NREL Planning Resources for States

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CESA Webinar on Energy Modeling for Decarbonization Planning: Advice and Resources for States

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NREL at-a-Glance

2,926

Workforce, including

219 postdoctoral researchers

60 graduate students

81 undergraduate students

World-class

facilities, renowned technology experts

More than 900

Partnerships

with industry, academia, and government

Campus

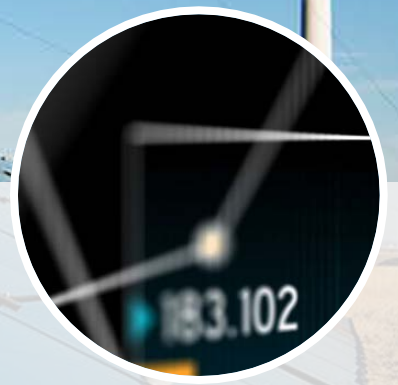
operates as a living laboratory

NREL examines the interactions between electricity users and infrastructure to enable a cost-effective and reliable grid at all scales

People +

Advanced technology +

Grid operations +



Markets and policy +

Economy-wide decarbonization

Publicly available, free resources

Annual Technology Baseline (ATB)

Standard Scenarios

Electrification Futures Study (EFS)

Annual Technology Baseline (ATB)

Credible, consistent, transparent, timely, relevant, and public data

Highly reviewed and vetted assumptions

Covers wide array of electricity and transportation technologies

Addresses key cost and performance metrics

1. Define resource bins for each technology
2. Develop cost and performance data
3. Calculate LCOE

IMPACT

Enables understanding of technology cost and performance across energy sectors and thus informs electric sector analysis nationwide.

For more: https://atb.nrel.gov/

ATB Technologies and Cost Projections Example

Electricity

Renewable Energy Technologies

- Wind
- Solar photovoltaics (PV)
- Concentrating solar power (CSP)
- Hydropower
- Geothermal
- Storage

Fossil Energy Technologies

- Natural gas
- Coal

Other Technologies (EIA AEO Data)

- Nuclear
- Biopower

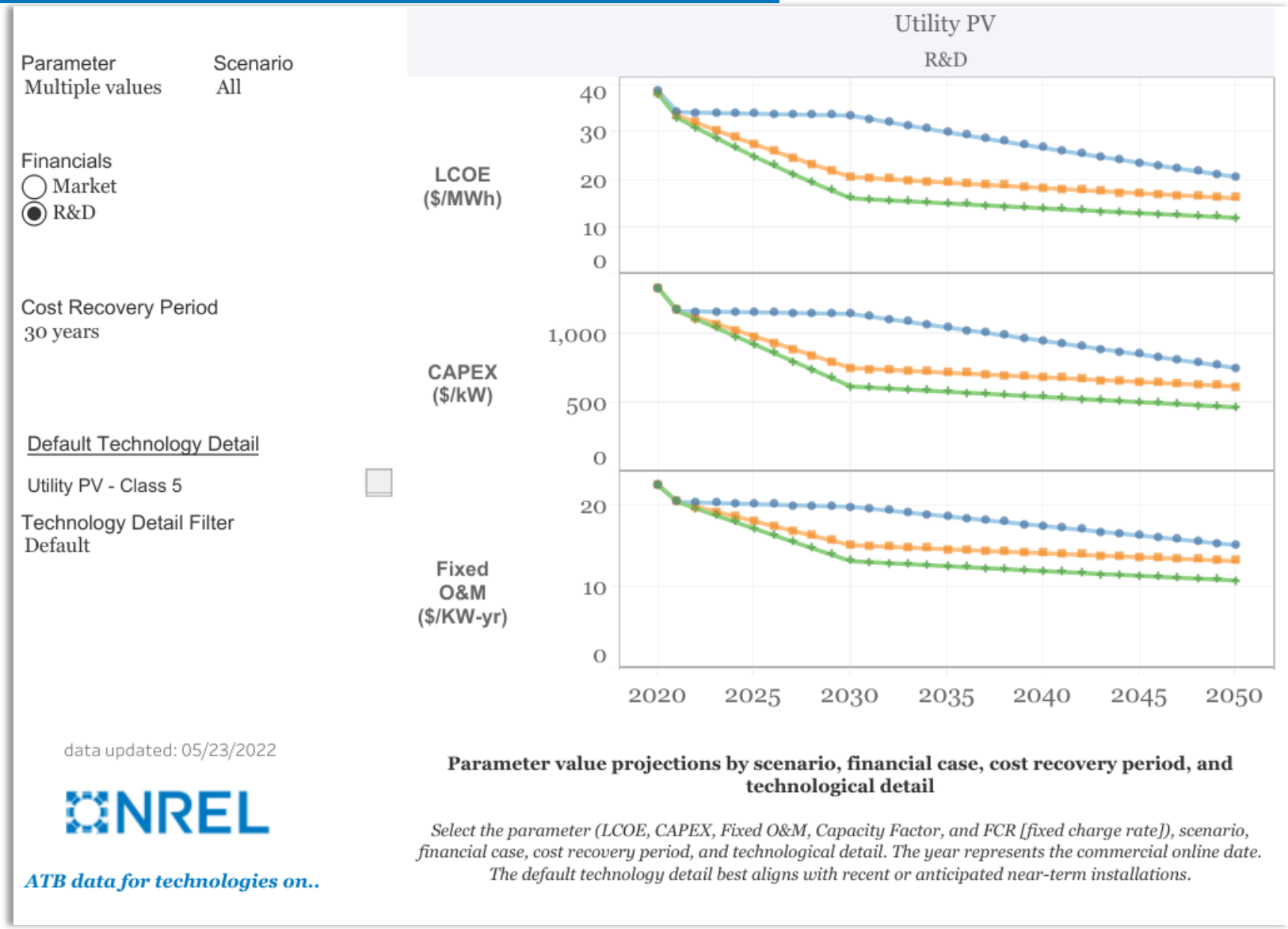
Transportation

Light-Duty Electric Vehicles

- Gasoline
- Diesel
- Natural Gas
- Gasoline Hybrid
- Plug-In Hybrid
- Battery Electric
- Fuel Cell

Fuels

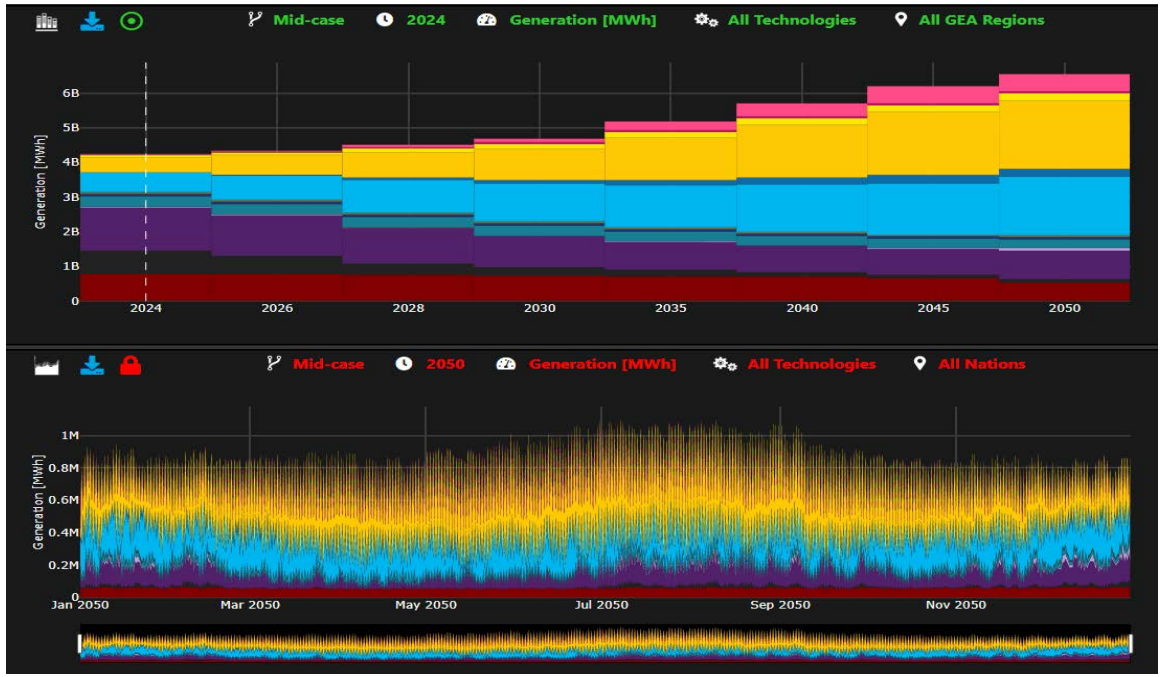
- On-Road Fuels
- Jet Fuel
- Marine Fuel



Parameter value projections by scenario, financial case, cost recovery period, and technological detail

Select the parameter (LCOE, CAPEX, Fixed O&M, Capacity Factor, and FCR [fixed charge rate]), scenario, financial case, cost recovery period, and technological detail. The year represents the commercial online date. The default technology detail best aligns with recent or anticipated near-term installations.

Cambium and Standard Scenarios



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Cambium **Standard Scenarios**

ReEDS

Pieter Gagnon

Wesley Cole

IMPACT

Hundreds of building engineers, architects, regulators, utilities, and other stakeholders use Cambium in their decision-making workflows—and Cambium data are part of a Carbon Index, LEED pilot credit, and published guidance for clean energy procurement decisions.

For more:
https://nrel.gov/analysis/standard-scenarios.html

EFS: The Electrification Futures Study

Technologies: What electric technologies are available now, and how might they advance?

Consumption: How might electrification impact electricity demand and use patterns?

System change: How would the electricity system need to evolve to meet changes in demand?

Flexibility: What role might demand-side flexibility play to support reliable operations?

Impacts: What are the potential costs, benefits, and impacts of widespread electrification?

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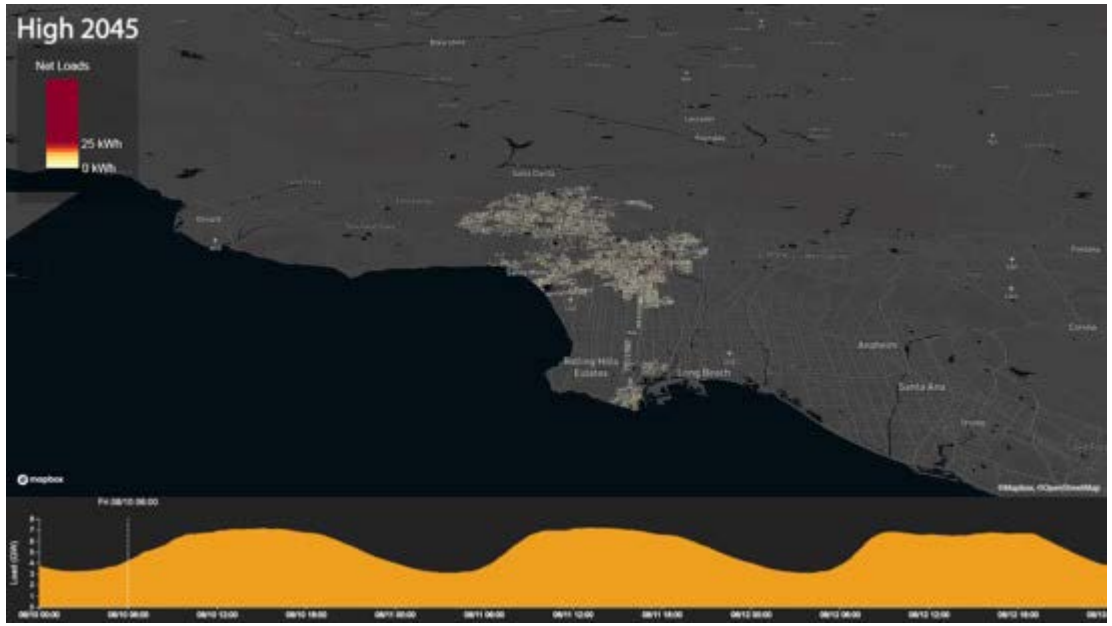
Answers crucial questions about technologies, consumption, system change, flexibility, and cost/benefit.

For more: https://nrel.gov/EFS

Local and regional integration studies

LA100: Los Angeles 100% Renewable Energy Study



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dsgrid

reV

dGen

+ dozens of other NREL models, including RPM

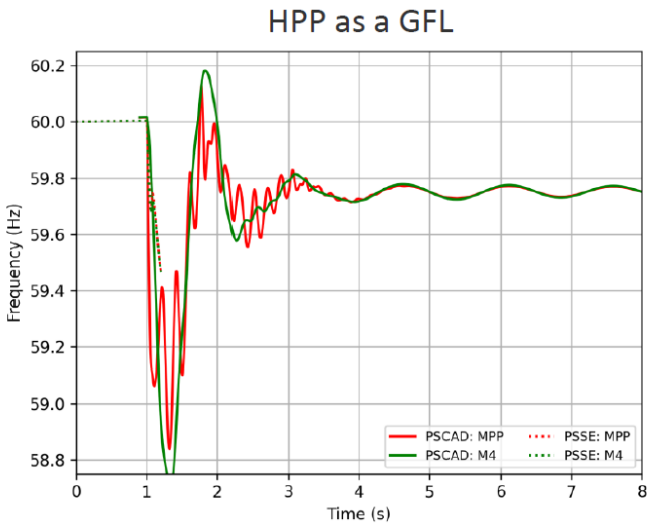
Jaquelin Cochran

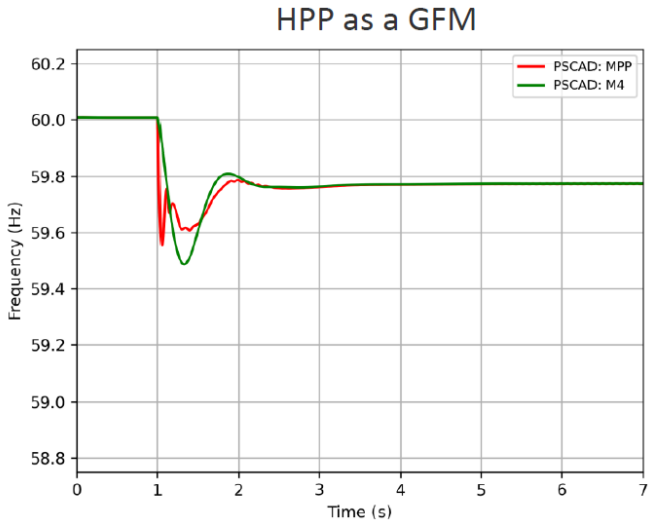
IMPACT

The Mayor and City Council of Los Angeles cited LA100 as the basis for their 100% clean energy by 2035 target. The study also provided the foundation for DOE's Clean Energy to Communities program and is informing other major 100% studies, including Lithuania 100 and Puerto Rico 100.

For more: https://maps.nrel.gov/la100

Inverter-Based Operation of Maui





IMPACT

Hawaiian Electric has advanced to the next step in a complex due-diligence process working toward operating Maui with 100% inverter-based resources—and is on track to achieve Hawaii's goal of reducing carbon emissions in 2030 by as much as 70% below 2005 levels.

For more:

https://www.osti.gov/biblio/1760667,
https://www.osti.gov/biblio/1922192,
https://www.osti.gov/biblio/1898009

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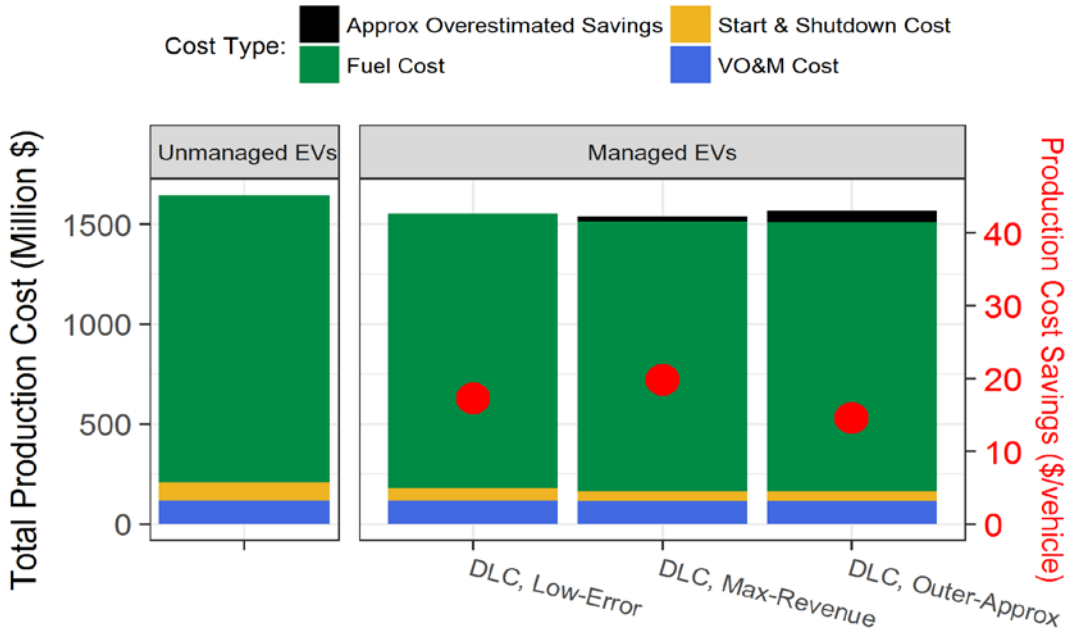
PSCAD

Bri-Mathias Hodge

Valuing Electric Vehicle (EV) Managed Charging for Bulk Power Systems



Results for 100% participation of all light-duty EVs (45% of the passenger light-duty vehicle fleet) in an envisioned 2038 ISO-NE system.

IMPACT

The new modeling approach unlocks more detailed insights for aggregators, utilities, and independent system operators (ISOs) who are planning power systems with widespread EV adoption and lots of wind and solar.

For more:
https://www.nrel.gov/docs/fy22osti/83404.pdf

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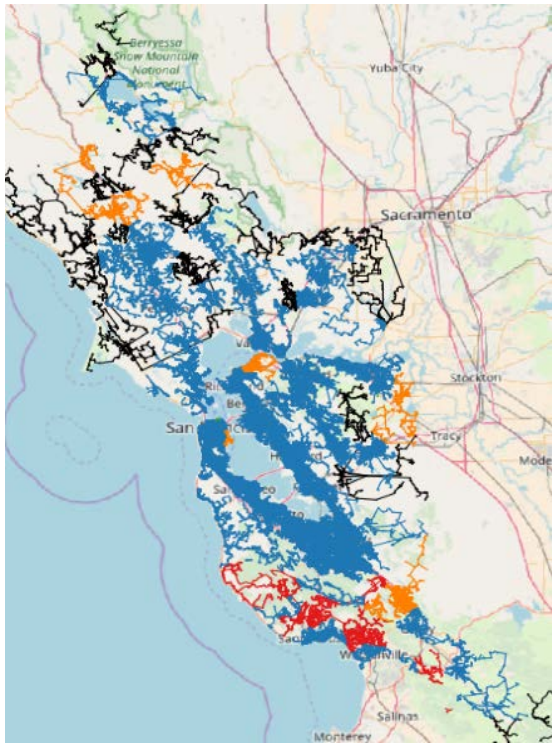
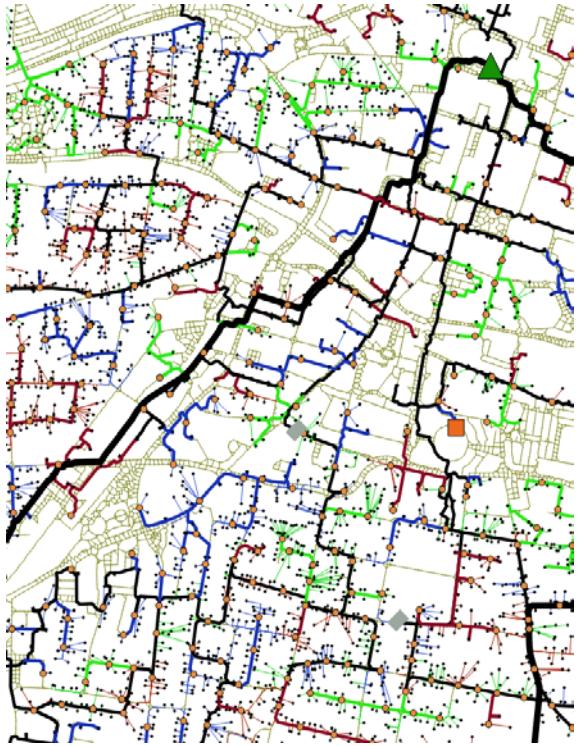
dsgrid TEMPO


Elaine Hale


Luke Lavin

Impact of Widespread EV Fast Charging on the Distribution Network





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GEMINI PyDSS

Bryan Palmintier

IMPACT

Identifying the most effective control strategies to mitigate the impact of widespread fast charging of light-duty and commercial passenger EVs.

For more:

https://www.osti.gov/biblio/1855174,
https://www.osti.gov/biblio/1958890

Forward vision

Standard scenarios for every state

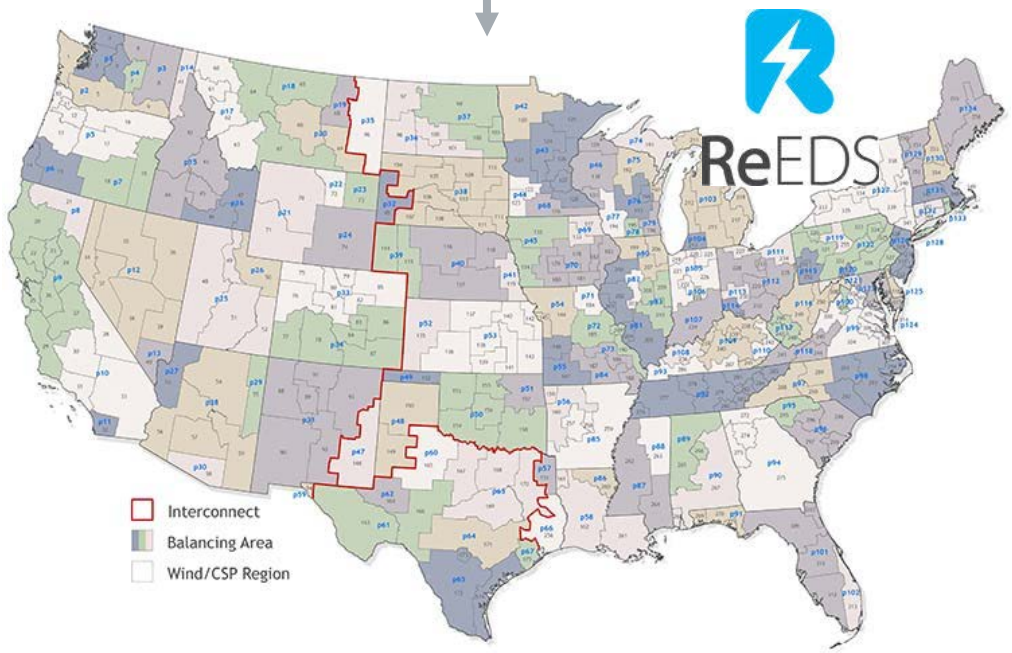
We are working toward specific, robust data sources for all key grid planning inputs

Existing System	Load Projections	Renewable Resource
GridDB	dsgrid Demand-Side Grid Toolkit	rev
Aggregate generators, storages, transmission	Aggregate over sectors, end-uses, counties	Supply curves for wind, solar, etc.

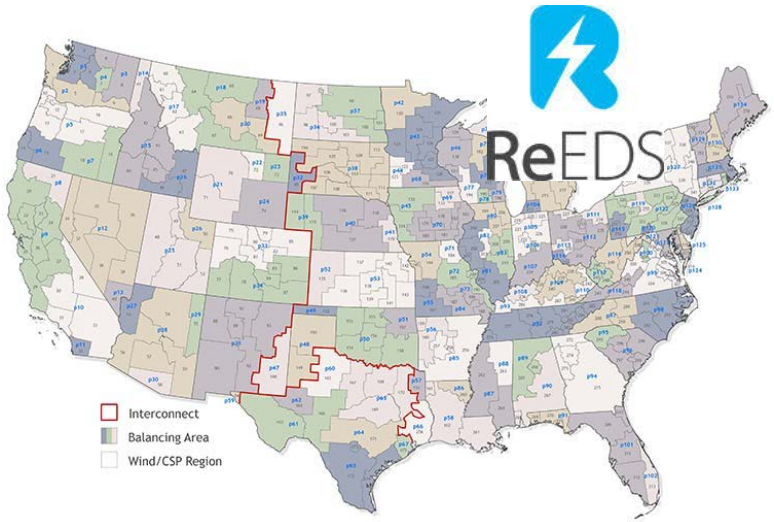
Strong link

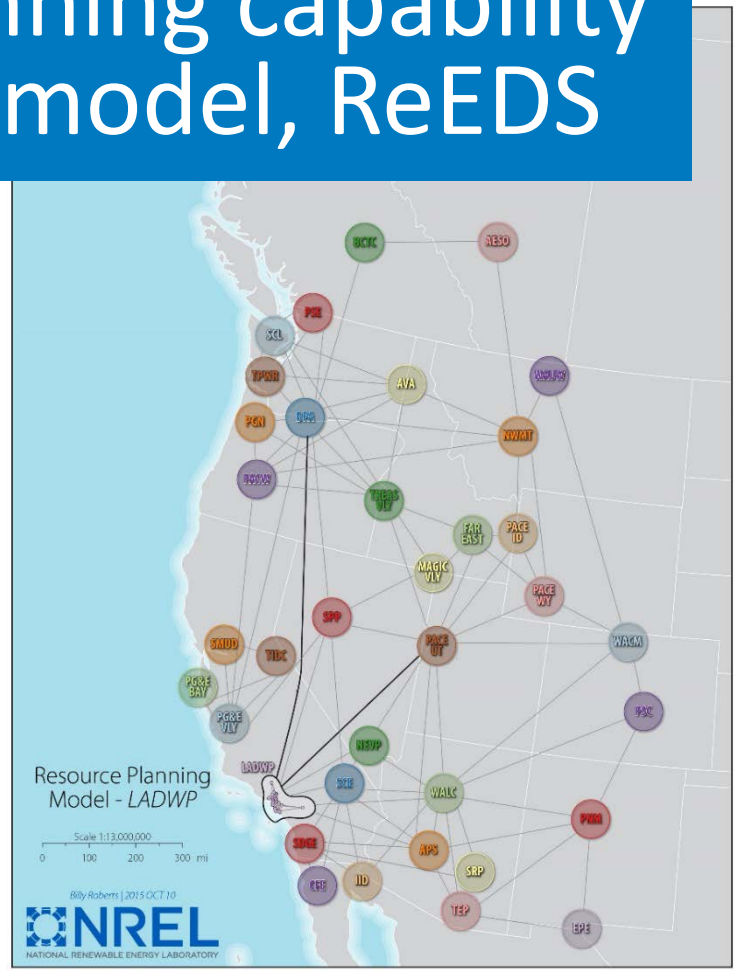
Initial link

Planned link



We are merging our nodal-zonal planning capability with our flagship national planning model, ReEDS





National-scale

- Balancing authorities
- Aggregated generators
- Pipe-flow transmission

Regional-scale

- Nodal-zonal structure
- Linear power flow within the focus region
- Limited validation

Community-scale

- Highly validated
- Additional reliability constraints (e.g., deliverability of reserves)

Combined with sufficient computing and staff resource, those developments could enable Standard Scenarios for each state

Existing System

GridDB

Load Projections

dsgrid
Demand-Side Grid Toolkit

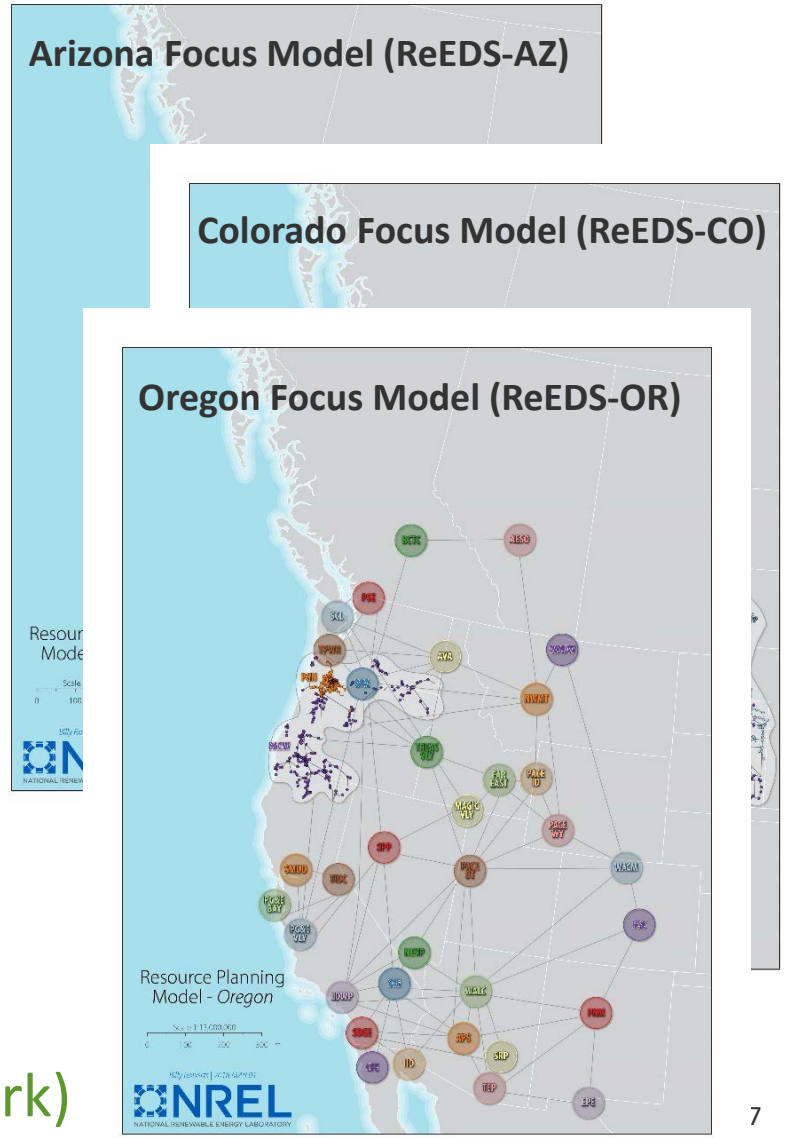
Renewable Resource

rev

Filter by Geography

Aggregate Neighboring Systems' Data

Unit-level and Nodal Data for Focus State



Annually update ….

?

(Desired Future Work)

Conclusion

Helpful resources

- **Free, publicly available resources:**
  - ATB, Standard Scenarios, EFS
  - Open Energy Data Initiative, NREL Data Catalog
  - State and local data portal: SLOPE
- **NREL-led integration studies**: LA100, Grid Forming Inverters on Maui, EV Managed Charging in New England, DCFC in San Francisco, and many more

- **Supporting capabilities:**
  - Renewable resource and generation profiles: reV
  - Customer-owned PV adoption: dGen
  - High resolution load data for grid models: dsgrid

Forward vision:

Standard Scenarios for each State

- Independent, transparent scenarios that can be used to, e.g., benchmark utility integrated resource plans
- Independent, transparent load, renewable resource, and system data that can be used by others
- Nodal-zonal models to capture state specifics (units, lines, ownership) and connections with neighbors

Please reach out if you are interested or would like to provide feedback!

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Thank You

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