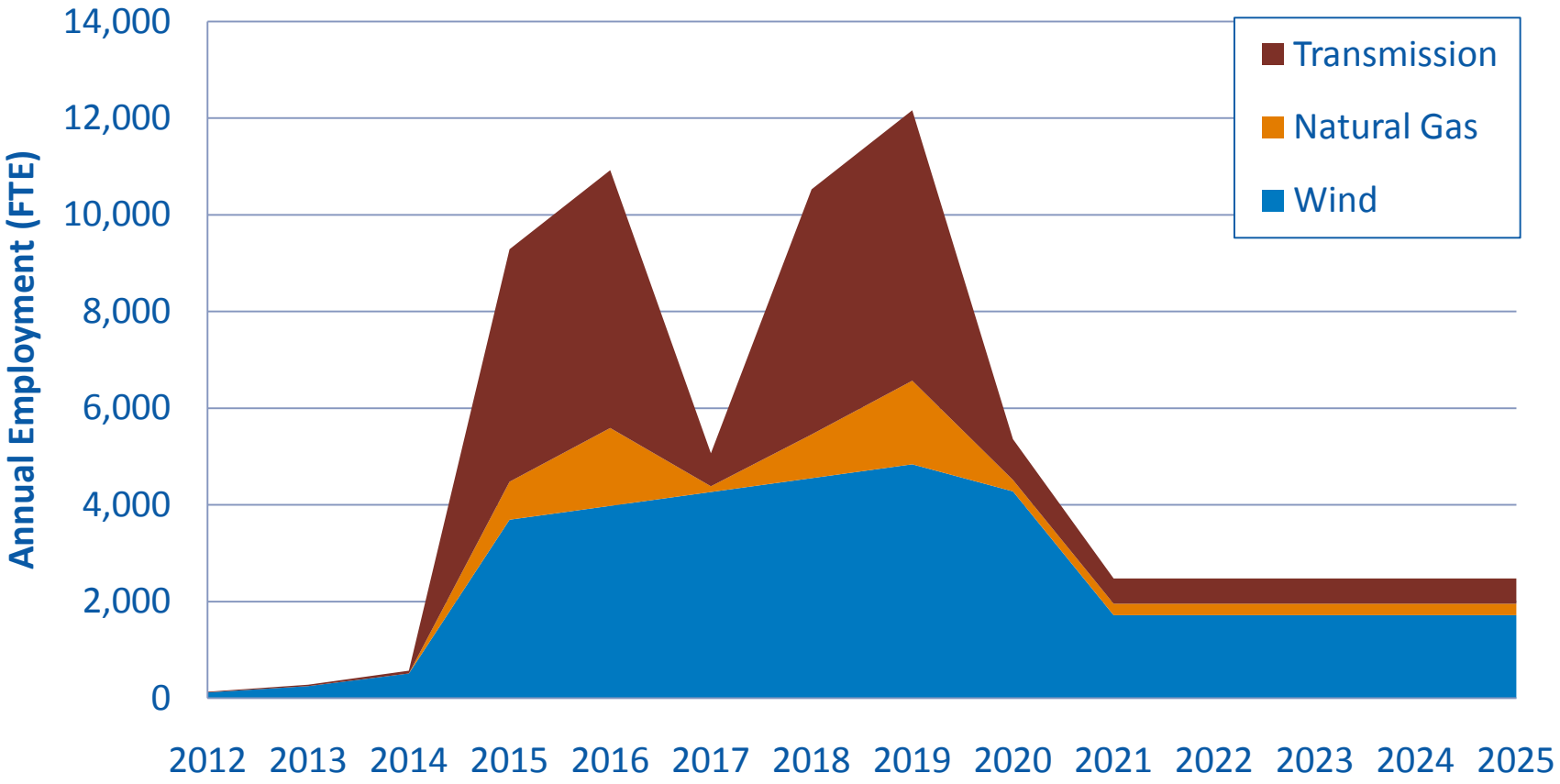
Sample Detailed Inputs

Wind Construction Parameters	Percentage of Total Installed Cost	Wyoming Local Purchase Coefficient		
		Base Case	High Case	Low Case
Turbine nacelle & drive train	43%		0%	
Blades	10%		0%	
Towers	11%	0%	50%	0%
Transportation	8%		0%	
General site materials	10%		70%	
Transformer	1%		0%	
Electrical equipment	1%		20%	
HV line extension	2%		10%	
Foundation labor	<1%		30%	
Turbine erection	1%	20%	75%	20%
Electrical craft labor	1%		30%	
Management/supervision	<1%	10%	20%	0%
Misc.	4%		50%	
Substation/interconnection materials	1%		10%	
Substation/interconnection labor	<1%		40%	
Engineering	1%		10%	
Legal services	1%	70%	70%	20%
Land easements	<1%		100%	
Site certificate/permitting	<1%		70%	
Sales tax	5%		100%	
Total	**100%**	**16%**	**22%**	**15%**

Results

Photo from HDR, NREL/PIX14307

Base Case Employment Over Time and by Infrastructure Type

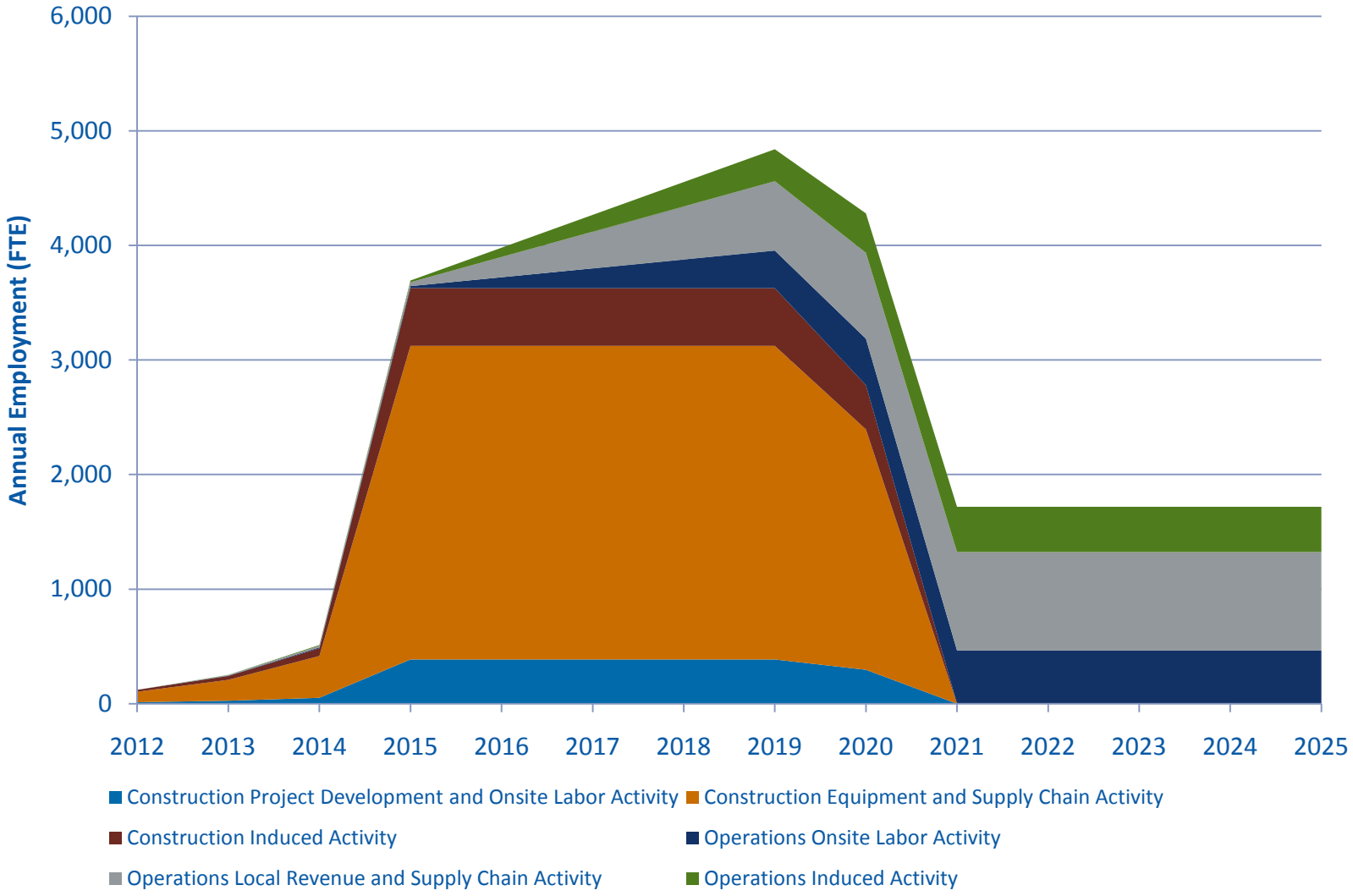


Wind Base Case Results

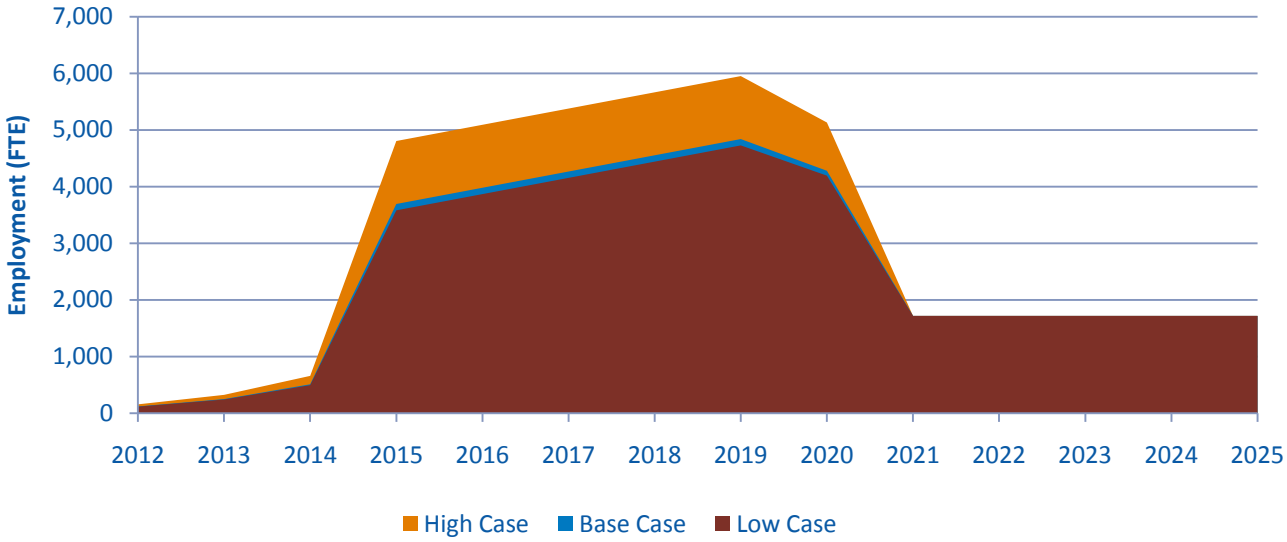
Construction (Average Annual over 10 years)	**Total Jobs**	**Earnings($M)**	**Output ($M)**
Project Development and Onsite Labor	230	$14	$19
Equipment and Supply Chain Activity	1,600	$77	$210
Induced Activity	300	$11	$37
Total	**2,200**	**$100**	**$270**

Operations (Annual for 20 Years)	**Total Jobs**	**Earnings($M)**	**Output ($M)**
Onsite Labor	470	$27	$27
Local Revenue and Supply Chain Activity	860	$35	$220
Induced Activity	400	$14	$48
Total	**1,700**	**$76**	**$290**

Base Case for New Wind over Time



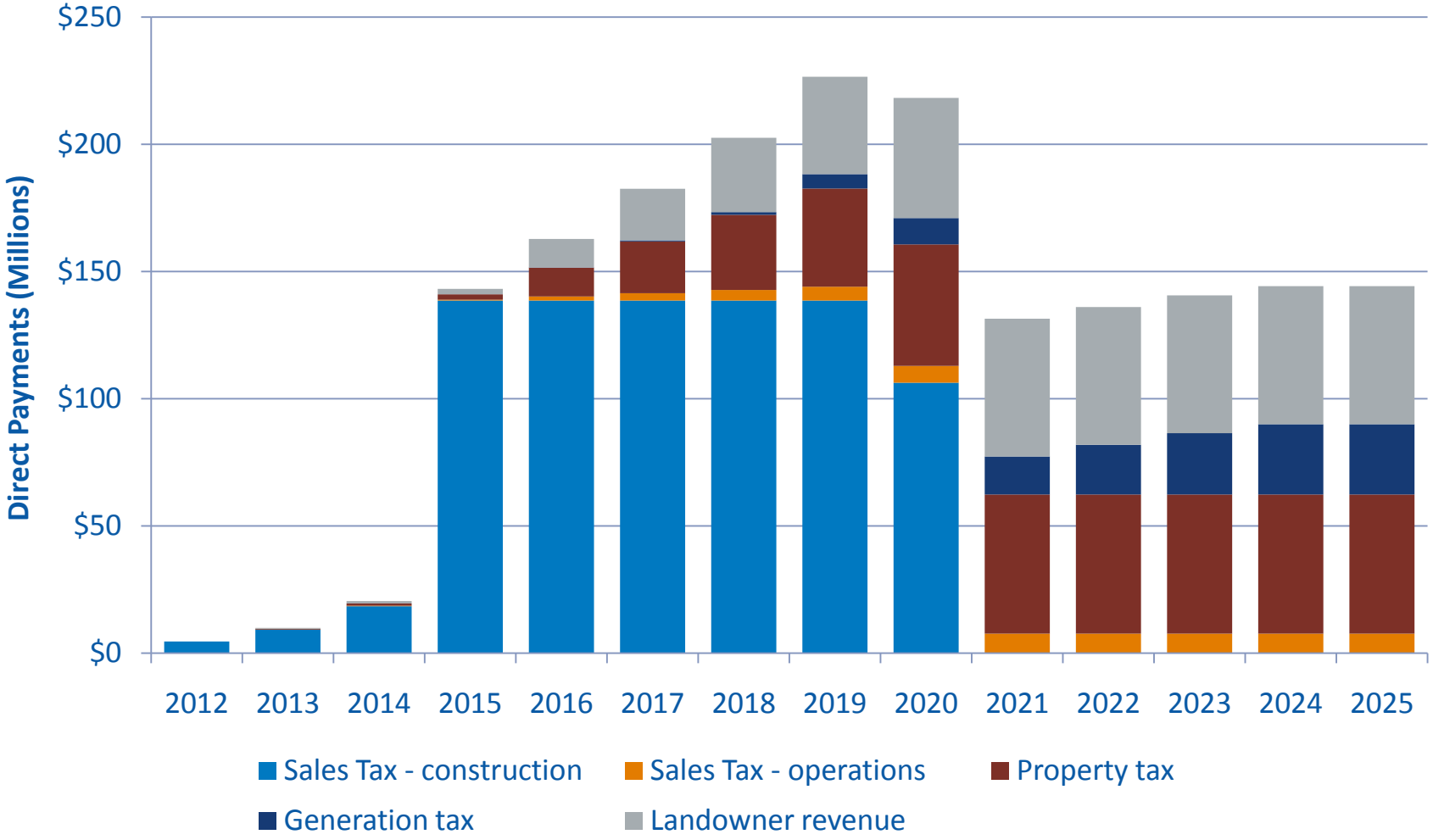
Wind Power Sensitivities



Low scenario: project management during construction all out-of-state and only 20% of legal services provided by Wyoming firms.

High scenario: 50% of towers manufactured in Wyoming, 75% of tower erection labor in-state (instead of 20%), and 20% of project management during construction based in Wyoming.

Wind Direct Payments to Government and Landowners



Conclusions

- Averaged over the duration of the construction period, 4,000 to 5,900 workers per year are employed as a result of construction-related economic activity.
    - Wages and benefits average $200 million - $330 million per year during construction.
    - ***Wind = 45% of construction-period employment***
- Ongoing operation of this infrastructure is estimated to employ 2,300 - 2,600 Wyoming workers for at least 20 years.
    - Wages and benefits average $100 million - $120 million per year during operations.
    - ***Wind = 70% of operations period employment***
    - ***Wind land leases = $54 million per year***
    - ***Wind property tax = $55 million per year***
- Economic output peaks at $1.2 billion in 2016 and $1.4 billion in 2019 before settling to about $380 million per year during operations-only years.
    - ***Wind = $450 million per year between 2014 and 2020*** ***(Construction-period average = $270 million)***
    - ***Wind = $290 million per year each year of operations (75%)***
- Total Wyoming economic activity from these investments is expected to be ~$12 billion - $15 billion (construction plus 20 years of operations).
    - ***Wind = $8 billion to $10 billion***
    - ***Wind manufacturing could drive these values higher.***

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Thank you

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