

Decision-Support Tools

This is a short demonstration of three decision-support tools: GsT, HOMER, and JEDI. These tools can be used to make informed decisions regarding the application of renewable energy technologies.

These tools have been developed at the National Renewable Energy Laboratory (NREL).

Geospatial Toolkit (GsT)

The GsT combines resource data with other relevant spatial datasets in GIS format for policy analysis, decision making, and planning for renewable energy projects. The GsT is a data viewer and data analysis tool.

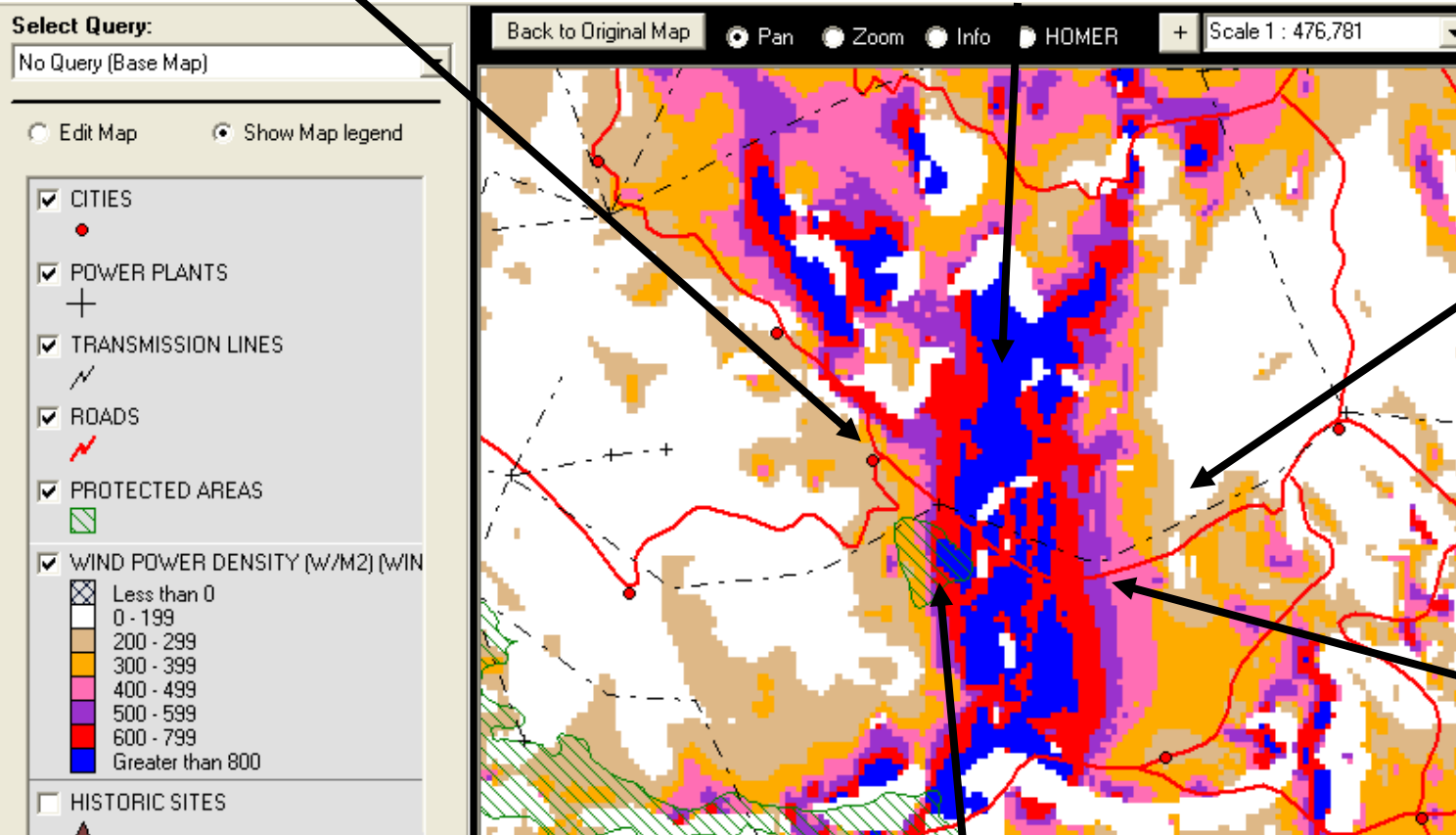
Load centers

View where a region's best resources are in relation to other relevant features.

Transmission lines

Roads

Protected areas where no development will take place



Ask how much land there is with good solar resource.

Total land area is tabulated.

Choose viable land use types.

Choose CSP or PV.

Select Query:
Best solar + Landuse

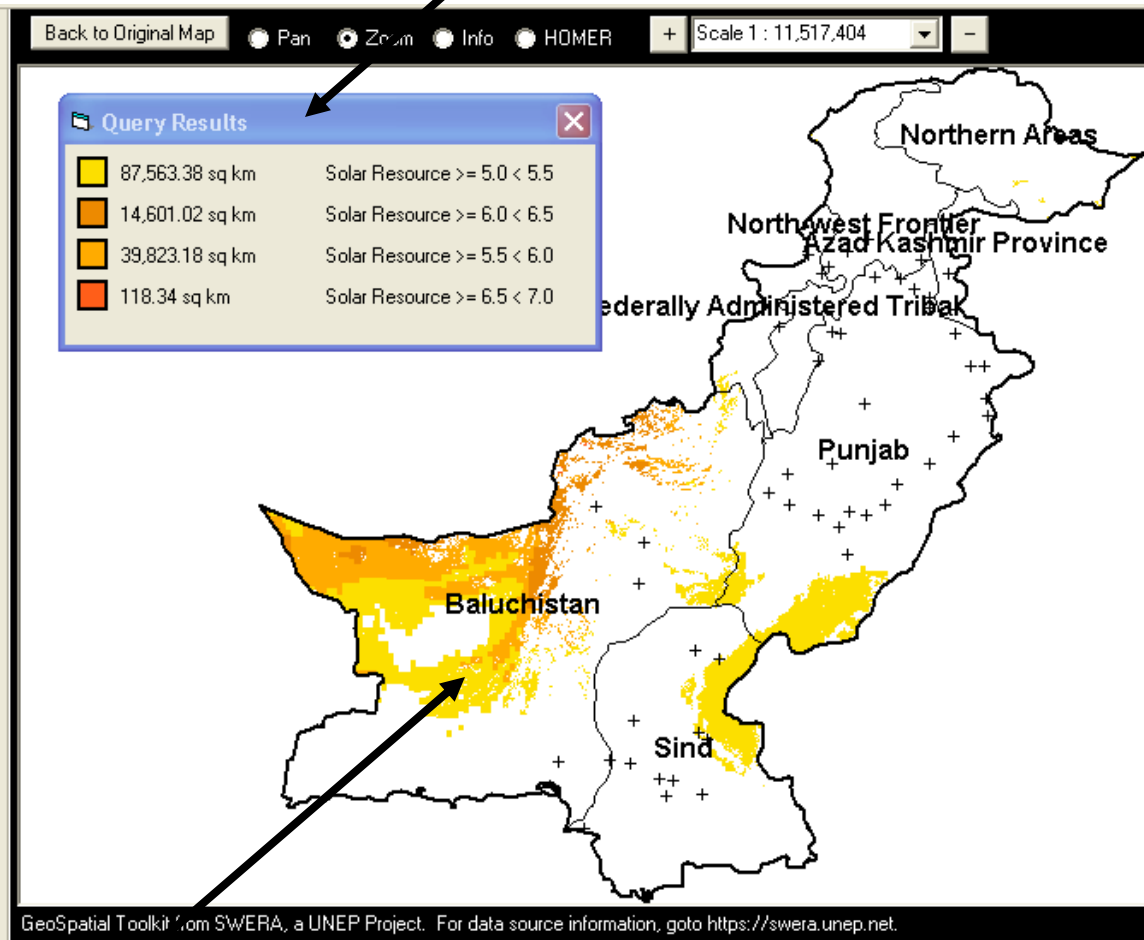
Edit Map Show Map legend

Query Parameters
Best solar + Landuse
Min Solar Resource: 5
Max Solar Resource: 6
Choose which land uses are suitable:
Barren or Sparsely Vegetated
Mixed Shrubland/Grassland
Wooded Tundra
Shrubland
Choose which solar resource:
10 KM Solar Concentrators Annua

Results Table Update Map

Layers currently displayed
Power Plants; Country Boundary;
State Boundaries;

Change Layers...



Areas meeting criteria are shown on the map.

Resource data are fed into HOMER application.

Choose the HOMER option.

The screenshot displays the HOMER software interface. On the left, a 'Select Query' panel shows various map layers, including 'WIND POWER DENSITY (W/M2) (WIN)' and '10 KM SOLAR GLOBAL HORIZONTAL'. The main map area shows a geographical region with a color-coded wind power density overlay. A mouse cursor is positioned over a specific area on the map. On the right, the 'HOMER GsT' window is open, displaying 'GsT data for 33.4N 60.9E, Elevation 700 m'. Below this, the 'User Inputs' section contains fields for 'What application would you like to model?' (Community II), 'Diesel fuel price (\$/liter)' (0.60), 'Annual energy requirement that can be unserved (%)' (1), and 'Interest rate minus inflation (%)' (5). The 'Analysis' section shows a table of 'Net Present Cost' for various system types, with 'Wind/PV/Gen/Batt' having the lowest cost at \$114,339.10.

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
Solar (kWh/m2/day)	2.89	3.82	4.74	5.97	6.82	8.13	7.96	7.49	6.52	5.15	3.48	2.64	5.47
Wind (W/m2)	206	321	297	218	295	489	731	638	379	181	141	209	347

System Type	Net Present Cost
Wind/PV/Gen/Batt	\$114,339.10
PV/Gen/Batt	\$117,470.10
Wind/Gen/Batt	\$124,116.10
Gen/Battery	\$131,519.90
PV/Gen	\$219,137.80
Wind/PV/Gen	\$223,145.10

Click area of interest on map.

Returns least cost systems based on load and resources.

HOMER

HOMER is a computer model that simplifies the task of evaluating design options for both off-grid and grid-connected power systems for remote, stand-alone, and distributed generation (DG) applications. HOMER models both conventional and renewable energy technologies:

HOMER models the following systems:

Load
Types

Add/Remove Equipment To Consider

Select check boxes to add elements to the schematic. Clear check boxes to remove the elements. The schematic represents systems that HOMER will simulate.

Hold the pointer over an element or click Help for more information.

Loads

- Primary Load
- Primary Load 2
- Deferrable Load
- Thermal Load 1
- Thermal Load 2
- Hydrogen load

Grid

- Do not model grid
- System is connected to grid
- Compare stand-alone system to grid extension

Components

- PV
- Wind Turbine 1
- Wind Turbine 2
- Hydro
- Generator 1
- Generator 2
- Generator 3
- Battery
- Converter
- Electrolyzer
- Hydrogen Tank
- Reformer

Renewable
Technologies

Conventional
Technologies

Newer
Technologies

Grid-
Tied or
Off-Grid
Systems

Help

Cancel

OK

HOMER Input/Output Page

User-Defined Configuration

Results - Sorted by Total Net Present Cost

The screenshot displays the HOMER software interface. On the left, a system configuration diagram shows a Generator connected to an AC bus, which is linked to a Converter and then to a DC bus. The DC bus is connected to a Battery and a PV panel. The system is labeled 'Village Power' with a capacity of 62 kWh/d and 11 kW peak. Below the diagram are sections for Resources (Solar resource, Diesel), Other (Economics, System control, Emissions, Constraints), and Document (Author, Notes).

On the right, the 'Sensitivity Results' tab is active, showing a table of simulation results. The table is sorted by Total Net Present Cost (NPC). The columns include PV (kW), Gen (kW), Batt. (kW), Conv. (kW), Initial Capital, Operating Cost (\$/yr), Total NPC, COE (\$/kWh), Ren. Frac., Diesel (L), and Gen (hrs). The first row is highlighted in blue.

	PV (kW)	Gen (kW)	Batt. (kW)	Conv. (kW)	Initial Capital	Operating Cost (\$/yr)	Total NPC	COE (\$/kWh)	Ren. Frac.	Diesel (L)	Gen (hrs)
	4	14	36	4	\$ 54,120	7,766	\$ 137,018	0.572	0.27	7,068	2,089
	4	14	48	4	\$ 56,760	7,645	\$ 138,371	0.577	0.27	7,032	2,046
	4	14	24	4	\$ 51,480	8,244	\$ 139,487	0.582	0.28	7,379	2,413
		14	36	4	\$ 24,120	11,424	\$ 146,066	0.610	0.00	10,357	3,139
		14	48	4	\$ 26,760	11,242	\$ 146,767	0.612	0.00	10,283	3,059
	4	14	12	4	\$ 48,840	9,904	\$ 154,558	0.645	0.26	8,732	3,377
	8	14	24	4	\$ 81,480	7,058	\$ 156,819	0.654	0.51	5,801	2,080
	8	14	36	4	\$ 84,120	6,844	\$ 157,183	0.656	0.51	5,678	2,000
		14	24	4	\$ 21,480	12,813	\$ 158,251	0.660	0.00	11,305	4,040
	4	14	48	4	\$ 86,760	6,761	\$ 158,929	0.663	0.51	5,666	1,994
	4	14	48	8	\$ 59,960	9,596	\$ 162,396	0.678	0.25	7,885	2,359
		14	12	4	\$ 18,840	13,727	\$ 165,368	0.690	0.00	12,235	4,956
		14	24	8	\$ 24,680	13,192	\$ 165,501	0.691	0.00	11,482	4,144
	4	14	12	8	\$ 52,040	10,674	\$ 165,985	0.693	0.26	9,240	3,637
	8	14	12	4	\$ 78,840	8,308	\$ 167,525	0.699	0.47	6,943	2,632
		14	24	12	\$ 27,880	13,272	\$ 169,554	0.708	0.00	11,482	4,144
		14	12	12	\$ 55,240	10,754	\$ 170,038	0.710	0.26	9,240	3,637
		14	48	8	\$ 29,960	13,188	\$ 170,739	0.713	0.00	11,136	3,354

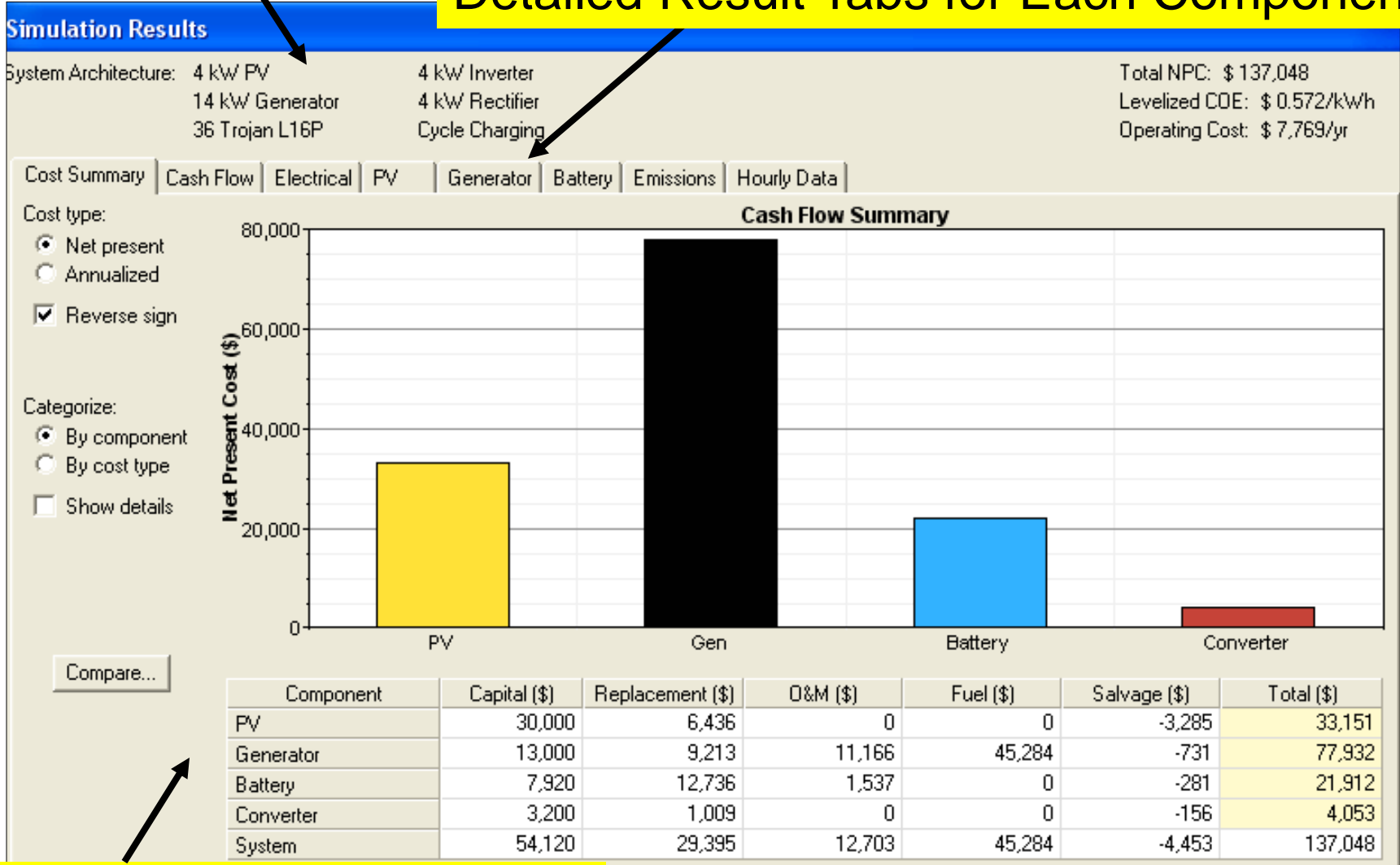
Site-Specific Resource Data

Other User-Defined Variables

System Components

Detailed Simulation Results

Detailed Result Tabs for Each Component

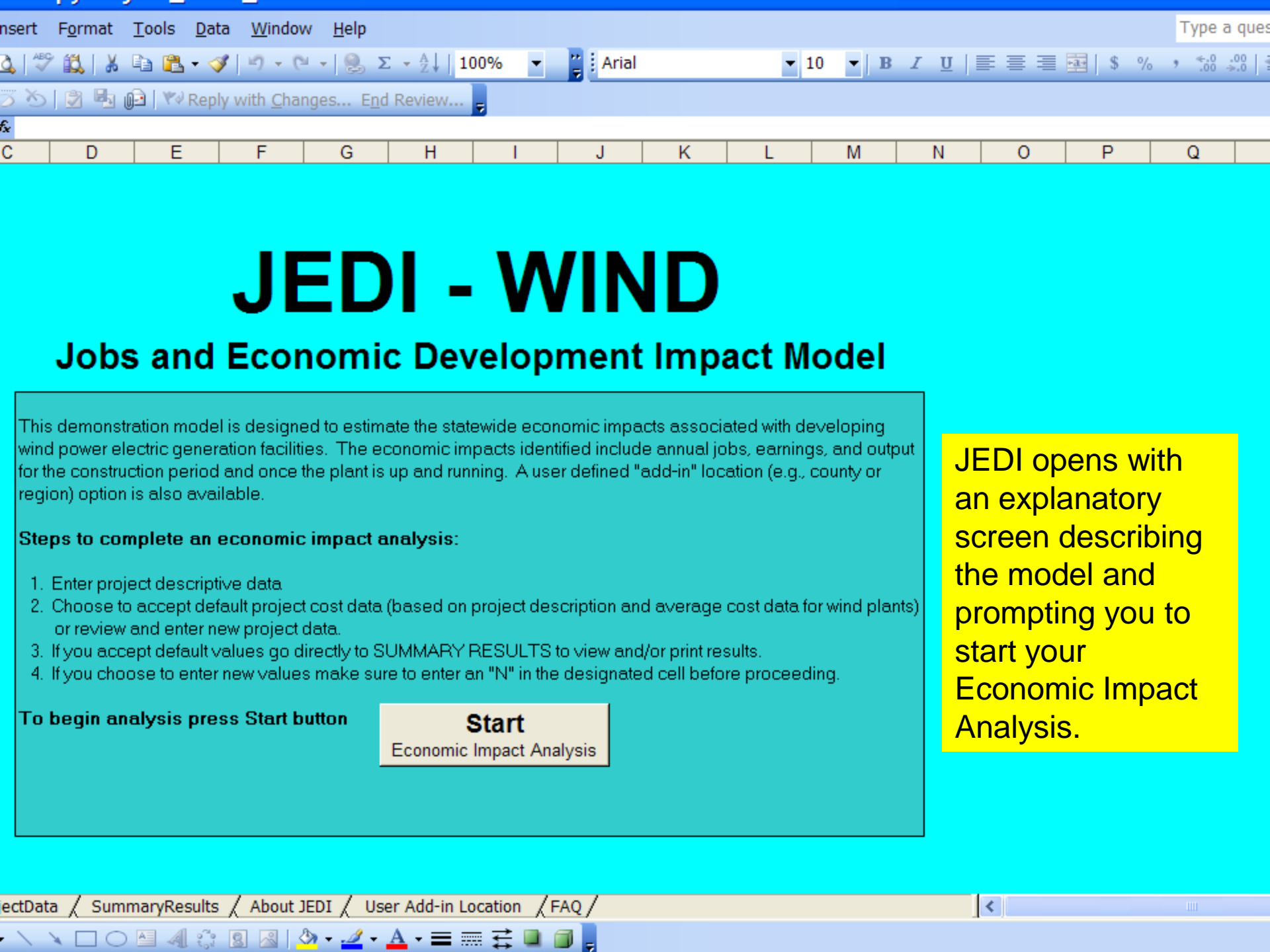


Life-Cycle Cost Information

Jobs and Economic Development Impact Model (JEDI)

JEDI is a spreadsheet based, input-output model that estimates the economic impact at the state level using IMPLAN multipliers from constructing and operating Renewable Energy Technology facilities.

What follows is a demonstration of JEDI-Wind.
Other JEDI modules nearing release are:
CSP, PV, Corn Ethanol, Sugar Cane
to Ethanol, Lignocellulosic Ethanol,
Natural Gas and Coal.



JEDI - WIND

Jobs and Economic Development Impact Model

This demonstration model is designed to estimate the statewide economic impacts associated with developing wind power electric generation facilities. The economic impacts identified include annual jobs, earnings, and output for the construction period and once the plant is up and running. A user defined "add-in" location (e.g., county or region) option is also available.

Steps to complete an economic impact analysis:

1. Enter project descriptive data
2. Choose to accept default project cost data (based on project description and average cost data for wind plants) or review and enter new project data.
3. If you accept default values go directly to SUMMARY RESULTS to view and/or print results.
4. If you choose to enter new values make sure to enter an "N" in the designated cell before proceeding.

To begin analysis press Start button

Start
Economic Impact Analysis

JEDI opens with an explanatory screen describing the model and prompting you to start your Economic Impact Analysis.

A B C D E F

Wind Plant Project Data

INSTRUCTIONS: Begin by entering Project Location (from pull-down list) and other Descriptive Data. After inserting required data press enter (or cursor to the next cell) to continue. Once Descriptive Data is complete, enter "Y" or "N" on Line 22 to continue.

Enter "Y" to accept Project Cost and Local Share defaults or "N" to review/enter all or some new values. To utilize new values in analysis you must enter an "N" in "Utilize Model Default Values (below)?" - Line 22

Additional information is available by pointing to the red triangles located in cell corners. Only those cells with a white background can be changed (accept new values).

Project Descriptive Data

13	Project Location	COLORADO
14	Year of Construction	2007
15	Project Size - Nameplate Capacity (MW)	100
16	Turbine Size (KW)	1,500
17	Number of Turbines	67
18	Construction Cost (\$/KW)	\$1,600
19	Annual Operations and Maintenance Cost (\$/kW)	\$15.50
20	Money Value - Current or Constant (Dollar Year)	2006
22	Utilize Model Default Values (below)? (Y or N)	Y

Go To Summary Impacts

First choose the state where the project will be located from a drop down menu and also indicate a start year for construction.

Accept the default cost data or enter your own project specific data.

	A	B	C	D	E
25	Project Cost Data - Default Values				
26	Construction Costs	Cost	Cost	Percent of	
27	Materials		Per KW		
28	Construction (concrete, rebar, equip, roads and site prep)	\$8,405,828	\$84		
29	Transformer	\$2,123,423	\$21		
30	Electrical (drop cable, wire,)	\$995,812	\$10		
31	HV line extension	\$1,830,537	\$18		
32	Materials Subtotal	\$13,355,601	\$134		
33	Labor				
34	Foundation	\$732,215	\$7		
35	Erection	\$732,215	\$7		
36	Electrical	\$805,436	\$8		
37	Management/supervision	\$439,329	\$4	0.3%	0%
38	Labor Subtotal	\$2,709,195	\$27	1.7%	
39	Construction Subtotal	\$16,064,796	\$161		
40	Equipment Costs				
41	Turbines (excluding blades and towers)	\$87,888,000	\$879		
42	Blades	\$29,296,000	\$293		
43	Towers	\$18,400,000	\$184		
44	Equipment Subtotal	\$135,584,000	\$1,356		
45	Other Costs				
46	HV Sub/Interconnection	\$5,857,720	\$59		
47	Engineering	\$1,920,000	\$19		
48	Legal Services	\$148,800	\$1		
49	Land Easements	\$0	na		
50	Site Certificate/Permitting	\$424,685	\$4		
51	Other Subtotal	\$8,351,204	\$84		
52	Total	\$160,000,000	\$1,600		

Cost inputs are shown here. Accept the default values or add your own project specific inputs on this portion of the spreadsheet.

In addition to **construction** cost inputs, default values are provided further down on the spreadsheet for **operating and maintenance** and **financial** parameters or you can opt to enter your own project specific data.

State Level Annual Economic Impact Estimation

	Jobs	Earnings	Output
Local Economic Impacts - Summary Results			
During construction period			
Direct Impacts	139	\$6.8	\$18.3
Construction Sector Only	134	\$6.5	
Indirect Impacts	58	\$2.2	\$5.9
Induced Impacts	64	\$2.1	\$6.7
Total Impacts (Direct, Indirect, Induced)	261	\$11.1	\$30.9
During operating years (annual)			
Direct Impacts	18	\$0.9	\$1.6
Plant Workers Only	9	\$0.5	
Indirect Impacts	4	\$0.2	\$0.5
Induced Impacts	7	\$0.2	\$0.8
Total Impacts (Direct, Indirect, Induced)	29	\$1.3	\$2.8

Notes: Earnings and Output values are millions of dollars in year 2006 dollars. Construction period related jobs are full-time equivalent for the construction period. Plant workers includes field technicians, administration and management. Economic impacts "During operating years" represent impacts that occur from plant operations/expenditures. The analysis does not include impacts associated with spending of plant "profits" and assumes no tax abatement unless noted. Totals may not add up due to independent rounding.

For Jobs,

Earnings and...

Output

During Construction and...

During Operating Years

More Information is Available at this Booth!

Or Contact:

- GsT
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 - Shannon Cowlin: Shannon_Cowlin@nrel.gov
- HOMER
 - Website: <http://www.homerenergy.com/>
 - Alicen Kandt: Alicen_Kandt@nrel.gov
- JEDI
 - Website: http://www.eere.energy.gov/windandhydro/windpoweringamerica/filer_detail.asp?itemid=707
 - Gail Mosey: Gail_Mosey@nrel.gov