# National Transmission Planning Study

## Government Subcommittee Meeting

**June 10, 2022**

# Project Overview

# Objectives of the study

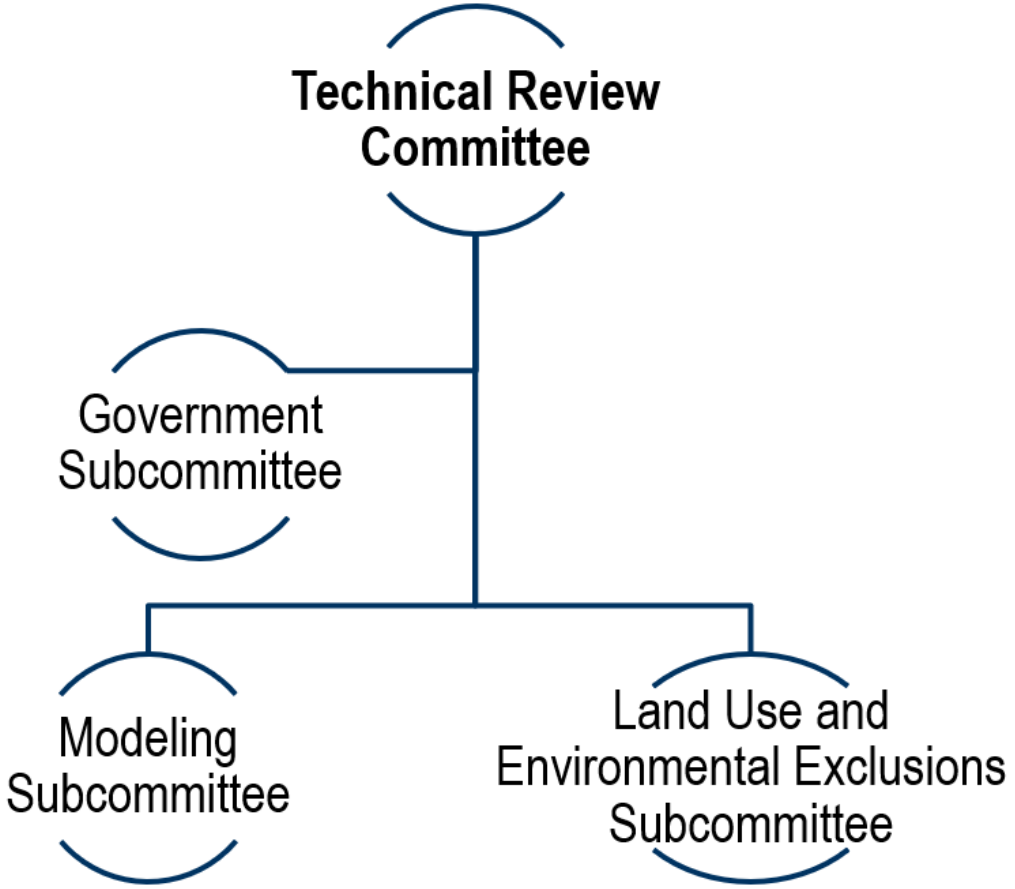
1. Identify interregional and national strategies to accelerate cost-effective decarbonization while maintaining system reliability

2. Inform regional and interregional transmission planning processes, particularly by engaging stakeholders in dialogue

3. Identify viable and efficient transmission options that will provide broad-scale benefits to electric customers

# Technical Review Committee

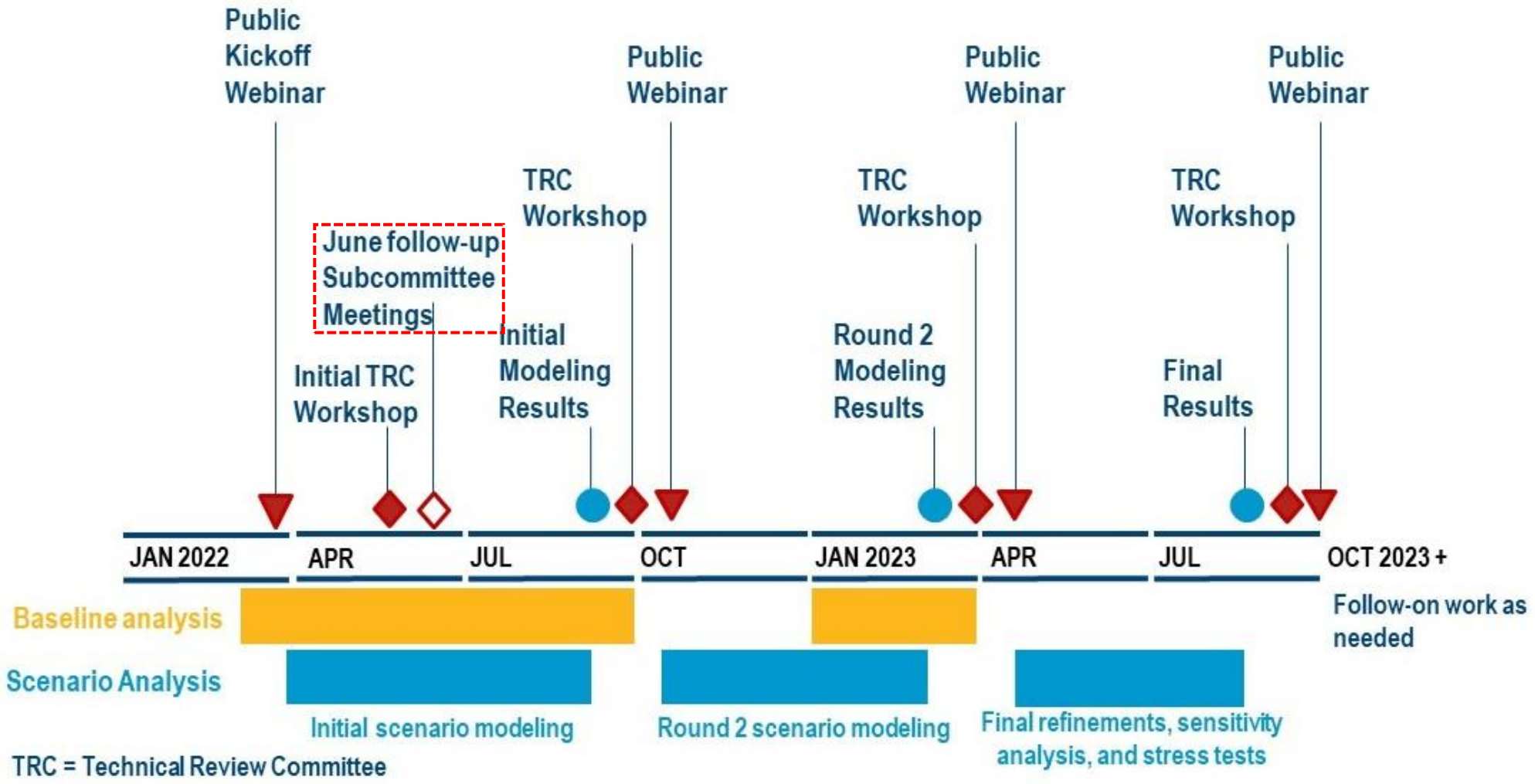
- **Technical Review Committee** (TRC) will constructively scrutinize and review the overall project and, where needed, will provide a forum for integrating input from all three subcommittees.
- **Government Subcommittee** will provide feedback on how to reflect federal and state policy and regulatory issues in the analysis.
- **Modeling Subcommittee** will provide technical feedback on assumptions, modeling, and data.
- **Land Use and Environmental Exclusions Subcommittee** will provide feedback on generalized issues related to constraints on locating new transmission and generation.



# Follow-up June subcommittee meetings

- Follow-up June subcommittee meetings will provide an opportunity for smaller-group dialogue and questions based on material presented during the May 20 TRC meeting
  - **Modeling Subcommittee** – June 7th
  - **Government Subcommittee** – today
  - **Land Use and Environmental Exclusions Subcommittee** – June 24th
- Future TRC meeting information will be posted on the public project website: https://www.energy.gov/oe/national-transmission-planning-study

# Public Engagement: Timeline



# Interregional Renewable Energy Zones

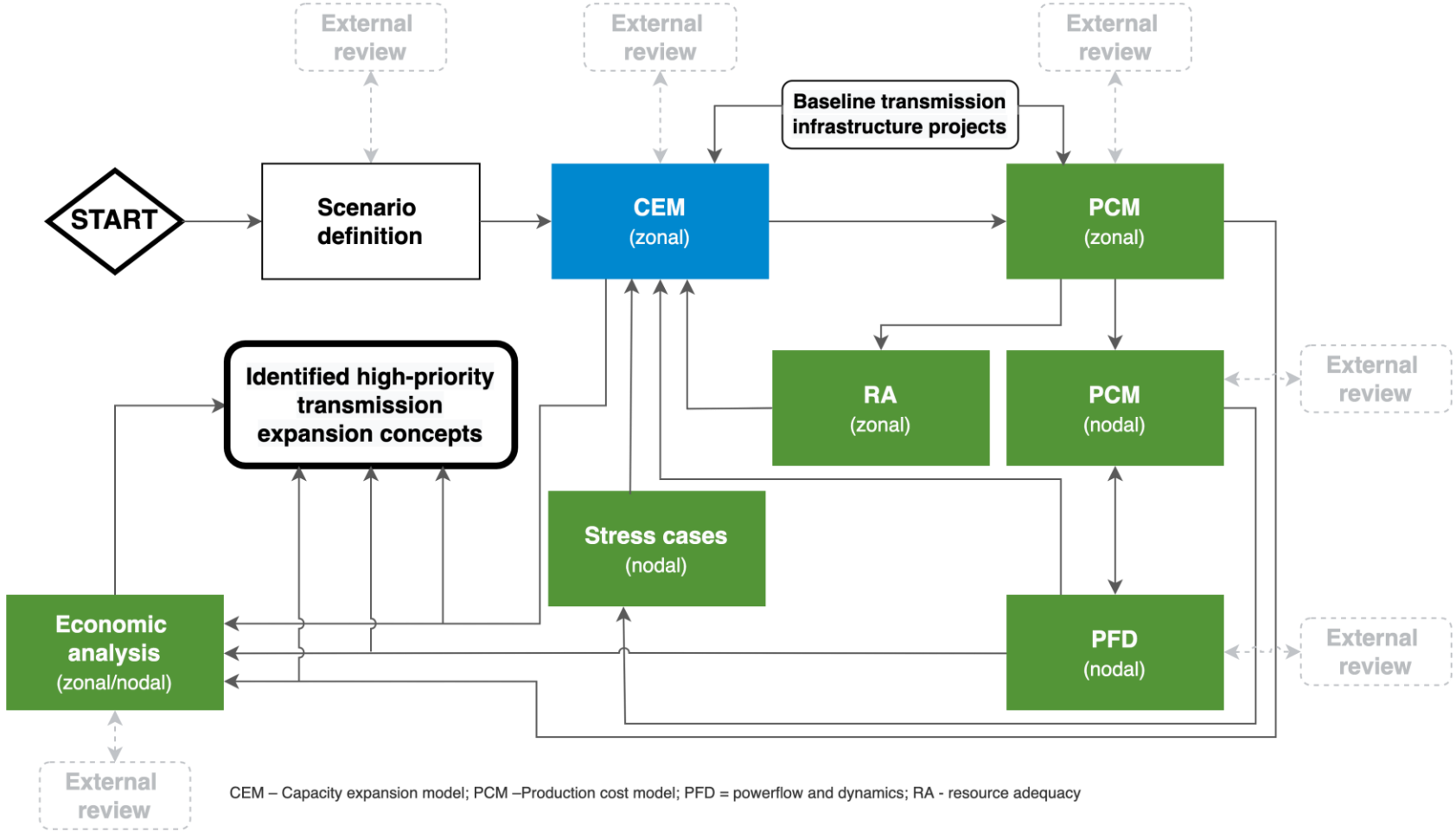
- Preliminary methodology will be vetted with the Land Use and Environmental Exclusions Subcommittee
- Revised methodology and results will be presented to the Government Subcommittee

| | Milestones |
|---|---|
| **June 3** | Identify test region (WestConnect); Implement spatial exclusions, resource overlays for wind and solar |
| **June 20** | Finalize clustering analysis for rest region |
| **June 22** | Conduct TRC preferences survey |
| **June 24** | Apply preliminary methodology to WestConnect test region. Present preliminary methodology to TRC Land Use Subcommittee for review and comment. |
| **July 11** | Post technical memorandum describing revised methodology on TRC website. |
| **Early Aug.** | Apply revised methodology to CONUS. Post IREZ map on TRC website. |
| **Late Aug.** | Conduct load-matching analysis, present results to TRC (government and land use subcommittees) for review and comment. |
| **Sept. 30** | Finalize IREZ methodology documentation<br>Solicit interest from TRC (government subcommittee) in customizing analysis for specific regions |

# Survey of state policies

- Lab team needs to confirm assumptions for and representation of:
  - Existing state policies for clean energy, emission reductions
  - Annual and peak demand under scenarios representing different possibilities for electrification, etc.
- Next month, expect to receive a spreadsheet tool that lists modeling assumptions state-by-state, year-by-year
  - TRC members interested in reviewing spreadsheet, please contact Lab team
  - Full survey will be circulated to states through NARUC, NASEO in early July
  - Results compiled early August
- Some demand data sets may be sent to TRC members for review on a separate timetable
  - Special demand scenarios
  - Feedback related to the Atlantic Offshore Wind Study

# No segment on model linkages, but there will be time at the end for questions and comments



# Baseline Analysis

# Approach for Developing Baseline Cases

| Cases | Name | Description |
|---|---|---|
| Case 1 | Industry Planning Case | WECC 2030 ADS/ MMWG 2031 |
| Case 2 | Baseline Transmission Case | Industry Planning Case + new base Transmission Lines |
| Case 3 | High Renewables Industry Case | Case 1 + New Renewables<br>• Identify substations with large retirements<br>• Use queue information to identify regions with high developer interest<br>• Use transmission loading results from Case 1 to identify underutilized transmission |
| Case 4a | High Renewables only using Baseline Transmission | Case 2 + Renewable additions maximizing the use of new base transmission<br>• Use information from developers about any proposed wind and solar capacity to be added associated with the line<br>• Use transmission loading results from Case 2 to identify additional capacity to utilize baseline projects.<br>This case will show us the additional achievable decarbonization due to the new base transmission lines |
| Case 4b | High Renewables using Baseline Transmission +High Renewables Industry Case | Case 4a + Case 3<br><br>This case will show us the highest potential achievable decarbonization |

# Select items from TRC feedback received to date

## Data sets to be used

## Baseline Transmission Criteria

- Line length and voltage requirement
- Criteria for Advanced Development Stage
- Power flow / dynamic data availability

## Approach

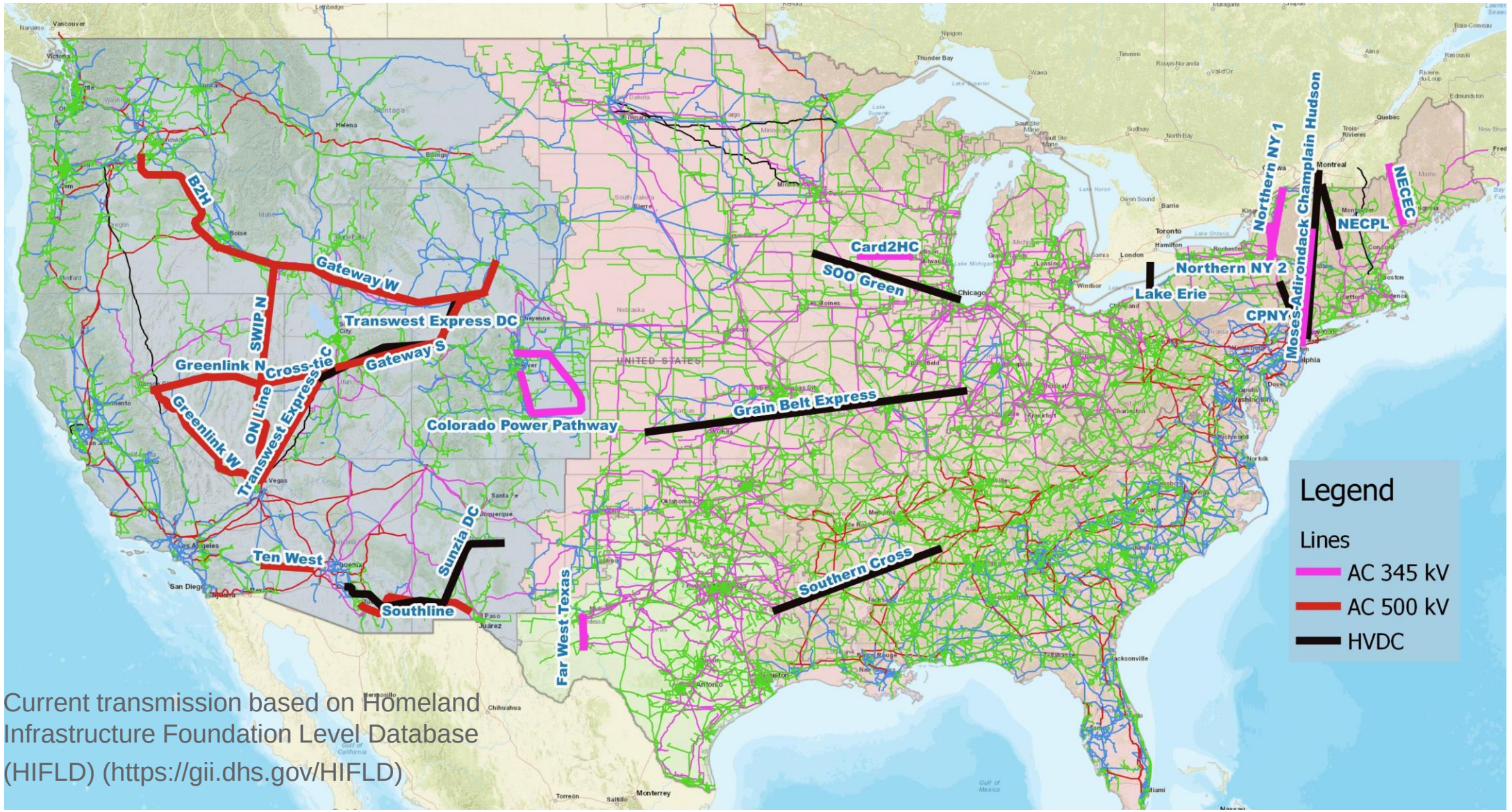
- Methods for new wind and solar additions
- Solar vs. Hybrid solar+storage project

## Open discussion for other feedback

# TRC Feedback: Baseline Transmission - Selection Criteria

- We only considered large transmission projects that are 345KV or above and at least 70 miles in length
- Projects were screened based on meeting **two** or more of the following criteria:
  1. New Line construction or rebuild of an existing line is underway. (multi-phase/segments projects), starting in one segment, does not guarantee the build of the second segment)
  2. New line developers are in active communications with FERC Order 1000 entities and are providing transmission line visibility/impact studies and PFM data.
  3. Developers actively / successfully acquiring federal and/or state permits
  4. Developers actively / successfully securing power purchaser commitment for proposed lines (load-serving entities, power trade in RTO, state energy commission approvals for Regulated utilities)
  5. Developers actively / successfully engaging public to address concerns and gain acceptance
- Availability of lines Power Flow data and dynamic data for HVDC is a must, we are not developing such models from scratch

# Baseline transmission projects at advanced development stage




Current transmission based on Homeland Infrastructure Foundation Level Database (HIFLD) (https://gii.dhs.gov/HIFLD)

Most of them have the objective of connecting renewable resources with load centers

# TRC Feedback: Methodology for how much RE will be added

- Reliability-limited: Requires contingency analysis to test for line overloading in case of new transmission line outage
- Economically-limited: which may be a tighter constraint than is reliability constraint.
  - ***Criterion***: if wind/solar capacity - last added - is curtailed above a threshold of potential annual generation. We suggest threshold to be set to 5%-20%
- Question:
  - What is a plausible threshold for curtailment at which wind/solar capacity becomes uneconomical?

# TRC Stated: “It makes sense if extensive storage is added along with new wind and solar” in the Baseline

- Yes, recently new solar capacity (bulkpower-sized) has energy storage with 50% of the solar nameplate with energy  duration of up to 4 hour
- Rather than adding more sensitivity analyses to the Baseline, we feel that such sensitivity analysis is more meaningful to be added to the Scenario Analysis, when we are looking at zero-carbon generation mix.

# Scenario Framework

# Clarifications

- Transmission, generation, storage are co-optimized.
  - Transmission is an output of the model. Topologies represent constraints applied to transmission (e.g., inter-regional or not)
  - Onshore and offshore wind deployment levels are outputs of the model
- Carbon constraints and electrification levels are not forecasts
- CEM is zonal (134 zones) only, but zonal-to-nodal linkage process is part of the study.
- Grid-enhancing technologies are not part of CEM but will be considered in the study
- Retirements: announced, age, and economic
- Demand assumptions and coordination with other studies (AOWTS)

# Capacity expansion modeling: proposed scenario framework

4 transmission topologies

**x**

9 emissions variants = 3 grid decarbonization X 3 electrification

**+**

14 sensitivities = 2 emissions variants X 7 other drivers

**+**

model formulation sensitivities

**=**

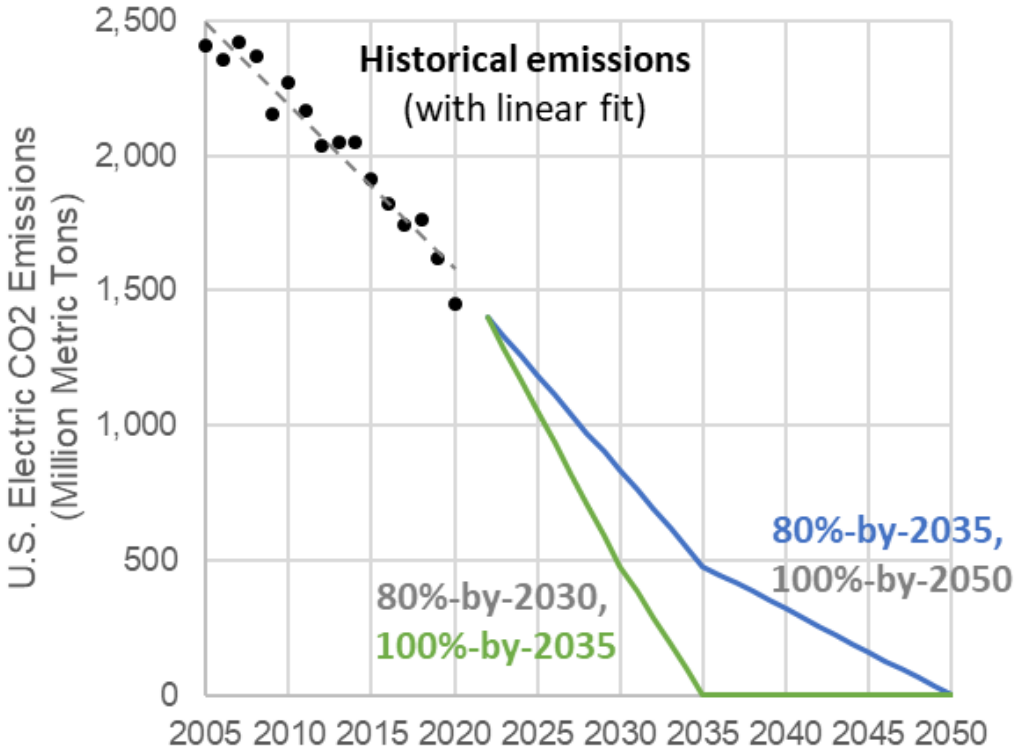
~100 total sensitivities from CEM

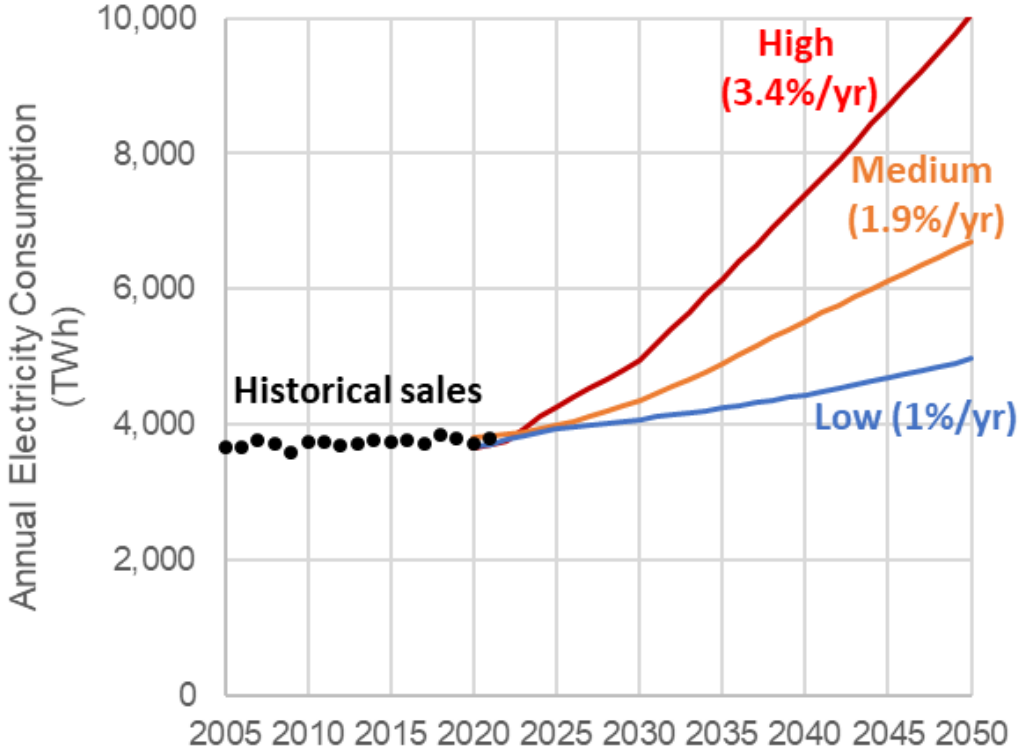
1. High transmission costs → 2–10x default assumptions
2. High distributed PV adoption → 170 GW in 2035 (default = 93 GW)
3. Low solar & storage costs → ATB Advanced
4. Low wind costs → ATB Advanced
5. Constrained renewable energy siting → Limited Access *(see next slide)*
6. Limited non-RE techs → no CCS, no new nuclear
7. Expanded non-RE techs → incl. $CO_2$ removal, nuclear-SMR

**Does the proposed scenario framework capture the main drivers relevant for national transmission planning? Are there any missing or extraneous drivers?**

9 emissions variants = 3 grid decarbonization X 3 electrification

# Emissions and electrification assumptions



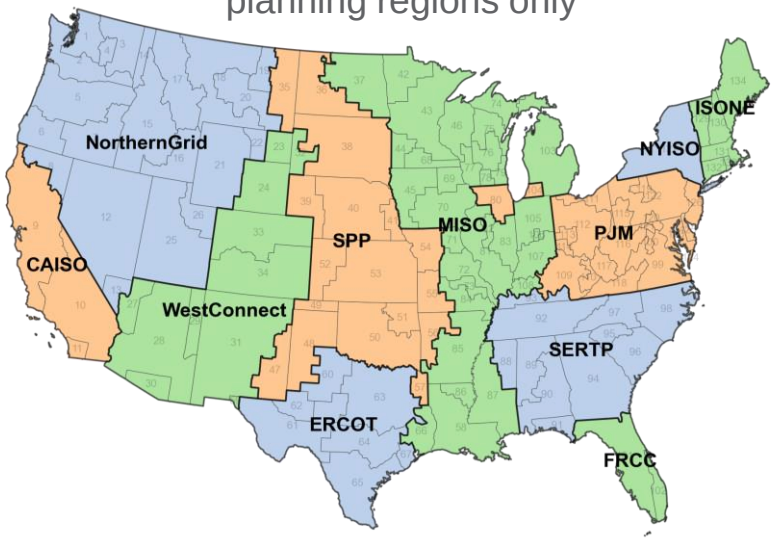




**Do the range of assumptions appropriately bound expectations - especially within the lens of decarbonization? Reactions to the electrification and demand growth assumptions would be most helpful.**

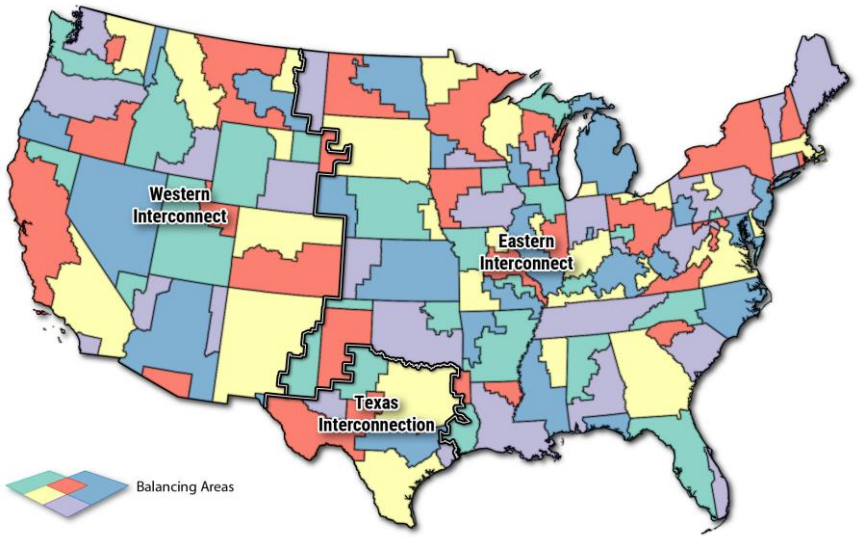
# 4 transmission topologies

**Are there specific variations to the transmission topologies that should be prioritized?**

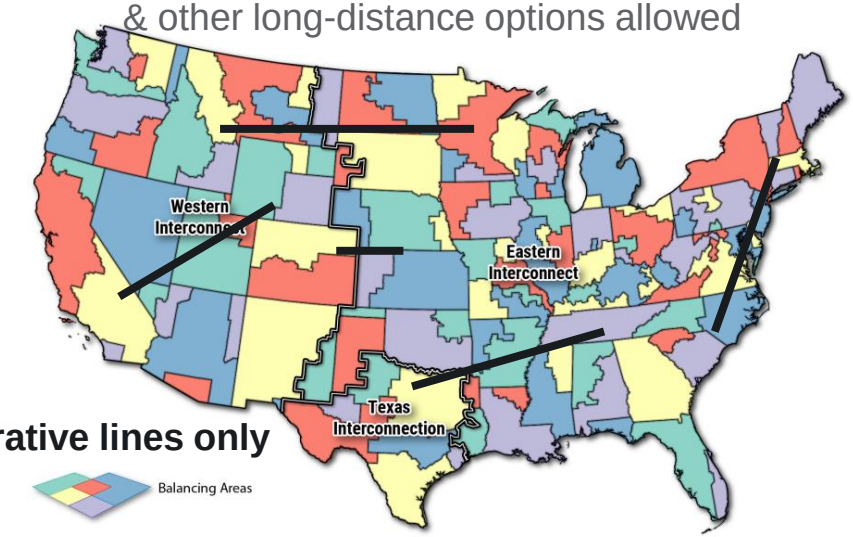
**Intra-regional:** expansion within 11 transmission planning regions only




**Intra-interconnection:** expansion between 134 model zones

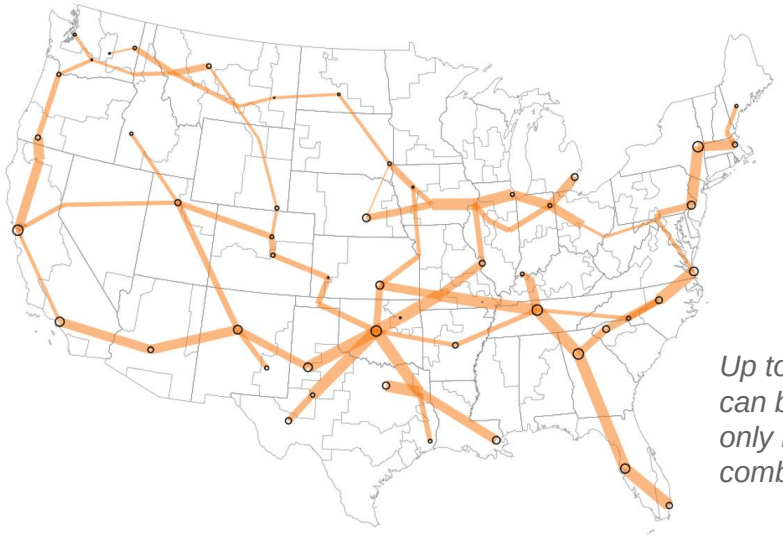



**Inter-interconnection:** back-to-back DC ties & other long-distance options allowed




**Illustrative lines only**

**Macrogrid:** multi-terminal HVDC-VSC



*Up to 3 additional variations can be tested, but plan to only run ~4 across the full combinations of scenarios*

# Select items from TRC feedback received to date

**Scenarios and sensitivities**

- Demand-side flexibility and distributed resources
- Reserve margin and extreme weather
- Fuel price variations
- Energy justice (generator and transmission siting)
- Clean gas
- Low-cost storage
- Constraints on new transmission due to siting and environmental challenges

**Range of parameters**

- 100% by 2035 and high electrification may be ambitious

**Transmission topologies**

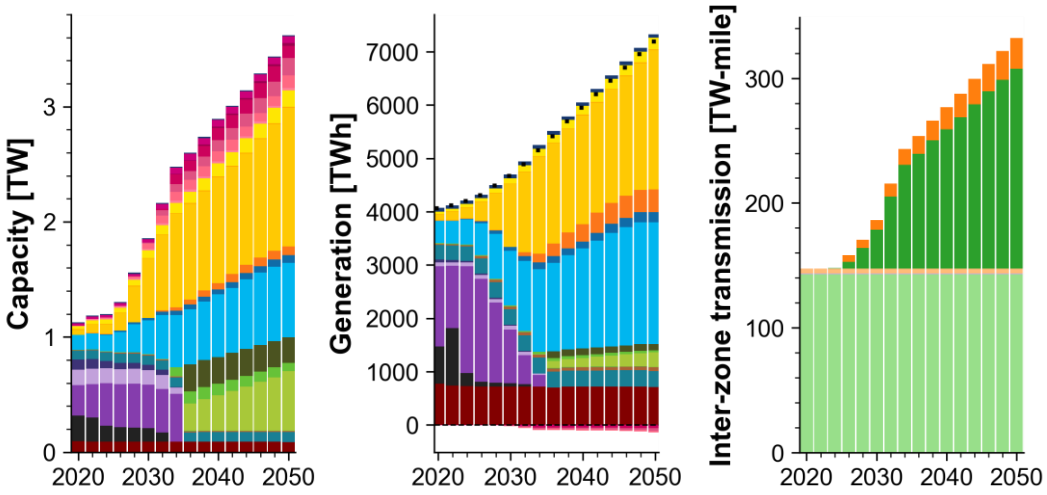
- More constraints on intra-regional expansions
- Trade-offs between inter- vs. intra-regional transmission
- Prioritize inter-interconnection and macrogrid, less interest in intra-interconnection one

# Capacity Expansion Modeling

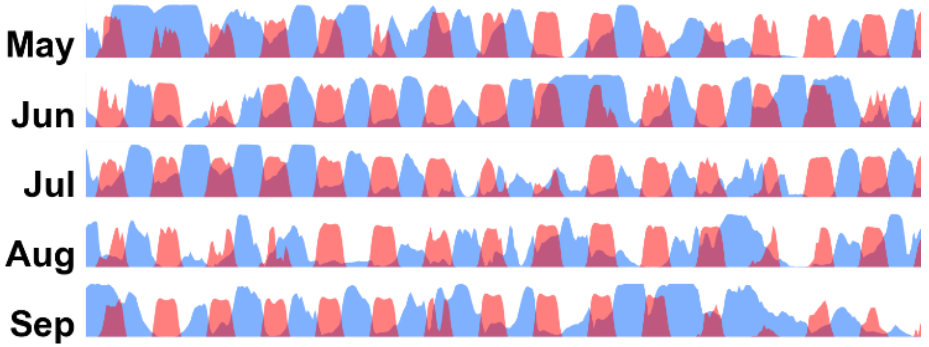
# ReEDS: Key Takeaways



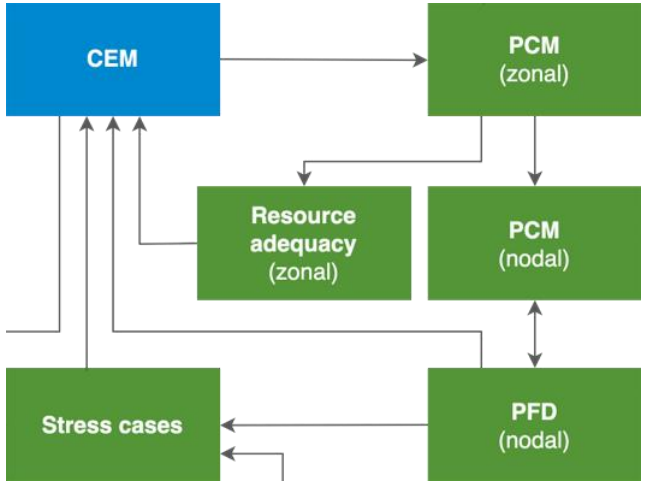
**Co-optimizes** generation, storage, and transmission capacity nationwide over the next 3+ decades



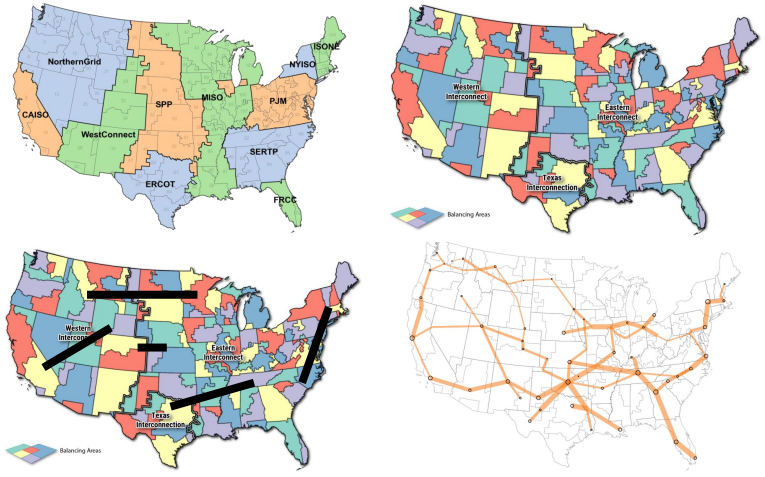

Explicit treatment of issues related to **VRE and storage**; flexible tradeoff of spatial vs. temporal resolution




Provides **starting point** for more detailed operational models

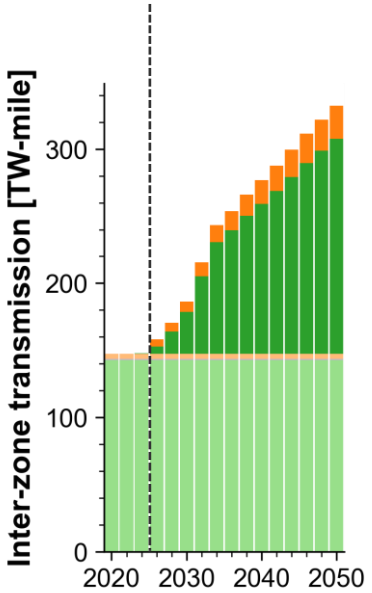



Capable of covering a **broad range** of scenario designs & transmission frameworks



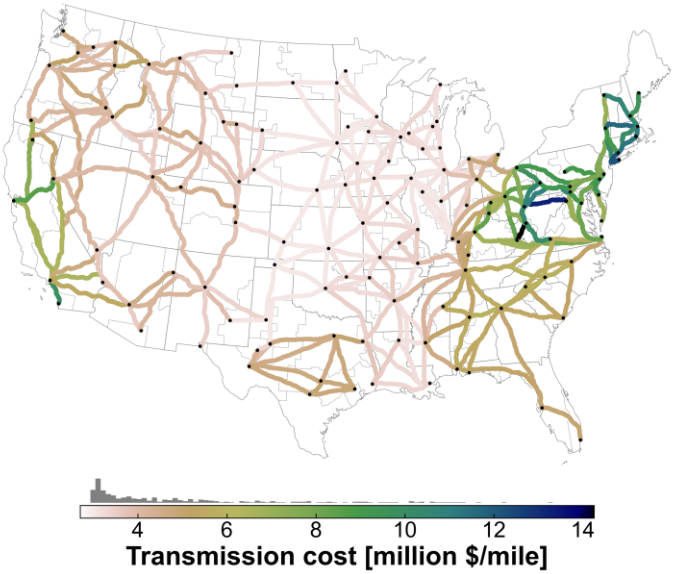
# Key capacity-expansion questions for the TRC





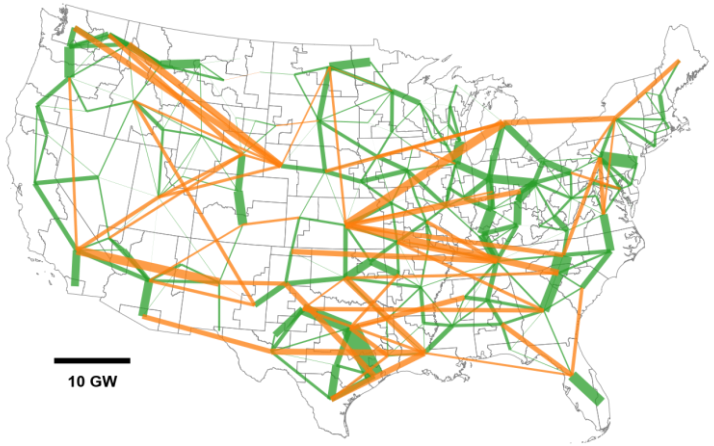

1. In what year should new, **currently unplanned** transmission capacity additions start to be allowed?

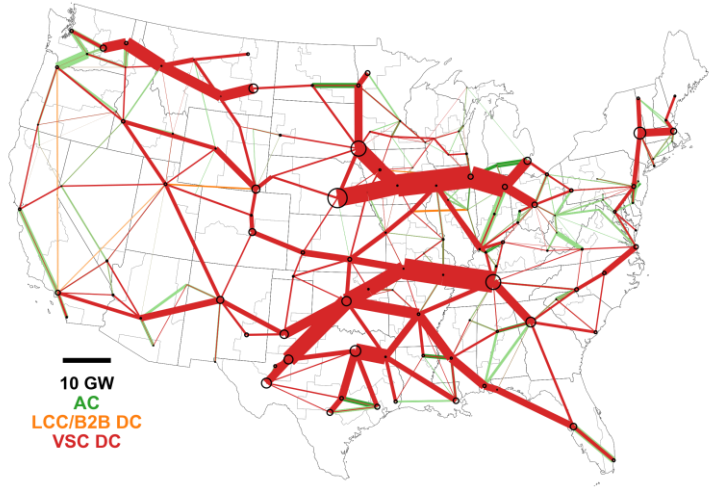
Should it depend on technology, location, or other factors?




2. Are the assumed **cost and performance** characteristics appropriate?

Are there other characteristics that should be considered?




3. Is it worthwhile to consider both **LCC** and **VSC** DC, or other high-capacity options?

4. **What geographic resolution** for transmission construction is needed for actionable findings? (Total TW-miles, inter-region capacities, individual lines…?)

# Select items from TRC feedback received to date

**First year for new transmission builds**

- 2026 is too early, 2028 is aggressive, 2030s is more realistic (consistent feedback but not uniform)
- Depends on multiple factors

**Transmission costs**

- How do costs differ with different voltages and associated land requirements?
- Can ROW costs be considered
- Reasonable process and assumptions, though some specific regions may differ

**LCC vs. VSC, geographic resolution**

- Mixed on whether LCC vs. VSC should be studied—more input from HVDC vendors?
- Mixed on individual lines vs. inter-regional

# Next Steps


Pacific Northwest
NATIONAL LABORATORY
NREL
NATIONAL RENEWABLE ENERGY LABORATORY
U.S. DEPARTMENT OF
ENERGY

# Next Steps

- TRC members complete and submit the feedback form provided
- Next subcommittee meetings
  - **Land Use and Environmental Exclusions Subcommittee** – June 24th
  - **Modeling Subcommittee** – July 29th
- Lab team will
  - Continue conducting the baseline and scenario analyses
  - Develop methodology for interregional renewable energy zones (IREZs), present draft methodology to Land Use and Environmental Exclusions Subcommittee June 24th
  - Explore energy justice tools and modeling with DOE Office of EJ Policy and Analysis
- Next TRC meeting - September
- Next public webinar will be in October 2022 to share interim results

# https://www.energy.gov/oe/national-transmission-planning-study

- Overview of NTP Study goals and objectives
- Project news and milestone results
- Webinar presentations
- NTP Study mailing list
- TRC meeting schedules and presentation materials
- **Public comment form**