



GDO

GRID DEPLOYMENT OFFICE

Department of Energy's Draft National Transmission Needs Study

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February 28, 2023



Notice

- ▶ None of the information presented herein is legally binding.
- ▶ The content included in this presentation is intended for informational purposes only relating to the Draft 2023 National Transmission Needs Study.
- ▶ Any content within this presentation that appears discrepant from the Needs Study language is superseded by the Needs Study language.



Needs

Overview of National Transmission ~~Congestion~~ Study

as amended by Bipartisan Infrastructure Law

Federal Power Act §216(a) directs DOE to conduct assessments of:

historic *and expected* transmission *capacity* constraints and congestion
every three years

with consultation* from States, *Indian tribes*, and regional grid entities

- ▶ Department's triennial **state of the grid report**
- ▶ Reviews historic industry data, recent power system studies, published capacity expansion results
- ▶ Final published Summer 2023 **following public comment period**



Understanding the Needs Study

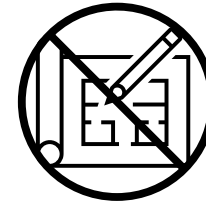
What It Is

What It Isn't

Objective



Assessment of Needs

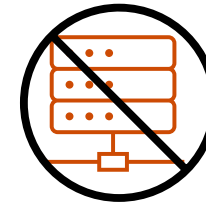


Not prescribing solutions

Methods



Considers published data and reports (80 references)



No new modeling, cost-benefit analysis, or system planning

Output



Needs organized by geographic regions



Regions not synonymous with corridors

National Transmission Needs Study

Executive Summary

- I. Introduction
- II. Legislative Language
- III. Transmission Concepts
- IV. Historical Data: Current Need**
- V. Review of Existing Studies: Current and Future Needs**
- VI. Capacity Expansion Modeling: Anticipated Future Need**

<https://www.energy.gov/gdo/national-transmission-needs-study>





1. There is a pressing need for new transmission infrastructure.
2. Interregional transmission results in the largest benefits.
3. Needs will shift over time.

IV. Historical Data: Current Need

IV.a. Historical Transmission Investments

IV.b. Market Price Differentials

IV.b.1. Regional Price Differentials

IV.b.2. Interregional Price Differentials

IV.b.3. Transmission Value during Extreme Events

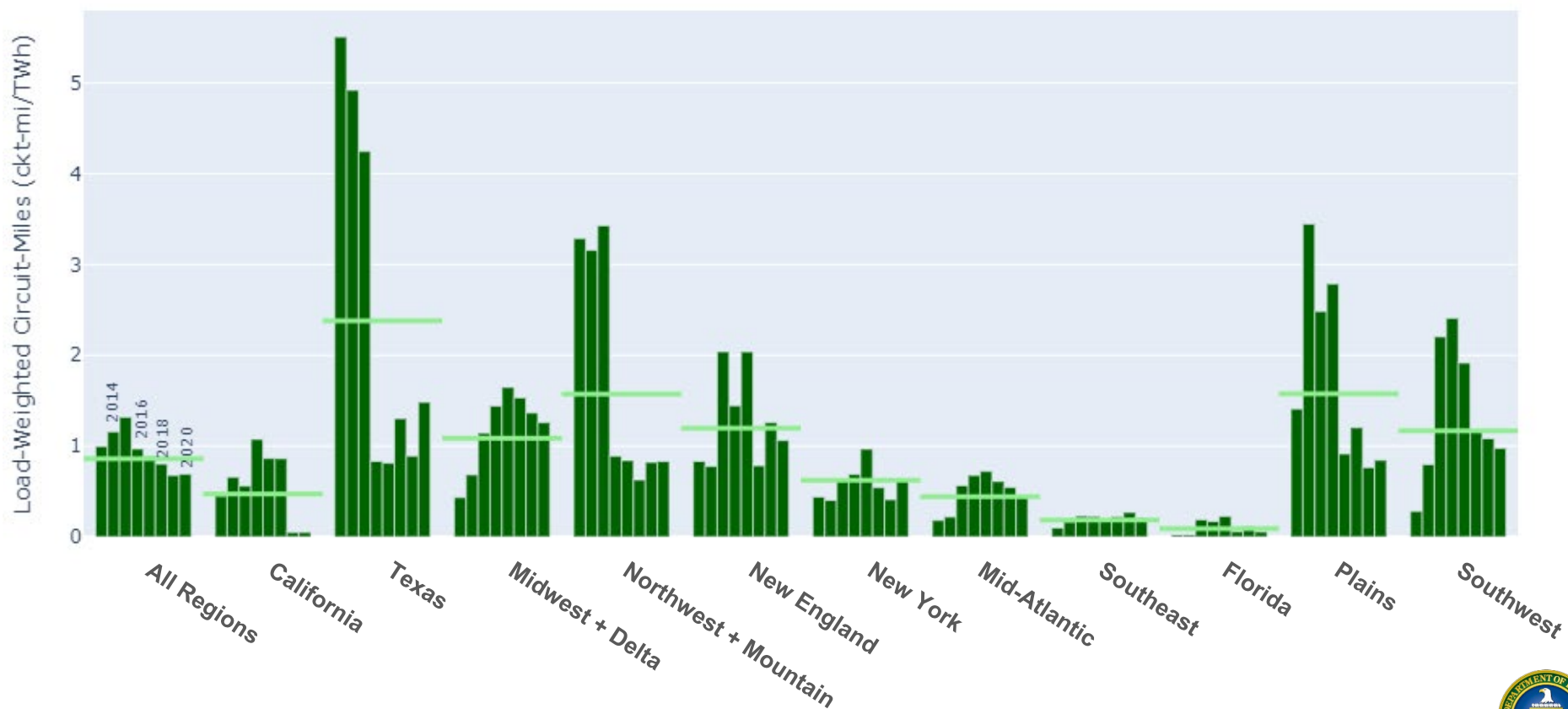
IV.c. Qualified Paths

IV.d. Interconnection Queues



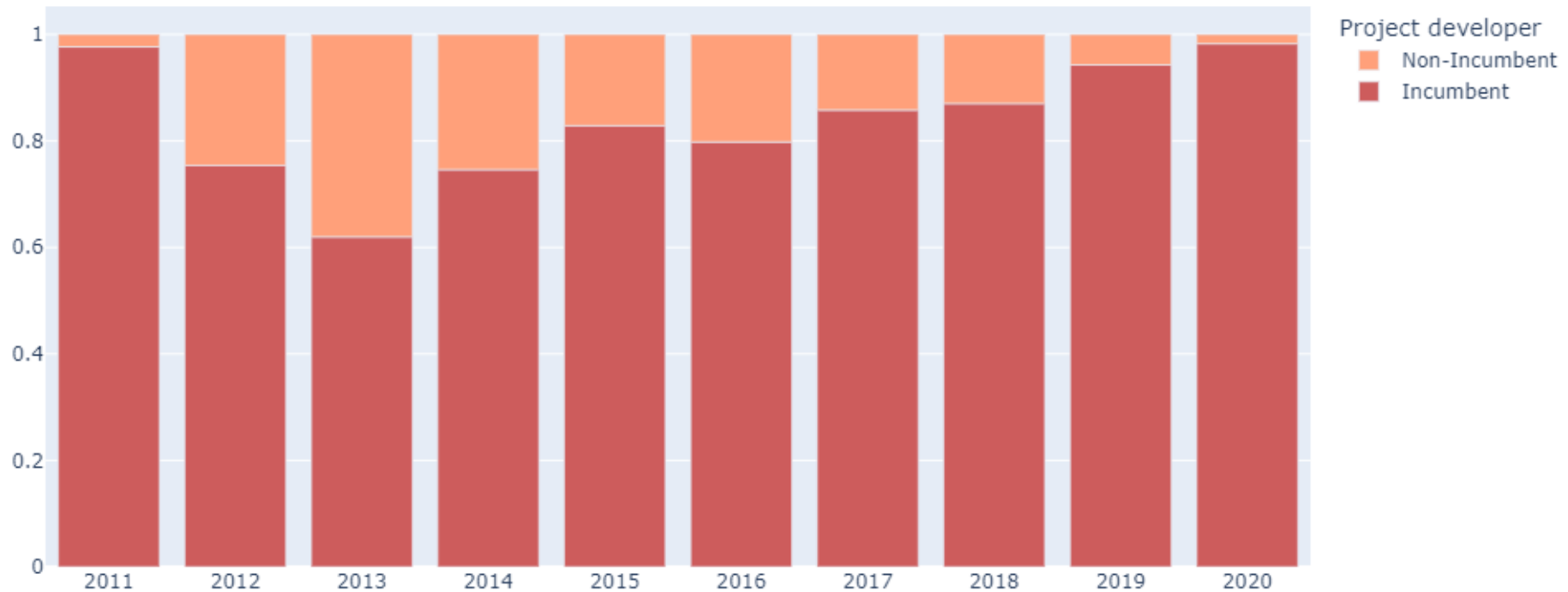
Transmission investments decreased during the second half of the 2010's.

Rolling 3-yr Average Load-Weighted Circuit-Miles, 2013-2020



Non-incumbent developers' share of energized projects has decreased from 40% in 2013 to less than 5% in 2020.

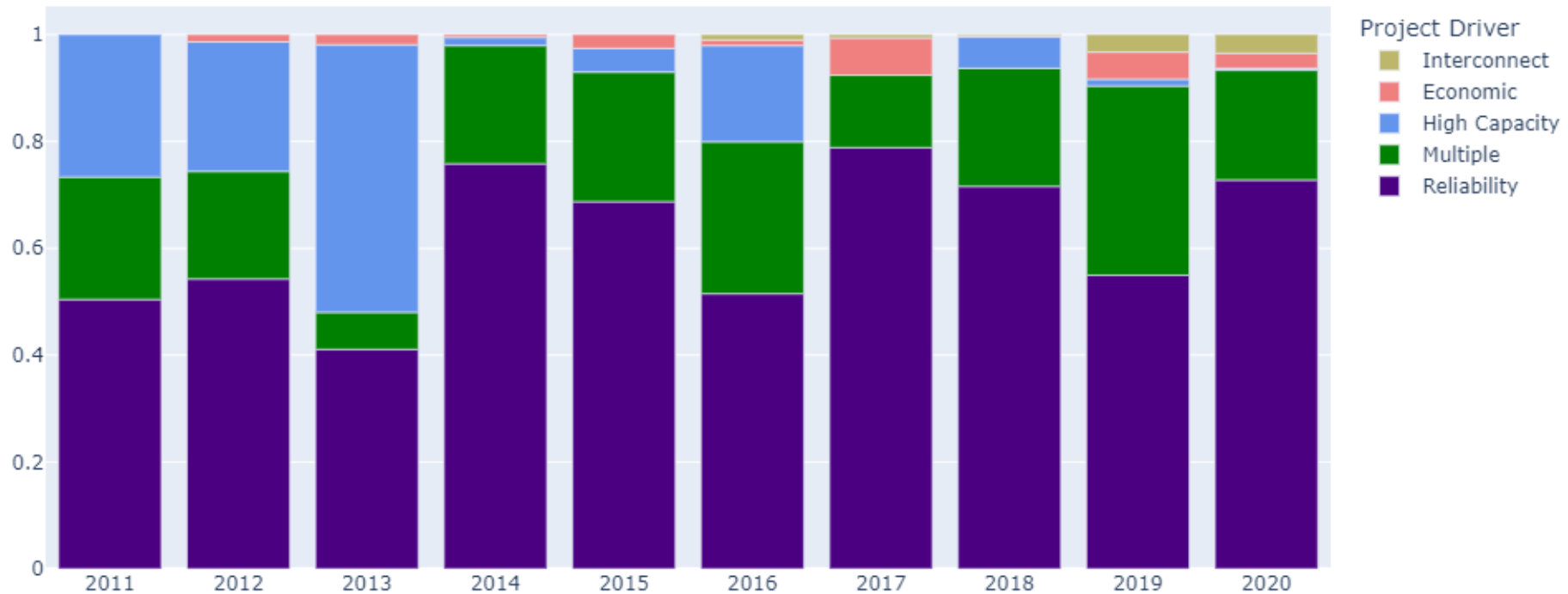
Proportion of national circuit-miles installed each year by developer type



Data from MAPSearch Transmission Database (2020). All transmission lines rated at or above 100kV.

Share of projects addressing reliability concerns have increased. Share of high-capacity projects moving generation have decreased.

Proportion of national circuit-miles installed each year by project driver



Data from MAPSearch Transmission Database (2020). All transmission lines rated at or above 100kV.

Interconnect projects are designed to connect power plants to grid.

Economic projects are designed to alleviate congestion causing high electricity prices.

High-capacity projects are designed to bring large amounts of generation far distances, usually at voltages ≥ 345 kV.

Reliability projects are meant to address a reliability concern on the grid.

Multiple drivers are for projects designed for at least two of the above drivers.



V. Review of Existing Studies: Current and Future Needs

V.a. Reliability

V.b. Resource Adequacy

V.c. Clean Energy

V.c.1. Offshore Wind

V.c.2. Clean energy on tribal lands

V.d. Congestion

V.d.1. New England

V.d.2. New York

V.d.3. Mid-Atlantic

V.d.4. Midwest and Delta

V.d.5. Plains

V.d.6. California and the West

V.e. Curtailment

V.f. Resilience

V.g. Electrification

V.h. Non-Wires Alternatives

V.h.1. Energy Storage

V.h.2. Distributed Energy Resources

V.h.3. Grid-Enhancing Technologies

V.h.4. Microgrids

V.i. Barriers to Transmission Development



50 Transmission studies reviewed (2018-2022)

Dept. of Energy

1. **NREL** Renewable Energy Potential on Tribal Lands (2018)
2. **NREL** Microgrids for Resiliency (2020)
3. **NREL** Interconnection Seams Study (2020)
4. **DOE** Solar Futures Study (2021)
5. **NREL** North American Renewable Energy Integration Study (2021)
6. **NREL** 2021 Standard Scenarios (2021)
7. **NREL** Extreme Weather and High Variable Renewable Energy (2021)
8. **NREL** Microgrids for Resiliency (2021)
9. **DOE** Renewable Energy Resource Assessment for the U.S. (2022)
10. **DOE** Grid-Enhancing Technologies: Ratepayer Impact (2022)
11. **LBNL** Empirical Estimates of Transmission Value (2022)
12. **NREL** Storage Futures Study: Grid Operational Impacts (2022)

Consultant

13. **Wood Mackenzie** Regulatory Evolution for Decentralized Grid (2019)
14. **Americans for a Clean Energy Grid** Consumer, Employment, and Environmental Benefits of Electricity Transmission Expansion (2020)
15. **Brattle / Anbaric** Offshore Wind Transmission in New England (2020)
16. **Brattle / Anbaric** Offshore Wind Transmission for New York (2020)
17. **Evolved Energy Research** Massachusetts Energy Pathways (2020)
18. **Vibrant Clean Energy** Why local solar for all costs less (2020)
19. **American Council on Renewable Energy** Transmission Makes the Power System Resilient to Extreme Weather (2021)
20. **Brattle** Transmission Planning and Benefit-Cost Analyses (2021)
21. **Breakthrough Energy** A 2030 United States Macro Grid (2021)
22. **Evolved Energy Research** Oregon Clean Energy Pathways (2021)
23. **Vibrant Clean Energy** Plan for Economy-Wide Decarbonization (2021)

Academic

25. **MIT** Two-Way Trade in Green Electrons: Decarbonization in NE (2020)
26. **UC Berkeley** The 2035 Report (2020)
27. **MIT** The Value of Inter-Regional Coordination and Transmission (2021)
28. **Princeton** Net Zero America Final Report (2021)
29. **Texas A&M** Stability Considerations for Synchronous Interconnect (2022)

Industry

30. **ISO-NE** 2019 Economic Study: Offshore Wind Integration (2019)
31. **FERC** Barriers And Opportunities For High Voltage Transmission (2020)
32. **WECC** 2038 Scenarios Reliability Assessment (2020)
33. **EIPC** State of the Grid (2021)
34. **FERC** February 2021 Cold Weather Outages (2021)
35. **ISO-NE** First Cape Code Resource Integration Study (2021)
36. **ISO-NE** 2021 Economic Study: Future Grid Reliability Study (2021)
37. **MISO** Renewable Integration Impact Analysis (2021)
38. **NERC** Long-Term Reliability Assessment (2021)
39. **BPA** Strategic Asset Management Plan (2022)
40. **CAISO** 20-year Transmission Outlook (2022)
41. **MISO** Long Range Transmission Planning to Address Reliability (2022)
42. **NERC** State of Reliability Report (2022)
43. **SPP & MISO** Joint Transmission Interconnection Queue Study (2022)
44. **WECC** 2040 Clean Energy Sensitivities Study (2022)
- 45.-50. **Independent Market Monitor** 2020 reports for each RTO (2021)



VI. Capacity Expansion Modeling: Anticipated Future Need

VI.a. Included Studies and Scenarios

VI.b. Within Region Transmission Deployment


VI.c. Interregional Transfer Capacity

VI.d. International Transfers



Data from 6 capacity expansion studies are analyzed to identify future regional and interregional transmission needs.

National Lab Reports

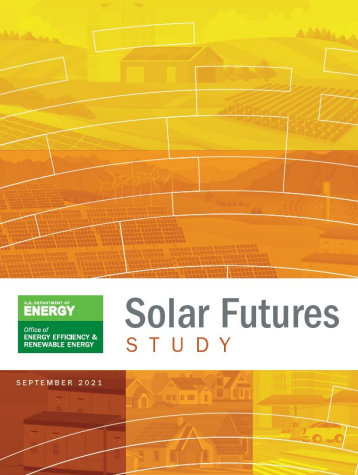


2021 Standard Scenarios Report: A U.S. Electricity Sector Outlook

Primary Authors: Wesley Cole and J. Vincent Carag

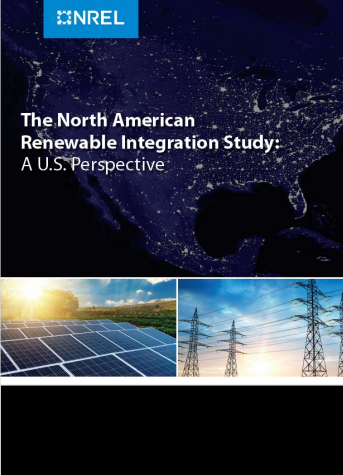
Contributing Authors: Maxwell Brown, Patrick Brown, Stuart Cohen, Kelly Eurek, Will Frazier, Pieter Gagnon, Nick Grue, Jonathan Ho, Anthony Lopez, Trieu Mai, Matthew Mowers, Caitlin Murphy, Brian Sergi, Dan Sternberg, and Travis Williams

NREL is a national laboratory of the U.S. Department of Energy Office of Energy Efficiency & Renewable Energy. Operated by the National Renewable Energy Laboratory (NREL) at www.nrel.gov/publications. Contract No. DE-AC35-09G02809

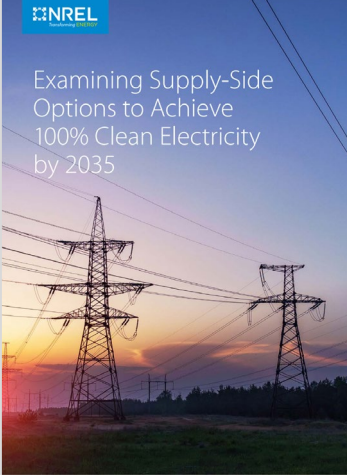


Solar Futures STUDY

SEPTEMBER 2021



The North American Renewable Integration Study: A U.S. Perspective



Examining Supply-Side Options to Achieve 100% Clean Electricity by 2035

Academic Reports


Princeton's Net-Zero America study
Annex F: Integrated Transmission Line Mapping and Costing

Andrew Pascale
Andriag Center for Energy and the Environment (Princeton University) and Dow Center for Sustainable Engineering Innovation (The University of Queensland)

Justin D. Jenkins
Department of Mechanical & Aerospace Engineering and Andriag Center for Energy and the Environment, Princeton University

With contributions from
Emily Leslie
Matthew Mowbray

01 August 2021

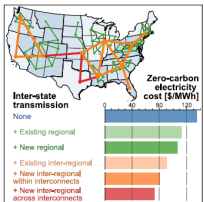


POTENTIAL PATHWAYS, INFRASTRUCTURE, AND IMPACTS
FINAL REPORT SUMMARY

SEPTEMBER 20, 2021

Joule | CalPress

Article
The Value of Inter-Regional Coordination and Transmission in Decarbonizing the US Electricity System



Inter-state transmission cost (\$/MWh)

- None
- + Existing regional
- + New regional
- + Existing inter-regional
- + New inter-regional within interconnects
- + New inter-regional across interconnects

Zero-carbon electricity cost (\$/MWh)

Regional decarbonization of electricity is a critical component of climate change mitigation. This model assesses electricity generation for the continental US, using technologies currently deployed at grid-scale (solar, wind, natural gas, hydro, nuclear, and transmission). Inter-regional coordination reduces the cost of decarbonization, allowing new inter-state transmission and new power and long-duration energy storage have the potential to reduce system cost but are not necessary for decarbonization of electricity across hundreds of gigawatts of new solar and wind.

Patrick M. Brown, Andriag Professor

With Emily Leslie, Andriag Center for Energy and the Environment, Princeton University

Inter-regional coordination and transmission construction significantly reduce cost

Neither, if available, plays a significant role in reducing cost projections

Nationally planned decarbonization is more efficient than state or regional approaches

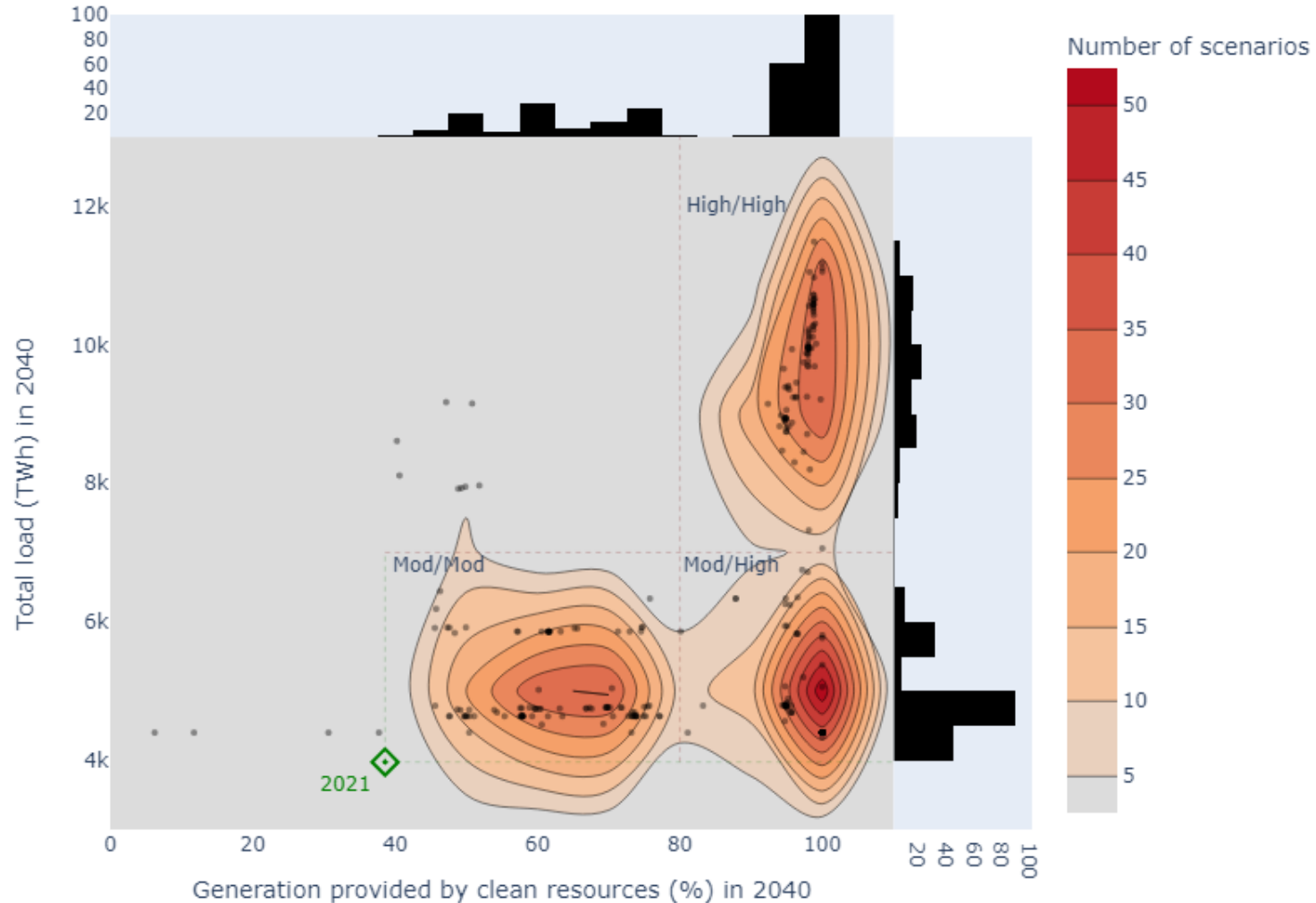
June 9, 2021, Joule 1:10
https://doi.org/10.1016/j.joule.2021.06.001

Capacity expansion models optimize for least cost power sector solutions nation-wide given a range of input assumptions.

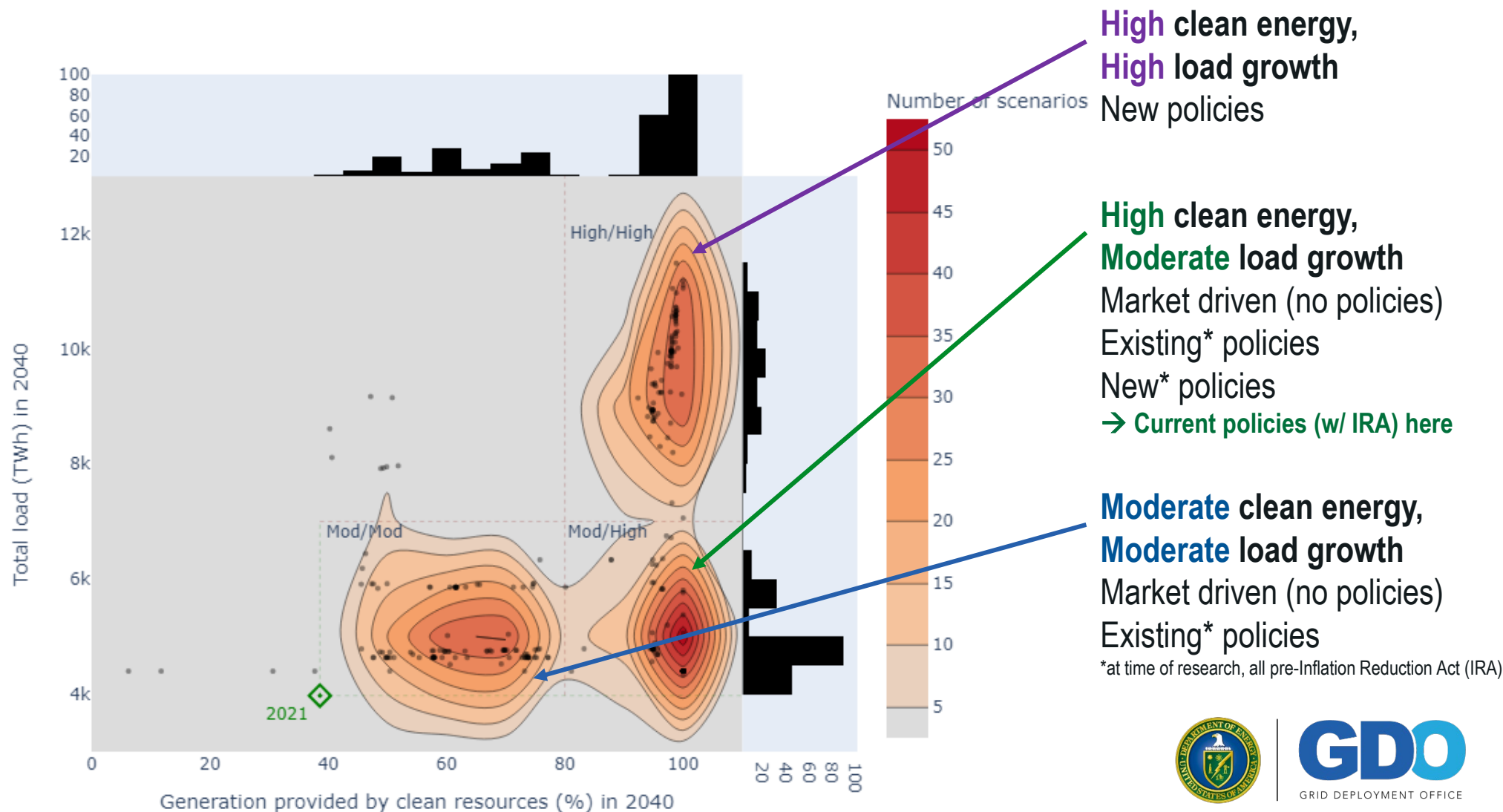
Model results help identify quantities of cost-effective transmission solutions and are used here as a proxy for future need to meet generation and demand growth.



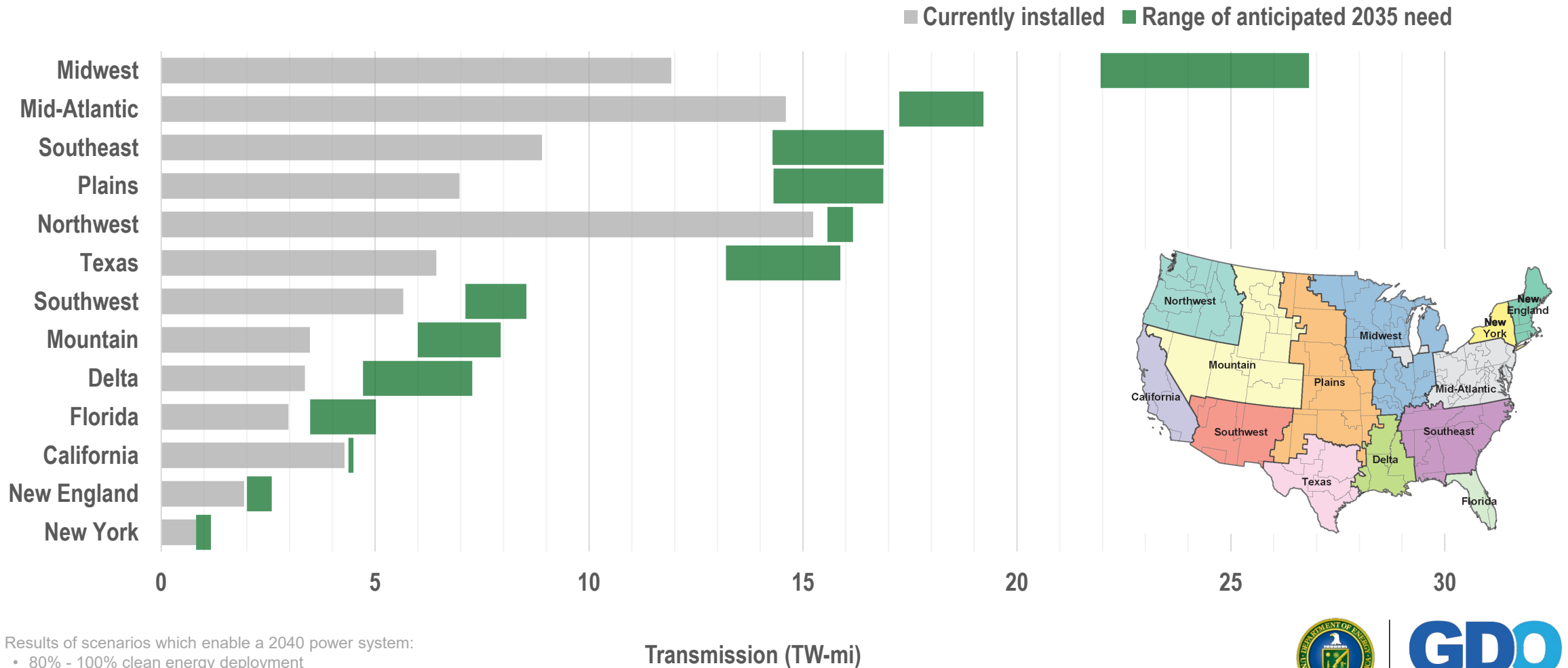
300 scenarios among 6 studies describe a wide range of power sector futures in different years.



Natural grouping of all scenarios based on power sector characteristics



Regional Transmission Expansion Results: 2035 Mod/High

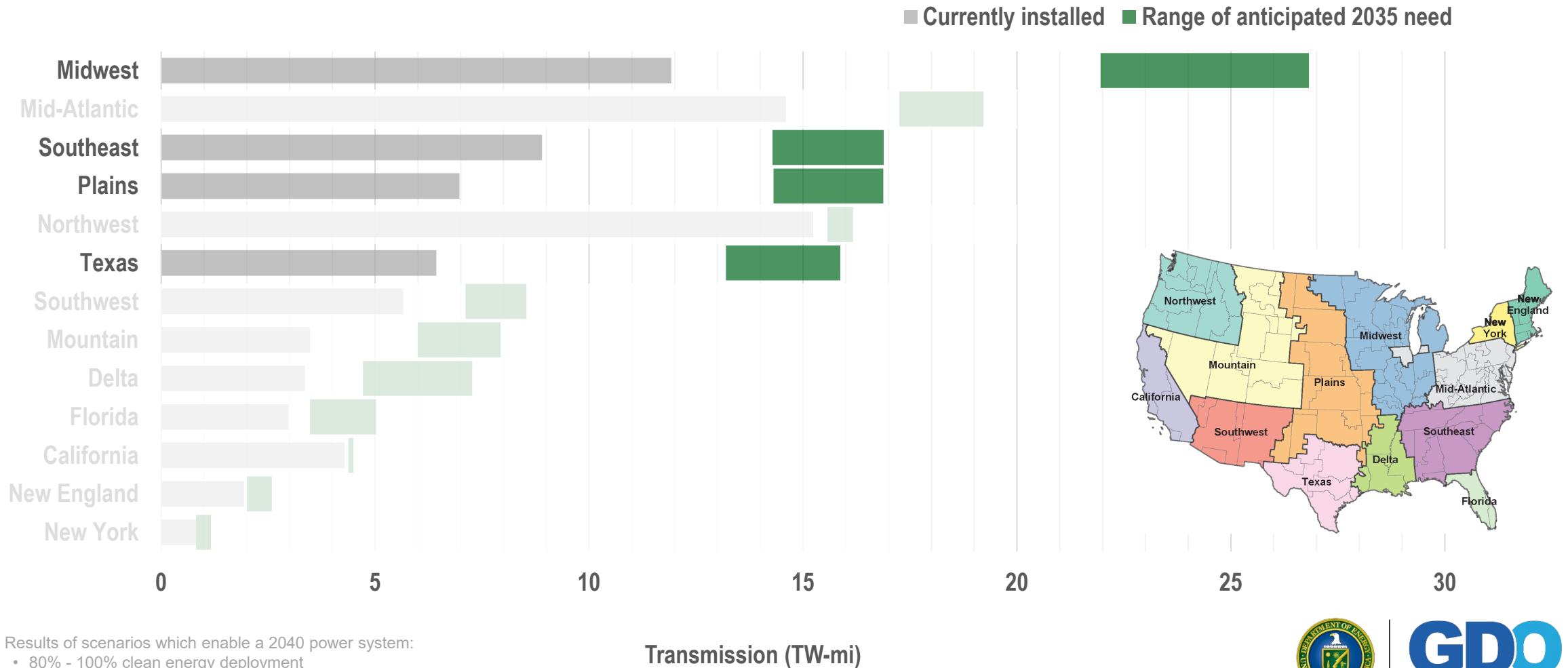


Results of scenarios which enable a 2040 power system:

- 80% - 100% clean energy deployment
- 25% - 75% load growth
- 95 - 100% decarbonization from 2005 levels



Regional Transmission Expansion Results: 2035 Mod/High



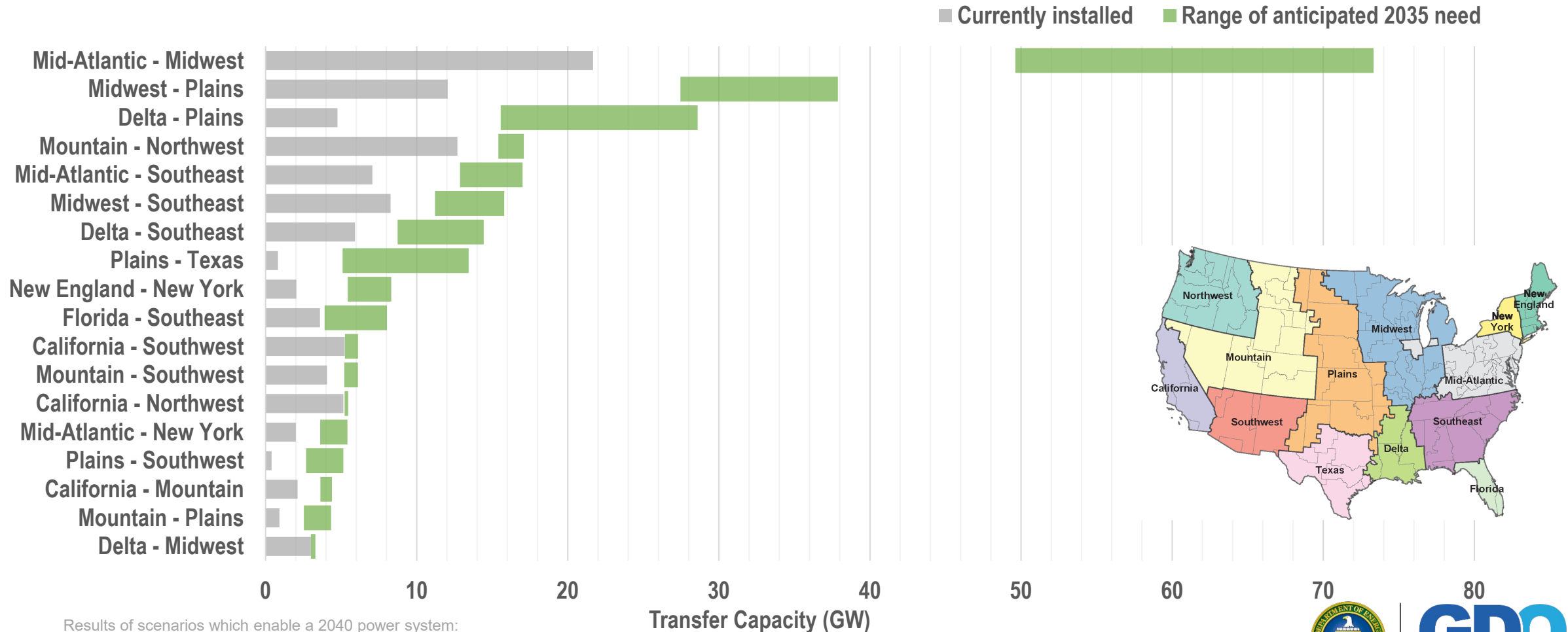
Results of scenarios which enable a 2040 power system:

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Transmission (TW-mi)



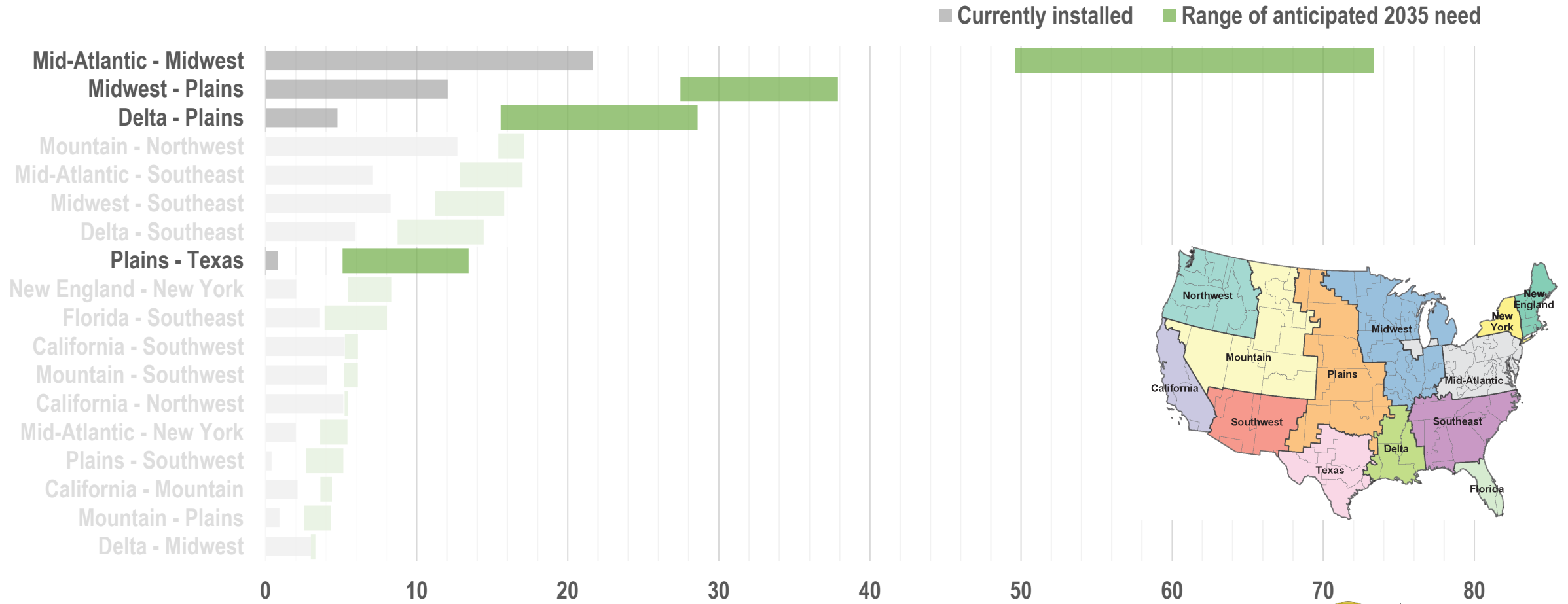
Interregional Transfer Capacity Expansion Results: 2035 Mod/High



Results of scenarios which enable a 2040 power system:

- 80% - 100% clean energy deployment
- 25% - 75% load growth
- 95 - 100% decarbonization from 2005 levels

Interregional Transfer Capacity Expansion Results: 2035 Mod/High



Results of scenarios which enable a 2040 power system:

- 80% - 100% clean energy deployment
- 25% - 75% load growth
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Your input is requested!

To comment on the Needs Study, please email your comments as a **pdf attachment** to

NeedsStudy.Comments@hq.doe.gov

Deadline April 20 (or 45 days after posted in Federal Register)

