



2021 Standard Scenarios Report: A U.S. Electric Sector Outlook

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2021 is the 7th Edition

2015

2016

2017

2018

2019

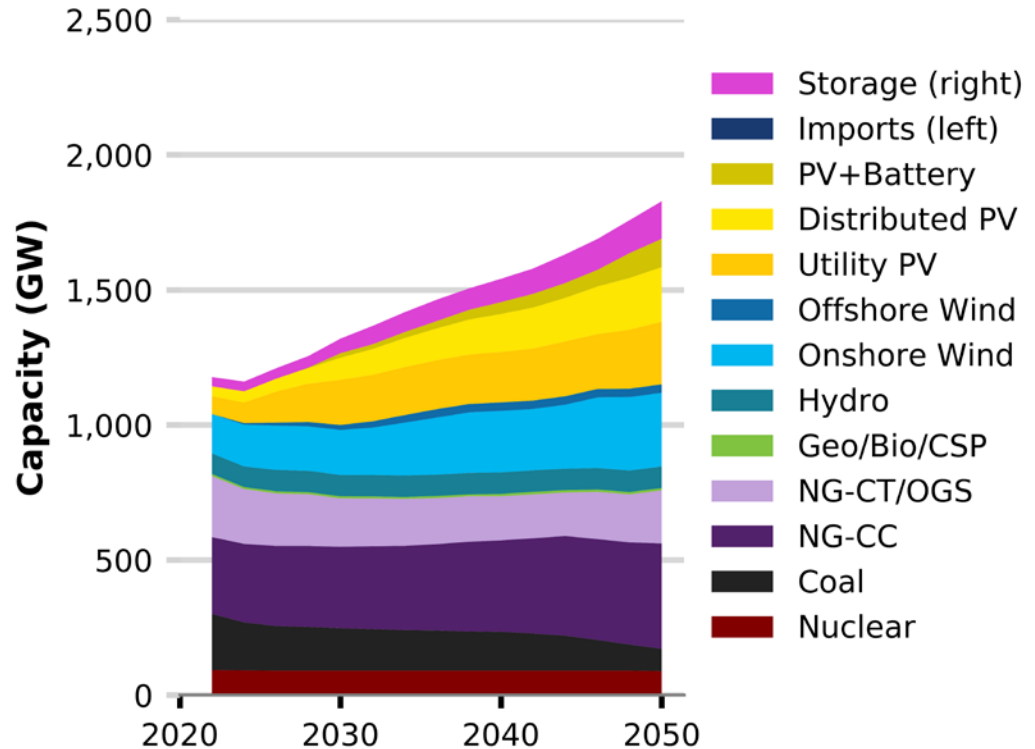
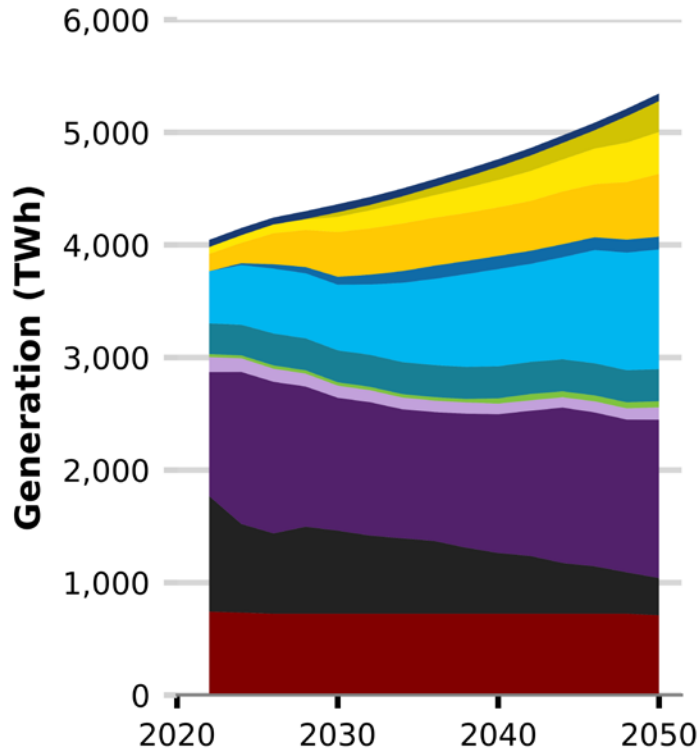
2020

2021

The Scenarios: Start with the Mid-Case

Mid-case Assumptions

- Mid Technology Costs
- Reference Fuel Prices
- Reference Demand Growth
- Default Resource Constraints
- Existing Policies as of June 2021



Sensitivities

16 sensitivity scenarios help to capture a broad range of futures

Electricity Demand Growth

- Low Demand Growth
- High Demand Growth
- High Electrification with Base Demand Flexibility
- Reference with Enhanced Demand Flexibility
- High Electrification with Enhanced Demand Flexibility

Resource and System Conditions

- High Transmission Availability
- Low Transmission Availability
- Reduced RE Resource
- No CCS

Electricity Generation Technology Costs

- Low RE and Battery Cost
- High RE and Battery Cost
- Low Nuclear and CCS Cost
- Low RE, Battery, Nuclear, and CCS Cost

Fuel Prices

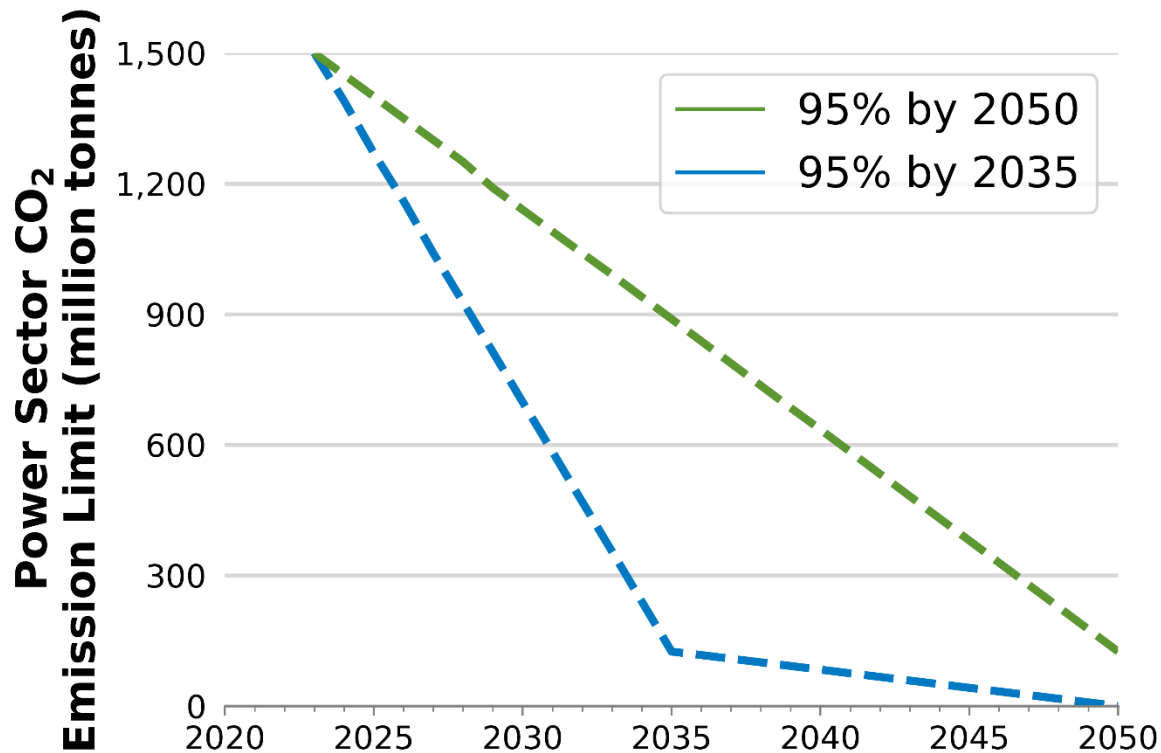
- Low Natural Gas Prices
- High Natural Gas Prices

Policy Assumptions

- Tax Credit Extension

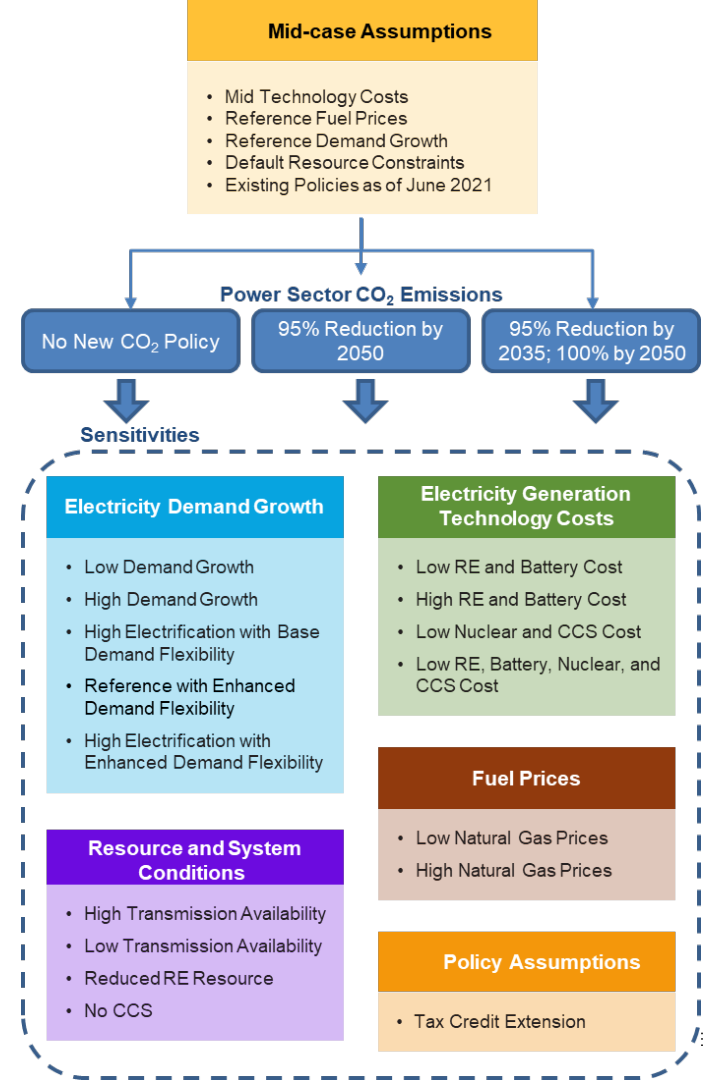
Futures with Alternate Emissions

- New to 2021 edition
- Two pathways
 - Moderate (95% by 2050)
 - Rapid (95% by 2035 and 100% by 2050)



Full Suite of Scenarios

- Each CO₂ limit is applied to all sensitivity scenarios
- There are 50 total scenarios as part of the 2021 Standard Scenarios
- All scenarios are available in the scenario viewer (cambium.nrel.gov)



Why do we do the Standard Scenarios?



DATA



TOOLS

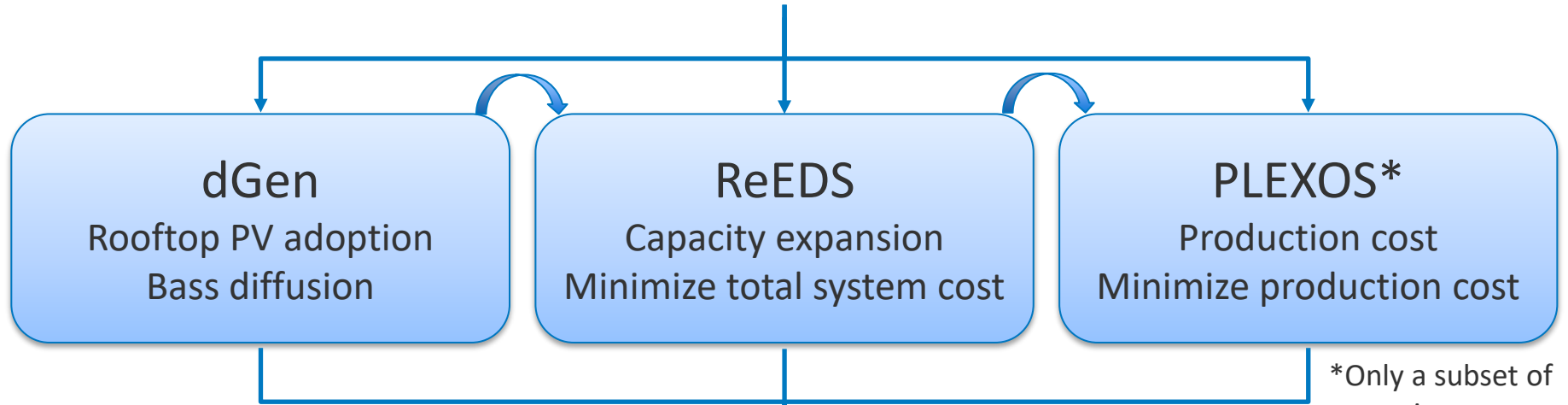


TRANSPARENCY



IDEAS

Scenarios Definitions



dGen

Rooftop PV adoption
Bass diffusion

ReEDS

Capacity expansion
Minimize total system cost

PLEXOS*

Production cost
Minimize production cost

Cambium

Output Processing

*Only a subset of scenarios were run in PLEXOS

dGen:

<https://www.nrel.gov/analysis/dgen/model-access.html>

ReEDS:

<https://www.nrel.gov/analysis/reeds/request-access.html>

Standard Scenario Results

What is Different this Year?

Input Updates

- Updated wind, PV, PSH, and biomass supply curves
- Policy updates
- Fuel prices and technology costs
- ... (see Table A-4)

Model Updates

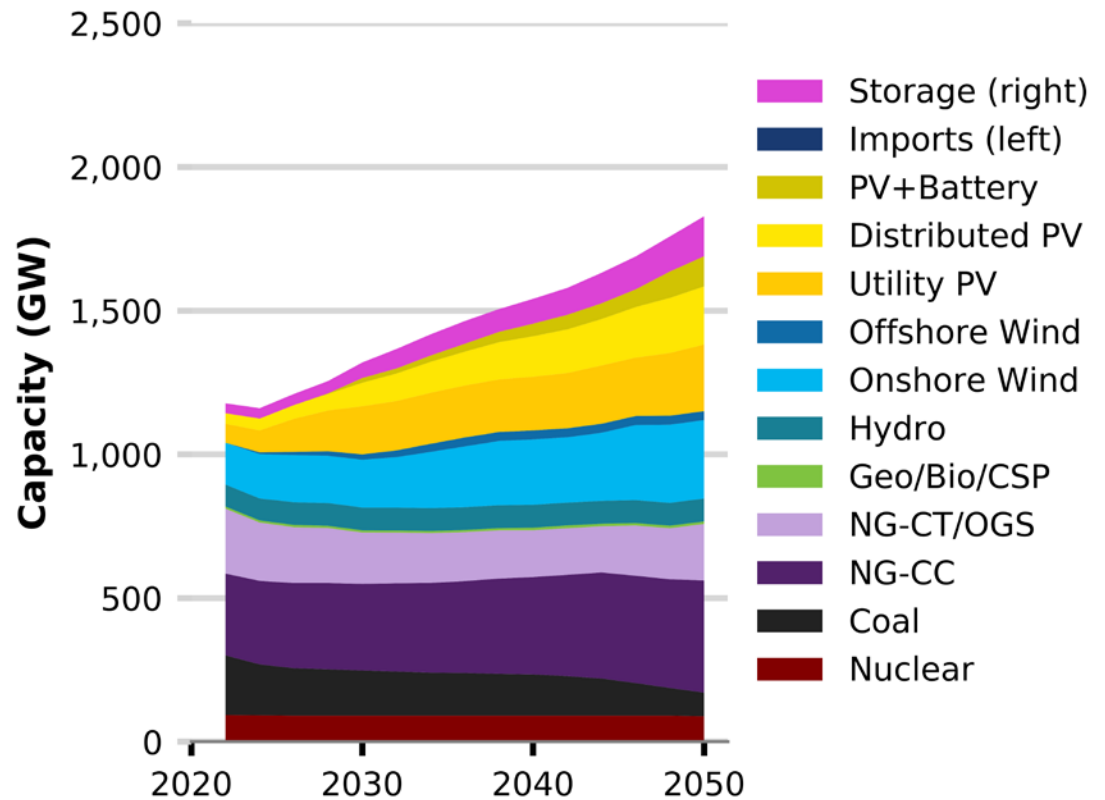
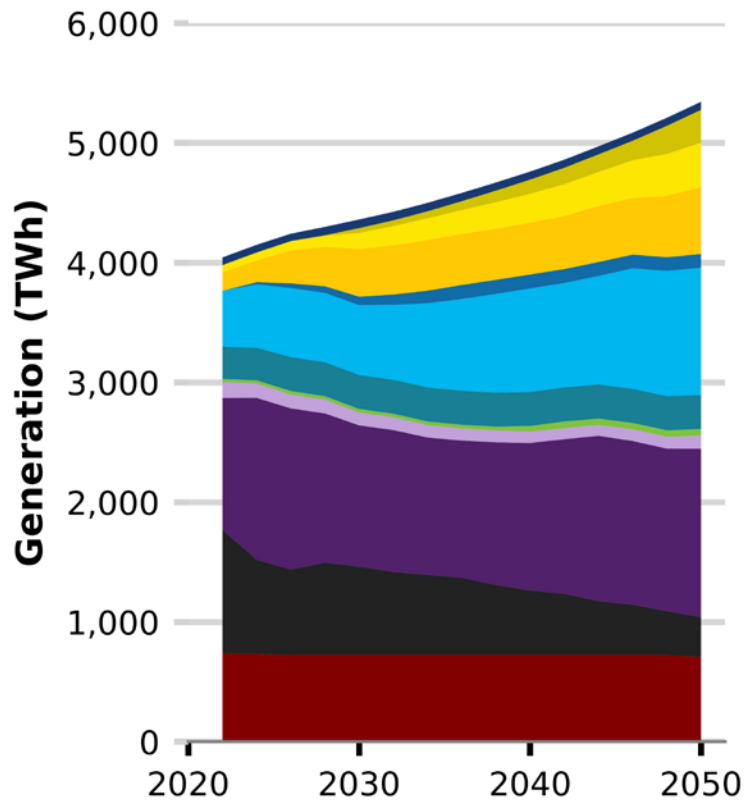
- Retail rate module
- HVDC transmission options (VSC & LCC)
- New technologies, including for H₂ production and negative emissions
- ... (see Table A-4)

Scenario Updates

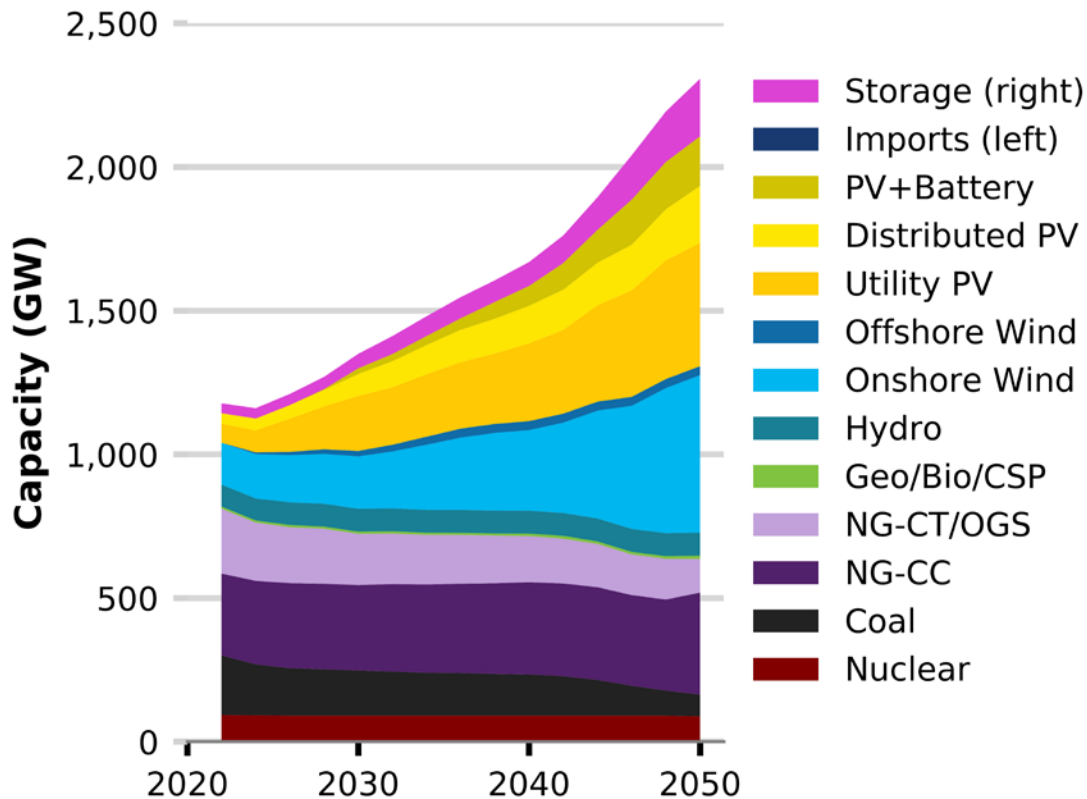
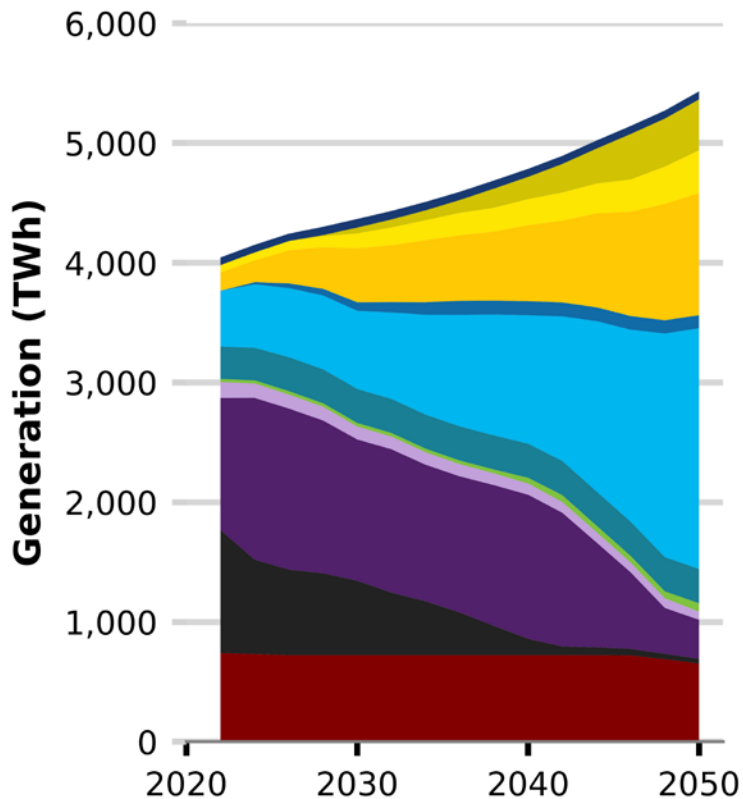
- Inclusion of CO₂ emission reduction scenarios
- Sensitivities performed off multiple cases

Report Summary

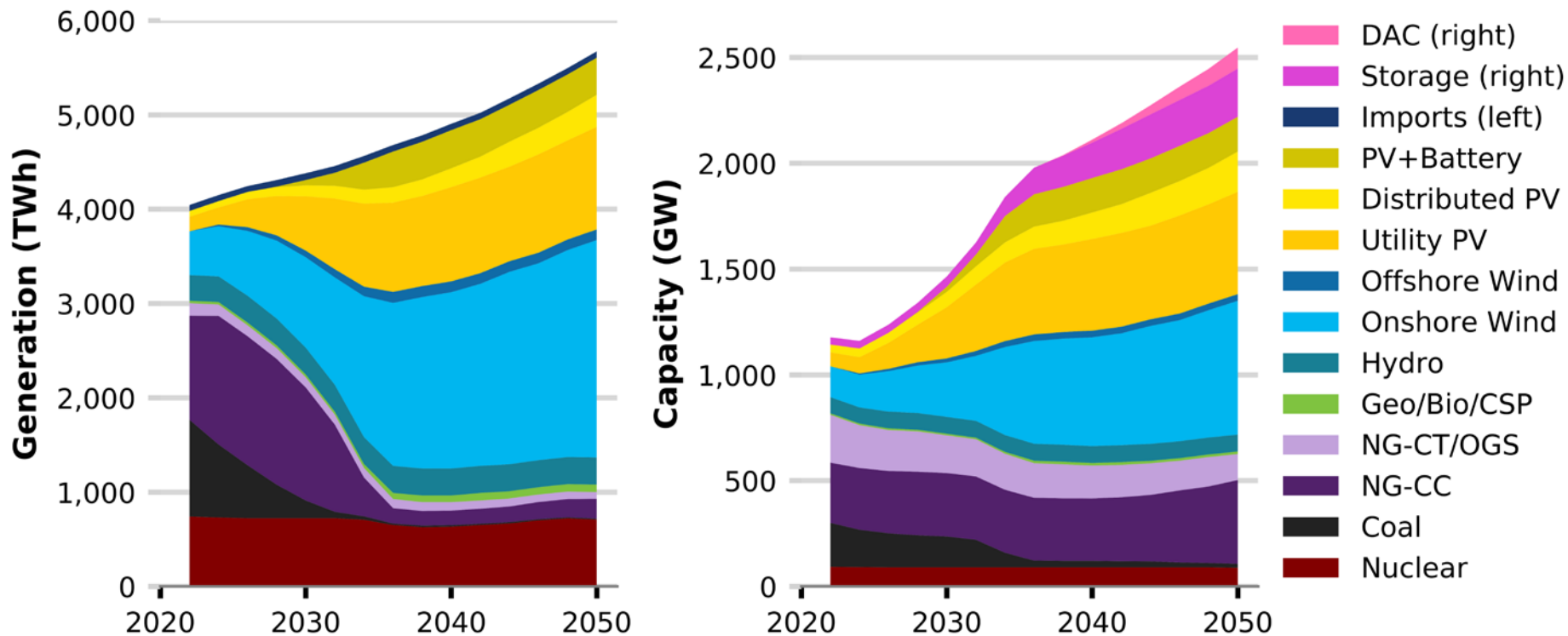
U.S. Power Sector Evolution: No New Policy



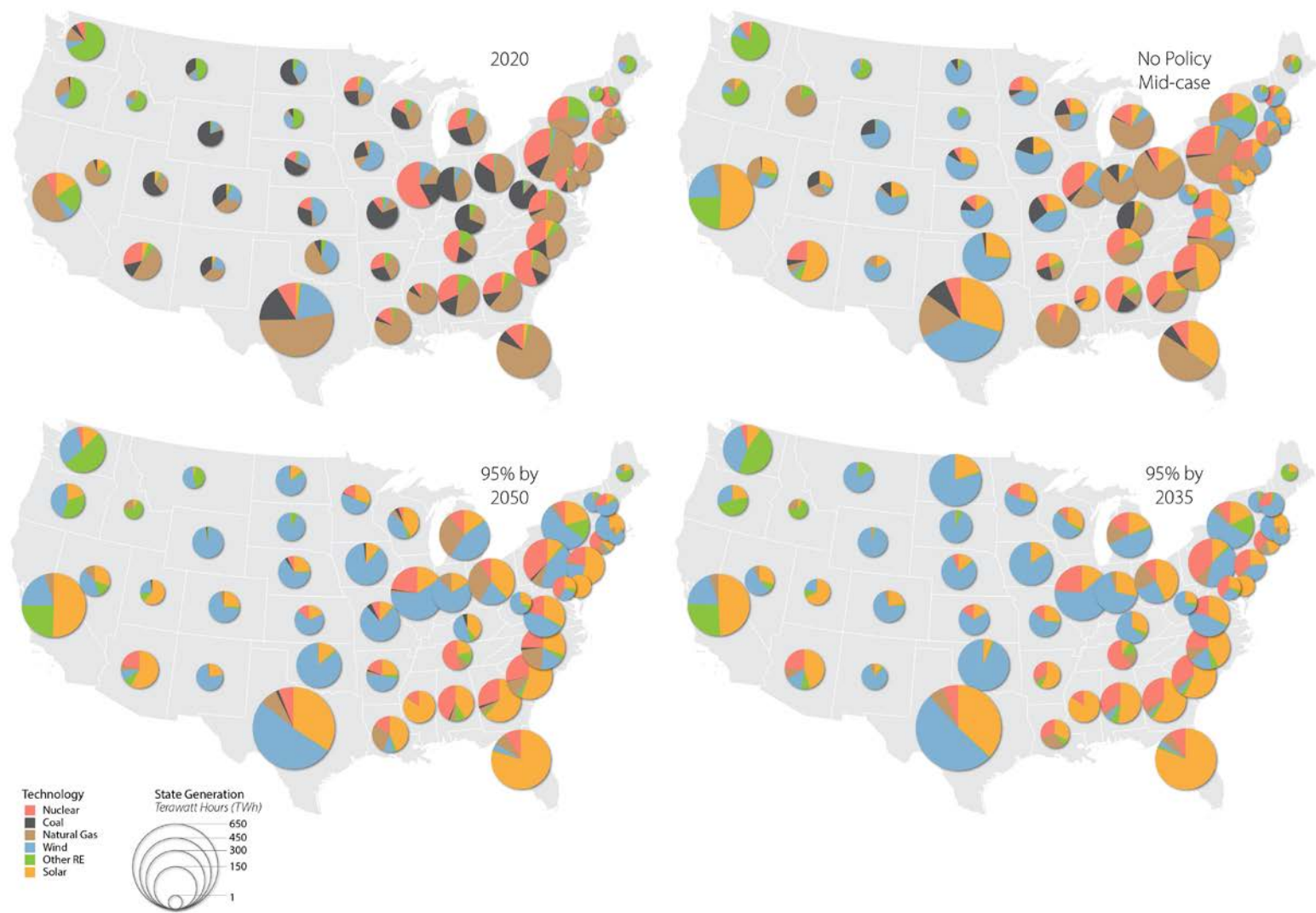
U.S. Power Sector Evolution: 95% by 2050



U.S. Power Sector Evolution: 95% by 2035



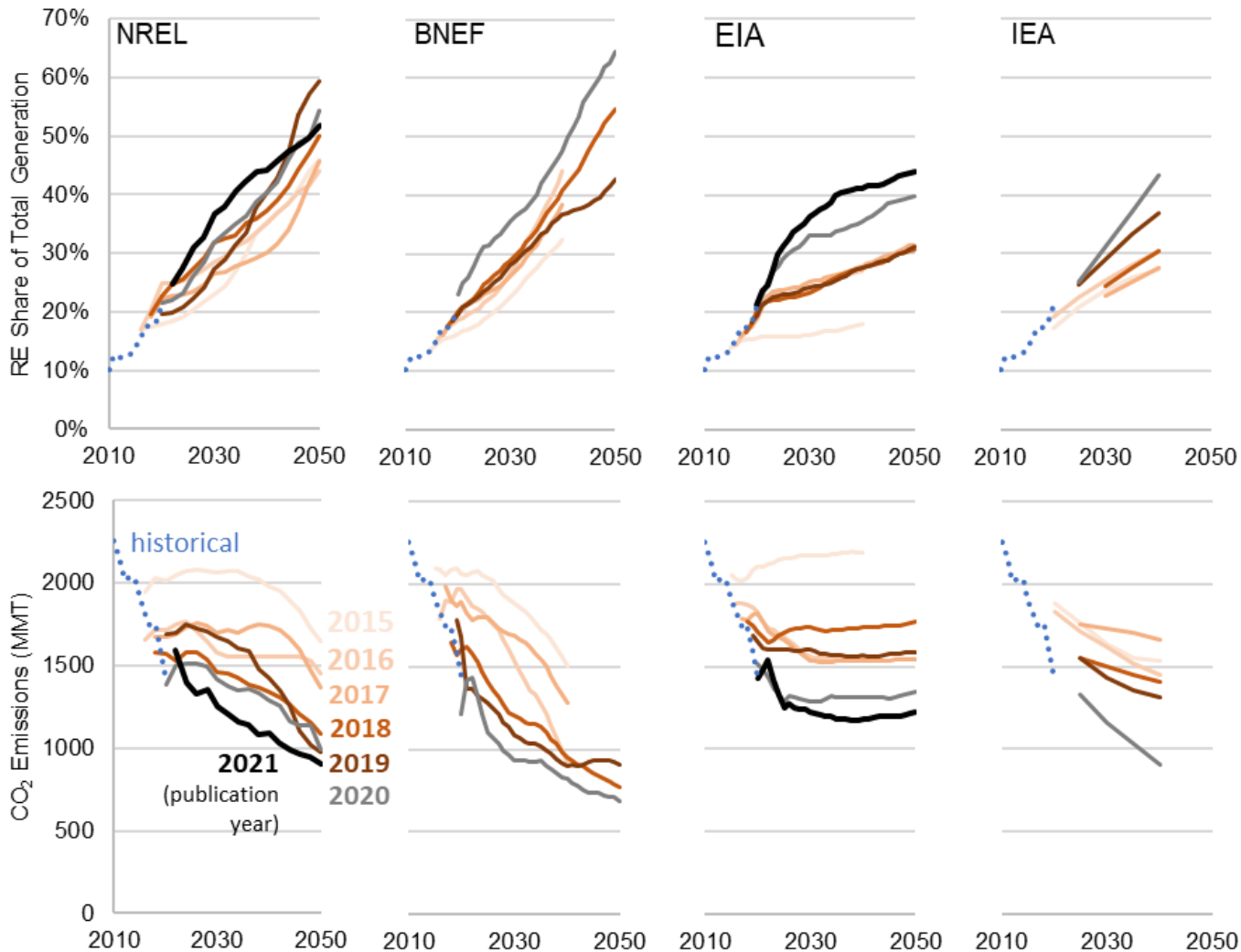
System Evolution by State



How the Mid-case Compares

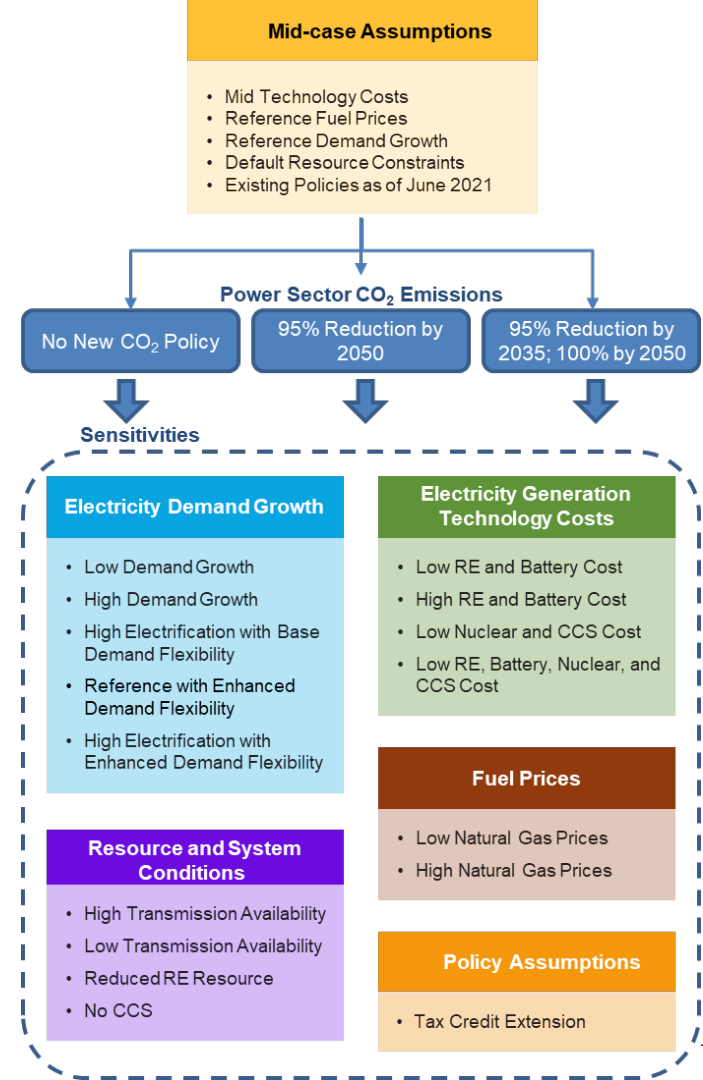
Comparisons:

- Bloomberg New Energy Finance (BNEF)
- Energy Information Administration (EIA)
- International Energy Agency (IEA)

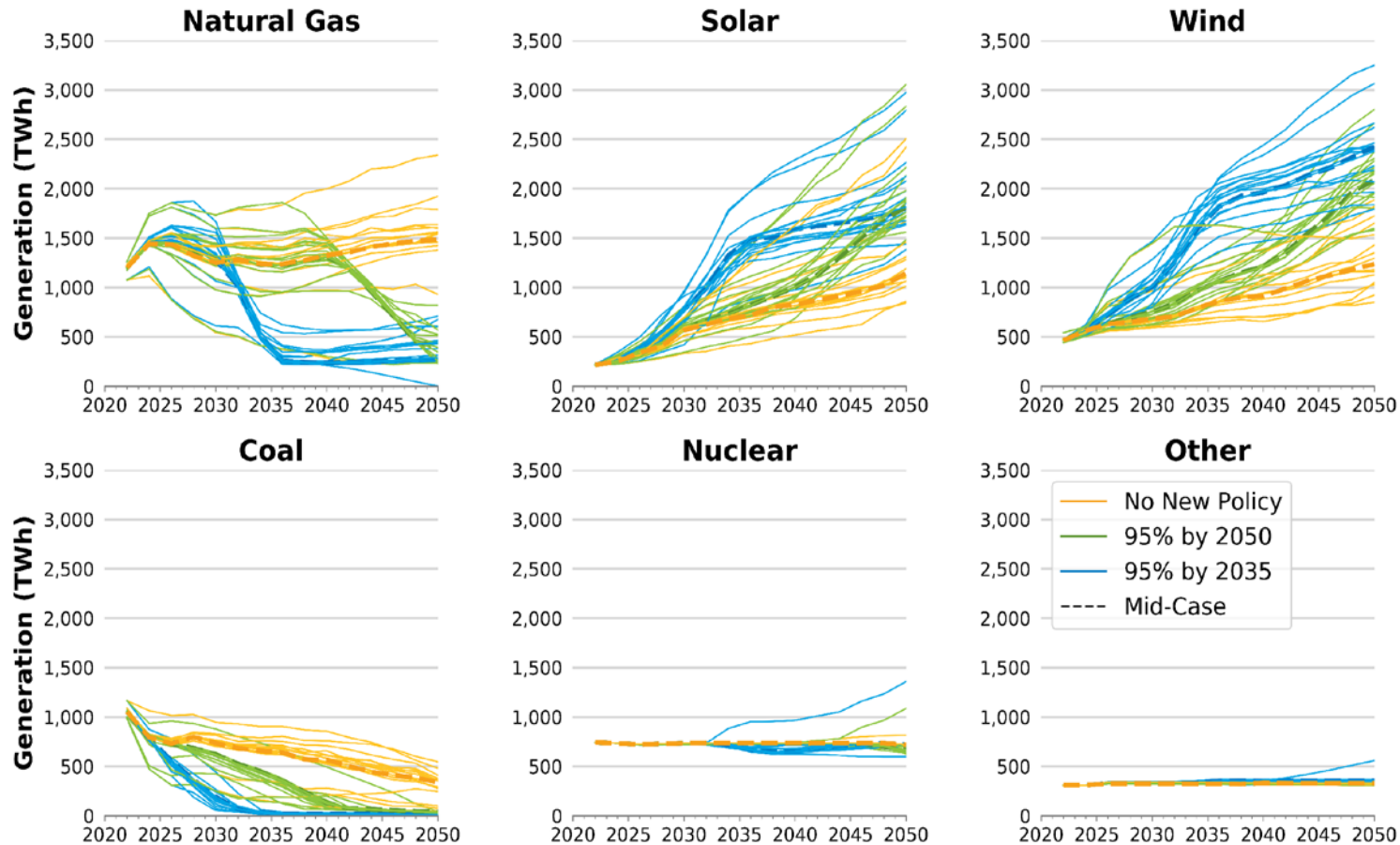


Sensitivity Scenarios

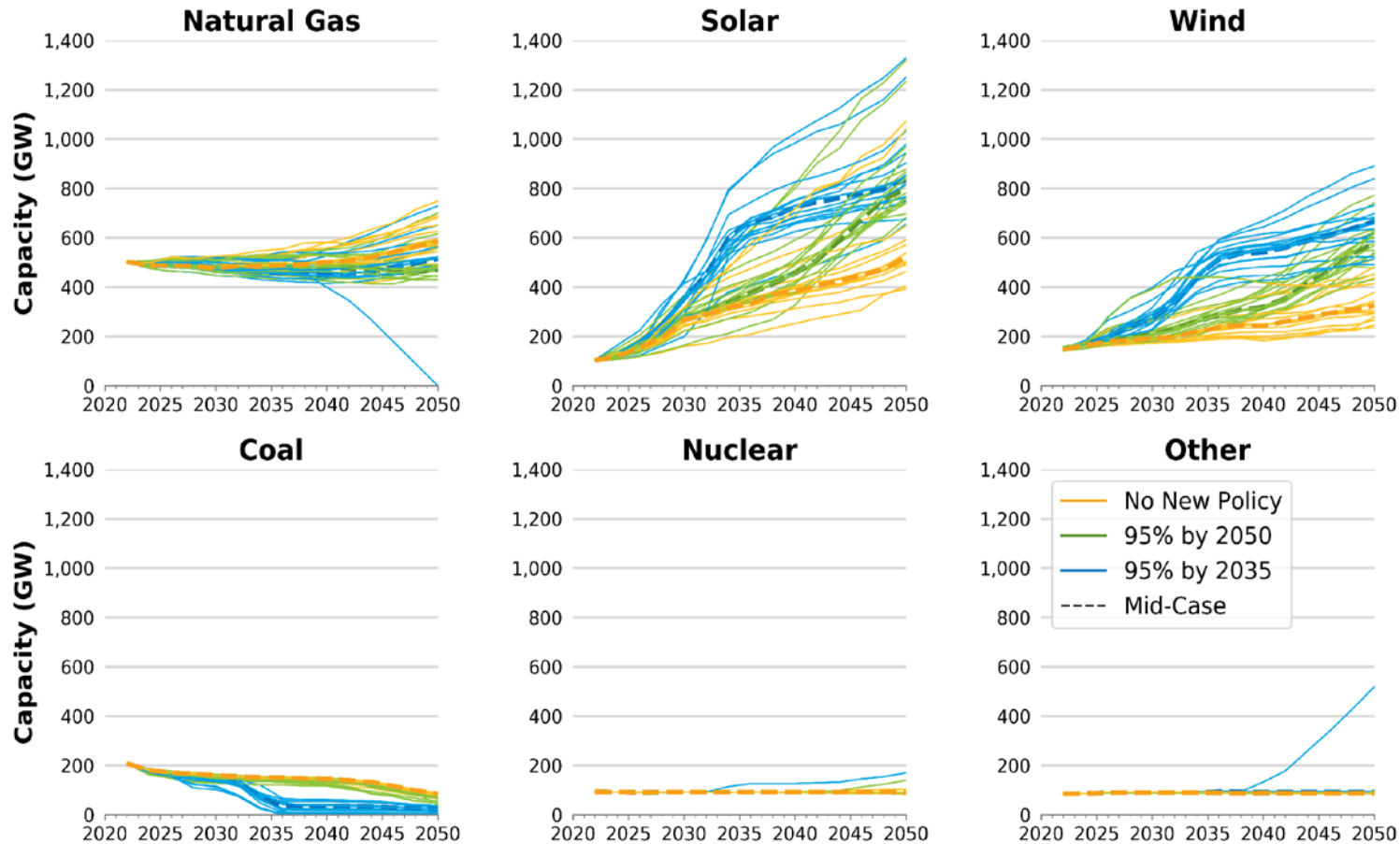
- Performed for each level of CO₂ emissions reduction
- 50 total sensitivities



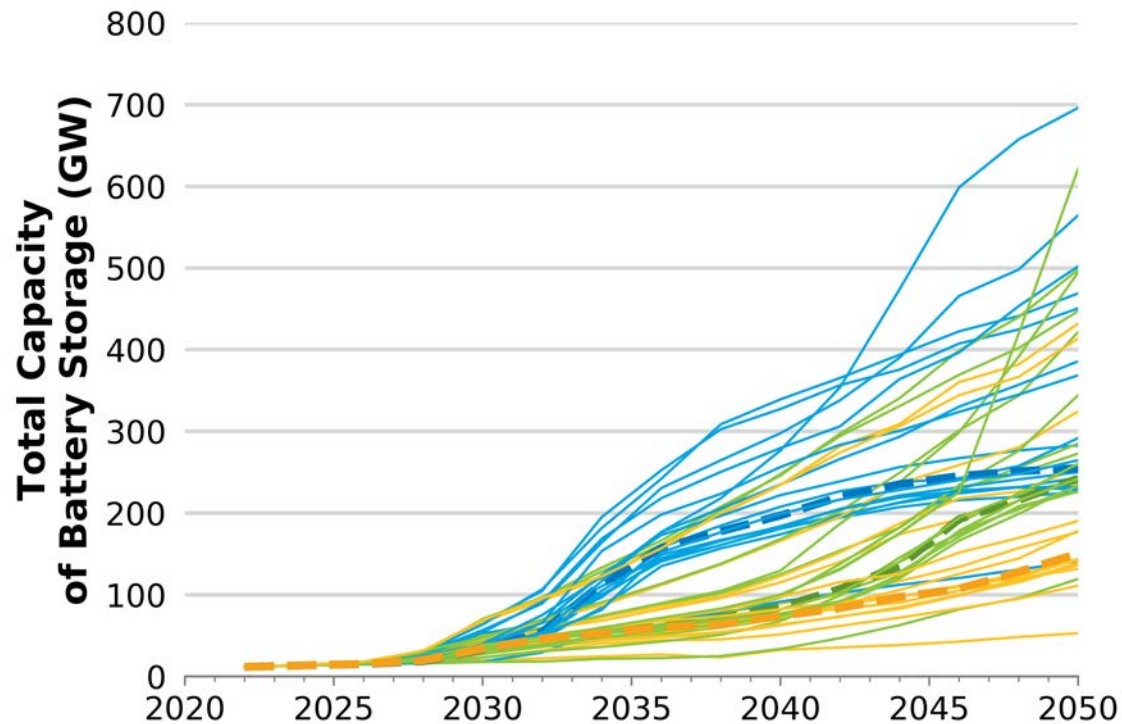
Generation by Fuel Type Across the Scenarios



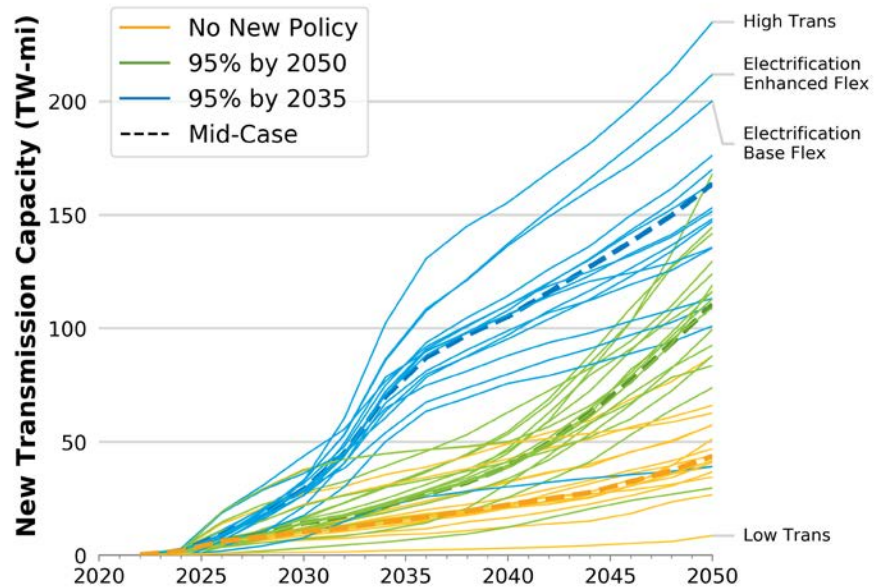
Capacity by Fuel Type Across the Scenarios



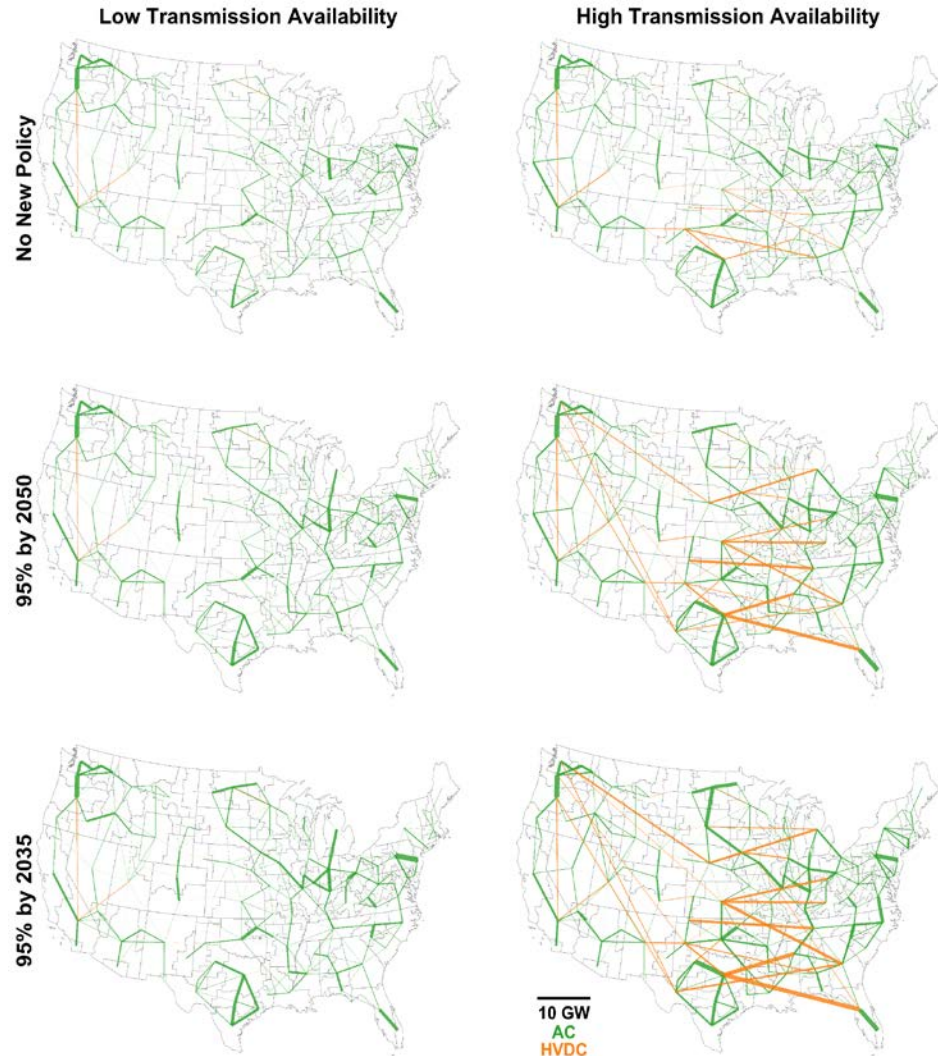
Battery Storage Capacity



New Transmission Capacity



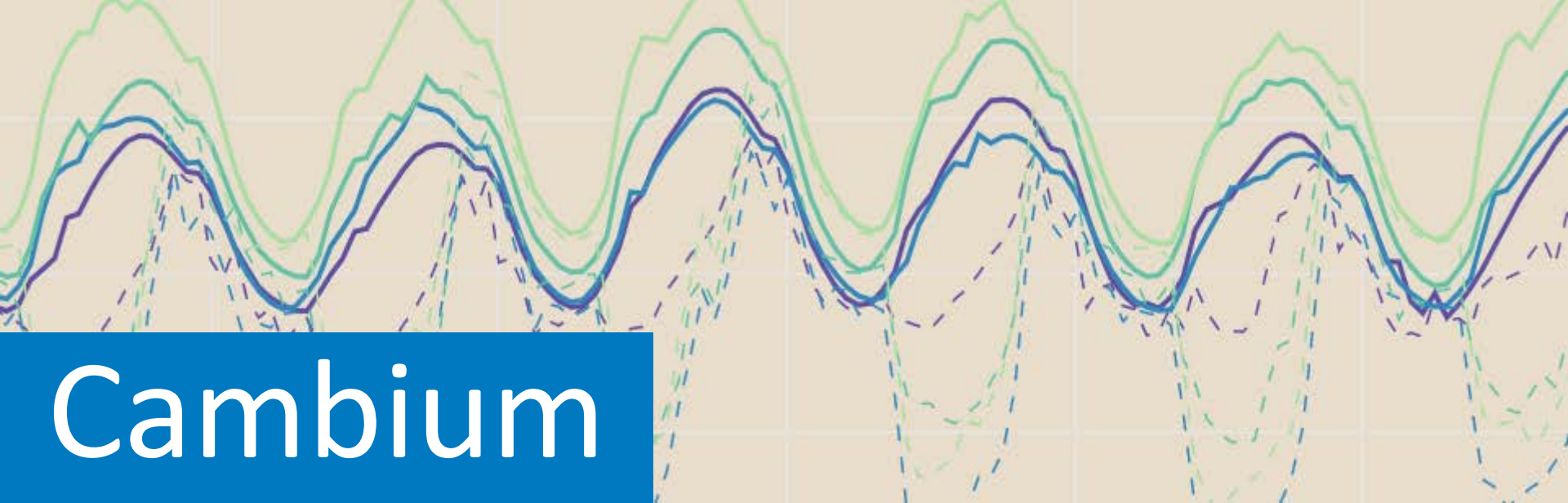
The system has 148 TW-mi in 2020



New Carbon Capture and Storage (CCS) Capacity

CCS Capacity (in GW) deployed by 2050 across the suite of scenarios

	No New Policy	95% by 2050	95% by 2035
NG-CC with CCS	0	6 – 96	1 – 64
Coal with CCS	0	0	0
Biopower with CCS	0 – 0.3	0.3 – 3.5	0.5 – 4.4
Direct air capture	0	0.1 – 42	60 – 141



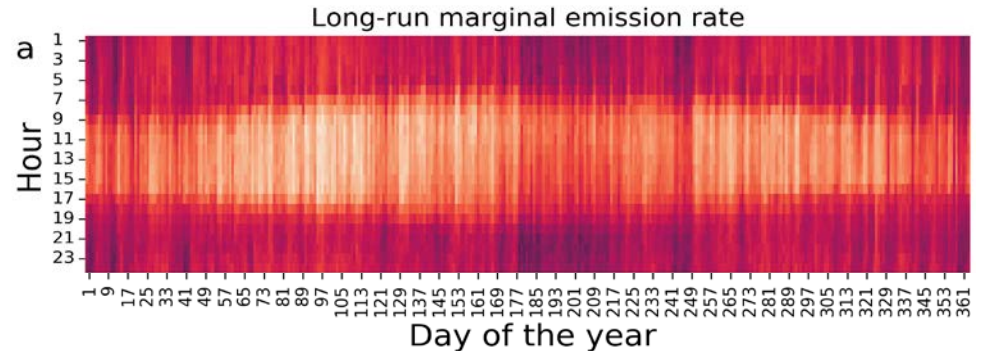
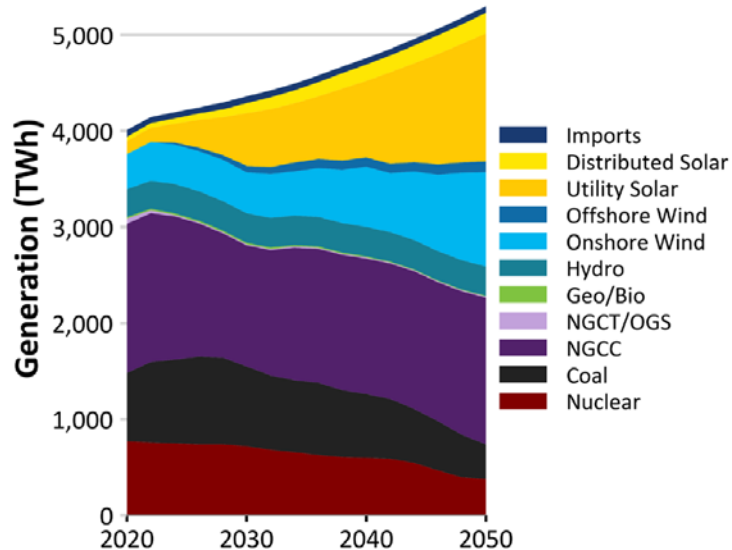
Cambium

Extending the Standard Scenarios to include hourly emission, cost, and operational metrics

NREL's Cambium Data Sets

What is Cambium:

Annually-updated, publicly available database of emission, cost, and operational metrics for the U.S. electric sector through 2050



What is new in the 2021 data release?

- Two national decarbonization scenarios (95% by 2050 and 2035)
- Extend emissions data to both combustion and precombustion for CO₂, CH₄, and N₂O
- New geographic (GEA/eGrid regions) and temporal (month-hour and time-of-day) resolutions

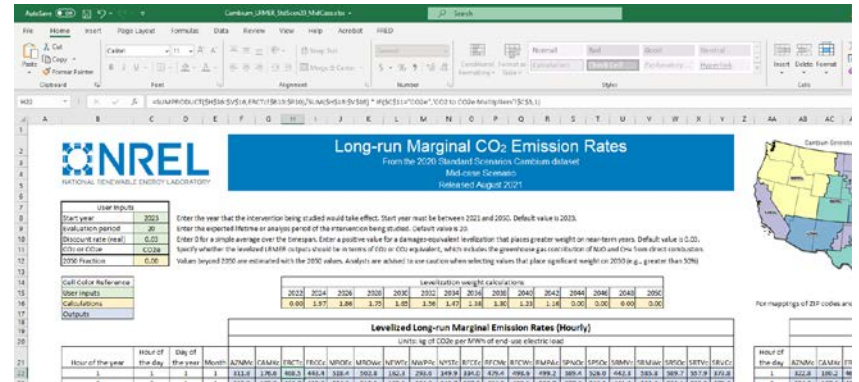
How to Access the Data

<https://www.nrel.gov/analysis/cambium.html>

Full data available for viewing and downloading



Workbooks available for long-run emission rate data



Questions or Comments?

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www.nrel.gov

Full Report: <https://www.nrel.gov/docs/fy22osti/80641.pdf>

Results Viewer: <https://cambium.nrel.gov/>

Cambium Documentation: <https://www.nrel.gov/docs/fy22osti/81611.pdf>

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