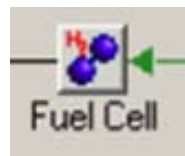
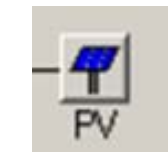
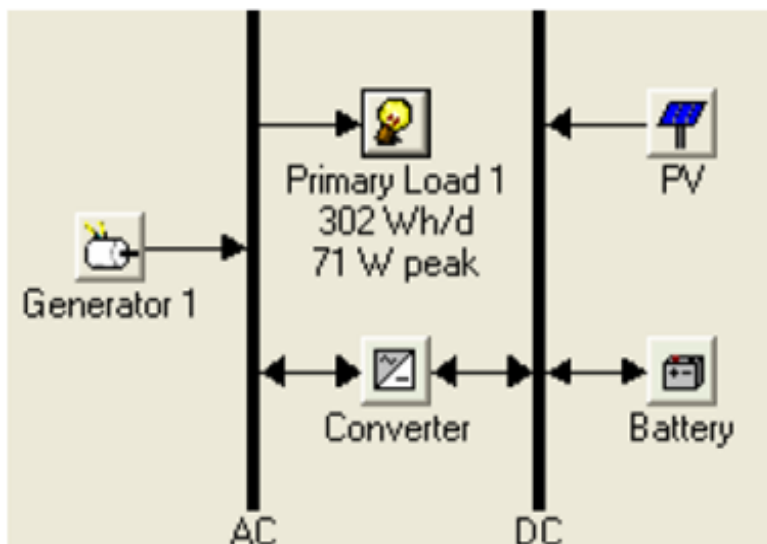


Lab 9 - Renewable Power System Modeling using HOMER

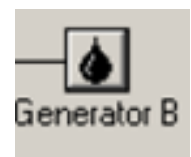
HOMER introduction

Homer (Hybrid Optimization Model for Electric Renewables)



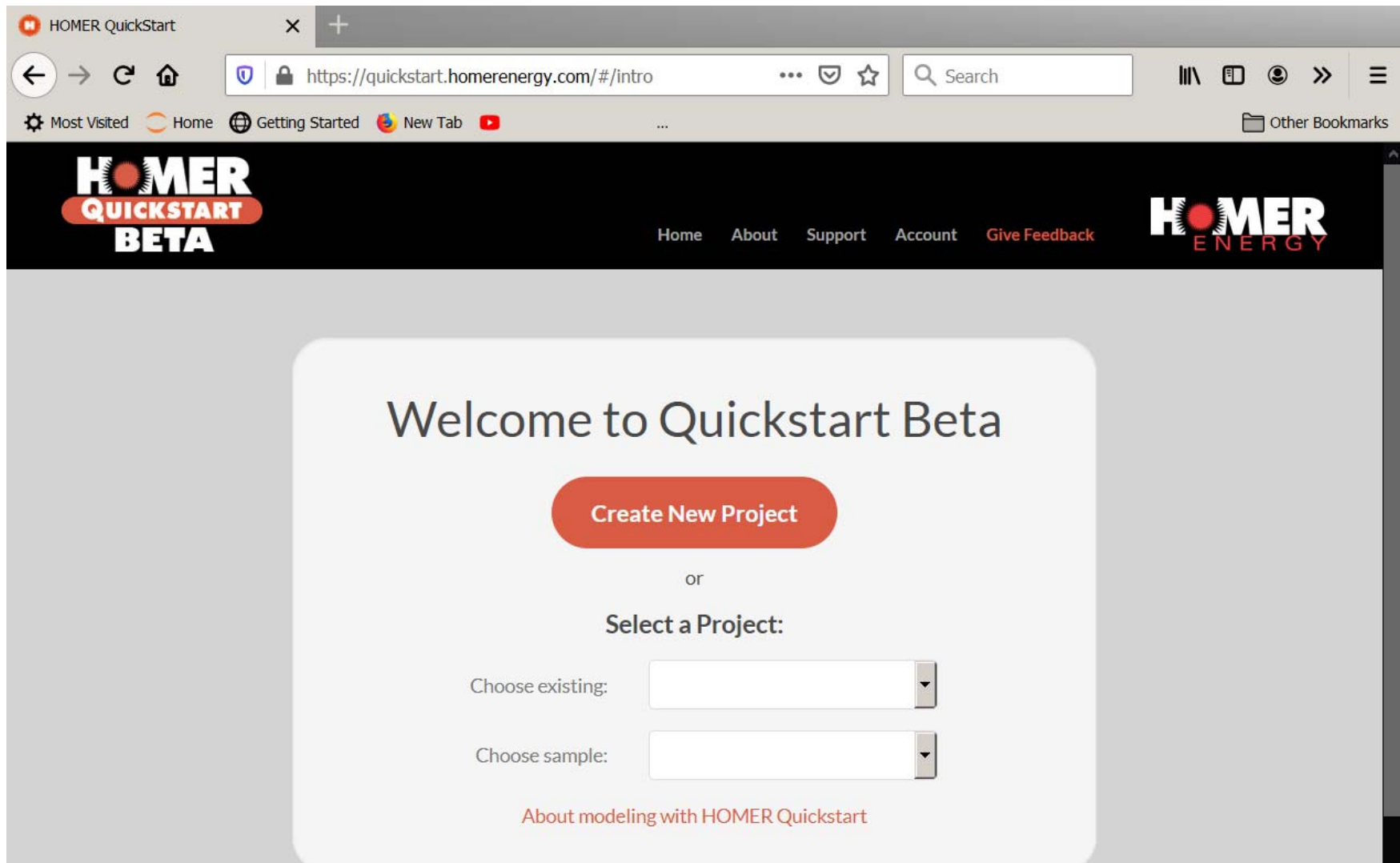
**HOMER models
micropower systems
with single or multiple
power sources:**

Photovoltaics
Wind turbines
Biomass power
Run-of-river hydro
Diesel and other
reciprocating engines
Cogeneration
Microturbines
Batteries
Grid
Fuel cells
Electrolyzers



HOMER versions/types

- HOMER Pro – purchase required
- HOMER Legacy – free but not deprecated.
- Web-Based FREE version
 - HOMER QuickStart (<https://quickstart.homer.com>)



Homer - Features

□ Simulation

- Simulate each system configuration
- Estimates the cost
- Determines the feasibility of a system design over the 8760 hours in a year, and
- Display list of systems sorted by net present **cost** (NPC)

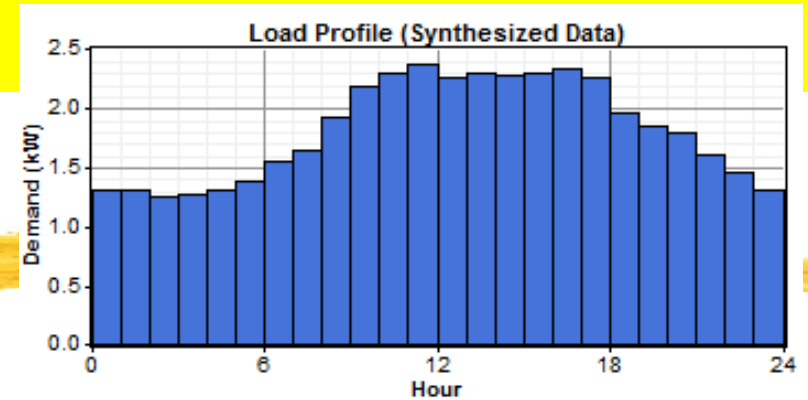
□ Cost

- Life-Cycle Cost:
 - Initial cost – purchases and installation
 - Cost of owning and O&M and replacement
- NPC: Life-cycle cost expressed as a lump sum in “today’s dollars”
- Cf. **Annualized Cost**

Inputs we need to provide

□ Load Information

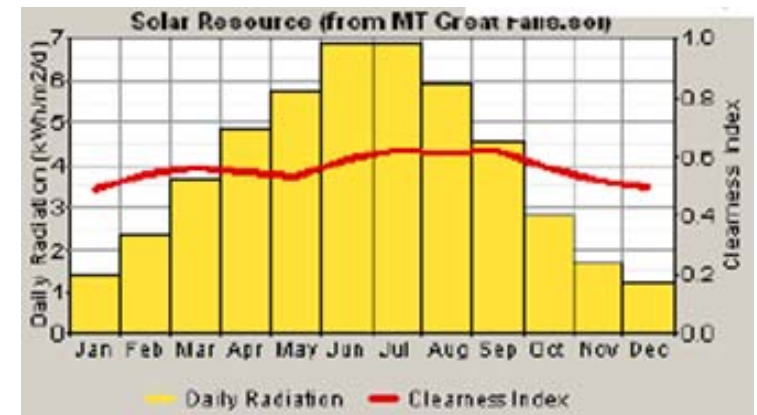
- Electrical - Hourly kW demand)
- Thermal
- Hydrogen



□ Solar Resource Data

- Monthly Average solar radiation on horizontal surface (kWh/m²/day), (\bar{I}_H)

or

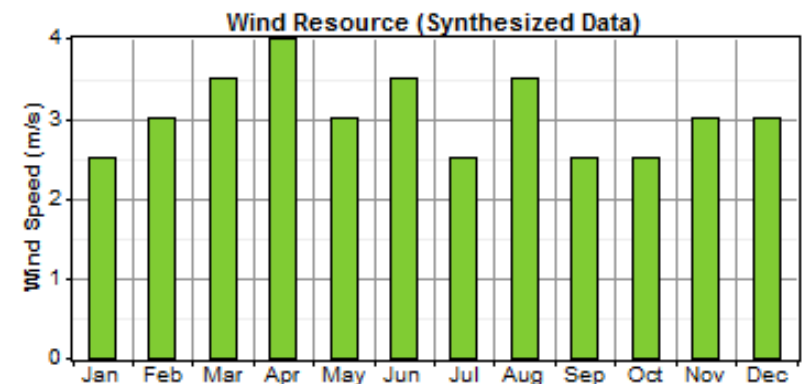


$$K_T = \frac{\bar{I}_H}{I_0}$$

Monthly average clearness index K_T

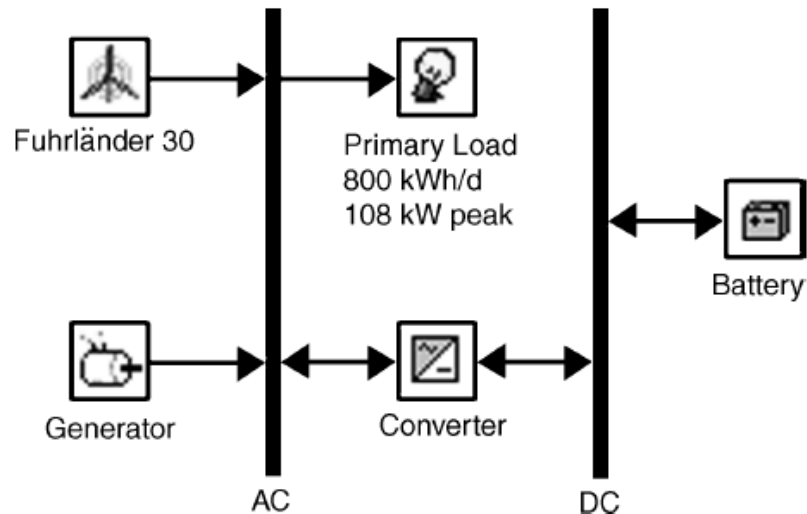
□ Wind Resource Data

- Average monthly wind speed (m/s)



Simulation Example

- Search all possible combinations



- Overall Optimization results

				FL30	Gen (kW)	Batt.	Conv. (kW)	Initial Capital	Total NPC	COE (\$/kWh)	Diesel (L)	Gen (hrs)
				1	135	64	30	\$ 216,500	\$ 849,905	0.273	75,107	4,528
					135	64	30	\$ 86,500	\$ 885,175	0.284	101,290	5,528
					135			\$ 0	\$ 996,273	0.320	132,357	8,760
				1	135			\$ 130,000	\$ 1,130,637	0.363	127,679	8,740

HOME QuickStart - Example



Step 2 of 8: *Start* > **Project** > Load > PV > Wind > Battery > Summary > Calculate



Project Information

Enter Project details:

Name

Project 2

Notes

Example Project #2

Enter Project location:

- Click on a location on the map below, or
- Enter an address or location in the Location Search field and click "Search"

Boulder, CO

Search

Latitude 38.964°, Longitude -77.000°



HOME QuickStart - Example



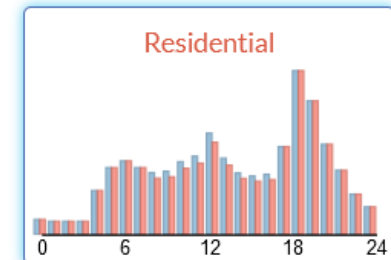
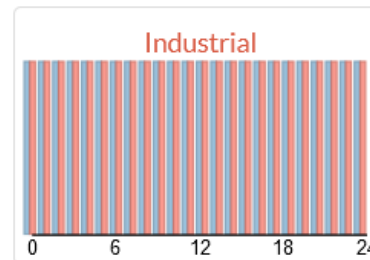
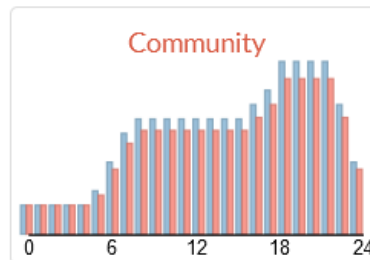
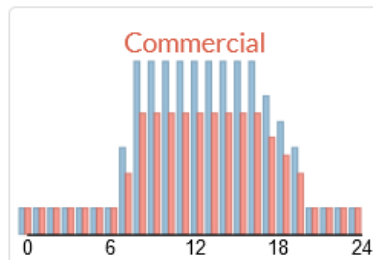
Step 3 of 8: [Start](#) > [Project](#) > [Load](#) > [PV](#) > [Wind](#) > [Battery](#) > [Summary](#) > [Calculate](#)



Electrical Load

Load Profile

Select a daily profile that describes your load:



■ weekday ■ weekend

Average Load



kWh/day

< Back

Cancel



Next >

HOME QuickStart - Example



Step 4 of 8: Start > Project > Load > **PV** > Wind > Battery > Summary > Calculate



Solar Photovoltaic (PV)

☒ Add solar PV to my system

Type:

Generic flat plate PV

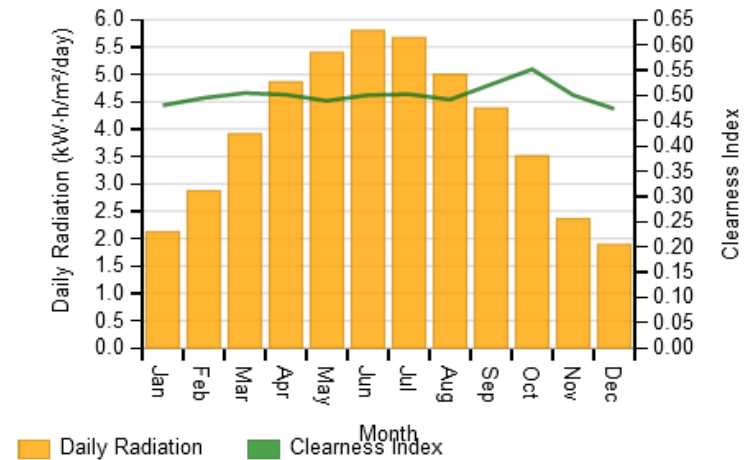
Cost:

3000



\$/kW

Global Horizontal Irradiance
at latitude 38.964°, longitude -77.000°



Annual Average 3.98 ($\text{kW}\cdot\text{h}/\text{m}^2/\text{day}$)

< Back

Cancel

LEARN
MORE

Next >

HOME QuickStart - Example

Wind Turbine

☒ Add wind turbine(s) to my system

Type:

Generic 10 kW

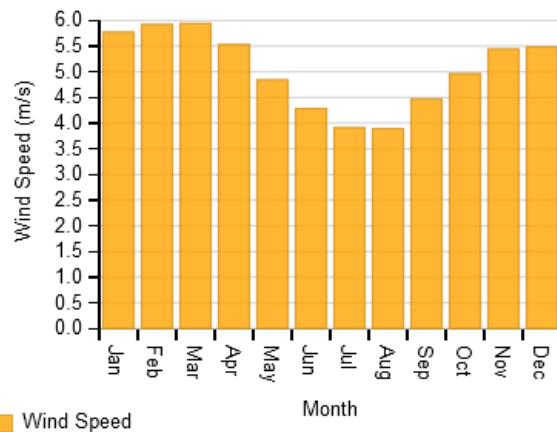
Cost:

50000

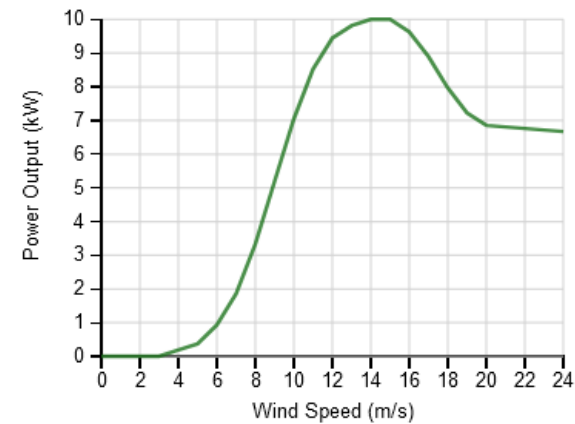
\$/wind turbine

Wind Speed

at latitude 38.964°, longitude -77.000°



Power Curve



Power Output

HOME QuickStart - Example



[Home](#) [About](#) [Support](#) [Account](#) [Give Feedback](#)



Project 2 Details

My Projects ▾

Refine Your Results

[Download HOMER File](#)

[Try HOMER Pro](#)

Here are the best results for each system category. From here, you can:

- 1) Click the Details buttons for a detailed report for each system
- 2) Add, subtract or modify your Load or Components from the [Schematic](#)
- 3) Include a Sensitivity Analysis. [?](#)

				Initial Capital...	Operating Cos...	COE	NPC (\$) ▲	Fuel	
	1			\$550	\$1,847	\$1.03	\$29,645	1,254	Details
	1		0.0	\$573	\$1,847	\$1.03	\$29,665	1,254	Details
	1	1		\$50,550	\$2,361	\$3.05	\$87,737	550	Details
	1	1	0.1	\$50,925	\$2,355	\$3.06	\$88,026	546	Details

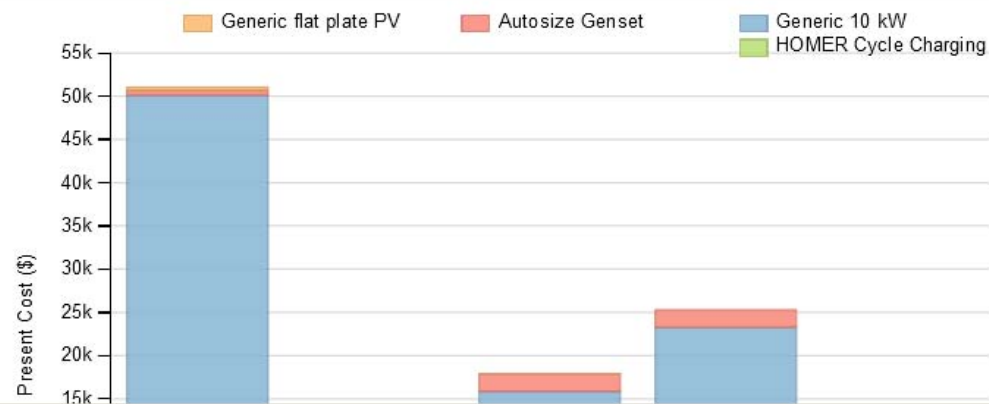
HOME QuickStart - Example

System Report

System architecture

PV	Generic flat plate PV	0	kW
Wind Turbine	Generic 10 kW	1	
Generator	Autosize Genset	1	kW
Dispatch Strategy	HOMER Cycle Charging		

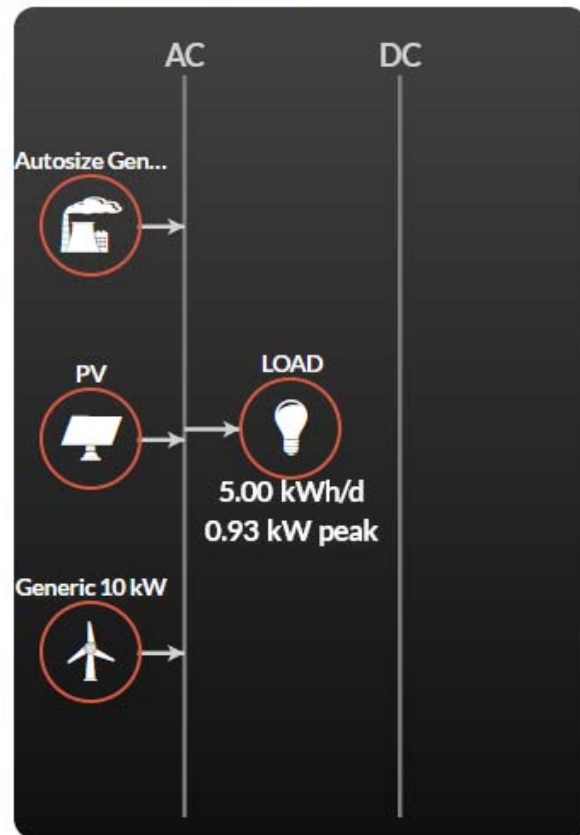
Cost summary



HOME QuickStart - Example

Schematic

Modify Load or Components



Add Components



Sensitivity

With a sensitivity analysis, the radio button you select will update the Results table and highlight the corresponding system in the OST chart.

Choose Fuel Price: ☐ 0.50 ☒ 1.00 ☐ 2.00

Choose Wind Speed: ☐ 3.00 ☒ 6.54 ☐ 8.00

Perform Sensitivity Analysis

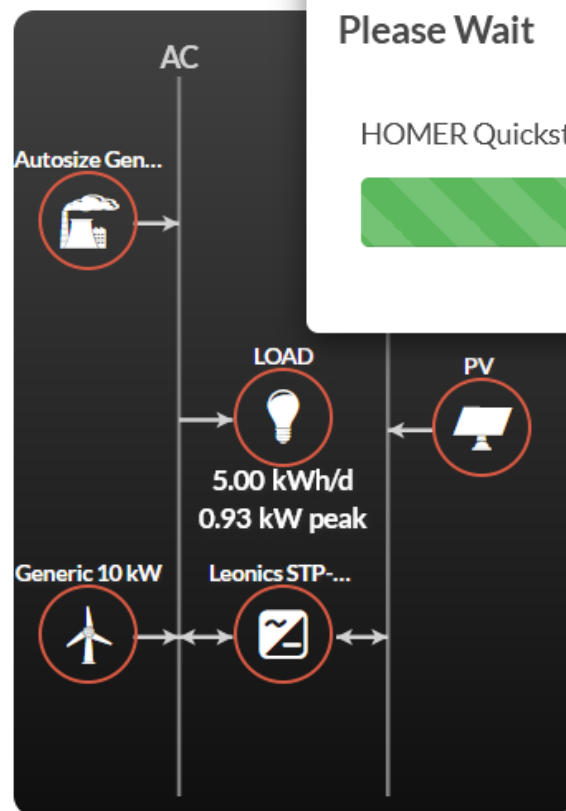
Sensitivity cases were not included initially. Click to include and calculate.

**LEARN
MORE**

HOME QuickStart - Example

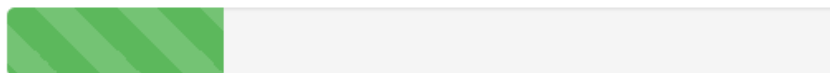
Schematic

Modify Load or Components



Please Wait

HOMER Quickstart is simulating all possible solutions



Cancel

LEARN

							Initial Capital...	Operating Cos...	COE	NPC (\$) ▲	Fuel	
	1		0.0	0.0		CC	\$562	\$1,848	\$1.03	\$29,669	1,254	Details
	1	1				CC	\$50,550	\$2,361	\$3.05	\$87,737	550	Details
	1		0.4	0.1	1	LF	\$71,944	\$1,883	\$3.53	\$101,609	952	Details
	1			0.1	1	LF	\$70,600	\$2,009	\$3.56	\$102,250	1,037	Details

Lab Report

Objective:

Familiarity with HOMER QuickStart

- 1. Choose your load types and size (kWh)
- 2. Connect/add equipment of your free choice
 - PV (as DC Load)
 - Inverter
 - Battery as storage
- 3. Run the HOMER QuickStart
- 4. Submit the Result screen (screen capture) and the “Detail” system report.