

A large white wind turbine stands in a grassy field. In the background, there are rolling hills and mountains covered in green trees under a blue sky with scattered white clouds. A tan utility building is visible in the lower left foreground.

Distributed Wind Energy Futures Study – Results at the Local Level

Caleb Phillips, Jane Lockshin, Paula Pérez,
Paritosh Das, Slater Podgorny, JD
Laurence-Chasen, Sara Abril-Guevarra,
Paul Crook

Caleb.Phillips@nrel.gov

DWFS Study Background and Goals

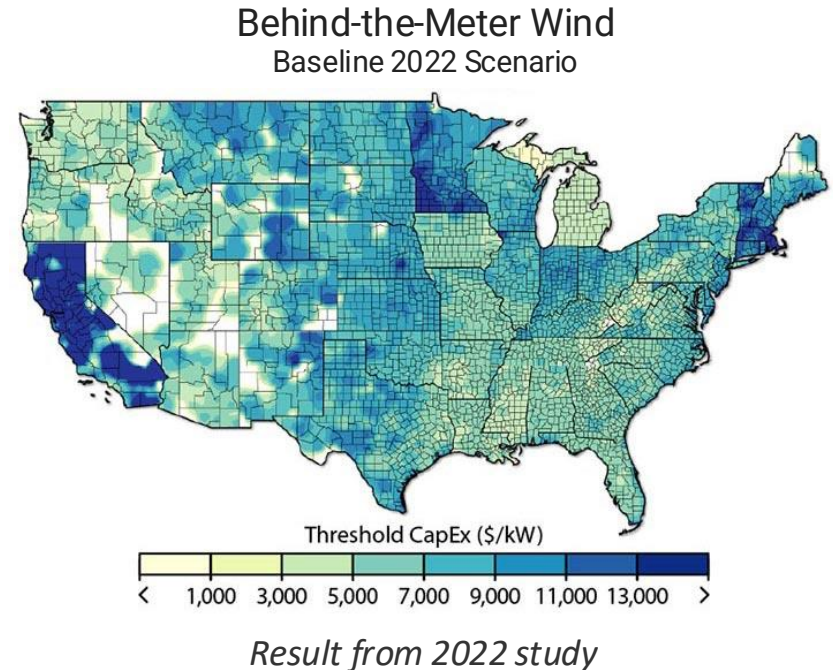
What is the US opportunity for distributed wind now, and in the future?

Key Innovation: use of parcel data to assess location-specific land use, resource, and siting. Assess each parcel's technical and economic viability:

- By business model: behind-the-meter (BTM) vs front-of-meter (FTM)
- By Scenario: policy financing and incentives, performance improvement pathways to 2035

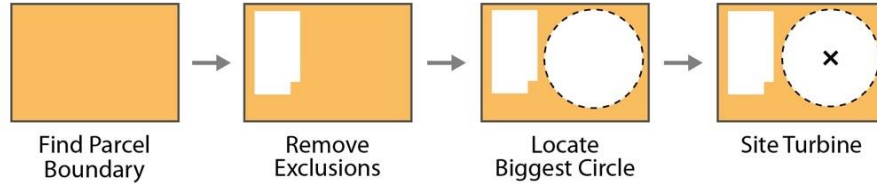
Metrics:

- Breakeven cost by site (\$/kW)
- Technical potential (kW)
- Annualized energy productivity (kWh)

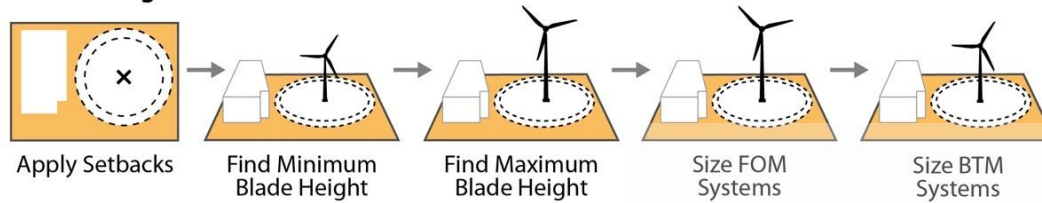


Example Parcel-level Analysis

Turbine Siting



Turbine Sizing



Using NREL's supercomputer Kestrel, we do this 155 million times for all contiguous US land parcels.



Key Metrics

Power

Technical Potential
Generation (KW) if All Turbines Running
at Nameplate Capacity



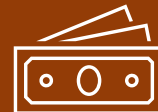
Energy

Annual Energy Productivity (AEP)
Energy Production (KWh), accounting for
technology and wind resource



Cost

Breakeven Cost
Capital & O/M cost at which a turbine
would pay for itself, in \$/kW

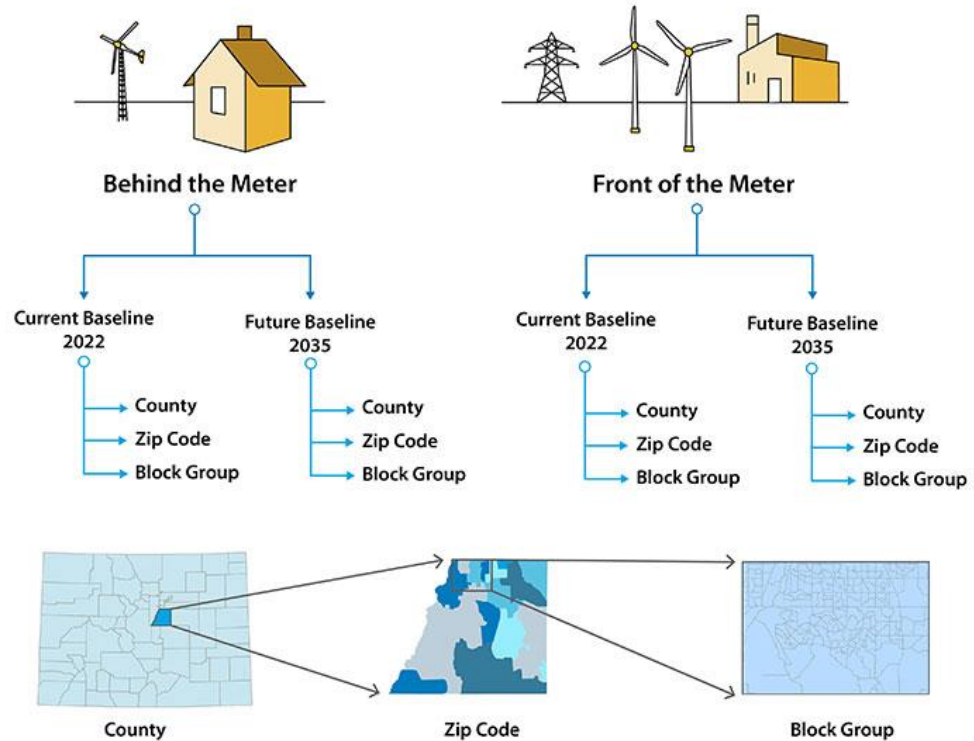


Cost Viable

Technical
Potential

Annual Energy
Productivity

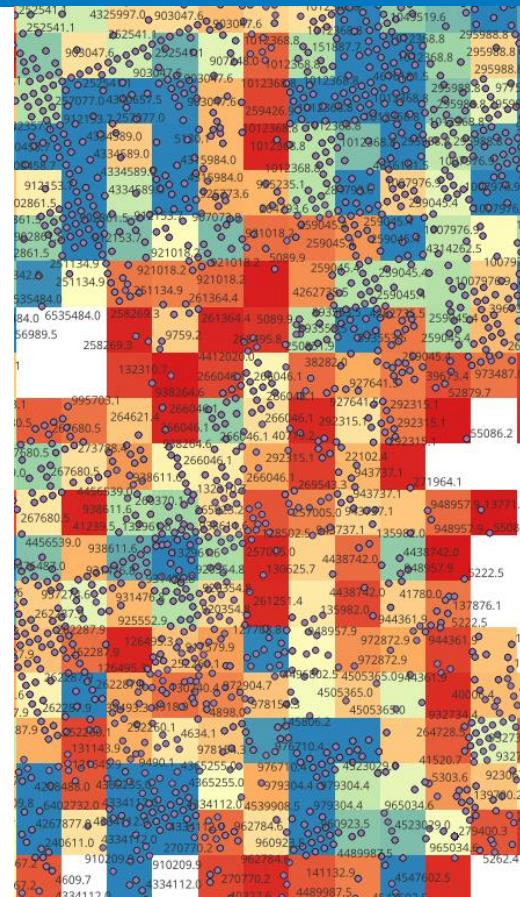
Business Models & Scenarios



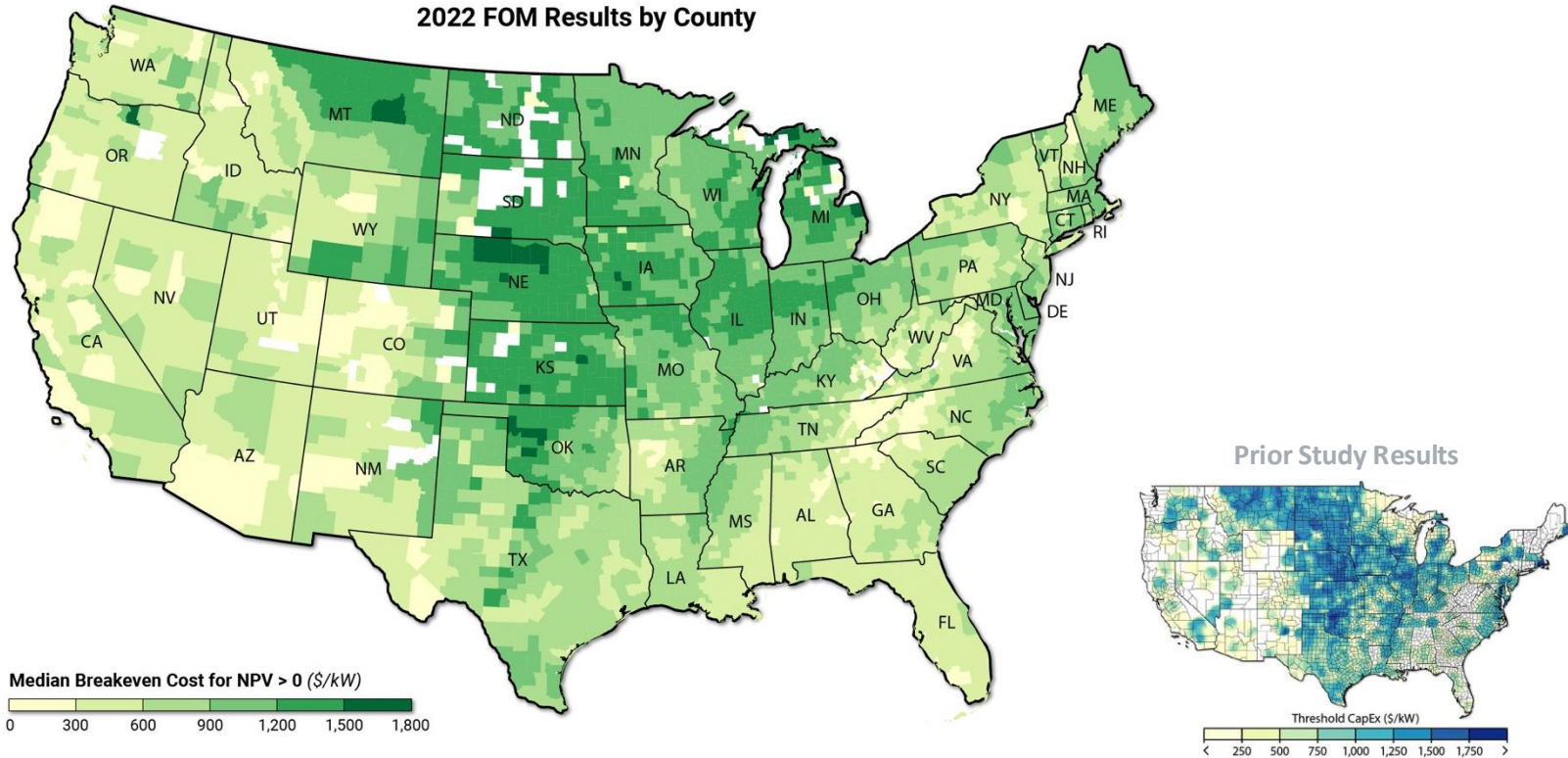
2024 - Key Improvements & Updates

We are advancing the precision, accuracy and means of communicating our results.

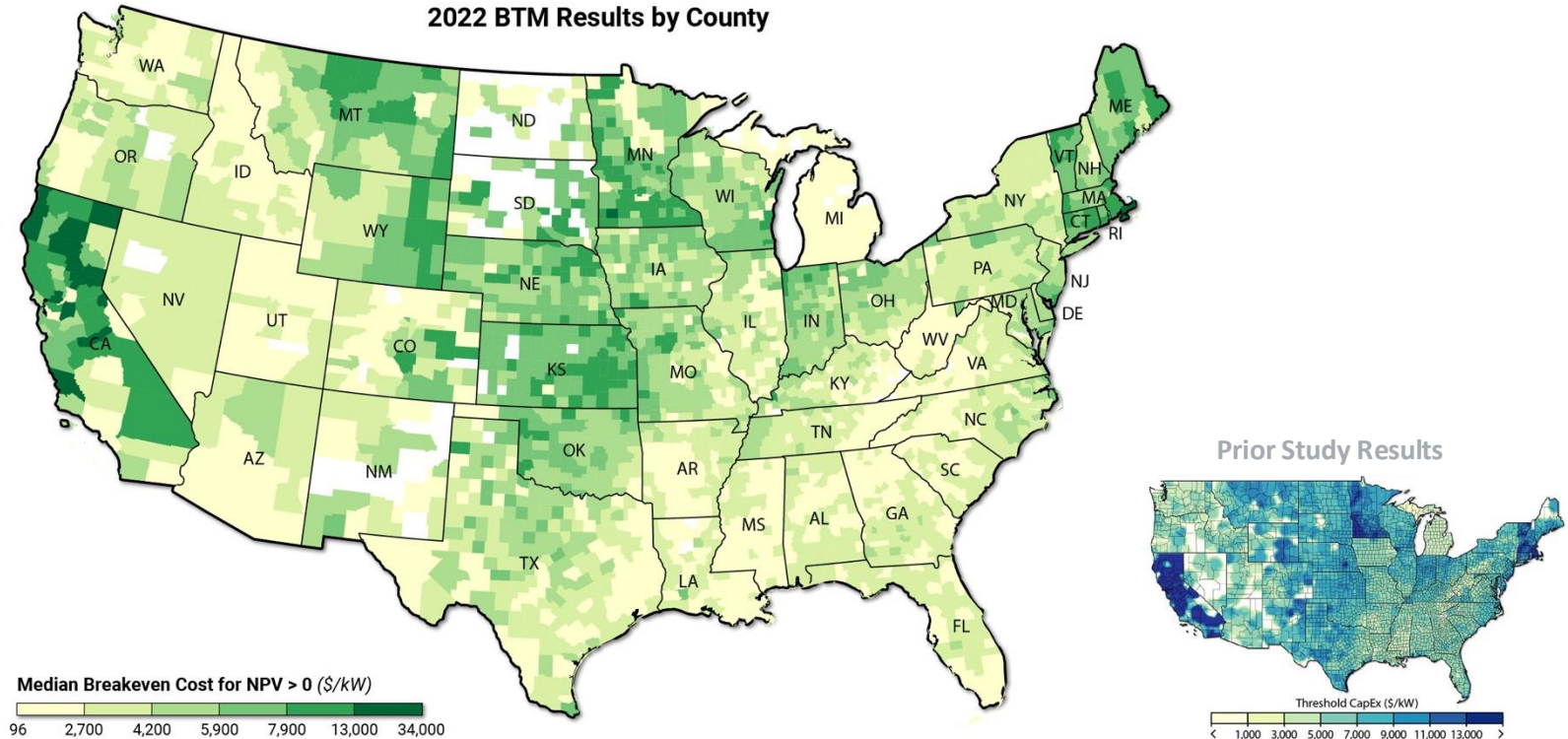
- 1) **Full parcel-level database** – The 2022 study utilized a random sample (1M) and 'scaled up'. In the 2024 study **we use all 155M CONUS parcels directly**.
- 2) **Economic cost updates** – **key cost values are being updated** to reflect changes in the industry and impacts of inflation on costs.
- 3) **Model improvements** – better sizing and locating turbines leading to **more accurate results**, as well as key performance improvements.
- 4) **Higher resolution outputs** – new methods for aggregating and releasing data to increase accessibility and **resolution of data products**.



All Parcel FOM Results Counties, 2022

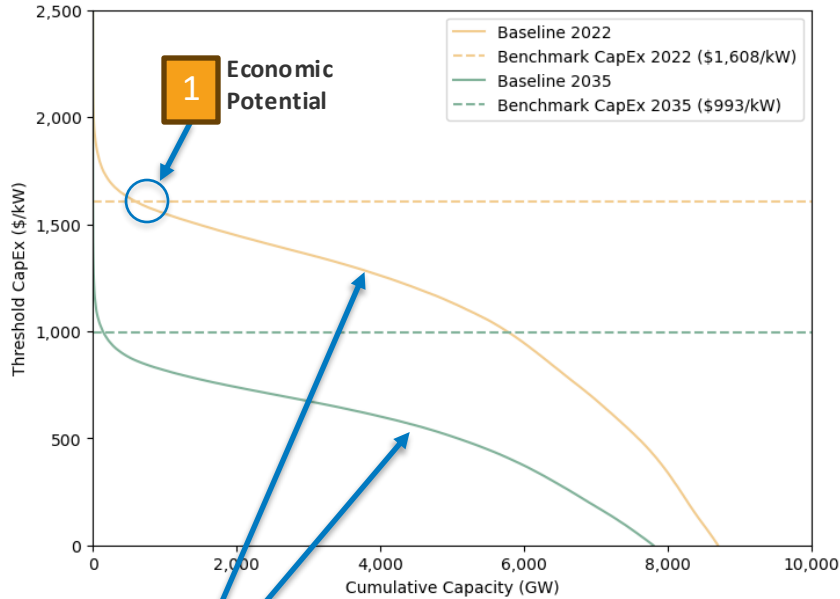


All Parcel BTM Results Counties, 2022

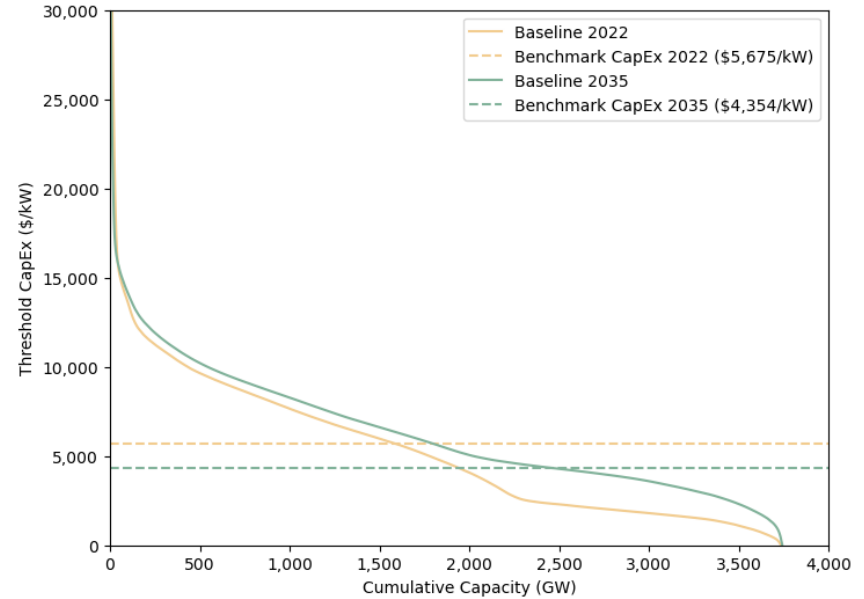


CapEx / Capacity Curves

Front of Meter



Behind the Meter



FOM	Tech Pot (GW)	Econ Pot (GW)	BTM	Tech Pot (GW)	Max Econ Pot (GW)	Min Econ Pot (GW)
2022	8,695	584	2022	3,735	1,595	28
2035	7,796	151	2035	3,743	2,443	50

2

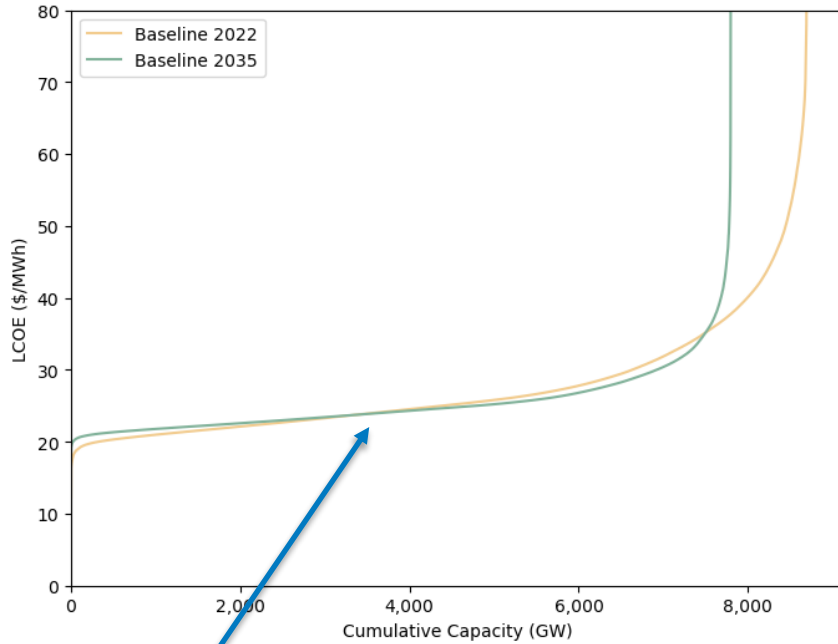
Additional economic capacity could be enabled with incentives or cost savings

3

612 GW of combined economic capacity using the most conservative estimates

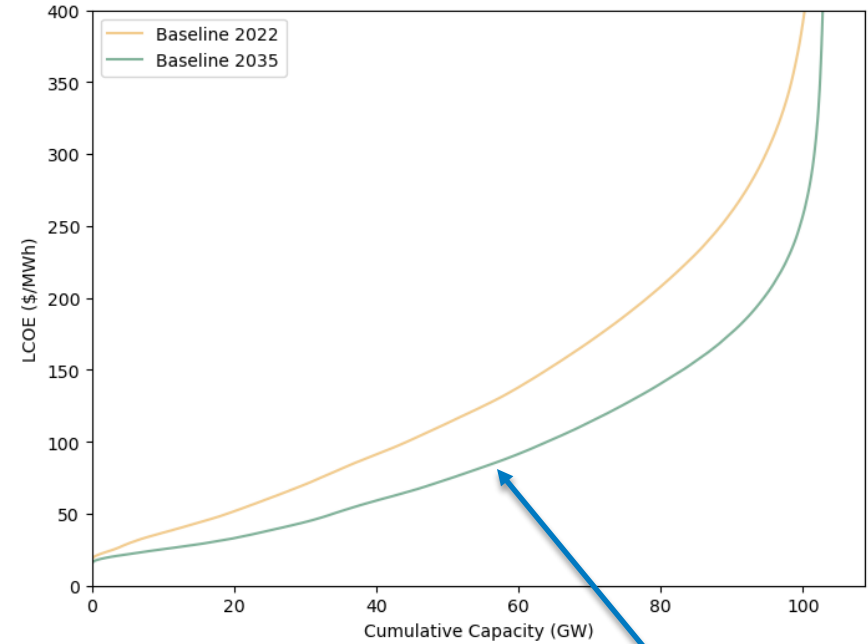
LCOE Curves: \$0.01 per MWh

Front of Meter



1 Substantial capacity at ~\$0.20-\$0.30/kWh

Behind the Meter

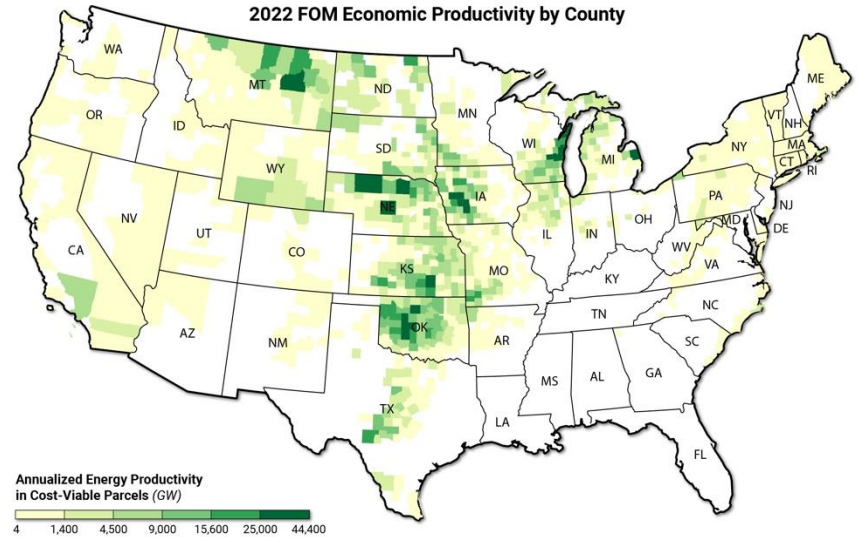
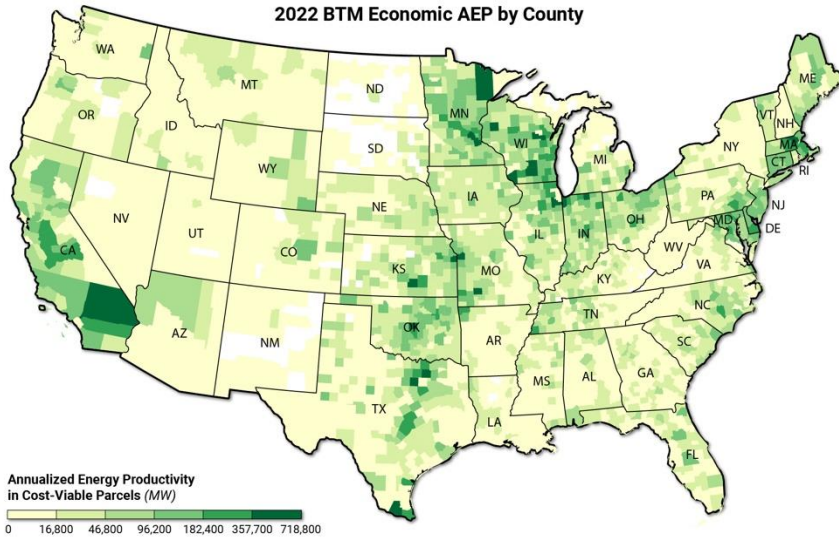


2 More linear relationship between cost/capacity. Costs reduced in future scenarios

Cost Viable (Economic) AEP

BTM

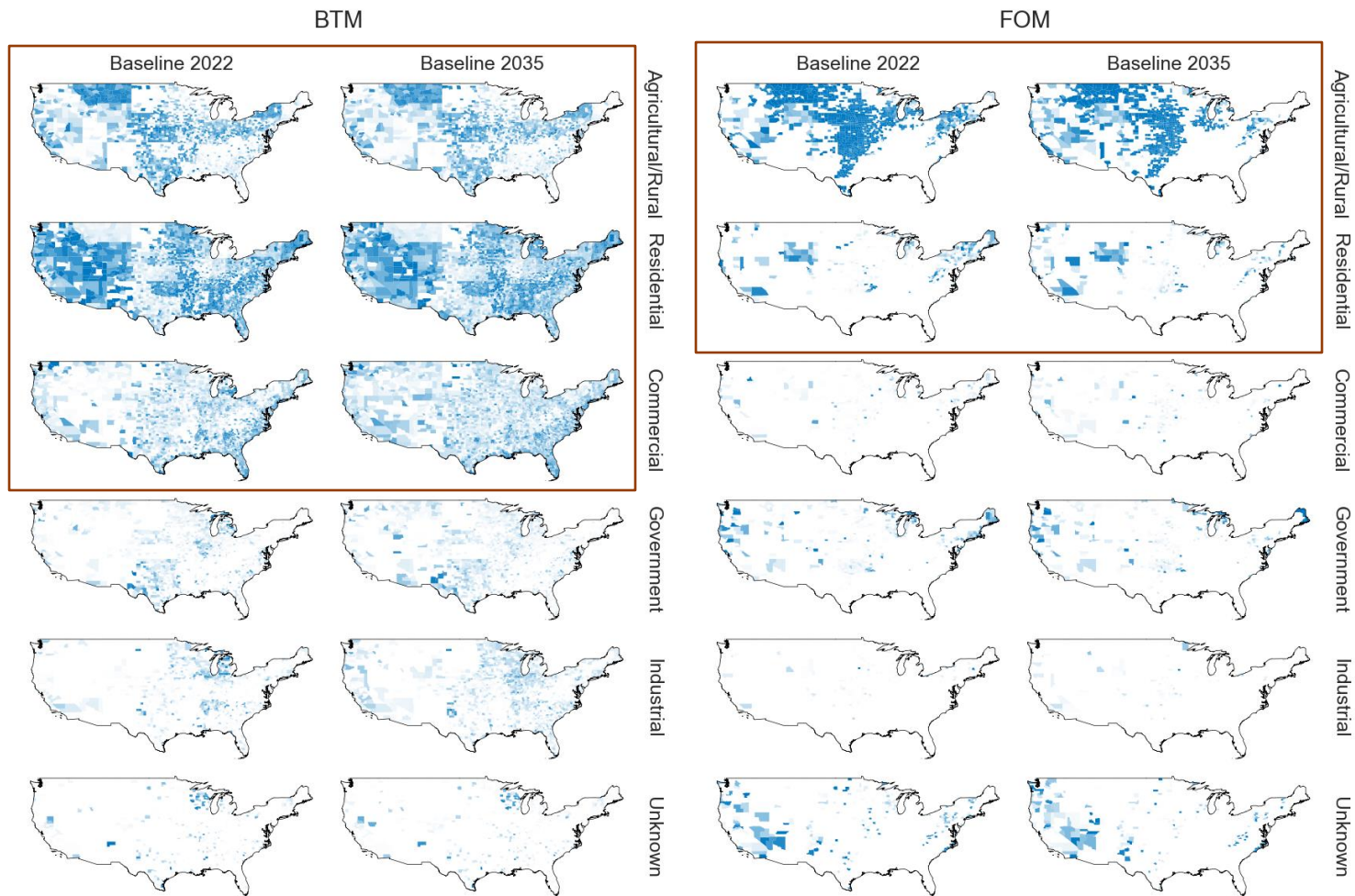
FOM



Cost Viable AEP (TWh)	Min. BTM	FOM
Baseline 2022	102	3,142
Baseline 2035	171	802

Land use and zoning analysis

- Substantial opportunity in **Agricultural and Rural** parcels.
- Substantial opportunity for BTM in **Residential, Commercial and Industrial**

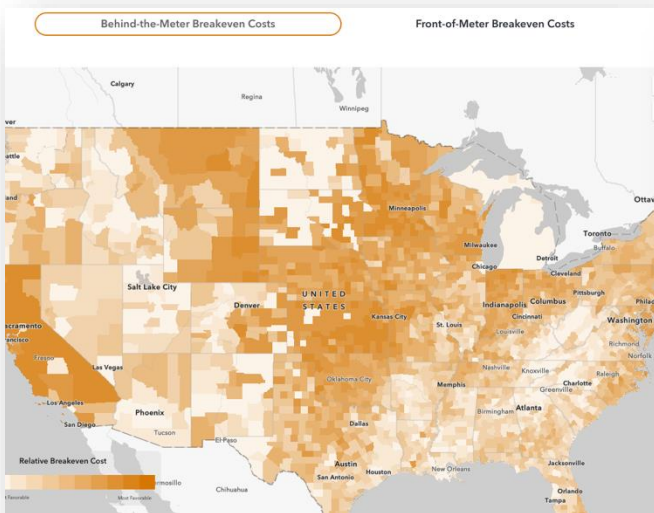


Explore the Data Yourself

We support three ways to access the data:

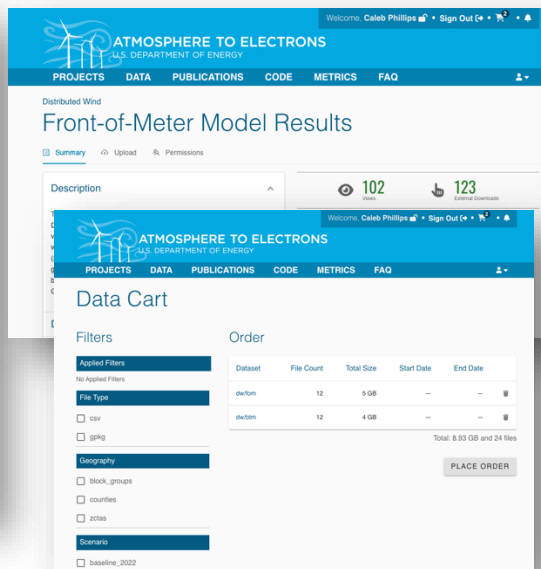
The Distributed Wind Explorer

<https://arcg.is/9C5uD1>



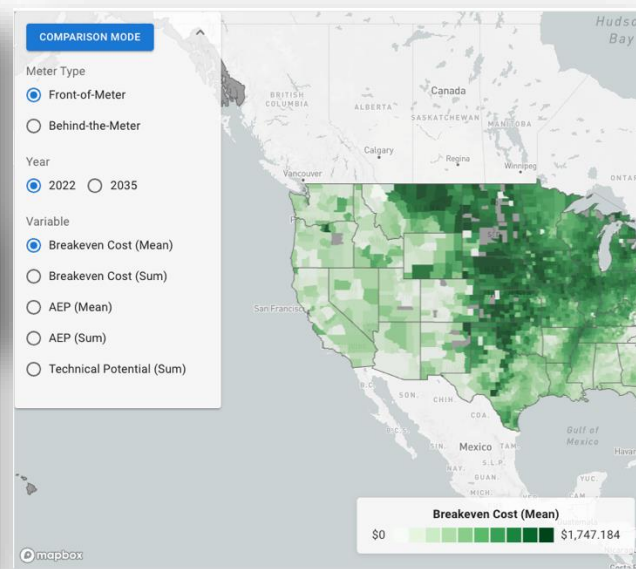
A2E Wind Data Portal

<https://a2e.energy.gov/project/dw>



DW Scenario Analyzer

<https://hero.nrel.gov/app/dwind/map>

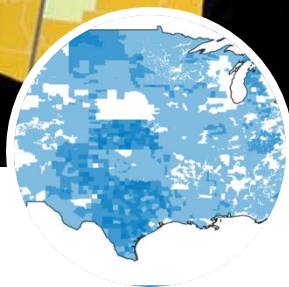


What's Next



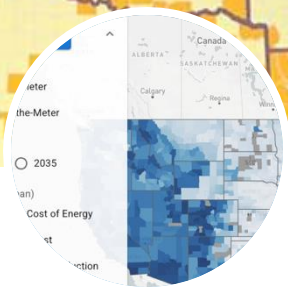
Hybrid Systems Modeling

Initial exploration of model improvements to adopt solar and storage



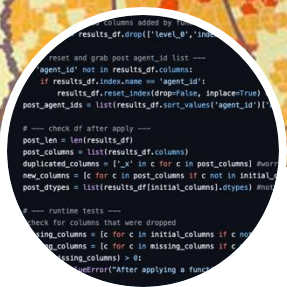
Spatial Analysis

Detailed exploration of spatial trends and correlating variables including work with USDA



Accessible Products

Locally tailored data products and tools to enable communities to leverage results



Software Updates

First full update of open source codebase in 5 years



New Scenarios

Updated scenarios and process for 2025, including updates to key data sources



Thank you

Photo Credit: Caleb Phillips

Caleb.Phillips@nrel.gov

dweifs@nrel.gov

dw.nrel.gov

