REBA Connect 2021 Virtual Member Summit

REBA INSTITUTE

Assessing GHG Impacts of New Renewable Energy Projects

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Overview

Goal: Empower you to increase the emissions impact of your renewable energy procurement.

Help you understand which renewable energy projects are most likely to have the greatest decarbonization impact on the grid:

1. Scope 2 accounting vs accounting for grid impact
2. Calculating emissions impact
3. Review four available data sets

Maximizing Impact on Grid Decarbonization

Quantifying carbon reduction in scope 2

- **Inventory** or **attributional** accounting
- Allocate, or attribute, emissions based on a defined inventory boundary
- All renewable energy purchasing has equal benefit (zero emissions

Comparing 1,000,000 MWh from 3 locations	
Project Description	**Scope 2 Reporting**
Texas wind	0 MT co2e / year
California solar	0 MT co2e / year
Kansas wind	0 MT co2e / year

Maximizing Impact on Grid Decarbonization

Quantifying carbon reduction on grid

- **Intervention** or **consequential** accounting
- Establish boundary based on emissions impact of activity
- Renewable energy projects will have different GHG benefit based on location

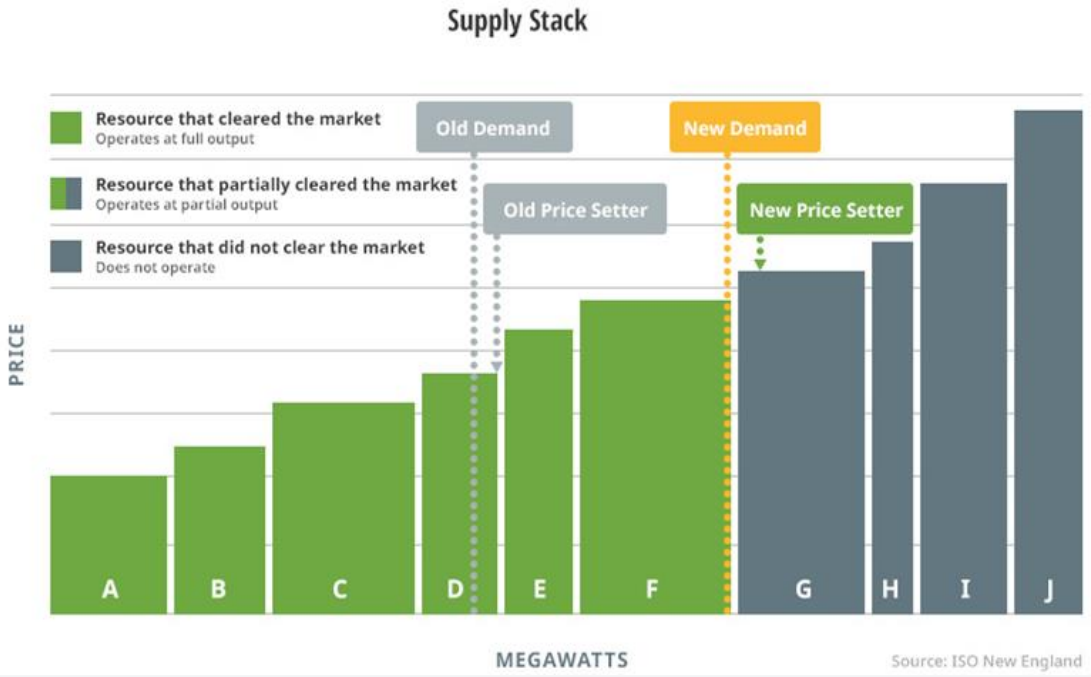
Comparing 1,000,000 MWh from 3 locations

Project Description	Scope 2 Reporting	Carbon Reduction
Texas wind	0 MT co2e / year	573,000 MT co2e / year
California solar	0 MT co2e / year	343,000 MT co2e / year
Kansas wind	0 MT co2e / year	789,000 MT co2e / year

Source: WattTime -- Richardson, H. and Evans, M. (2018). *Avoided Emissions Assessment of Three Renewable Energy Projects.*

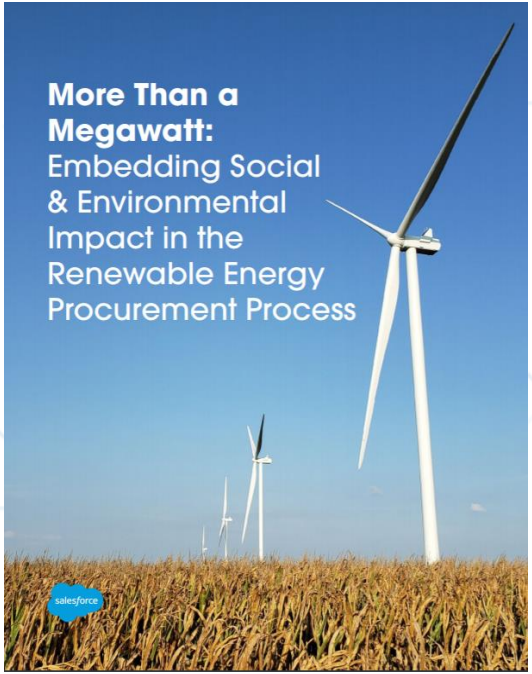
Intervention Accounting: “Marginal Resource”

- Carbon impact on the grid is based on “**marginal resource**” in region
- Reflects how load would be met in absence of (“must run”) RE project - i.e. the "displaced" resource
- Establishing “marginal resource” is not strictly economic – varies based on hour, season, other grid factors



Incorporating GHG Impact into Procurement

Buyer's Perspective



Incorporating GHG Impact into Procurement

Option A: Buy zero-emissions MWh → procurement today

- Buy zero emissions renewable electricity to zero out scope 2
- Make general marketing claims on avoided emissions ("The generation we support avoids emission equivalent to taking 100 cars off the road") using EPA GHG Calculator

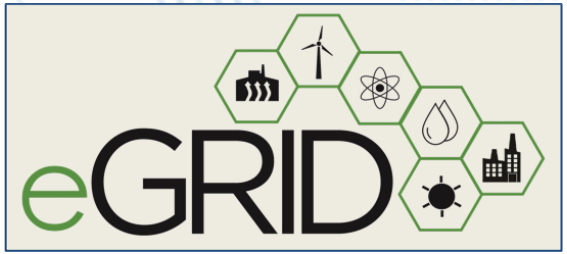
Option B: Incorporate avoided emissions into procurement → this presentation

- Establish a cost bound and, within this bound, prioritize projects that have biggest impact on emissions
- e.g. Beyond the MW procurement matrix

Option C: Goals centered on avoided emissions → to explore

- Develop a procurement framework to offset your electricity emissions with "verified emissions reductions"
- *Note: this may result in under-achieving conventional carbon footprint accounting*

Available Data and Tools



Available Data and Tools: eGRID

Data	Description	Ideal Use	Limitations
Annual generation data from EIA is matched with annual emissions data from EPA's Clean Air Markets Division (CAMD) Generators are assigned to baseload or marginal based on capacity factor	The data set provides an estimate of marginal emissions rate in each NERC subregion in a given data year Assumes that generators that were used at fractions of capacity are marginal	Basic understanding of sub-region with highest marginal rate Used for avoided emissions claims Industry standard data set for average emissions	Cannot consider generation profile Does not provide granular (hourly) data Weaknesses of capacity factor methodology

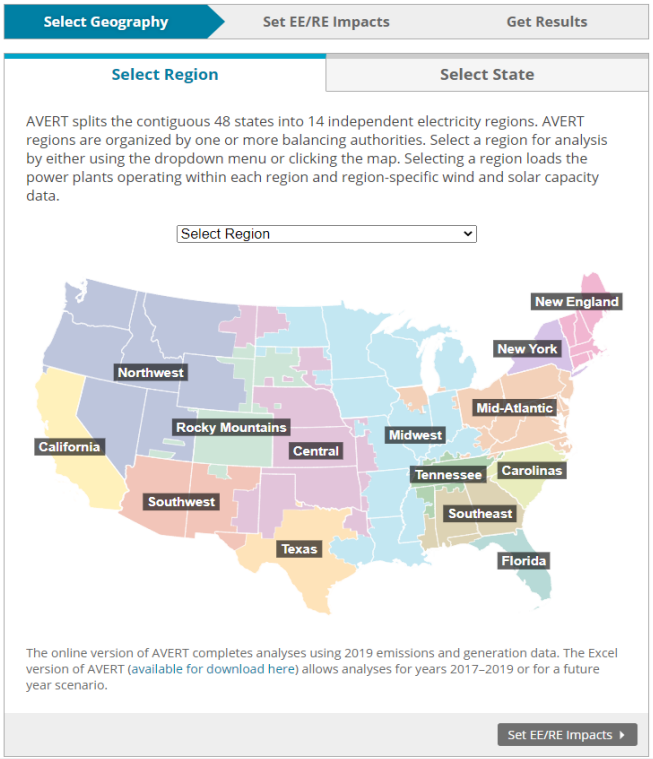
Access: https://www.epa.gov/egrid

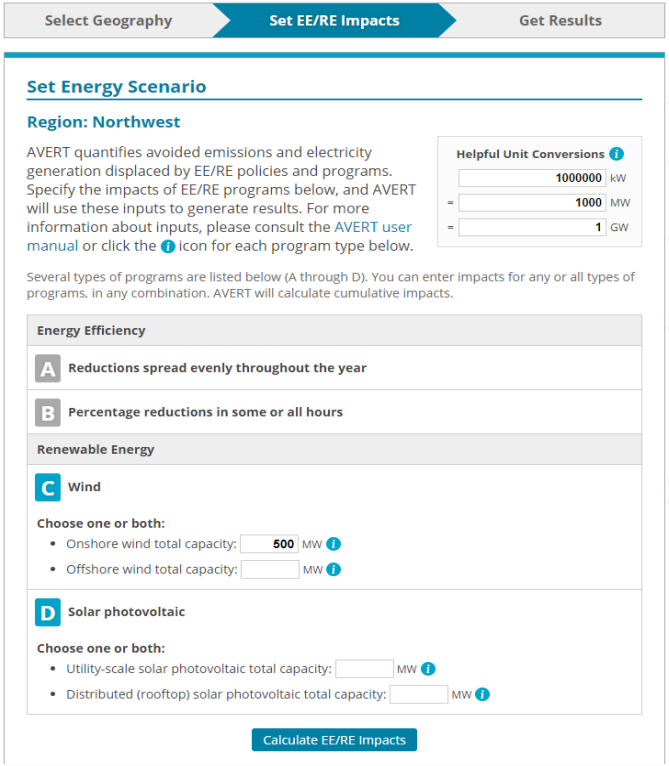
Available Data and Tools: AVERT

Data	Description	Ideal Use	Limitations
Hourly generation data and hourly emissions data from a single year from CAMD. Generator operations under specific load conditions are statistically estimated through a Monte Carlo analysis to establish marginal emission rates. Predicts how each power plant is generating and emitting in each hour	Matches the hourly load profile of the resource to determine the avoided emissions Regional emissions factors available	Inform procurement decisions based on avoided emissions impact over next 5 years Three versions (table, online, excel) Excel tool provides more flexibility (capacity factor, 8760 data, etc.)	Uses historical behavior to predict future behavior No granularity within regions 5 years max

Access: https://www.epa.gov/statelocalenergy/avoided-emissions-and-generation-tool-avert

Available Data and Tools: AVERT





Available Data and Tools: AVERT

Results: Avoided Regional, State, and County-Level Emissions

Annual Regional Displacements:
Northwest Region

	Original	Post-EE/RE	EE/RE Impacts
Generation (MWh)	132,302,160	131,200,340	-1,101,820
Total emissions of fossil EGUs			
SO_2 (lbs)	95,417,940	94,662,230	-755,700
NO_X (lbs)	144,287,390	143,134,550	-1,152,830
CO_2 (tons)	104,233,730	103,413,990	-819,730
$PM_{2.5}$ (lbs)	10,942,010	10,850,140	-91,860
Emission rates of fossil EGUs			
SO_2 (lbs/MWh)	0.721	0.722	
NO_X (lbs/MWh)	1.091	1.091	
CO_2 (tons/MWh)	0.788	0.788	
$PM_{2.5}$ (lbs/MWh)	0.083	0.083	

Negative numbers indicate displaced generation and emissions. All results are rounded to the nearest ten. A dash ('–') indicates a result greater than zero, but lower than the level of reportable significance.

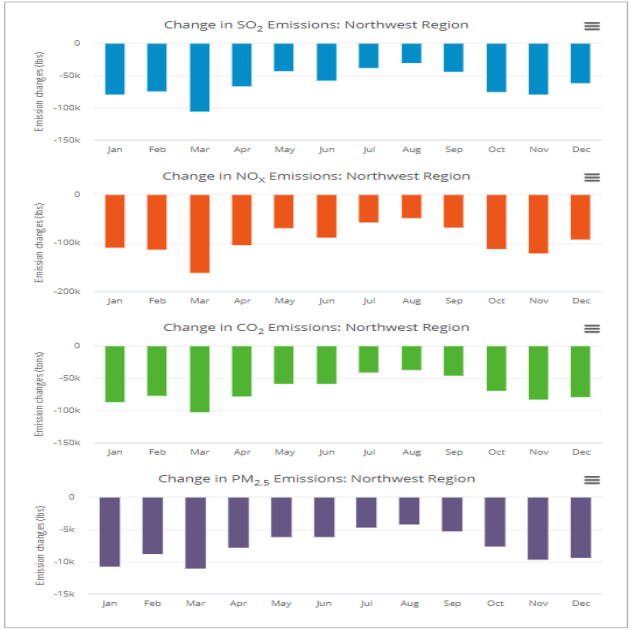
Annual State Emission Changes:
Northwest Region

State	SO_2 (lbs)	NO_X (lbs)	CO_2 (tons)	$PM_{2.5}$ (lbs)
Idaho	-260	-19,165	-30,744	-3,528
Montana	-156,579	-212,681	-99,076	-19,395
Nevada	-84,293	-81,862	-112,937	-14,931
Oregon	-156,148	-122,917	-115,426	-20,995
Utah	-114,388	-305,130	-156,404	-15,323
Washington	-53,034	-197,601	-178,936	-10,210
Wyoming	-191,002	-213,478	-126,217	-7,488

Monthly Emission Changes:
Northwest Region

Select level of aggregation: ◉ Region ○ State ○ County

Select units: ◉ Emission changes (lbs or tons) ○ Percent change

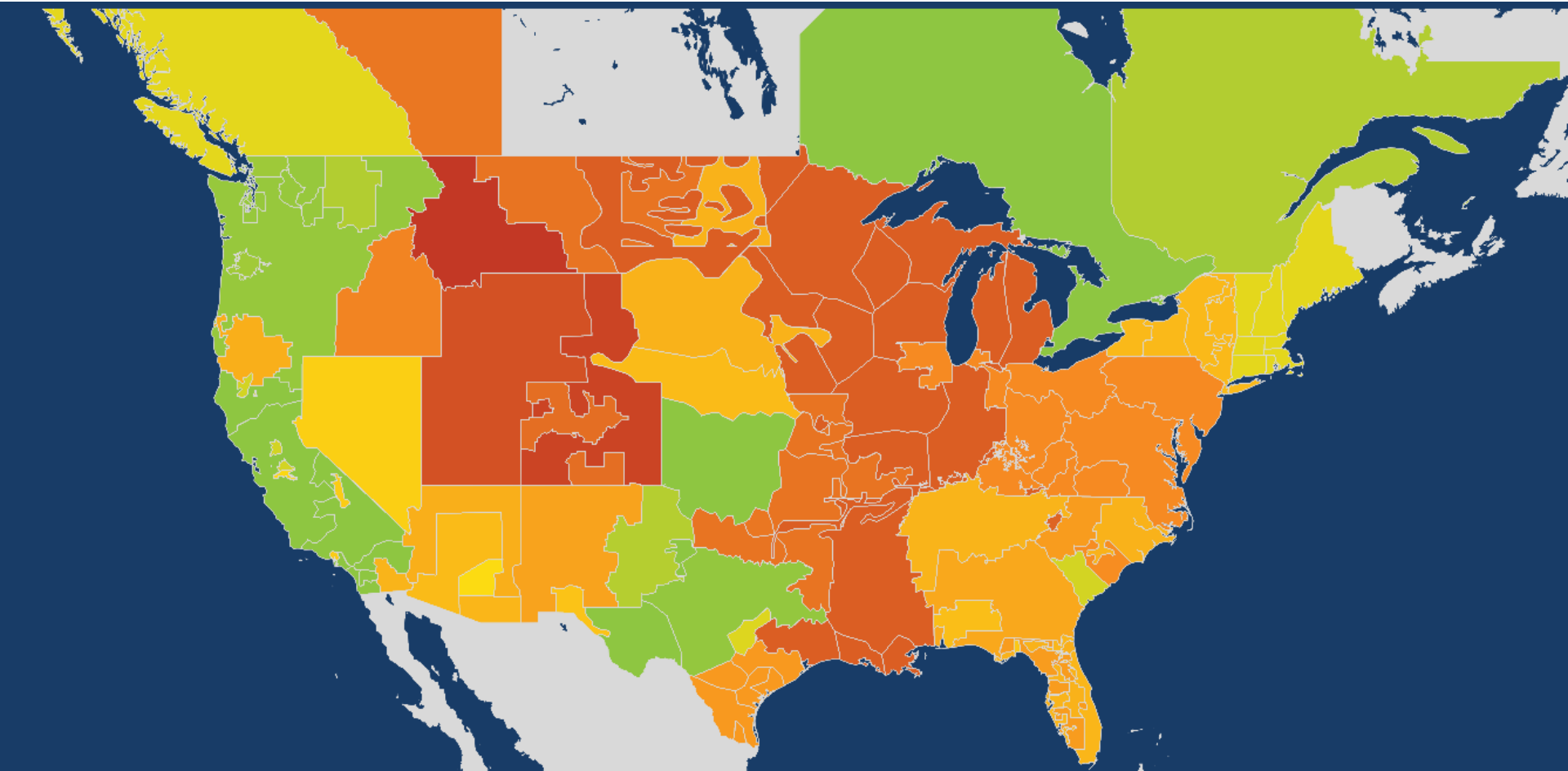


Available Data and Tools: WattTime

Data	Description	Ideal Use	Limitations
Hourly generation and emissions data from 3 years of CAMD, plus gen data from EIA and ISO Statistical analysis is used to establish which generators were marginal in response to increases in RE. Creates hourly profile for each day of each month.	Matches the hourly load profile of the resource to determine the avoided emissions Geographic granularity reflect balancing authorities	Inform procurement decisions based on avoided emissions impact over the next 5 years WattTime can provide data, run project analyses, draft reports, etc., and offers real time controls.	Uses historical behavior to predict future behavior Cost

Access: https://www.watttime.org/contact/

Available Data and Tools: WattTime



Available Data and Tools: Cambium

Data	Description	Ideal Use	Limitations
ReEDS projects evolution of bulk power sector and finds least cost solutions of grid build out given policy, existing fleet lifetime, price, etc.	The data set provide hourly and annual long-run marginal emissions rates (LRMER) under five scenarios (all assuming existing policy)	Inform avoided emissions that will result over 5+ years. Empirical models (WattTime, etc.) are more precise but only over short-term	Cost-minimizing perspective does not reflect irrational decision-making. New model (though feedback has been positive)
PLEXOS simulates hourly operation of system projected by ReEDS	Seeks to predict how the grid will adapt to changes in load or generation	For hourly, user must have generation profile & analyze	No criteria pollutants

Access: https://cambium.nrel.gov/ Released in Nov., updated annually

Available Data and Tools: Cambium

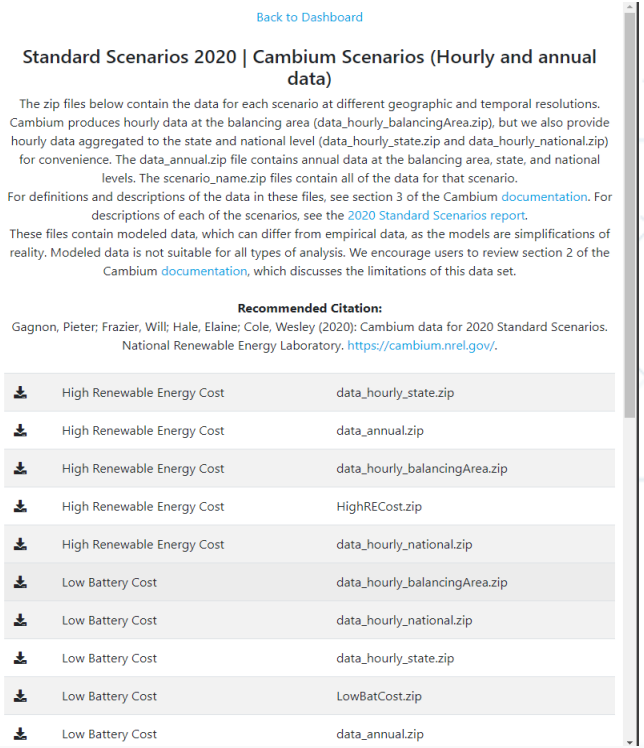
Available Data and Tools: Cambium

Scenarios:

- High renewable energy cost
- Low battery cost
- Low Renewable Energy Cost
- Low Wind Cost
- Mid-case

Data sets for each scenario (2020-2050):

- Hourly state
- Hourly national
- Hourly balancing area
- Annual (state, national, BA)



Back to Dashboard

Standard Scenarios 2020 | Cambium Scenarios (Hourly and annual data)

The zip files below contain the data for each scenario at different geographic and temporal resolutions. Cambium produces hourly data at the balancing area (data_hourly_balancingArea.zip), but we also provide hourly data aggregated to the state and national level (data_hourly_state.zip and data_hourly_national.zip) for convenience. The data_annual.zip file contains annual data at the balancing area, state, and national levels. The scenario_name.zip files contain all of the data for that scenario.
For definitions and descriptions of the data in these files, see section 3 of the Cambium documentation. For descriptions of each of the scenarios, see the 2020 Standard Scenarios report.
These files contain modeled data, which can differ from empirical data, as the models are simplifications of reality. Modeled data is not suitable for all types of analysis. We encourage users to review section 2 of the Cambium documentation, which discusses the limitations of this data set.

Recommended Citation:
Gagnon, Pieter; Frazier, Will; Hale, Elaine; Cole, Wesley (2020): Cambium data for 2020 Standard Scenarios. National Renewable Energy Laboratory. https://cambium.nrel.gov/.

⬇	High Renewable Energy Cost	data_hourly_state.zip
⬇	High Renewable Energy Cost	data_annual.zip
⬇	High Renewable Energy Cost	data_hourly_balancingArea.zip
⬇	High Renewable Energy Cost	HighRECost.zip
⬇	High Renewable Energy Cost	data_hourly_national.zip
⬇	Low Battery Cost	data_hourly_balancingArea.zip
⬇	Low Battery Cost	data_hourly_national.zip
⬇	Low Battery Cost	data_hourly_state.zip
⬇	Low Battery Cost	LowBatCost.zip
⬇	Low Battery Cost	data_annual.zip

Available U.S. Data and Tools

Tool	Access	Description	Ease of use	Ideal use	Contact
eGRID	Free EPA Website	+ Annual generation from EIA + Annual emissions from EPA's Clean Air Markets Division (CAMD)	Data easy to access; requires user to multiply rates by annual generation	Basic understanding of marginal emissions by sub-region	johnson.travis@epa.gov
AVERT	Free EPA Website	+ CAMD hourly generation + CAMD hourly emissions data	Versions meet user needs. Online tool: user inputs total capacity of resource (by type) and AVERT calculates annual avoided emissions. Excel tool: greater flexibility.	Inform procurement decisions, with 5-year view max	avert@epa.gov
WattTime	Contact WattTime	+ Hourly generation from CAMD, ISOs, and EIA + Hourly emissions from CAMD	For a fee, WattTime can provide data sets, provide avoided emissions of project(s), or deliver analysis reports	Inform procurement decisions, with 5-year view max	henry@watttime.org
Cambium	Free NREL Website	+ ReEDS projects grid build out + PLEXOS stimulates hourly system operation	Data easy to access; requires user to multiply rates by annual or hourly generation data	Inform procurement decisions for procurement 5+ years	Pieter.Gagnon@nrel.gov

Maximizing Grid Decarbonization

- Emissions benefit of a new renewable energy project varies by location and time
- Available data sets can be used to incorporate emissions impact into selection of new projects
- Additional areas to explore:
  - Additionality
  - Annual look-back on avoided emissions
  - An emissions-centric framework of procurement

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