Interregional Renewable Energy Zones (IREZs)

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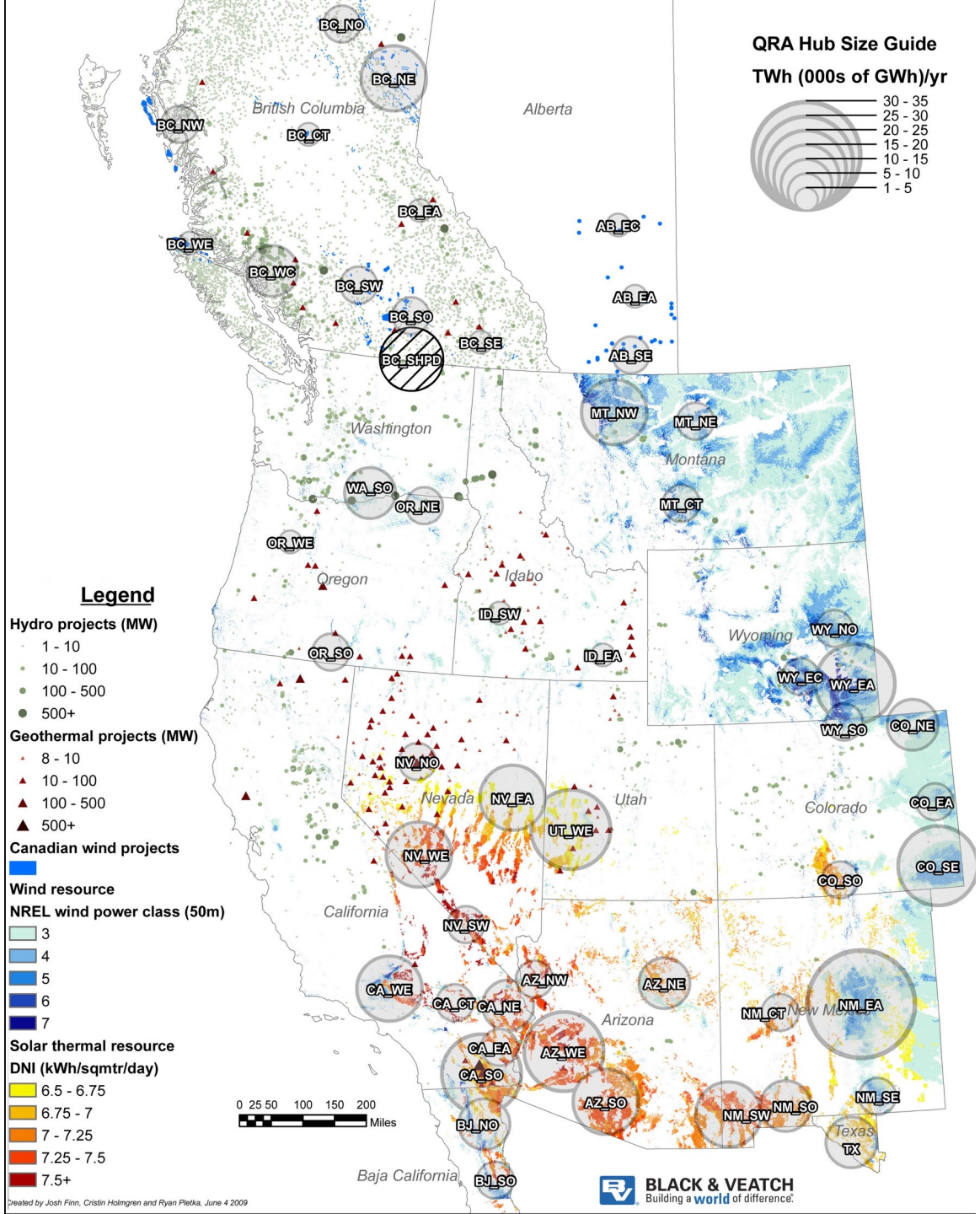
- Purpose of the IREZ analysis
- How preliminary zones were identified
- Downselection of preliminary zones

Western Renewable Energy Zones

- Analysis conducted by NREL and Black&Veatch in 2009
- American Recovery and Reinvestment Act funding
- State-led steering committee with technical working groups (including precursor to EDTF)

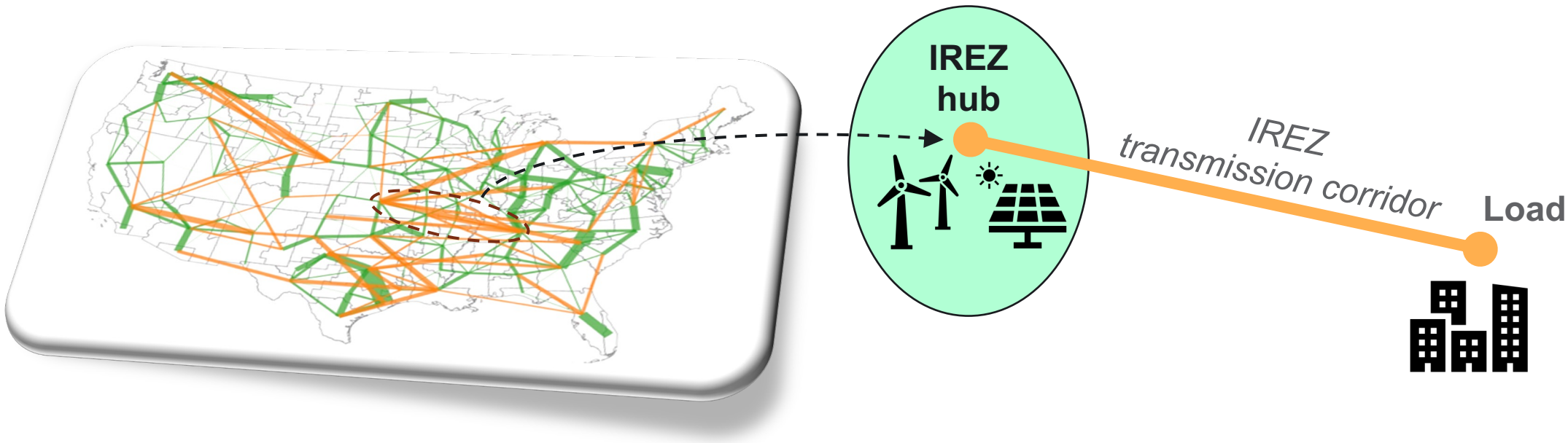


IREZ Analysis in the NTP Study: Rationale

- Implementation of a national scenario will depend on actions by states (individually, regionally)
- Technical studies—even the most robust—are not responsive to some of the critical regulatory issues and concerns that states must address when deciding whether to approve a transmission project
  - Who pays for what? Why? How much? Is the rate impact just and reasonable?
- If a solution seems reasonable on paper but has insufficient precedent in case law, utility planners might need a push from their states
  - Texas Competitive Renewable Energy Zones (CREZs) required legislative action
  - MISO's cost allocation plan for multi-value projects: support from state regulators was important
  - Interregional transmission is outside the precedents of normal utility planning
- The IREZ analysis aims to help state and regional decision-makers extract the components of NTP Study outcomes that are specific to their constituencies

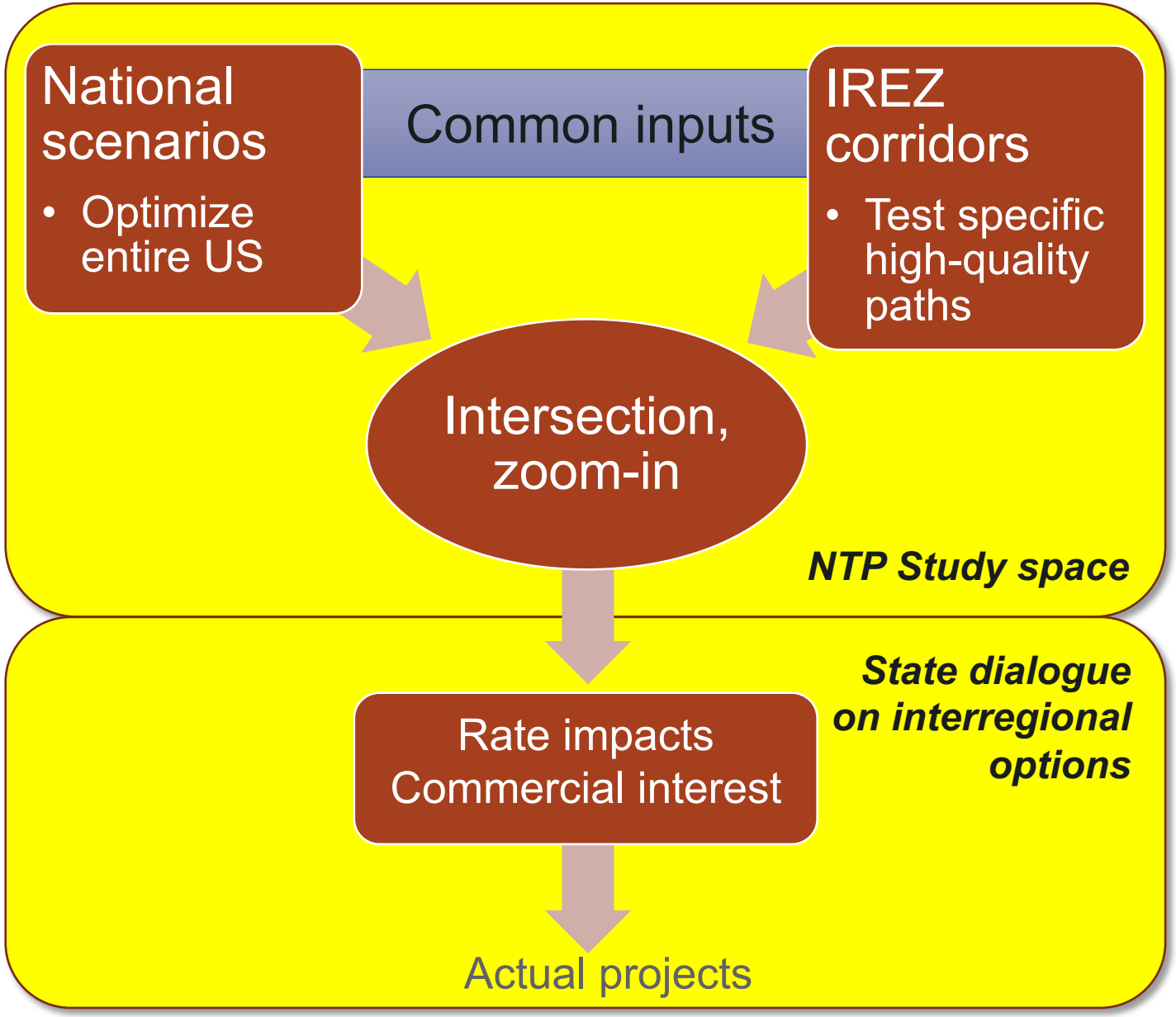
IREZ Corridors Complement Scenario Analysis

- NTP Study scenario analysis shows the national picture.
  - Capacity expansion model solves for everything everywhere all at once.
    - ✓ Captures spatial interdependencies of each scenario.
  - But, customers don't pay for everything everywhere all at once.
- IREZ analysis complements scenario analysis by showing where benefits of a specific interregional corridor might accrue to specific constituencies and customers.



Parallel, Intersecting Analyses to Inform State Dialogue

- IREZ analysis begins in parallel with scenario analysis
- Where corridor results match up,
  - the IREZ analysis will provide more information on specific opportunities for specific states, constituencies, and customers
  - information will help states and stakeholders can determine the level of commercial interest, rate impacts



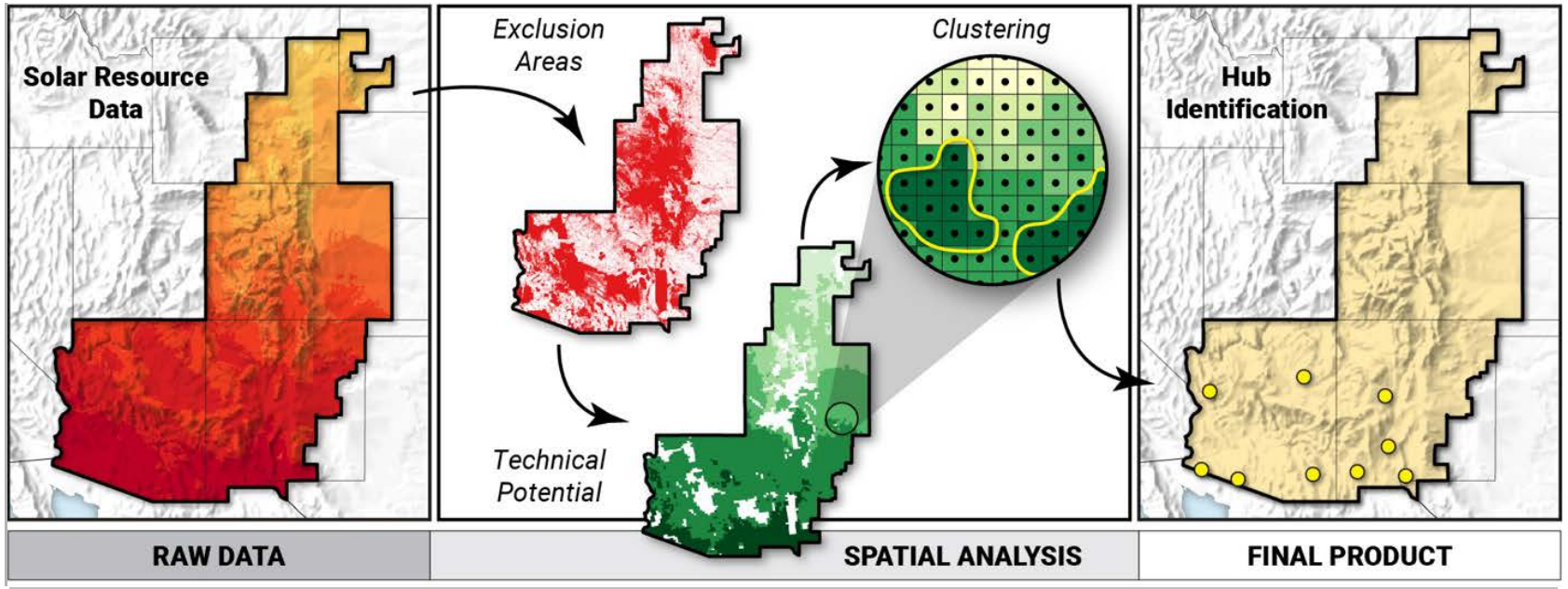
What IREZs Are (and Are Not) Intended To Do

- IREZ corridors are
  - an aid to applying national scenarios results to a specific state, a specific set of constituents, or a specific set of paying customers in a planning region
  - based on the same wind, solar, and land use inputs used in CEM and PCM
  - a tool for helping understand and visualize interregional transmission and resource options (planning's missing piece)
  - intended to stimulate and inform stakeholder action on specific interregional transmission projects

What IREZs Are (and Are Not) Intended To Do

- IREZ corridors do not
  - represent a region's development of local renewable resources
    - ✓ Regional and local planning already address this
  - suggest specific siting of new renewable projects
    - ✓ A zone has significantly more options for project siting than the new transmission line could accommodate
    - ✓ Limitations on land use are taken into account, but development on remaining land in a zone is driven by market conditions, site-specific issues, and developer expertise
  - set boundaries around where development can occur
    - ✓ No legal basis for doing so
    - ✓ Distance from hub (and the resulting gen-tie cost) will economically focus development near the IREZ hub without setting a boundary
  - account for benefits other than cost
    - ✓ First test cost-effectiveness, then test reliability, resource adequacy, other benefits

Steps to Determine Preliminary IREZs

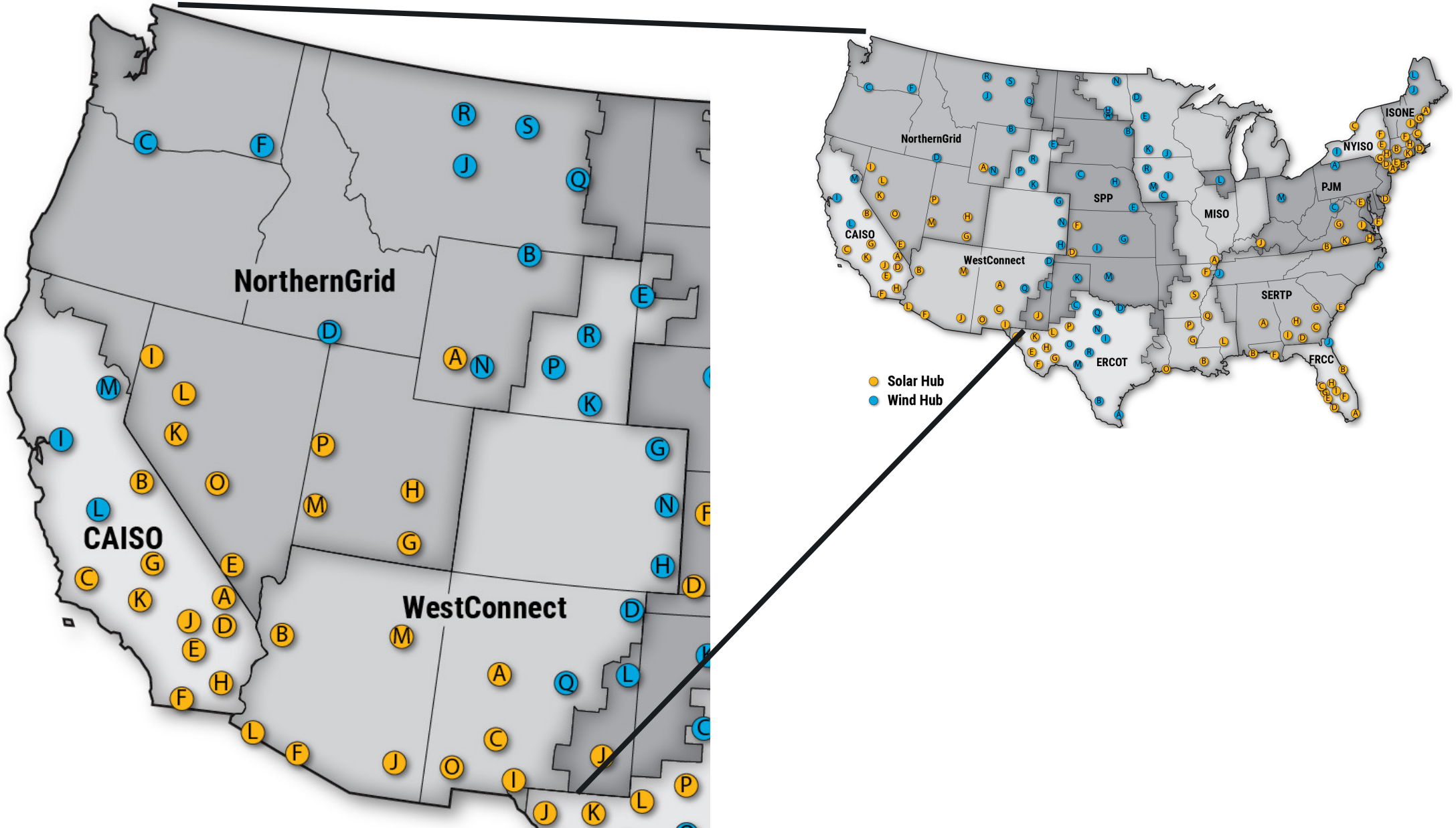


1. Apply raw resource data for wind quality, solar quality
2. Eliminate areas where development is prohibited or infeasible
3. Conduct geospatial analysis of remaining areas to identify clusters (large, contiguous areas with many options for wind or solar project development)
4. Screen for the most economically competitive clusters
5. For remaining clusters, identify collection hubs that minimize busbar energy cost and gen-tie distance

Additional Parameters for Preliminary Screening

- Wind and solar were screened separately
  - Differences in resource density (MW per km^2) made a combined analysis problematic
  - Did not co-optimize wind and solar, however zones based on wind include solar (and vice versa)
  - Diversity of resources within a zone increases transmission utilization
- Preliminary screening was done by planning region, not nationally
  - Intent was to identify the “best of the best” concentrations in each region
  - Algorithm was required to select at least one wind zone and at least one solar zone in each region
- Resource quality represented as levelized cost of energy
  - Standard technology and financial assumptions applied to wind speed, insolation
  - Not a true indicator of project cost, but permits an even geospatial comparison
- Cost benchmarks were the 10^{th} percentile LCOE of a region’s available resources
  - Where could these resources be clustered with at least 4GW within reach of a hub?

Preliminary IREZ Hubs



Example Corridor: SPP to TVA, Georgia Power

IREZ SPP-M

264 GW of potential wind sites
- LCOE $18-$20/MWh

1,000 GW of potential solar sites
- LCOE $27/MWh

(LCOE does not account for IRA)

How much could each circuit of a line move from SPP-M to the TVA and Georgia Power BAAs?

At what cost?

How many circuits could the corridor reasonably accommodate?

TVA, Georgia Power

ReEDS modeled net inflows for 2035, with HVDC transmission:
- 149 TWh to 213 TWh

2021 power production expense:
- $43/MWh (Georgia Power)

Next Step: Downselecting the Number of Hubs

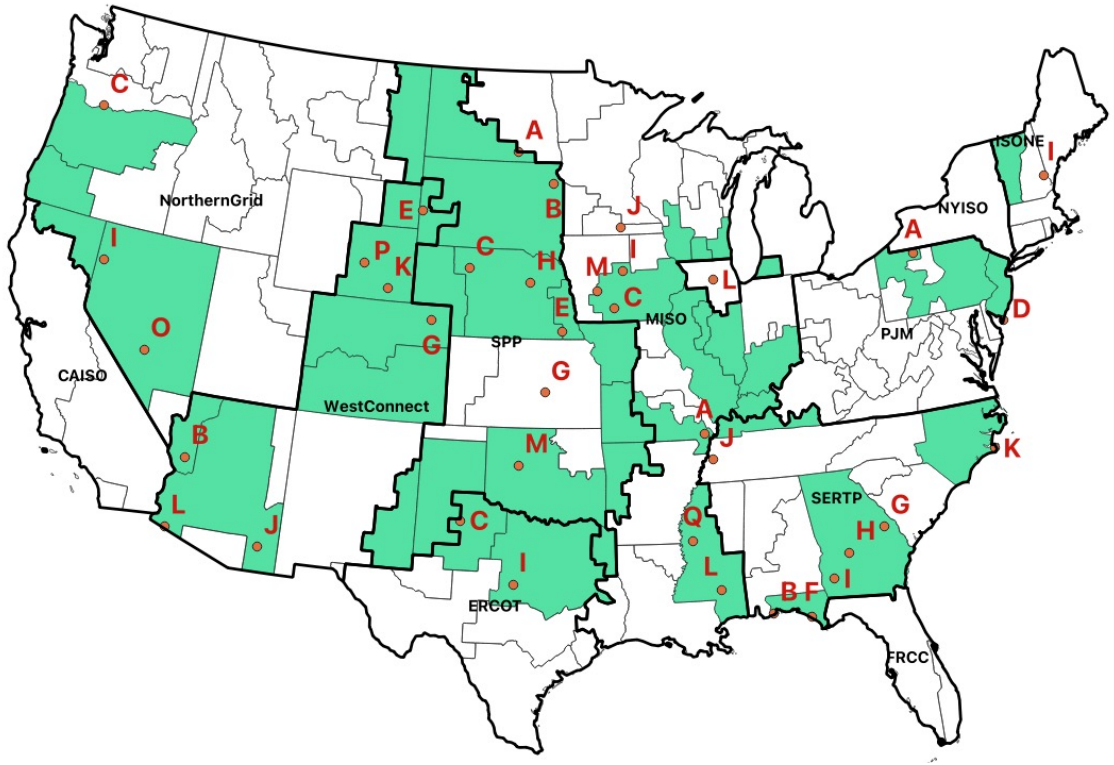
- The initial IREZ analysis identified a total of 155 *preliminary* zones nationwide
  - *Preliminary methodology is agnostic to ultimate goal of identifying interregional transmission*
  - Zones were identified in each FERC order 1000 transmission planning region based purely on supply-side criteria relating to the geographic distribution of wind and solar technical potential and cost
  - Zones do not inherently reflect demand for renewable energy
  - Therefore, we would not expect all *preliminary* zones to have equal relevance under scenarios of future energy systems
- Which of these zones could help meet interregional transmission needs under future scenarios?

Approach

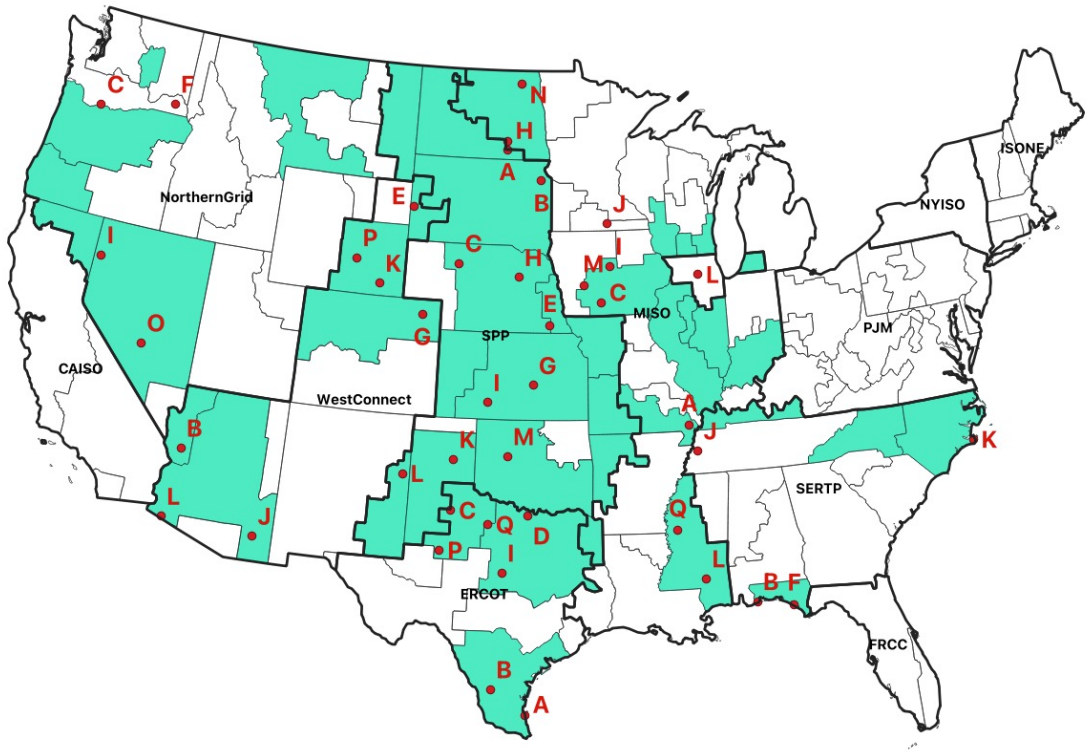
- ReEDS outputs can be used to inform which of the IREZs are most relevant under different scenarios
  - ReEDS optimizes future buildout of the entire bulk power system—including RE and transmission investments—accounting for many criteria
  - ReEDS models the local and interregional transmission of energy from one balancing authority (BA) to another
  - From ReEDS outputs, we can determine the amount of RE energy that is generated and transmitted between regions
  - Theoretically, energy from a BA that is a net exporter could be supplied by IREZs
- Working backwards from ReEDS outputs, we can identify which zones are located in or near BAs that ReEDS says are net exporters to other regions
  - These are the most likely candidates for supporting interregional transmission

Contrasting intra-regional and interregional scenarios

Scenario: Transmission expansion limited to AC network within a region



Scenario: Allow new point-to-point DC lines between regions



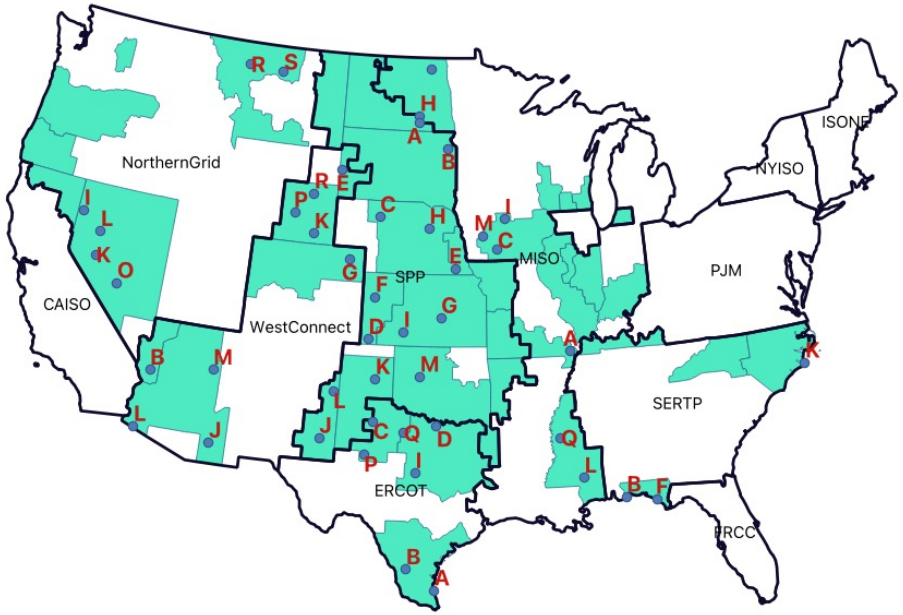
These maps show hubs that could contribute energy exports based on their spatial intersection with BAs that are net exporters in these two ReEDS scenarios. In cases where there are no hubs with these BAs, the nearest hub (within the same planning region) is displayed. Hubs included in both scenarios are robust to the type of transmission expansion considered; differences imply shifts in a hub's economic strength related to transmission opportunities.

Next iteration

- Examine hub utilization (percentage of a hub's technical potential that is likely to be required under the given scenario)
  - Is any hub overallocated?
    - ✓ The ability to sustain competition is an important attribute of an IREZ
    - ✓ If the analysis suggests most of zone's resources would be used, it leaves little room for competition
  - How should we deal with a hub that is overallocated?
    - ✓ One option is to limit each hub's supply using an LCOE threshold, which could effectively reduce the amount of secondary resources available

Status of IREZ Task

- Report on initial screening and clustering methodology has been published.
  - https://www.nrel.gov/docs/fy22osti/83924.pdf
  - DOE filed report with FERC in transmission planning rulemaking (Docket No. RM21-17-000).
- Next steps:
  - Complete analysis of IREZ intersections with scenario modeling results; if necessary, update analysis once selection of core scenarios has been finalized
  - Conduct economic analysis:
    - ✓ Which IREZs are the best match for load in an importing region?
  - Refine locations of final IREZ hubs to account for energy justice, state preferences, and other factors
  - Identify and characterize specific IREZ corridors, return to TRC for review.



Questions and discussion

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