

Land-Based Wind Jobs and Economic Development Impact (JEDI) Model:

Installation and Use Guide for MacOS Users

For version released 09/30/2020

This document is a draft designed to accompany the beta version of the land-based wind JEDI model. The model and installation and use guide will be updated throughout the beta testing phase and upon final release of the model.

The Land-Based Wind Jobs and Economic Development Impact (JEDI) Model underwent a series of updates in the 2020 fiscal year. These updates, listed below, aim to keep the model on trend with the current land-based wind industry and increase the model's accuracy when analyzing wind plants throughout various regions of the country. The updates made to the land-based wind JEDI model in 2020 require specific steps to be followed in order for the model to run and for JEDI to calculate accurate costs for your project.

Please follow the steps in this document to correctly install and run the JEDI model.

Key Updates to the Land-Based Wind JEDI Model:

- **Integration of the NREL LandBOSSE Balance-of-System Cost Model**
 - The LandBOSSE model is a Python-based tool used for modeling the balance-of-system costs for land-based wind plants. This model has been fully integrated into the JEDI Microsoft Excel-based model, allowing the user to calculate and view LandBOSSE outputs through Excel. The integration of this model requires that the JEDI user installs LandBOSSE prior to using the JEDI model. Steps for this installation process are described below.
 - Information on the LandBOSSE Balance of System Cost Model can be found at <https://www.nrel.gov/docs/fy19osti/72201.pdf>
- **Addition of state-specific land lease data**
 - Data sourced from American Wind Energy Association WindIQ Database, as well as additional NREL literature review
- **Addition of state-specific property tax data**
 - Data sourced from American Wind Energy Association WindIQ Database, as well as additional NREL literature review
- **Addition of regional, capacity-based curves to determine # of O&M jobs**
 - Data from NREL's Workforce and Economic Development Considerations from the Operations and Maintenance of Wind Plants Report (M. Kotarbinski, NREL/TP-5000-76957), was used to develop job curves within JEDI that estimate the number of O&M jobs based on a wind plants region and capacity.
- **Redesign of model layout and step-by-step format**
 - The latest version of the land-based wind JEDI model includes a redesign of the model layout and function. The model now uses a step-by-step method requiring the user to press the appropriate buttons in Excel to run macros to proceed through the steps and properly run all calculations.

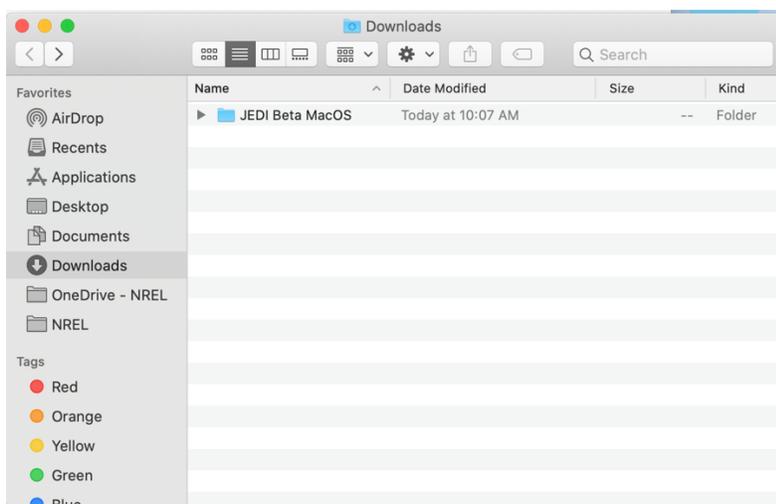
How to Install and Use the Land-Based Wind JEDI Model:

Step 1 - Download the JEDI Model Package:

For the latest version of the land-based wind JEDI model, please visit the NREL website at the following link: <https://www.nrel.gov/analysis/jedi/wind.html>. Click on the Land-Based Wind JEDI Model “Download” button for MacOS to download a .zip folder containing the JEDI Model and LandBOSSE installation package titled “JEDI Beta MacOS.zip.”

Step 2 - Extract and Save the Folder to your Computer:

Once the download is complete, you will see the .zip folder in your computer’s download folder. Please extract/decompress this folder and save the “unzipped” folder to your computer. The JEDI Beta MacOS folder should automatically decompress upon by double clicking on the folder. You can drag this folder to your desktop or wherever you would prefer to save it, but all folder contents must be kept in one location.

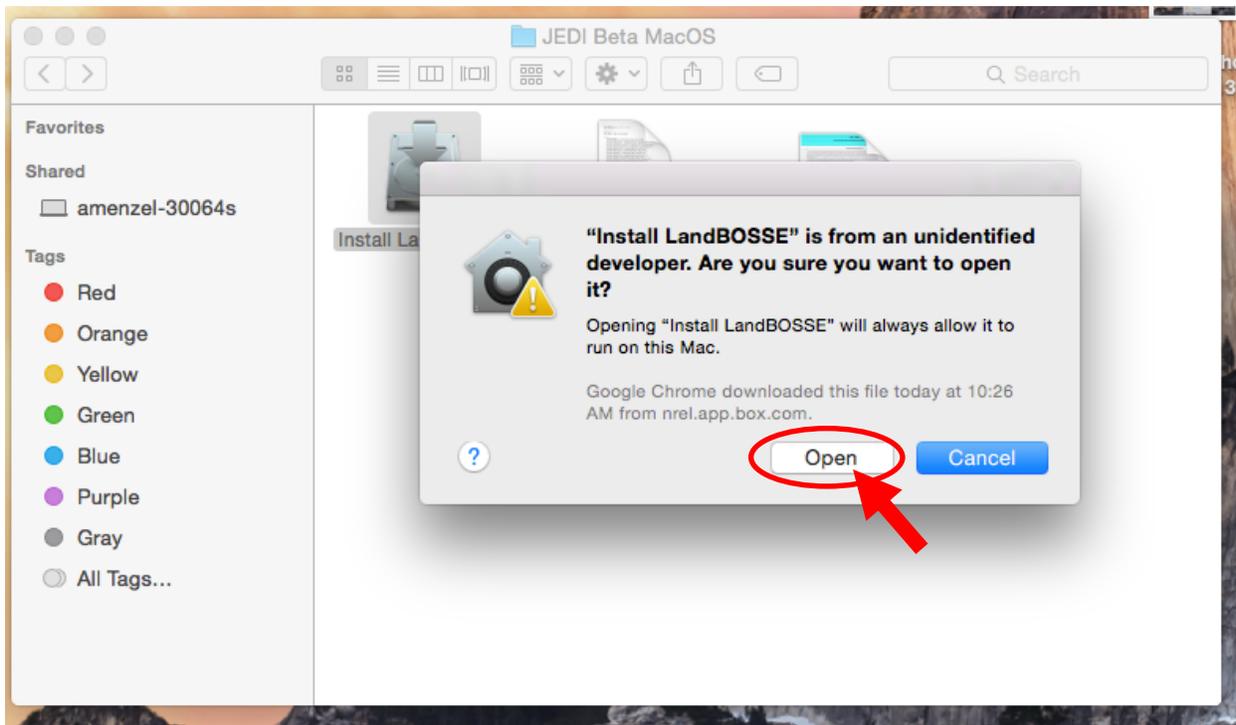
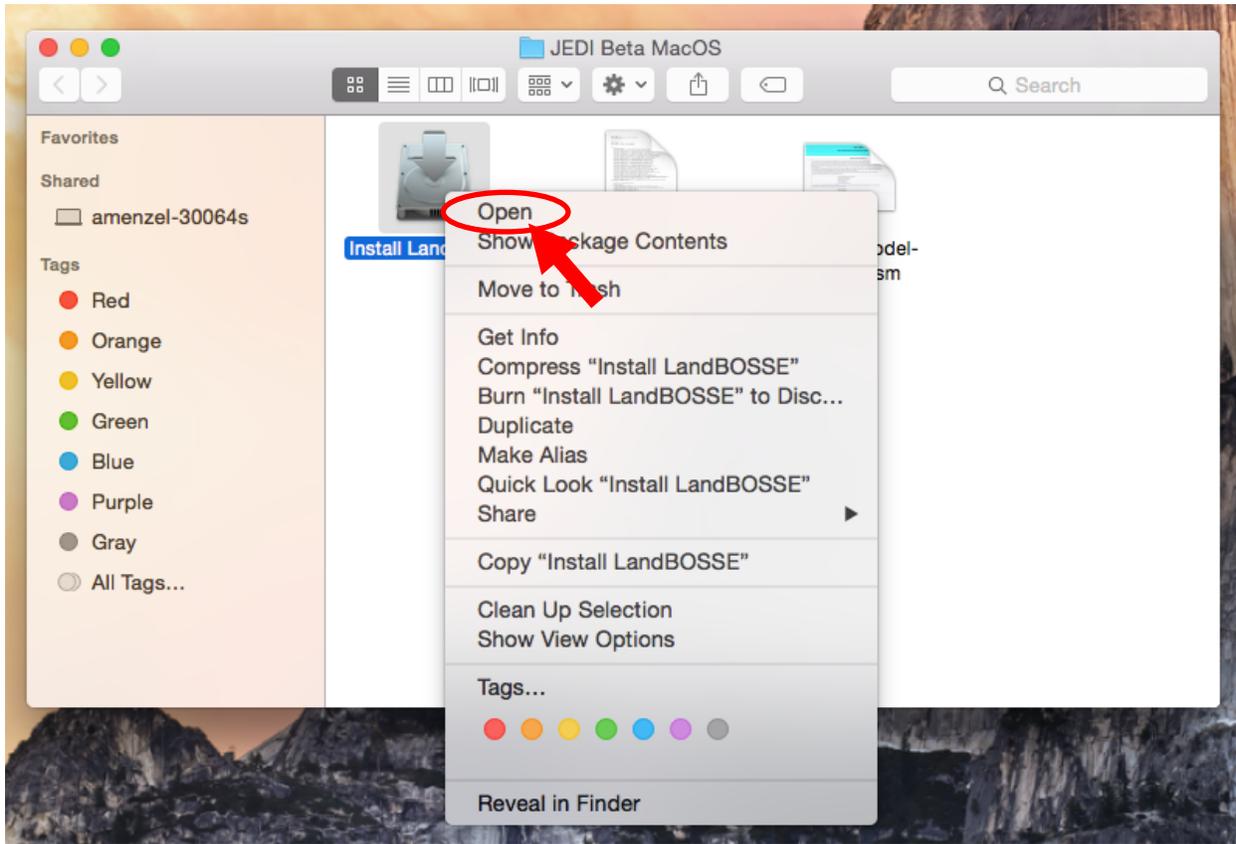


Move this .zip folder to desktop and double click to create “unzipped” version. You can then delete the .zip folder.

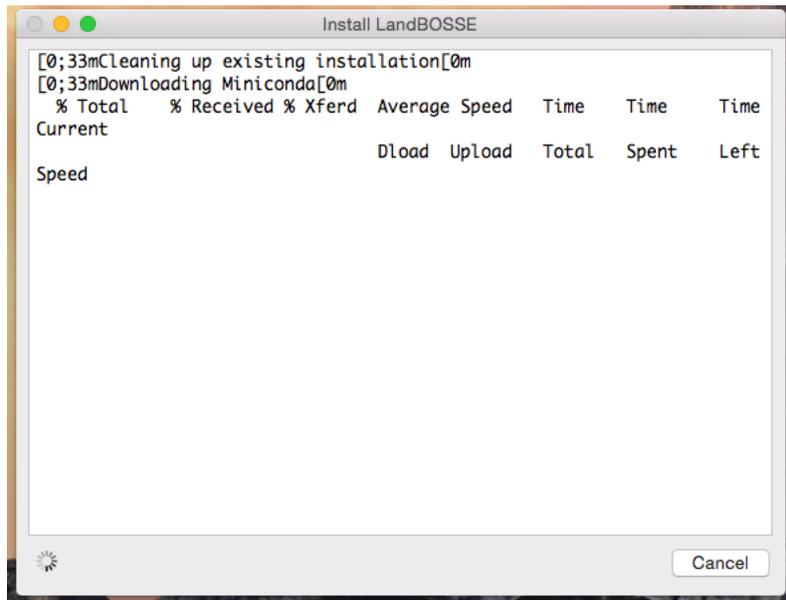
Step 3 - Install LandBOSSE:

Open the JEDI Beta MacOS folder from the location where the folder was saved in Step 2. Right-click on the installer icon labeled “Install LandBOSSE” and select “Open.” You may get a warning asking if you are sure you would like to open this application. Please click “Open.”

**Note – this step must be completed prior to using the JEDI Model Excel File. This installation will only need to be completed the first time you are using the model and will not need to be re-installed every time you use the JEDI model.*

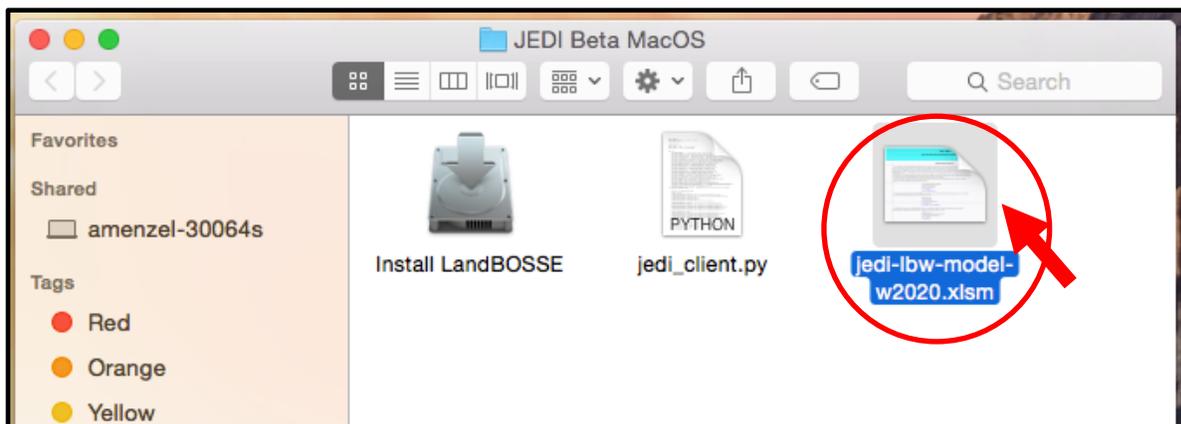


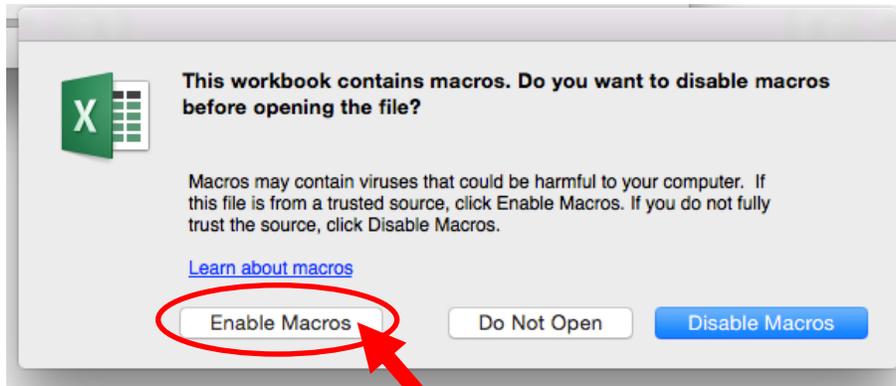
LandBOSSE will automatically begin to install and you will see the following screen. Please wait until the installation is complete and this screen disappears (this can take up to 10 minutes.)



Step 4 – Open the JEDI Model:

After the LandBOSSE installation is complete, you can return to the JEDI Beta MacOS folder and open the Excel file titled “jedi-lbw-model-w2020.xlsm.” When the file opens, please opt to “Enable Macros” to ensure the model runs all calculations.

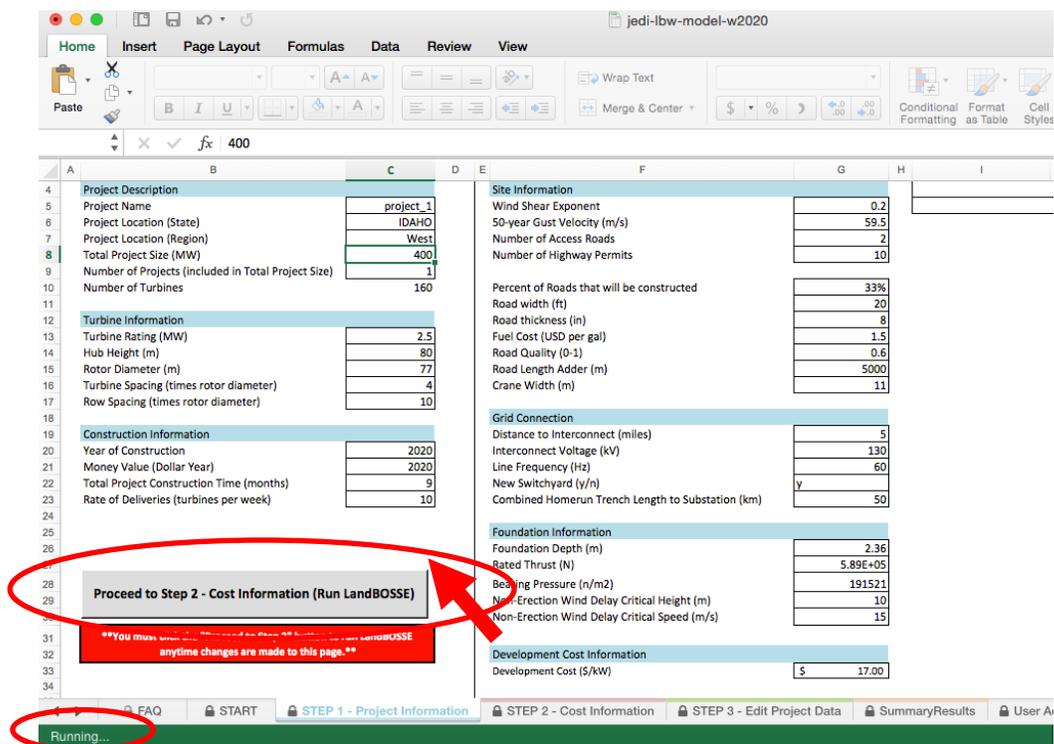




Step 5 – Run the JEDI Model:

With the Excel-based model open, start on the tab titled “Step 1 – Project Information.” Here you can change any of the basic and advanced inputs for your project. When you have finished altering your inputs on this page, please click the button “Proceed to Step 2 – Run LandBOSSE.” This button will take your inputs and run a Python code for the LandBOSSE Balance-of-Systems cost model in the background.

You may have to wait a few minutes for the costs on the Step 2 sheet to recalculate. While LandBOSSE is running, you will notice that the Excel sheet says “Running...” in the bottom left corner. When the LandBOSSE calculations are complete, the Excel sheet should say “Ready” in the bottom left corner.



***Note – anytime changes are made to the inputs on the Step 1 page, this button must be clicked to re-run LandBOSSE.**

Step 6 – Continue through JEDI Model Steps

After you have clicked the button to Proceed to Step 2 and LandBOSSE has successfully run, you should see new costs populated on the “Step 2 – Cost Information” tab. These costs are the outputs from the LandBOSSE model.

STEP 2 - Cost Information

Please WAIT until LANDBOSSE has completed running and Excel no longer says "Running..." at the bottom left hand corner. This will allow the costs below to recalculate based on your inputs on Step 1.

The following are outputs from NREL's Balance of System Cost Model for Land-Based Wind (LandBOSSE):

Balance of System (BOS) Costs		Cost for Project *LandBOSSE Outputs	Cost per kW	Percent of Total Cost
Development Costs				
Total		\$8,500,000	\$17	9.3%
Equipment Rental		\$0	\$0	0.0%
Labor		\$0	\$0	0.0%
Materials		\$0	\$0	0.0%
Mobilization		\$0	\$0	0.0%
Other		\$0	\$0	0.0%
Site Preparation Costs				
Total		\$5,742,388	\$11	6.3%
Materials		\$1,513,971	\$3	1.7%
Equipment Rental		\$762,432	\$2	0.8%
Labor		\$972,136	\$2	1.1%
Mobilization		\$148,517	\$0	0.2%
Other		\$2,345,331	\$5	2.6%
Foundation Costs				
Total		\$19,259,468	\$39	21.1%
Equipment Rental		\$615,107	\$1	0.7%
Labor		\$6,581,181	\$13	7.2%
Materials		\$11,146,062	\$22	12.2%
Mobilization		\$917,118	\$2	1.0%
Erection Costs				
Total		\$14,163,072	\$28	15.5%
Equipment Rental		\$1,497,823	\$3	1.6%
Fuel		\$57,588	\$0	0.1%
Labor		\$11,708,351	\$23	12.8%
Materials		\$0	\$0	0.0%
Mobilization		\$899,310	\$2	1.0%
Other		\$0	\$0	0.0%
Collection Costs				
Total		\$13,515,803	\$27	14.8%
Equipment Rental		\$1,238,681	\$2	1.4%
Labor		\$2,729,442	\$5	3.0%
Materials		\$8,904,070	\$18	9.7%
Mobilization		\$643,610	\$1	0.7%
Grid Connection Costs				
Total		\$1,563,881	\$3	1.7%
Substation Costs				
Total		\$8,974,604	\$18	9.8%
Management Costs				
Total		\$19,660,524	\$39	21.5%
Insurance		\$401,628	\$1	0.4%
Construction Permitting		\$585,189	\$1	0.6%

User Input Needed:

Project Cost Information	
Total Equipment Cost (\$/kW)	\$1,115
Operations and Maintenance Costs (\$/kW)	\$44
Money Value (Dollar Year)	2018
Total Installed Project Cost (\$/kW)	\$1,298

Restore Default Equipment and O&M Costs

****You must click the "Proceed to Step 3" button to generate accurate equipment cost estimates****

Proceed to Step 3 - Edit Project Data

Balance of System Costs

During this step, user inputs to the project cost information can be made for Total Equipment Cost (\$/kW), Operations and Maintenance Costs (\$/kW), and Money Value (Dollar Year.)

After any changes are made, please click the button to “Proceed to Step 3 – Edit Project Data.” In Step 3, the LandBOSSE outputs are then re-grouped together into the corresponding categories used by JEDI.

Wind Farm Annual Operating and Maintenance Costs				
	Cost	Per kW	Percent of	Local Share or % of Time Onsite (for itinerate workers)
Labor				
Personnel				
Field Salaries (i.e., onsite wind technicians, etc.)	\$606,037	\$2.02	4.4%	100%
Administrative	\$86,097	\$0.29	0.6%	100%
Management	\$99,004	\$0.33	0.7%	100%
Labor/Personnel Subtotal	\$791,137	\$2.64	5.7%	
Materials and Services				
Vehicles	\$354,488	\$1.18	2.6%	100%
Site Maint/Misc. Services	\$138,250	\$0.46	1.0%	80%
Fees, Permits, Licenses	\$69,125	\$0.23	0.5%	100%
Utilities	\$276,501	\$0.92	2.0%	100%
Insurance	\$2,658,662	\$8.86	19.2%	0%
Fuel (motor vehicle gasoline)	\$138,250	\$0.46	1.0%	0%
Consumables/Tools and Misc. Supplies	\$898,628	\$3.00	6.5%	0%
Replacement Parts/Equipment/ Spare Parts Inventory	\$7,874,958	\$26.25	56.9%	0%
Materials and Services Subtotal	\$12,408,863	\$41.36	89.6%	
Sales Tax (Materials & Equipment Purchases)	\$644,974	\$2.15	4.7%	100%
Other Taxes/Payments	\$0	\$0.00	0.0%	100%
Total O&M Cost	\$13,844,974	\$46.15	100.0%	

Other Parameters		
Financial Parameters		Local Share
Debt Financing		
Percentage financed	80%	0%
Years financed (term)	10	
Interest rate	6%	
Equity Financing/Repayment		
Percentage equity	20%	
Individual Investors (percent of total equity)	0%	100%
Corporate Investors (percent of total equity)	100%	0%
Return on equity (annual interest rate)	12%	
Repayment term (years)	10	
Tax Parameters		
Local Property Tax Rate (avg millage rate - \$/\$1,000)	\$10.00	
Assessed value (percent of construction cost)	100%	
Taxable Value	\$411,137,371	
Taxes Per MW	\$15,693	
Local Taxes	\$4,111,374	100%
Local Sales Tax Rate	7.25%	100%
Land Lease Parameters		
Land Lease Cost (\$/per turbine)	\$20,985	
Number of Turbines	120	
Land Lease (total cost)	\$2,518,200	
Lease Payment recipient (F = farmer/household, O = Other)	F	100%
Payroll Parameters		
Construction Labor		Employer Payroll Overhead
Foundation	Wage per hour \$50.29	37.6%
Erection	\$52.14	37.6%
Electrical	\$55.80	37.6%
Management/Supervision	\$47.03	37.6%
O&M Labor		Employer Payroll Overhead
Field Salaries (technicians, other)	Wage per hour \$28.12	37.6%
Administrative	\$18.00	37.6%
Management/Supervision	\$45.00	37.6%

Go To Summary Impacts

Return To Top Project Description and Cost Data

STEP 2 - Cost Information

STEP 3 - Edit Project Data

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On the Step 3 Edit Project Data page, you will see the balance of plant costs and project information that was inputted during the previous steps. On this sheet, you can edit local share percentages, financial parameters, and O&M costs as needed for your project.

After all inputs are completed, hit the “Go To Summary Impacts” button at the bottom of the sheet to view the summary of economic impacts for your project.

	A	B	C	D	E	F
1	Wind Farm - Project Data Summary based on User modifications to default values					
2	Project Location	CALIFORNIA				
3	Year of Construction	2020				
4	Total Project Size - Nameplate Capacity (MW)	300				
5	Number of Projects (included in total)	1				
6	Turbine Size (kW)	2500				
7	Number of Turbines	120				
8	Installed Project Cost (\$/kW)	▼	\$1,370	\$1,291	without taxes	Print Project Data Summary and Summary Results
9	Annual O&M Cost (\$/kW)	▼	\$46.15	\$44.00	without taxes	
10	Money Value (Dollar Year)	2018				
11	Total Installed Project Cost	▼	\$411,137,371			
12	Local Spending	▼	\$64,904,419			
13	Total Annual Operational Expenses					
14	Direct Operating and Maintenance Costs	\$80,353,148				
15	Local Spending	\$13,844,974				
16	Other Annual Costs	▼	\$1,601,852			
17	Local Spending	\$66,508,174				
18	Debt and Equity Payments	\$7,274,548				
19	Property Taxes	\$0				
20	Land Lease	\$4,111,374				
21		\$2,518,200				
22	Local Economic Impacts - Summary Results					
23		Jobs ▼	Earnings ▼	Output ▼	Value Added ▼	
24	During construction period					
25	Project Development and Onsite Labor Impacts	▼				Return to Project Description and Cost Data
26	Construction and Interconnection Labor	76	\$11.3			
27	Construction Related Services	4	\$0.4			
28	Total	80	\$11.7	\$12.0	\$11.8	
29	Turbine and Supply Chain Impacts	▼	213	\$15.5	\$48.6	\$25.2
30	Induced Impacts	▼	169	\$11.6	\$33.1	\$20.9
31	Total Impacts	462	\$38.8	\$93.7	\$57.9	
32	During operating years (annual)					
33	Onsite Labor Impacts	▼	10	\$0.7	\$0.7	\$0.7
34	Local Revenue and Supply Chain Impacts	▼	30	\$2.1	\$10.6	\$8.1
35	Induced Impacts	▼	25	\$1.8	\$5.2	\$3.3
36	Total Impacts	66	\$4.6	\$16.6	\$12.1	
37	Notes: Earnings and Output values are millions of dollars in year 2018 dollars. Construction and operating jobs are full-time equivalent for a period of one year (1 FTE = 2,080 hours). Wind farm workers includes field technicians, administration and management. Economic impacts "During operating years" represent impacts that occur from wind farm operations/expenditures.					
38	The analysis does not include impacts associated with spending of wind farm "profits" and assumes no tax abatement unless noted.					
39	Totals may not add up due to independent rounding. Results are based on User modifications to default values.					
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42						
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44						

Help with the Land-Based Wind JEDI Model

For help using or installing this model or to submit any feedback on the latest model version, please contact the JEDI team at JEDIsupport@nrel.gov to be directed to the appropriate contact.