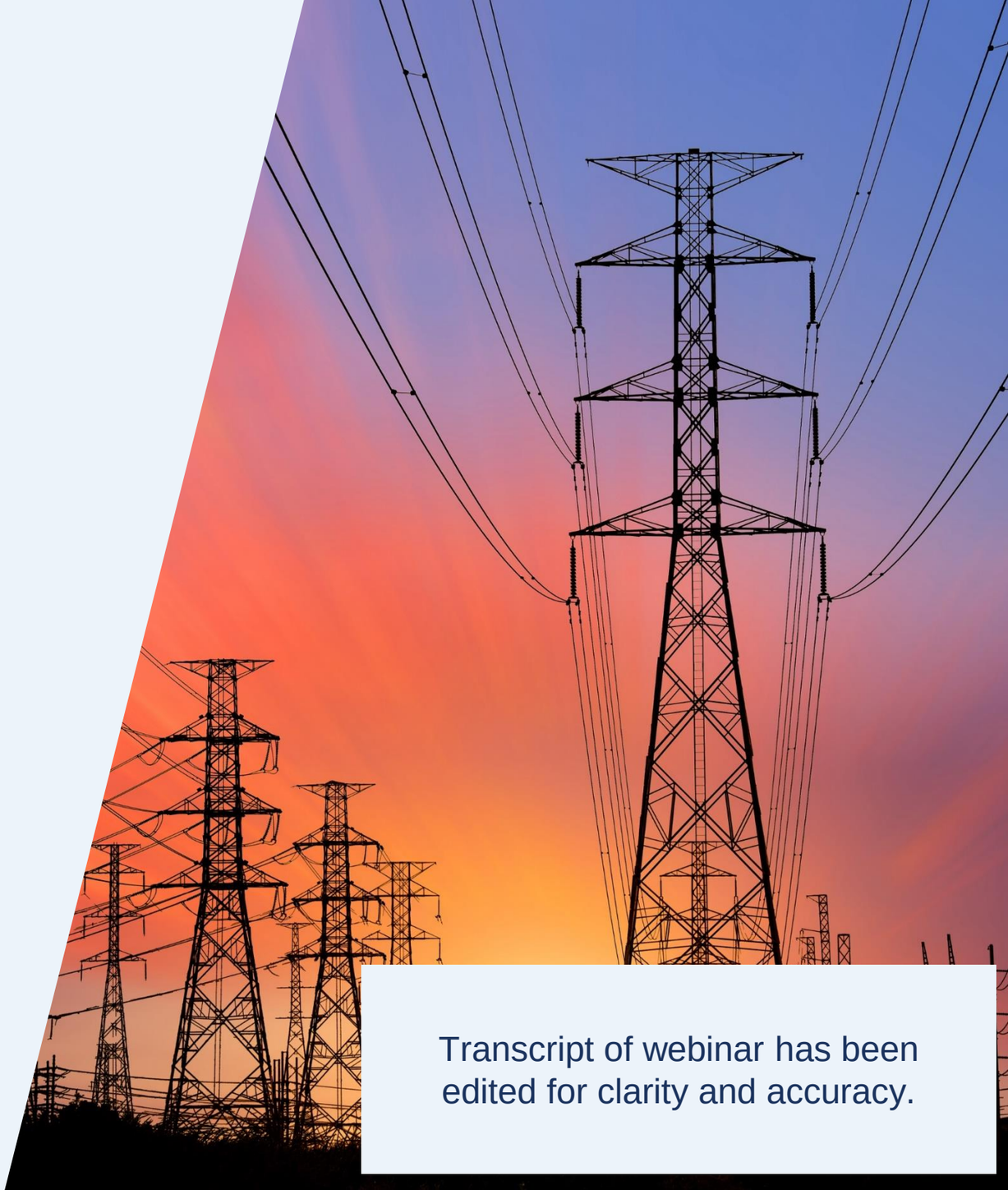
GRID DEPLOYMENT OFFICE

Draft National Transmission Needs Study Webinar

March 3, 2023



Transcript of webinar has been edited for clarity and accuracy.

Housekeeping

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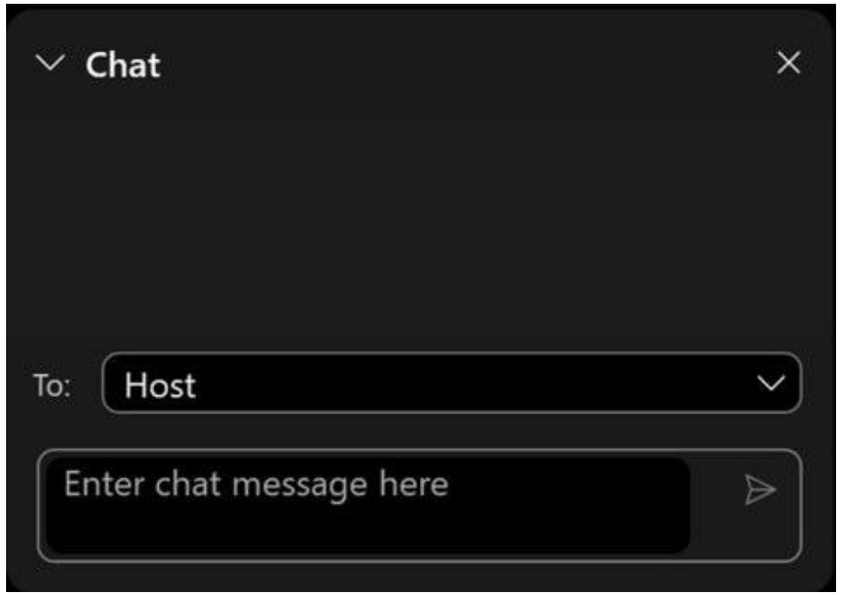

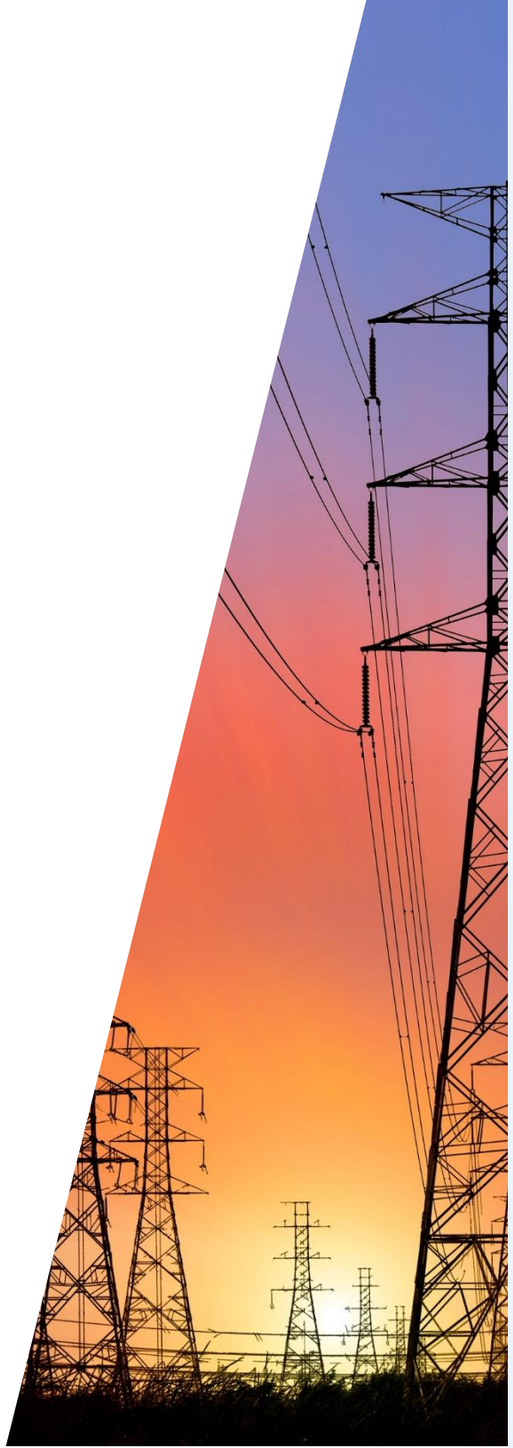

Hello and welcome to the Draft National Transmission Needs Study Webinar. I'm Whitney Bell with ICF and I will be your host today. First, we have a few housekeeping items for today's webinar. This WebEx meeting is being recorded and may be used by the U.S. Department of Energy. If you do not wish to have your voice recorded, please do not speak during the call. If you do not wish to have your image recorded, please turn off your camera or participate by phone. If you speak during the call or use a video connection, you are presumed consent to recording and use of your voice or image. All participants are in listen only mode. If you need to view the live captioning, please refer to the link that will appear in the chat momentarily. If you have any technical issues or questions, please type them in the chat box and select send to host.

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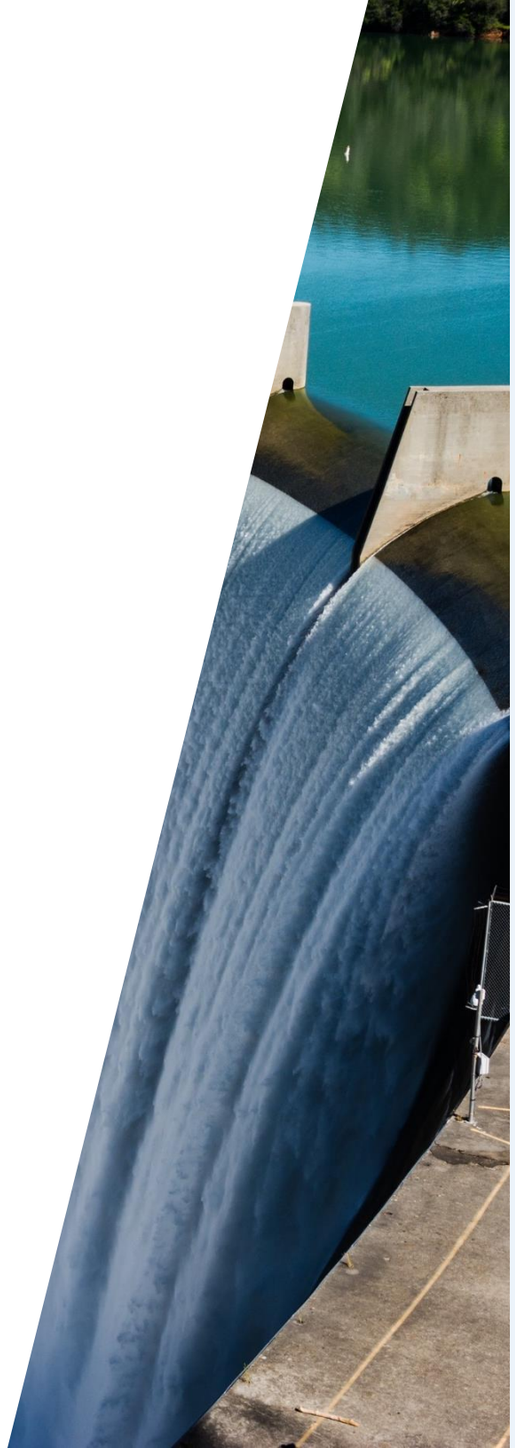
Agenda

1. **Grid Deployment Office Overview**
2. **Background**
3. **Outreach to Date**
4. **Draft Results**
5. **Questions & Answers**



Today we'll hear an overview of the Grid Deployment Office and a background on the study before moving on to an update on the study and draft results. We will have some time for Q&A at the end.

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Menti

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Instructions

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Or use QR code

Speaking of Q&A, we're going to run Q&A a little bit differently than we have in the past, you may submit your questions throughout the event using Menti. Please go to menti.com using your computer or mobile device and enter the code 1302994. You can then enter your questions throughout the event. We ask that you keep this open and you like any questions that are submitted by other people throughout the event, because the questions that the most likes will be where we start with our Q&A, when we get to the time at the end. The link and the code to join us is also in the chat and you can use your phone to join using the QR code that's on the screen now.

Finally, the recording of today's webinar will be available in about two weeks on the Draft National Transmission Needs Study Webinar webpage. We will notify you when that is available.

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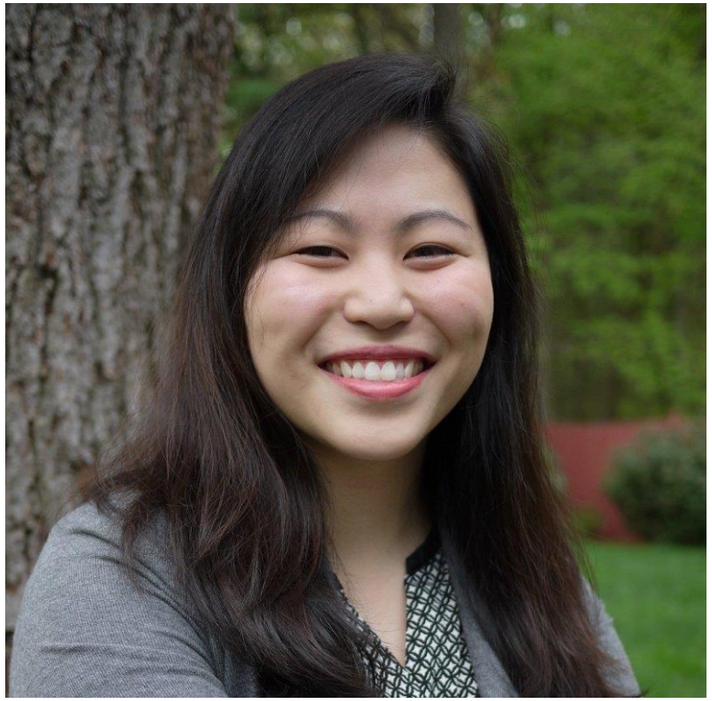

Maria Robinson

Director,
Grid Deployment Office,
U.S. Department of Energy

To kick off today's meeting you'll hear from Maria Robinson, Director of the Grid Deployment Office for some opening remarks. Maria, welcome.

MARIA ROBINSON:
Thank you so much, Whitney and welcome everyone today. My name is Maria Robinson. I lead the Grid Deployment Office here at the Department of Energy and just want to welcome all of you to today's webinar. And we're so thankful for your interest in our National Transmission Needs Study.

GRID DEPLOYMENT OFFICE

DOE's Grid Deployment Office

Mission Statement: The Grid Deployment Office (GDO) works to provide electricity to everyone, everywhere by maintaining and investing in critical generation facilities to ensure resource adequacy and improving and expanding transmission and distribution systems to ensure all communities have access to reliable, affordable electricity.

Power Generation Assistance Division	The Power Generation Assistance Division works with existing generation facilities to ensure resilience and reliability.
Transmission Division	The Transmission Division supports innovative efforts in transmission reliability and clean energy analysis and programs, and energy infrastructure and risk analysis in support of the Administration's priorities to enhance grid resilience.
Grid Modernization Division	The Grid Modernization Division oversees activities that prevent outages and enhance the resilience of the electric grid.

We have a slide here that shows an overview of our relatively new office, that was started back in August of last year. We have three different areas –

The Power Generation Assistance Division, which focuses on our civil nuclear credit program – which had a big announcement just yesterday – as well as our hydropower incentives.

Our Transmission Division, which works on commercial facilitation, planning and permitting related work for transmission. Of course today we will dig into the planning side of that fairly significantly.

And our Grid Modernization Division that focuses on financing programs relating to resilience, smart grid incentives and grants, as well as a lot of technical assistance relating to all of the above topics.

We're really excited to be here and grateful for your participation in this. And for those of you who have helped to participate in the Draft National Transmission Needs Study to date, we are particularly grateful for your contributions. So with that, I will send it back to you, Whitney, and we can get started.

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Jeffery Dennis

Deputy Director, Transmission Development,
Grid Deployment Office,
U.S. Department of Energy

WHITNEY BELL:
Thank you so much. I would now like to welcome Jeffery Dennis, the Deputy Director for Transmission Development with the Grid Deployment Office to provide us with a background on this study. Jeff, the floor is yours.

JEFFERY DENNIS:
Well, thank you, Whitney, and thank you, Maria. Good afternoon. My name is Jeff Dennis, Deputy Director for Transmission in the Grid Deployment Office. I'm going to provide just a couple of minutes of background on the Need Study before turning it over to the real experts to get into the meat.

As Maria mentioned, the Department and the Grid Deployment Office are taking a three pronged approach to address our nation's transmission needs and the challenges to meeting those needs – Enhanced planning of transmission, that's really where the work that you're going to hear about today fits. Siting and permitting, including support for states and local communities, and federal permitting coordination. And commercial facilitation to help resolve commercial caps to transmission.

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Needs Study Background

Overview of National Transmission Congestion Study

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**

The Transmission Needs Study is part of that enhanced planning work, as I mentioned, and it's statutorily required. It's required under Section 216(a) of the Federal Power Act; a report that the Department conducts that is an assessment of historic transmission constraints congestion every three years. This is what the Department is has classically referred to as its triennial State of the Grid Report.

Previous iterations of this report have reviewed historic industry data. We've had previous studies published, as you see there, four times. The most recent before this one was published in draft form in 2020 and not finalized. But if we go to the next slide, you will see a graphical depiction of how this study has changed in response to Congress's direction in the Bipartisan Infrastructure Law.

Overview of National Transmission ~~Congestion~~ Needs 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**

consultation* = **ability to contribute to Study draft as referred to in Federal Power Act; NOT government-to-government *Consultation* with Tribes as defined by DOE Order 144.1

In that historic bill, Congress amended the Federal Power Act, Section 216(a) in its direction to us to conduct a transmission needs study to not only consider historic transmission constraints and congestion, but also to look at expected future transmission capacity constraints and congestion in this three-year triennial State of the Grid Report, with consultation from states, Indian tribes and regional grid entities.

And so today's draft report that you will hear about looks a little bit different because we are responding to this direction of Congress to expand our analysis to look, not just at historic constraints and congestion negatively impacting consumers, but also future expected transmission capacity constraints and congestion negatively impacting consumers. So this report, taking that direction from Congress, looks not only at historic industry data, but also at recent power system studies, a wide variety of studies that look at future needs and published capacity expansion results. You'll hear a lot more about that in a minute.

We are aiming to publish a final report in 2023 following the public comment period that we have opened with the issuance of this draft and you'll hear in a minute about how we did that. So let's move to the next slide and talk about how this National Transmission Needs Study will be used.

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How will the Needs Study be Used?

Helps inform **DOE prioritization of future funding** and **focuses the attention** of federal, state, and Tribal policymakers, industry, and other stakeholders on most pressing national and regional transmission needs

[The Needs Study] will help inform DOE's prioritization of future funding opportunities related to transmission. And really, it's primary role is to focus the attention of federal, state and tribal policymakers, industry and other stakeholders on the most pressing national and regional transmission needs.

If we click forward one more time, we note that this study will also help inform the designation of National Interest Electric Transmission Corridors under that same section of the Federal Power Act, Section 216.

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How will the Needs Study be Used?

Helps inform **DOE prioritization of future funding** and **focuses the attention** of federal, state, and Tribal policymakers, industry, and other stakeholders on most pressing national and regional transmission needs

Helps inform **designation of National Interest Electric Transmission Corridors** (NIETC, \nit-SEE\) under FPA §216

- **The Needs Study does not designate any NIETCs**
- While DOE must complete the Needs Study before designating a NIETC, actual designation happens through a separate process
- NIETC designation considers the Needs Study and many other statutory factors, including whether designation would promote economic vitality, diversity of supply, reduction of consumers' costs, and national energy security and independence.

It is important to note that the Need Study today does not designate any National Interest Electric Transmission Corridors. Completion of the Needs Study is one prerequisite in order for the Department to potentially designate such a corridor, but that actual designation will happen through a separate future process. That future process will consider not just the Needs Study, but many other statutory factors included by Congress, including by Congress most recently in the Bipartisan Infrastructure Law, including whether the designation would promote economic vitality, diversity of supply, reduction of consumer costs and national energy security and independence.

So if we flip to my last slide, I just want to give you an overview, before you hear the details, of really what this Study intends to do, its objectives, and what it should not be misunderstood as doing, what it really is not doing and what other processes will do.

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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

The objective of this Study is to identify pressing national transmission needs. It does not prescribe solutions or identify any sort of master plan or major transmission plan that would solve these transmission needs, it is purely an assessment of needs and a comprehensive one.

The methods that we used are to consider existing data – that historic data I talked about – published reports, and capacity expansion models. It does not conduct new modeling, new cost benefit analysis, or system planning. That happens in other procedures -- in industry-run planning procedures and in other planning studies that the Department and others are undertaking – but that is not the Transmission Needs Study today. The Needs Study organizes these needs by geographic region, but those regional [areas] are not synonymous with potential National Interest Electric Transmission Corridors.

As I mentioned earlier, the Study does not identify corridors and does not designate corridors. That will happen in the separate process that the Department announced last January in the Building a Better Grid Initiative. It will be applicant driven and route specific and the Department will announce further plans on that in coming months, but today this Study is about needs and not about designation of corridors.

So with that bit of background and overview, I want to turn it back to Whitney who will turn it over to Adria Brooks on our team to lead you through the details of the Study.

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Dr. Adria Brooks

Transmission Planning Engineer,
Grid Deployment Office,
U.S. Department of Energy

WHITNEY BELL:
Thank you so much, Jeff. We now welcome Doctor Adria Brooks, Transmission Engineer from the Grid Deployment Office, to provide the updates on the on the Draft National Transmission Needs Study. Adria, I'll turn this over to you.

ADRIA BROOKS:
Thanks Whitney, and thanks Jeff and Maria for kicking us off. If folks could please submit their questions – the link was just dropped into to the chat – on Menti as I'm going and then folks can upvote if they had the same question. That way we can try to prioritize questions, although we're leaving lots of time to try to get through all of them.

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Department of Energy's **Draft National Transmission Needs Study**

Dr. Adria Brooks (she/her)
adria.brooks@hq.doe.gov

March 3, 2023

Webinar 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.

Just a quick notice, none of the information presented herein is legally binding. Also, the content included in this presentation is intended for informational purposes relating to the Draft National Transmission Needs Study. If there's any content within this presentation that appears discrepant from what's in the study itself, the study language supersedes what's in this presentation.

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Outreach to Date

2023 Needs Study Outreach & Engagement

Jan/Feb 2022
- Federal Register
- Public webinar

March 2022
- National State Association meeting
- DOE Tribal Consultation webinar

Alright, with that, I just want to give a brief overview of our outreach to date on the study. In January of last year, the Department kicked off what we called our Building a Better Grid Initiative. In this initiative we outlined several of the different programs that the department is undertaking related to building a better grid, to increase reliability of the grid, to integrate more clean energy resources, and to lower cost for consumers. The Needs Study is one of these programmatic activities. It was announced at the time [of the Initiative].

And in March we sent out preliminary notification to a handful of organizations; those organizations that Jeff mentioned that we're obligated to consult with. We met with national and state associations and we announced the Needs Study on the DOE Tribal Consultation Webinar that happened that month. In July, we sent a formal notification letter to those same entities and attended a number of conferences during the summer to announce the Study and to talk to lawmakers at the state level.

consultation* = **ability to contribute to Study draft as referred to in Federal Power Act; NOT government-to-government *Consultation* with Tribes as defined by DOE Order 144.1

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2023 Needs Study Outreach & Engagement

NOTICE OF INTENT
Building a Better Grid

Jan/Feb 2022
- Federal Register
- Public webinar

PRELIMINARY NOTIFICATION

March 2022
- National State Association meeting
- DOE Tribal Consultation webinar

FORMAL NOTIFICATION

July 2022
- Tribes, states, regional grid coordinators
- National State Association conferences

CONSULTATION* DRAFT RELEASED

October 2022
- Tribes, states, regional grid coordinators

CONSULTATION* PERIOD

October-November
- Webinar and calls open to consultation entities
- Written or verbal comments received

Then, in October, we released what we're calling the consultation draft and, again, that went to those same entities -- tribes, states, regional grid coordinators -- to get their feedback on the draft Study at that point. Our consultation period lasted from October through November. We received plenty of comments and then staff worked to integrate those comments into the Study that you all now have in front of you.

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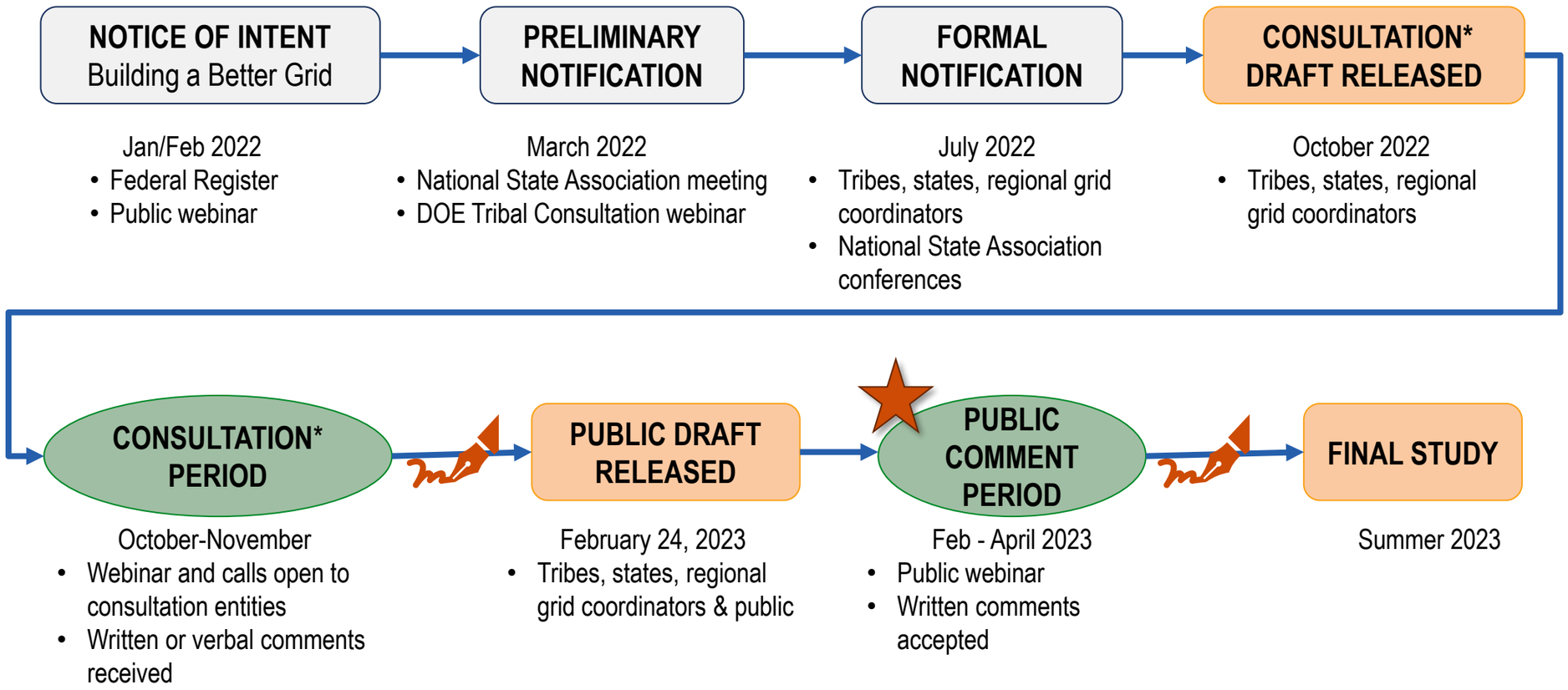
2023 Needs Study Outreach & Engagement



Last Friday we released the public draft version. One reason for us trying to get this out last Friday is to give as much time as possible for the public comment period. So the public comment period is now open. That will close on April 20th and I have instructions at the very end [of the presentation] on how you can submit comments. We will accept written comments. The e-mail address is at the very bottom of all of these slides. You can also reach out to the e-mail address if you have follow-up questions that you would like answered. Once the public comment period ends, DOE staff is going to work to revise any comments we receive, try to integrate what we can into the Study, and then publish a final Study in summer of 2023.

*_consultation_ = **ability to contribute to Study draft** as referred to in Federal Power Act; NOT government-to-government _Consultation_ with Tribes as defined by DOE Order 144.1

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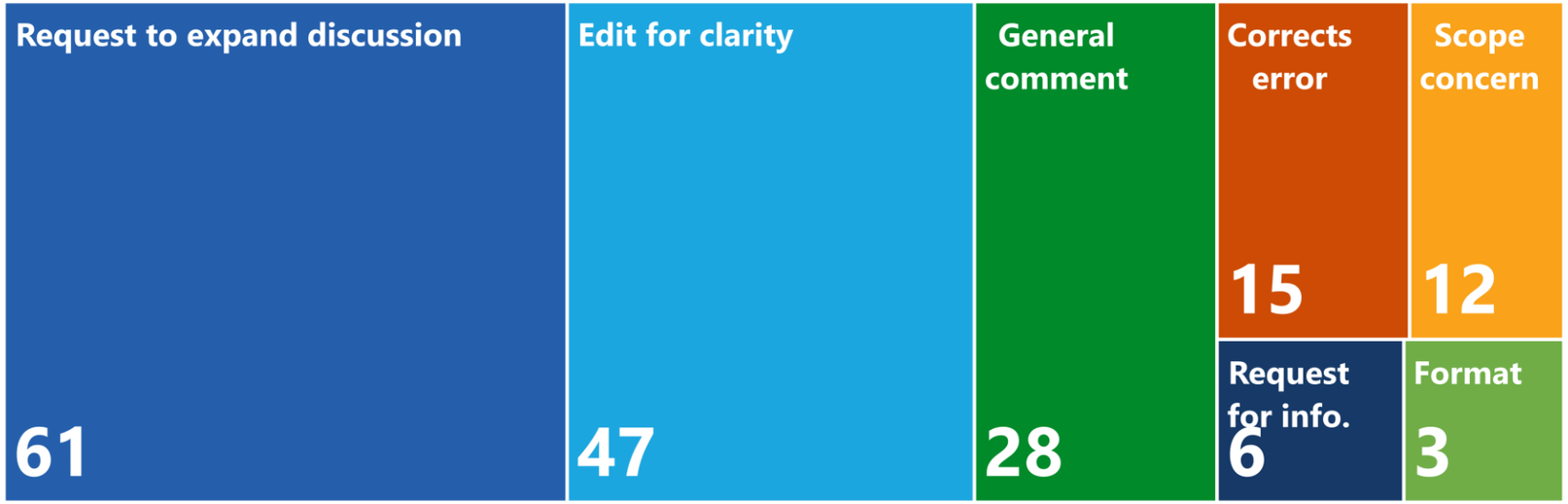
Summary of Consultation Comments Received

20 different entities submitted nearly 180 unique comments



All comments and revisions made are provided in the Appendix of the Draft Needs Study.

Here's a really high-level overview of the consultation comments that we received in October, November of last year. 20 different entities submitted comments and among those entities we estimate there were about 180 unique comments that came through. Here's just a general breakdown of them. 61 were requesting to expand discussion in various parts of the Needs Study. 47 comments provided edits for clarity or suggesting where we need to clarify our language. We also had 28 general comments. So for example, states letting us know about studies that they're undertaking that eventually would be useful to include the Needs Study, maybe the next Needs Study three years from now. We had 15 comments that corrected factual errors. 12 related to concerns of the scope of the Study. A handful of requests for more information and then just some small formatting suggestions, all of which we tried to resolve in the public version that you all have.

All the comments received and our attempts to revise based on those comments are provided in the Appendix of the draft Needs Study. So the last 80 pages or so of the Needs Study is in fact, all those comments that we received.

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Draft Results

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

Now diving into the draft results of the Study. Here's the outline of the Needs Study. Of course, there's an executive summary, there's an introduction which goes over all the background information that Jeff covered, legislative language that motivates the study, a chapter on transmission concepts, trying to bring folks up to a similar page before diving into the results. Those last three chapters really do focus on detailed results of the Study. The first one [fourth chapter] talks about historical data, understanding the current needs of the power grid. The fifth chapter reviews existing studies, both current and future needs. In the sixth and final chapter, we look at capacity expansion modeling to try to understand anticipated future needs on the power grid.

Here's the website again, although I imagine most of you have found this already since you're at the webinar, but if you need it, there is a website to go download the study itself.

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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

Now I'm going to really just focus on results in this webinar; we're not going to go over those first three chapters. So I'll talk about high level summaries – the executive summary -- then I'll really dive into some of the detailed results later on.

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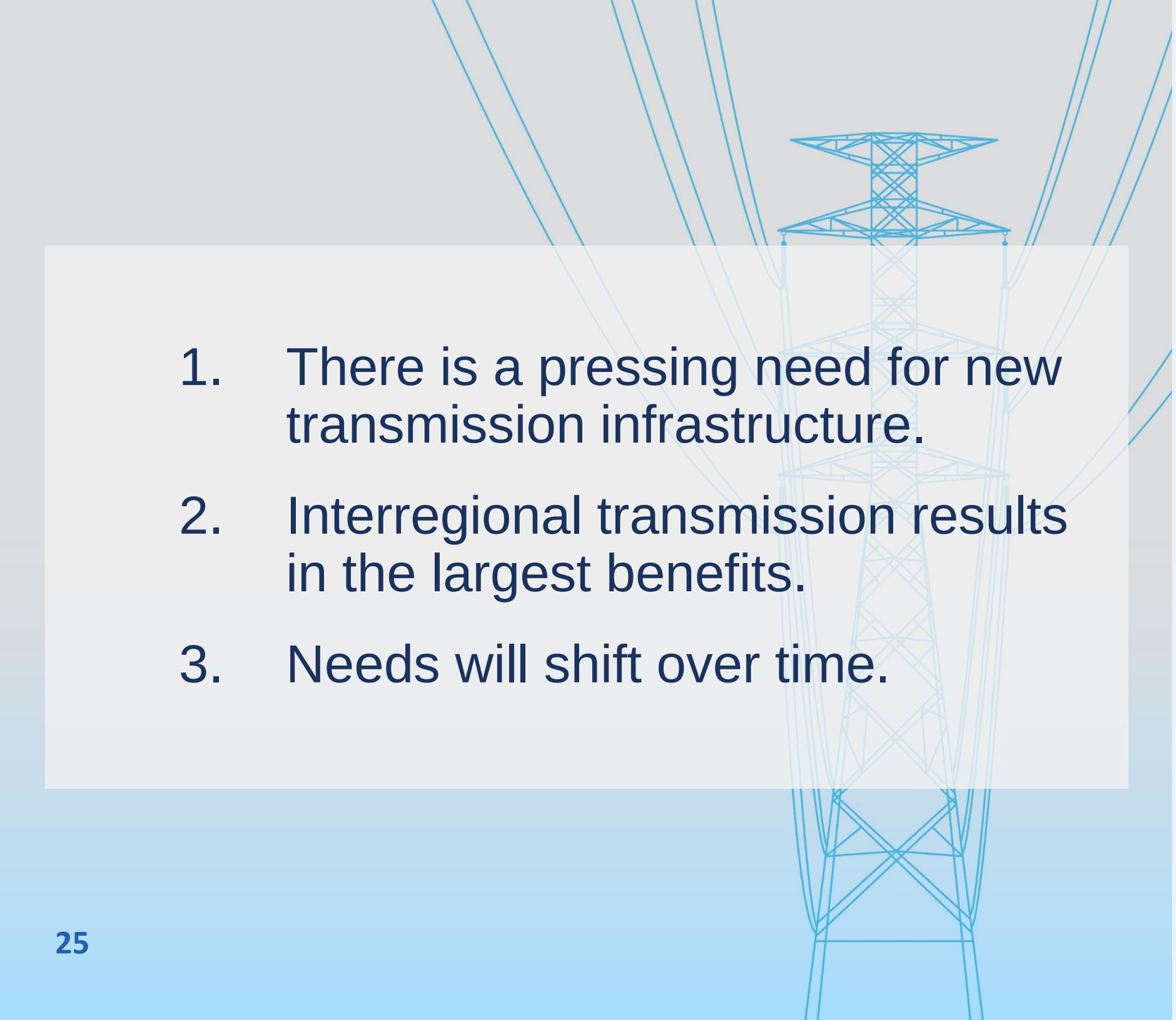

1. There is a pressing need for new transmission infrastructure.
2. Interregional transmission results in the largest benefits.
3. Needs will shift over time.

Here are the three big takeaways from the study, when we're looking nationwide.

There's a pressing need for new transmission infrastructure.

Interregional transmission is what results in the largest benefits. So of all the different ways to install transmission, looking at those interregional facilities is really where we see the largest benefit to the power grid.

And then finally, needs are going to shift over time. So what we need today is different than we need in 2030, which is different than what we need in 2040. Those needs are constantly evolving.

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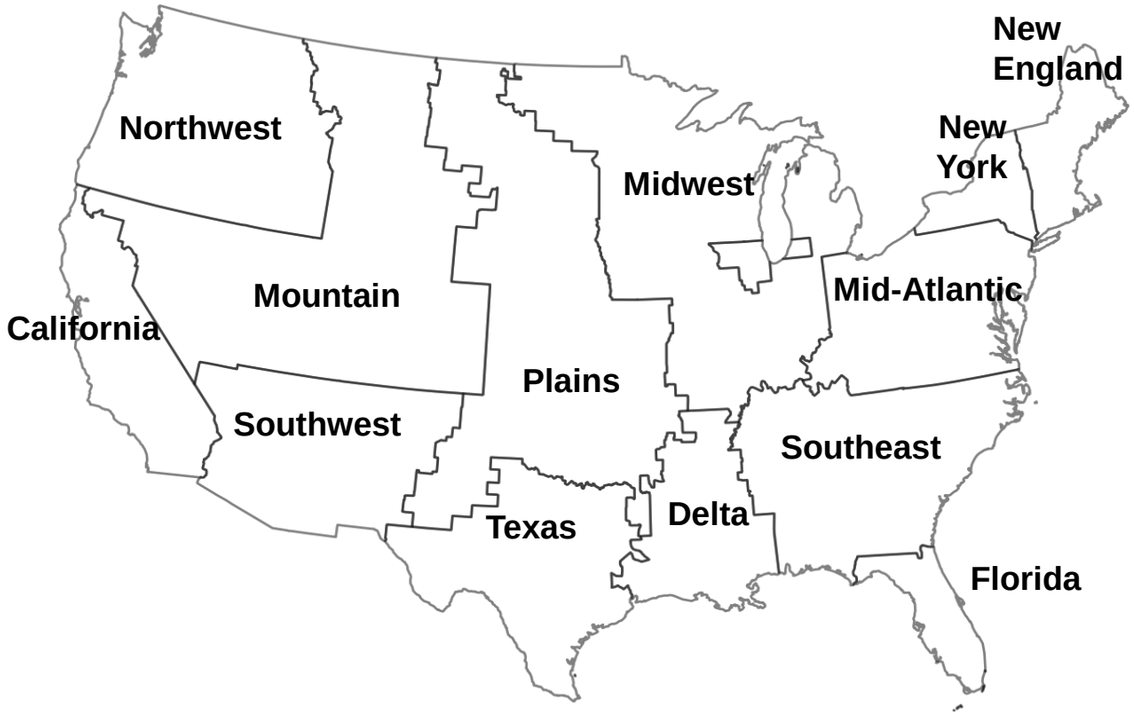
Geographic areas…



In the executive summary, we try to organize the detailed results in the rest of the report by these 13 geographic areas. We use this for purposes of the executive summary and then it shows up a few times in the detailed report. We really wanted make the detailed information understandable at a high level looking at these 13 regions.

Geographic areas where a transmission need exists could benefit from an upgraded or new transmission facility to…

Current:

- Improve reliability and resilience
- Alleviate congestion & unscheduled flows
- Alleviate transfer capacity limits between neighbors
- Deliver low-cost generation to high-priced demand

Anticipated future:

- Meet future demand with interregional transfer capacity
- Meet future demand with regional transmission

⋆ Represents ≥50% growth in 2035 relative to 2020 for mod/high scenario

◌ Lack of transparency in dataset used

Geographic areas where a transmission need exists could benefit from an upgraded or new transmission facility to do one of six things. These are the high level buckets that we used for categorizing all the needs that we found in the Study, for the executive summary. I'll go through them one by one so you can see how these different needs fall into each region.

We look at current need: the need to improve reliability and resilience in the power grid, to alleviate congestion and unscheduled power flows, to deliver low-cost generation to high price demand areas, and alleviating transfer capacity limits between neighbors. And, going into the future, also to meet future demand with interregional transfer capacity and to meet future demand with regional transmission deployment.

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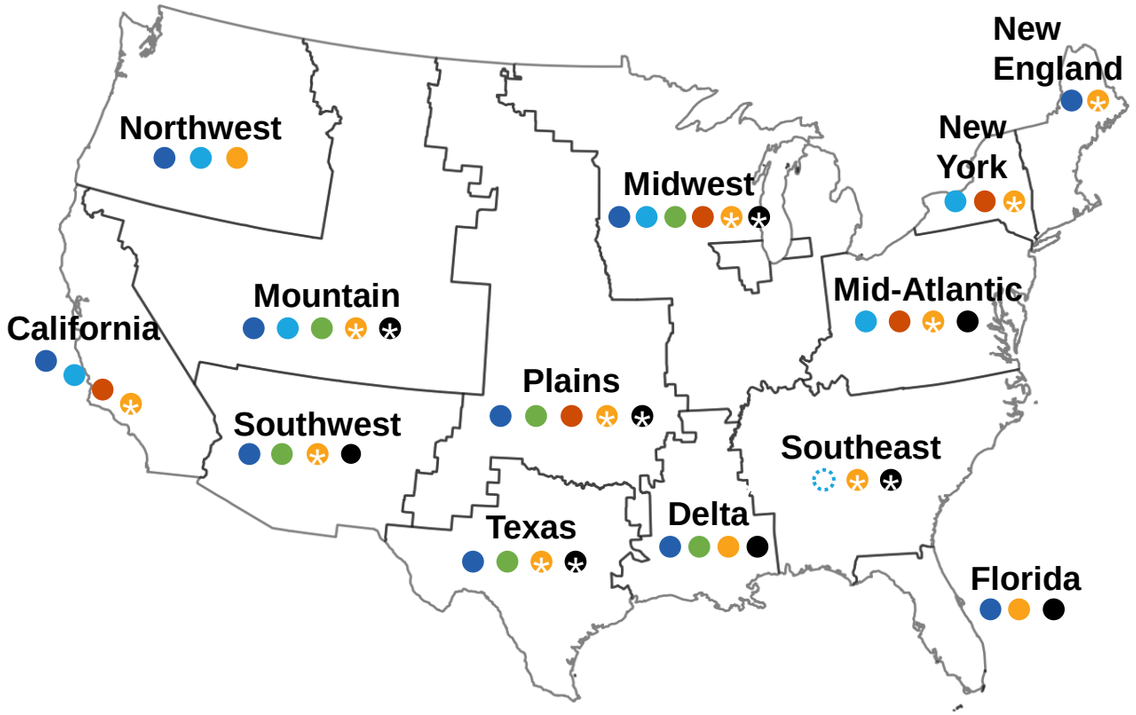
High-level summary of regional needs, supported by detailed findings.



Current:

- Improve reliability and resilience
- Alleviate congestion & unscheduled flows
- Alleviate transfer capacity limits between neighbors
- Deliver low-cost generation to high-priced demand

Anticipated future:

- Meet future demand with interregional transfer capacity
- Meet future demand with regional transmission

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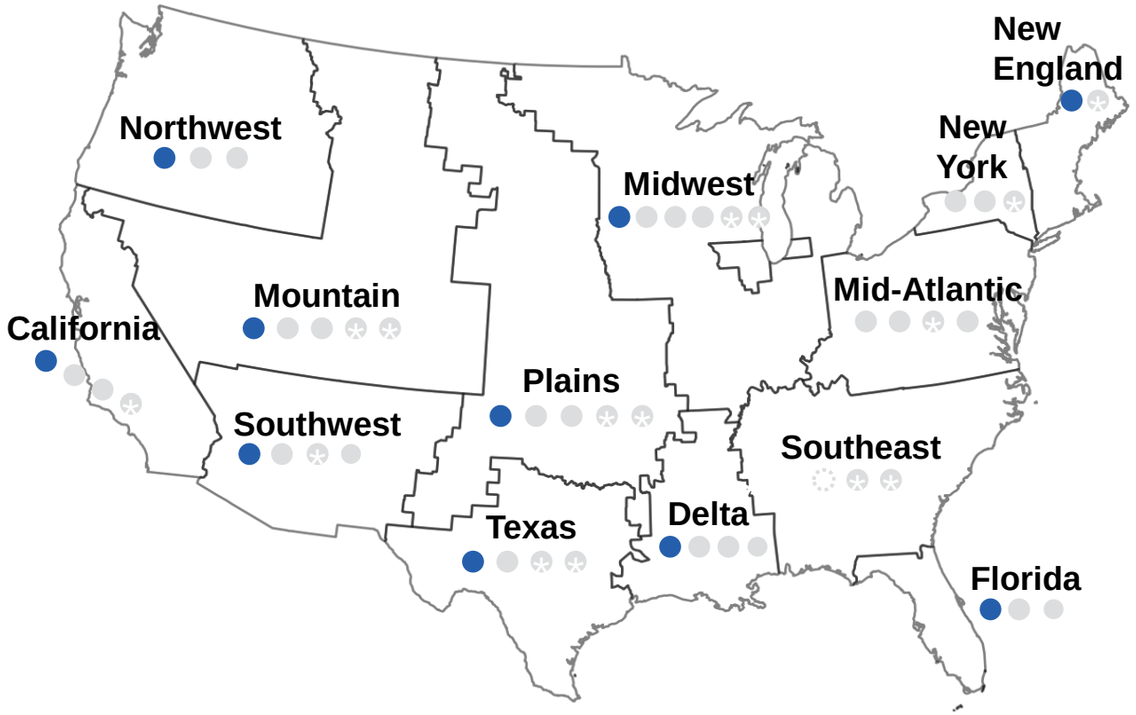
◌ Lack of transparency in dataset used

Here's a high level summary of the regional needs. And, again, all these that are in the executive summary are supported by the detailed findings, which I'll cover some of those in the rest of this webinar. Just going to run through each of these quickly.

Nearly all regions in the United States will benefit from improved reliability and resilience given additional transmission investments.

So it seems that nearly all regions in the U.S. will benefit from improved reliability and resilience given additional transmission investments. That showed up for almost all regions in the data that we looked at.



Current:

Improve reliability and resilience	Alleviate congestion & unscheduled flows
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Meet future demand with interregional transfer capacity	Meet future demand with regional transmission

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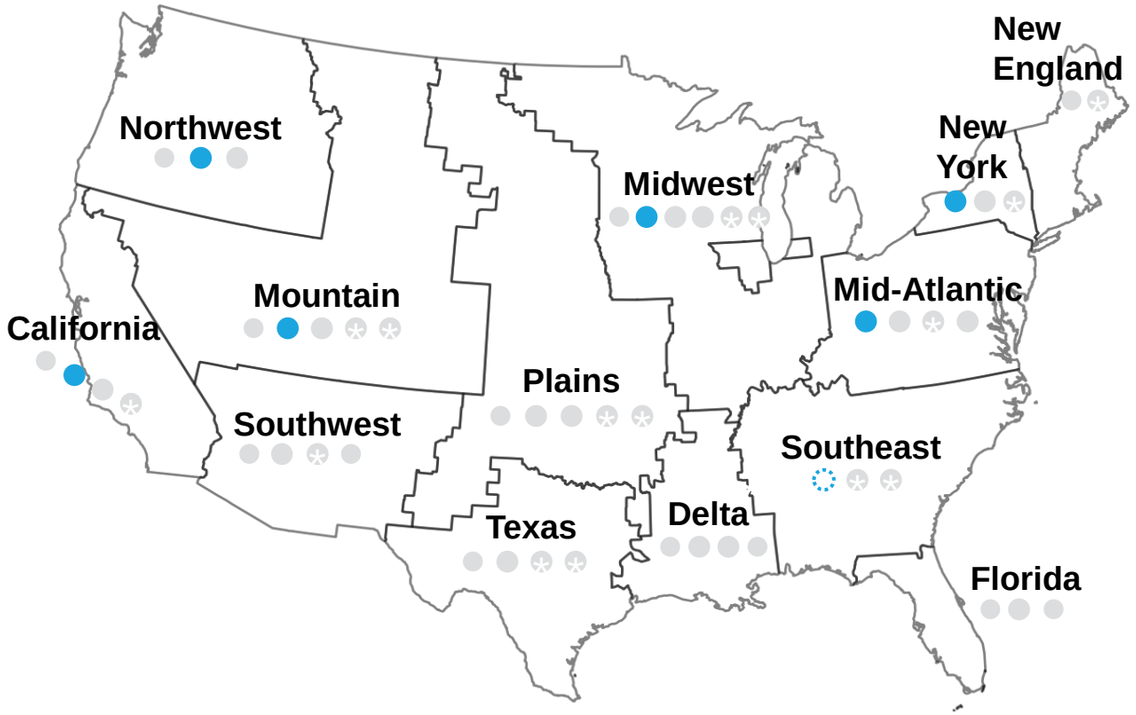
High congestion in the Midwest, Mid-Atlantic and New York could be mitigated by additional transmission assets. Unscheduled power flows in the West are prominent in California, the Northwest and Mountain regions.



Current:

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Anticipated future:

Meet future demand with interregional transfer capacity	Meet future demand with regional transmission

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◌ Lack of transparency in dataset used

High congestion in the Midwest, Mid-Atlantic and New York could be mitigated by additional transmission assets. Also, unscheduled power flows in the west are prominent in California and the northwest and the mountain regions.

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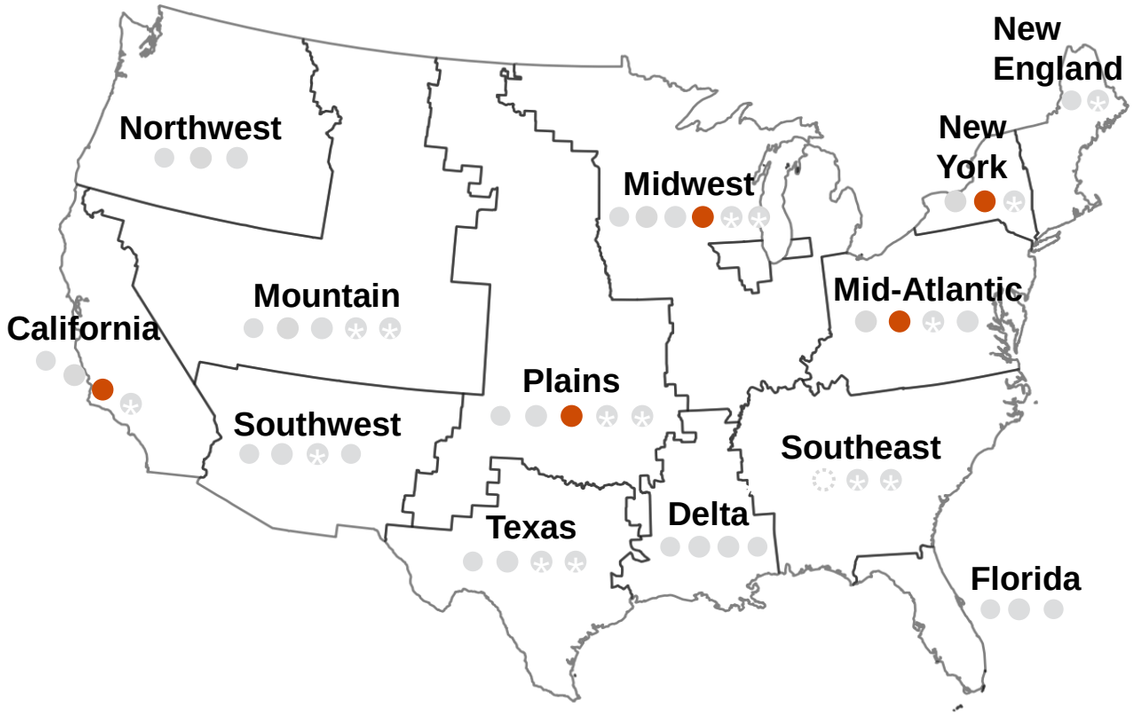
Regions with high electricity costs—notably portions of the Plains, Midwest, Mid-Atlantic, New York, and California—will benefit from transmission that delivers cost effective generation

Regions with high electricity costs, notably portions of the Plains, Midwest, Mid-Atlantic, New York and California, will benefit from transmission that delivers cost effective generation.



Current:

Improve reliability and resilience	Alleviate congestion & unscheduled flows
Alleviate transfer capacity limits between neighbors	Deliver low-cost generation to high-priced demand

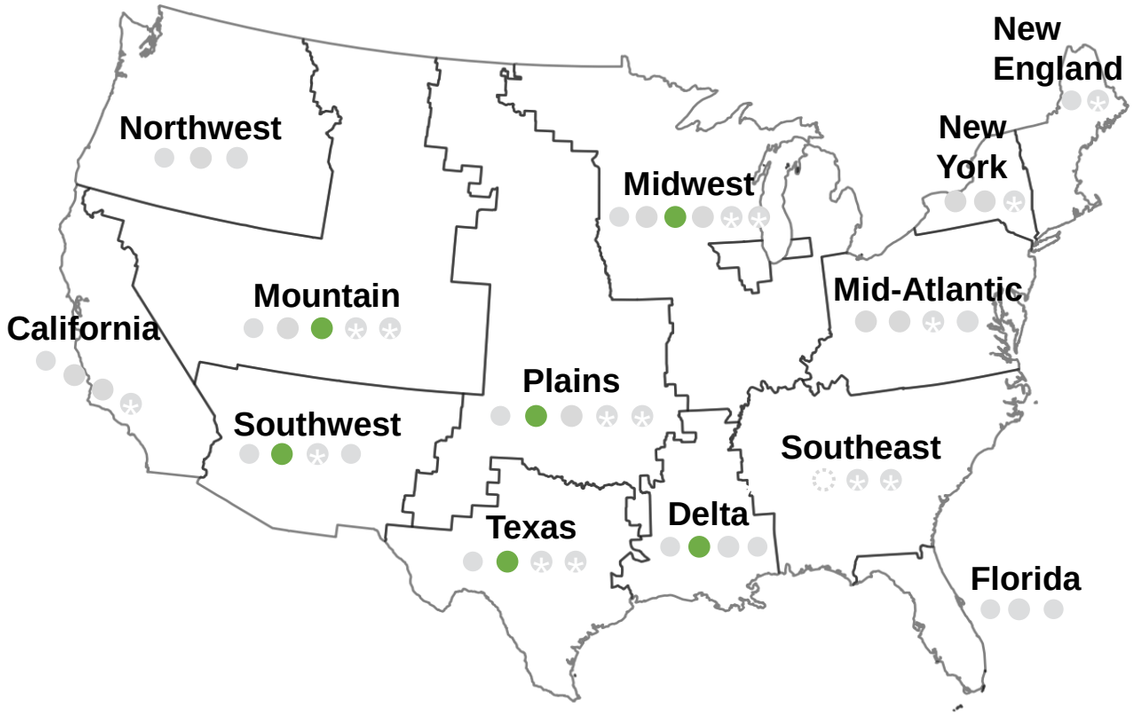
Anticipated future:

Meet future demand with interregional transfer capacity	Meet future demand with regional transmission

⋆ Represents ≥50% growth in 2035 relative to 2020 for mod/high scenario

◌ Lack of transparency in dataset used

Historically, the largest benefits in new interregional transfer capacity additions are found across the interconnection seams and in the middle of the country.



Current:

Improve reliability and resilience	Alleviate congestion & unscheduled flows
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Anticipated future:

Meet future demand with interregional transfer capacity	Meet future demand with regional transmission

⋆ Represents ≥50% growth in 2035 relative to 2020 for mod/high scenario

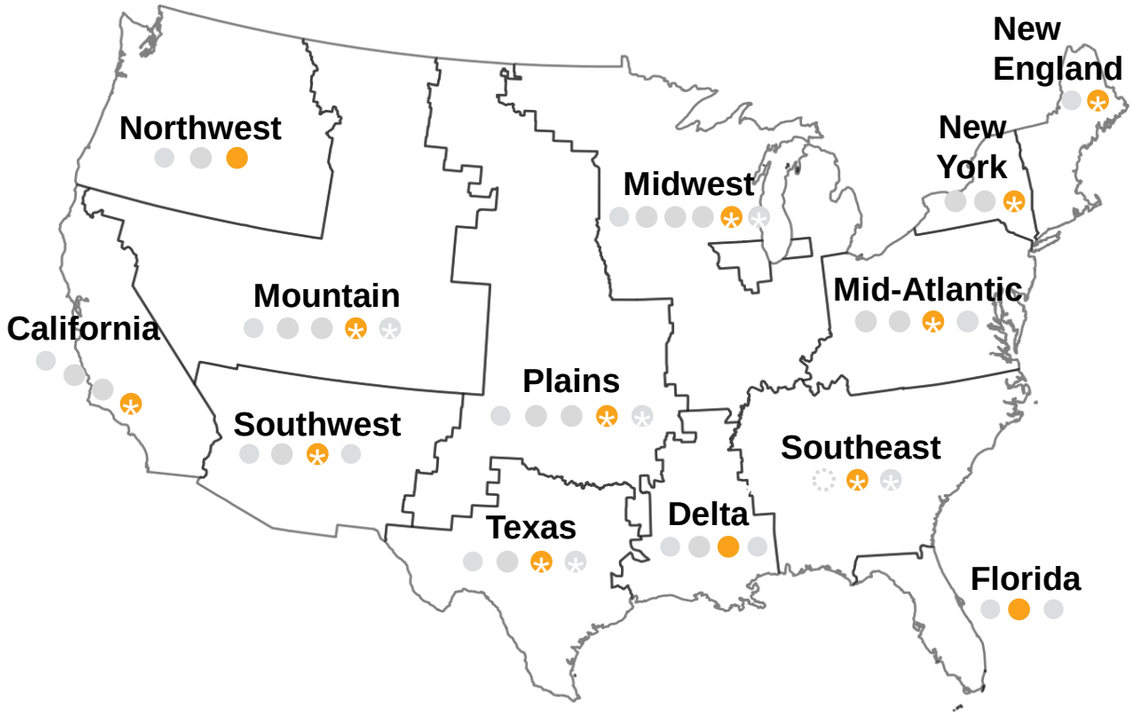
◌ Lack of transparency in dataset used

And, historically, the largest benefits in new interregional transfer capacity additions are found across the interconnection seams and in the middle of the country.

So here, if we're just looking at historic data, we see these six regions in the middle of the country where we're already seeing a need to alleviate transfer capacity limits.

GRID DEPLOYMENT OFFICE

By 2040 there will be a significant need for new interregional transmission between nearly all regions.



Current:

Improve reliability and resilience	Alleviate congestion & unscheduled flows
Alleviate transfer capacity limits between neighbors	Deliver low-cost generation to high-priced demand

Anticipated future:

Meet future demand with interregional transfer capacity	Meet future demand with regional transmission

⋆ Represents ≥50% growth in 2035 relative to 2020 for mod/high scenario

◌ Lack of transparency in dataset used

However, once we start to look into the future, out to 2040, there's going to be a significant need for new interregional transmission between nearly all regions. In every region there was a need to share with at least one of their neighbors in the future. So today, the middle of the country [has a need to increase transfer capacity limits with neighbors], and later on almost everywhere [has that need]. That's an example of these changing needs on the grid.

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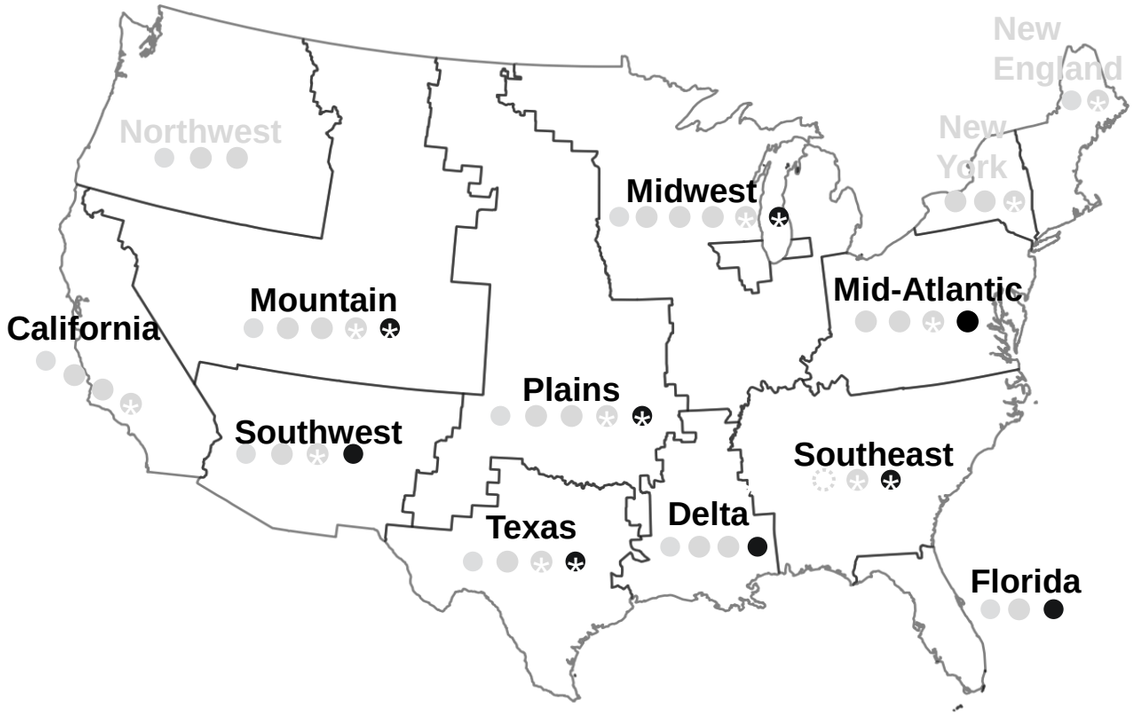
Significant transmission deployment is needed as soon as 2030 in the Plains, Midwest, and Texas regions. By 2040, large deployments will also be needed in the Mountain, Mid-Atlantic, and Southeast regions.



Current:

Improve reliability and resilience	Alleviate congestion & unscheduled flows
Alleviate transfer capacity limits between neighbors	Deliver low-cost generation to high-priced demand

Anticipated future:

Meet future demand with interregional transfer capacity	**Meet future demand with regional transmission**

⋆ Represents ≥50% growth in 2035 relative to 2020 for mod/high scenario

◌ Lack of transparency in dataset used

And then finally, significant transmission deployment is needed as soon as 2030 in the Plains, Midwest and Texas regions. But by 2040, large deployments will also be needed in the mountains, Mid-Atlantic and Southeast. So again, we're seeing more regions with needs changing with time.

Now, having gone over that, if you were sitting here in your region thinking, “Oh, one of those doesn't look quite right for us, I'm not sure why.” -- this is the type of feedback that we want to get during comment period. Dive into the report, understand where we're pulling these findings from, and then please respond to us [with any new or clarified information you think we need].

GRID DEPLOYMENT OFFICE

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

OK, so I'm going to dive into the first chapter that has detailed results; looking at historical data. The first section of this chapter is historical transmission investments. The second section is looking at market price differentials, we do that both regionally and inter-regionally, and also looking at transmission value during extreme events. Another section is on qualified paths in the West. And then finally a section on interconnection queues.

GRID DEPLOYMENT OFFICE

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**

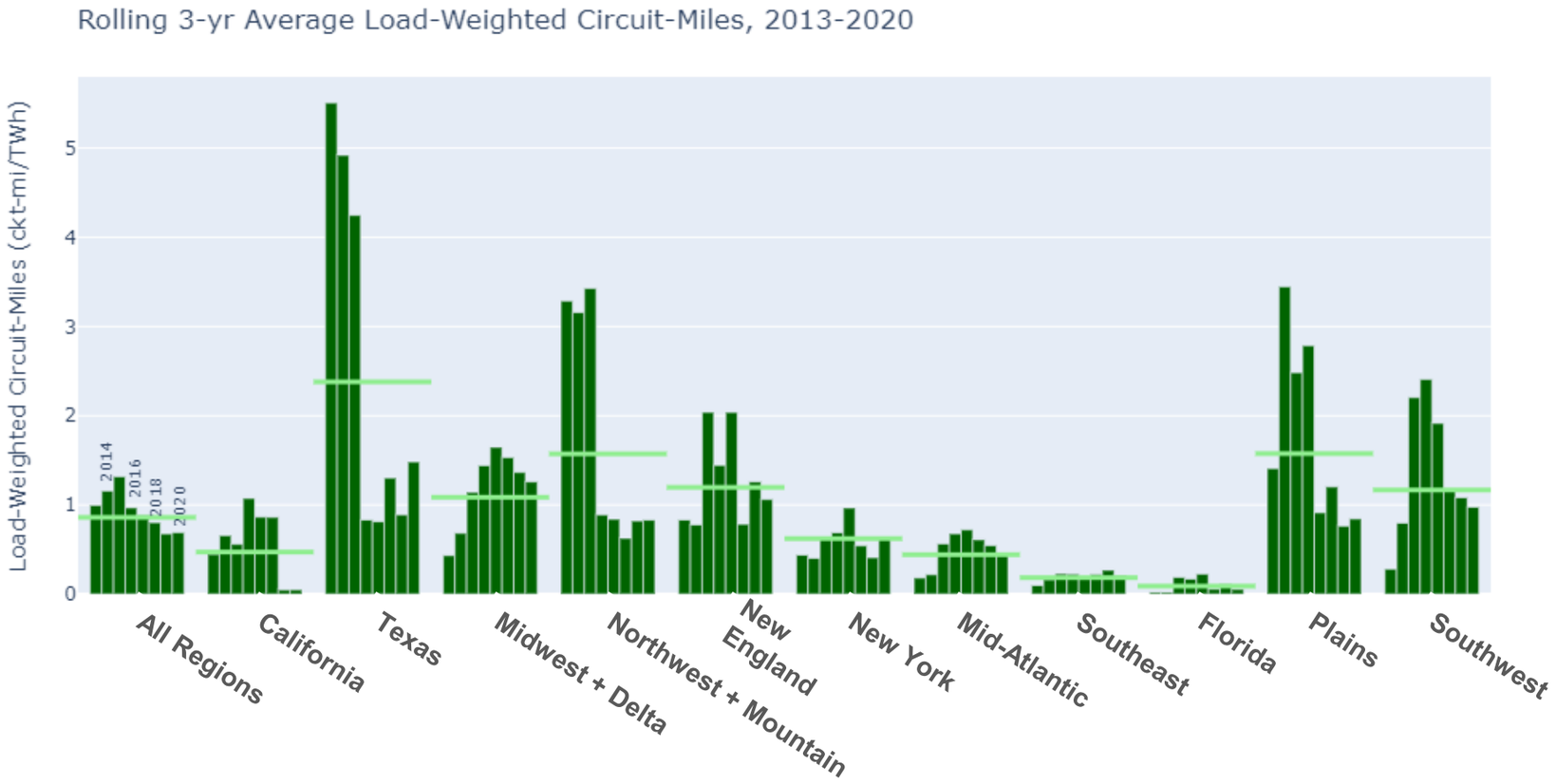
IV.c. Qualified Paths

IV.d. Interconnection Queues

Now because of time, I'm not going to go into detailed reports or detailed findings for all of these sections, I'm just going to focus on a handful of them.

GRID DEPLOYMENT OFFICE

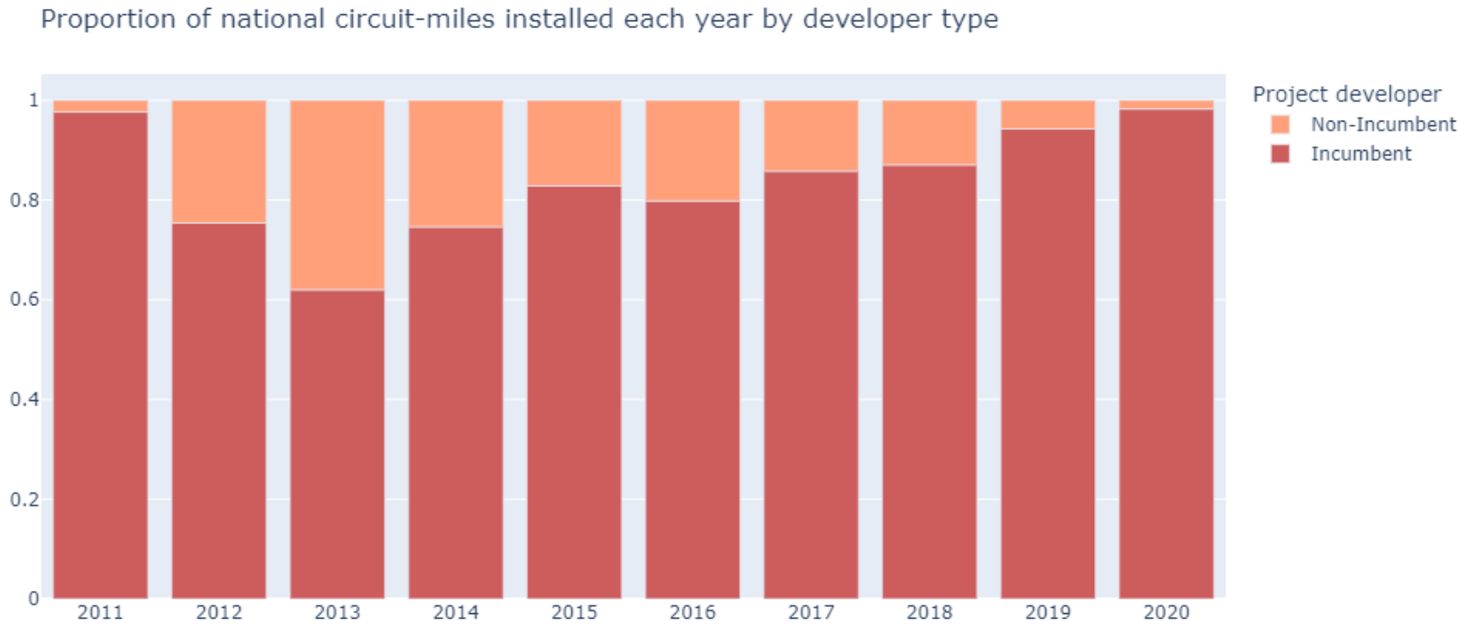
Transmission investments decreased during the second half of the 2010's.



One of the first findings is that transmission investments decreased during the second-half of the 2010s. What's plotted here is load weighted circuit miles for all the last decade, so 2011 through 2020. We present these as rolling three year averages to get rid of some of the lumpiness by which transmission lines come online. This is broken out by regions, so the number of circuit miles weighted by electric load for each region. Understanding that if you have high load, you might have more need for transmission than if you have lower load.

Now the clustered bar charts all the way to the left, where it's labeled All Regions, that's the entire United States. You can see this increase in transmission that was installed up through 2015 and then that dropped off from 2015 to 2020. So there's certainly this increase in the beginning of the decade and then decrease the latter half of the decade. And that trend was generally true for all regions individually as well, to differing degrees. So that was something that stood out right away.

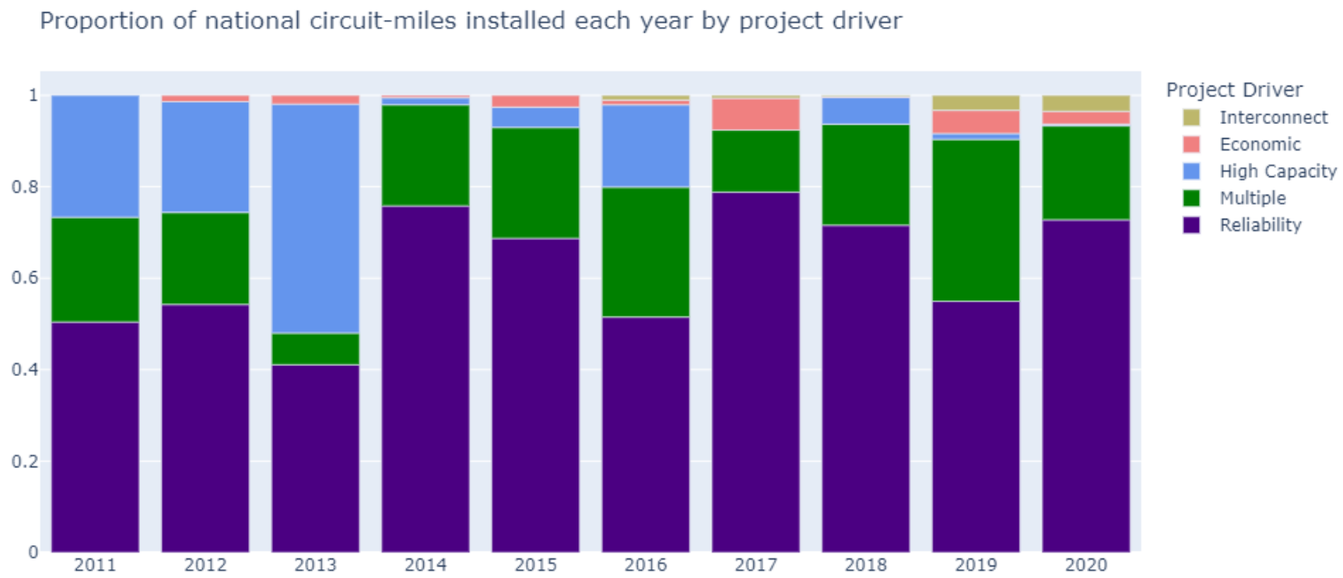
Non-incumbent developers' share of energized projects has decreased from 40% in 2013 to less than 5% in 2020.



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

We can also look at who is installing projects. We found that non-incumbent developers share of energized projects decreased from 40% in 2013 to less than 5% in 2020. The peach color at the top of all bar charts are non-incumbent developers' share of all [transmission] projects. Non-incumbent developers are also sometimes referred to as merchant developers. In 2013, there was the most even mix between non-incumbent developers and the incumbent developers -- the regulated utility developers -- in the salmon color. That dropped off precipitously through 2020, where non-incumbent developers had less than 5% of all projects installed.

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



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

Interconnect projects to 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 >=345kV.
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.

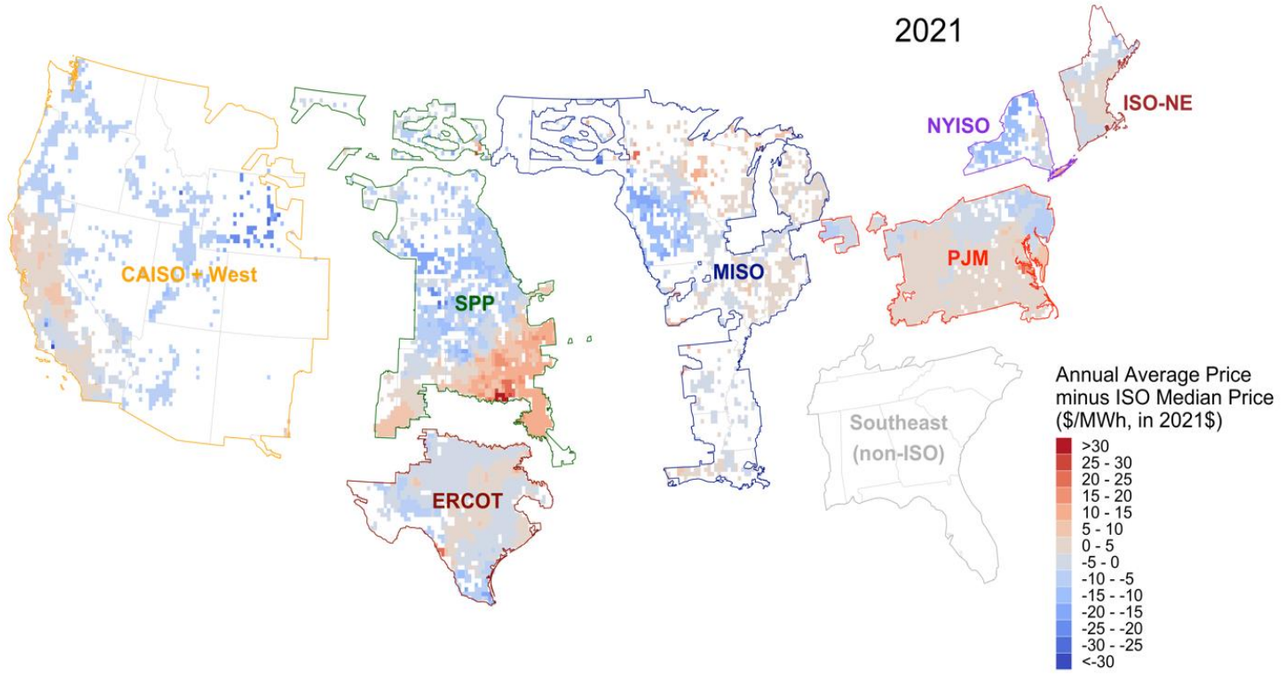
In addition to looking at who was installing, we also want to look at why projects were installed.

The share of projects addressing reliability concerns, in purple at the bottom portion of these bar charts, have increased. So in 2011, projects that were installed to address reliability concerns were about 50% of all projects, but in 2020, that increased to about 75%.

If we look at the share of high capacity projects -- so those projects that are really high voltage meant to move generation long distances, shown here in light blue -- those decreased over the course of the last decade. They had the most installs in 2013, about 50% of circuit miles installed were for high capacity projects. And then that decreased in the latter half of the decade, and in 2020 where there were hardly any that were installed.

GRID DEPLOYMENT OFFICE

Historic electricity prices reveal areas experiencing congestion today. Directions of within region congestion is maintained over time.



Increased transmission capacity between high- and low-priced areas would enable low-cost generation to reach high-priced markets.

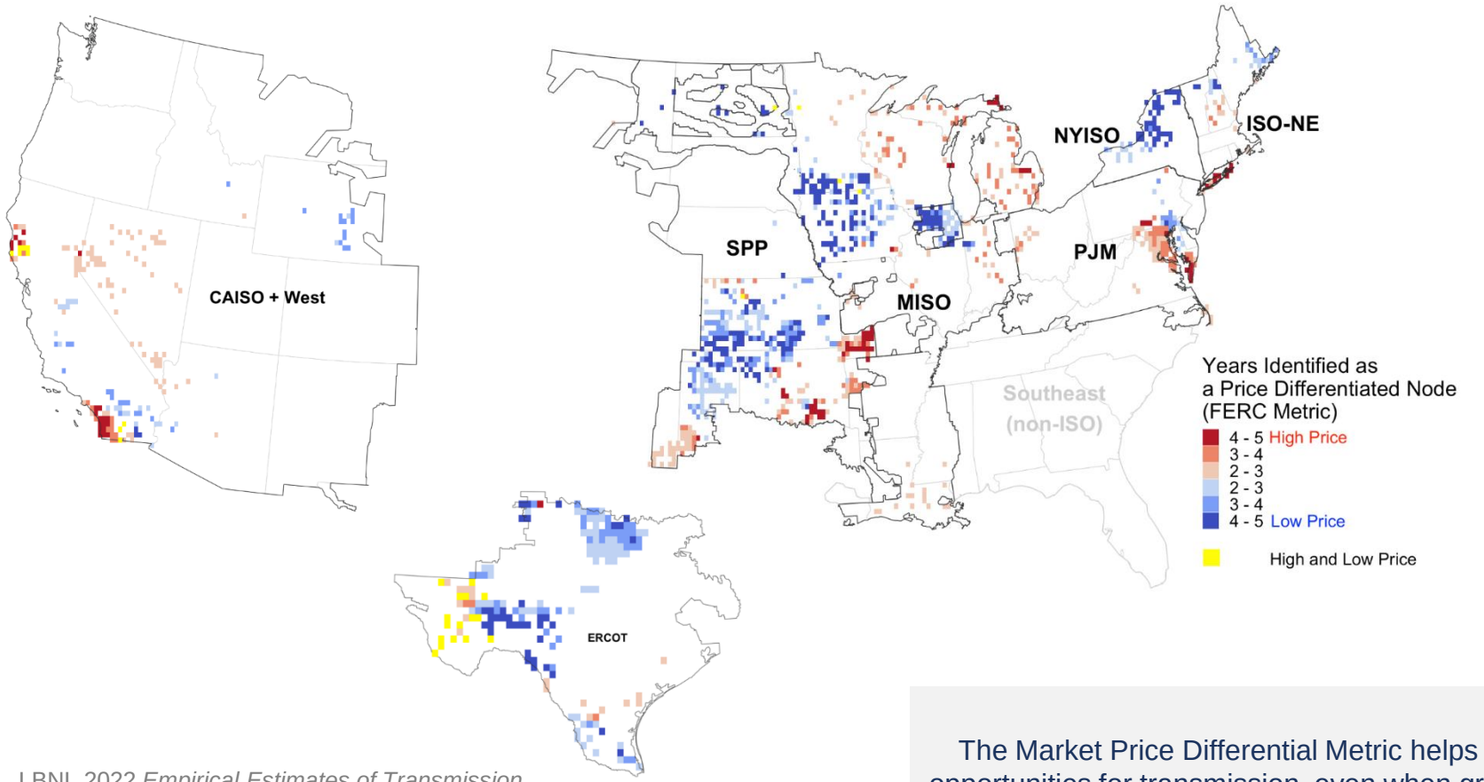
Moving now to look at wholesale electricity prices, historic wholesale prices. These prices reveal areas experiencing congestion today. Where there's a difference between a high price region and a low price region nearby, that indicates there's some type of congestion on the power grid. And the directions of within-region congestion is maintained overtime. So looking back even to 2012 data, we find the same areas had low prices and the same areas had high prices, that was consistent throughout all of the decade.

In general, increased transmission capacity between these low price regions, shown here in blue, and the high price regions, in red, would help alleviate or could help alleviate those high-priced regions by offering them low-cost generation.

Now it's much easier to see these congestion trends if instead of looking at average prices, which is done here, we look at where there are persistently low and high prices.

LBNL 2022 *Empirical Estimates of Transmission Value using Locational Marginal Prices*
ESIG webinar recording link

A look at persistently high and low prices isolates areas that are strongly impacted by congestion, regardless of average annual price.



The Market Price Differential Metric helps identify opportunities for transmission, even when grouping all interconnect regions together.

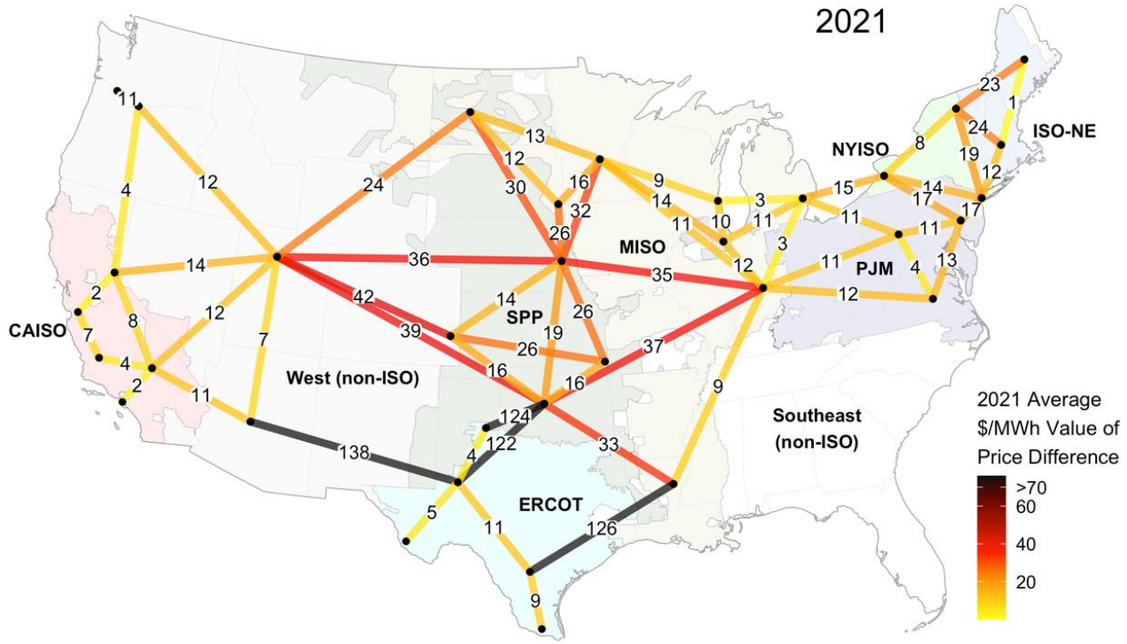
So again, high prices in red, low prices in blue, this really helps us isolate areas that are strongly impacted by congestion, regardless of the average annual price.

Energy prices change a lot, most linked to natural gas prices, so we can get rid of that if we just look at where they're persistently high and persistently low. Each one of these dots, these pixels, this is a place on the grid where we measure wholesale electricity prices. These nodes, if they're red, that means that these were at the top 5% of electricity prices within that interconnect year after year. So really, really dark red, that means for even four or five years in a row [these locations had] consistently the highest prices, even on an hourly basis. The opposite is true for the dark blue; these are places on the grid where the prices were persistently low year after year. This again really helps us to isolate where additional transmission assets would help improve this congestion and potentially help reduce prices for consumers in these red regions.

LBNL 2022 *Empirical Estimates of Transmission Value using Locational Marginal Prices*
ESIG webinar recording link

GRID DEPLOYMENT OFFICE

Largest congestion value of new transmission is across the interconnects and during extreme weather events.



Each link shows marginal value ($/MWh) of relieving congestion.
Absolute values are high in 2021, but value trends are consistent dating back to 2012.

So here's another way to look at this. This is research that was done by Lawrence Berkeley National Lab. Actually, the last few slides were also done by Lawrence Berkeley National Lab for us, but this section of the report was spun off into their own report and there are links in the slides. You can also Google [the report title] and go see webinar recordings of the researchers presenting their own work. I'll just give a high level overview of it here.

We found the largest congestion value of new transmission is across the interconnects and during extreme weather. So what's being plotted here between each of these black dots? We're showing the differences between wholesale prices, hourly wholesale prices, over the course of the year on average. For example, if you were to look at that black dot in Phoenix, Arizona, that's not actually Phoenix, that's a hub price. So that would really represent the prices of all of Arizona, all of New Mexico. We can compare the difference between the prices in Arizona and New Mexico against, for example, the prices in California to the west or out to the east.

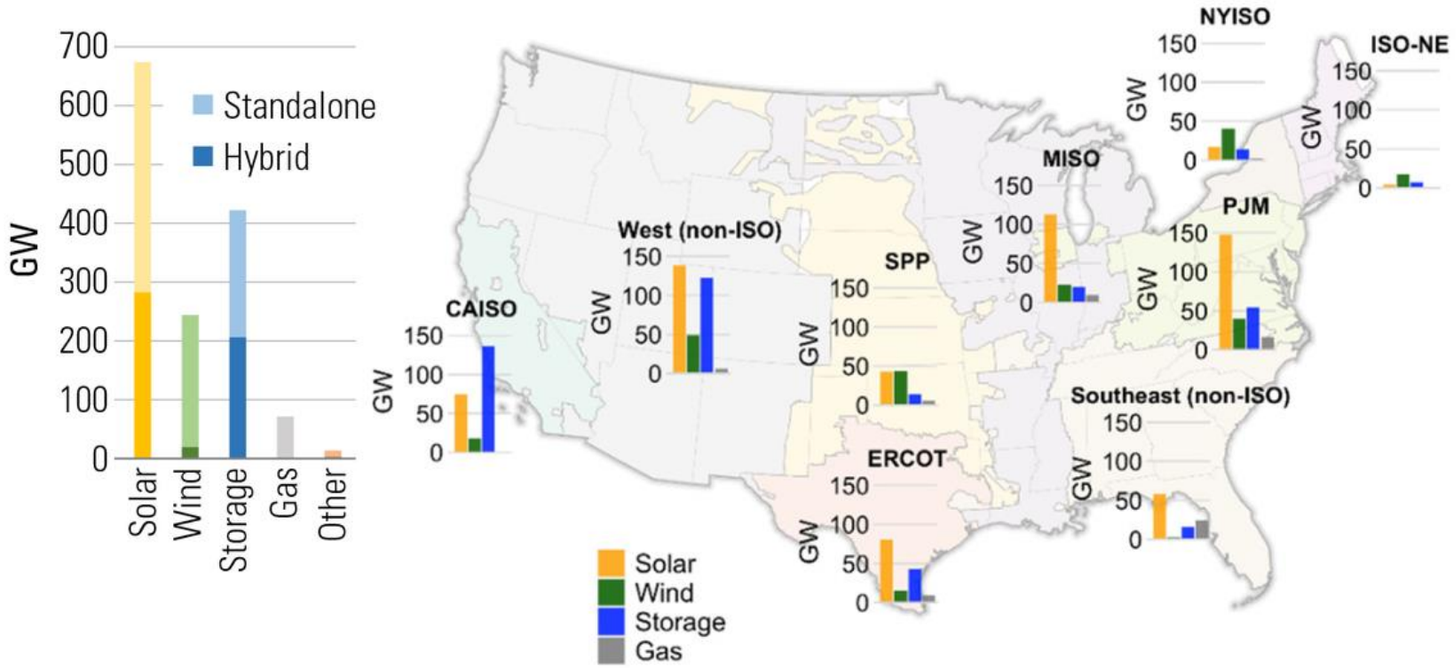
We see that there is a large difference in prices between Arizona and Texas. Where these high values exist, shown here by the high number and the darker color links, that's indicative that there would be high value in more transmission capacity between those locations on the grid to help reduce congestion. That really shows up when we look at Texas connecting with any of its neighbors, but then also connecting the eastern and the western interconnects, so shown here, connecting the West non-ISO to SPP. So the highest value is connecting the three interconnects. There's also high value in this chart when connecting SPP and MISO.

And that said, this is data from 2021, which was an extreme weather year for ERCOT where they experienced really high prices because of power outages in February of that year. If we were to look at different years, these numbers do drop off for Texas, but the same trends apply even going back to 2012. We see the highest value connecting across the interconnections and then also connecting SPP to its eastern neighbors.

LBNL 2022 *Empirical Estimates of Transmission Value using Locational Marginal Prices*
ESIG webinar recording link

GRID DEPLOYMENT OFFICE

Power plants seeking transmission interconnection are facing increasingly long wait times.



DOE / LBNL, *Queued Up But in Need of Transmission*
ESIG webinar recording link

And then a quick look at the interconnection queues in each region. We find that power plants seeking transmission interconnection are facing increasingly long wait times. In the 2000 – 2010 [timeframe], wait times for power plants to connect to the power grid were a little over two years. Last decade, they were more than 3 1/2 years.

There's lots of reasons why the interconnection queues are backlogged in the U.S., but one of those is that these power plants don't have adequate access to the existing transmission system. There's a need for serious upgrades on the transmission system and those costs can sometimes be cost prohibitive for the power generators versus [making those upgrades] in a transmission planning setting.

Shown here are the amount of power plants in the interconnection queue within each region. The majority of them are solar (in yellow) or storage (in blue), but there's also several wind (in green) and then also gas plants (in gray) in a handful of regions that are backlogged.

GRID DEPLOYMENT OFFICE

V. Review of Existing Studies: Current and Future Needs

OK, so moving on to the next chapter, our Review of Existing Studies. This is really capturing both current and future needs. We looked at 50 different studies in this chapter. As Jeff said, there are 80 different studies in the entire report, but just in this chapter alone, we looked at 50 of them. These were studies that were national in scope, sometimes regional in scope, and occasionally just looking at one state's power grid. Going through all of that information, we were trying to look for patterns that would tell us about needs of the power system. The way that we organized the chapter is how those patterns fell out.

We have a subsection on reliability needs, also on resource adequacy concerns, clean energy and some of the reliability concerns that come specifically with clean energy or the great integration concerns that are specific to clean energy. Now I should say that “clean energy” in this report considers lots of different power generation technologies. There's the obvious renewables that we think about: wind, solar and biomass, but there's also nuclear, there's also fossil fuel plants, so gas or coal that have carbon capture sequestration (CCS) technologies included. All those are considered “clean energy” here and they are in this section, but we did want to highlight offshore wind and also clean energy on tribal lands. Then there is a section on congestion and we organize that by each geographic region. Curtailment of power generators based on the needs of the grid. Resilience of the power grid. Electrification, so recognizing that the needs that we're going to have as we electrify more and more end use devices -- such as cars, turning those into electric vehicles -- that's going to create different needs on the power system.

And a section on non-wires alternatives. I'll note that this is really the first of our previous Congestion Studies, and now the Needs Study, this is really the first one that focuses so heavily on non-wires alternatives. Throughout the report, we think of transmission as technology agnostic. So where a non-wire solution is beneficial and could support a need, then we want to bring that in. Other cases where we need a traditional wire to address the need, we want to make sure that we are calling that out, too. We do put some information in here on non-wires alternatives and how they could help support the power grid. And then finally, there's a section on 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)

Here are the 50 studies that we reviewed. We had to give ourselves a cutoff point, so we stopped looking back [for reports] at 2018, but the majority of these were all of 2020, ’21, and then a handful of 2022 that we included. I won't go through each study, but I'm just going to name who the authors were in these general buckets. About a fifth of them were Department of Energy reports, so coming out of the National Labs. Another fifth were consultant reports, so those that have been doing a lot of work in this space the last several years. There's a handful of academic reports, but the vast majority of these, almost half of them came from industry itself. So the RTOs, and also the National [NERC, North American Electric Reliability Coordinator] and the Regional Reliability Coordinators. [We include] both the national and the regional perspectives here. There's a handful of other groups here as well, like the independent market monitors that are looking at the markets specifically, but to the extent that they are tied to the transmission system, we brought that in as well.

I'm not going to talk about the findings here, but did just want to show the variety of the different types of authors and reports that we were able to pull in.

GRID DEPLOYMENT OFFICE

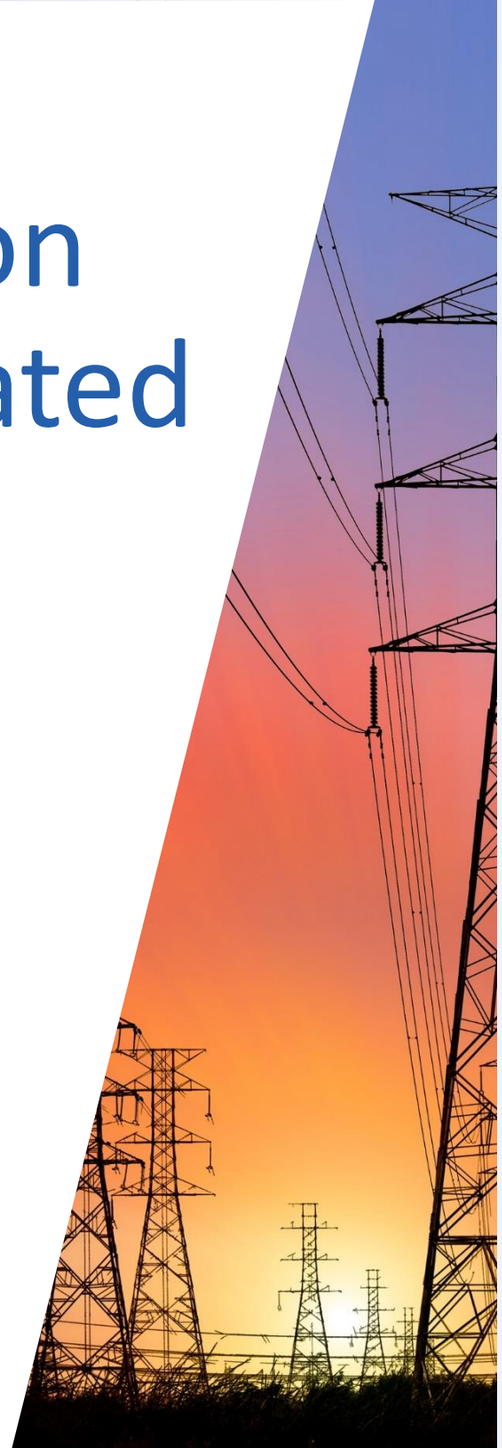
VI. Capacity Expansion Modeling: Anticipated Future Need

VI.a. Included Studies and Scenarios

VI.b. Within Region Transmission Deployment

VI.c. Interregional Transfer Capacity

VI.d. International Transfers



Finally we are going to talk about the last chapter Capacity Expansion Modeling: Anticipated Future Need. What's unique about this study compared to previous Congestion Studies is that they weren't not able to look at anticipated future need, so we did that here. I'll spend a lot of time on this chapter.

This is organized as included studies and scenarios – so the studies we used when we were working on this data – within regional transmission deployment, interregional transfer capacity results, and then also international transfers.

GRID DEPLOYMENT OFFICE

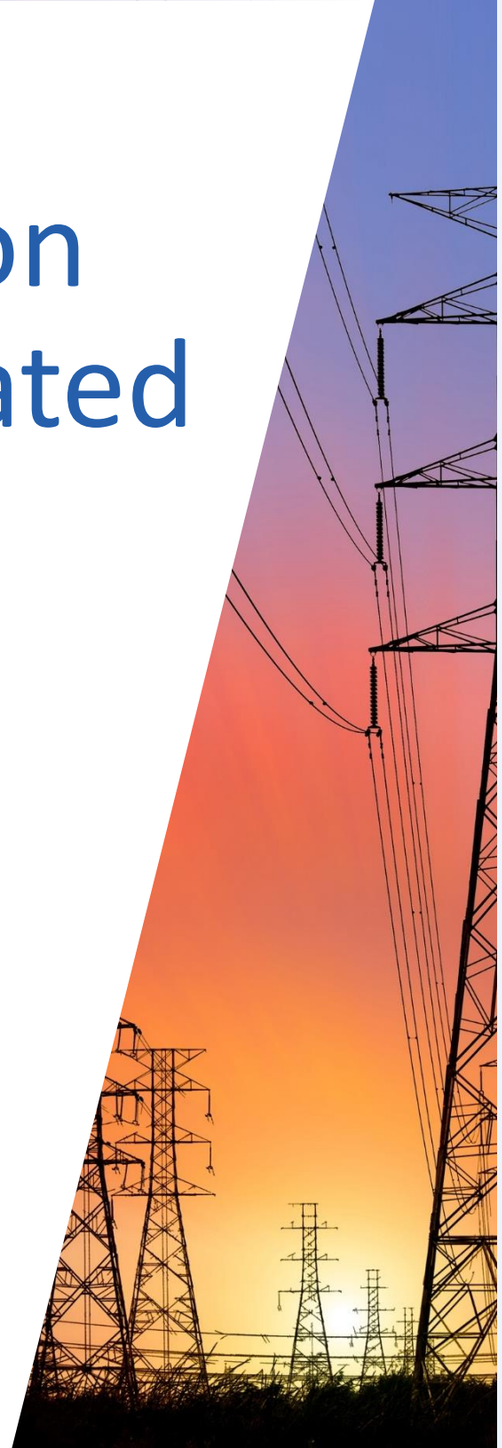
VI. Capacity Expansion Modeling: Anticipated Future Need

VI.a. Included Studies and Scenarios

VI.b. Within Region Transmission Deployment

VI.c. Interregional Transfer Capacity

VI.d. International Transfers

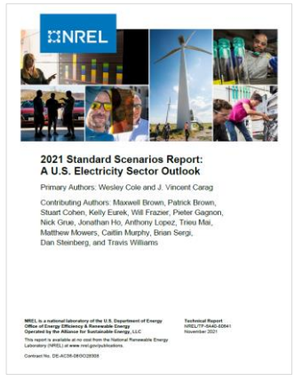


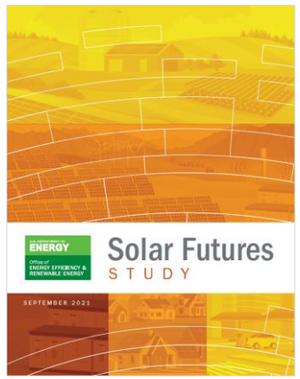
I'm just going to talk about the first three. I'm happy to answer questions about international transfers, if they come up, but because of time, I'm just going to focus here.

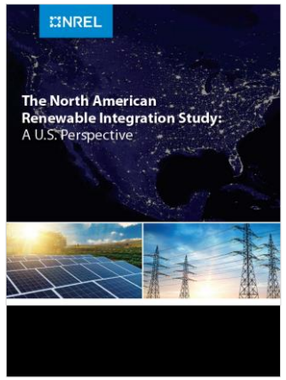
GRID DEPLOYMENT OFFICE

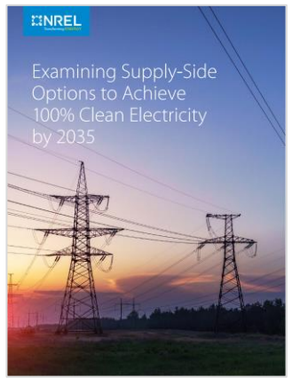
Data from 6 capacity expansion studies are analyzed to identify future regional and interregional transmission needs.

National Lab Reports

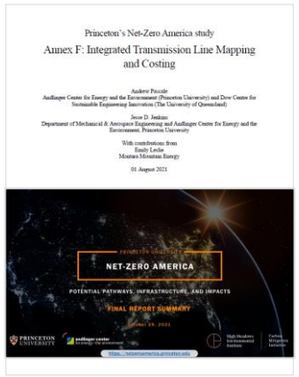


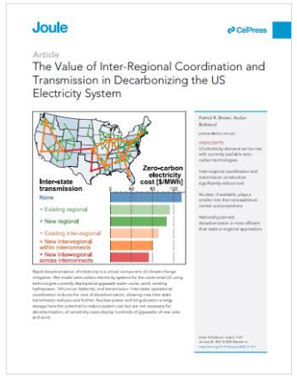






Academic Reports





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.

Data from six different capacity expansion studies were analyzed to identify future regional and interregional transmission needs. Four of those studies came from the National Labs -- notably the National Renewable Energy Laboratory -- and two academic reports were included, research done by Princeton University and by Massachusetts Institute of Technology or MIT. There were some other consultant academic reports that we tried to work in, but because of data quality issues or data being proprietary and not available to the public, we were not able to incorporate them, so we were left with these six.

I want to say something about capacity expansion models, for those who aren't familiar with it. These are models that optimize for least cost power sector solutions. They're looking nationwide and they use a large range of input assumptions. For example, how much demand are we going to have nationwide or within each region in a future year? What's the cost of energy going to be? How hard is it going to be to site different types of power plants in different places? What state or federal policies might come online that are going to impact the power system?

There are a lot of input assumptions. Once they have those inputs, they then can decide, all right, this is the optimal generation mix and the optimal amount of transmission that we're going to need to meet resource adequacy concerns and to provide enough electricity to consumers. Now these model results really help identify quantities of cost effective transmission solutions, and they're used here as a proxy for future need to meet generation and demand growth.

GRID DEPLOYMENT OFFICE

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

Of these six different studies there are 300 scenarios among them and they describe a really wide range of power sector futures in different years. Each dot here, this is one of those 300 scenarios and they're plotted for three different years, 2030, 2035 and 2040. Each color of the dot is indicative of which study it came from, so you can see the spread there by the different studies. On the Y-axis is carbon emission reductions from 2005 levels. If we just focus on 2030, we can see that these dots range anywhere from 25% carbon emission reductions from 2005 levels up to 80% reductions, with a lot in between.

Now today we're at about 40% [decarbonization] on the power sector, which is to say that some of these dots that are less than 40% assume that between now and 2030 we're going to be putting more carbon emissions into the air, whereas a good majority assume we're going to be emitting less carbon emissions, so increasing that power emission reduction level. That's a really wide range, 25 to 80% and that just grows with time. So in 2035, these scenarios assume that everywhere from 10% carbon emission reductions up to even 100% carbon emission reductions. Again, in 2040 that continues to get larger with more scenarios. So you can imagine the transmission system and the generation mix that is going to accommodate everywhere from 10% carbon emission reduction up to 100% is going to look very, very different. We need to have some way to try to understand the results coming out of all these disparate scenarios.

And I should also note that carbon emission reduction is plotted here, but there are lots of other power sector characteristics that we could and did plot as we were trying to look at this data and understand it. So [for example] total load on the grid, what type of generation gets installed and where. There's lots of other things we could have looked at and we saw these really large spreads in these scenarios too, for all those different characteristics. So this is a very wide-ranging group of scenarios.

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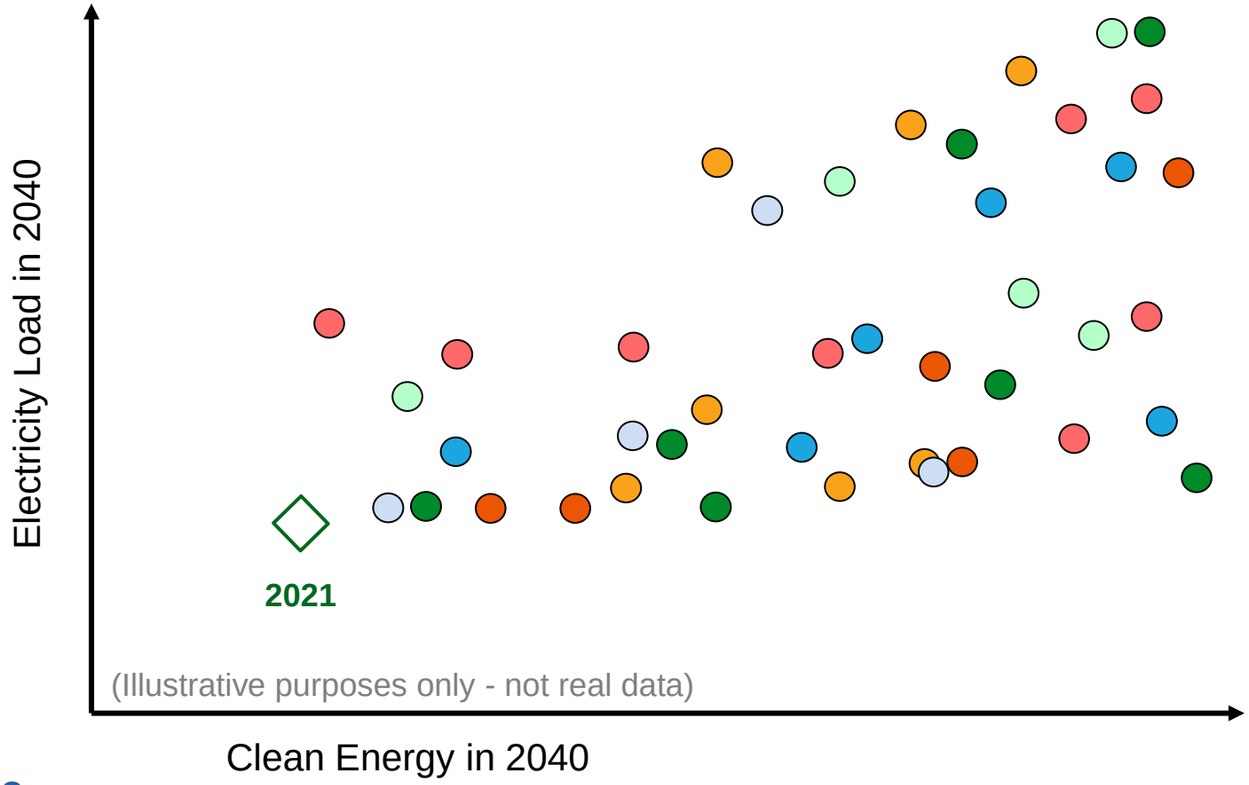
Need a way to group different scenarios in order to understand results: Looked to underlying scenario characteristics.



So with that, we needed a way to look at the different scenarios in order to understand the results. So we did that by looking at the underlying scenario characteristics. This is just illustrative data, it's not real data. I'm going to show the real data on the next slide, but just to help orient everyone.

So we take those same 300 scenarios from the last slide and we put them here on this plot, where we have clean energy in 2040 on the X-axis and then electricity load in 2040 on the Y-axis, right, and then the location [of the scenarios] changes based on those two things.

We can focus in on this 2021 diamond. This is the clean energy and electricity load mix in 2021. So any dot to the right of that green diamond means that there was a growth in clean energy between 2021 and 2040. Any dot that's above 2021, that means there was a growth in total electricity load between 2021 and 2040.

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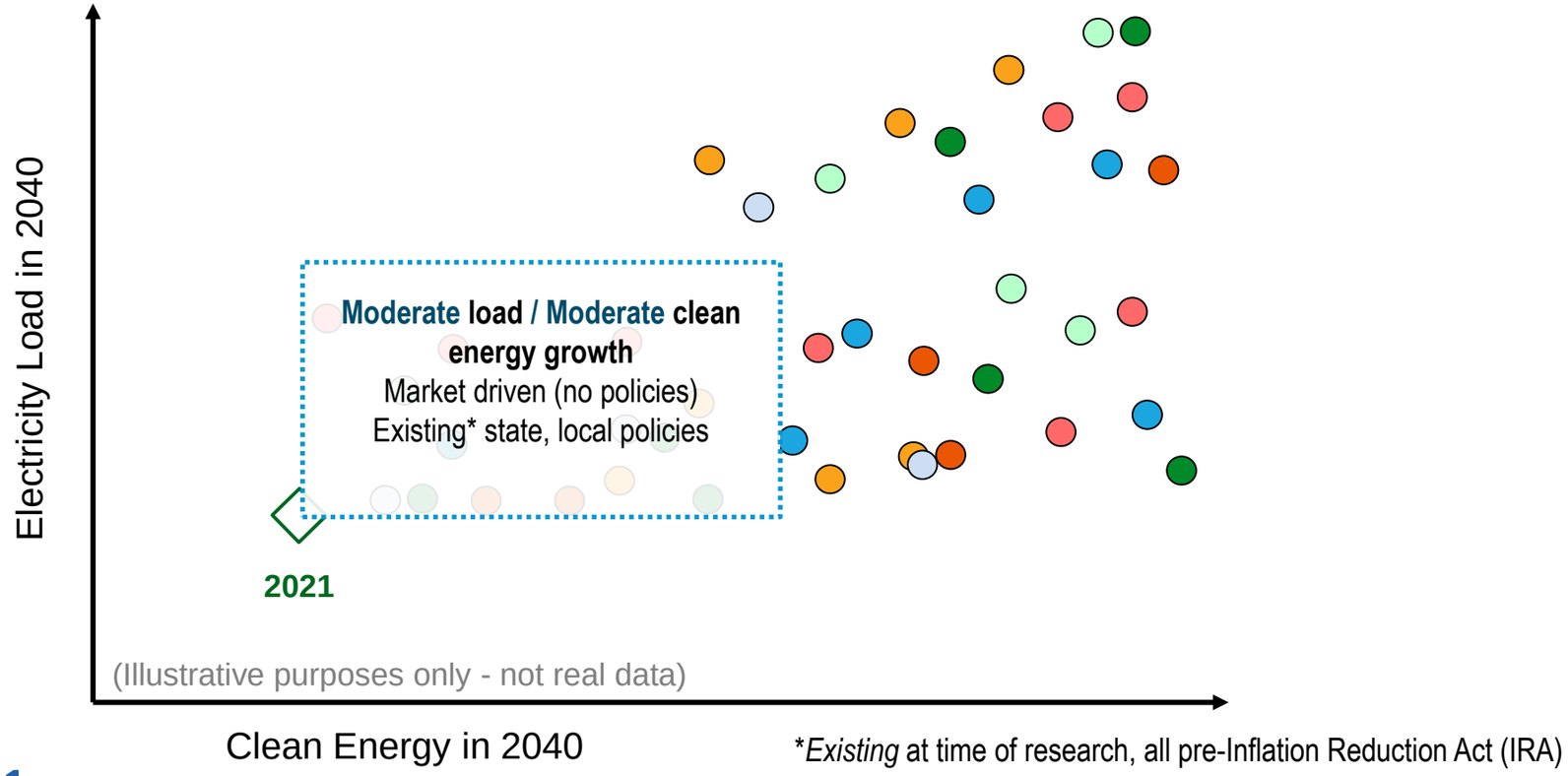
Need a way to group different scenarios in order to understand results: Looked to underlying scenario characteristics.



**Existing* at time of research, all pre-Inflation Reduction Act (IRA)

So with that, there were three major groups that really popped out when we plotted the data this way.

The first one is this moderate load, moderate clean energy growth group or what we call “mod-mod” or “moderate-moderate” throughout the report. There are about 80 or so scenarios that fell into this group. Of those scenarios, many of them were market driven, which means that the researchers took out all state policies, local policies, federal policies that were on the books at the time, just removed them and said “OK, how is the power sector going to change over the next so many years, based on only markets alone?” A lot of those scenarios fell here.

There are also scenarios that included existing state, local, federal policies. When I say “existing,” I mean what was on the books at the time the research was done. All six studies were published in different years, so they all may include slightly different policies.

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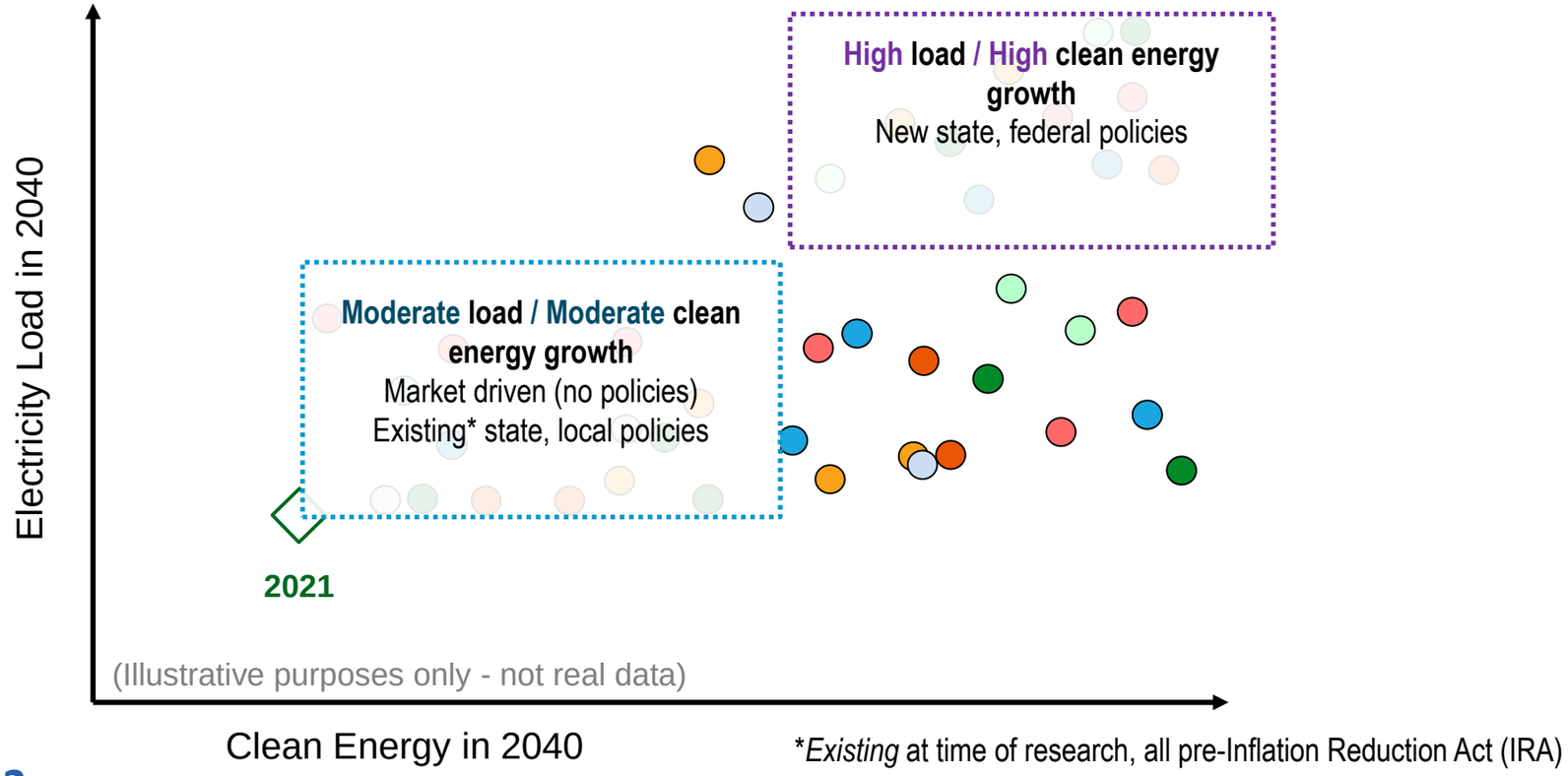
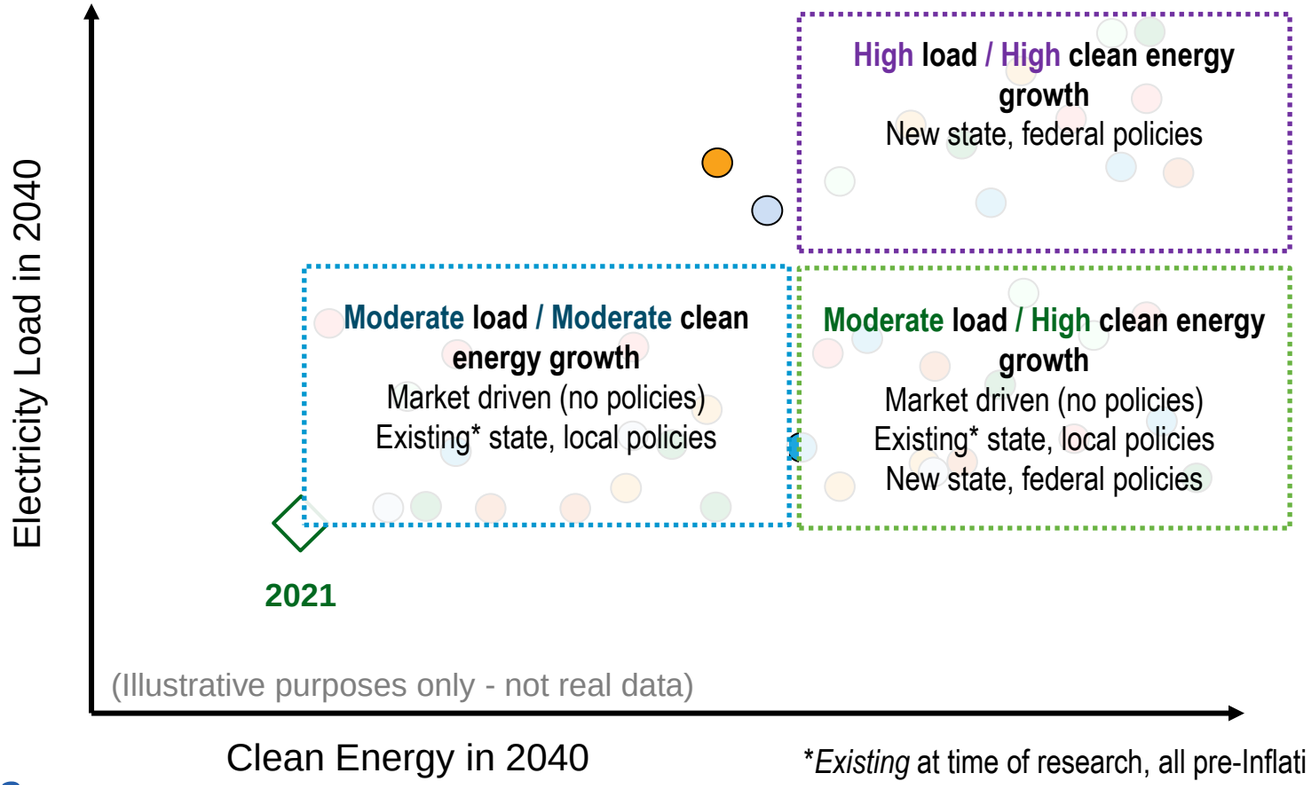
Need a way to group different scenarios in order to understand results: Looked to underlying scenario characteristics.



**Existing* at time of research, all pre-Inflation Reduction Act (IRA)*

On the opposite of the spectrum, we have these high load, high clean energy growth scenarios. There were not any scenarios that fell into this group that were driven by markets alone, or even existing policies. New state or federal policies would have to come online, which really push the power sector to this high load, high energy growth scenario group.

Need a way to group different scenarios in order to understand results: Looked to underlying scenario characteristics.

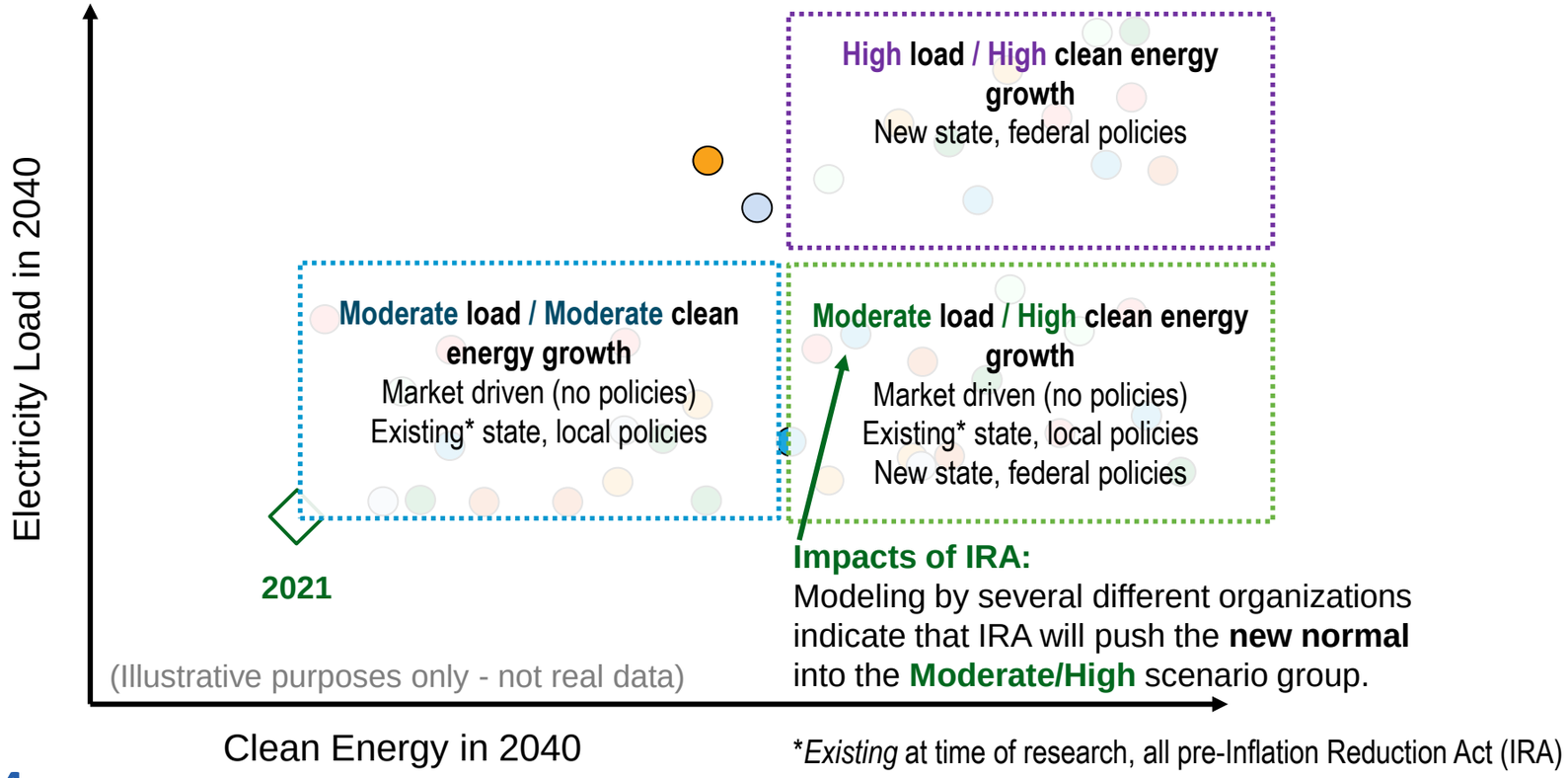


**Existing* at time of research, all pre-Inflation Reduction Act (IRA)

And then finally, there was this middle category, the moderate load, high clean energy growth. So again the load is not changing a whole lot compared to 2021, but the clean energy growth was pretty substantial.

There's a wide mix of scenarios that fell into this group: those that were driven by markets alone, those that were driven by existing policies -- again, those that were on the books at the time the research was done -- and then also scenarios that assume new state or federal policies are going to come online to impact the power system.

Need a way to group different scenarios in order to understand results: Looked to underlying scenario characteristics.

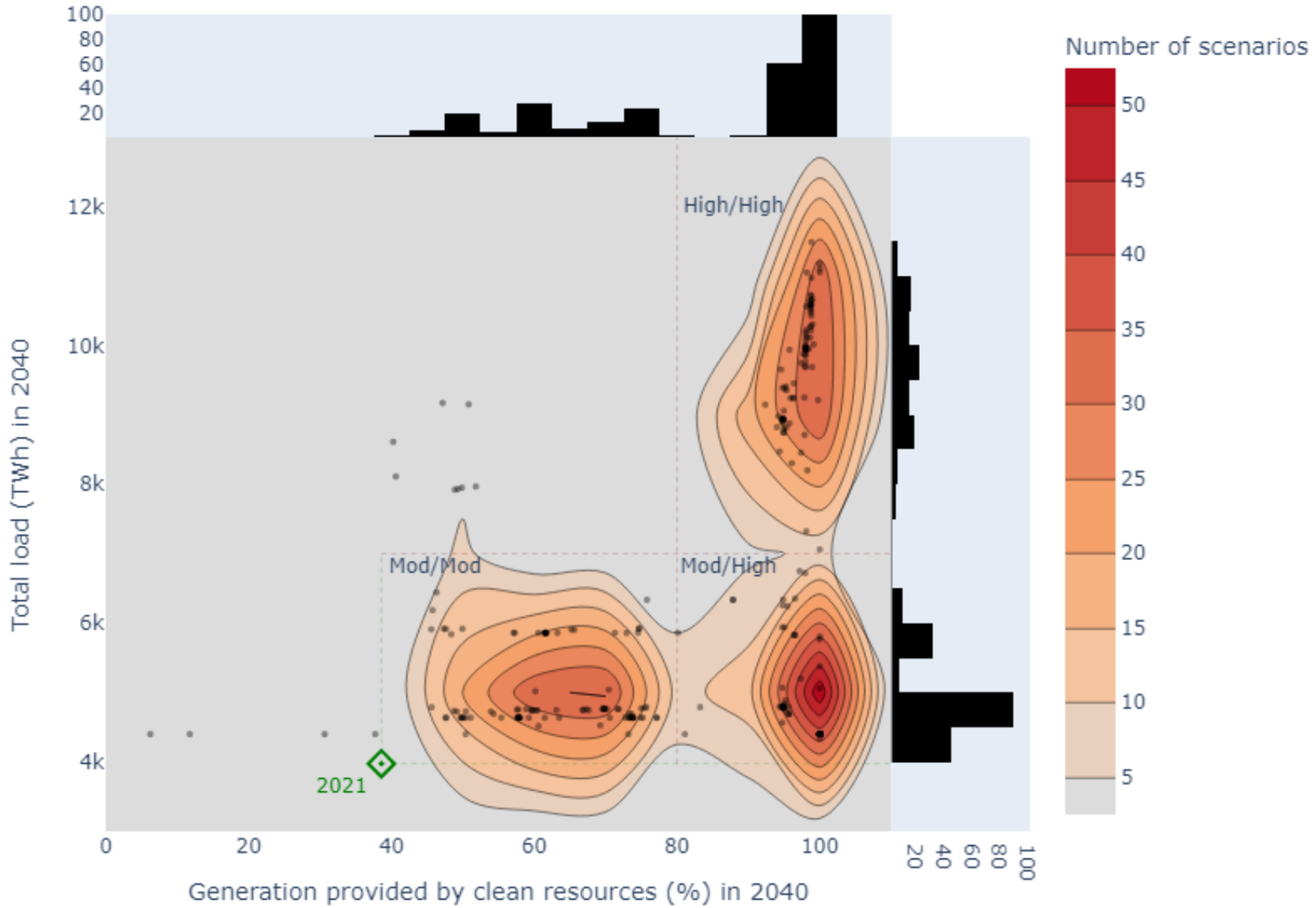


Existing at time of research, all pre-Inflation Reduction Act (IRA)

I want to also provide a quick note on the impacts of the Inflation Reduction Act or IRA. All six studies were done before IRA was announced, or signed and became a law. Because of that, none of them include the tax incentives and a lot of the [other policies] that are in the Inflation Reduction Act. Both DOE internal modeling and external modeling has been done since IRA came out to try to understand how it is going to push the power sector in the future. [Based on that modeling] we think that the new normal, the new power sector is going to wind up in this moderate-high group.

Before IRA we might have said our moderate-moderate group is going to be our business as usual case, that's where the 2040 system is going to be. But now it seems that our new normal is in this moderate-high case.

Natural grouping of all scenarios based on power sector characteristics



Here's the real data. Each black dot again is a scenario. We remove the color coding so all of the studies are combined together here. These red circles, these are kind of like a topographical map. It's a two dimensional histogram, so you can see these like three mountains popping out of the screen towards you. That shows how many scenarios fell within each of those mountains. This is where we got our three different scenario groups from, so our mod-mod, mod-high and high-high groups.

Quick tutorial on how to interpret transmission growth results

All study scenarios broken into three groups (60-85 each) and transmission results analyzed for three different years

	Mod/Mod	Mod/High	High/High
2030	2030 Mod/Mod	2030 Mod/High	2030 High/High
2035	2035 Mod/Mod	2035 Mod/High	2035 High/High
2040	2040 Mod/Mod	2040 Mod/High	2040 High/High

Just to summarize – all of the study scenarios are broken into those three groups, the mod-mod and mod-high and high-high group. There are between 60 and 85 scenarios that fell into each group. And the transmission results were analyzed within each group for three different years: 2030, 2035 and 2040. In the Needs Study itself, we actually present results in these nine different portions of this matrix. So you can go in and look at. [For example, say you're] only interested in mod-mod transmission solutions in 2040, what would that mean for each region? You can do that.

Today, I'm just going to talk about the mod-high results in 2035, and I'll show a glimpse also of 2030.

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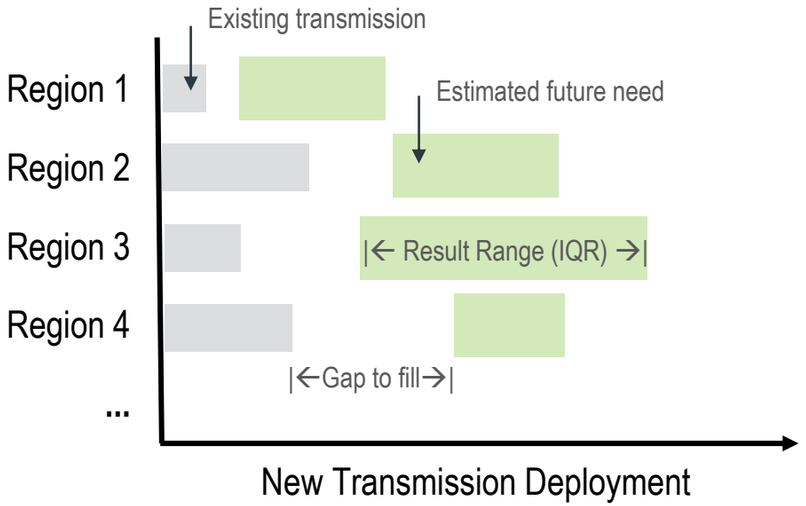
Quick tutorial on how to interpret transmission growth results

All study scenarios broken into three groups (60-85 each) and transmission results analyzed for three different years

	Mod/Mod	Mod/High	High/High
2030	2030 Mod/Mod	2030 Mod/High	2030 High/High
2035	2035 Mod/Mod	2035 Mod/High	2035 High/High
2040	2040 Mod/Mod	2040 Mod/High	2040 High/High

Make up of the future power system is unknown, so range of study results are presented



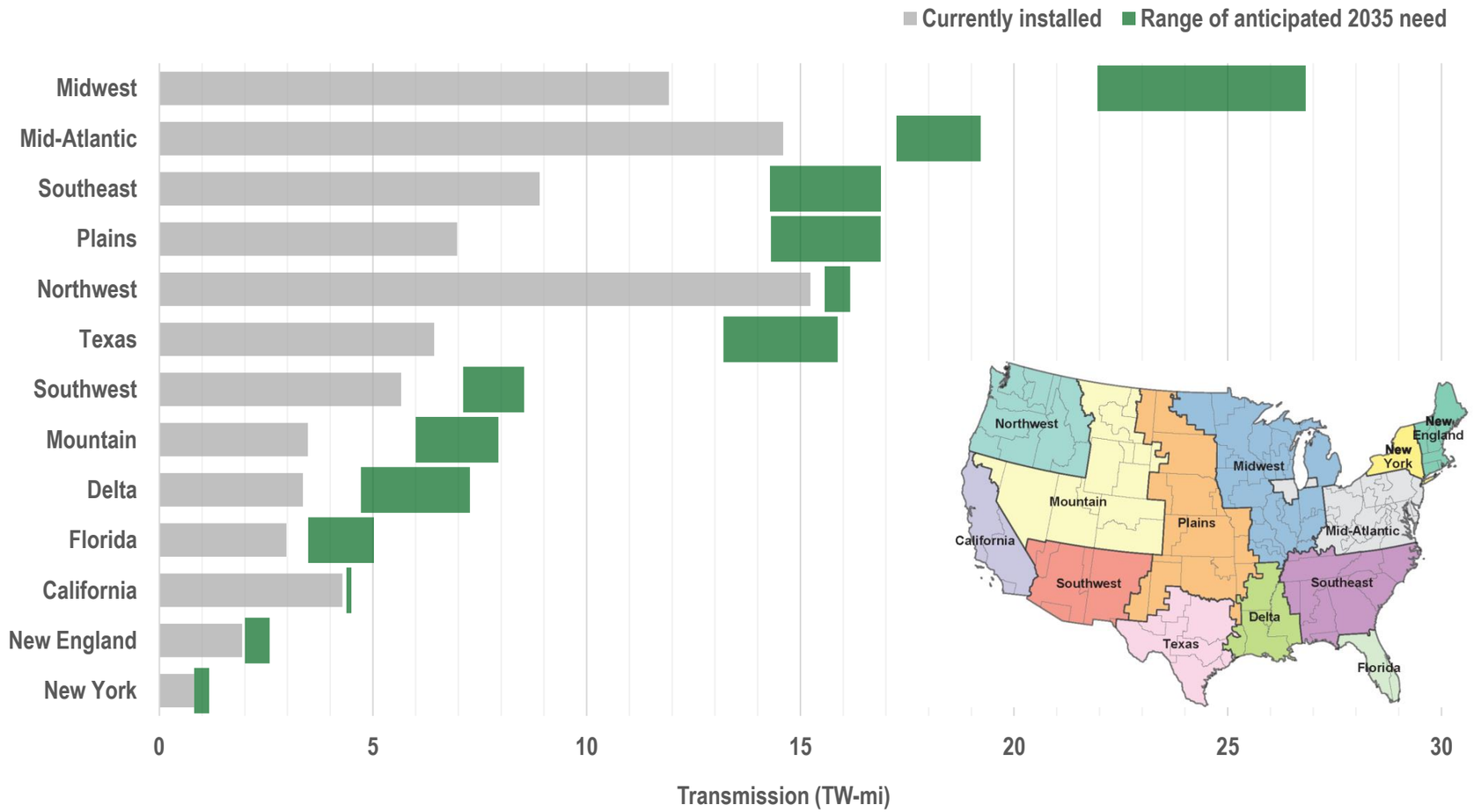
I'm going to provide a really quick overview of what you're going to see in the next couple of slides.

The makeup of the future power system is unknown, so there is a range of study results that we present. We don't assume that one scenario is going to be correct and therefore we would only present one number. We provide a range of results.

All the regions are going to be on the Y-axis and the gray bar is existing transmission, as recorded by the researchers when they did the study. The green bar is going to be that range of estimated future need. There's more detail in the in the paper itself, but the interquartile range, IQR, is what we use [to show the range of future need]. That is just the fancy stats name for the middle 50% of all of the scenario [results] that are within this group.

Importantly, the gap between the existing transmission in gray and the range of future need in green, that's the gap to fill between now and whatever date we're showing, in this case 2035.

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

So with all that [overview], here are the results for the regional transmission expansion, again 2035 in that moderate-high group, our new normal, thanks to the Inflation Reduction Act.

You can see all the regions stacked up on the left on the Y-axis. And then they are arranged based on how much total transmission is anticipated to be needed in 2035.

We also included a map here just to help orient folks.

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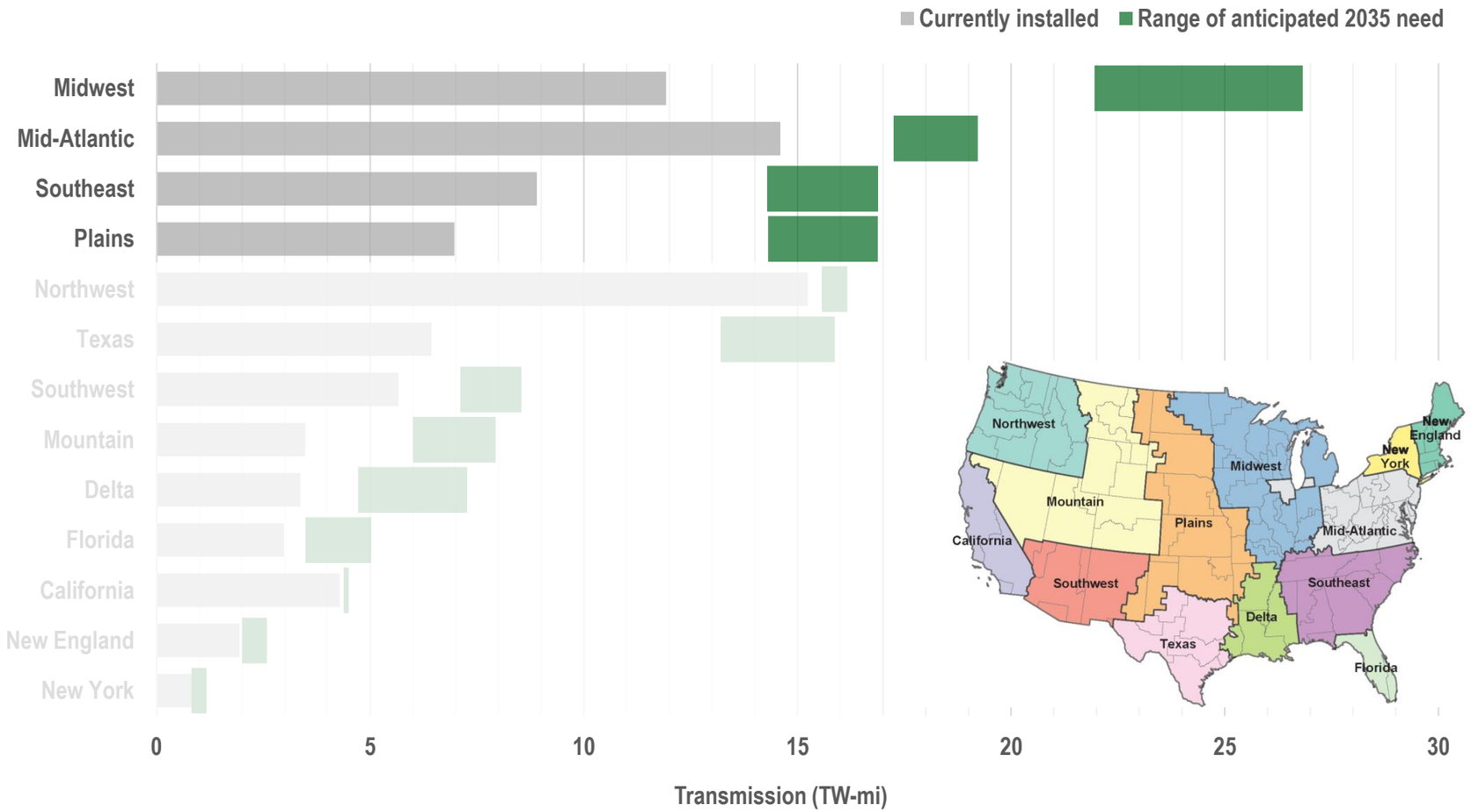
Regional Transmission Expansion Results: 2035 Mod/High



Results of scenarios which enable a 2040 power system:

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

We're going to focus in on the top four. The regions with the largest need going into 2035 are the Midwest, the Mid-Atlantic, the Southeast, and the Plains region. Now this is [ordered by] absolute transmission needed in 2035, it's not necessarily how much needs to be installed between now and then.

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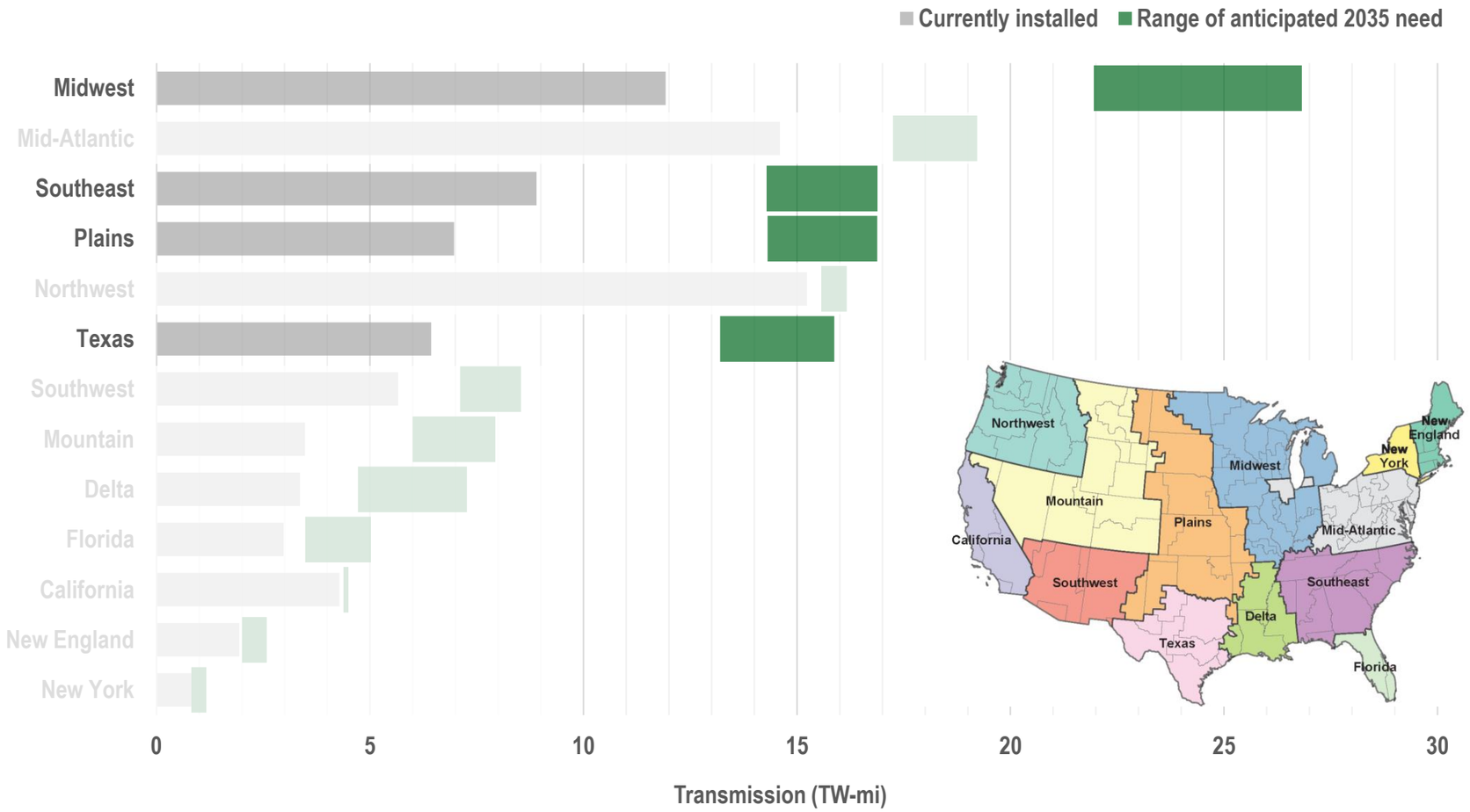
Regional Transmission Expansion Results: 2035 Mod/High



Results of scenarios which enable a 2040 power system:

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

If we look at that gap to fill, then our top four come out as the Midwest, Southeast, Plains, and now also Texas, where there's a lot of transmission to be built there in order to get into this cost optimal range.

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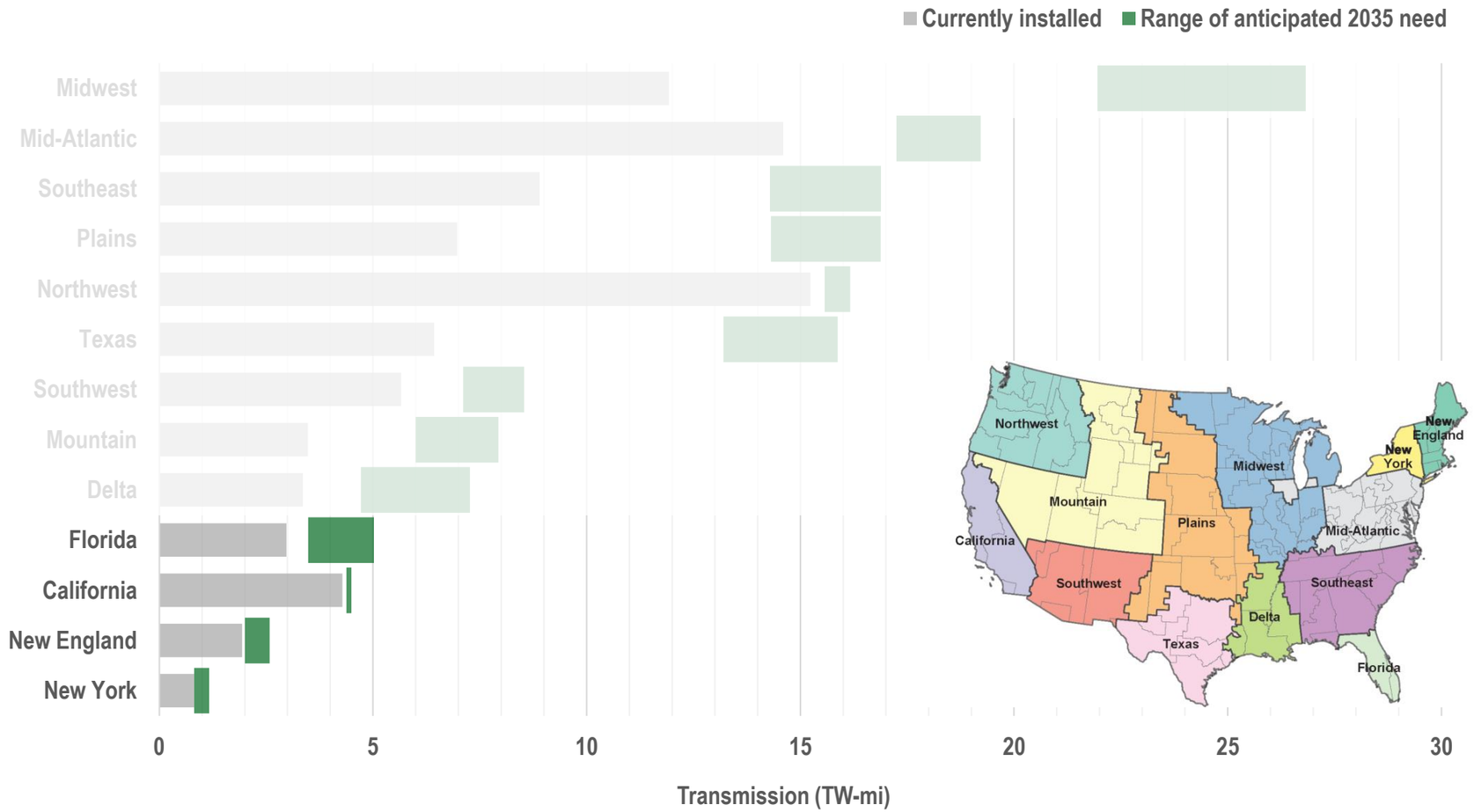
Regional Transmission Expansion Results: 2035 Mod/High



Results of scenarios which enable a 2040 power system:

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

Then a quick look at who has the least need for new transmission: Florida, California, New England, and New York.

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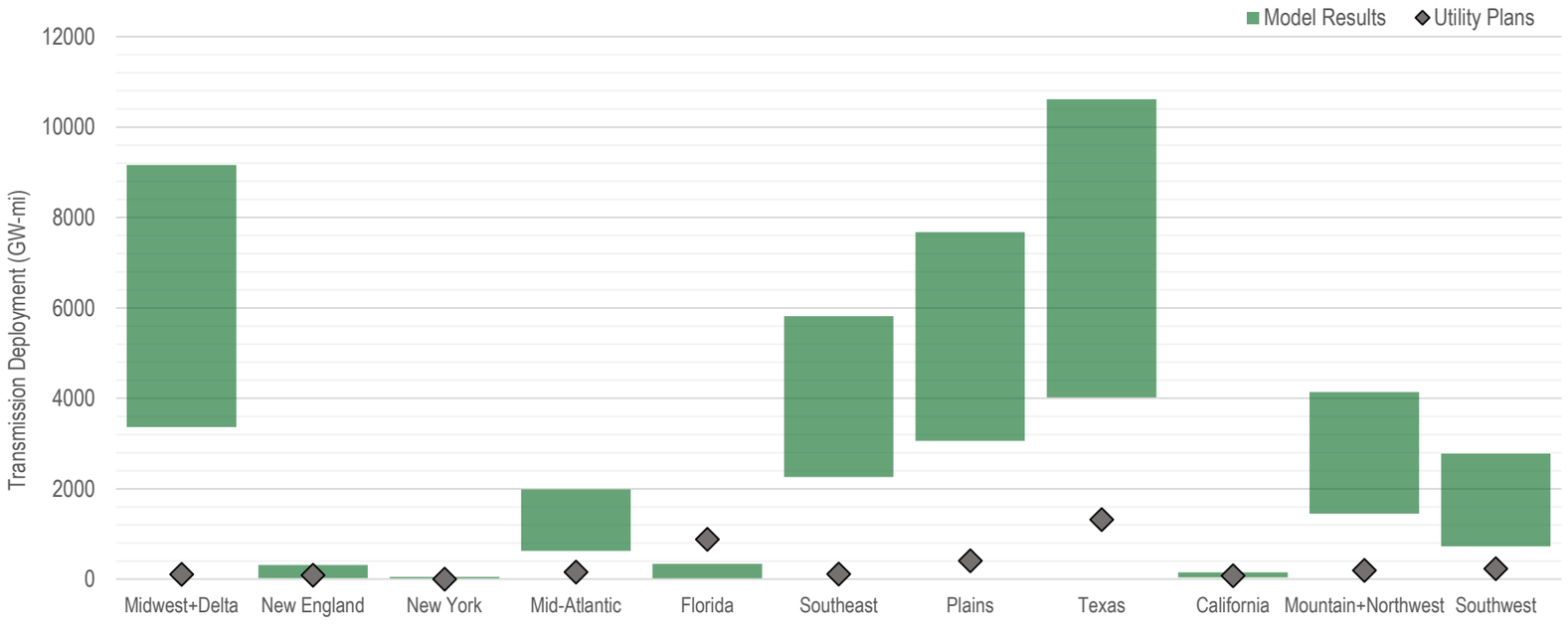
How close are we to realizing these futures? Comparison of utility plans against 2030 Mod/High Results



Utility Plans from NERC Energy Supply & Demand 2020 database

Results of scenarios which enable a 2040 power system:

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

So that's where we need to be in 2035. And it's natural for the next question to be “How close are we to realizing these futures?”

This is a comparison of the utility plans against those same results. Before those green bars were horizontal, we now turn them vertically. I also want to note that this is 2030 data, not 2035, it shows how much transmission we need in 2030 on our way to get to the 2035 need. The gray diamonds are utility plans. The reason we use 2030 is because the utility plans, at least for the dataset that we had, stopped at 2030. They didn't go out to 2035.

Now we can see that in a handful of regions – in those regions at the bottom of the last chart, New England, New York, Florida and California – the utility plans either meet or exceed the anticipated range suggested by the capacity expansion results. All other regions’ utility plans are falling short. I’ll make a quick note here that the data set that we used was from NERC’s Energy Supply and Demand 2020 database. Not all utilities reported their transmission development plans through this database, so we recognize that these utility plans are likely an underestimate. This was the best data that we had to look at all the regions at a national scale.

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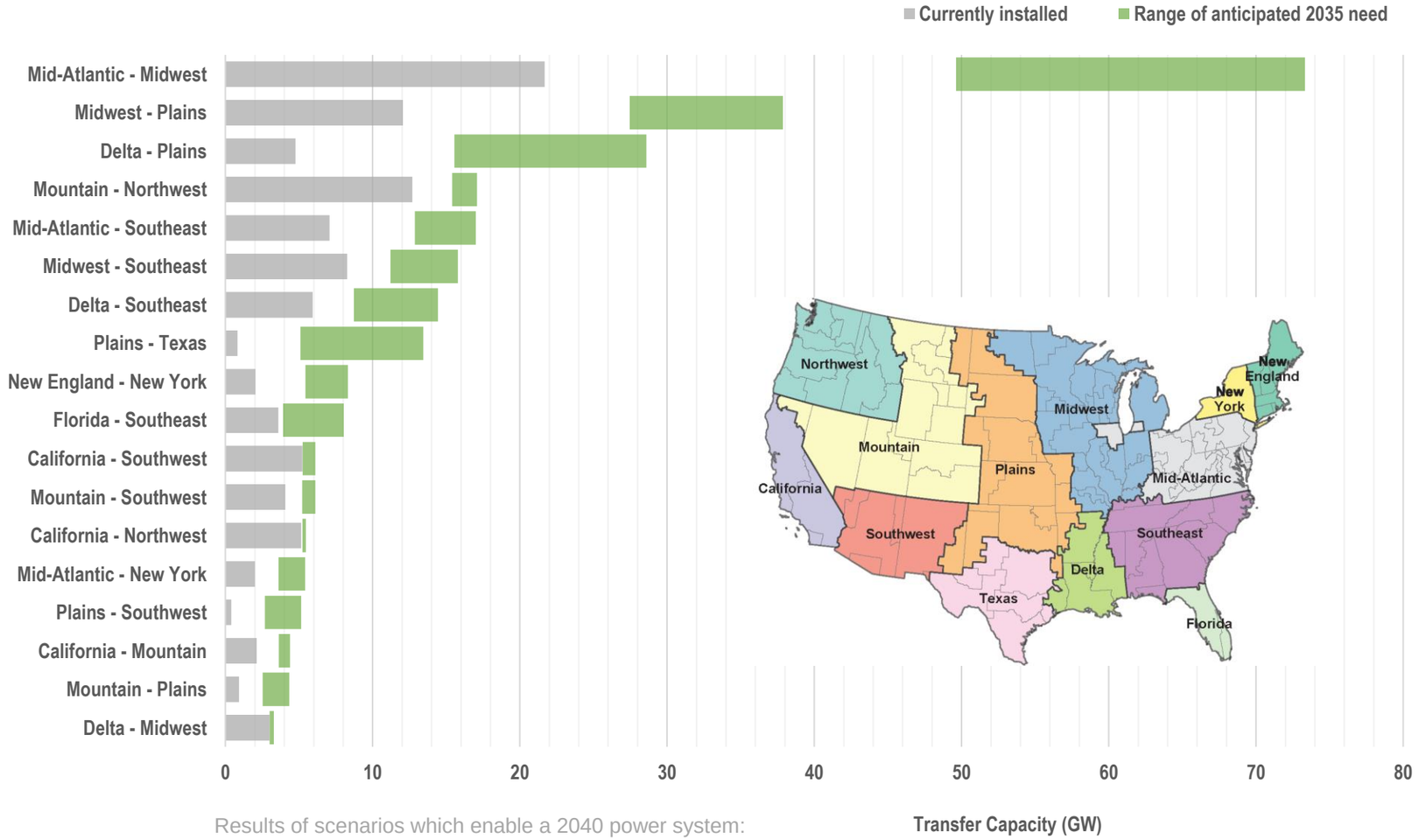
Interregional Transfer Capacity Expansion Results: 2035 Mod/High

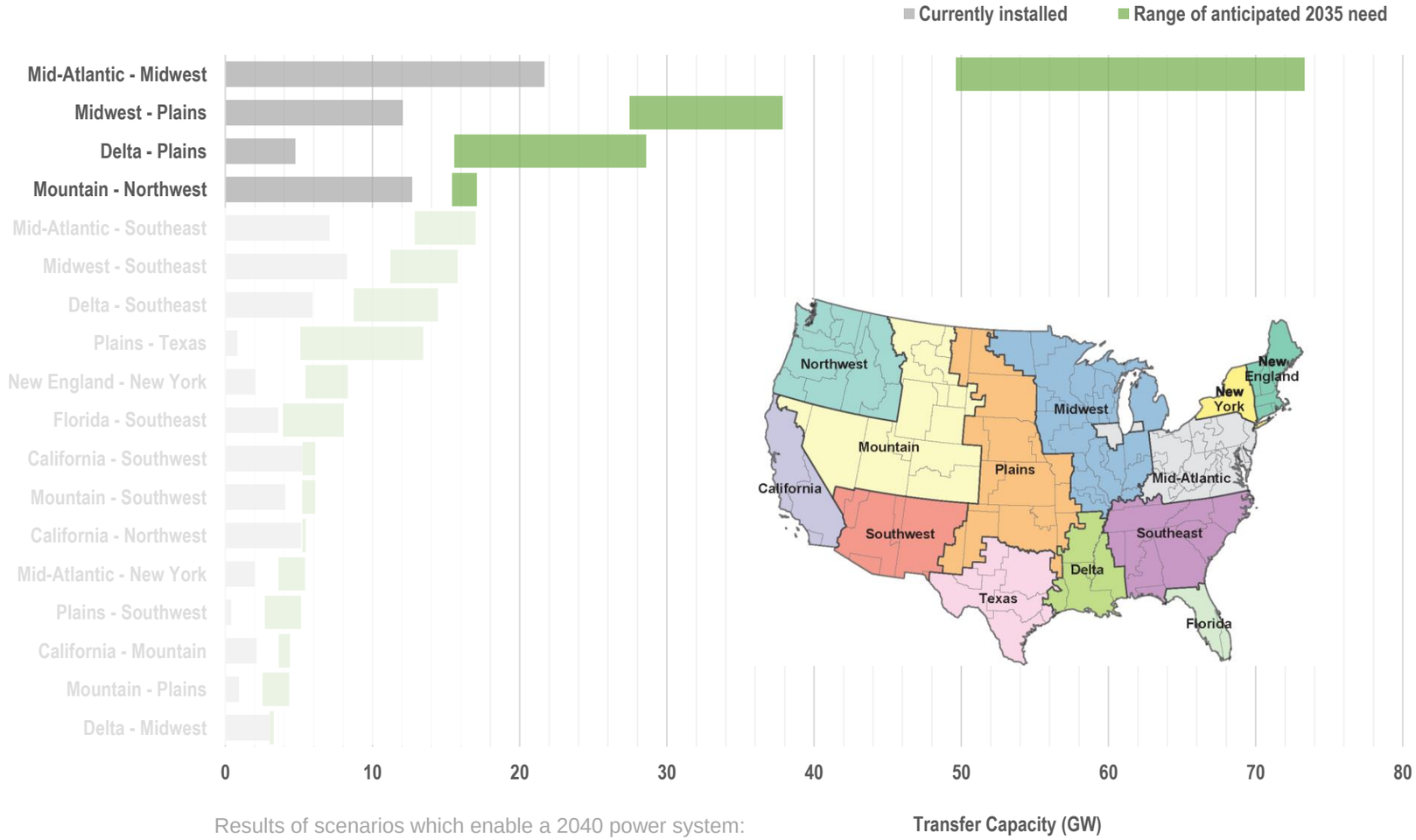


Results of scenarios which enable a 2040 power system:

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

Finally, we do the same thing for interregional transfer capacity. This is again 2035 mod-high [scenario group], our new normal, results. We can do the same thing, which is understand where are we today and where do we anticipate we need to be in 2035.

Interregional Transfer Capacity Expansion Results: 2035 Mod/High

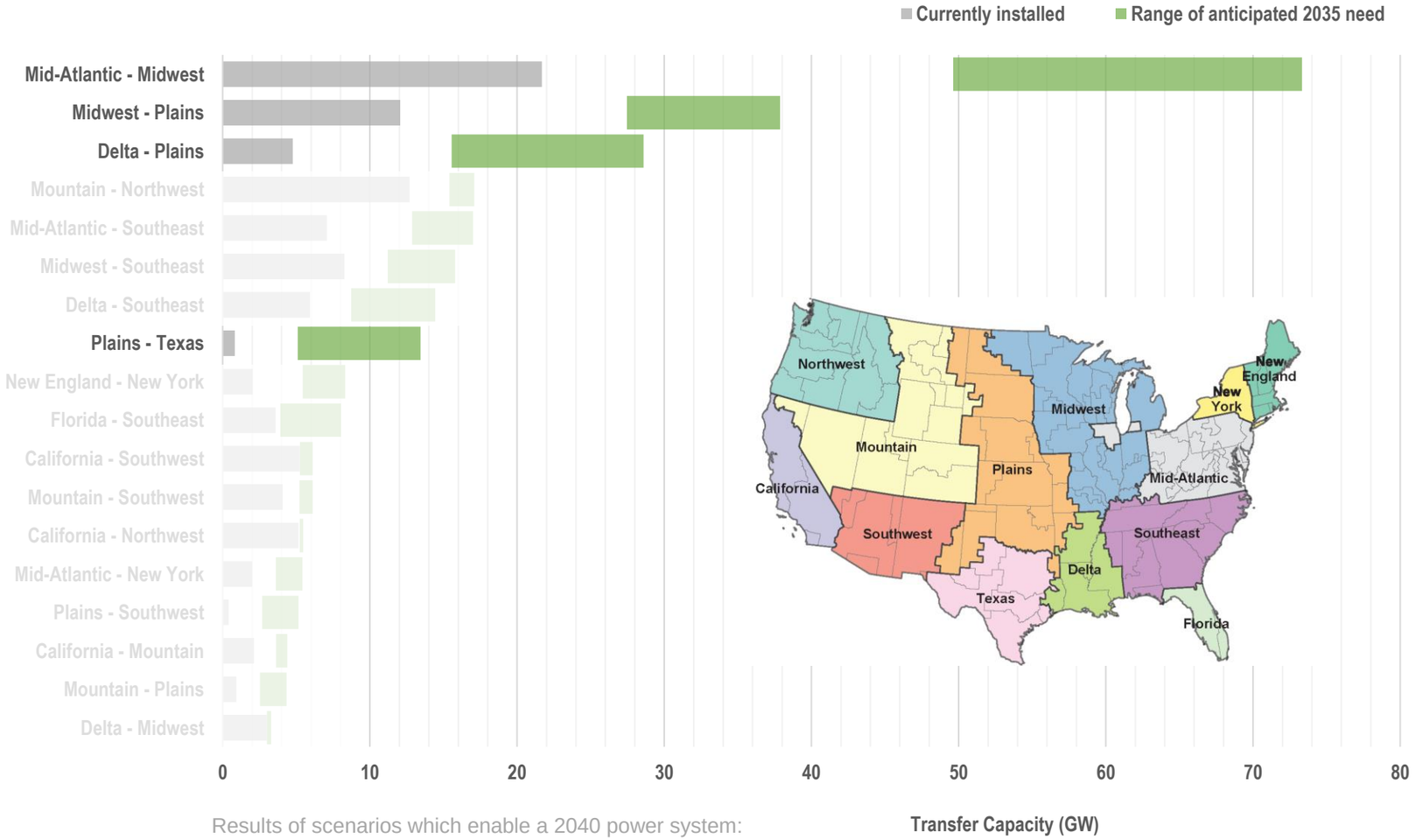


Results of scenarios which enable a 2040 power system:

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

We'll just focus on the top four. So the largest transfers that we see are from the Mid-Atlantic to the Midwest, Midwest to the Plains, Delta to the Plains, and Mountain to the Northwest.

Interregional Transfer Capacity Expansion Results: 2035 Mod/High

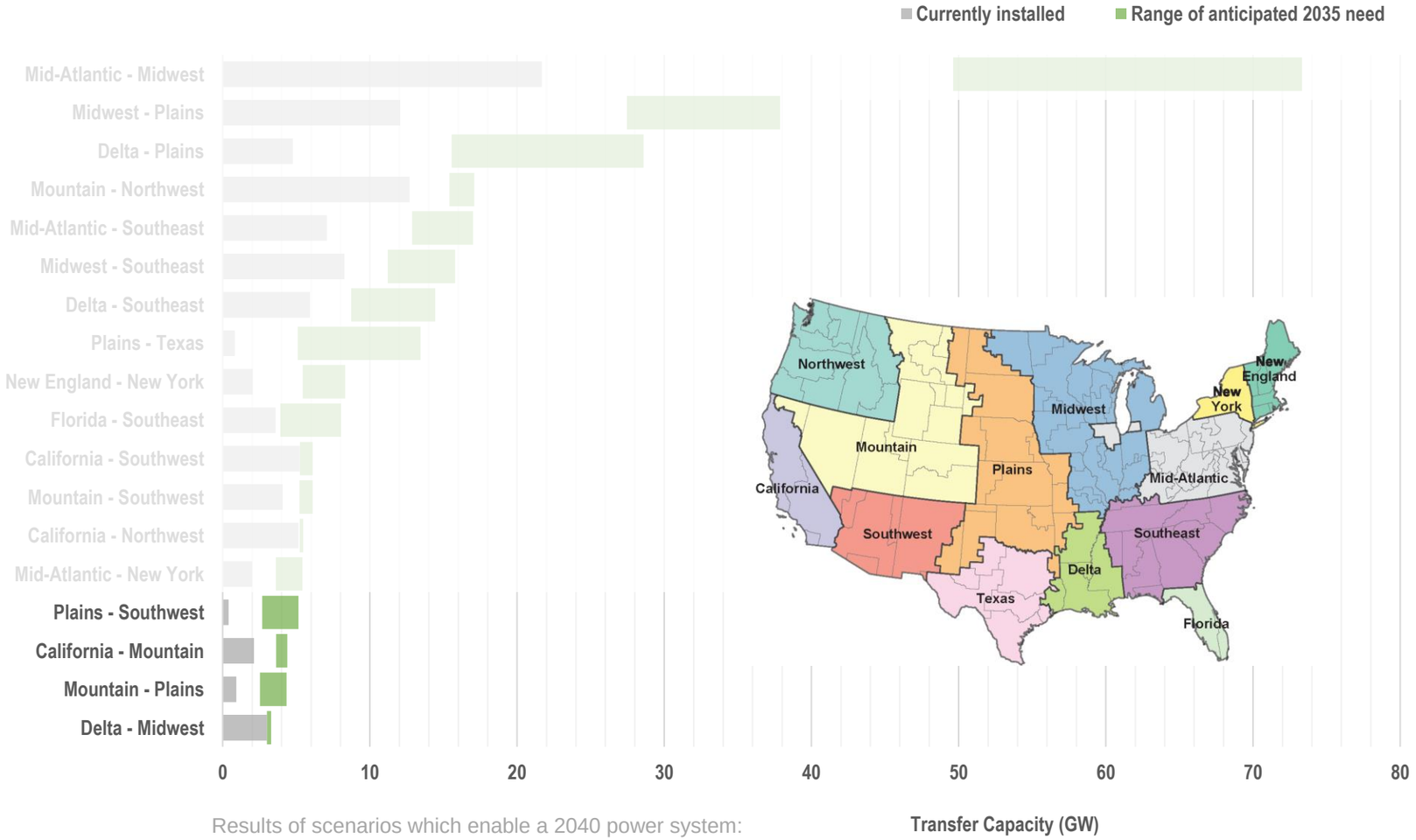


Results of scenarios which enable a 2040 power system:

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

We do the same thing of looking at where the largest growth needs to happen. And now we see Plains to Texas [transfer capacity need] coming online. There's not as much of an absolute need in 2035 compared to some other transfers, but [the Plains to Texas transfer] has a long way to go compared to what's there today.

Interregional Transfer Capacity Expansion Results: 2035 Mod/High

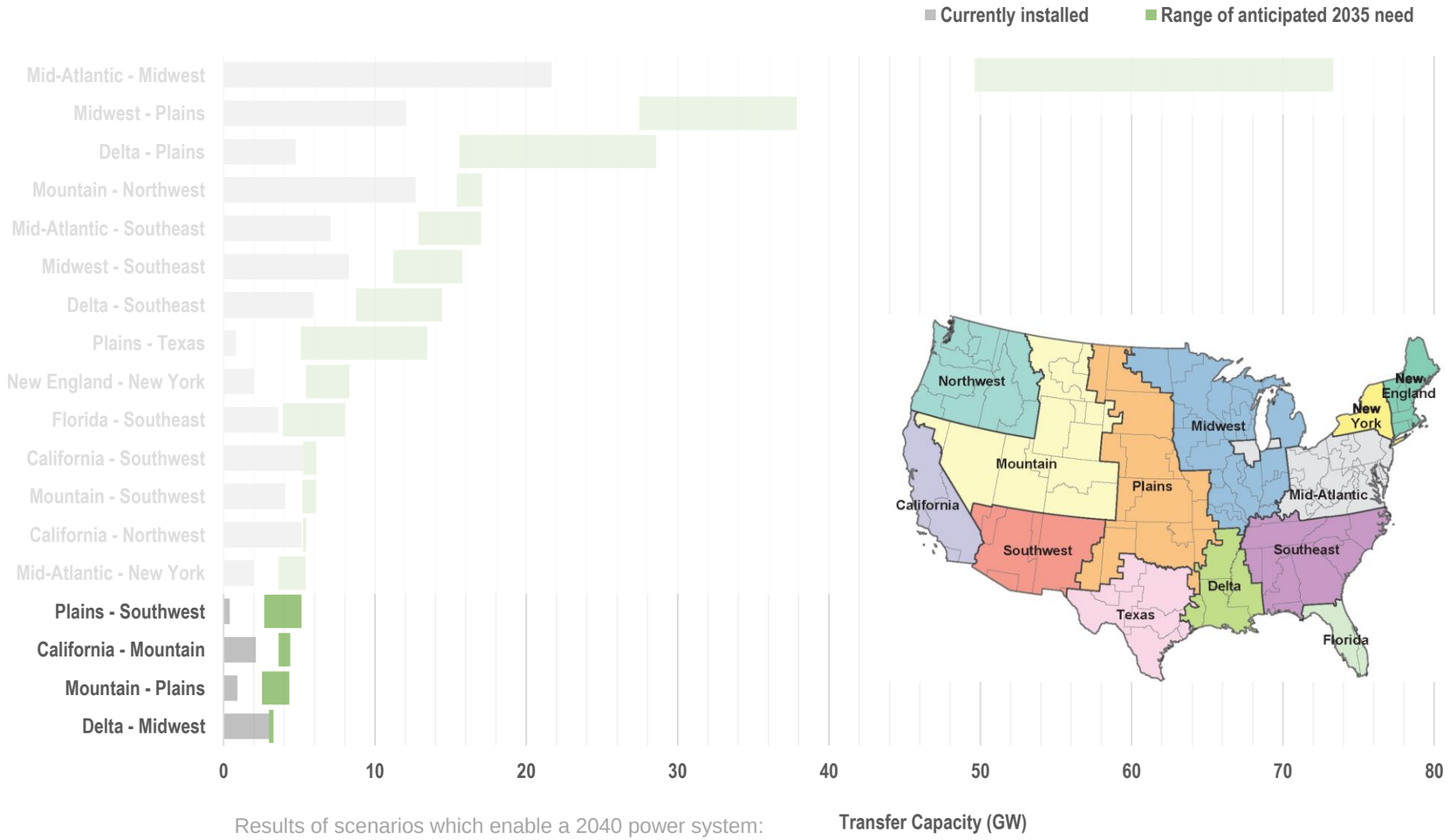


Results of scenarios which enable a 2040 power system:

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

And again, just to highlight the bottom four regions in terms of amount of [absolute transfer capacity need] – from the Plains to Southwest, California to Mountain, Mountain to Plains, and from the Delta to Midwest regions.

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

And then again, just to highlight also the bottom four regions in terms of amount of new capacity to come online, so the Plains to Southwest, California to Mountain, Mountain to Plains, and then the Delta to Midwest regions.

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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)

Here is how you comment on the report. To comment on the Needs Study, please e-mail your comments as a PDF attachment to this e-mail address. The same e-mail address that's been the bottom of all the slides: NeedsStudy.Comments@hq.doe.gov.

The deadline is April 20th, and that's assuming the Federal Register is posted as it's scheduled to be on Monday. If for some reason that's pushed back to Tuesday or Wednesday, then you all would have a couple extra days to get your comments in.

I want to thank you all for your time and I'll turn it back over to you, Whitney.

Thank you!

NeedsStudy.Comments@hq.doe.gov