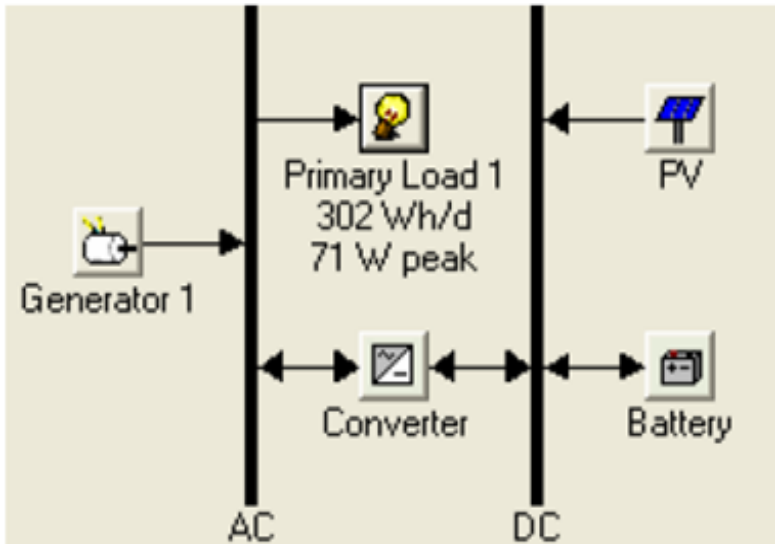
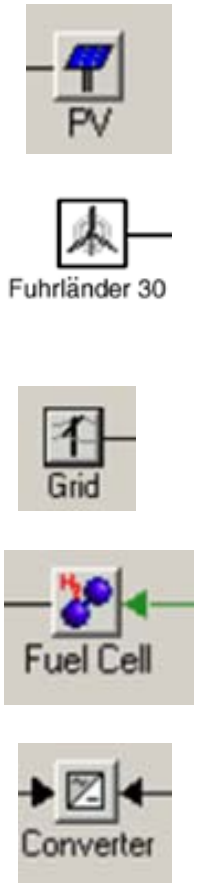
Lab 9 - Renewable Power System Modeling using HOMER

HOMER introduction

Homer (Hybrid Optimization Model for Electric Renewables)

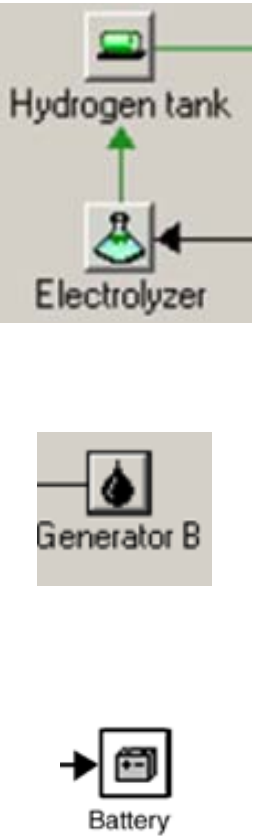
HOMER
The Micropower Optimization Model





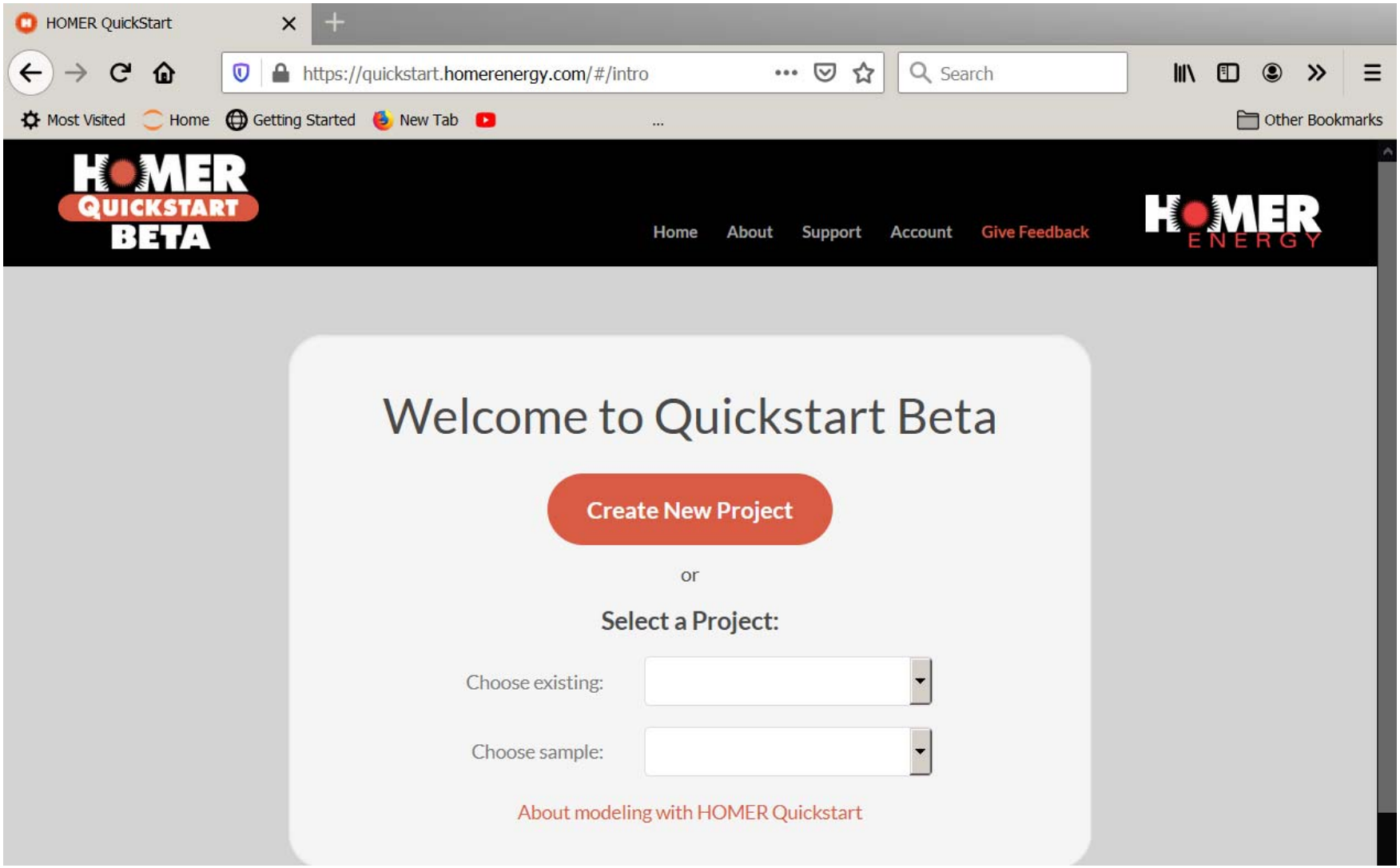
HOMER models micropower systems with single or multiple power sources:

- 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**)

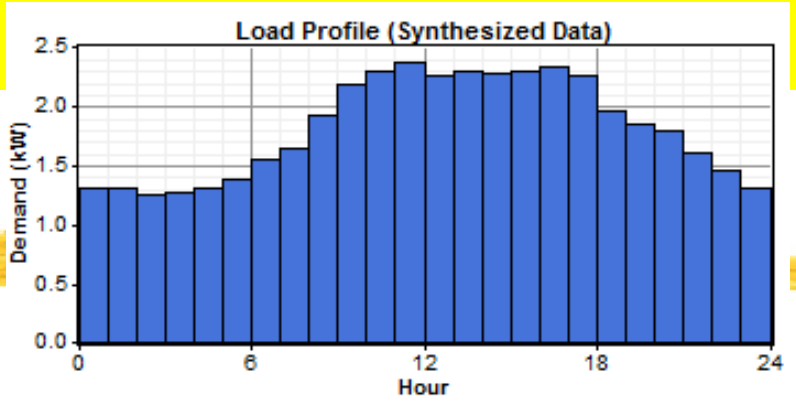


Homer - Features

- **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

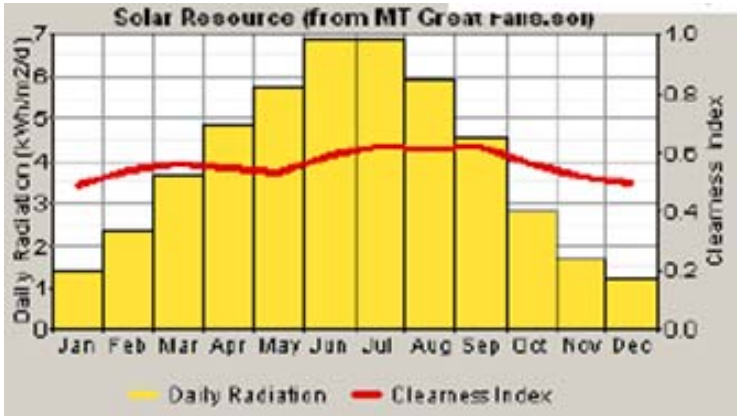
Inputs we need to provide

- **Load Information**
  - **Electrical - Hourly kW demand)**
  - Thermal
  - Hydrogen

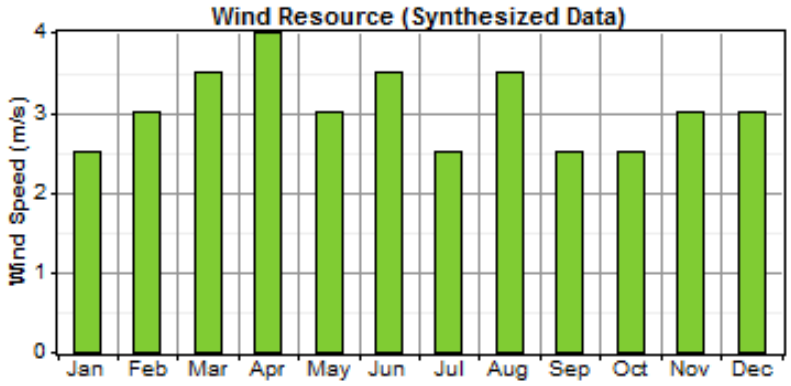


- **Solar Resource Data**
  - Monthly Average solar radiation on horizontal surface (kWh/m^2/day), **($\bar{I}_H$)**
    or
  - Monthly average clearness index K_T

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

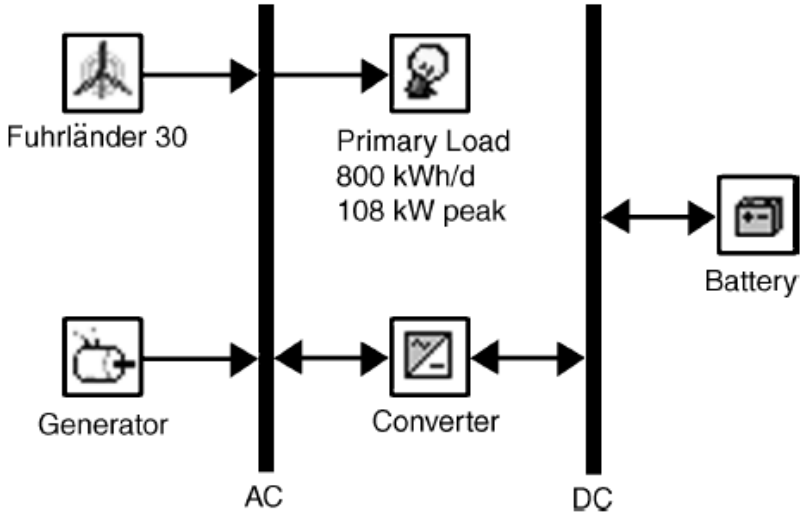


- **Wind Resource Data**
  - Average monthly wind speed (m/s)



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

HOMER QUICKSTART BETA

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

HOMER ENERGY

Project Information

Enter Project details:

Name: Project 2

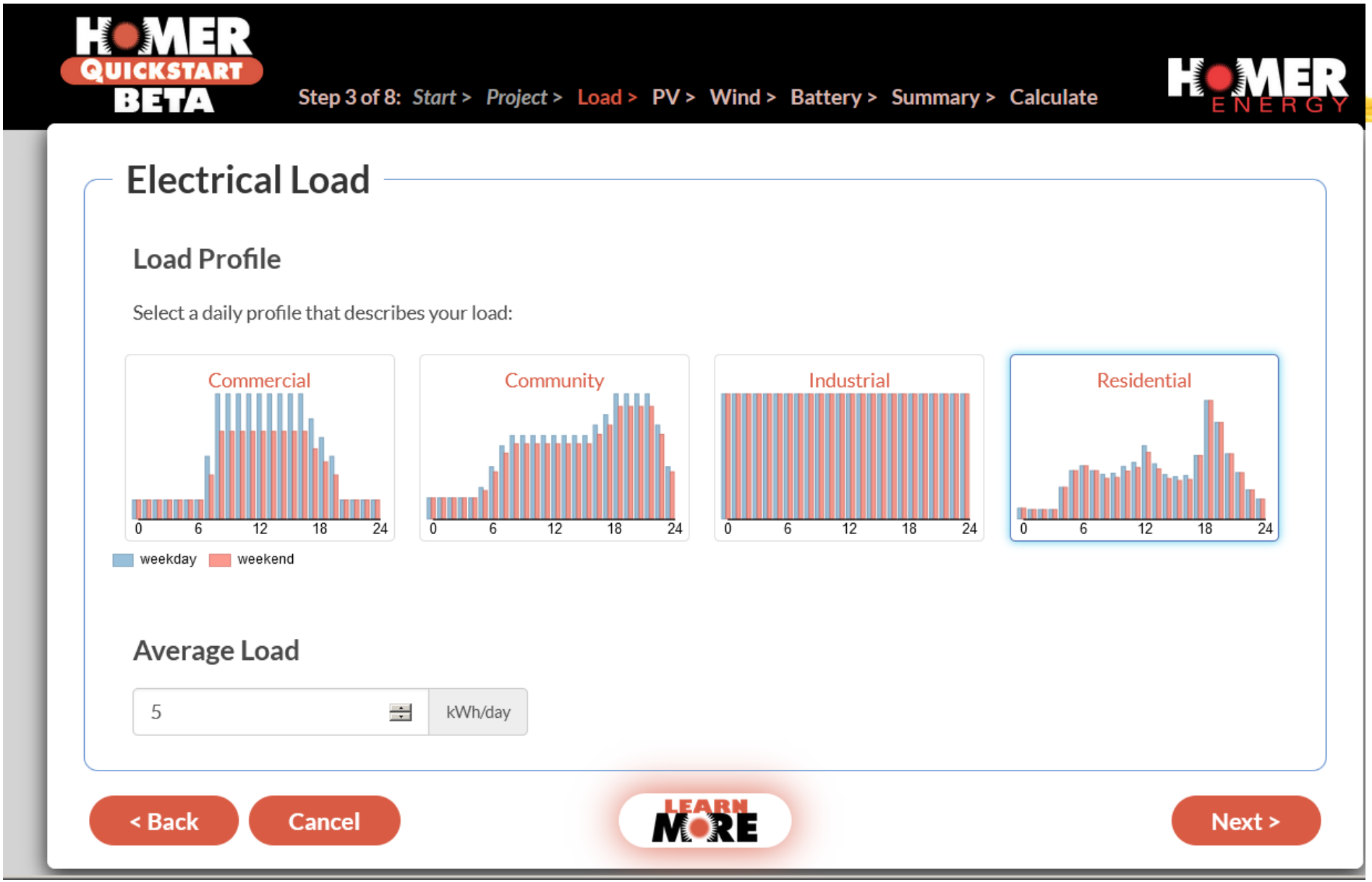
Notes: Example Project #2

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



HOME QuickStart - Example

HOMER QUICKSTART BETA

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

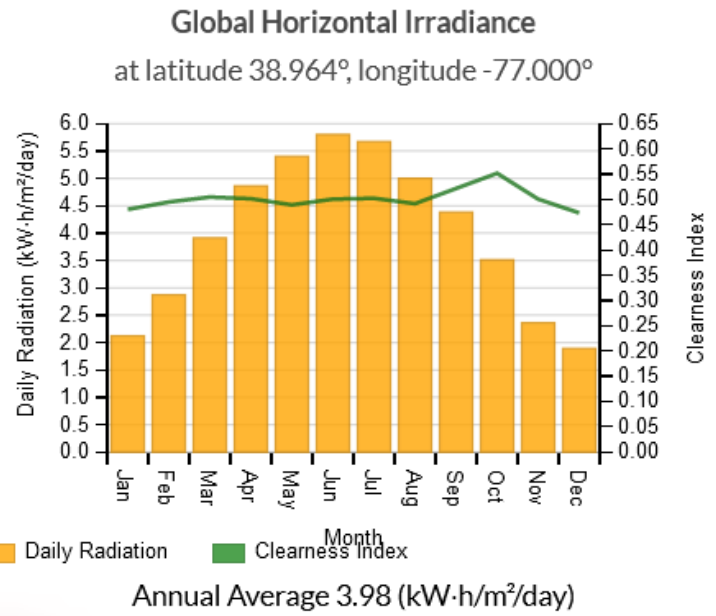
HOMER ENERGY

Solar Photovoltaic (PV)

☑ Add solar PV to my system

Type: Generic flat plate PV

Cost: 3000 $/kW



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HOME QuickStart - Example

HOMER QUICKSTART BETA

Step 5 of 8: *Start* > *Project* > *Load* > *PV* > Wind > Battery > Summary > Calculate

HOMER ENERGY

Wind Turbine

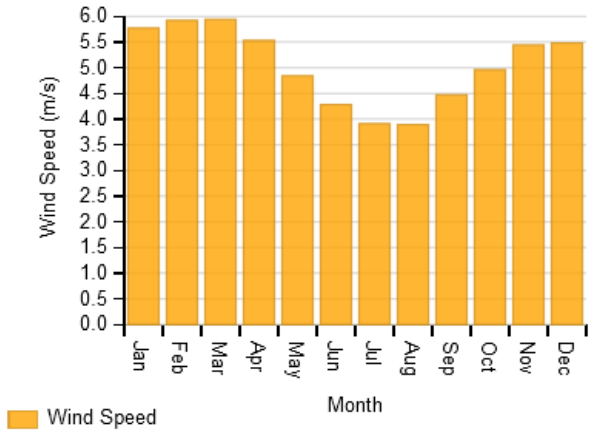
☑ Add wind turbine(s) to my system

Type: Generic 10 kW

Cost: 50000 $/wind turbine

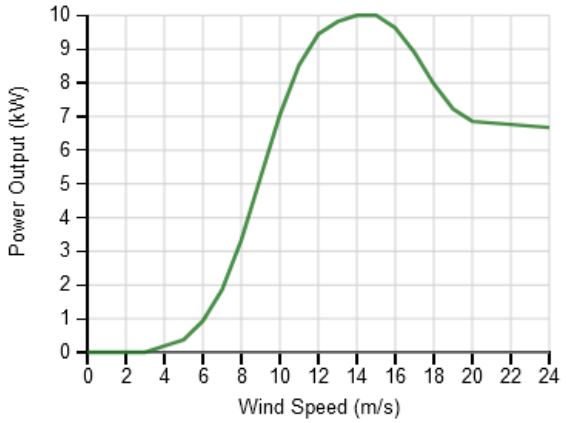
Wind Speed

at latitude 38.964°, longitude -77.000°

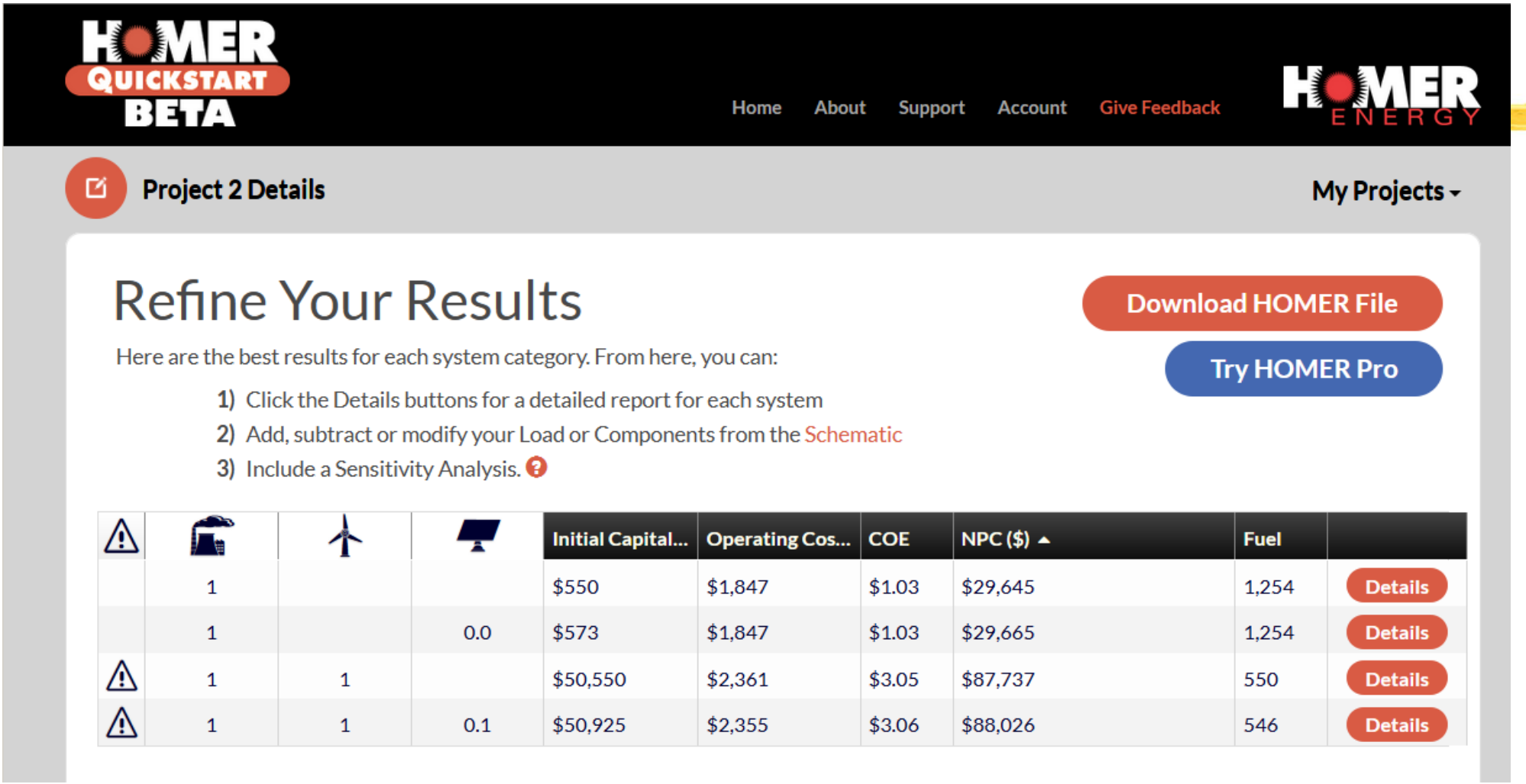


Annual Average 5.04 (m/s)

Power Curve



HOME QuickStart - Example



⚠				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

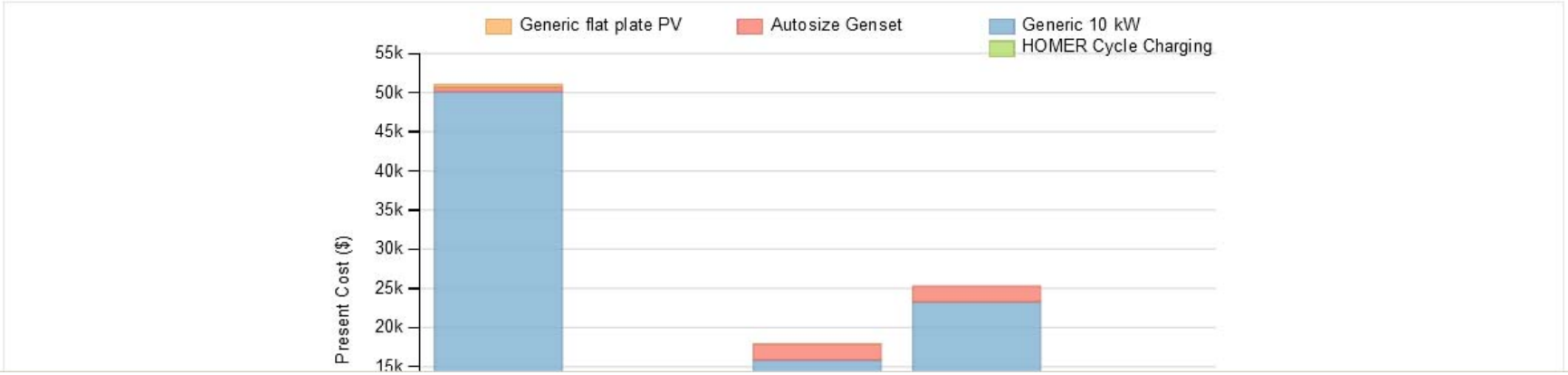
HOME QuickStart - Example

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

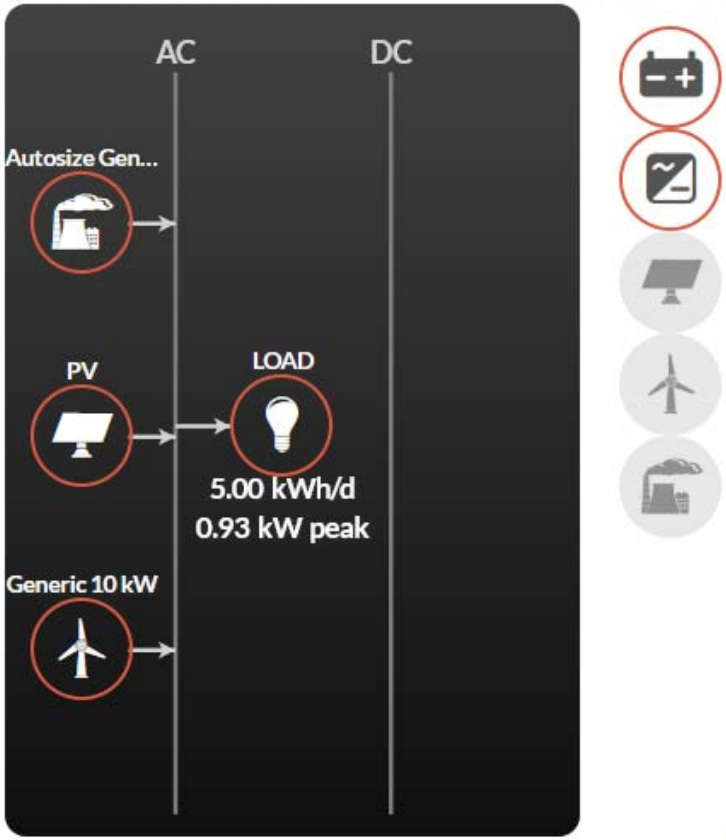


HOME QuickStart - Example

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

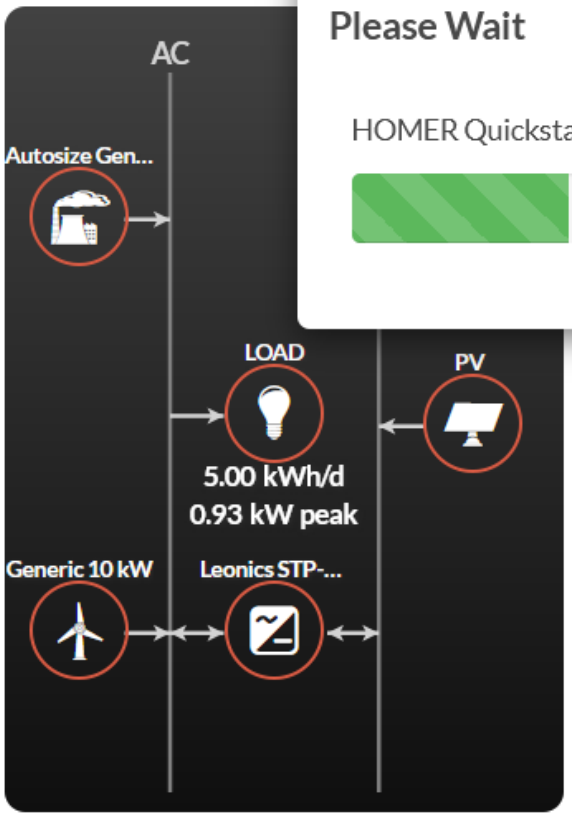
Sensitivity cases were not included initially. Click to include and calculate.

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.
- 5. Check the Lab Manual for more details