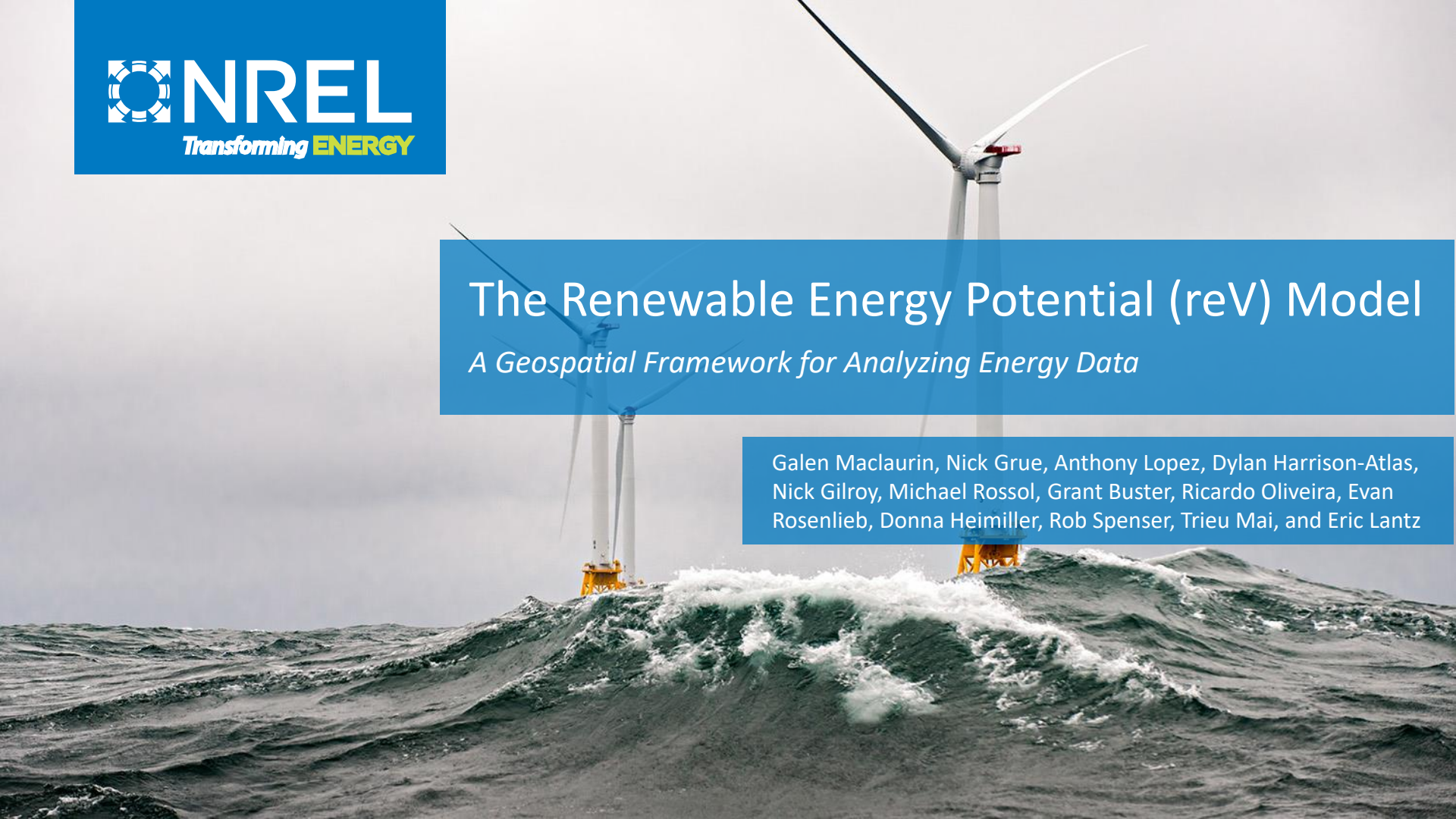


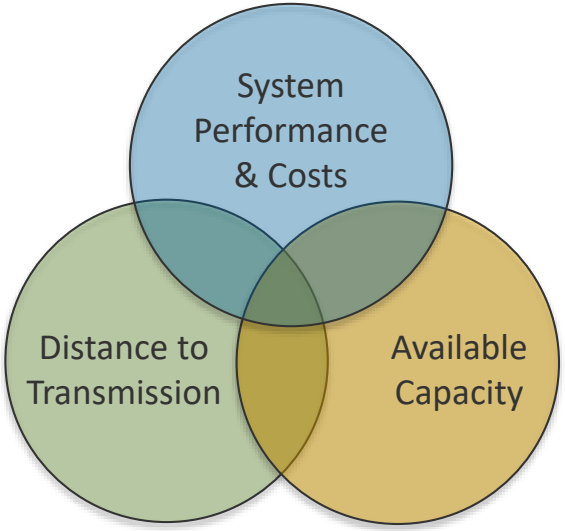
The Renewable Energy Potential (reV) Model

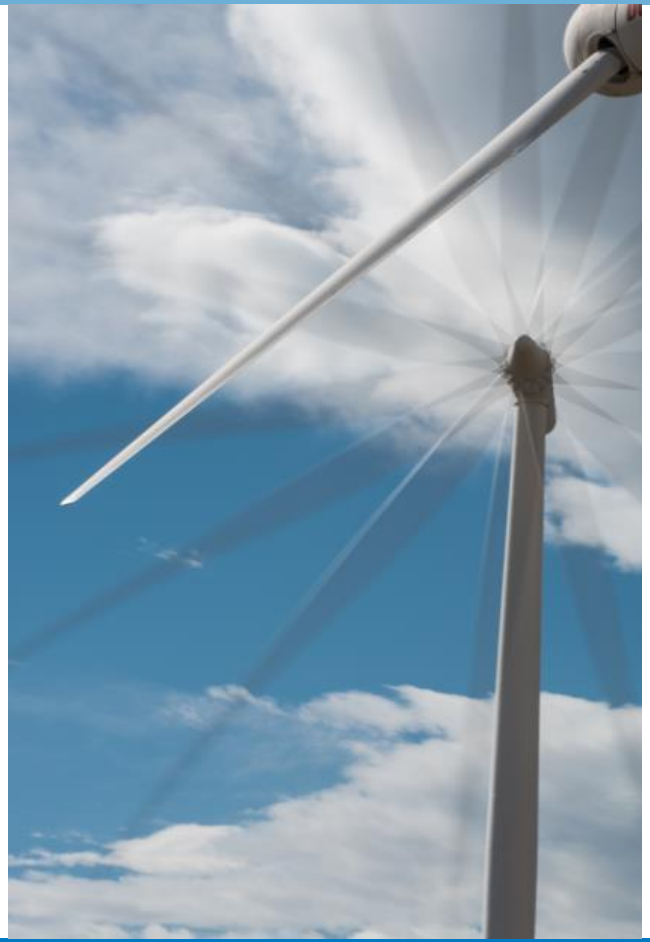
A Geospatial Framework for Analyzing Energy Data

Galen Maclaurin, Nick Grue, Anthony Lopez, Dylan Harrison-Atlas, Nick Gilroy, Michael Rossol, Grant Buster, Ricardo Oliveira, Evan Rosenlieb, Donna Heimiller, Rob Spenser, Trieu Mai, and Eric Lantz

The Renewable Energy Potential (V) Model

reV is a geospatial platform for assessing system performance, available capacity, distance to transmission, and total costs for potential wind and solar energy deployment at regional to continental scales.





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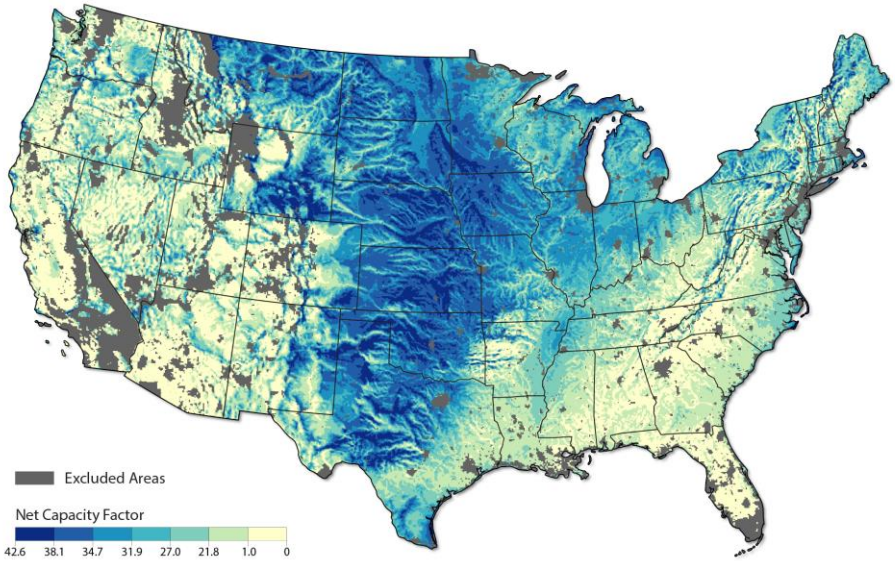
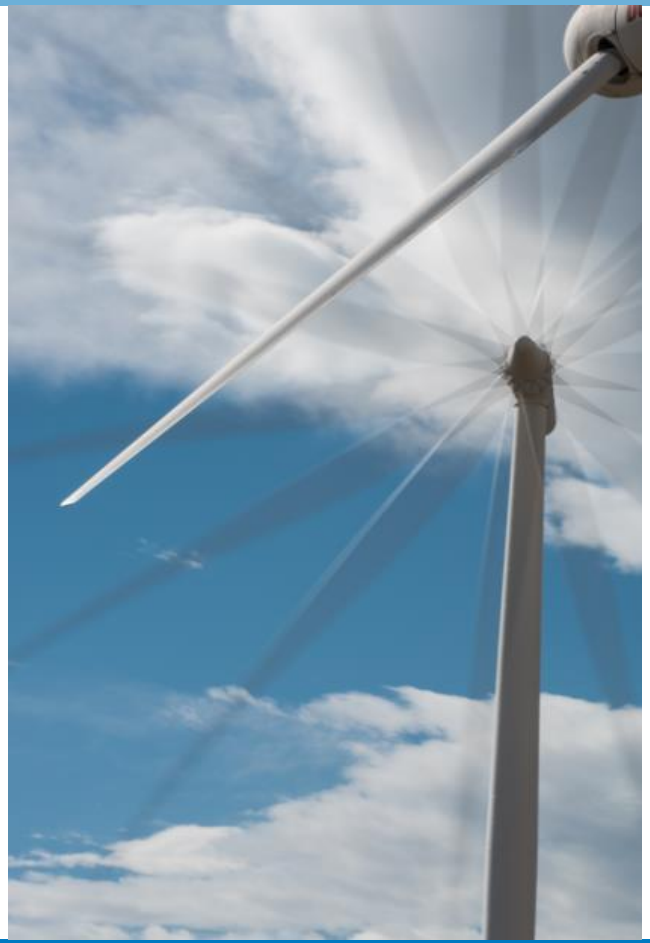
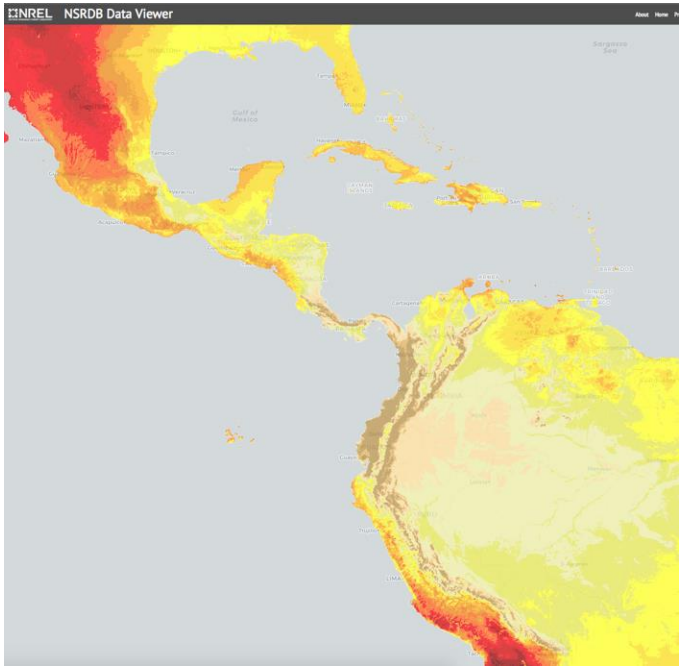




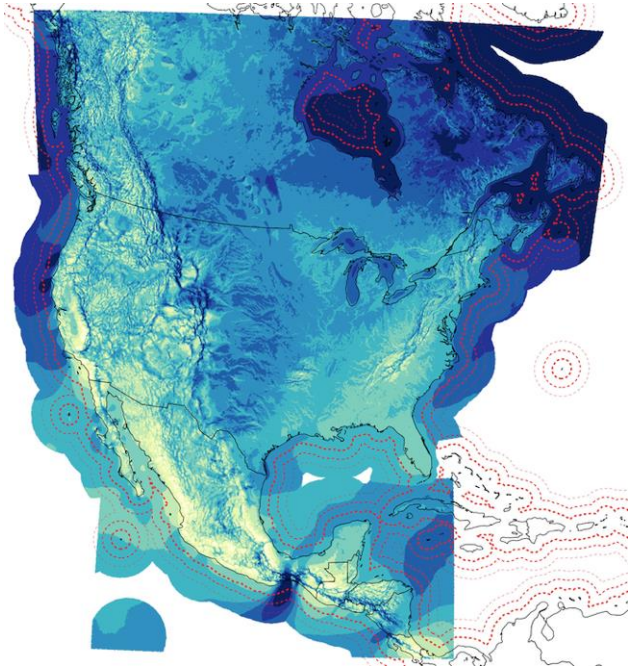
Big Data: Spatiotemporal Solar and Wind Resource Data Sets



National Solar Radiation Database (NSRDB)

- Temporal Range: 1998-2017
- Temporal Interval: 30-minute
- Spatial Resolution: nominal 4 km
- Spatial Extent: Western Hemisphere

nsrdb.nrel.gov

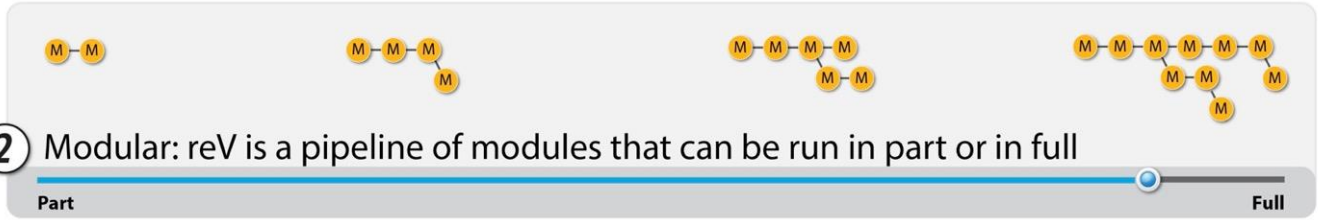


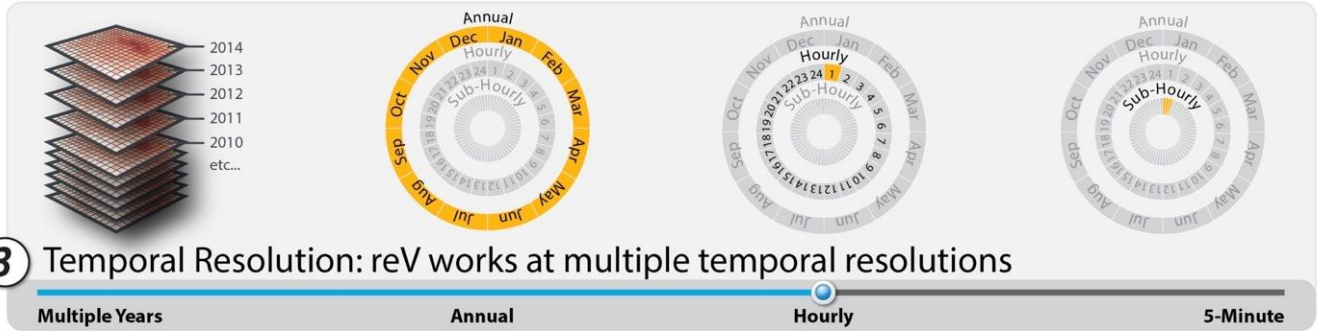
WIND Toolkit

- Temporal Range: 2007-2014
- Temporal Interval: 5-minute or hourly
- Spatial Resolution: nominal 2 km
- Spatial Extent: North America

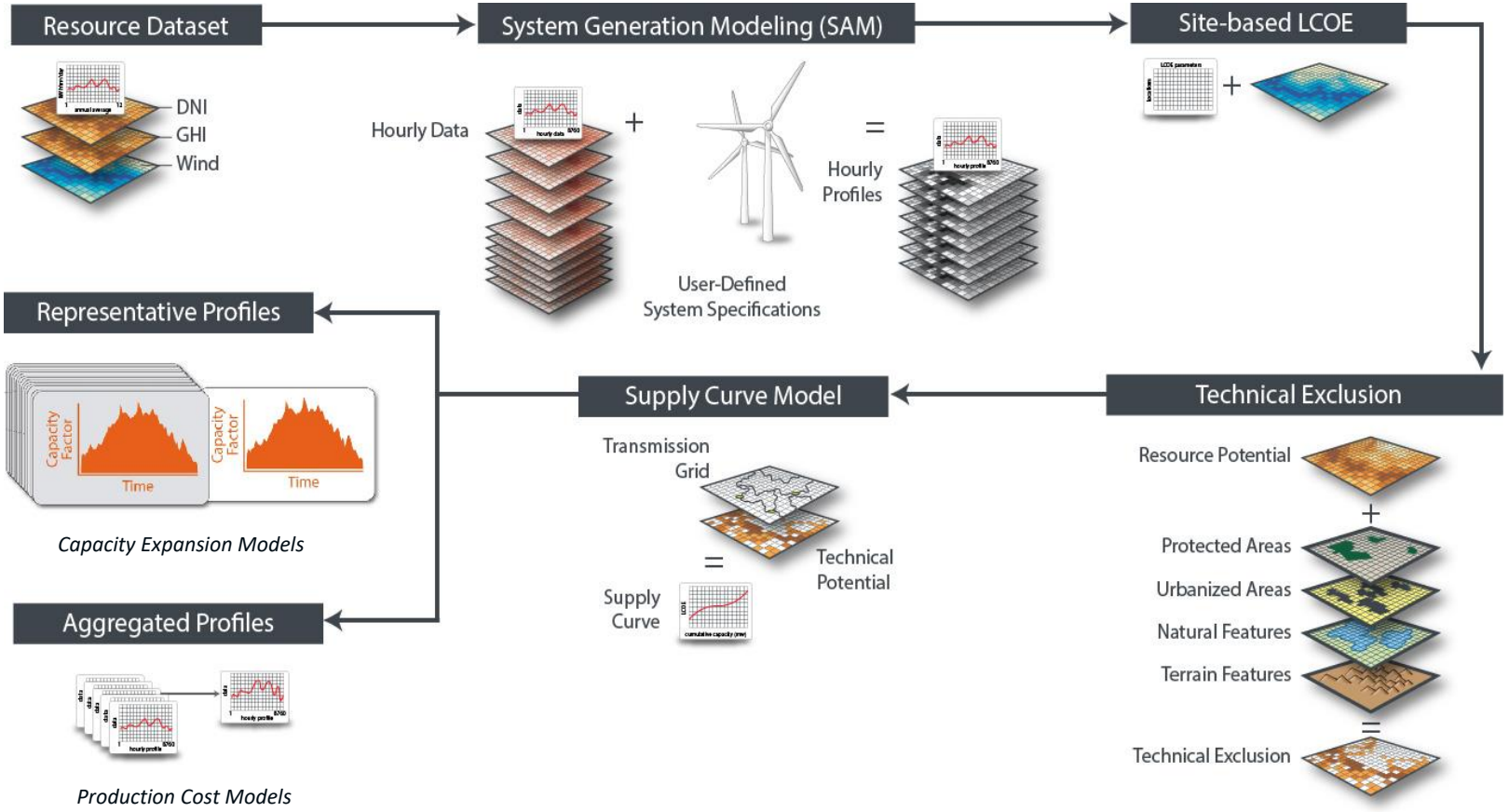
www.nrel.gov/grid/wind-toolkit.html

reV is Flexible in Scope and Scale



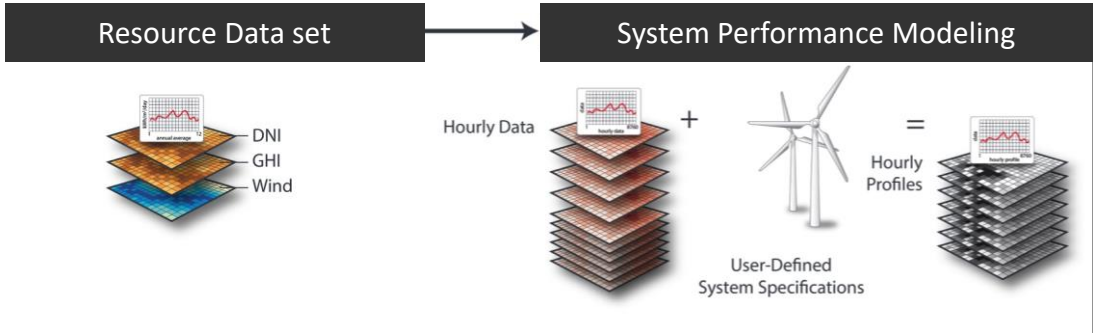


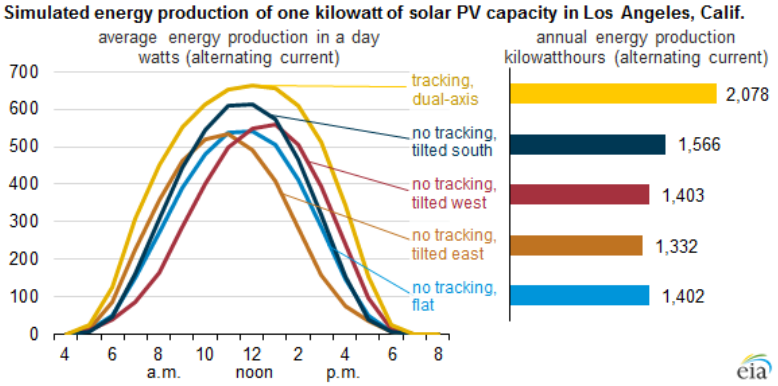
reV Model Diagram

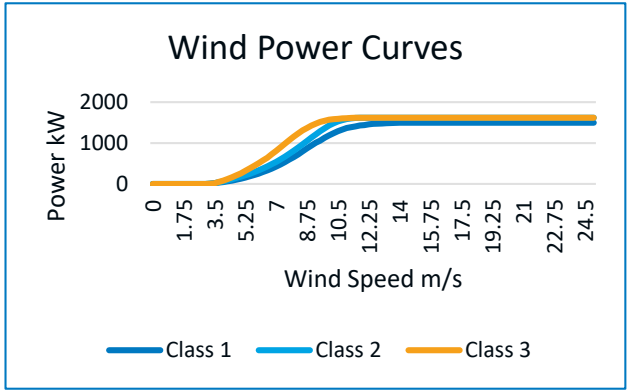


Generation Potential

reV couples with NREL's System Advisor Model (SAM)* to estimate time series capacity factors at the resource data resolution (e.g., 5-min, hourly)

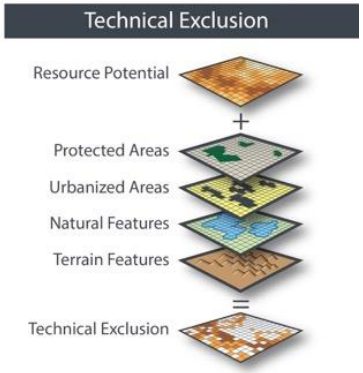


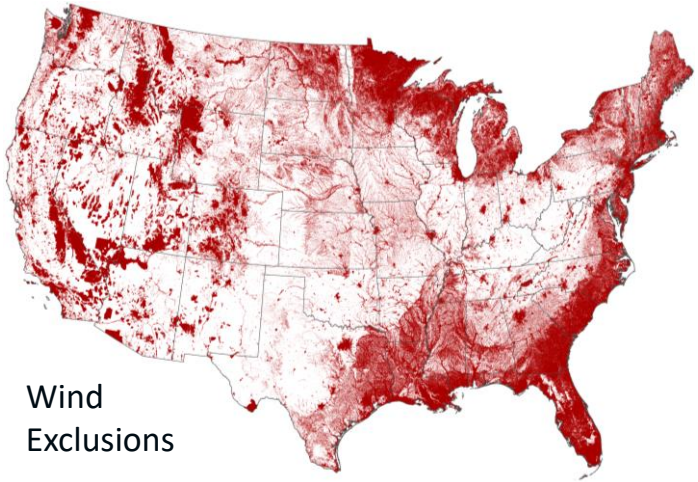




* sam.nrel.gov

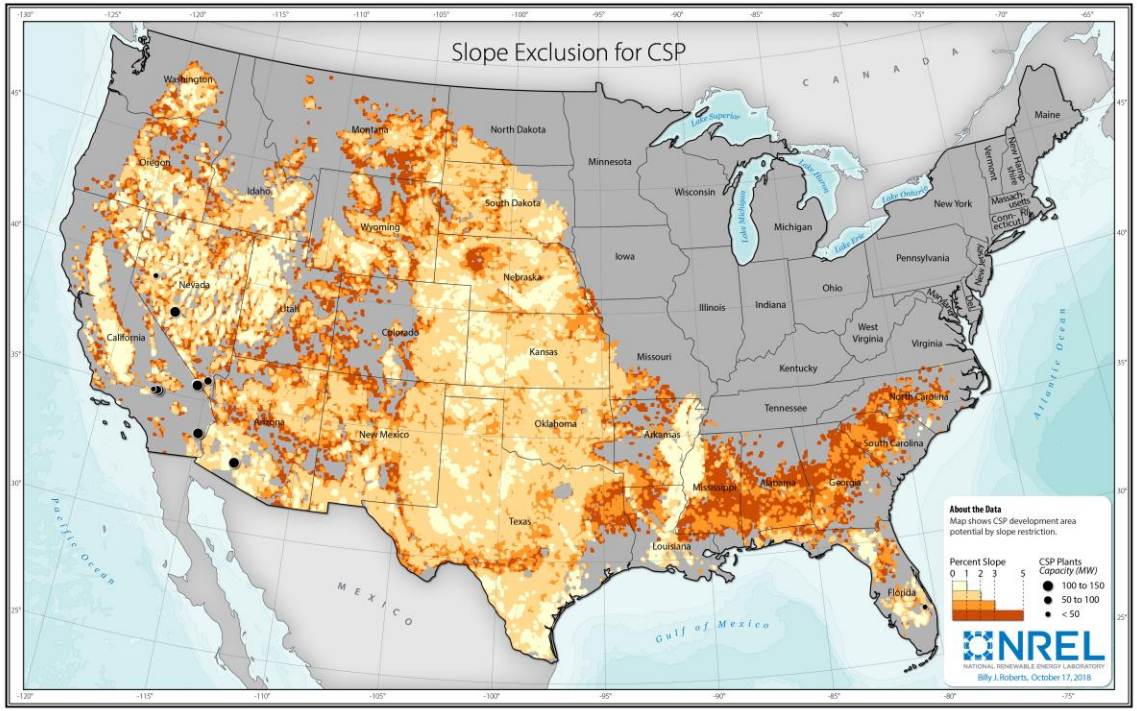
Technical Exclusions





Wind Exclusions

Limiting CSP deployment potential by resource quality and terrain slope

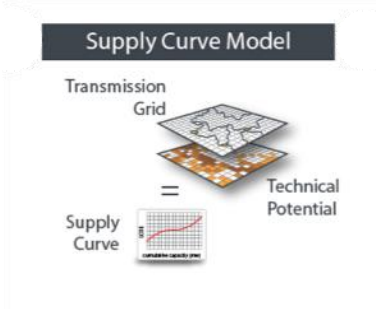


- Exclusions provide a means to model **siting considerations** and their **impact on supply**.
- Exclusions typically represent **sociopolitical**, **ecological**, and **technical constraints**.

Supply Curve: Technical Potential

Annual Technical Potential=

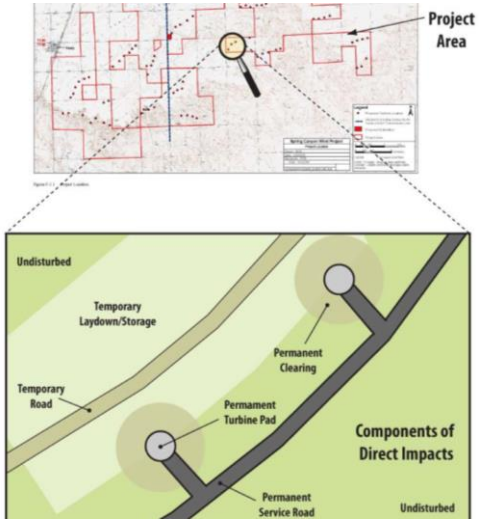
Available area (km^2) * **Power Density (MW/km^2)** * Mean Capacity Factor * 8760 hours



PV Plant

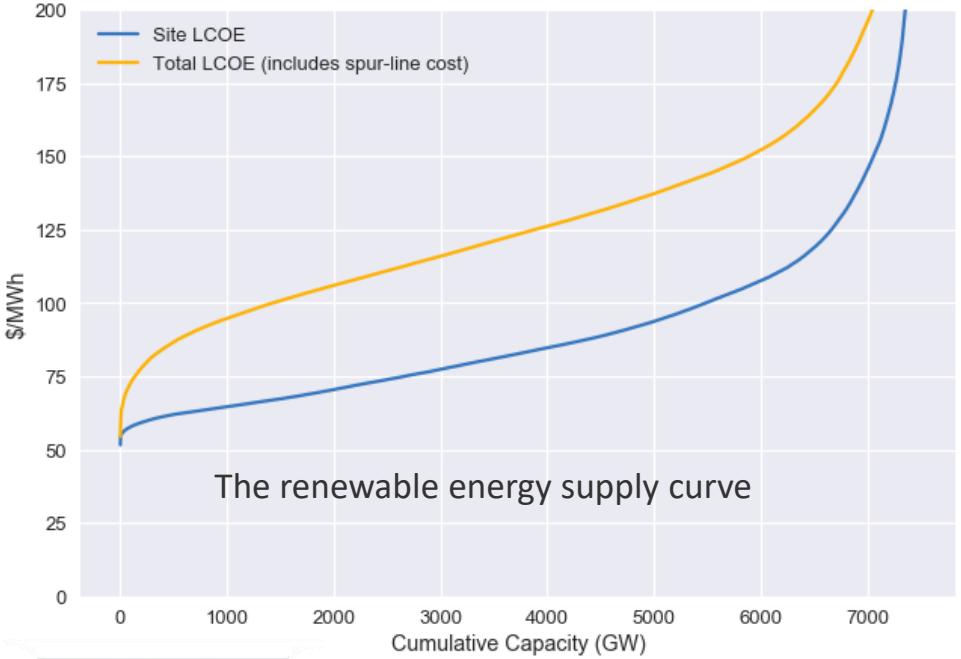
Typically 28-36 MW/km^2 Fixed-Tilt PV

Wind Plant

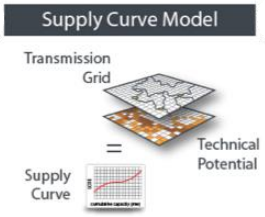


Typically 3-5 MW/km^2 Wind Plant

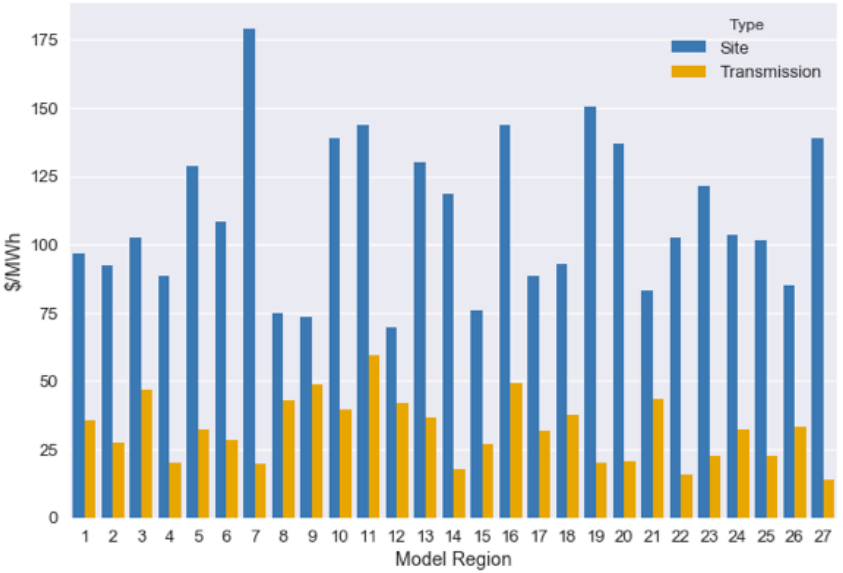
Supply Curve: Levelized Cost of Transmission (LCOT)



The renewable energy supply curve

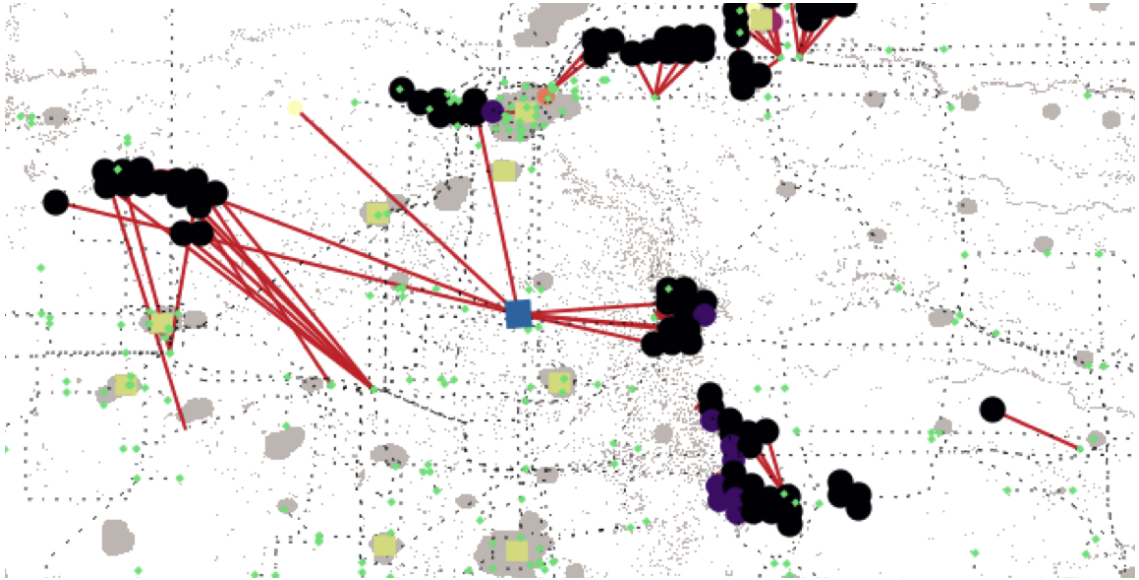


Transmission plays a vital role in assessing the deployment costs of renewable energy deployment



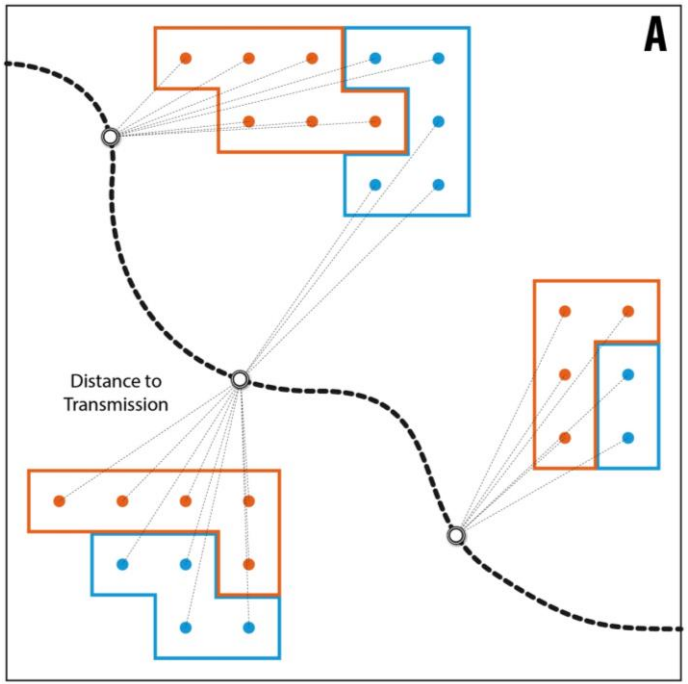
Distribution of plant and transmission costs across space

Supply Curve: Levelized Cost of Transmission (LCOT)



- Routing is by Euclidean distance
- Assumption of transmission capacity availability (10%)
- Synthetic features used to model high RE penetration scenarios
- Competitive connection method could be improved

reV routes spur lines from potential generator locations to transmission features (Point of Interconnect)



Integral Part of a Modeling Community

reV is Powerful Analysis and Modeling Software,

Resource Dataset Modeling
Where and How Much Resource is Available?

Site Suitability Analysis
Where Can We Build and How Much Power Can We Generate?

System Modeling
What Kind of System Do We Build to Generate the Power We Need?

Supply Curve Modeling
How Does Energy Cost Affect Energy Supply?

and its products enable others to do even more.

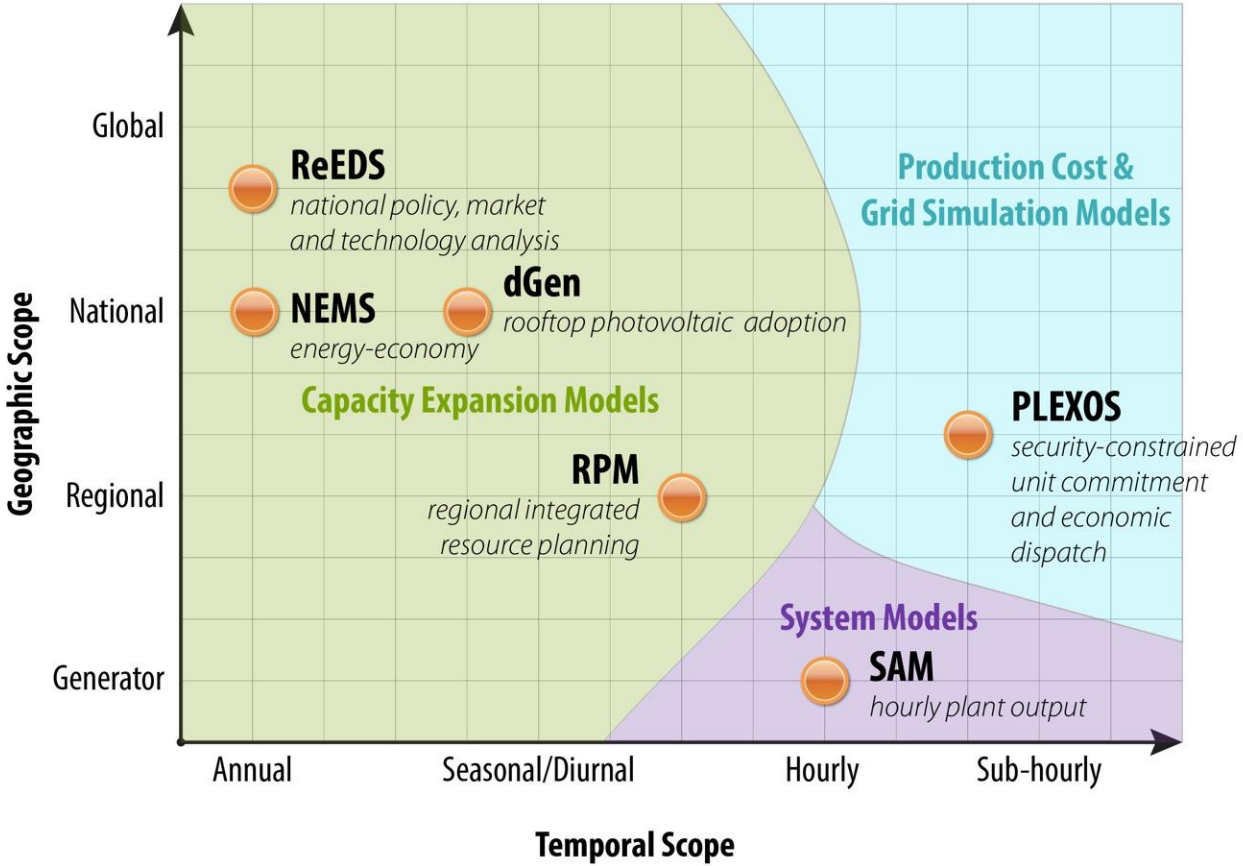
Production Cost Modeling
How Do We Get Power Where It's Needed, When It's Needed?

Renewable Energy Zones
How Do We Plan Transmission Systems to Access High Quality Renewable Energy?

Capacity Expansion Modeling
Where Do We Put New Power Plants?

Policy Design
How Do We Design Policy to Take Advantage of Local Resources?

Integral Part of a Modeling Community



Regional Energy Deployment System (ReEDS)
https://www.nrel.gov/analysis/reeds/

Regional Planning Model (RPM)
https://www.nrel.gov/analysis/models-rpm.html

National Energy Modeling System (NEMS)
https://www.eia.gov/outlooks/aeo/nems/overview/index.html

Distributed Generation (dGen) Model
https://www.nrel.gov/analysis/dgen/

PLEXOS and Production Cost Modeling
https://www.nrel.gov/analysis/electric-sector-integration.html

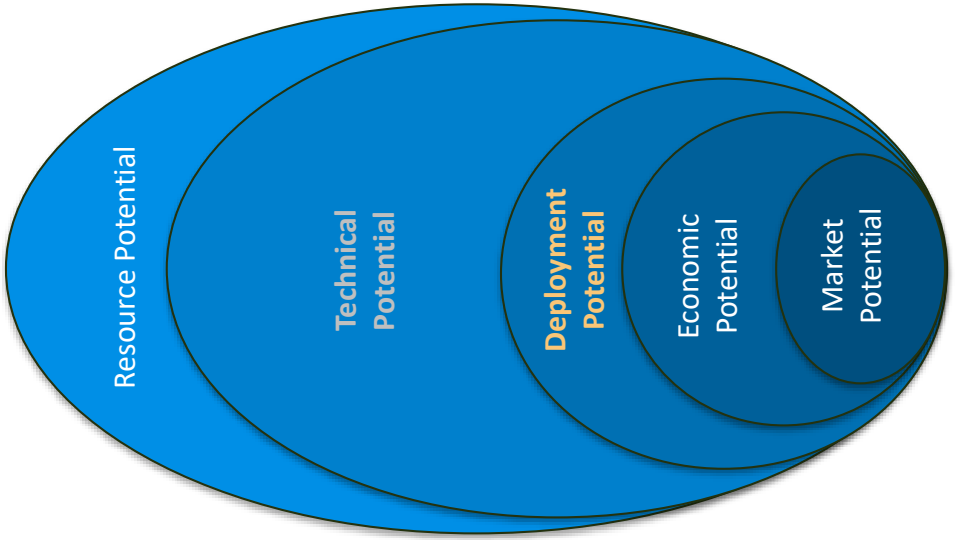
System Advisor Model (SAM)
https://sam.nrel.gov/

Next Steps: Deployment Potential

Technical potential provides an estimate of the upper bounds of available capacity which does not inform where solar or wind deployment is most viable.

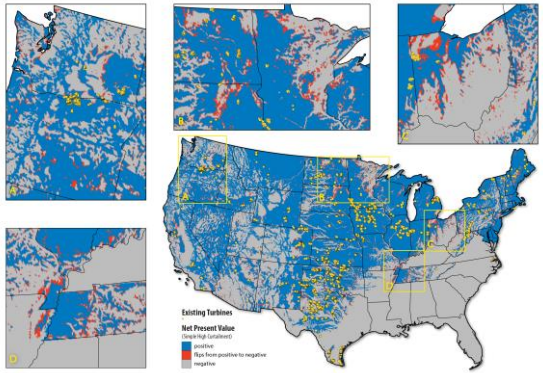
Deployment potential aims to represent the principal spatial drivers of solar and wind deployment viability.

- Where are the opportunities and barriers for solar and wind deployment?
- Where is it feasible and practical to deploy, and at what cost?
- Where is technological innovation needed and what role can it play to improve viability?

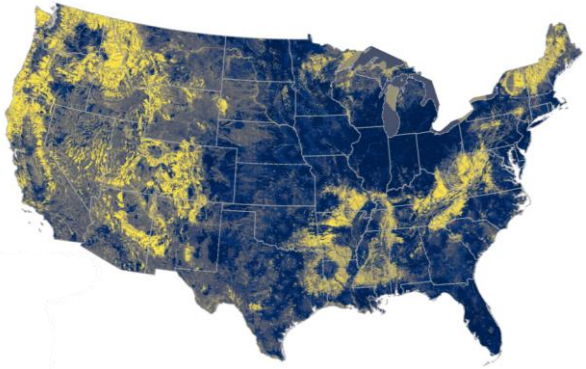


Next Steps: Deployment Potential

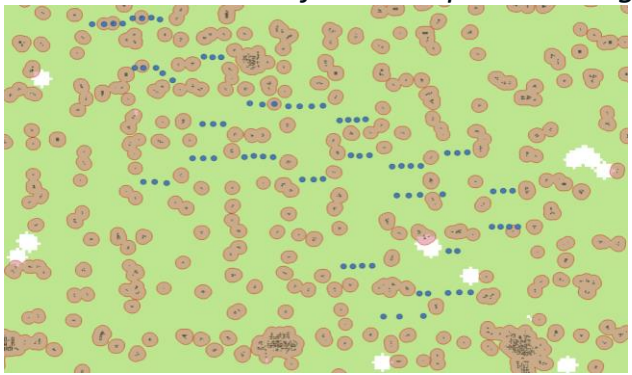
Spatially Explicit Cost Modeling



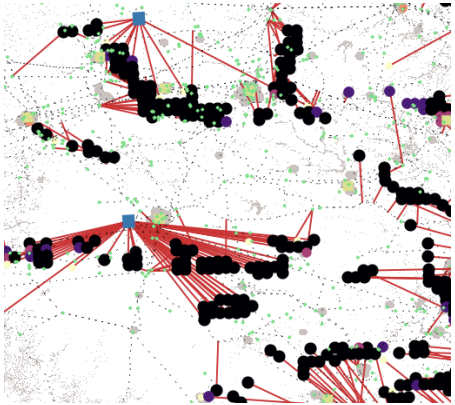
Variable Power Density



Wind turbine setbacks from occupied buildings

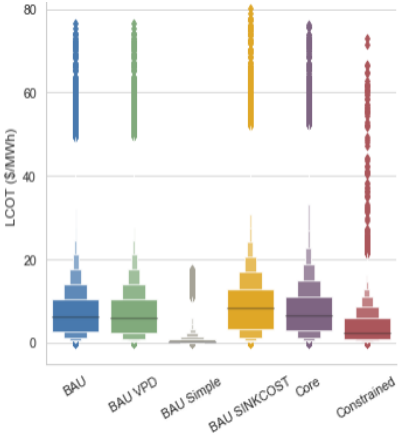


Transmission Routing



Offshore Wind Energy Potential

Scenario Modeling



Thank You!

www.nrel.gov

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nick.grue@nrel.gov
anthony.lopez@nrel.gov

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