NREL's Renewable Energy Optimization (REopt) Tool

NREL's REopt tool is an early screening tool that identifies and prioritizes renewable energy (RE) projects at a single site, or across a portfolio of geographically dispersed sites, to meet agency goals.

Key Features

- **Optimization.** REopt considers RE resources, energy rates, and utility policies to identify the most cost-effective technologies to meet energy goals.
- **Integration.** REopt simultaneously models the complex hourly interactions of multiple thermal and electric RE technologies, along with conventional energy sources.
- **Low cost.** REopt provides a quick and low-cost method to identify the most economically and technically viable technologies for further study. Minimal data is required from the client, which reduces the time and cost burden.

Technologies

REopt evaluates multiple RE technologies, along with existing utility electric and thermal options:

- Photovoltaics (PV)
- Solar Hot Water
- Solar Ventilation Preheating
- Wind: small, medium, and large
- Biomass: thermal, combined heat and power (CHP), and electric
- Waste-to-Energy: thermal, CHP, and electric
- Landfill Gas (LFG): thermal, CHP, and electric.

The REopt Process

REopt combines site, resource, cost, incentives, and financial data. The solver identifies the technology sizes that meet the defined goals at minimum cost, along with the optimal dispatch strategy. It also estimates capital costs, operation and maintenance (O&M) costs, and lifecycle cost (LCC) for the recommended solution, as well as the levelized cost of electricity for each technology. Batch mode automation allows input data to be iteratively refined and multiple scenarios to be run quickly and efficiently (Figure 1).
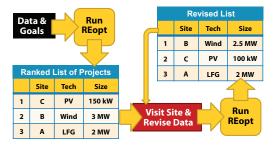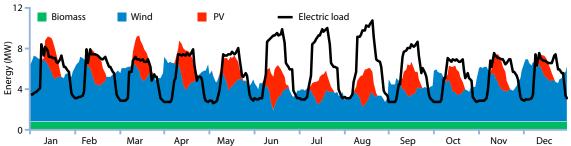

| Data & Goals | Run REopt |

Ranked List of Projects

	Site	Tech	Size
1	C	PV	150 kW
2	B	Wind	3 MW
3	A	LFG	2 MW

Visit Site & Revise Data → **Run REopt**

Revised List

	Site	Tech	Size
1	B	Wind	2.5 MW
2	C	PV	100 kW
3	A	LFG	2 MW

Figure 1. The REopt process

Results

REopt is highly adaptable to the needs of each project. Some common results include:

- **Optimum technologies for a site.** REopt evaluates the RE generation and site load on an hourly basis to identify the types and sizes of RE and conventional energy technologies that meet site goals at minimum LCC (Figure 2).
- **Prioritization across a portfolio of sites.** REopt compares the net present value (NPV) of projects across multiple sites to prioritize which sites an agency should target for further study.
- **Sensitivity analysis.** REopt runs thousands of scenarios to evaluate the effect of varying inputs (such as technology cost or utility escalation rate) on NPV.

Figure 2. Hourly electric load and total generation of the integrated solution for one typical day per month

Economic Model

Net Present Value

REopt compares the NPV of the base case LCC to the NPV of the RE case LCC to identify the opportunities that have the greatest LCC savings over the analysis period (typically 25 years).

- **Base Case LCC:** The client continues business as usual

- **RE Case LCC:** The client invests in RE now in exchange for reduced utility payments later.

Value of Energy Produced

REopt estimates the value of the energy produced onsite by comparing the hourly generation to the hourly site load. All energy produced that is less than the load is assumed to be used onsite and is valued at the retail rate. Energy produced in excess of the load is valued at the retail rate if total onsite generating capacity is under the net metering limit, the wholesale rate if it is under the interconnection limit, or zero if it is over the interconnection limit.

Data Inputs

REopt utilizes a combination of site-specific data, as well as internal and external databases.

Site Data

Client-supplied data includes site location, land available, and annual utility consumption and cost. The analysis can be refined with more detailed inputs if available.

RE Resource Data

REopt automatically queries NREL geographic information system databases to compile RE resource data.

- **Solar:** Direct normal, global horizontal, and diffuse horizontal irradiance[1]

- **Wind:** Hourly wind speed at 50 and 80 meters on a 20-kilometer grid[2]

- **Biomass:** Tons biomass within a 25 and 50 mile radius (including crop, forest, and primary and secondary mill residues)[3]

- **Municipal Solid Waste (MSW):** Tons MSW within a 25 mile radius and average state tipping fee[4]

- **LFG:** Candidate landfill location and potential energy generation.[5]

RE Technology and Cost Data

REopt estimates technology performance and cost based on proprietary energy and cost models. Capital costs, O&M costs, biomass fuel costs, and tipping fees are based on historical project costs, market data, and NREL research.

Incentives and Utility Data

REopt queries utility rates, policies, and incentives based on site location.

- **Incentives** including investment tax credits, rebates, and production incentives are obtained from the Database for State Incentives in Renewable Energy (DSIRE)

- **Sellback rates** for excess energy production are based on the utility wholesale rates in Ventyx database

- **Interconnection limits and net metering limits** are obtained from DSIRE.

Financial Parameters

Escalation rates are based on Energy Information Administration projections. Appropriate discount rates and depreciation schedules are selected in consultation with the client.

Load Profile

REopt estimates the thermal and electric load profile based on client-reported annual energy use and energy models developed for the appropriate building type and climate zone.

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[1] Data obtained from: Typical meteorological year 3.

[2] Data obtained from: AWS Truepower.

3 Data obtained from: Milbrandt, A. A Geographic Perspective on the Current Biomass Resource Availability in the United States. NREL/TP-560-39181. Golden, CO: National Renewable Energy Laboratory, 2005. http://www.nrel.gov/docs/fy06osti/39181.pdf.

[4] Data obtained from: Van Haaren, R.; Themelis, N.; Goldstein, N. "State of Garbage in America." BioCycle Journal (51:10), 2010; pp.16. http://www.biocycle.net/2010/10/the-state-of-garbage-in-america-4/.

[5] Data obtained from the U.S. Environmental Protection Agency Landfill Methane Outreach Program.

NREL's deployment and market transformation activities encompass the laboratory's full range of technologies, which span the energy efficiency and renewable energy spectrum. NREL staff members educate partners on how they can advance sustainable energy applications and also provide clients with best practices for reducing barriers to innovation and market transformation.

NREL's mission is to be the leader in technology innovation and to advance renewable energy efforts around the world. Let NREL help propel your organization toward a more sustainable energy future.

For more information about NREL's deployment and market transformation activities, see our website at *www.nrel.gov/tech_deployment*.

For more information regarding NREL's REopt tool, contact Kate Anderson at 303-384-7453 or kate.anderson@nrel.gov.