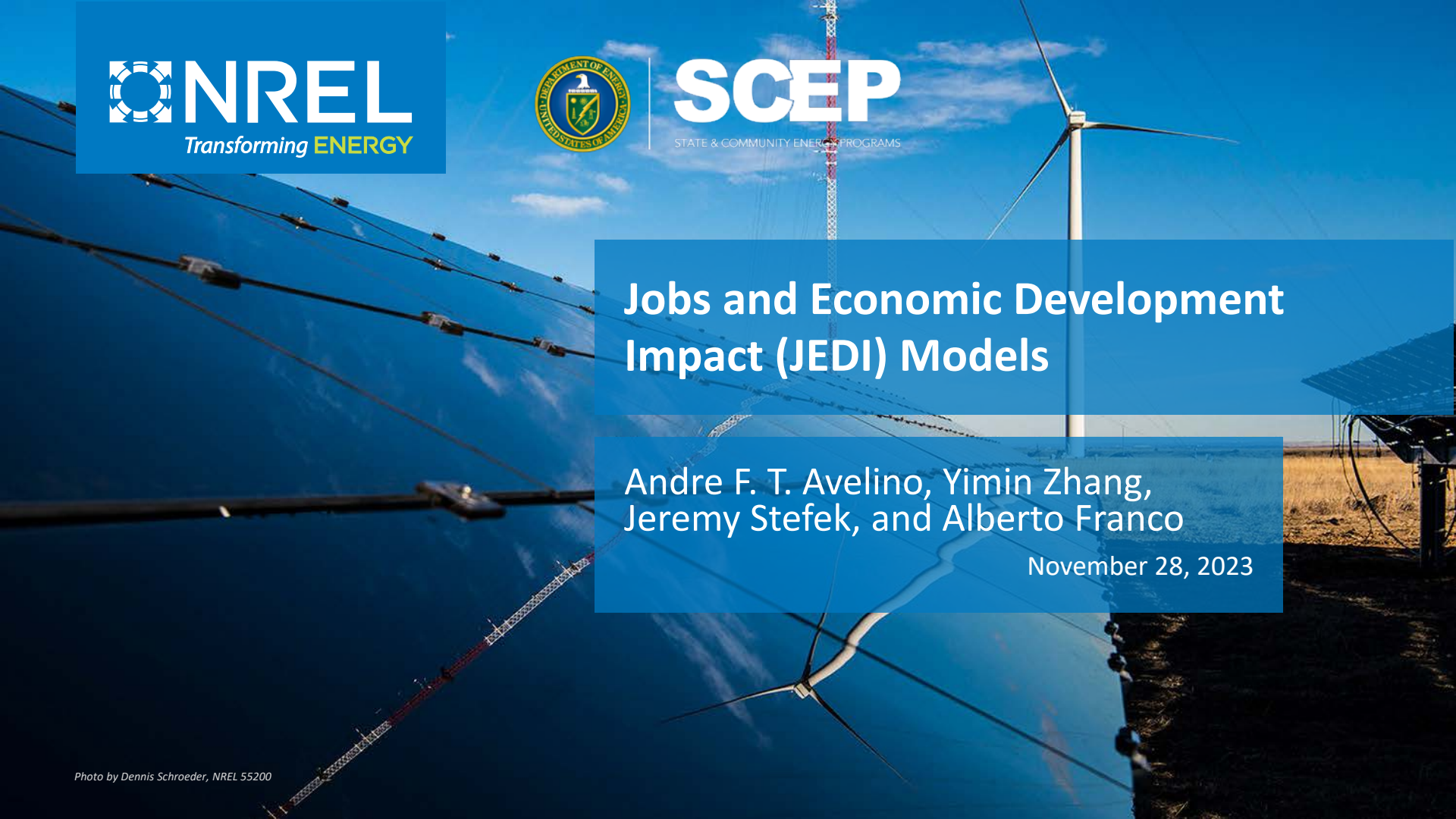


NREL Transforming ENERGY

SCEP STATE & COMMUNITY ENERGY PROGRAMS

Jobs and Economic Development Impact (JEDI) Models

Andre F. T. Avelino, Yimin Zhang, Jeremy Stefek, and Alberto Franco

November 28, 2023

Photo by Dennis Schroeder, NREL 55200

Outline

1. What is JEDI?
2. What has JEDI been used for?
3. JEDI Overview
4. How to use JEDI?
5. How to interpret JEDI results?
6. Main caveats
7. Breakout sessions: JEDI example

What is JEDI?

- The **Jobs and Economic Development Impact** (JEDI) models were developed as user-friendly tools to assess the job and economic impacts of power generation, infrastructure, and biofuel plants in terms of both construction (temporary effects) and operation (long-term effects) at a regional level.

- **JEDI** is an **Excel-based tool** that is intuitive and allows full cost customization by users.

- **JEDI** measures **local** jobs supported, economic activity generated, earnings and wealth created by a project.

Photo by Werner Slocum, NREL 77079

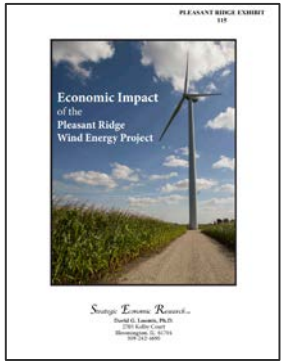
Photo by Dennis Schroeder, NREL 62223

Photo by Werner Slocum, NREL 80135

What has JEDI been used for?

- Over the years, **JEDI** has had a **significant impact** in both **academia and the private sector**, serving as the base for several peer-reviewed publications and impact analysis reports.

- **JEDI** can be used by itself or integrated into other models. Several stakeholders use JEDI to highlight and show the potential benefits of the implementation of their projects.



Project: Pleasant Ridge Wind Energy Project (243 MW) 136 wind turbines ($363 million)

Location: Livingston County, IL

Costs: detailed cost estimates + location of suppliers and labor from Invenergy (developer)

Method: customized JEDI costs with available information + county-level multipliers from IMPLAN to assess county-level impacts

Table 2. — Total Employment Impact from the Pleasant Ridge Wind Energy Project

	Livingston County	State of Illinois
Construction		
Project Development and Onsite Labor Impacts	177	293
Turbine and Supply Chain Impacts	173	350
Induced Impacts	34	151
New Local Jobs during Construction	384	794
Operations		
Onsite Labor Impacts	13	13
Local Revenue and Supply Chain Impacts	56	71
Induced Impacts	23	53
New Local Long Term Jobs	92	137

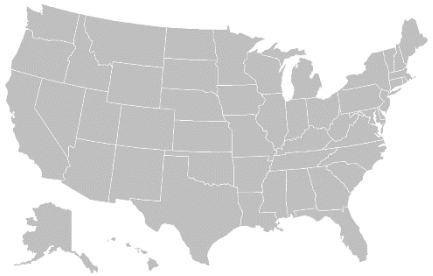
Loomis, David G. 2014. *Economic Impact of the Pleasant Ridge Wind Energy Project*. Strategic Economic Research. 2014. https://www.livingstoncounty-il.org/wordpress/wp-content/uploads/2014/11/PR-Ex.-115-Economic-Impact-Report.pdf.

Overview: Goals, Methods and Data

- **Goal:** analyze the regional economic impacts associated with constructing and operating new or existing power plants, fuel production facilities, or other projects

Impacts on jobs, GDP (gross domestic product), and production

- ***Temporary Effects*** → Construction
- ***Permanent Effects*** → Operation & Maintenance



- **Method:** *Input-Output Analysis* (IOA) is one of the most commonly used and straightforward frameworks to estimate economic impacts from a change in demand in a region.

- **Data:** **Technology** → techno-economic analysis (TEA) data, NREL expertise, industry experts, reports, and project developers

  Economy → state-level economic data from IMPLAN (IMpact Analysis for PLANning)

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Overview: Available JEDI Models

POWER

- **Biopower** (rel. B12.23.16)
- **Transmission Line Model** (rel. TL12.23.16)
- **Coal** (rel. C12.23.16)
- **Conventional Hydropower** (rel. CH12.23.16)
- **Concentrating Solar Power** (rel. CSP12.23.16)
- **Geothermal** (rel. GT12.23.16)
- **Marine and Hydrokinetic Power** (rel. MH12.23.16)
- **Natural Gas Model** (rel. NG4.17.17)
- **Photovoltaics** (rel. PV05.20.21)
- **Land-Based Wind** (rel. W10.30.20)
- **Offshore Wind** (rel. 2021-3)
- **Distributed Wind** (rel. DW12.23.16)

FUELS

- **Biorefinery Sugars to Hydrocarbon** (rel. SH1.13.17)
- **Cellulosic Ethanol** (rel. CE1.13.17)
- **Corn Ethanol** (rel. CE12.23.16)
- **Fast Pyrolysis** (rel. FP12.23.16)
- **Petroleum** (rel. P12.23.16)

*__JEDI__ currently does not include Electric Vehicle Station Equipment (EVSE) infrastructure.

If you are interested in EVSE, use the **JOBS model** (https://www.anl.gov/esia/jobs-models).

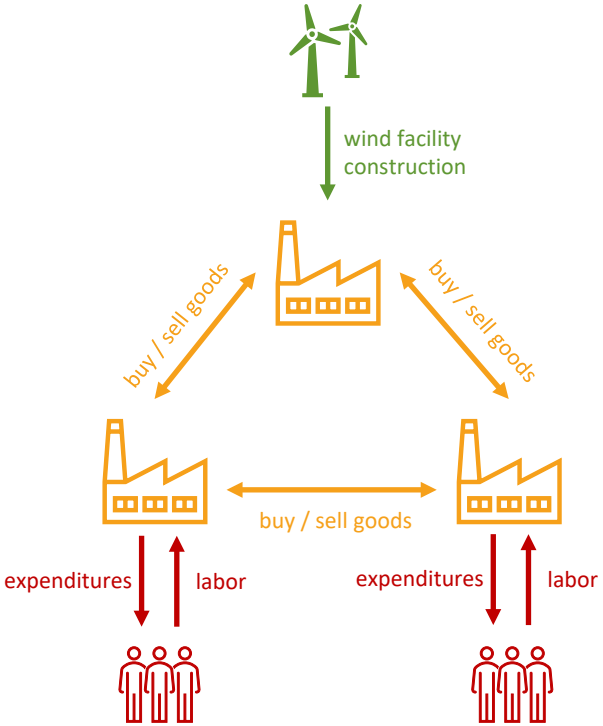
Overview: Method - Input-Output Analysis

Input-Output Analysis (IOA):

The accounting system underlying IOA describes the *structure of the economy* as a *network of sectors* that sell to one another, to local households and governments, and to external markets.

Impacts on all sectors in the region are estimated, as *all supply chains* are considered simultaneously.

The provided input-output data in JEDI comes from IMPLAN.



DIRECT Effect
Total investment

INDIRECT Effect
Supply chains

INDUCED Effect
Labor expenditures

Overview: Economic Metrics Definitions

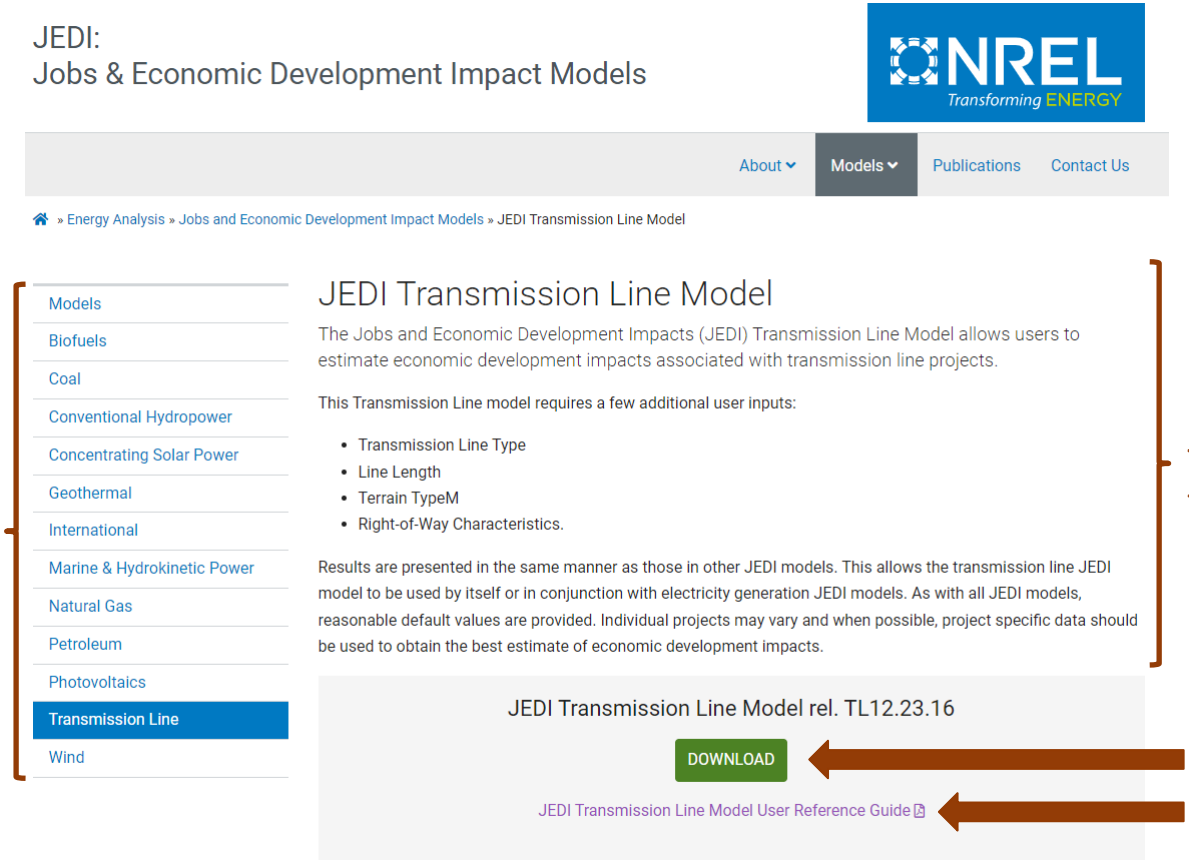
- **Jobs**: sum of full-time equivalent (FTE: 2,080 hr/yr) workers employed at the place of business. All jobs *supported* by local companies are accounted for, including those of out-of-state commuters (who might spend part of their wages outside the state). Includes salary and wage employees and proprietors (business owners, partners, and tax-exempt cooperative members).

- **Output**: the value of production. It includes all sales and purchases of a particular sector; hence, it measures the economic activity generated by the project.

- **Value Added**: the wealth generated by an economic activity. It includes compensation of employees (wages and benefits), profit-type income, property income, and taxes on production.

- **Earnings**: part of the value added that represents total compensation of employees (wages, salaries and benefits) and proprietor income (income of sole proprietorships, partnerships, and tax-exempt cooperatives), pretax.

Publicly Available Models: JEDI Website



Available JEDI Models

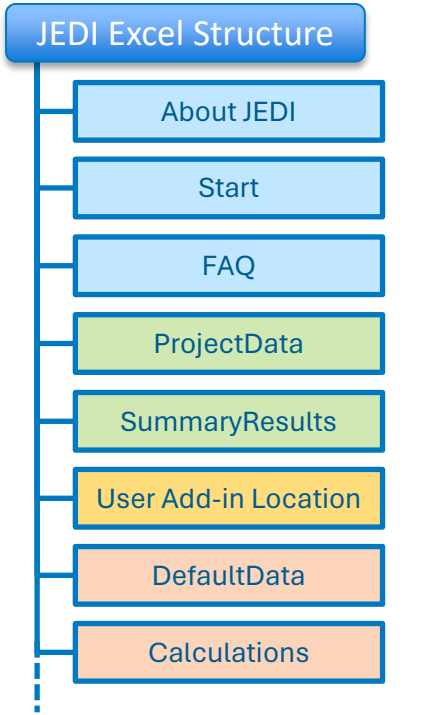
Short model summary

Excel file download

Documentation

https://www.nrel.gov/analysis/jedi/models.html

JEDI Excel File Structure



Model information

Instructions on running the model

Frequently asked questions (e.g., data sources, definitions, and interpretation of results)

User interface for data input

Estimated impacts

main tabs

(optional)

Custom area data input: users can provide their own multipliers to use in the analysis

Default detailed project data

Model calculations (deflation, impact analysis, cost allocation, etc.)

View-only tabs, edits are not allowed

Interface: Required Inputs

JEDI Excel Structure

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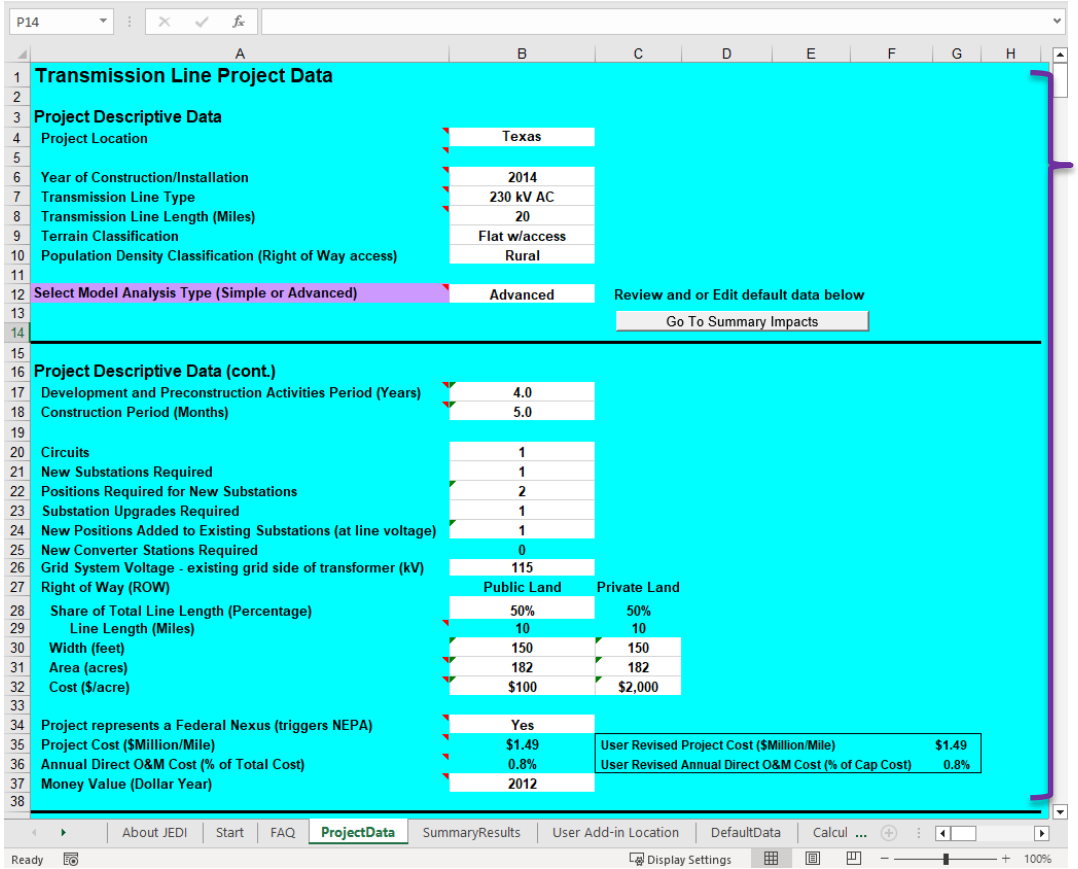
- Calculations

Additional model-specific tabs



Transmission Line Project Data

Project Descriptive Data

Project Location	Texas
Year of Construction/Installation	2014
Transmission Line Type	230 kV AC
Transmission Line Length (Miles)	20
Terrain Classification	Flat w/access
Population Density Classification (Right of Way access)	Rural
Select Model Analysis Type (Simple or Advanced)	Advanced

Review and or Edit default data below

Go To Summary Impacts

Project Descriptive Data (cont.)

Development and Preconstruction Activities Period (Years)	4.0	
Construction Period (Months)	5.0	
Circuits	1	
New Substations Required	1	
Positions Required for New Substations	2	
Substation Upgrades Required	1	
New Positions Added to Existing Substations (at line voltage)	1	
New Converter Stations Required	0	
Grid System Voltage - existing grid side of transformer (kV)	115	
Right of Way (ROW)	Public Land	Private Land
Share of Total Line Length (Percentage)	50%	50%
Line Length (Miles)	10	10
Width (feet)	150	150
Area (acres)	182	182
Cost ($/acre)	$100	$2,000
Project represents a Federal Nexus (triggers NEPA)	Yes	
Project Cost ($Million/Mile)	$1.49	
Annual Direct O&M Cost (% of Total Cost)	0.8%	
Money Value (Dollar Year)	2012	

User Revised Project Cost ($Million/Mile)	$1.49
User Revised Annual Direct O&M Cost (% of Cap Cost)	0.8%

Minimum required information for the model

(Each model has a different type of input requirement.)

Default (average) detailed project expenses will auto-populate

JEDI Transmission Line Model: https://www.nrel.gov/analysis/jedi/transmission-line.html

Interface: Detailed Expenses (default data)

JEDI Excel Structure

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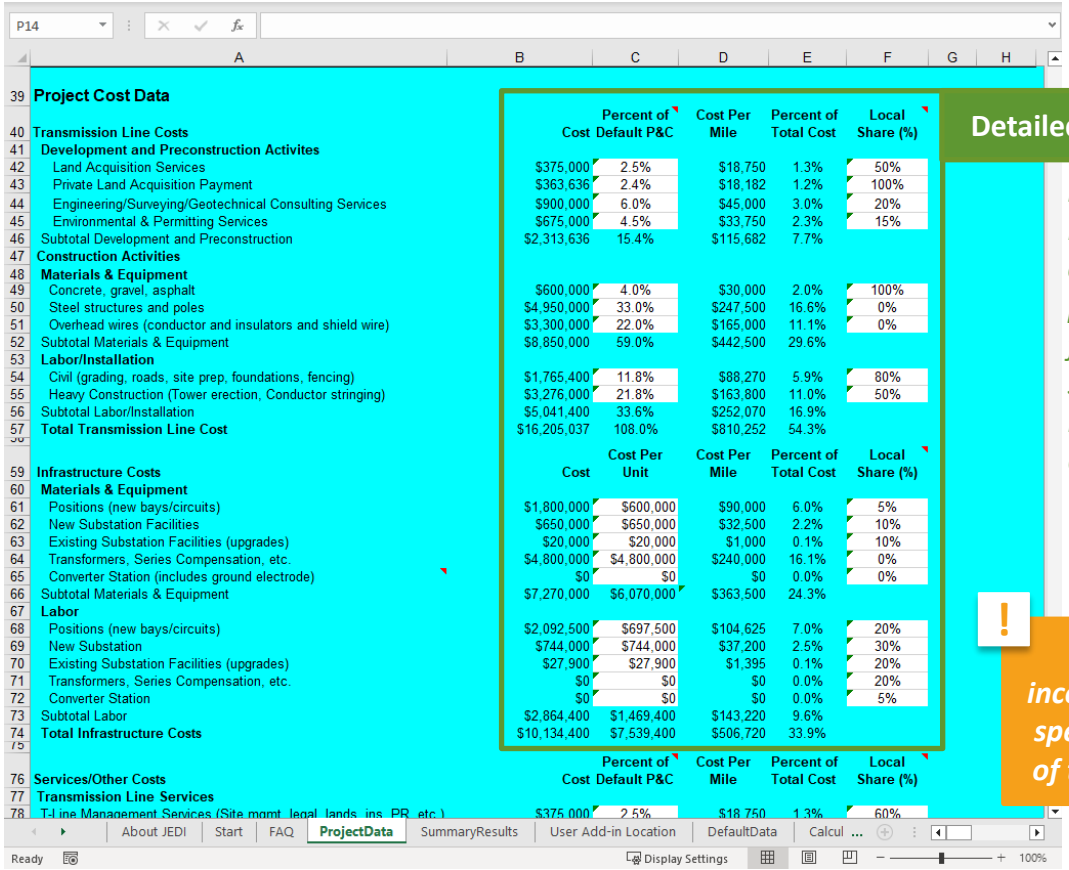
Additional model-specific tabs



	A	B	C	D	E	F
39	**Project Cost Data**					
40	**Transmission Line Costs**	Cost	Percent of Default P&C	Cost Per Mile	Percent of Total Cost	Local Share (%)
41	**Development and Preconstruction Activites**					
42	Land Acquisition Services	$375,000	2.5%	$18,750	1.3%	50%
43	Private Land Acquisition Payment	$363,636	2.4%	$18,182	1.2%	100%
44	Engineering/Surveying/Geotechnical Consulting Services	$900,000	6.0%	$45,000	3.0%	20%
45	Environmental & Permitting Services	$675,000	4.5%	$33,750	2.3%	15%
46	Subtotal Development and Preconstruction	$2,313,636	15.4%	$115,682	7.7%	
47	**Construction Activities**					
48	**Materials & Equipment**					
49	Concrete, gravel, asphalt	$600,000	4.0%	$30,000	2.0%	100%
50	Steel structures and poles	$4,950,000	33.0%	$247,500	16.6%	0%
51	Overhead wires (conductor and insulators and shield wire)	$3,300,000	22.0%	$165,000	11.1%	0%
52	Subtotal Materials & Equipment	$8,850,000	59.0%	$442,500	29.6%	
53	**Labor/Installation**					
54	Civil (grading, roads, site prep, foundations, fencing)	$1,765,400	11.8%	$88,270	5.9%	80%
55	Heavy Construction (Tower erection, Conductor stringing)	$3,276,000	21.8%	$163,800	11.0%	50%
56	Subtotal Labor/Installation	$5,041,400	33.6%	$252,070	16.9%	
57	**Total Transmission Line Cost**	$16,205,037	108.0%	$810,252	54.3%	
59	**Infrastructure Costs**	Cost	Cost Per Unit	Cost Per Mile	Percent of Total Cost	Local Share (%)
60	**Materials & Equipment**					
61	Positions (new bays/circuits)	$1,800,000	$600,000	$90,000	6.0%	5%
62	New Substation Facilities	$650,000	$650,000	$32,500	2.2%	10%
63	Existing Substation Facilities (upgrades)	$20,000	$20,000	$1,000	0.1%	10%
64	Transformers, Series Compensation, etc.	$4,800,000	$4,800,000	$240,000	16.1%	0%
65	Converter Station (includes ground electrode)	$0	$0	$0	0.0%	0%
66	Subtotal Materials & Equipment	$7,270,000	$6,070,000	$363,500	24.3%	
67	**Labor**					
68	Positions (new bays/circuits)	$2,092,500	$697,500	$104,625	7.0%	20%
69	New Substation	$744,000	$744,000	$37,200	2.5%	30%
70	Existing Substation Facilities (upgrades)	$27,900	$27,900	$1,395	0.1%	20%
71	Transformers, Series Compensation, etc.	$0	$0	$0	0.0%	20%
72	Converter Station	$0	$0	$0	0.0%	5%
73	Subtotal Labor	$2,864,400	$1,469,400	$143,220	9.6%	
74	**Total Infrastructure Costs**	$10,134,400	$7,539,400	$506,720	33.9%	
76	**Services/Other Costs**	Cost	Percent of Default P&C	Cost Per Mile	Percent of Total Cost	Local Share (%)
77	**Transmission Line Services**					
78	T-Line Management Services (Site mgmt, legal, lands, ins, PR, etc.)	$375,000	2.5%	$18,750	1.3%	60%

About JEDI | Start | FAQ | ProjectData | SummaryResults | User Add-in Location | DefaultData | Calcul ...

Ready | Display Settings | 100%

Detailed Project Expenses

Default values *represent* ***average costs*** *and spending patterns derived from several sources (reports, industry surveys, and studies).*

We recommend incorporating project-specific values in lieu of the default values.

JEDI Transmission Line Model: https://www.nrel.gov/analysis/jedi/transmission-line.html

Interface: Advanced Inputs (optional)

JEDI Excel Structure

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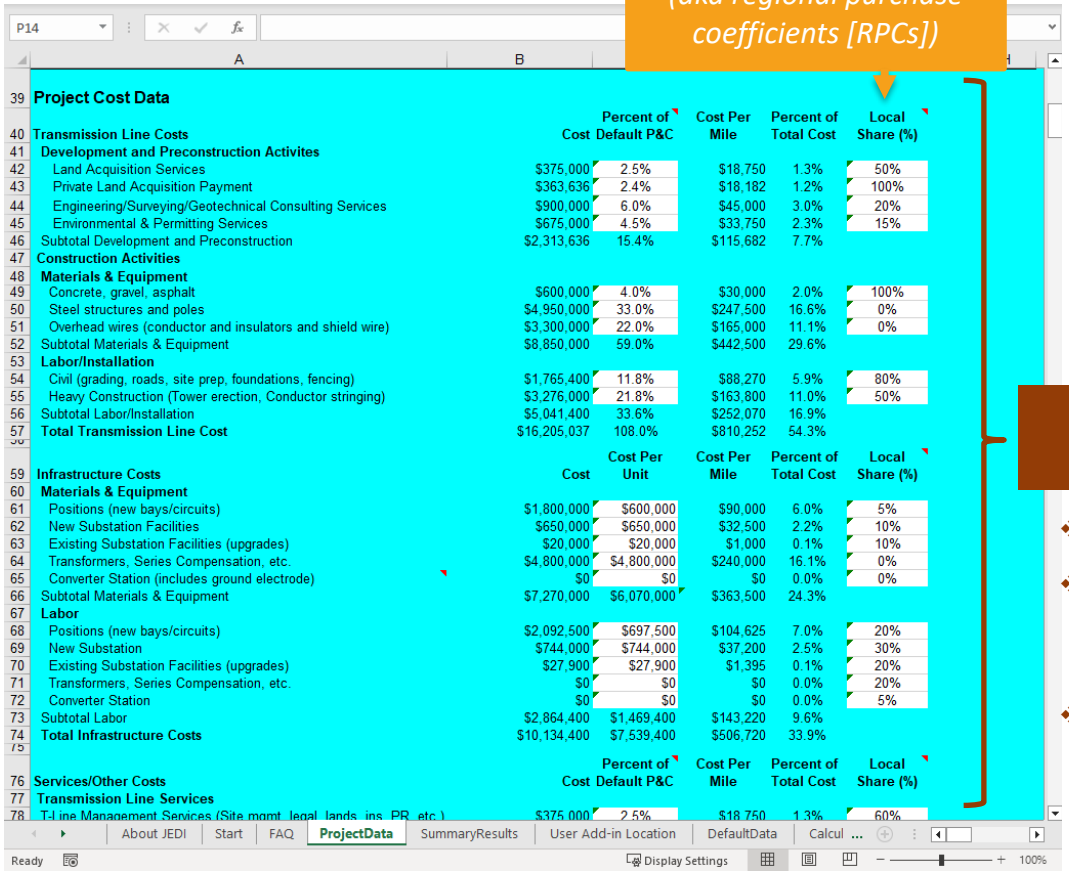
Additional model-specific tabs

Local share: *percentage of purchases made locally (aka regional purchase coefficients [RPCs])*



Project Cost Data

	Cost	Percent of Default P&C	Cost Per Mile	Percent of Total Cost	Local Share (%)
Transmission Line Costs					
Development and Preconstruction Activites					
Land Acquisition Services	$375,000	2.5%	$18,750	1.3%	50%
Private Land Acquisition Payment	$363,636	2.4%	$18,182	1.2%	100%
Engineering/Surveying/Geotechnical Consulting Services	$900,000	6.0%	$45,000	3.0%	20%
Environmental & Permitting Services	$675,000	4.5%	$33,750	2.3%	15%
Subtotal Development and Preconstruction	$2,313,636	15.4%	$115,682	7.7%	
Construction Activities					
Materials & Equipment					
Concrete, gravel, asphalt	$600,000	4.0%	$30,000	2.0%	100%
Steel structures and poles	$4,950,000	33.0%	$247,500	16.6%	0%
Overhead wires (conductor and insulators and shield wire)	$3,300,000	22.0%	$165,000	11.1%	0%
Subtotal Materials & Equipment	$8,850,000	59.0%	$442,500	29.6%	
Labor/Installation					
Civil (grading, roads, site prep, foundations, fencing)	$1,765,400	11.8%	$88,270	5.9%	80%
Heavy Construction (Tower erection, Conductor stringing)	$3,276,000	21.8%	$163,800	11.0%	50%
Subtotal Labor/Installation	$5,041,400	33.6%	$252,070	16.9%	
Total Transmission Line Cost	$16,205,037	108.0%	$810,252	54.3%	

	Cost	Cost Per Unit	Cost Per Mile	Percent of Total Cost	Local Share (%)
Infrastructure Costs					
Materials & Equipment					
Positions (new bays/circuits)	$1,800,000	$600,000	$90,000	6.0%	5%
New Substation Facilities	$650,000	$650,000	$32,500	2.2%	10%
Existing Substation Facilities (upgrades)	$20,000	$20,000	$1,000	0.1%	10%
Transformers, Series Compensation, etc.	$4,800,000	$4,800,000	$240,000	16.1%	0%
Converter Station (includes ground electrode)	$0	$0	$0	0.0%	0%
Subtotal Materials & Equipment	$7,270,000	$6,070,000	$363,500	24.3%	
Labor					
Positions (new bays/circuits)	$2,092,500	$697,500	$104,625	7.0%	20%
New Substation	$744,000	$744,000	$37,200	2.5%	30%
Existing Substation Facilities (upgrades)	$27,900	$27,900	$1,395	0.1%	20%
Transformers, Series Compensation, etc.	$0	$0	$0	0.0%	20%
Converter Station	$0	$0	$0	0.0%	5%
Subtotal Labor	$2,864,400	$1,469,400	$143,220	9.6%	
Total Infrastructure Costs	$10,134,400	$7,539,400	$506,720	33.9%	

	Cost	Percent of Default P&C	Cost Per Mile	Percent of Total Cost	Local Share (%)
Services/Other Costs					
Transmission Line Services					
T-Line Management Services (Site mgmt, legal, lands, ins, PR, etc.)	$375,000	2.5%	$18,750	1.3%	60%

Project Expenses **(optional)**

- *bill of goods*
- *annual operating and maintenance costs*
- *local share*

Do you have more specific cost information? Feel free to edit!

JEDI Transmission Line Model: https://www.nrel.gov/analysis/jedi/transmission-line.html

Interface: Advanced Inputs (optional)

JEDI Excel Structure

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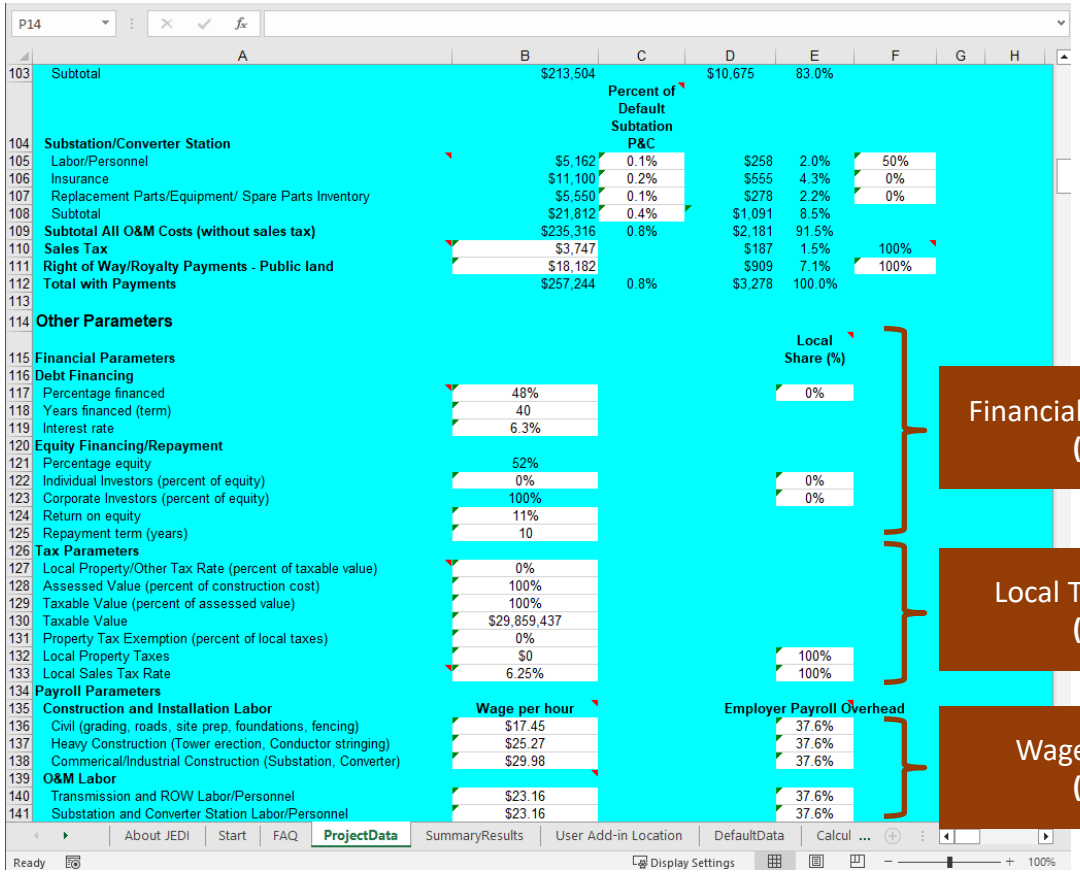
Additional model-specific tabs



	A	B	C	D	E	F
103	Subtotal	$213,504		$10,675	83.0%	
			Percent of Default Subtation P&C			
104	**Substation/Converter Station**					
105	Labor/Personnel	$5,162	0.1%	$258	2.0%	50%
106	Insurance	$11,100	0.2%	$555	4.3%	0%
107	Replacement Parts/Equipment/ Spare Parts Inventory	$5,550	0.1%	$278	2.2%	0%
108	Subtotal	$21,812	0.4%	$1,091	8.5%	
109	**Subtotal All O&M Costs (without sales tax)**	$235,316	0.8%	$2,181	91.5%	
110	**Sales Tax**	$3,747		$187	1.5%	100%
111	**Right of Way/Royalty Payments - Public land**	$18,182		$909	7.1%	100%
112	**Total with Payments**	$257,244	0.8%	$3,278	100.0%	
113						
114	**Other Parameters**					
					Local Share (%)	
115	**Financial Parameters**					
116	**Debt Financing**					
117	Percentage financed	48%			0%	
118	Years financed (term)	40				
119	Interest rate	6.3%				
120	**Equity Financing/Repayment**					
121	Percentage equity	52%				
122	Individual Investors (percent of equity)	0%			0%	
123	Corporate Investors (percent of equity)	100%			0%	
124	Return on equity	11%				
125	Repayment term (years)	10				
126	**Tax Parameters**					
127	Local Property/Other Tax Rate (percent of taxable value)	0%				
128	Assessed Value (percent of construction cost)	100%				
129	Taxable Value (percent of assessed value)	100%				
130	Taxable Value	$29,859,437				
131	Property Tax Exemption (percent of local taxes)	0%				
132	Local Property Taxes	$0			100%	
133	Local Sales Tax Rate	6.25%			100%	
134	**Payroll Parameters**					
135	**Construction and Installation Labor**	**Wage per hour**			**Employer Payroll Overhead**	
136	Civil (grading, roads, site prep, foundations, fencing)	$17.45			37.6%	
137	Heavy Construction (Tower erection, Conductor stringing)	$25.27			37.6%	
138	Commerical/Industrial Construction (Substation, Converter)	$29.98			37.6%	
139	**O&M Labor**					
140	Transmission and ROW Labor/Personnel	$23.16			37.6%	
141	Substation and Converter Station Labor/Personnel	$23.16			37.6%	

About JEDI | Start | FAQ | ProjectData | SummaryResults | User Add-in Location | DefaultData | Calcul ...

Ready | Display Settings | 100%

Financial Parametrization **(optional)**

Local Tax Information **(optional)**

Wage Information **(optional)**

JEDI Transmission Line Model: https://www.nrel.gov/analysis/jedi/transmission-line.html

Summary Results: Overview

JEDI Excel Structure

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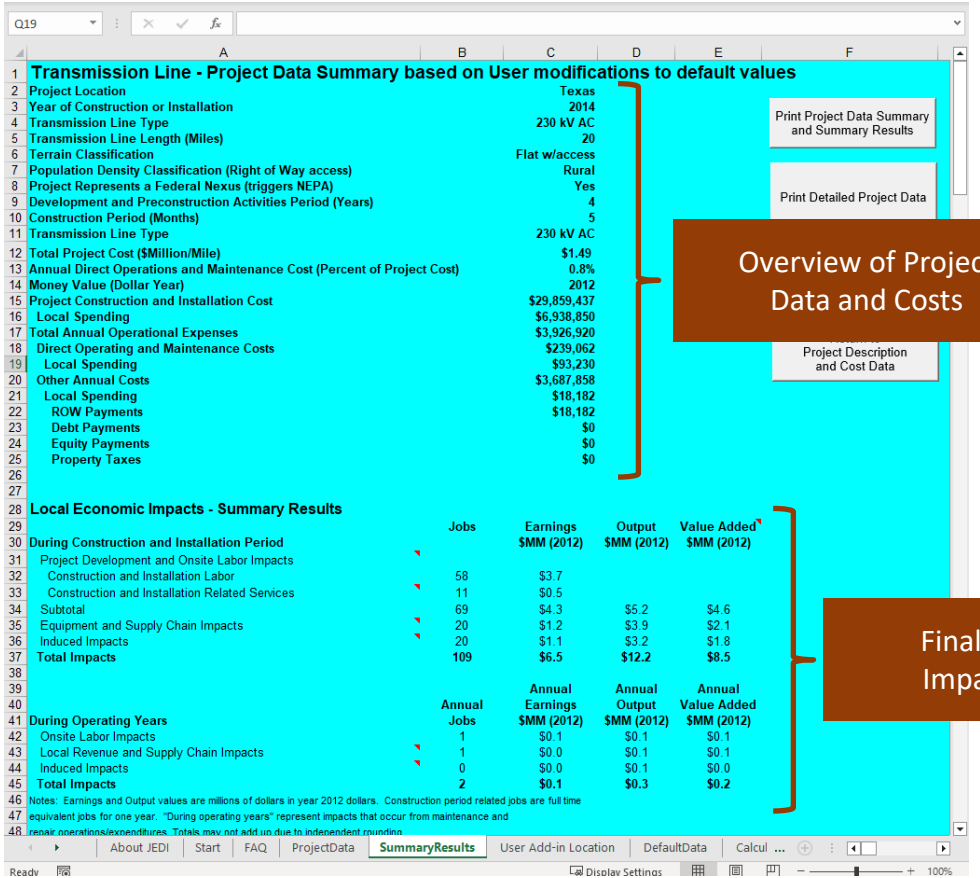
Additional model-specific tabs



Transmission Line - Project Data Summary based on User modifications to default values

Project Location	Texas
Year of Construction or Installation	2014
Transmission Line Type	230 kV AC
Transmission Line Length (Miles)	20
Terrain Classification	Flat w/access
Population Density Classification (Right of Way access)	Rural
Project Represents a Federal Nexus (triggers NEPA)	Yes
Development and Preconstruction Activities Period (Years)	4
Construction Period (Months)	5
Transmission Line Type	230 kV AC
Total Project Cost ($Million/Mile)	$1.49
Annual Direct Operations and Maintenance Cost (Percent of Project Cost)	0.8%
Money Value (Dollar Year)	2012
Project Construction and Installation Cost	$29,859,437
Local Spending	$6,938,850
Total Annual Operational Expenses	$3,926,920
Direct Operating and Maintenance Costs	$239,062
Local Spending	$93,230
Other Annual Costs	$3,687,858
Local Spending	$18,182
ROW Payments	$18,182
Debt Payments	$0
Equity Payments	$0
Property Taxes	$0

Print Project Data Summary and Summary Results

Print Detailed Project Data

Project Description and Cost Data

Overview of Project Data and Costs

Local Economic Impacts - Summary Results

	Jobs	Earnings $MM (2012)	Output $MM (2012)	Value Added $MM (2012)
During Construction and Installation Period				
Project Development and Onsite Labor Impacts				
Construction and Installation Labor	58	$3.7		
Construction and Installation Related Services	11	$0.5		
Subtotal	69	$4.3	$5.2	$4.6
Equipment and Supply Chain Impacts	20	$1.2	$3.9	$2.1
Induced Impacts	20	$1.1	$3.2	$1.8
Total Impacts	**109**	**$6.5**	**$12.2**	**$8.5**

	Annual Jobs	Annual Earnings $MM (2012)	Annual Output $MM (2012)	Annual Value Added $MM (2012)
During Operating Years				
Onsite Labor Impacts	1	$0.1	$0.1	$0.1
Local Revenue and Supply Chain Impacts	1	$0.0	$0.1	$0.1
Induced Impacts	0	$0.0	$0.1	$0.0
Total Impacts	**2**	**$0.1**	**$0.3**	**$0.2**

Notes: Earnings and Output values are millions of dollars in year 2012 dollars. Construction period related jobs are full time equivalent jobs for one year. "During operating years" represent impacts that occur from maintenance and repair operations/expenditures. Totals may not add up due to independent rounding

Final Economic Impact Results

JEDI Transmission Line Model: https://www.nrel.gov/analysis/jedi/transmission-line.html

Summary Results: Project Data

Transmission Line - Project Data Summary based on User modifications	
Project Location	Texas
Year of Construction or Installation	2014
Transmission Line Type	230 kV AC
Transmission Line Length (Miles)	20
Terrain Classification	Flat w/access
Population Density Classification (Right of Way access)	Rural
Project Represents a Federal Nexus (triggers NEPA)	Yes
Development and Preconstruction Activities Period (Years)	4
Construction Period (Months)	5
Transmission Line Type	230 kV AC
Total Project Cost ($Million/Mile)	$1.49
Annual Direct Operations and Maintenance Cost (Percent of Project Cost)	0.8%
Money Value (Dollar Year)	2012
Project Construction and Installation Cost	$29,859,437
Local Spending	$6,938,850
Total Annual Operational Expenses	$3,926,920
Direct Operating and Maintenance Costs	$239,062
Local Spending	$93,230
Other Annual Costs	$3,687,858
Local Spending	$18,182
ROW Payments	$18,182
Debt Payments	$0
Equity Payments	$0
Property Taxes	$0

Construction Costs

$29.8 MM: total cost

$6.9 MM: purchased locally

$22.9 MM: purchased from other US states or imported

***Economic leakage**, does NOT create any local impacts.*

Operation and Maintenance Costs (annual)

$3.9 MM/yr: total annual cost

$0.1 MM: purchased locally

$3.8 MM: purchased from other US states or imported

***Economic leakage**, does NOT create any local impacts.*

JEDI Transmission Line Model: https://www.nrel.gov/analysis/jedi/transmission-line.html

Summary Results: Local Economic Impacts

During Construction and Installation Period

Construction Period: 6 months

	Jobs (FTE)	Earnings $MM (2012)	Output $MM (2012)	Value Added $MM (2012)
Project Development and On-Site Labor Impacts				
1 Construction and Installation Labor	58	$3.7		
2 Construction and Installation Related Services	11	$0.5		
Subtotal	**69**	**$4.3**	**$5.2**	**$4.6**
3 Equipment and Supply Chain Impacts	20	$1.2	$3.9	$2.1
4 Induced Impacts	20	$1.1	$3.2	$1.8
Total Impacts	**109**	**$6.5**	**$12.2**	**$8.5**

1. Direct impacts from the *construction sector*
2. Direct impacts from *professional* and *other services* sectors
3. Rest of direct impacts (on-site materials/equipment) + indirect impacts (supply chains)
4. Induced impacts from reinvestment and spending of earnings by direct and indirect beneficiaries

Summary Results: Local Economic Impacts

During Construction and Installation Period

Construction Period: 6 months

	Jobs (FTE)	Earnings $MM (2012)	Output $MM (2012)	Value Added $MM (2012)
Project Development and On-Site Labor Impacts				
Construction and Installation Labor	58	$3.7		
Construction and Installation Related Services	11	$0.5		
Subtotal	**69 (4)**	**$4.3**	**$5.2**	**$4.6**
Equipment and Supply Chain Impacts	20	$1.2	$3.9	$2.1
Induced Impacts	20	$1.1	$3.2	$1.8
Total Impacts	**109 (1)**	**$6.5 (2)**	**$12.2 (3)**	**$8.5 (5)**

! How to interpret these results:

This project is estimated to (1) *support 109 jobs* (FTE for a year) during construction, generating (2) *$6.5 million in income* for those workers and (3) *$12.2 million in local economic activity*. Of those 109 jobs, (4) 69 jobs are expected to be construction sector jobs. The project is also estimated to add (5) *$8.5 million to the state's GDP* (gross domestic product).

Summary Results: Local Economic Impacts

During Construction and Installation Period

Construction Period: **2 years**

	Jobs (FTE)	Earnings $MM (2012)	Output $MM (2012)	Value Added $MM (2012)
Project Development and On-Site Labor Impacts				
Construction and Installation Labor	58	$3.7		
Construction and Installation Related Services	11	$0.5		
Subtotal	**69**	**$4.3**	**$5.2**	**$4.6**
Equipment and Supply Chain Impacts	20	$1.2	$3.9	$2.1
Induced Impacts	20	$1.1	$3.2	$1.8
Total Impacts	**109** ❶	**$6.5** ❷	**$12.2** ❸	**$8.5**

What if the construction period was *longer than a year*? ➡ Divide impacts by number of years.

This project is estimated to ❶ *support on average 55 jobs in each year* of construction, generating ❷ *$3.25 million in income* for those workers and ❸ *$6.1 million in local economic activity per year*.

Summary Results: Local Economic Impacts

During Operating Years

	Jobs (FTE)	Earnings $MM (2012)	Output $MM (2012)	Value Added $MM (2012)
1 On-Site Labor Impacts	1	$0.1	$0.1	$0.1
2 Local Revenue and Supply Chain Impacts	1	$0.0	$0.1	$0.1
3 Induced Impacts	0	$0.0	$0.1	$0.0
Total Annual Impacts	**2**	**$0.1**	**$0.3**	**$0.2**

1. Direct impacts from the *materials, supplies and services* required for maintenance/operation
2. Indirect impacts from upstream *supply chains*
3. Induced impacts from reinvestment and spending of earnings by direct and indirect beneficiaries, including on-site labor

Summary Results: Local Economic Impacts

During Operating Years

	Jobs (FTE)	Earnings $MM (2012)	Output $MM (2012)	Value Added $MM (2012)
On-Site Labor Impacts	1 (2)	$0.1	$0.1	$0.1
Local Revenue and Supply Chain Impacts	1	$0.0	$0.1	$0.1
Induced Impacts	0	$0.0	$0.1	$0.0
Total Annual Impacts	**2 (1)**	**$0.1 (4)**	**$0.3 (3)**	**$0.2 (5)**

How to interpret these results:

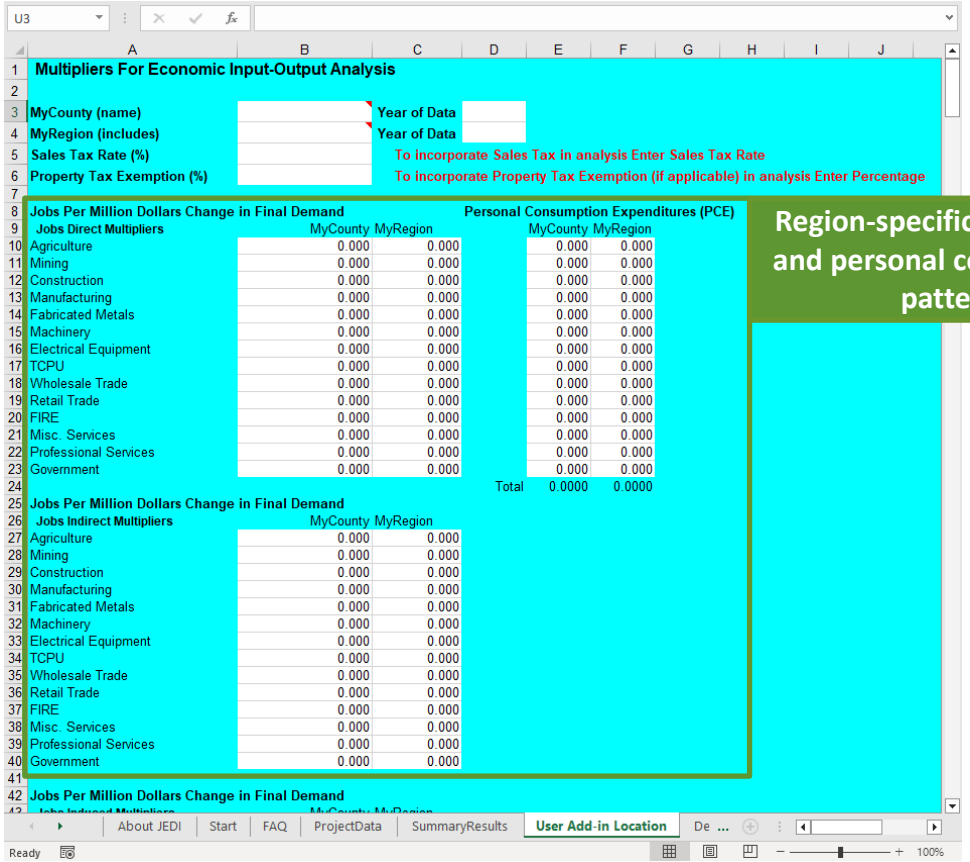
Once in operation, this project continues to impact the state. Around (1) *2 jobs* (full-time equivalent for each year of operation) *are supported*, with approximately (2) *1 directly employed by the line operator*. The total *annual local economic activity* supported by ongoing operations is just over (3) *$0.3 million* and (4) *income of $0.1 million.* Annual operations are estimated to add (5) *$0.2 million to the state's GDP* (gross domestic product).

Interface: Advanced Users

JEDI Excel Structure

- About JEDI
- Start
- FAQ
- ProjectData
- SummaryResults
- User Add-in Location
- DefaultData
- Calculations

Additional model-specific tabs



Multipliers For Economic Input-Output Analysis

MyCounty (name)		Year of Data		
MyRegion (includes)		Year of Data		
Sales Tax Rate (%)		To incorporate Sales Tax in analysis Enter Sales Tax Rate		
Property Tax Exemption (%)		To incorporate Property Tax Exemption (if applicable) in analysis Enter Percentage		

Jobs Per Million Dollars Change in Final Demand

Jobs Direct Multipliers	MyCounty	MyRegion
Agriculture	0.000	0.000
Mining	0.000	0.000
Construction	0.000	0.000
Manufacturing	0.000	0.000
Fabricated Metals	0.000	0.000
Machinery	0.000	0.000
Electrical Equipment	0.000	0.000
TCPU	0.000	0.000
Wholesale Trade	0.000	0.000
Retail Trade	0.000	0.000
FIRE	0.000	0.000
Misc. Services	0.000	0.000
Professional Services	0.000	0.000
Government	0.000	0.000

Personal Consumption Expenditures (PCE)

	MyCounty	MyRegion
	0.000	0.000
	0.000	0.000
	0.000	0.000
	0.000	0.000
	0.000	0.000
	0.000	0.000
	0.000	0.000
	0.000	0.000
	0.000	0.000
	0.000	0.000
	0.000	0.000
	0.000	0.000
	0.000	0.000
	0.000	0.000
Total	0.0000	0.0000

Jobs Per Million Dollars Change in Final Demand

Jobs Indirect Multipliers	MyCounty	MyRegion
Agriculture	0.000	0.000
Mining	0.000	0.000
Construction	0.000	0.000
Manufacturing	0.000	0.000
Fabricated Metals	0.000	0.000
Machinery	0.000	0.000
Electrical Equipment	0.000	0.000
TCPU	0.000	0.000
Wholesale Trade	0.000	0.000
Retail Trade	0.000	0.000
FIRE	0.000	0.000
Misc. Services	0.000	0.000
Professional Services	0.000	0.000
Government	0.000	0.000

Jobs Per Million Dollars Change in Final Demand

About JEDI | Start | FAQ | ProjectData | SummaryResults | User Add-in Location | De ...

Ready

Region-specific multipliers and personal consumption pattern

*Users can supply their **own economic data** instead of using JEDI's state-level data (from IMPLAN); for example, data for a specific county or a more updated state data.*

Some multipliers are available from IMPLAN, BEA (RIMS II), and EPA (USEEIO).

Additional Information: https://www.nrel.gov/analysis/jedi/advanced.html

Main Caveats

As in any model, JEDI simplifies reality and employs many assumptions!
Hence, **results are an estimate, not a precise forecast**.

Things to keep in mind:

➢ **Results reflect gross impacts.**	*No substitution or price effects, no displacement of economic activity*
➢ **Data inputs matter!**	*Region-specific economic data, project-specific data*
➢ **No measure of profitability/viability**	*JEDI assumes projects are financially viable.*
➢ **Not accounting for intangible effects**	*For example, impacts on grid reliability, emissions, land use*
➢ **Be careful when comparing/combining JEDI models.**	*Economic data sets from different years may skew results.*

Details: https://www.nrel.gov/analysis/jedi/limitations.html

Additional Resources: Examples of Applications

- ***Offshore Wind: Generating Economic Benefits in North Carolina*** (North Carolina Department of Commerce 2022)
- ***The Road to 100% Renewable Electricity by 2030 in Rhode Island*** (Brattle 2021)
- ***Measuring the Economic Impacts of Utility-Scale Solar in Ohio*** (Michaud et al. 2020)
- ***Economic Development Benefits of the Proposed Astoria Replacement Project*** (Navigant 2020)
- ***The State of the Energy Industry in Ohio: Job Trends and Projections*** (Michaud, Driver, and Smith 2017)
- **Sustainable Development for the Navajo Nation Replacing the Navajo Generating Station with Renewable Energy** (Ackerman, Jackson, and Fields 2014)

May the Force be with you...

Q&A

www.nrel.gov **JEDIsupport@nrel.gov**

NREL/PR-6A20-87769

Additional information for JEDI is available at https://www.nrel.gov/analysis/jedi/about.html.

NREL
Transforming ENERGY

Breakout Sessions

1. Andre Avelino
2. Yimin Zhang
3. Alberto Franco
4. Jeremy Stefek

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List of Abbreviations and Acronyms

CapEx	capital expenditures
DOE	U.S. Department of Energy
eqpt	equipment
GDP	gross domestic product
hr	hour
inv.	investment
IOA	input-output analysis
JEDI	Jobs and Economic Development Impact model
k	thousand(s)
mach	machinery
mfg	manufacturing
MM	million(s)
O&M	operation and maintenance
OpEx	operating expenditures
Q&A	question and answer
RPC	regional purchase coefficient
svcs	services
TEA	techno-economic analysis
yr	year

Additional Slides

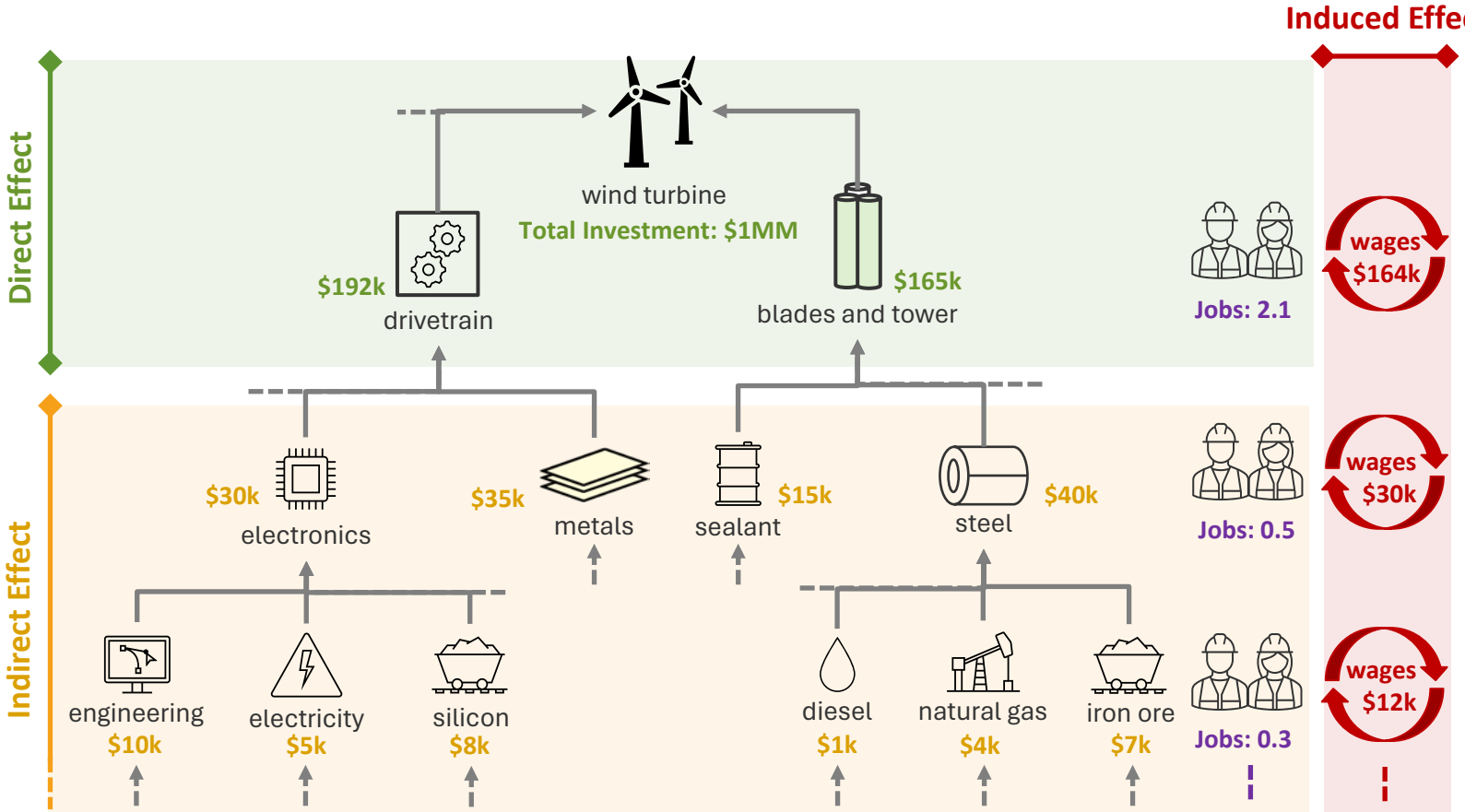
Additional Resources: Literature

Additional information for JEDI is available at https://www.nrel.gov/analysis/jedi/about.html.

Input-Output Literature

- **For the Practitioner:** EPA (U.S. Environmental Protection Agency). 2010. *Assessing the Multiple Benefits of Clean Energy: A Resource for States*. https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P100FLQ9.txt
- **For the Academic:** Miller, R., and Peter Blair. 2022. *Input-Output Analysis: Foundations and Extensions*. 3rd edition. New York: Cambridge University Press.

Overview: Method - The Multiplier Effect



INDUSTRIAL OUTPUT

Direct	$1,000k
Indirect	$194k
Induced	$486k
Total	**$1,680k**

Output Multiplier: 1.68 $/$ inv.

JOBS

Direct	2.11
Indirect	0.96
Induced	2.51
Total	**5.58**

Jobs Multiplier: 5.6 jobs/$MM inv.

JEDI Workflow

Construction/O&M default cost data for each technology were obtained from techno-economic analyses and literature (reports, industry surveys, and studies), and they are used to pre-populate the model.

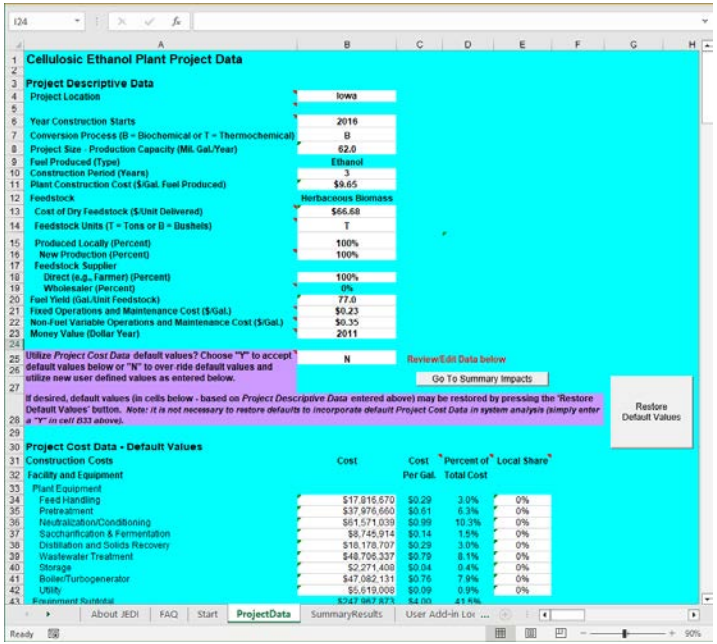
Process Engineering Analysis for Ethanol From Mixed Alcohol Synthesis (2,000 dry metric tons/day)

Capital Costs	
Gasification	$43,250,000
Tar Reforming & Quench	$26,940,000
Acid Gas & Sulfur Removal	$28,490,000
Syngas Compression & Expansion	$80,630,000
Alcohol Synthesis Reaction	$41,420,000
Alcohol Separation	$20,310,000
Steam System & Power Generation	$45,840,000
Cooling Water & Other Utilities	$9,560,000
Total Installed Equipment Cost (TIC)	$296,450,000
Land (115 acres at $14000 per acre)	1,600,000
Site Development	9,640,000
(% of ISBL)	4.0%
Indirect Costs & Project Contingency	183,650,000
(% of TIC)	62.0%
Fixed Capital Investment (FCI)	491,350,000
Working Capital	24,490,000
Total Capital Investment (TCI)	515,840,000

Operating Costs ($ / Year)	
Feedstock	$47,560,000
Natural Gas	$0
Catalysts	$6,380,000
Olivine & Magnesium Oxide	$0
Other Raw Materials	$380,000
Waste Disposal	$520,000
Electricity	$0
Fixed Costs	$23,240,000
Co-Product Credits at $1.88 per Gallon	-$15,380,000
Capital Depreciation	$24,490,000
Average Income Tax	$7,450,000
Average Return on Investment	$37,210,000

Dutta et al. (2011)

JEDI Interface



JEDI Workflow

Once the user customizes the project, the **project-specific cost data** (which represent costs in purchasing prices; i.e., include transportation and wholesale/retail margins) are allocated as demand for different commodities in the local economy.

Project-specific data

Capital Costs	
Gasification	$43,250,000
Tar Reforming & Quench	$26,940,000
Acid Gas & Sulfur Removal	$28,490,000
Syngas Compression & Expansion	$80,630,000
Alcohol Synthesis Reaction	$41,420,000
Alcohol Separation	$20,310,000
Steam System & Power Generation	$45,840,000
Cooling Water & Other Utilities	$9,560,000
Total Installed Equipment Cost (TIC)	$296,450,000
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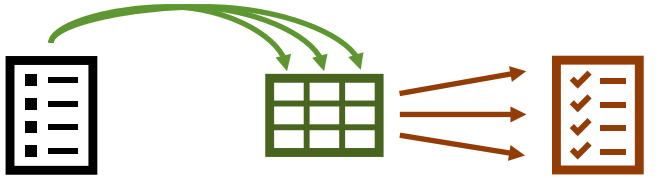
Dutta et al. (2011)



Cost Allocation

Each itemized expense is broken down into **cost of materials** and **installation costs**.

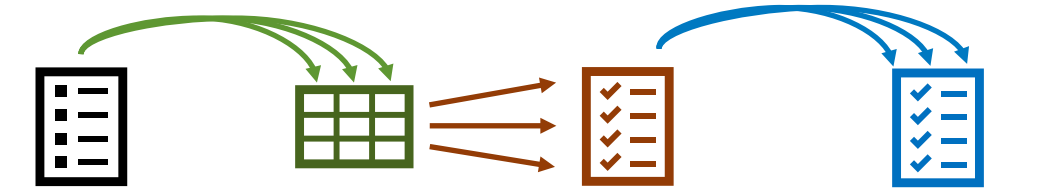
Sector Allocation

Each cost is allocated to an **economic sector** in the model.

NAICS	Industry Description	Purchasing Prices
233230	Manufacturing structures	$ 115,910,000
332310	Plate/structural product mfg	$ 190,000
332410	Power boiler/heat exchanger mfg	$ 26,820,000
332420	Metal tank mfg	$ 8,820,000
33329A	Other industrial machinery mfg	$ 63,460,000
333413	Fan/blower/air purification mfg	$ 3,450,000
333414	Heating equipment mfg	$ 950,000
333415	Air conditioning, refrigeration mfg	$ 1,800,000
333611	Turbine/generator set units mfg	$ 15,260,000
333912	Air and gas compressor mfg	$ 47,060,000
33391A	Pump and pumping eqpt mfg	$ 2,440,000
33399A	General purpose machinery mfg	$ 770,000
423800	Wholesale of mach/eqpt/supplies	$ -
484000	Truck transportation	$ -
541300	Architectural/engineering svcs	$ 167,610,000
5241XX	Insurance carriers	$ 34,970,000
531ORE	Other real estate	$ 1,840,000

JEDI Workflow

Cost data allocated by commodity is then margined (i.e., broken down into producer prices, transportation and wholesale/retail margins). This final allocation is used as the impact vector for the input-output model.



Cost Allocation

Each itemized expense is broken down into **cost of materials** and **installation costs**.

Sector Allocation

Each cost is allocated to an **economic sector** in the model.

Margins Allocation

Purchasing values are separated into **producer costs**, **transportation costs** and **wholesale/retail margins.**

NAICS	Industry Description	Producer Prices
233230	Manufacturing structures	$ 115,910,000
332310	Plate/structural product mfg	$ 170,000
332410	Power boiler/heat exchanger mfg	$ 19,770,000
332420	Metal tank mfg	$ 8,390,000
33329A	Other industrial machinery mfg	$ 52,620,000
333413	Fan/blower/air purification mfg	$ 2,580,000
333414	Heating equipment mfg	$ 710,000
333415	Air conditioning, refrigeration mfg	$ 1,280,000
333611	Turbine/generator set units mfg	$ 12,650,000
333912	Air and gas compressor mfg	$ 39,010,000
33391A	Pump and pumping eqpt mfg	$ 2,020,000
33399A	General purpose machinery mfg	$ 640,000
423800	Wholesale of mach/eqpt/supplies	$ 27,430,000
484000	Truck transportation	$ 3,770,000
541300	Architectural/engineering svcs	$ 167,610,000
5241XX	Insurance carriers	$ 34,970,000
531ORE	Other real estate	$ 1,840,000

JEDI Workflow