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Evaluating Emissions Reductions from DERs in REopt Lite

Track 4: Financing and Implementing Federal Energy and Water Projects S10: Enhancing the Business Case for Energy and Water Projects



Which DERs Will Work for My Site?



RE ResourceTechnology Costs &Site GoalsUtility Cost &IncentivesConsumption

- Financial Parameters
- Distributed energy resources (DERs) can provide cost savings, resilience benefits, and emissions reduction
- Many technical and economic factors affect which distributed energy technologies can best meet site goals, and should be considered concurrently
- With increasingly integrated and complex systems, back-of-the envelope calculations are no longer sufficient to determine distributed energy project potential



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How Does REopt Lite Work?



REopt Lite User Interface

- REopt Lite is a free, publicly available tool that federal agencies can use to evaluate distributed energy options.
- Financial mode optimizes PV, wind, CHP, and battery system sizes and dispatch strategy to minimize life cycle cost of energy; and
- Resilience mode optimizes PV, wind, CHP, and storage systems, along with backup generators, to sustain critical load during grid outages.
- Access REopt Lite at <u>reopt.nrel.gov/tool</u>.

Step 1: Choose Your Focus

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





Step 2: Enter Your Site Data

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

Ŷ	Site and Utility (required)	0
d	Load Profile (required)	0
\$	Financial	0

Step 3: Select Your Technologies





REopt Lite Key Outputs





Hourly Dispatch

	Business As Usual O	Financial O	Difference Ø
System Size, Energy Produc	tion, and System Cost		
PV Size 🧿	0 kW	113 kW	113 kW
Annualized PV Energy Production 0	0 kWh	132,000 kWh	132,000 kWh
Battery Power O	0 kW	0 kW	0 kW
Battery Capacity 🤨	0 kWh	0 kWh	0 kWh
Net CAPEX + Replacement + O&M 🥹	\$0	\$133,318	\$133,318
Energy Supplied From Grid in Year 1 🧿	132,000 kWh	65,384 kWh	66,616 kWh
Year 1 Utility Cost	– Before Tax		
Utility Energy Cost 🥹	\$18,112	-\$404	\$18,515
Utility Demand Cost 🧿	\$0	\$0	\$0
Utility Fixed Cost 🧿	\$0	\$0	\$0
Utility Minimum Cost Adder 🛛	\$0	\$0	\$0

Detailed Financial Outputs



Emissions Datasets Overview

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eGRID Annual Emissions Values

CO₂ total output emission rate (lb/MWh) by eGRID subregion, 2019



- Emissions factors are used to convert electricity generation to emissions and vary across the US.
- EPA's eGRID dataset provides **annual** values for *total* and *marginal* emissions
 - Marginal emissions may be more appropriate to evaluate impact of adding or reducing loads
- eGRID spatial resolutions include balancing areas, states, and eGRID subregions
 - eGRID subregion may be most accurate spatial resolution

https://www.epa.gov/egrid/summary-data; https://www.epa.gov/egrid/data-explorer; https://cfpub.epa.gov/ghgdata/inventoryexplorer/index.html#electricitygeneration/entiresector/allgas/category/current

AVERT Hourly Emission Rates

Hourly Marginal Emissions Factor (lbs. CO2/MWh)



- Emissions also vary throughout the year
- EPA's AVERT dataset captures hourly average and marginal emission factors for 14 US regions
- More accurately reflects contribution of energy efficiency, energy storage, and renewable energy measures on today's grid

Cambium Projected Future Emission Rates

- Projects annual and hourly emissions rates by state for each year 2020-2050, accounting for projected future "greening of the grid"
- Includes average and marginal (short term and long run) emissions rates





Emissions Modeling in REopt Lite

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Specifying Emissions Dataset



 Three ways to specify emissions factors:

- AVERT hourly
- Custom annual
- Custom hourly



Chart Hourly Emissions Profile





Example



	Business as Usual	Optimal PV + Storage
PV size (kW)	-	5,530
Storage size (kW)	273	364
Storage size (kWh)	548	1,265
Life Cycle Cost (LCC) (\$000)	\$21,286	\$20,123
Net Present Value (NPV) (\$000)	-	\$1,586
Emissions – eGRID marginal (1,000 lb. CO ₂)	17,483	11,431
Emissions – eGRID average (1,000 lb. CO ₂)	8,219	5,374
Emissions – AVERT marginal (1,000 lb. CO ₂)	25,653	16,872



Future Work

- Integrating Cambium dataset for long-run marginal emission rates
 - Data sets of hourly cost, emission, and operational data for modeled futures of the U.S. electric sector with metrics designed to be useful for long-term decision-making.
- Adding constraint to specify % CO₂ reduction target
 - What is the most cost-effective combination of technologies to meet 50% carbon reduction goal
- Adding cost of carbon to the objective function
 - How does costing carbon change optimal system sizing







Thank you! Emma Elgqvist: <u>emma.elgqvist@nrel.gov</u> REopt: <u>https://reopt.nrel.gov/</u>



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