

# Scenario Solar PV Jobs and Economic Development Impact (JEDI) Model



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U.S. Department of Energy

# Why Do Impact Modeling?

- **Evaluate potential scenarios – current or future**
- **Inform residents, stakeholders, decision makers**
- **Assist businesses**
  - Identify potential customers
  - Evaluate economic development efforts
- **Assist government**
  - Representing public interest
  - Planning and evaluating
  - Community development



Photo Credit: NREL PIX #14936

# Jobs and Economic Development Impacts (JEDI)

- Freely available input-output tool to estimate employment and economic impacts that result from an investment in new power generation or fuel production.
- JEDI default inputs are from developers and industry experts, based on existing projects.
- User input can be minimal using defaults or be very detailed for more precise results.



Photo Credit: Warren Gretz / NREL PIX #10603

<http://www.nrel.gov/analysis/jedi>

# JEDI Background

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- All models contain two basic elements: the project description in terms of expenditures and the input-output model
- Expenditures can either be customized or model users can opt to use defaults
- Defaults based on real-world projects or input from engineers, experts
- IMPLAN input-output model currently used

# Input-Output Models

- **Snapshot of the relationships between sectors of an economy at a single point in time**
  - Industries, labor, households, capital, investments, government, imports/exports
- **Expenditures in an economy**
  - Inputs: goods/services from other industries, payments for labor, capital, taxes, imports
  - Outputs: goods/services to other industries, households, and governments, exports
- **Captures ripple effects within a region**
  - i.e., an increase in demand for electricity might increase demand for turbines, which will further increase demand for electricity

# Interpreting Results and Model Limitations

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- JEDI results are gross, not net
- JEDI does not factor in far-reaching impacts from development such as changes in utility rates, greenhouse gas emissions, property values or public health
- Input-output models cannot estimate impacts from supply-side changes such as technological improvements, price changes, or changes in taxes/subsidies
- JEDI doesn't evaluate a project's feasibility or profitability
- NREL is not responsible for how the model is used, applied or results interpreted

# Interpreting Results and Model Limitations

- JEDI models use an input-output model from a single year (currently 2010; updated as new data become available).
- Scenario JEDI assumes that the economy has the same structure over time - relative prices don't change, technology doesn't change, and production/consumption patterns don't change.



Photo credit: Aspen Skiing Company / NREL PIX # 14729

# JEDI Results

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- **Jobs (FTEs)**

- Number of people working the equivalent of 40 hr. weeks, 52 weeks/yr.

- **Earnings**

- Income from work
- Includes wages, salaries, employer provided supplements (retirement, health)

- **Gross output**

- Measure of total economic activity
- Value of production plus inputs
- Not the same as GDP, which is the value of production

# Project Development & Onsite Labor Impacts

## ■ Sample job types

- Installer
- Electrician
- Truck driving
- Crane operation
- Management, support
- Siting

Photo credit: Jim Tracy / NREL PIX #09275



Photo Credit: Craig Miller Productions / NREL PIX #03500

Photo credit: Susan Bilo / NREL PIX #21393



Photo credit: Dennis Schroeder / NREL PIX #22182

# Local Revenues, Turbine, Module, & Supply Chain Impacts



Photo Credit: Dennis Schroeder / NREL PIX #22569



Photo Credit: United Solar  
Ovonic / NREL PIX # 15779



Photo Credit: Evergreen Solar  
/ NREL PIX # 14722

- Polysilicon manufacturers
- Module and component manufacturers
- Equipment sales and financing
- Property taxes, banking, accounting

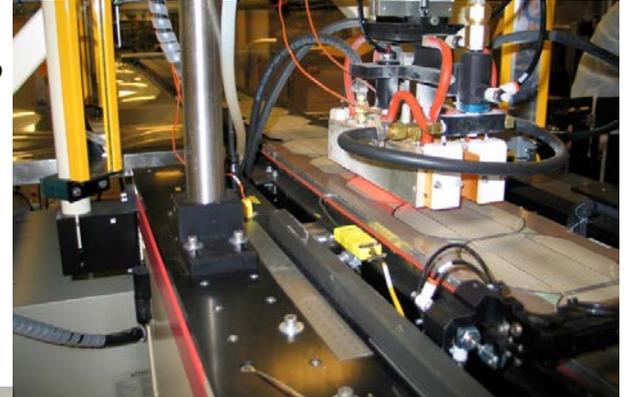


Photo Credit: Shell Solar Industries/  
NREL PIX #13856



Photo Credit: SunPower / NREL PIX #13451



Photo Credit: John De La Rosa / NREL PIX #26513



Photo Credit: Frank Jeffrey / NREL  
PIX #07781

# Induced Impacts



Photo from iStock/9774681



Photo from iStock/8783332



Photo from iStock/4363756

Money spent in the local area on goods and services from increased revenue: *sandwich shops, child care, grocery stores, clothing, other retail, public transit, new cars, restaurants, medical services*



Photo from iStock/3275965



Photo from iStock/8007815



Photo from iStock/8913075

# Scenario JEDI

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- **Looks at deployment scenario over time**
  - *Example: What is the impact of 10 MW of solar installed over a 5 year period that is split between utility, residential and commercial installations?*
  
- **Other JEDI models look at single projects or single grouping of projects**
  - *Example: What is the impact of 150 kW in small commercial rooftop installations?*

# Other Innovations New for Scenario JEDI

- Users have flexibility in selecting scenario targets. Available formats include:
  - Capacity (MW)
  - Electricity generated (GWh)
  - Investment (\$m)
  - Percent of retail consumption
  - Number of systems
- Users have flexibility in inputting costs for improving output accuracy:
  - e.g., user can input assumed cost for any component for any year within the study period.
- Users can access expanded and in-depth guidance, including:
  - Methodology explanations and sources for data, which are located in cell help bubbles right at the point of entry. This obviates the inconvenience of having to flip to search for information in FAQs.
  - Marked increase in use of “breadcrumbs,” hot link buttons that make it easier for user to navigate to other locations within the model they will most likely want to visit next.

# Other Innovations New for Scenario JEDI

- **More granularity, with new breakouts for:**
  - Market sectors that distinguish:
    - Large commercial and small commercial
    - Residential new construction and residential retrofit
  - PV technologies that distinguish:
    - Fixed mount and single-axis tracking
    - C-Si and thin film
- **New data resources within the model to save users' time in conducting additional research, including:**
  - Projected market size (SEIA/GTM) by state
  - Projected solar carve-out capacity by state
  - State average capacity factors used in the model
  - Property tax information by state
  - List of solar firms by state

# Scenario JEDI Timeline

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- **Impacts reported in year that projects are specified to come online, not necessarily when construction is started or expenditures made.**
  - Example: 10 MW online in 2013 that uses components purchased in 2012 reports all impacts in 2013
- **Construction and Installation Phase**
  - Equivalent of one year, regardless of how long the project actually takes to build
- **Operating Phase**
  - Annual, ongoing results

# Basic Scenario

- **Time frame**
- **Deployment scenario type**
  - Nameplate capacity, generation, cost, number of systems or percentage of total electricity generated
- **Distribution between residential, commercial, utility**
- **Contains default cost values, but users can enter their own information**

Photo credit: Jim Yost /NREL PIX #02024

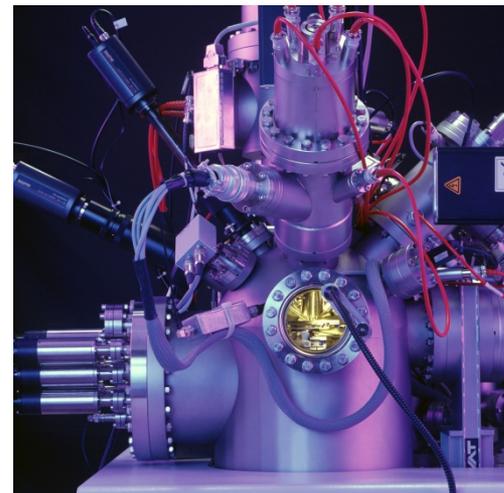
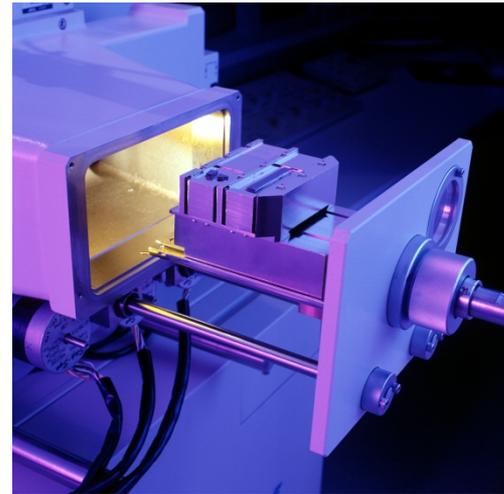


Photo credit: Jim Yost /NREL PIX #02014

# Basic Scenario

11 NOTE: Additional information is available by pointing to the red triangles located in cell corners, referring to  
 12 the FAQ worksheet. Only those cells with a white background can accept new values.

13			
14			
15	<b>Scenario and Deployment Parameters</b>		Scenario Run:
16	Geographic Location	CALIFORNIA	
17	Target Year of Analysis	2030	
18	Start Year of Analysis	2013	
19	Deployment Scenario (Type)	MW	
20	Deployment Goal (MW)	100.000	
21			
22	<i>Distribute Deployment Goal - with constant rate of annual increase?</i>	Yes	
23	<b>Market Sector Share (distribution of Goal)</b>		
24	Residential	50.0%	
25	Retrofit (percent of Residential)		80.0%
26	New Construction (percent of Residential)		20.0%
27	Small Commercial	20.0%	
28	Large Commercial	10.0%	
29	Utility	20.0%	
30	<b>Total</b>	<b>100.0%</b>	
31			

# Advanced Inputs

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- Deployment over time can be specified (default is constant percentage change).
- Expenditures for each type of solar (new/retrofit residential, small/large commercial, utility) can be specified.
- If you do specify expenditures, be careful! The I-O model represents the entire economy at a single point in time with constant prices - if you change specific prices, they should be adjusted for inflation.

# Advanced Inputs

	A	B	C	D	E	F														
13																				
14																				
15	<b>Scenario and Deployment Parameters</b>		Scenario Run:		1															
16	Geographic Location	CALIFORNIA																		
17	Target Year of Analysis	2030																		
18	Start Year of Analysis	2013		Projection (based on available resource data)																
19	Deployment Scenario (Type)	MW		No Market Data Available for Local																
20	Deployment Goal (MW)	100.000																		
21	<i>Distribute Deployment Goal - with constant rate of annual increase?</i>		Yes																	
22	<b>Market Sector Share (distribution of Goal)</b>																			
23																				
24	Residential	50.0%		<table border="1"> <thead> <tr> <th colspan="2">Market Sector Deployment by Target Year</th> </tr> </thead> <tbody> <tr> <td>80.0%</td> <td>40.0 MW 66.384 GWh</td> </tr> <tr> <td>20.0%</td> <td>10.0 MW 16.596 GWh</td> </tr> <tr> <td>20.0%</td> <td>20.0 MW 33.192 GWh</td> </tr> <tr> <td>10.0%</td> <td>10.0 MW 16.596 GWh</td> </tr> <tr> <td>20.0%</td> <td>20.0 MW 38.796 GWh</td> </tr> <tr> <td>100.0%</td> <td>100.0 MW 171.564 GWh</td> </tr> </tbody> </table>			Market Sector Deployment by Target Year		80.0%	40.0 MW 66.384 GWh	20.0%	10.0 MW 16.596 GWh	20.0%	20.0 MW 33.192 GWh	10.0%	10.0 MW 16.596 GWh	20.0%	20.0 MW 38.796 GWh	100.0%	100.0 MW 171.564 GWh
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27	Small Commercial	20.0%																		
28	Large Commercial	10.0%																		
29	Utility	20.0%																		
30	Total	100.0%																		
31																				
32																				
33																				
34	Select Model Analysis Type (Simple or Advanced)	Advanced		<div style="border: 1px solid blue; padding: 5px; display: inline-block;">             Click to see/edit detailed annual data           </div>																
35																				
36	<i>Choose a market sector button below to review/edit detailed PV system data and then go to summary results.</i>																			
37																				
38	Review/Edit Residential Retrofits Systems		Review/Edit Residential New Construction Systems		Review/Edit Small Commercial Systems															
39					Review/Edit Large Commercial Systems															
40					Review/Edit Utility Systems															
41																				

# Advanced Inputs

	A	B	C	D	E
17					
18	<b>Utility Size</b>	<b>Total (all years)</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>
19					
20	<b>System Application</b>	<b>Utility</b>		<b>Typically 1 MW or larger</b>	
21	<b>Solar Cell/Module Material</b>	<b>Crystalline Silicon</b>			
22	<b>System Tracking</b>	<b>Fixed Mount</b>		<b>Restore Default Values</b>	
23	<b>Average System Size - DC Nameplate Capacity (kW)</b>	<b>1,000.0</b>	<b>1000.0</b>	<b>1000.0</b>	<b>1000.0</b>
24	<b>Average Annual System Capacity Factor (percentage)</b>	<b>22.1%</b>	<b>22.1%</b>	<b>22.1%</b>	<b>22.1%</b>
25	<b>Number of Systems Installed</b>	<b>20</b>	<b>0.0</b>	<b>0.2</b>	<b>0.2</b>
26	<b>Total DC Nameplate Capacity (kW)</b>	<b>20,000.0</b>	<b>0.0</b>	<b>204.9</b>	<b>240.6</b>
27	<b>Annual Goal Distribution (Review and/or Edit)</b>	<b>Set Goal Distribution</b>			
28	<b>Annual System Costs and Other Parameters (Review and/or Edit)</b>	<b>Set Annual Costs and Other Parameters</b>			
29					
30	<b>Money Value (Dollar Year)</b>	<b>2012</b>			
31					
32	<b>Project Cost Data</b>				
33	<b>Installation Costs</b>	<b>Cost</b>	<b>Cost</b>	<b>Cost</b>	<b>Cost</b>
34	<b>Materials &amp; Equipment</b>				
35	Mounting (rails, clamps, fittings, etc.)	\$3,279,491	\$0	\$76,096	\$82,948
36	Modules	\$6,968,918	\$0	\$161,704	\$176,263
37	Electrical (wire, connectors, breakers, etc.)	\$2,213,656	\$0	\$51,365	\$55,990
38	Inverter	\$1,885,707	\$0	\$43,755	\$47,695
39	Subtotal	\$14,347,773	\$0	\$332,920	\$362,895
40	<b>Labor</b>				
41	Installation	\$4,099,364	\$0	\$95,120	\$103,684
42	Subtotal	\$4,099,364	\$0	\$95,120	\$103,684
43	<b>Total</b>	<b>\$18,447,136</b>	<b>\$0</b>	<b>\$428,040</b>	<b>\$466,580</b>
44	<b>Other Costs</b>				
45	<b>Permitting</b>	\$409,936	\$0	\$9,512	\$10,368
46	Other Costs	\$1,311,796	\$0	\$30,438	\$33,179
47	Business Overhead	\$5,247,185	\$0	\$121,754	\$132,716
48	Subtotal	\$6,968,918	\$0	\$161,704	\$176,263
49	<b>Subtotal</b>	<b>\$25,416,055</b>	<b>\$0</b>	<b>\$589,744</b>	<b>\$642,843</b>
50	<b>Sales Tax (Materials &amp; Equipment Purchases)</b>	\$1,176,517	\$0	\$27,299	\$29,757
51	<b>Total</b>	<b>\$26,592,572</b>	<b>\$0</b>	<b>\$617,043</b>	<b>\$672,601</b>
52					

Click to change annual parameters

# Advanced Inputs - Costs

9					
10	<b>Market Sector</b>	2013			
11	<b>Utility</b>				
12	Base Installed System Cost (\$/kW <sub>DC</sub> )	\$2,878			
13	Annual Direct Operations and Maintenance Cost (\$/kW)	\$17.02			
14	Average System Size - DC Nameplate Capacity (kW)	1,000.0			
15	Number of Systems Installed	0			
16	Total DC Nameplate Capacity (kW)	204.9			
17	<input type="button" value="Return to Utility"/>	<input type="button" value="Restore UT Default Data"/>			
18					
19	<b>Project Cost Data</b>				
20	<b>Installation Costs</b>	<b>Percent of Total Cost</b>	<b>Cost per kW</b>	<b>Purchased Locally (%)</b>	<b>Manufactured Locally (%)</b>
21	<b>Materials &amp; Equipment</b>				
22	Mounting (rails, clamps, fittings, etc.)	12.9%	\$371	0%	0%
23	Modules	27.4%	\$789	0%	0%
24	Electrical (wire, connectors, breakers, etc.)	8.7%	\$251	0%	0%
25	Inverter	7.4%	\$214	0%	0%
26	Subtotal	56.5%	\$1,625		
27	<b>Labor</b>				
28	Installation	16.1%	\$464	100%	
29	Subtotal	16.1%	\$464		
30	Total	72.6%	\$2,089		
31	<b>Other Costs</b>				
32	Permitting	1.6%	\$46	100%	
33	Other Costs	5.2%	\$149	100%	
34	Business Overhead	20.6%	\$594	100%	
35	Subtotal	27.4%	\$789		
36	<b>Subtotal</b>	100.0%	\$2,878		
37	<b>Sales Tax (Materials &amp; Equipment Purchases)</b>				
38	<b>Total</b>				

# Advanced Inputs - Deployment

	A	B	C	D	E	F	G	H	I	J	
1	<b>Deployment Goal Distribution</b>		Review and/or Edit cells (with white background) to incorporate new annual values in After editing, default values may be restored by pressing the Restore Default Data button								
2	Analysis Type: Advanced										
3											
4	Return to Scenario Data										
5											
6	<b>Market Sector</b>	MW	2012	2013	2014	2015	2016	2017	2018	2019	20
7	<b>Residential Retrofit</b>	<b>Goal</b>									
8	Goal	40.000	0.410	0.481	0.565	0.663	0.779	0.915	1.074		
9	User revised total	40.000									
10											
11	Return to Residential Retrofit	Restore RR Default Data									
12	<b>Residential New Construction</b>	<b>Goal</b>									
13	Goal	10.000	0.102	0.120	0.141	0.166	0.195	0.229	0.269		
14	User revised total	10.000									
15											
16	Return to Residential New Construction	Restore RNC Default Data									
17	<b>Small Commercial</b>	<b>Goal</b>									
18	Goal	20.000	0.205	0.241	0.283	0.332	0.390	0.457	0.537		
19	User revised total	20.000									
20											
21	Return to Small Commercial	Restore SC Default Data									
22	<b>Large Commercial</b>	<b>Goal</b>									
23	Goal	10.000	0.102	0.120	0.141	0.166	0.195	0.229	0.269		
24	User revised total	10.000									

Default is constant percentage change

# Results

		Go To All Sectors Detailed Results			Go To Residential Retrofit Detailed Results		
<b>Local Economic Impacts - Summary Results</b>		Total	100.000	MW	Residential Retrofit	40.000	MW
		Cumulative	Earnings	Output	Cumulative	Earnings	Output
		Job Years	\$Million (2012)	\$Million (2012)	Job Years	\$Million (2012)	\$Million (2012)
22	<b>Local Economic Impacts - Summary Results</b>						
23							
24	<b>During construction and installation period</b>						
25	Project Development and Onsite Labor Impacts						
26	Construction and Installation Labor	201	\$14.9	\$17.1	113	\$7.3	\$7.3
27	Construction and Installation Related Services	331	\$18.1	\$39.1	150	\$10.7	\$17.7
28	<b>Subtotal</b>	<b>532</b>	<b>\$33.0</b>	<b>\$56.1</b>	<b>262</b>	<b>\$18.1</b>	<b>\$25.0</b>
29	Module and Supply Chain Impacts						
30	Manufacturing Impacts	0	\$0.0	\$0.0	0	\$0.0	\$0.0
31	Trade (Wholesale and Retail)	219	\$12.7	\$39.2	120	\$9.2	\$21.6
32	Finance, Insurance and Real Estate	0	\$0.0	\$0.0	0	\$0.0	\$0.0
33	Professional Services	56	\$2.7	\$9.4	26	\$1.6	\$4.3
34	Other Services	150	\$10.3	\$36.9	66	\$6.0	\$16.2
35	Other Sectors	219	\$8.7	\$26.3	105	\$5.5	\$13.6
36	<b>Subtotal</b>	<b>644</b>	<b>\$34.4</b>	<b>\$111.8</b>	<b>317</b>	<b>\$22.4</b>	<b>\$55.8</b>
37	<b>Induced Impacts</b>	<b>562</b>	<b>\$24.7</b>	<b>\$90.0</b>	<b>271</b>	<b>\$15.3</b>	<b>\$43.2</b>
38	<b>Total Impacts</b>	<b>1,739</b>	<b>\$92.1</b>	<b>\$257.9</b>	<b>850</b>	<b>\$55.8</b>	<b>\$124.0</b>
39	<b>Average Annual Impacts</b>	<b>97</b>	<b>\$5.1</b>	<b>\$14.3</b>	<b>47</b>	<b>\$3.1</b>	<b>\$6.9</b>
40							
41							
42							
43	<b>During operating years - Cumulative</b>						
44	Onsite Labor Impacts						
45	PV Project Labor Only	46.2	\$3.8	\$3.8	26	\$1.6	\$1.6
46	Local Revenue and Supply Chain Impacts	24.0	\$1.9	\$3.6	5	\$0.4	\$1.0
47	Induced Impacts	20.9	\$1.2	\$3.5	6	\$0.3	\$1.0
48	<b>Total Impacts</b>	<b>91.1</b>	<b>\$7.0</b>	<b>\$10.9</b>	<b>38</b>	<b>\$2.3</b>	<b>\$3.5</b>
49	<b>Average Annual Impacts</b>	<b>5.1</b>	<b>\$0.4</b>	<b>\$0.6</b>	<b>2</b>	<b>\$0.1</b>	<b>\$0.2</b>
50							
51							
52							
53							
54	<b>During operating years (Target)</b>						
55	Onsite Labor Impacts						
56	PV Project Labor Only	6.9	\$0.6	\$0.6	4	\$0.2	\$0.2
57	Local Revenue and Supply Chain Impacts	3.5	\$0.3	\$0.5	1	\$0.1	\$0.1
58	Induced Impacts	3.1	\$0.2	\$0.5	1	\$0.1	\$0.1
59	<b>Total Impacts</b>	<b>13.6</b>	<b>\$1.0</b>	<b>\$1.6</b>	<b>6</b>	<b>\$0.3</b>	<b>\$0.5</b>

Sum over all years

Final year

# Results - Detailed

11	System Application	Utility			Utility		
12	Number of Systems Installed	20			0		
13	Total DC Nameplate Capacity (kW)	20,000,000			240,622		
14	Money Value (Dollar Year)	2012			2012		
15							
16	<b>Local Economic Impacts - Summary Results</b>						
17		<b>Total</b>	<b>All Years</b>	<b>Output</b>	<b>Total</b>	<b>2014</b>	<b>Output</b>
18	During construction and installation period	<b>Job Years</b>	<b>Earnings</b>	<b>\$Million</b>	<b>Job Years</b>	<b>\$Million</b>	<b>\$Million</b>
19	Project Development and Onsite Labor Impacts						
20	Construction and Installation Labor	28	\$4.1	\$4.1	1	\$0.1	\$0.1
21	Construction and Installation Related Services	31	\$2.2	\$3.6	1	\$0.1	\$0.1
22	<b>Subtotal</b>	<b>58</b>	<b>\$6.3</b>	<b>\$7.7</b>	<b>1</b>	<b>\$0.2</b>	<b>\$0.2</b>
23	Module and Supply Chain Impacts						
24	Manufacturing	0	\$0.0	\$0.0	0	\$0.0	\$0.0
25	Trade (Wholesale and Retail)	6	\$0.4	\$1.0	0	\$0.0	\$0.0
26	Finance, Insurance and Real Estate	0	\$0.0	\$0.0	0	\$0.0	\$0.0
27	Professional Services	5	\$0.3	\$0.9	0	\$0.0	\$0.0
28	Other Services	14	\$1.3	\$3.4	0	\$0.0	\$0.1
29	Other Sectors	22	\$1.1	\$2.4	1	\$0.0	\$0.1
30	<b>Subtotal</b>	<b>47</b>	<b>\$3.1</b>	<b>\$7.6</b>	<b>1</b>	<b>\$0.1</b>	<b>\$0.2</b>
31	<b>Induced Impacts</b>	<b>52</b>	<b>\$2.9</b>	<b>\$8.3</b>	<b>1</b>	<b>\$0.1</b>	<b>\$0.2</b>
32	<b>Total Impacts</b>	<b>157</b>	<b>\$12.3</b>	<b>\$23.6</b>	<b>4</b>	<b>\$0.3</b>	<b>\$0.6</b>
33	<b>Average Annual Impacts</b>	<b>9</b>	<b>\$0.7</b>	<b>\$1.3</b>			
34							
35							
36	During operating years (cumulative)	<b>Total</b>	<b>Total</b>	<b>Total</b>			
37	Onsite Labor Impacts	<b>Cumulative</b>	<b>Earnings</b>	<b>Output</b>			
38	PV Project Labor Only	5	\$0.7	\$0.7			
39	Local Revenue and Supply Chain Impacts	1	\$0.1	\$0.3			
40	Induced Impacts	2	\$0.1	\$0.4			
41	<b>Total Impacts</b>	<b>9</b>	<b>\$0.9</b>	<b>\$1.3</b>			
42	<b>Average Annual Impacts</b>	<b>0</b>	<b>\$0.1</b>	<b>\$0.1</b>			
43							
44	During operating years (Target and annual)	<b>2030</b>	<b>Earnings</b>	<b>Output</b>	<b>2014</b>	<b>Earnings</b>	<b>Output</b>
45	Onsite Labor Impacts	<b>Jobs</b>	<b>\$Million</b>	<b>\$Million</b>	<b>Jobs</b>	<b>\$Million</b>	<b>\$Million</b>
46	PV Project Labor Only	1	\$0.1	\$0.1	0	\$0.0	\$0.0
47	Local Revenue and Supply Chain Impacts	0	\$0.0	\$0.0	0	\$0.0	\$0.0
48	Induced Impacts	0	\$0.0	\$0.1	0	\$0.0	\$0.0
49	<b>Total Impacts</b>	<b>1</b>	<b>\$0.1</b>	<b>\$0.2</b>	<b>0</b>	<b>\$0.0</b>	<b>\$0.0</b>



**Thank you**

Barry Friedman

David Keyser

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