

Modeling using HOMER – Part 2 (Making a new file from scratch)



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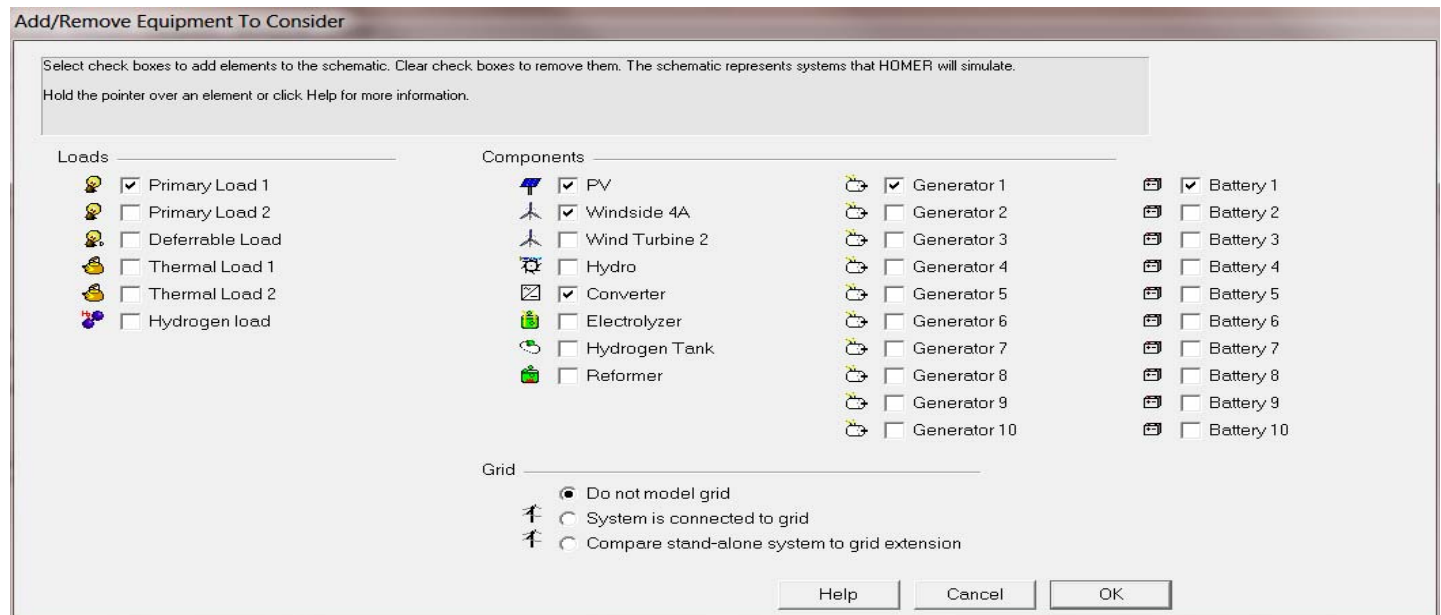
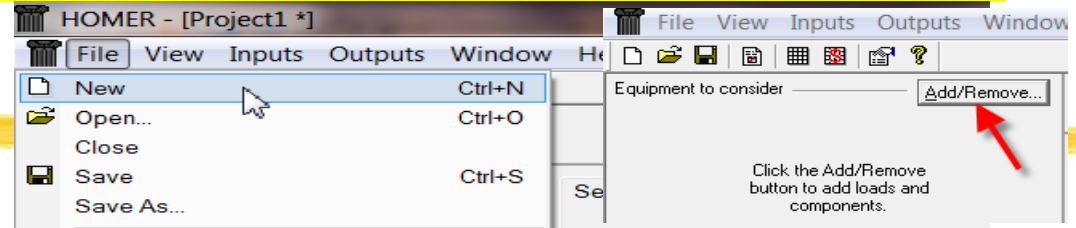
HOMER practice 2: Making a New file from scratch

⌘ HOMER

⌘ File > New

⌘ Click “Add/Remove”

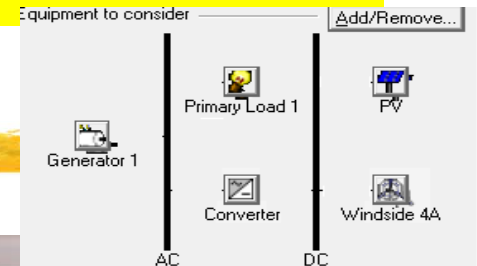
⌘ Select: Primary Load, PV, Wind Turbine 1, Converter, and Generator1



⌘ Click “OK”

Load Data

- ⌘ HOMER buttons appear
- ⌘ NOW click the load button
- ⌘ Type in the load [kW] every hour period of your application



Primary Load Inputs

File Edit Help

Choose a load type (AC or DC), enter 24 hourly values in the load table, and enter a scaled annual average. Each of the 24 values in the load table is the average electric demand for a single hour of the day. HOMER replicates this profile throughout the year unless you define different load profiles for different months or day types. For calculations, HOMER uses scaled data: baseline data scaled up or down to the scaled annual average value.

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

Label: Primary Load 1 Load type: AC DC Data source: Enter daily profile(s) Import time series data file Import File...

Baseline data

Month: January Day type: Weekday

Hour	Load (kW)
09:00 - 10:00	2.180
10:00 - 11:00	2.330
11:00 - 12:00	2.360
12:00 - 13:00	2.350
13:00 - 14:00	2.310
14:00 - 15:00	2.310
15:00 - 16:00	2.330
16:00 - 17:00	2.370
17:00 - 18:00	2.280
18:00 - 19:00	1.980
19:00 - 20:00	1.860
20:00 - 21:00	1.810
21:00 - 22:00	1.640
22:00 - 23:00	1.430
23:00 - 00:00	1.330

Daily Profile: Bar chart showing load (kW) vs Hour (0-24). Peak load is approximately 2.37 kW at 16:00-17:00.

DMap: Heatmap showing load (kW) vs Hour of Day (0-24) vs Month (Jan-Dec). Color scale ranges from 0.00 (blue) to 4.50 (red).

Seasonal Profile: Box plot showing load (kW) vs Month (Jan-Dec, Ann). Y-axis ranges from 0 to 5 kW. Legend: max, daily high, mean, daily low, min.

Random variability: Day-to-day: 15% Time-step-to-time-step: 20%

Scaled annual average (kWh/d): 43.4

	Baseline	Scaled
Average (kWh/d)	43.4	43.4
Average (kW)	1.81	1.81
Peak (kW)	4.37	4.36
Load factor	0.414	0.414

Efficiency Inputs...

Plot... Export... Help Cancel OK

Load Profile Example

⌘ Load Data Example

Small Commercial Load Profile [kW]

0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100
1.31	1.30	1.27	1.27	1.30	1.39	1.54	1.67	1.90	2.18	2.33	2.36
1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300
2.35	2.31	2.31	2.33	2.37	2.28	1.98	1.86	1.81	1.64	1.43	1.33

Daily Total [kW] 44.60

Street Light Load Profile [kW]

0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100
3.24	3.24	3.24	3.24	3.24	2.62	1.40	0.18	1.90	0.00	0.00	0.00
1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300
0.00	0.00	0.00	0.00	0.00	0.42	0.88	1.28	2.47	3.24	3.24	3.24



How about Load Profile for this Mobile Security on Demand?

- ⌘ Mobile security: 2 PV, 4 cameras, Digital recording, battery charger circuits, battery status of charge monitoring and wireless alerting.



Solar and Wind Resources ---Import XLM File from SWERA

⌘ 1. Find Lat & Lon of your location

⌘ 2. On SWERA

⊞ Type in Lat & Long

⊞ Click “Get Homer”

⊞ From the XLM data screen

⊞ CTRL+S (save to an XLM file)

⌘ 3. Now with HOMER

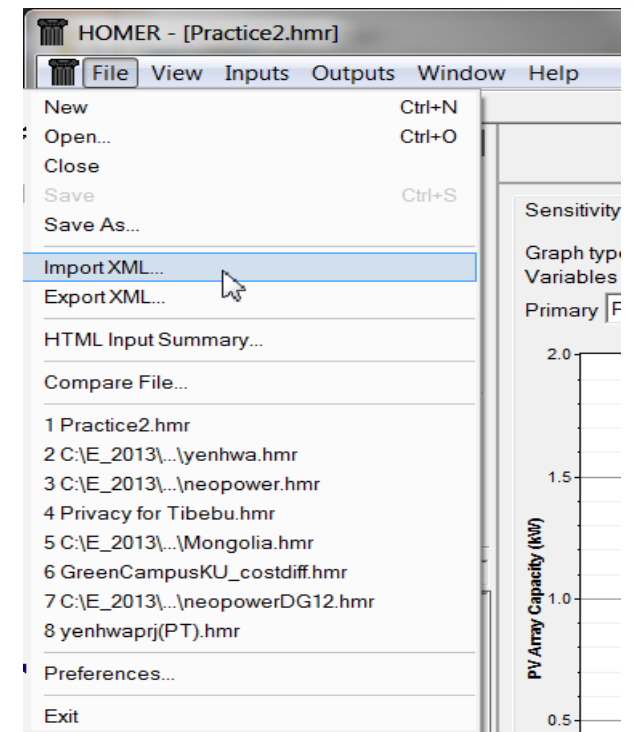
⊞ File>”Import XLM”

⊞ Wind Resources are automatically filled

⊞ Solar Resources are automatically filled

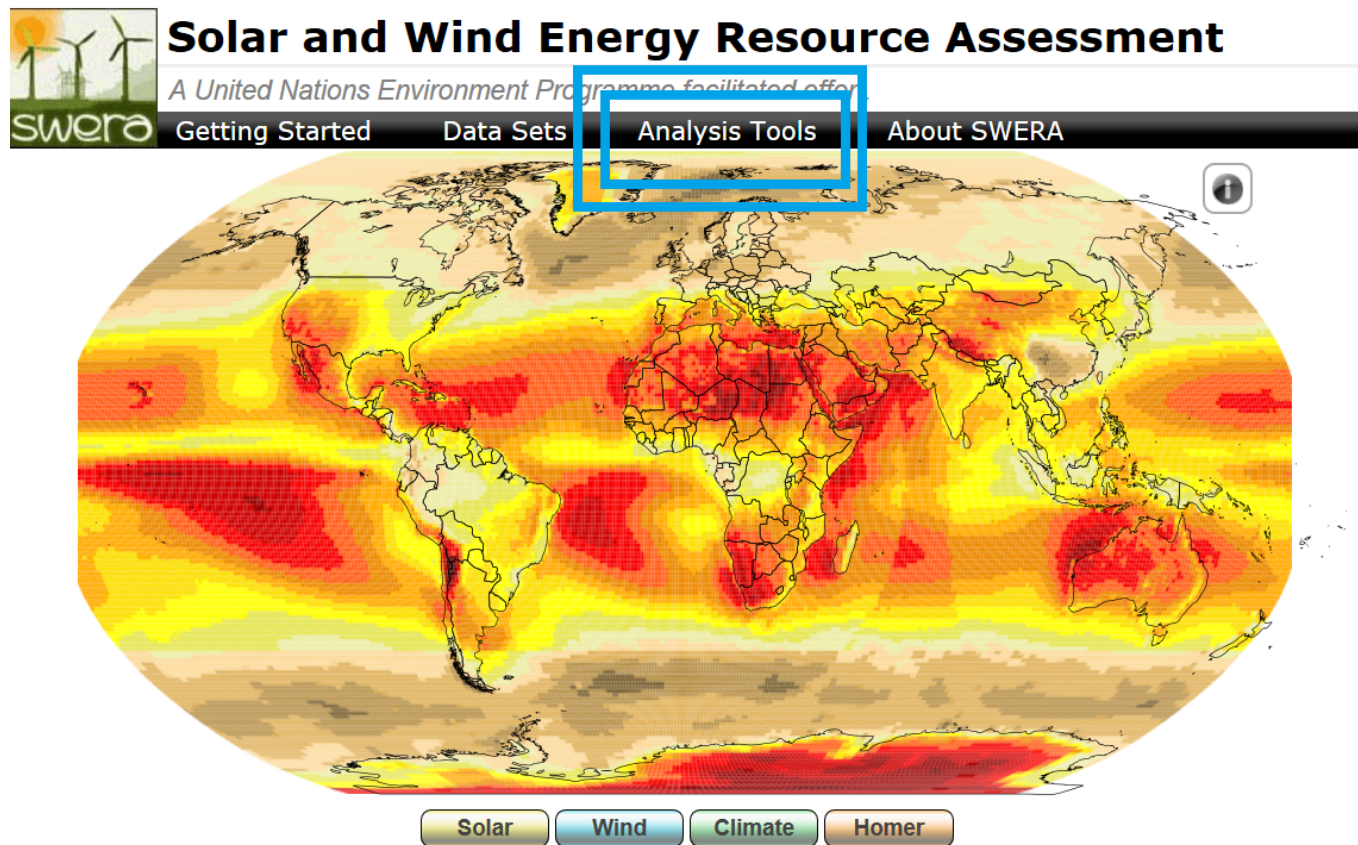
⊞ Lat N, Long E → marking error

⊞ But kWh/m² is kept the same.



If SWERA Does **not** connect with Homer

⌘ 1. From SWERA, click **Analysis Tools**



The screenshot displays the SWERA website header and a world map. The header includes the SWERA logo (wind turbines and sun) and the text "Solar and Wind Energy Resource Assessment". Below this, a navigation bar contains the following links: "Getting Started", "Data Sets", "Analysis Tools", and "About SWERA". The "Analysis Tools" link is highlighted with a blue rectangular box. Below the navigation bar is a world map showing energy resource potential with a color scale from yellow to red. At the bottom of the map, there are four buttons: "Solar", "Wind", "Climate", and "Homer".

If SWERA Does not connect with Homer

2. Then Click **OpenCarto**.



The screenshot shows the OpenEI website header with navigation links for Information, Data, and Apps. Below the header is a banner for the Solar and Wind Energy Resource Assessment (SWERA) Analysis Tools, powered by OpenEI. A navigation bar below the banner includes links for Getting Started, Data Sets, Analysis Tools, and About SWERA. The OpenCarto link is highlighted with a red box.

OpenCarto houses the SWERA web based GIS application and provides the tools and data to support a variety of user communities in both small and large project planning, feasibility assessment, policy making, and decision support. The interface is designed to support collaboration across industries, geography, and research domains by providing interoperability between a wide range of data types and data sources. All of the data accessible through the SWERA application can be made available as web services based on spatial data standards and the application itself can display and explore data from any standards based spatial data service provider. This support for interoperability allows data from a wide range of providers including government, industry, and academia to be seamlessly integrated into one interface for analysis, querying, and exploration.

Because the OpenCarto framework was developed to support multiple independent applications each application has an intuitive, self-contained interface that provides users with a focused portal specific to their needs. This is expressed in the SWERA web based GIS where the potential to provide users with a very large catalog of data does not present data overload in the interface, an identified issue related to many data catalogues.

HOMER

HOMER is used for designing and analyzing hybrid power systems, which contain a mix of conventional generators, cogeneration, wind turbines, solar photovoltaics, hydropower, batteries, fuel cells, hydropower, biomass and other inputs.

If SWERA Does not connect with Homer

- ⌘ Select one of Irradiance dataset
- ⌘ Move your cursor to the city (of your site)
- ⌘ Then click it
- ⌘ The data appears in a pop-up window
- ⌘ Use the data for manually putting the solar/wind resource information
- ⌘ See the next pages for Solar and Wind data

If SWERA Does not connect with Homer

Browser address bar: <https://maps.nrel.gov/swera/#/?aL=qoNlp8%255Bv%255D%3Dt%26qoNI>

Page title: NREL SWERA (beta release)

Navigation: Home, Print, Feedback

Map controls: Change Base Map, Search, Zoom in (+), Zoom out (-), Full screen (⌕)

Left sidebar: Select and Query Data, Run Analysis

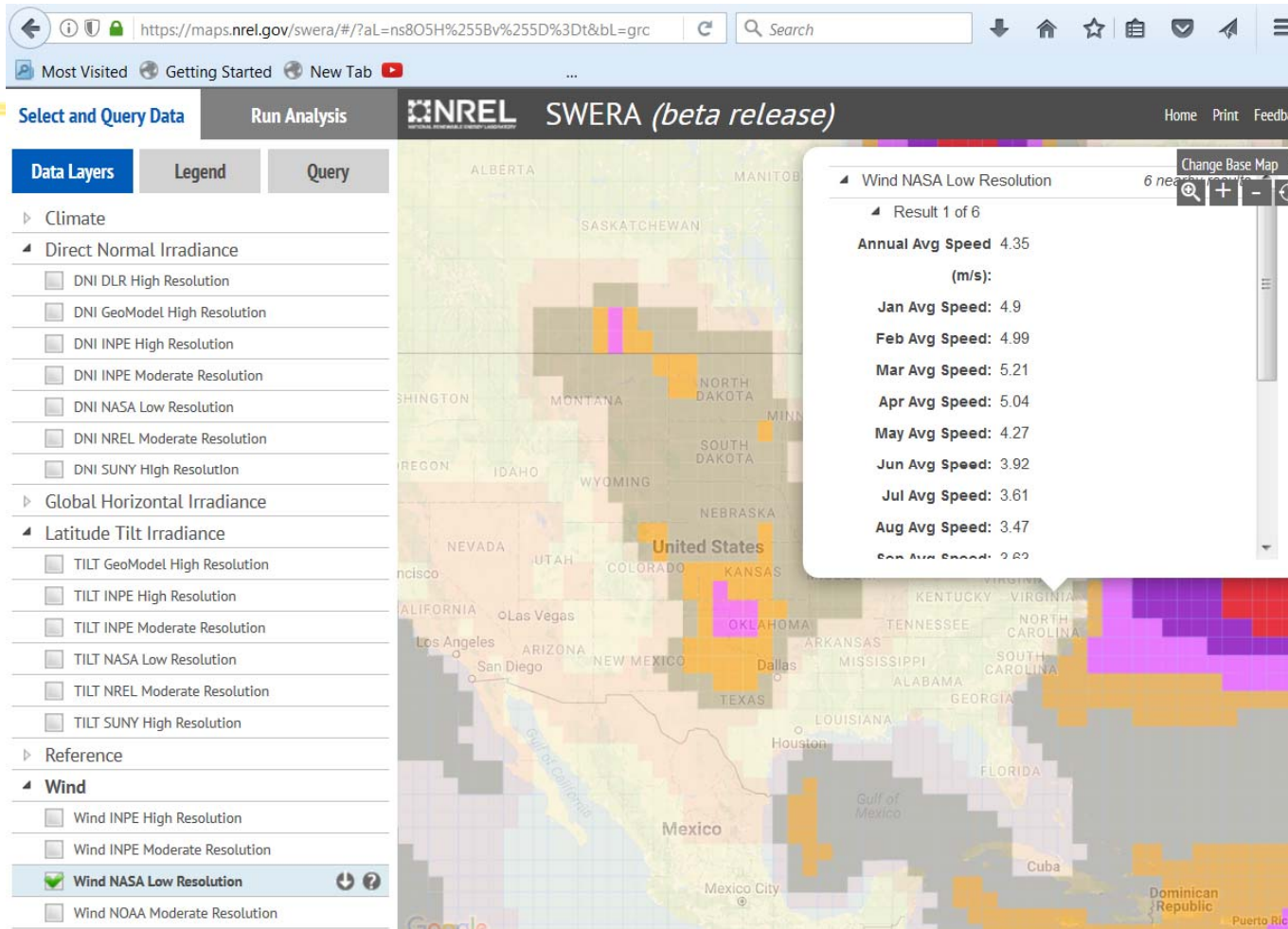
Left sidebar - Data Layers:

- Climate
 - Direct Normal Irradiance
 - DNI DLR High Resolution
 - DNI GeoModel High Resolution
 - DNI INPE High Resolution
 - DNI INPE Moderate Resolution
 - DNI NASA Low Resolution
 - DNI NREL Moderate Resolution
 - DNI SUNY High Resolution
 - Global Horizontal Irradiance
 - Latitude Tilt Irradiance
 - TILT GeoModel High Resolution
 - TILT INPE High Resolution
 - TILT INPE Moderate Resolution
 - TILT NASA Low Resolution
 - TILT NREL Moderate Resolution**
 - TILT SUNY High Resolution
 - Reference
 - Wind
 - Wind INPE High Resolution
 - Wind INPE Moderate Resolution
 - Wind NASA Low Resolution
 - Wind NOAA Moderate Resolution

Map data (from pop-up):

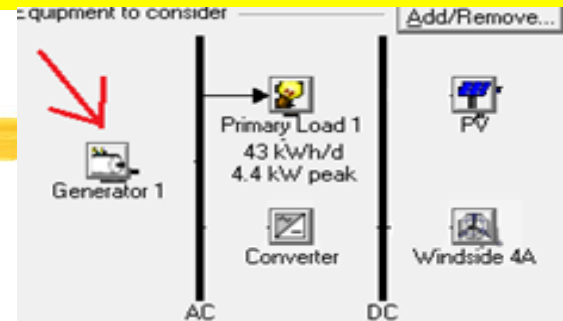
Category	Value
Annual Avg TILT	5.11 (kWh/m sq. per day)
Jan Avg TILT	3.99
Feb Avg TILT	4.48
Mar Avg TILT	5.49
Apr Avg TILT	5.85
May Avg TILT	5.76
Jun Avg TILT	6.01
Jul Avg TILT	5.69
Aug Avg TILT	5.45
Sep Avg TILT	5.4

If SWERA Does not connect with Homer



Generator Information

- ⌘ Now arrow appears from AC bus to load
- ⌘ Click “Generator”
- ⌘ Size: 5.0 kW
- ⌘ Capital: \$2000
- ⌘ Replacement: \$2000
- ⌘ O&M: \$0.02/hr
- ⌘ Sizes to consider: 0, 2.5kW, 5.0kW
- ⌘ Minimum load capacity: 30%



Generator Inputs

File Edit Help

Choose a fuel, and enter at least one size, capital cost and operation and maintenance (O&M) value in the Costs table. Note that the capital cost includes installation costs, and that the O&M cost is expressed in dollars per operating hour. Enter a nonzero heat recovery ratio if heat will be recovered from this generator to serve thermal load. As it searches for the optimal system, HOMER will consider each generator size in the Sizes to Consider table.

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

Cost | Fuel | Schedule | Emissions

Costs			
Size (kW)	Capital (\$)	Replacement (\$)	O&M (\$/hr)
5.000	2000	2000	0.020

Sizes to consider	
Size (kW)	
0.000	
2.500	
5.000	

Properties

Description: Generator 1 Type: AC DC

Abbreviation: Label

Lifetime (operating hours): 15000

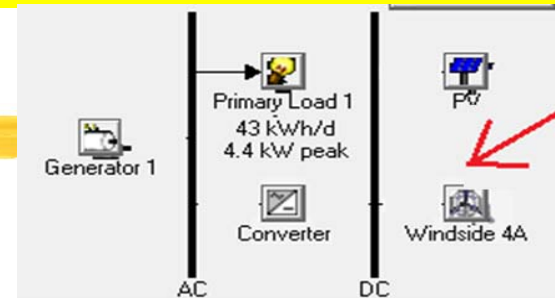
Minimum load ratio (%): 30

Cost Curve

Help Cancel OK

Wind Turbine Information

- ⌘ Click Wind Turbine 1
- ⌘ Quantity: 1
- ⌘ Capital: \$30000
- ⌘ Replacement: \$25000
- ⌘ O&M: \$500/yr
- ⌘ Sizes to consider (Qty): 0, 1, 2, and 3



Wind Turbine Inputs

File Edit Help

Choose a wind turbine type and enter at least one quantity and capital cost value in the Costs table. Include the cost of the tower, controller, wiring, installation, and labor. As it searches for the optimal system, HOMER considers each quantity in the Sizes to Consider table. Hold the pointer over an element or click Help for more information.

Turbine type: Windside 4A Details... New... Delete

Turbine properties

Abbreviation: WS-4A (used for column headings)
 Rated power: 1.2 kW DC
 Manufacturer:
 Website: www.windside.com

Costs

Quantity	Capital (\$)	Replacement (\$)	O&M (\$/yr)
1	30000	25000	500

Sizes to consider

Quantity
0
1
2

Other

Lifetime (yrs) 15 {}
 Hub height (m) 25 {}

Power Curve

Cost Curve

Help Cancel OK

Wind Resources (Unless already done in slide #6)

- ⌘ Click Wind Resources Button
- ⌘ **Location of your choice**
 - ☑ Your small store
 - ☑ Your side of street lights
 - ☑ Your (future) vacation home
- ⌘ Find **Latitude and Longitude**
- ⌘ Find Wind Speed [m/s] using **SWERA** or **WINDFINDER**
- ⌘ Type in the speed



Wind Resource Inputs

File Edit Help

HOMER uses wind resource inputs to calculate the wind turbine power each hour of the year. Enter the average wind speed for each month. For calculations, HOMER uses scaled data: baseline data scaled up or down to the scaled annual average value. The advanced parameters allow you to control how HOMER generates the 8760 hourly values from the 12 monthly values in the table.

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

Data source: Enter monthly averages Import time series data file

Baseline data

Month	Wind Speed (m/s)
January	0.000
February	0.000
March	0.000
April	0.000
May	0.000
June	0.000
July	0.000
August	0.000
September	0.000
October	0.000
November	0.000
December	0.000

Annual average: 0.000

Scaled annual average (m/s) { }

Wind Resource

Other parameters

Altitude (m above sea level)
 Anemometer height (m)

Advanced parameters

Weibull k
 Autocorrelation factor
 Diurnal pattern strength
 Hour of peak windspeed

PV Information



- ⌘ Click “PV”
- ⌘ Size: 2kW
- ⌘ Capital: \$7000
- ⌘ Replacement: \$7000
- ⌘ O&M: \$0/yr
- ⌘ Sizes to consider: 0, 2kW, 4kW
- ⌘

PV Inputs

File Edit Help

Enter at least one size and capital cost value in the Costs table. Include all costs associated with the PV (photovoltaic) system, including modules, mounting hardware, and installation. As it searches for the optimal system, HOMER considers each PV array capacity in the Sizes to Consider table.

Note that by default, HOMER sets the slope value equal to the latitude from the Solar Resource Inputs window.

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

Costs

Size (kW)	Capital (\$)	Replacement (\$)	O&M (\$/yr)
2.000	7000	7000	0

Sizes to consider

Size (kW)
0.000
2.000
4.000

Cost Curve

Properties

Output current AC DC

Lifetime (years)

Derating factor (%)

Slope (degrees)

Azimuth (degrees W of S)

Ground reflectance (%)

Advanced

Tracking system

Consider effect of temperature

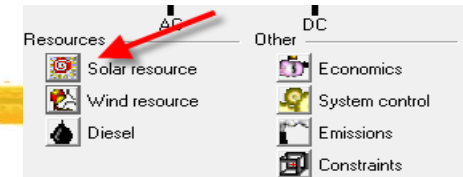
Temperature coeff. of power (%/°C)

Nominal operating cell temp. (°C)

Efficiency at std. test conditions (%)

Solar Resources Information (Unless already done in slide #6)

⌘ Type in the solar radiation data obtained from **SWERA**



Solar Resource Inputs

File Edit Help

HOMER uses the solar resource inputs to calculate the PV array power for each hour of the year. Enter the latitude, and either an average daily radiation value or an average clearness index for each month. HOMER uses the latitude value to calculate the average daily radiation from the clearness index and vice-versa. Hold the pointer over an element or click Help for more information.

Location

Latitude: North South
 Longitude: East West
 Time zone: (GMT) Iceland, UK, Ireland, West Africa

Data source: Enter monthly averages Import time series data file

Baseline data

Month	Clearness Index	Daily Radiation (kWh/m ² /d)
January	0.280	2.820
February	0.355	3.690
March	0.427	4.490
April	0.529	5.400
May	0.577	5.570
June	0.536	4.990
July	0.442	4.170
August	0.423	4.190
September	0.382	3.950
October	0.343	3.550
November	0.273	2.760
December	0.257	2.550

Average: 0.401 4.011

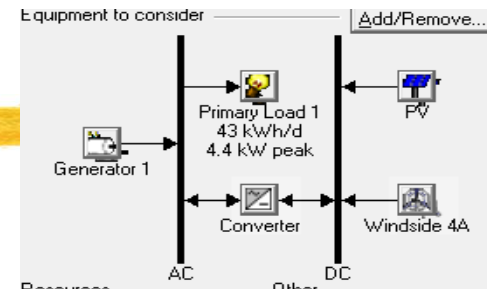
Scaled annual average (kWh/m²/d)

Global Horizontal Radiation

Plot... Export...
 Help Cancel OK

Converter Information

- ⌘ Converter (DC→ AC)
- ⌘ Size: 1kW
- ⌘ Capital: \$800
- ⌘ O&M: \$0
- ⌘ Sizes to consider: 0, 1, 2 kW



Converter Inputs

File Edit Help

A converter is required for systems in which DC components serve an AC load or vice-versa. A converter can be an inverter (DC to AC), rectifier (AC to DC), or both.

Enter at least one size and capital cost value in the Costs table. Include all costs associated with the converter, such as hardware and labor. As it searches for the optimal system, HOMER considers each converter capacity in the Sizes to Consider table. Note that all references to converter size or capacity refer to inverter capacity.

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

Size (kW)	Capital (\$)	Replacement (\$)	O&M (\$/yr)
1.000	800	800	0

Size (kW) { } { } { }

Sizes to consider

Size (kW)
0.000
1.000
2.000

Cost Curve

Cost (\$)

Size (kW)

— Capital — Replacement

Inverter inputs

Lifetime (years) 15 { }

Efficiency (%) 90 { }

Inverter can operate simultaneously with an AC generator

Rectifier inputs

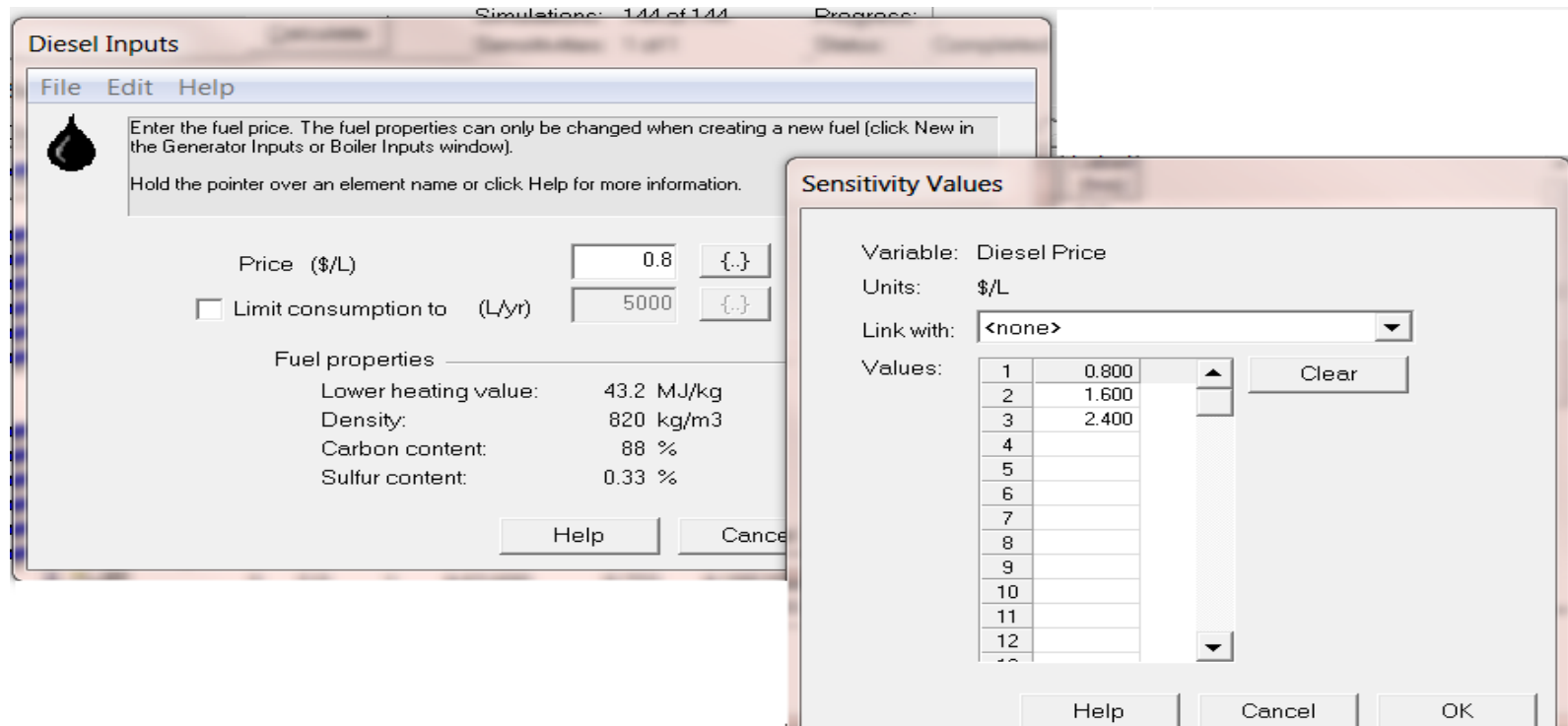
Capacity relative to inverter (%) 100 { }

Efficiency (%) 85 { }

Help Cancel OK

Diesel Resources Information

- ⌘ Fuel Price: \$0.8/L
- ⌘ Sensitivity Price: \$0.8, 1.6, 2.4/L



Emission Information

- ⌘ CO2: \$3/ton
- ⌘ CO: \$0
- ⌘ CO2: Sensitivity Data {0, 1, 2, 3}

The screenshot displays the HOMER software interface. On the left, a sidebar contains a tree view with categories: PV, Windside 4A, DC, Economics, System control, Emissions (highlighted with a red circle), and Constraints. The main window is titled 'Emissions Inputs' and contains a menu bar (File, Edit, Help) and a help text area. Below this, there are two sections: 'Emissions penalties' and 'Limits on emissions'. The 'Emissions penalties' section has a table with columns for pollutant name, cost (\$/t), and a help icon. The 'Limits on emissions' section has a table with columns for pollutant name, limit (kg/yr), and a help icon. A 'Sensitivity Values' dialog box is open in the foreground, showing 'Variable: CO2 Emissions Penalty', 'Units: \$/t', and a 'Link with:' dropdown set to '<none>'. The 'Values:' section contains a table with 12 rows and 2 columns. A red circle highlights the help icon for Carbon dioxide (\$/t) in the 'Emissions penalties' table, with a red arrow pointing to the 'Sensitivity Values' dialog box.

Emissions penalties		
Carbon dioxide (\$/t)	3	{}
Carbon monoxide (\$/t)	0	{}
Unburned hydrocarbons (\$/t)	0	{}
Particulate matter (\$/t)	0	{}
Sulfur dioxide (\$/t)	3	{}
Nitrogen oxides (\$/t)	3	{}

Limits on emissions		
<input type="checkbox"/> Carbon dioxide (kg/yr)	0	{}
<input type="checkbox"/> Carbon monoxide (kg/yr)	0	{}
<input type="checkbox"/> Unburned hydrocarbons (kg/yr)	0	{}
<input type="checkbox"/> Particulate matter (kg/yr)	0	{}
<input type="checkbox"/> Sulfur dioxide (kg/yr)	0	{}

Sensitivity Values	
1	3.00
2	2.00
3	1.00
4	0.00
5	
6	
7	
8	
9	
10	
11	
12	

Simulation

Optimization Result

Sensitivity Results | Optimization Results

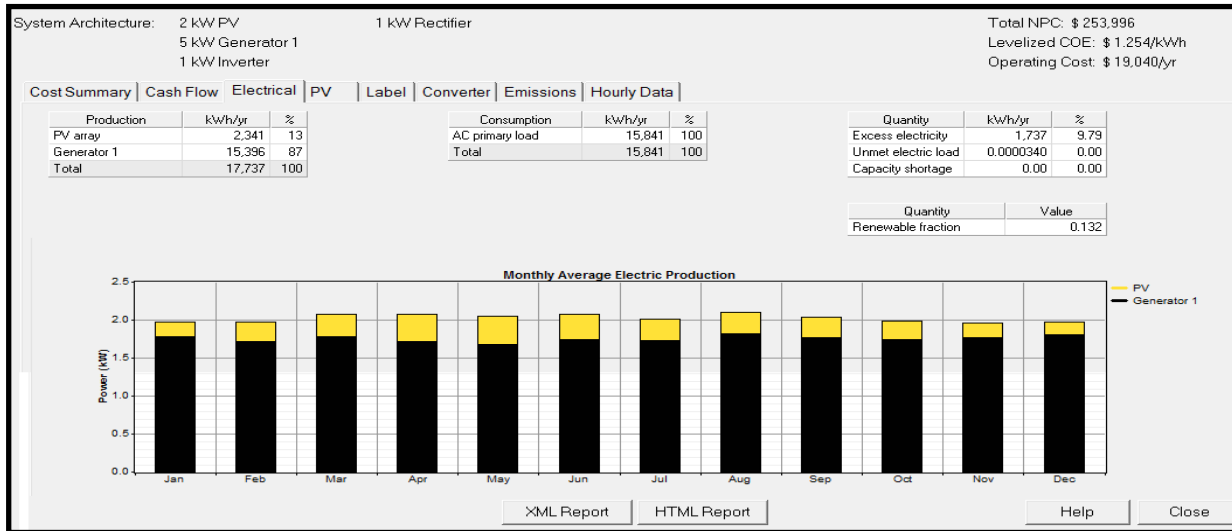
Sensitivity variables

Diesel Price (\$/L) 2.4

Double click on a system below for simulation results. Categoriz Ov

	PV (kW)	WS-...	Label (kW)	Conv. (kW)	Initial Capital	Operating Cost (\$/yr)	Total NPC	COE (\$/kWh)	Ren. Frac.	Diesel (L)	Label (hrs)
	2		5.0	1	\$ 10,600	19,040	\$ 253,996	1.254	0.13	7,350	8,754
			5.0		\$ 2,000	19,788	\$ 254,962	1.259	0.00	7,711	8,759
	2		5.0	2	\$ 12,200	19,056	\$ 255,798	1.263	0.13	7,339	8,754
	4		5.0	2	\$ 19,200	18,596	\$ 256,925	1.269	0.24	7,123	8,658
	4		5.0	1	\$ 17,600	18,836	\$ 258,390	1.276	0.24	7,235	8,743
	6		5.0	2	\$ 26,200	18,239	\$ 259,355	1.281	0.33	6,952	8,517
	6		5.0	1	\$ 24,600	18,781	\$ 264,687	1.307	0.32	7,181	8,735
	2	1	5.0	1	\$ 40,600	20,107	\$ 297,631	1.470	0.15	7,310	8,753
	2	1	5.0	2	\$ 42,200	20,116	\$ 299,351	1.478	0.15	7,296	8,753
		1	5.0	1	\$ 33,600	20,856	\$ 300,205	1.482	0.02	7,653	8,759
	4	1	5.0	2	\$ 49,200	19,673	\$ 300,683	1.485	0.26	7,086	8,652
	4	1	5.0	1	\$ 47,600	19,927	\$ 302,339	1.493	0.25	7,204	8,742
		1	5.0	2	\$ 35,200	20,898	\$ 302,348	1.493	0.02	7,653	8,759
	6	1	5.0	2	\$ 56,200	19,333	\$ 303,343	1.498	0.34	6,923	8,514
	6	1	5.0	1	\$ 54,600	19,885	\$ 308,802	1.525	0.33	7,156	8,735

Electrical

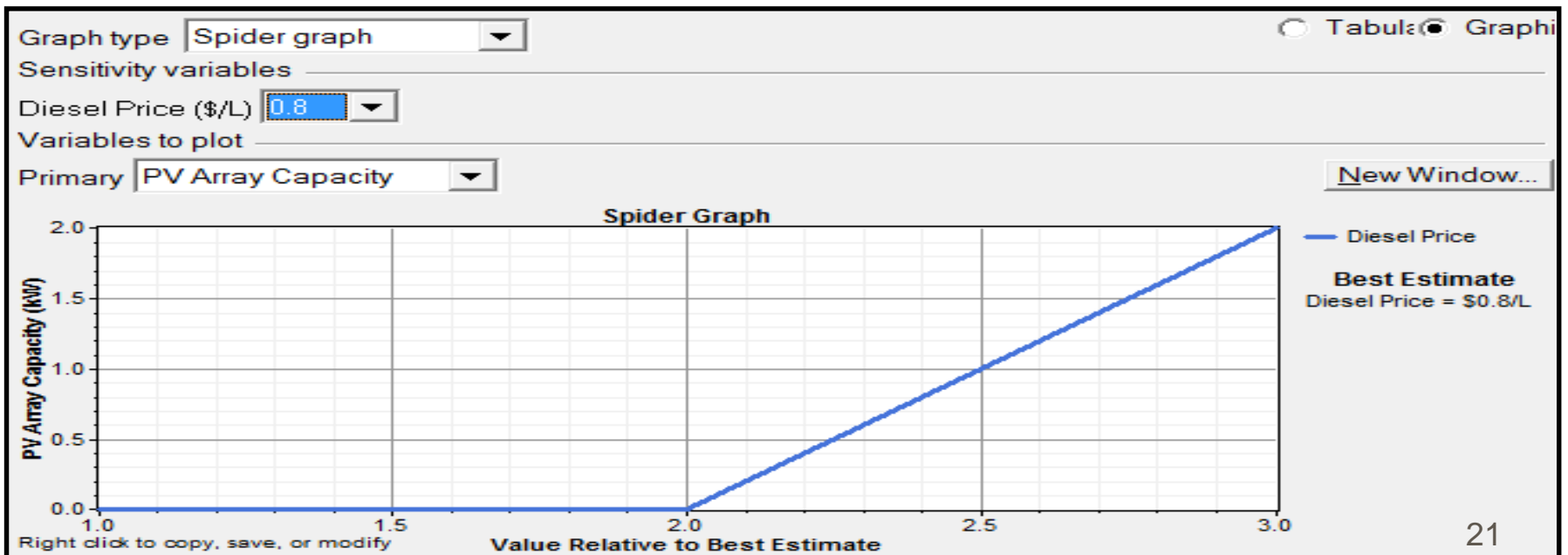


Sensitivity Analysis

Double click on a system below for optimization results

Tabular Graphical
 Export... Details...

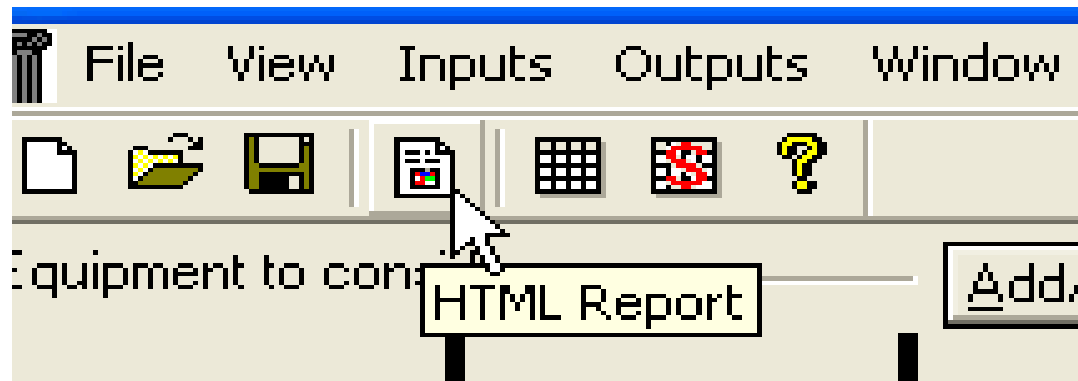
Diesel (\$/L)		PV (kW)	WS-...	Label (kW)	Conv. (kW)	Initial Capital	Operating Cost (\$/yr)	Total NPC	COE (\$/kW...)	Ren. Frac.	Diesel (L)	Label (hrs)
0.800				5.0		\$ 2,000	7,451	\$ 97,252	0.480	0.00	7,711	8,7...
1.600				5.0		\$ 2,000	13,620	\$ 176,107	0.870	0.00	7,711	8,7...
2.400		2		5.0	1	\$ 10,600	19,040	\$ 253,996	1.254	0.13	7,350	8,7...



HOMER – Input Summary Report

⌘ HOMER Produces An Input Summary Report:

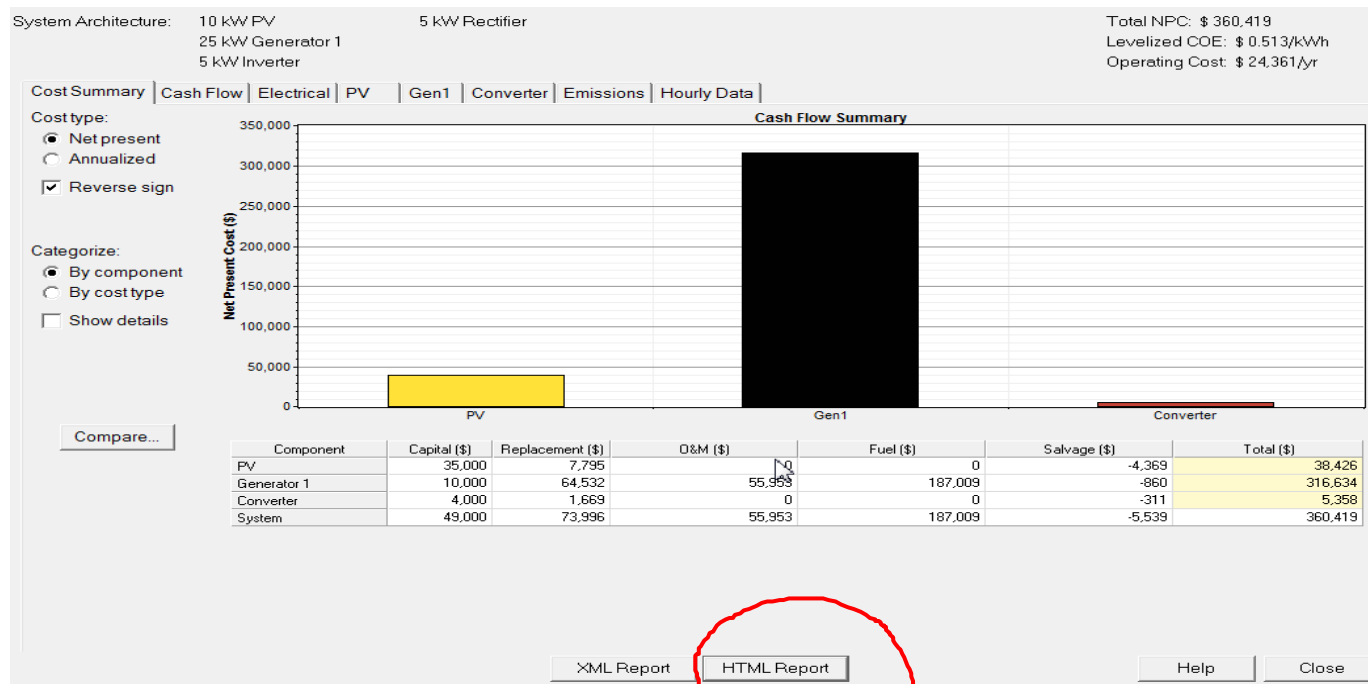
- ☑ Click HTML Input Summary from the File menu, or click the toolbar button:
- ☑ HOMER will create an HTML-format report summarizing all the relevant inputs, and display it in a browser. From the browser, you can save or print the report, or copy it to the clipboard so that you can paste it into a word processor or spreadsheet program.



HOMER – Simulation Result Report

⌘ HOMER Produces A Report Summarizing The Simulation Results

📄 Just click the HTML Report button in the Simulation Results window:



What is this message for?



PV search space may be insufficient.



Converter search space may be insufficient.



Completed in 3:17.

⌘ Those messages mean that:

- ☒ you need to expand your search space to be sure you have found the cheapest system configuration.
- ☒ If the total net present cost varied with the PV size in this way, and you simulated 10, 20, 30, and 40 kW sizes, HOMER would notice that the optimal number of turbines is 40 kW, but since that was as far as you let it look, it would give you the "search space may be insufficient" warning because 50 kW may be better yet.
- ☒ It doesn't know that until you let it try 50kW and 60kW.
- ☒ If you expanded the search space, HOMER would no longer give you that warning, since the price started to go up so you have probably identified the true least-cost point.

Lab 10 -- Report

- ⌘ Follow the steps for creating a new Homer file for your own load at your own location
- ⌘ Submit your report:
 - ☑ Description of your load and your application and location
 - ☑ Homer reports (input, electrical, etc)
 - ☑ Conclusion