EECE326 Fundamentals of Energy Lab 9: HOMER



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Lab 9 - HOMER

- 1. "ExampleProject.hmr"
- 2. Open the Example Project File: ExampleProject.hmr
- ₭ 3. Click the Primary Load



4. Exit out of HOMER – We have things to do





Find the Site [Location]

- **K** Latitude and Longitude
- 🔀 Your dorm room
- 🔀 Your home
- Hour favorite place



HOMER: Open the file again



Equipment

 Click Wind Turbine
 From the drop down list click through the wind turbines and look at the power curve. Try to find a Wind Turbine that would best maximize





Equipment

Add/Remove..

Windside 4A

- **T**

Elifetime, De-rating factor, slope, No-tracking

Primary Load 1 151 kWh/d 25 kW peak

> ◆ 📶 🗲 Converter

Equipment to consider

Generator

#Click PV

Enter at least one size and capita hardware, and installation. As it s Note that by default, HOMER set Hold the pointer over an element	al cost value in the Costs earches for the optimal s is the slope value equal t or click Help for more inf	table. Include all costs assoc ystem, HOMER considers eac o the latitude from the Solar F ormation.	siated with the PV (photovoltaid ch PV array capacity in the Size tesource Inputs window.	c) system, including modules, mounting ss to Consider table.
 Costs Size (kW) Capital (\$) Replacemen 10.000 35000 25	nt (\$) 0&M (\$/yr) 5000 0	Sizes to	0 consider 100 0.000 \$0 15.000 \$6 20.000 \$6	Cost Curve
Caperties Caper	{}	↔	25.000 § 40 20 0	Capital — Replacement
Lifetime (years) Derating factor (%)	20 {} 90 {}	Advanced Tracking sys	tem No Tracking	•
Slope (degrees)	45 {} 0 {}	Consider	effect of temperature ature coeff. of power (%/*	C) -0.5 {}
Ground reflectance (%)	20 {}	Nominal Efficience	operating cell temp. (°C) y at std. test conditions (?	47 {} 6) 13 {}
			Help	Cancel OK

Solar Resources: Enter your Lat/Long and click "Get Data via Internet"

Wind Resources: Try https://www.weather-and-climate.com for monthly wind speed data for selected cities



Equipment

Click Converter icon

∺5kW \$4,000

 \sim

Equipment to consider

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 (\$) 0&M (\$/yr) 5.000 4000 0	Sizes to consider
Inverter inputs	0 5 10 15 Size (kW)
Lifetime (years)	- Capital - Replacement
Efficiency (%) 90 {}	
🔽 Inverter can operate simultaneously with an AC generator	
Rectifier inputs	
Capacity relative to inverter (%) 100 {}	
Efficiency (%) 85 {}	
	Help Cancel OK



Other Information

#Constraints

 Operating reserve 10%
 Capacity shortage 0%

onstrai	nstraints												
ile [tdit] Help													
F	Constraints are conditions that systems must meet to be feasible. Infeasible systems do not ap reserve provides a margin to account for intra-hour deviation from the hourly average of the lo margin for each hour based on the operating reserve inputs.												
	Hold the pointer over an element name or click Help for more information.												
	Maximum annual capacity shortage (%)			{}									
	Minimum renewable fraction (%)		0	{}									
	Operating reserve												
	As percent of load												
	Hourly load (%)		10	{}									
	Annual peak load (%)		0	{}									
	As percent of renewable output												
	Solar power output (%)		25	{}									
	Wind power output (%)	į	50	{}									
	Primary energy savings												
	Minimum primary energy savings (%)		10	{}									
	Reference electrical efficiency (%)		33	-{}									
	Reference thermal efficiency (%)		75	{}									

Emission Input – Emission Penalty

🗅 🚅 🔲 🗟 🖩 🐯	8	
Equipment to consider	Add/Remove	Calculate Simulations: 0 of 144 Progress: Sensitivities: 0 of 3 Status:
Generator 1	← Ţ PV Windside 4A	Sensitivity Results Optimization Results Graph type Line graph Variables to plot
AC [Resources Other -		Emissions Inputs
Solar resource		File Edit Help
Diesel	Emissions	Costs resulting from emissions penalties appear as 'Other O&M cost'. HOMER discards systems that exceed the specified emissions limits.
Ø	Constraints	Hold the pointer over an element or click Help for more information.
Warnings		Emissions penalties
Your license has expired.		Carbon dioxide (\$/t)
Author Charles		Carbon monoxide (\$/t) U {}
Notes		Unburned hydrocarbons (\$/t) U {}
Get 1		Particulate matter (\$/t)
		Sulfur dioxide (\$/t)
		Nitrogen oxides (\$/t) 0 {}

Analysis of the System

1. Click "Calculate" to start the analysis



Click Overall: view all possible combinations

				<u>C</u> alcul	ate	Simula Sensit	ations: 400 ti∨ities: 1 of	of 400 1	Progre: Status:	ss: Co	mpleted i	n3seco	onds.
Se	Sensitivity Results Optimization Results												
Do	Double click on a system below for simulation results.												
7	*20	PV (kW)	WS	Gen1 (kW)	Conv. (kW)	Initial Capital	Operating Cost (\$/yr)	Total NPC	COE [\$/kW	Ren. Frac.	Diesel (L)	Gen1 (hrs)	
	é,			25		\$ 10,000	24,713	\$ 325,917	0.464	0.00	38,374	8,7	=
1	උං 🗹	10		25	5	\$ 49,000	24,361	\$ 360,419	0.513	0.12	36,573	8,7	
1	ථ සි	10		25	10	\$ 53,000	24,450	\$ 365,558	0.521	0.12	36,530	8,7	
197	ථා 🗹	10		25	15	\$ 57,000	24,557	\$ 370,916	0.528	0.12	36,530	8,7	
	爋氹ً⊠		1	25	5	\$ 44,000	25,964	\$ 375,906	0.535	0.00	38,325	8,7	
1	<u>à</u> 🗹	15		25	5	\$ 66,500	24,268	\$ 376,727	0.536	0.17	36,038	8,7	
	ත්			30		\$ 12,000	28,814	\$ 380,341	0.542	0.00	43,945	8,7	
4	<u>à 2</u>	15		25	10	\$ 70,500	24,279	\$ 380,866	0.542	0.17	35,813	8,7	
	爋氹ً⊠		1	25	10	\$48,000	26,070	\$ 381,265	0.543	0.00	38,325	8,7	

Analysis of the System

Click "Categorized"

_					Calcul	ate	Simula Sensit	ations: 400 tivities: 1 of 1	of 400 1	Progre: Status:	ss: Co	ompleted i	n 3 seco	nds. <mark>e</mark>
	Sensi	tivity R	esults	Optir	nizatio	n Resu	ults							
	Doubl	e click	onas	ystem	below	for sim	ulation resul	ts.	Categoria	Ove	ral <u>t</u>	xport	Detai	ls
	7 *	<u>7</u>	PV (kW)	WS	Gen1 (kW)	Conv. (kW)	Initial Capital	Operating Cost (\$/yr)	Total NPC	COE (\$/kW	Ren. Frac.	Diesel (L)	Gen1 (hrs)	
	-	è èr	10		25 25	5	\$ 10,000	24,713 24,361	\$ 325,917	0.464	0.00	38,374	8,7	_
	 本 		10	1 1	25 25	5 5	\$ 44,000 \$ 79,000	25,964 25,508	\$ 375,906 \$ 405,075	0.535	0.00	38,325 36,531	8,7 8,7	

How back to "Overall", and choose any system of interest by clicking/ double clicking

				<u>C</u> alcula	ate	Simula	ations: 400 tivities: 1 of	of 400 1	Progres Status:	ss: 🗌	ompleted i	n 3 cori	- onds
Sens	itivity R	esults	Optin	mizatio	n Resu	Its	uviues. 1 Oi	· .			Simpleteur	11 3 5 6 6	Jinda
Doub	le click	onas	ystem	below	for sim	ulation resul	ts.	Categoriz	Ove	ral	<u>E</u> xport	Deta	ails
7 *	do Z	PV (kW)	WS	Gen1 (kW)	Conv. (kW)	Initial Capital	Operating Cost (\$/yr)	Total NPC	COE (\$/kW	Ren. Frac.	Diesel (L)	Gen1 (hrs)	
	ර			25		\$ 10,000	24,713	\$ 325,917	0.464	0.00	38,374	8,7	:
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4	<u>d</u>	10		25	10	\$ 53,000	24,450	\$ 365,558	0.521	0.12	36,530	8,7	
7	ੴ ⊠	10		25	15	\$ 57,000	24,557	\$ 370,916	0.528	0.12	36,530	8,7	
🍂	ເ 🖒 🗹		1	25	5	\$ 44,000	25,964	\$ 375,906	0.535	0.00	38,325	8,7	
4	ථා 🗹	15		25	5	\$ 66,500	24,268	\$ 376,727	0.536	0.17	36,038	8,7	
	N			~~~		+ + + + + + + + + + + + + + + + + + + +	00.014	+	0.540	0.00	10.015	~ ~	

Sensitivity Analysis

- ₭ Click Wind resource
- Click "Edit Sensitivity Values" >> Do so for Load, Solar, and Diesel
- Wind Resources

Primary Load

Solar Resources

•

ОK



Sensitivity Analysis

Save and Calculate \mathbb{H} New we see the tab for "Sensitivity Results"

Sensitivity Results Optimization Results

Graph type Optimal system type 💌

Sensitivity variables

Variables to plot

16

Simulations: 400 of 400 Progress: <u>C</u>alculate Sensitivities: 4 of 4 Status: Sensitivity Results Optimization Results Sensitivity variables Wind Speed (m/s) 9.5 -○ Tabulε Graphi Primary Load 1 (kWh/d) x-axis 👻 Global Solar (kWh/m²/d) y-axis 👻 Wind Speed (m/s) 3.26 💌 Diesel Price (\$/L) 0.4 💌 New Window. Superimposed PV Production -Optimal System Type System Types Gen1 0 PV/Gen1 Superimposed PV Production (kWh/yr)



Input Summary Report generation

- **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.



Input summary Report - Example

PV



HOMER Input Summary

File name: Practice2.hmr File version: 2.68 beta Author: Charles

AC Load: Primary Load 1

Data source:	Synthetic
Daily noise:	15%
Hourly noise:	20%
Scaled annual average:	43.4 kWh/d
Scaled peak load:	4.36 kW
Load factor:	0.414



	Size (kW)	Capital (\$)		Replace	ement (\$)	O&M (\$/yr)			
	2.000	7	,000,		7,000	0			
	Sizes to con	sider:	0, 2,	4, 6 kW					
Lifetime:			20 y	20 yr					
	Derating factor:		80%						
	Tracking sys	stem:	No T	Fracking					
	Slope:		0 de	0 deg					
	Azimuth:		0 deg						
	Ground refle	ectance	: 20%						





System Report generation

HOMER Produces A Report Summarizing The Simulation Results Just click the HTML Report button in the Simulation Results window:



Example System Report

System Report - Practice2.hmr

Sensitivity case

Diesel Price: 2.4 \$/L

System architecture

P∨ Array	2	ΚW
Generator 1	5	κw
Inverter	1	кw
Rectifier	1	k₩

Cost summary

Total net present cost	\$ 254,738
Levelized cost of energy	\$ 1.258/kWh
Operating cost	\$ 19,098/yr

Net Present Costs

Component	Capital	Replacement	M8O	Fuel	Salvage	Total
component	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)
PV	7,000	2,183	0	0	-1,223	7,959
Generator 1	2,000	14,340	2,238	225,506	-191	243,893
Converter	1,600	668	0	0	-124	2,143
Other	0	0	742	0	0	742
System	10,600	17,191	2,980	225,506	-1,539	254,738



Electrical

Component	Production	Fraction
	(KWh/yr)	
P∨ array	2,341	13%
Generator 1	15,396	87%
Total	17,737	100%

Report Submission for Lab 9

Write your report describing

- Location
- 🔼 Load
- Solar Resources
- Wind Resources
- Optimum result (the Price of energy. \$/kWh)?
- Comment and Opinion
- Appendix 1: Input Summary Report from HOMER
- Appendix 2: System Report from HOMER