



REopt Lite Tutorial: Utility Rate Analysis

This tutorial shows how to use the [REopt Lite™ web tool](#) to perform a utility rate analysis that compares the life cycle electricity costs of available utility rates at a given site. Find additional REopt Lite [tutorials](#).

Using REopt Lite for Utility Rate Analysis

The REopt Lite web tool is most often used to identify an optimal system size for grid-connected distributed energy resources (DERs) such as solar photovoltaics (PV), wind, and/or battery storage at a site.

However, the tool can also be used to compare the life cycle costs (LCCs) of different utility rates for a specific site. When optimizing DER sizes, the tool uses the charges for the chosen utility rate, along with the site load profile, to calculate the utility costs for the business as usual (BAU) cost case where all electricity required for the electric load is purchased from the utility at the chosen utility rate.

REopt Lite uses this BAU cost case as a baseline for comparison with the value of adding DERs. The tool can be run multiple times with different utility rates, and you can compare BAU costs while ignoring any renewable energy system recommendations or even forcing the tool to give no recommendations at all.

You don't need to register or log in to a REopt Lite account to run a utility rate analysis; however, if you are logged in, your evaluations will be saved for easier access and you can create custom electric rates.

REopt Lite Inputs

If you are using REopt Lite for utility rate analysis, many of the tool's default values can be used.

Step 1: Choose Either a Financial or Resilience Focus

For a utility rate analysis, choose the financial option shown in Figure 1.

Step 1: Choose Your Focus

Do you want to optimize for financial savings or energy resilience?

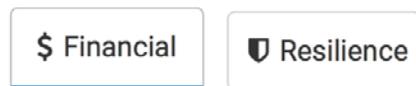


Figure 1. Choose the financial analysis button



Step 2: Enter Site Data Inputs

Start by entering your site data. Data is entered under each expandable section (Figure 2) and required inputs are marked with an asterisk. There are only a few required inputs in REopt Lite, and location and electricity rate are two of them.

Step 2: Enter Your Site Data

Enter information about your site and adjust the default values as needed to see your results.



Figure 2. REopt Lite site data inputs

Site and Utility Inputs

Begin by entering your site's location. You can enter a specific address or a city and state, but in either case the choice must be selected from the resulting dropdown menu.

Next, select the electricity rate that you want to analyze from the dropdown menu (Figure 3). The most common rates are listed first, based on the number of customers. You can typically find your current rate name on your utility bill.

There is often a long list of available utility rates, divided into classifications for commercial, industrial, and residential rates. The list of rates includes rates available within 25 miles of the location specified.

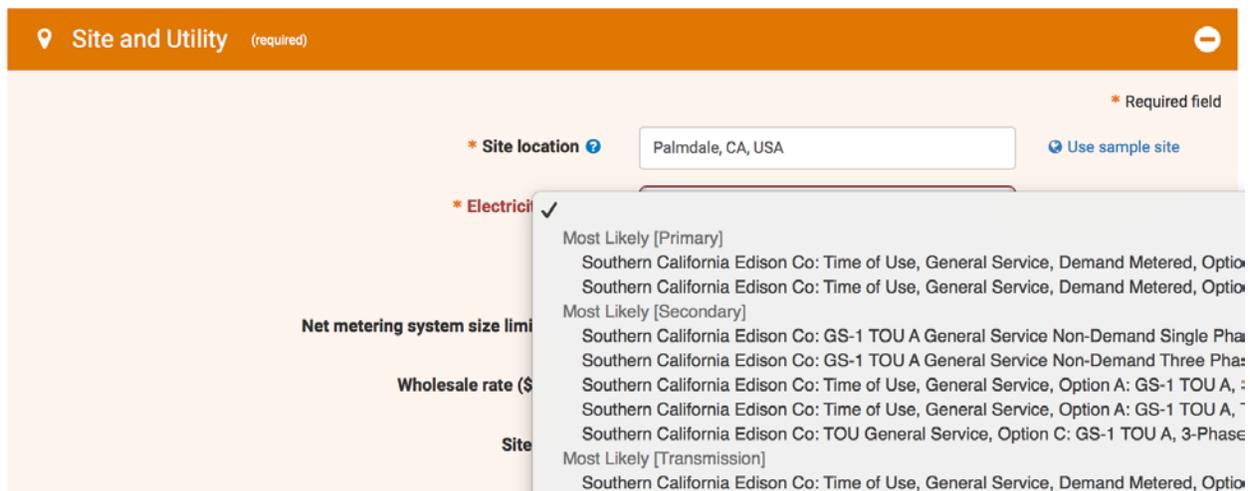


Figure 3. Choose a local electricity rate

You can view more information about the rate you have selected by clicking on the “Rate Details” link, which opens the Utility Rate Database (an OpenEI database of utility rates



maintained by NREL). REopt Lite uses this detailed data from the Utility Rate Database to calculate utility costs.

If you do not find your rate listed in the dropdown menu, check the box to enter custom utility rate values and then toggle Annual, Monthly, or Detailed, based on the level of detail with which you'd like to model your site's rate. You can enter annual or monthly energy and demand costs without being logged in, but you will need to log in before you build and save a detailed custom utility rate.

For the annual custom rate, you can enter a per-kilowatt-hour (kWh) energy charge that will apply to all electricity purchases throughout the year. The per-kilowatt (kW) demand charge will apply to the monthly peak demand for each month of the year (Figure 4).

* Electricity rate ?

Rate Details

Use custom electricity rate ?

Annual Monthly Detailed

Energy Cost (\$/kWh) Demand Cost (\$/kW/month)

0.10 15

Figure 4. Annual custom utility rate inputs

Similarly, for the monthly custom rate, you can enter the per-kWh energy charge and the per-kW demand charge that will apply during all of a given month but can vary throughout the months of the year.

For a detailed custom rate, you must be logged in to REopt Lite, as custom rates are saved to your account (see REopt Lite Tutorial: Entering Site Data for more details).

The optional Site Name input field allows users to give each evaluation a distinct name. This helps users to more easily distinguish between various sites and scenarios on any downloaded results reports or on a registered user's saved evaluations dashboard. For utility rate analysis, you may want to enter the name of the utility rate that you are modeling for later reference.

Load Profile Inputs

Next, enter an electric load profile for your location (Figure 5). You can choose to either upload interval data from your utility, or simulate a load based on your building type and annual consumption.

If you upload data, it needs to be in a .csv file format with either hourly, 30-minute, or 15-minute load data with no commas and no blank or text entries. You can download a sample file by clicking "Download typical load file."



Figure 5. Enter an electric load profile for your site

When you select the Simulate Profile option, you will select a building type from 17 options based on U.S. Department of Energy (DOE) Commercial Reference Buildings, plus a flat load option for the unusual situation where the electric load is a constant value in all 24 hours of the day (Figure 6). Each building has a different load shape that reflects the expected times of the day and year when load would be low or high for that type building in the climate zone for your location. You can click “Chart typical load data” to see the differences.

The default annual energy consumption number that automatically populates when you choose a building type is an average consumption for a building of the type that you are simulating in the climate zone of your site. Estimated consumption changes depending on which building type and part of the country you have entered and is based on typical building sizes and climate zones listed in the “Building Details” pop-up. You will get a more accurate approximation if you overwrite the default consumption with your building’s actual annual consumption. In that case, the simulated profile will be scaled to match your building’s consumption.

Figure 6. Building types from DOE Commercial Reference Buildings

Financial Inputs

For a utility rate analysis, you can leave the default values in the financial input fields.



Step 3: Choose the Technology to Be Evaluated

In order for the tool to give a solution, REopt Lite requires the user to specify at least one technology to evaluate. The model defaults to solar PV and battery systems. If you are interested only in the BAU, you can deselect the box next to “Battery” and leave only PV selected, then edit the PV inputs to force a 0-kW recommendation (Figure 7).

If you expand the PV section, you can overwrite the default value for the first input, system capital cost, to the maximum allowed value of \$100,000/kW. This cost will be too expensive to result in a financially optimal PV recommendation, so the resulting recommendation will be for a 0-kW PV system, even if you leave all of the remaining inputs as default values (Figure 7).

Step 3: Select Your Technologies

Which technologies do you wish to evaluate?

PV ⚙️ Battery 🔋 Wind ↕️

PV

System capital cost (\$/kW) ⓘ

Existing PV system?

Figure 7. Evaluate PV, battery, and/or wind technologies in your financial modeling analysis

Once you have completed these steps, click “Get Results” to run the analysis.

REopt Lite Results

Technology Recommendations

The first output displayed on the Results page is the recommended size of each technology, based on the inputs that you provided for the evaluation. For a utility rate analysis, where the inputs were purposefully entered to cause no system recommendations, a 0-kW solar PV system will be recommended.

Note the “Download PDF” button near the top of the Results page. This will open a PDF version of your results and inputs in another browser window for you to save or print.



Results Comparison

The Results Comparison table is where you will find the results for your utility rate analysis. The first column BAU case gives the utility costs to meet your entered electric load profile at the utility rate you selected or created. The energy costs, demand costs, and fixed charges are given for both year one and over the life cycle of the analysis (Figure 8).

Results Comparison

These results show how doing business as usual compares to the optimal case.

	Business As Usual	Financial	Difference
System Size, Energy Production, and System Cost			
PV Size	0 kW	0 kW	0 kW
Annualized PV Energy Production	0 kWh	N/A	N/A
Net CAPEX + Replacement + O&M	\$0	\$0	\$0
Energy Supplied From Grid in Year 1	1,000,000 kWh	1,000,000 kWh	0 kWh
Year 1 Utility Cost – Before Tax			
Utility Energy Cost	\$74,602	\$74,602	\$0
Utility Demand Cost	\$80,133	\$80,133	\$0
Utility Fixed Cost	\$5,551	\$5,551	\$0
Utility Minimum Cost Adder	\$0	\$0	\$0
Life Cycle Utility Cost – After Tax			
Utility Energy Cost	\$714,851	\$714,851	\$0
Utility Demand Cost	\$767,851	\$767,851	\$0
Utility Fixed Cost	\$53,191	\$53,191	\$0
Utility Minimum Cost Adder	\$0	\$0	\$0
Total System and Life Cycle Utility Cost – After Tax			
Total Life Cycle Costs	\$1,535,894	\$1,535,894	\$0
Net Present Value	\$0	\$0	\$0

Figure 8. The BAU case for one utility rate can be compared to the result for another utility rate and the same load

Example Rate Comparison

To compare one rate to another, make sure that you have clicked the “Download PDF” button near the top of the Results page to open a PDF version of your results and inputs to save or print. Alternatively, make sure that you are logged in so that your results will be saved to your Saved Evaluations dashboard.

Then, you can click the “Back” button near the top of your Results page. This will allow you to return to your evaluation inputs and change only the utility rate, leaving the electric load and other inputs the same. You can also simply reenter the inputs, or, if you are logged in, click “Copy” in the Actions column for your first evaluation.



For this example, change the electricity rate from Southern California Edison Co: TOU-GS-3, Option B, to Southern California Edison Co: TOU-GS-3, Option A, which is a rate with a flat demand charge with no time-of-use (TOU) increased demand charge and a similar energy charge TOU schedule, but with higher rates in the peak periods. Figure 9 shows that this rate is more expensive overall. It an LCC of \$1,582,260 compared to the previous LCC of \$1,535,894.

Results Comparison

These results show how doing business as usual compares to the optimal case.

	Business As Usual	Financial	Difference
System Size, Energy Production, and System Cost			
PV Size	0 kW	0 kW	0 kW
Annualized PV Energy Production	0 kWh	N/A	N/A
Net CAPEX + Replacement + O&M	\$0	\$0	\$0
Energy Supplied From Grid in Year 1	1,000,000 kWh	1,000,000 kWh	0 kWh
Year 1 Utility Cost – Before Tax			
Utility Energy Cost	\$104,049	\$104,049	\$0
Utility Demand Cost	\$55,526	\$55,526	\$0
Utility Fixed Cost	\$5,551	\$5,551	\$0
Utility Minimum Cost Adder	\$0	\$0	\$0
Life Cycle Utility Cost – After Tax			
Utility Energy Cost	\$997,012	\$997,012	\$0
Utility Demand Cost	\$532,057	\$532,057	\$0
Utility Fixed Cost	\$53,191	\$53,191	\$0
Utility Minimum Cost Adder	\$0	\$0	\$0
Total System and Life Cycle Utility Cost – After Tax			
Total Life Cycle Costs	\$1,582,260	\$1,582,260	\$0
Net Present Value	\$0	\$0	\$0

Figure 9. The business-as-usual case for a second utility rate can be compared to the result for other utility rates for the same load



Example Load Growth Scenario

You can also approximate an anticipated growth or reduction in your electric load and analyze the resulting change in electric costs. For example, suppose you anticipate a 25% increase in your electric load. You would run the evaluation leaving all the inputs the same except for the load profile input.

If you used a simulated load in your original evaluation, you would simply multiply the annual energy consumption input (1,000,000 kWh for example) by 1.25, giving a new annual energy consumption of 1,250,000 kWh. The increase in the annual consumption input will scale each hour of the load up by 25%.

If you uploaded interval data from your utility, you can edit your file to reflect the same load growth. Save a copy of the interval data as a new file, then increase all the rows of this load profile 25% by entering the formula “=B2*1.25” in column next to the first data point in the load column (Cell B2, if your load data starts there as shown in Figure 10), then selecting (or highlighting) all the cells from C2 down to the last row of data (C8761 for hourly data in this format), then going to the “Edit” menu and selecting “Fill down.”

	A	B	C
1	Hour	Load (kW)	
2	1	31.876	=B2*1.25
3	2	31.876	
4	3	31.876	
5	4	32.165	
6	5	32.388	
7	6	32.759	
8	7	32.725	
9	8	11.632	
10	9	60.891	
11	10	59.896	
12	11	112.504	
13	12	112.504	
14	13	147.931	
15	14	147.931	
16	15	147.931	
17	16	147.931	
18	17	151.357	
19	18	133.062	
20	19	97.634	

Figure 10. Enter a growth multiplication formula or reduction formula, and “fill down” to the last row of data

This will copy the multiplication formula into each row. You can then replace the original load data with this new data that has been increased by 25% by copying the new data and selecting “Edit>Paste Special>Values” to paste the new numbers into column B as values rather than multiplication formulas. Then simply delete column C, save your new estimated interval data, and upload it for your new comparison evaluation in REopt Lite.



The comparison evaluation for this load growth of 25% of the original sample load, at the original utility rate of Southern California Edison Co: TOU-GS-3, Option B, is shown in Figure 11. The load growth of 25% at the original utility rate has an LCC of \$1,906,569 compared to the previous LCC of \$1,535,894 (~24.3% increase).

Results Comparison

These results show how doing business as usual compares to the optimal case.

	Business As Usual	Financial	Difference
System Size, Energy Production, and System Cost			
PV Size	0 kW	0 kW	0 kW
Annualized PV Energy Production	0 kWh	N/A	N/A
Net CAPEX + Replacement + O&M	\$0	\$0	\$0
Energy Supplied From Grid in Year 1	1,250,000 kWh	1,250,000 kWh	0 kWh
Year 1 Utility Cost – Before Tax			
Utility Energy Cost	\$93,253	\$93,253	\$0
Utility Demand Cost	\$100,167	\$100,167	\$0
Utility Fixed Cost	\$5,551	\$5,551	\$0
Utility Minimum Cost Adder	\$0	\$0	\$0
Life Cycle Utility Cost – After Tax			
Utility Energy Cost	\$893,564	\$893,564	\$0
Utility Demand Cost	\$959,814	\$959,814	\$0
Utility Fixed Cost	\$53,191	\$53,191	\$0
Utility Minimum Cost Adder	\$0	\$0	\$0
Total System and Life Cycle Utility Cost – After Tax			
Total Life Cycle Costs	\$1,906,569	\$1,906,569	\$0
Net Present Value	\$0	\$0	\$0

Figure 11. The business-as-usual case for a load growth of 25% at the original utility rate

Similar calculations can be made for a load reduction scenario.



Learn More

For more information on tool inputs and default values, please see the [REopt Lite Web Tool User Manual](#).

Find additional REopt Lite tutorial documents and videos on reopt.nrel.gov/user-guides.html.



NREL's REopt Lite web tool helps users evaluate the economic viability of grid-connected PV, wind, and battery storage systems at a site. It identifies system sizes and battery dispatch strategies to minimize energy costs, and estimates how long a system can sustain the site's critical load during a grid outage.

Learn more about REopt Lite at reopt.nrel.gov/tool.

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