



# Student Project Activity #3: Distributed Energy Resources

## Overview

This activity introduces you to distributed energy resource (DER) optimization and illustrates the different results obtained when using individual building vs. community-scale optimization approaches. We will run DER optimization through the REopt web-based API. When using URBANopt with REopt optimization, a scenario-level analysis assumes a primary-meter and a feature-level analysis assumes individually-metered buildings. Optimal PV and battery sizes can vary depending on the type and number of buildings (e.g., load diversity) and the utility rate structures. This activity addresses how the optimization results differ between a primary-metered district or community compared to individually-metered buildings.

Utility rate structures typically charge for energy use on a \$/kWh basis. These charges may be constant, but often involve some level of variation based on the time of day (also called time-of-use utility rates). Charges may also be assessed on a “peak demand” basis, where consumers are charged for their maximum power demand over a given period—typically one billing cycle. This peak demand is calculated over a short averaging window (e.g., 15-minutes) and priced in terms of \$/kW.

## Tasks

1. (1 min) Create REopt Scenario: Create a REopt compatible scenario file using your baseline scenario file.

[Connecting REopt to URBANopt](#)

```
$ cd <working>
$ uo create -f coincident/class_project_coincident.json -r
coincident/baseline_scenario.csv

>>> Creating ScenarioFile with REopt functionality, extending from
coincident/baseline_scenario.csv...

>>> Done
```

This will generate a new scenario file that starts with `Reopt\_baseline\_scenario.csv`. Open the newly created file in a text editor to better understand how the mapper uses the `reopt/multiPV\_assumptions.json` file. You can also open the `multiPV\_assumptions.json` file in a text editor to see the more detailed assumptions.

2. (30 mins) Run Command: Run the newly created REopt scenario file using URBANopt and the REopt API by using the command below. Additional instructions can be found on the [REopt](#) pages:

```
$ cd <working>
$ uo run -f coincident/class_project_coincident.json -s
coincident/REopt_baseline_scenario.csv

>>> Simulating features of 'class_project_coincident.json' as
directed by 'REopt_baseline_scenario.csv'...

>>> Lots of simulation output
>>> DONE, result = true
>>> Done Running Scenario
```

3. (60 mins) Process with REopt Commands: Post-process your existing results using REopt:

### [REopt and URBANopt](#)

- a. Process Scenario with REopt Command. The `process -r` portion of the command will send the analysis to REopt for optimization of the entire scenario.

```
$ cd <working>
$ uo process -r -f coincident/class_project_coincident.json -s
coincident/REopt_baseline_scenario.csv

>>> Running the REopt Scenario post-processor with scenario
assumptions file:
<working>/coincident/reopt/multiPV_assumptions.json

>>> Post-processing entire scenario with REopt
```



**Issues** – If you see a message that has `reopt\_request`:  
Check\_connection Failed (RuntimeError), then doublecheck 1) your internet connection, 2) general connection via the web browser to <https://reopt.nrel.gov>, 3) your API key is in your environment variables (as discussed in Activity 0).

- b. Process Features with REopt Command: The `process -e` portion of the command will send the analysis to REopt but for optimization of each feature (building).

```
$ cd <working>
$ uo process -e -f coincident/class_project_coincident.json -s
coincident/REopt_baseline_scenario.csv

>>> Running the REopt Scenario post-processor with scenario
assumptions file:
<working>/coincident/reopt/multiPV_assumptions.json

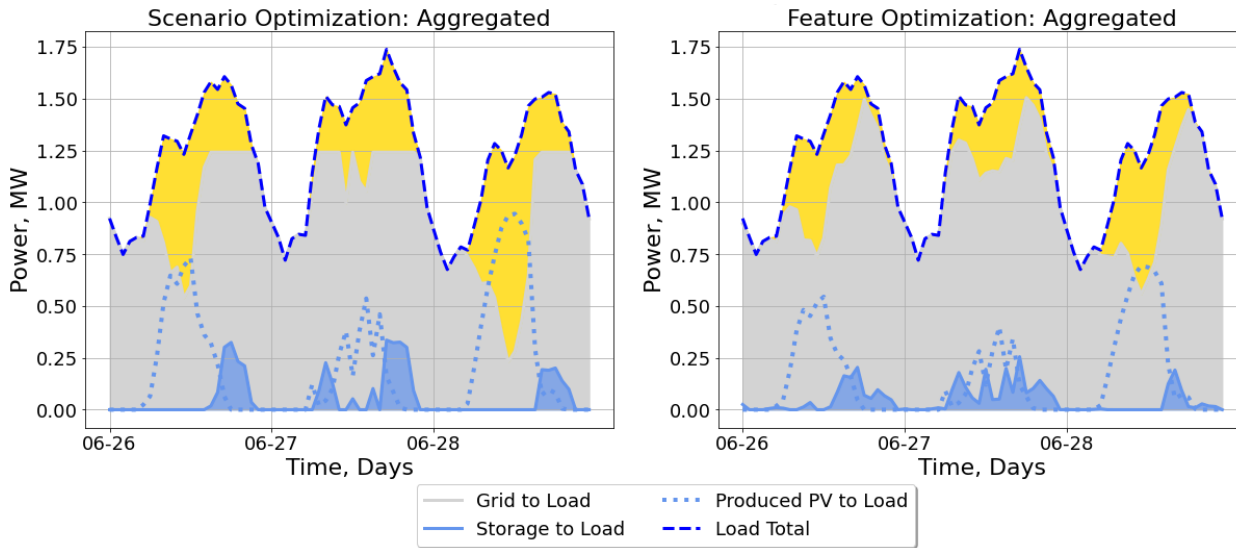
>>> Post-processing each building individually with REopt
```

4. (120 mins) Repeat this process for the other project directory/other feature file (coincident or diverse)  
 5. (120 mins) Write a 1-2 Page Report:

Analyze the results and compile a report with the following information

- a. Size of solar PV and battery (located in the [coincident|diverse]/run/REopt\_baseline\_scenario folder)
  - i. Scenario Results: scenario\_optimization.json
  - ii. Feature Results: feature\_optimization.json
- b. Other results can be found here (located in the [coincident|diverse]/run folder)
  - i. Scenario Results: scenario\_optimization.csv
  - ii. Feature Results: feature\_optimization.csv
- c. Report must contain:
  - i. Brief description of the PV and battery systems to be used by the REopt optimization
  - ii. A table comparing the PV and battery capacities for each building feature when using the two optimization methods.
  - iii. A comparison of total energy use and net present value between the two cases.
  - iv. Figures comparing the timeseries energy performance over a 3-day period of your choosing showing total-load, PV-to-load, grid-to-load, and storage usage. Select data to plot that illustrates the differences in system performance (if there are any). You should have two figures for this purpose, one for each optimization method, both covering the same 3-days. Both figures should plot the baseline (no optimization) total electricity use profile as a reference.
  - v. A discussion on the advantages and limitations of optimization at the community-scale vs. at the individual-building scale.

Note: Below is an example timeseries plot for your reference. This figure is meant to illustrate one option for showing how the REopt results can be visualized using a combination figure with line and stacked area charts



## Deliverables (Week 6)

- A 1-2 page report as stated in Task #5.