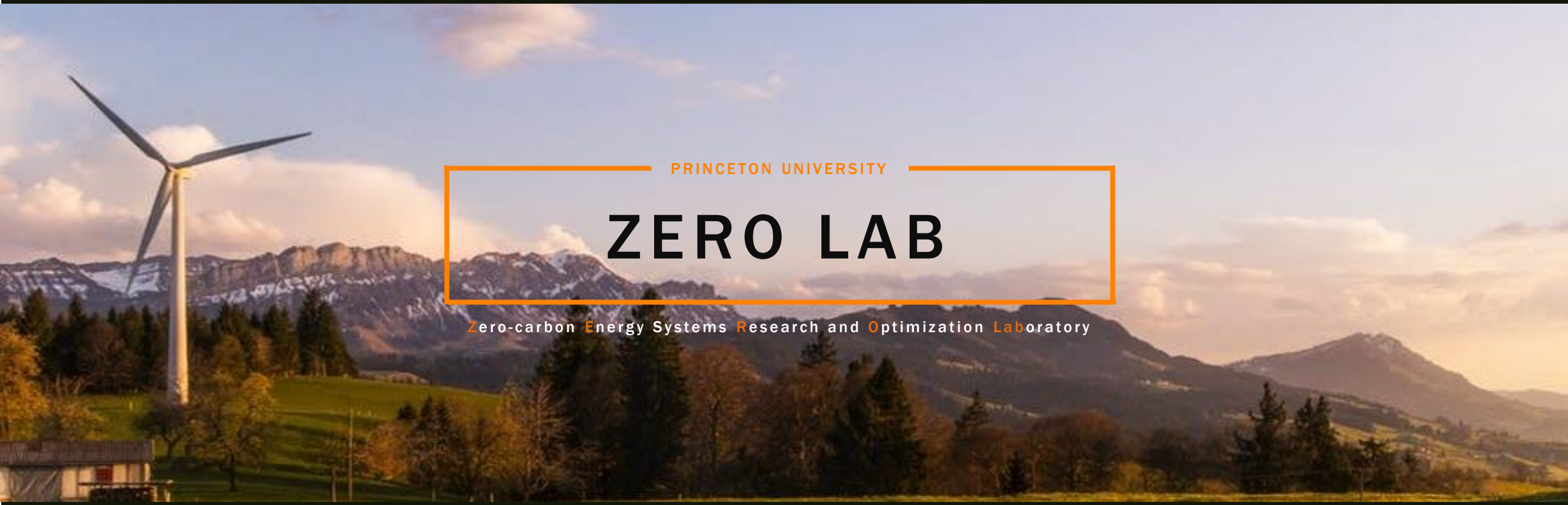
Geospatial Data in Capacity Expansion Planning: Grounding Inputs, Communicating Results



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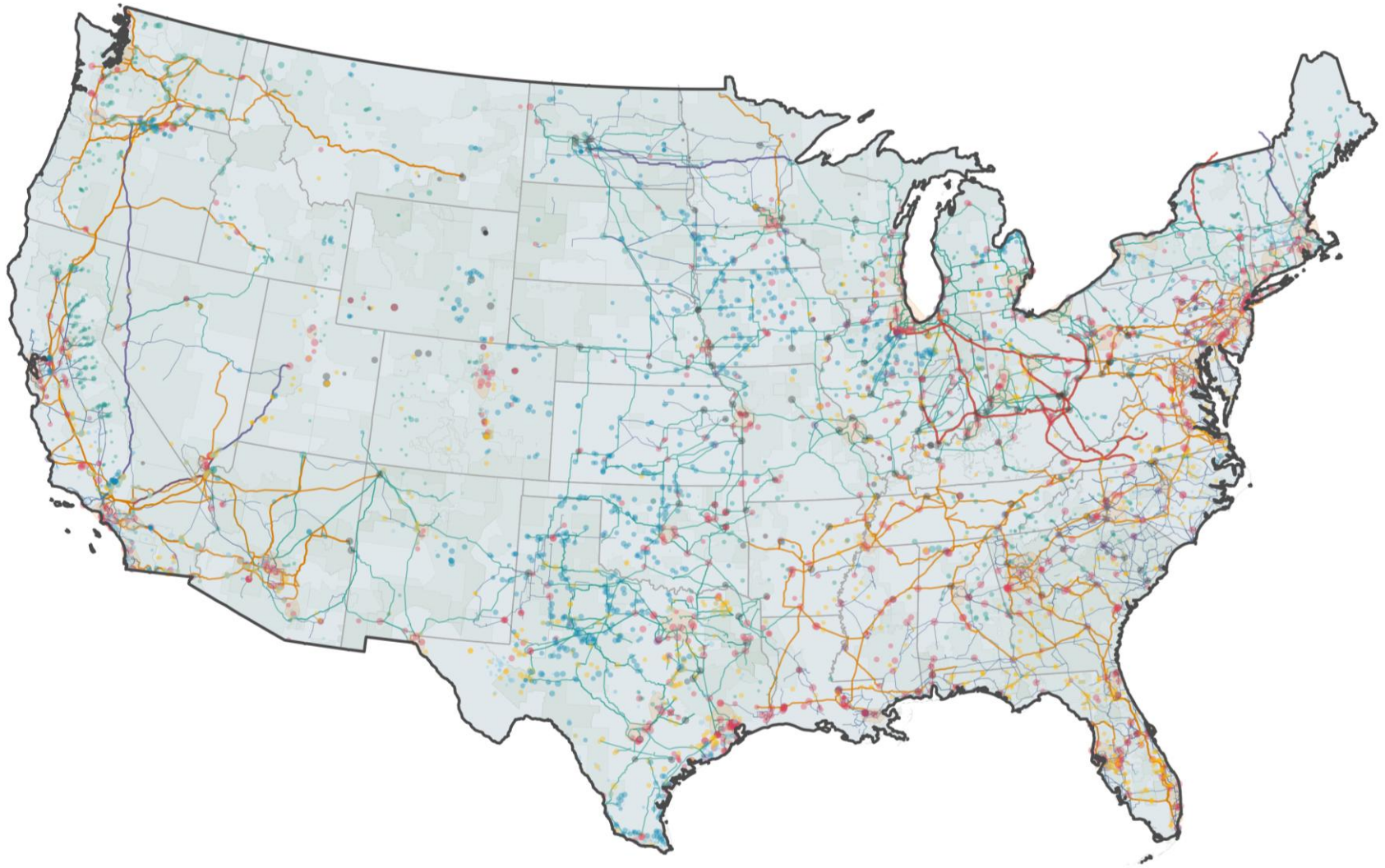
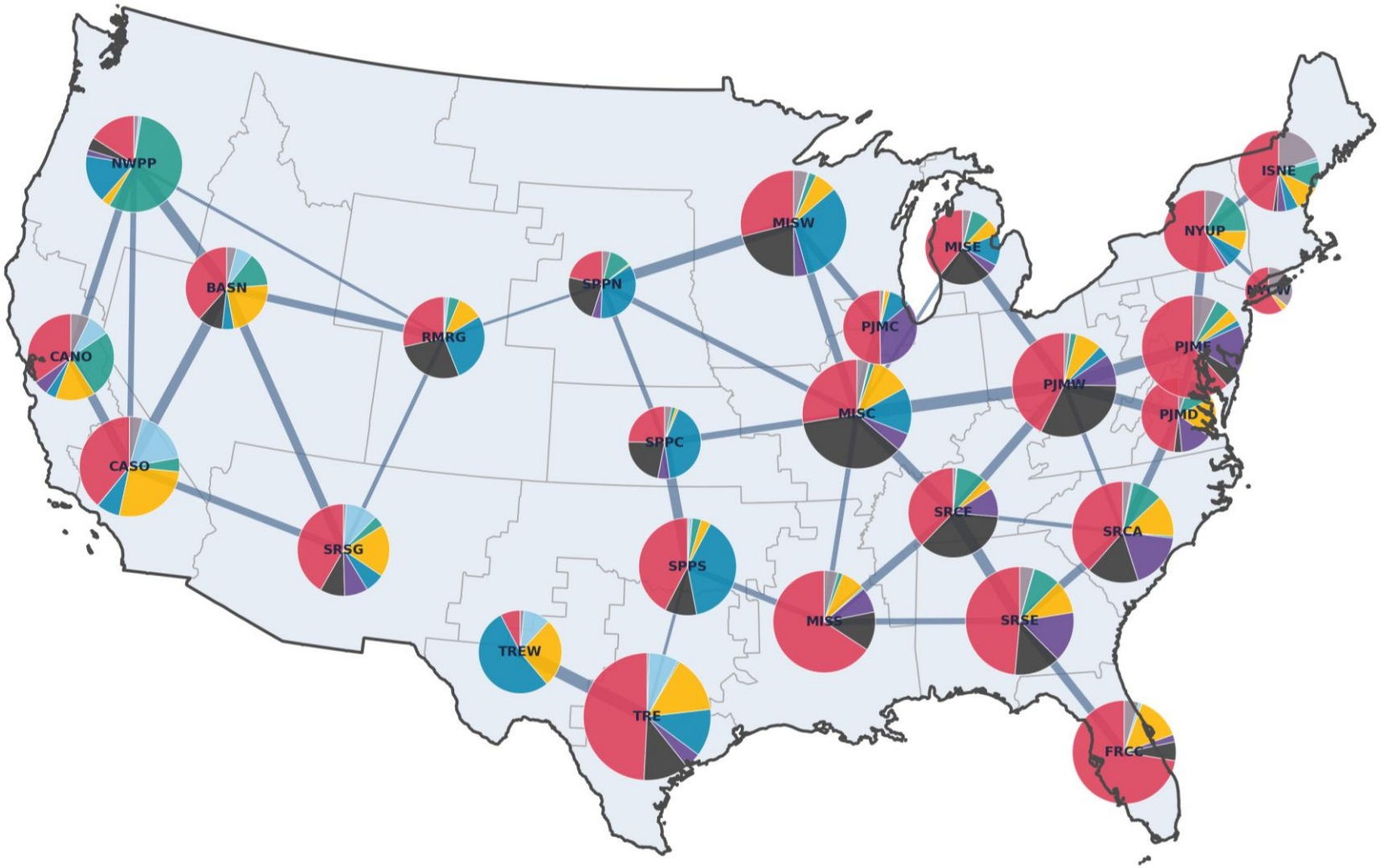
What exists in the world



Full nodal AC system

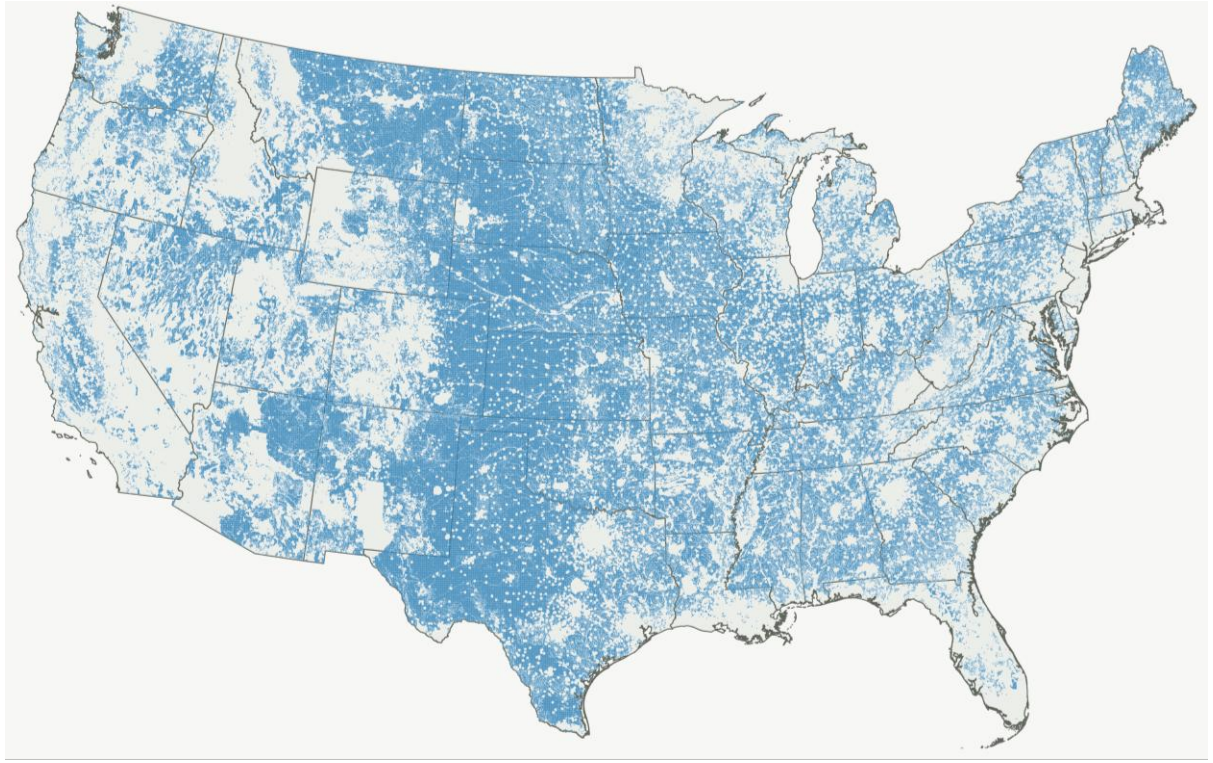
What the model sees

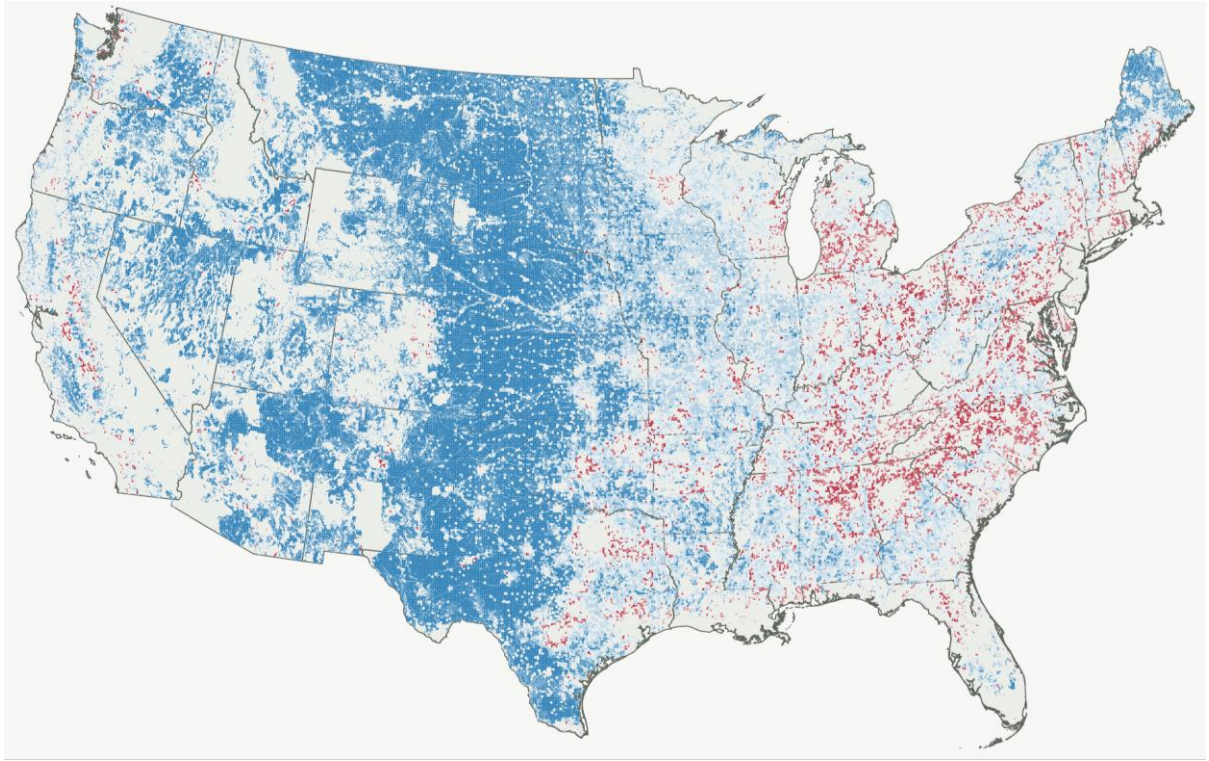
Everything spatial gets collapsed



Part 1: Grounding Inputs — Candidate Project Areas

Buildable land → Useable capacity



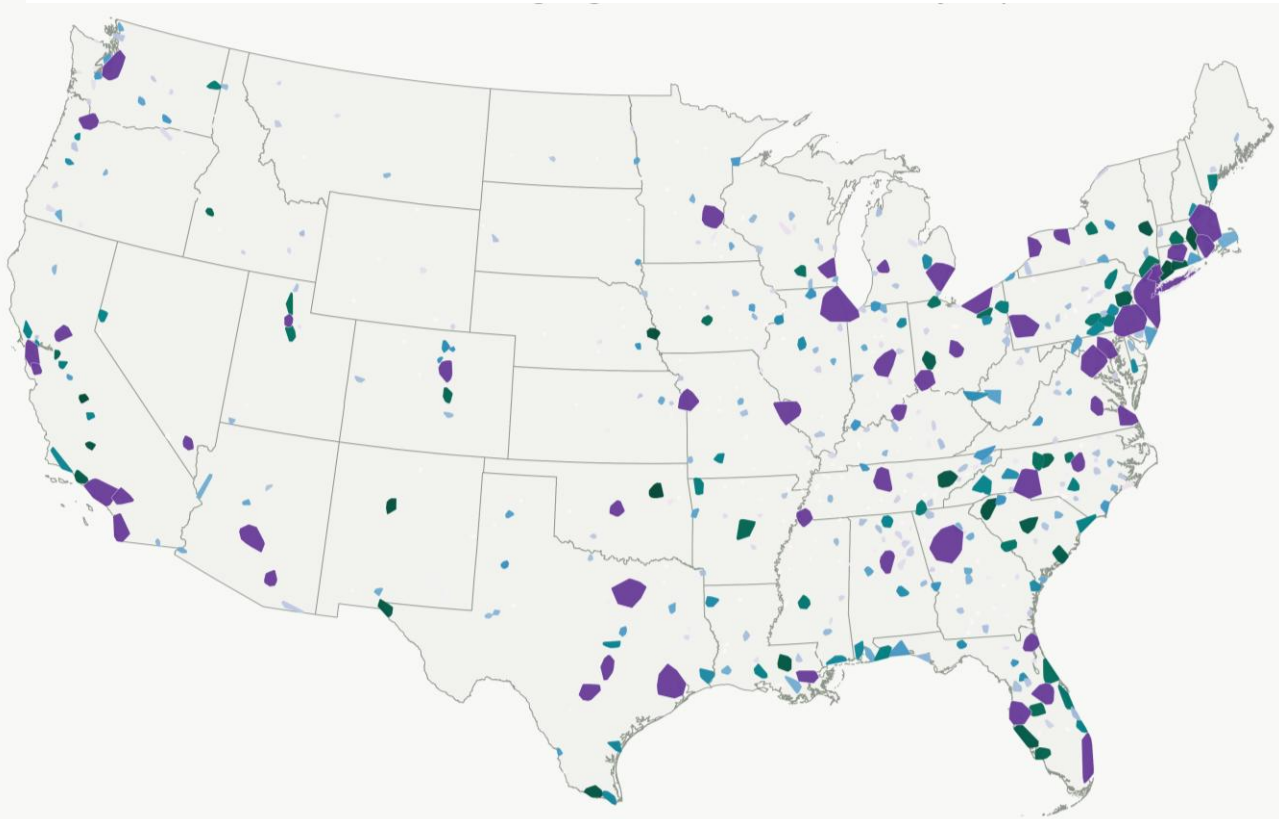


Derate using population density

Interconnection: Load Centers & Routing

Where does power go?

Not unlimited to all metros — population and demand vary enormously



Solution:

Large metros accept all connections
Smaller metros capacity-limited

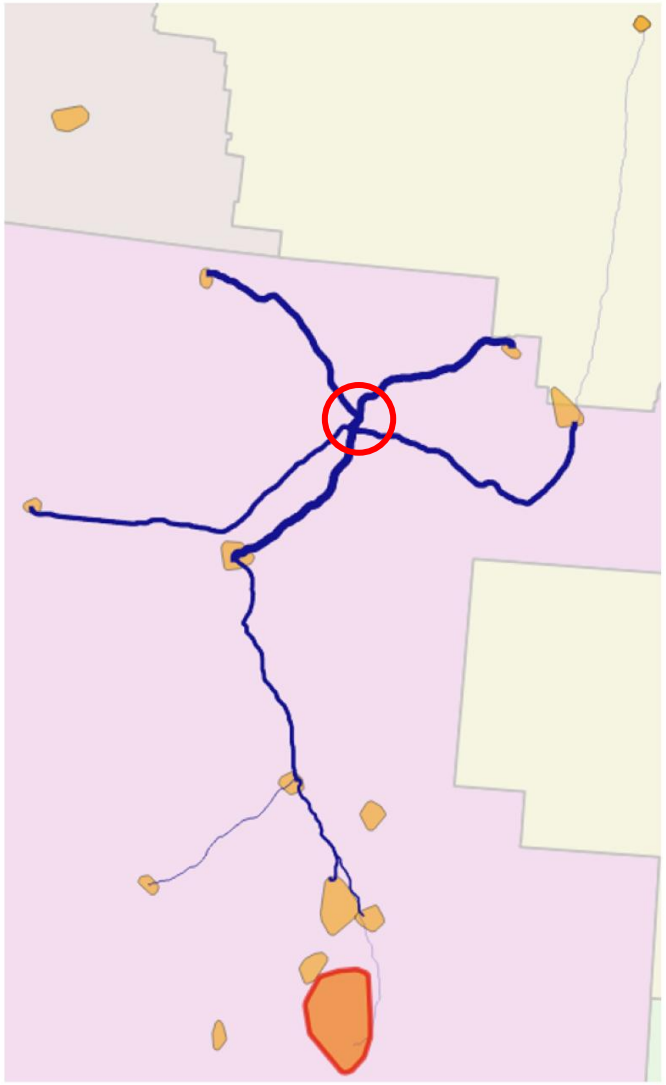
Interconnection: Load Centers & Routing

How does it get there?

Routes follow a cost surface, not straight lines

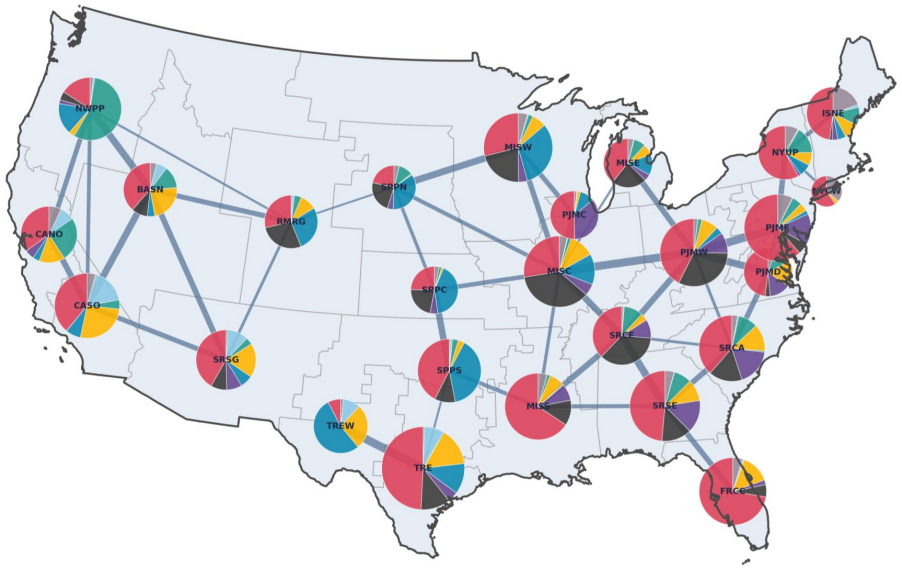
Sites connect to metros up to capacity limits

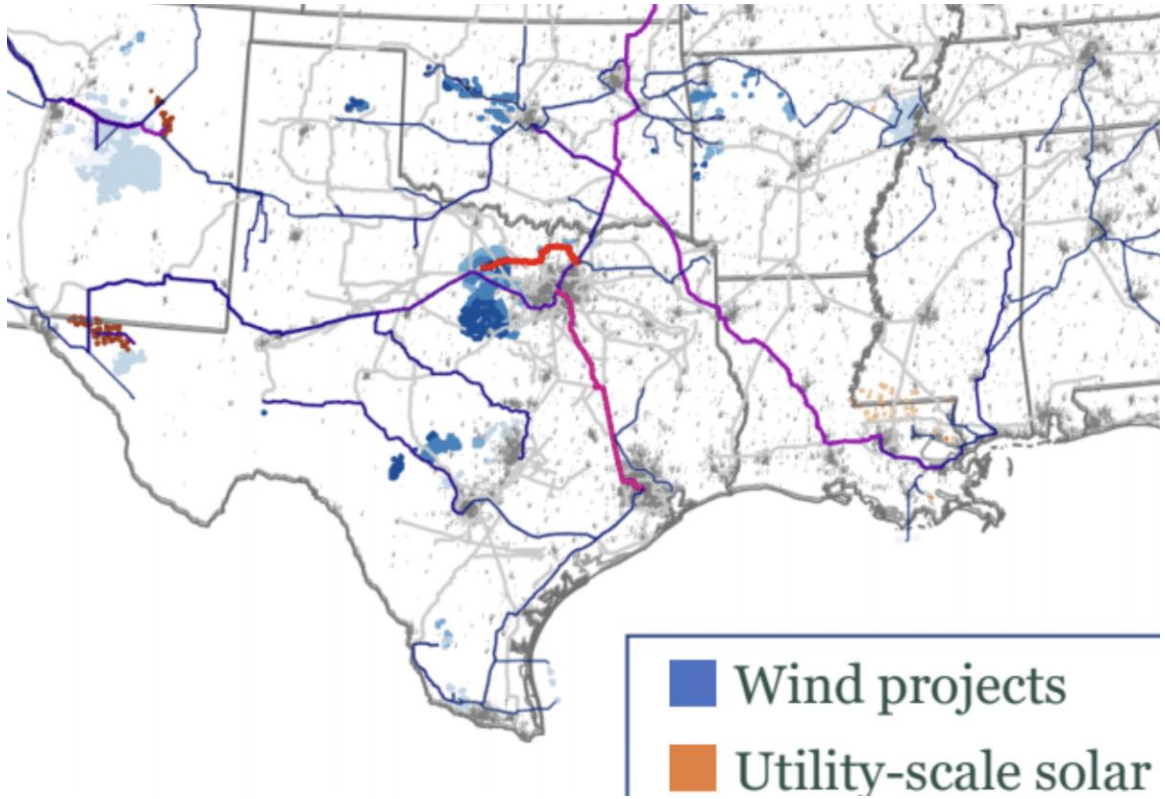
→ Some sites build longer transmission lines



Part 2: From Zones Back to Real World

Correct, but spatially opaque



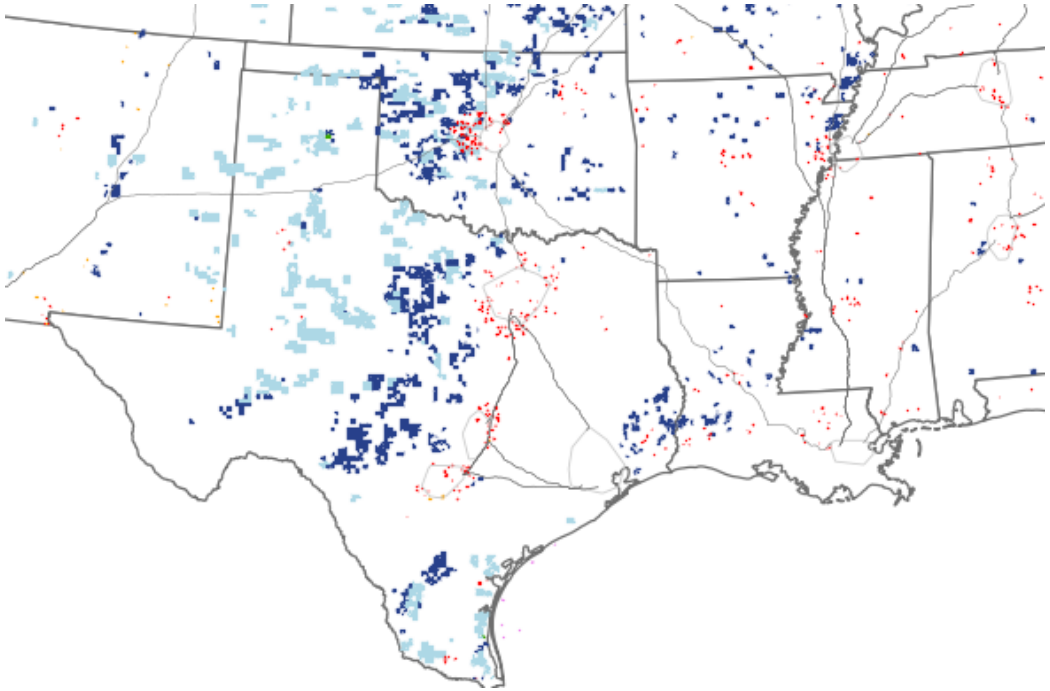


Connect sites with model resources → downscale results to land

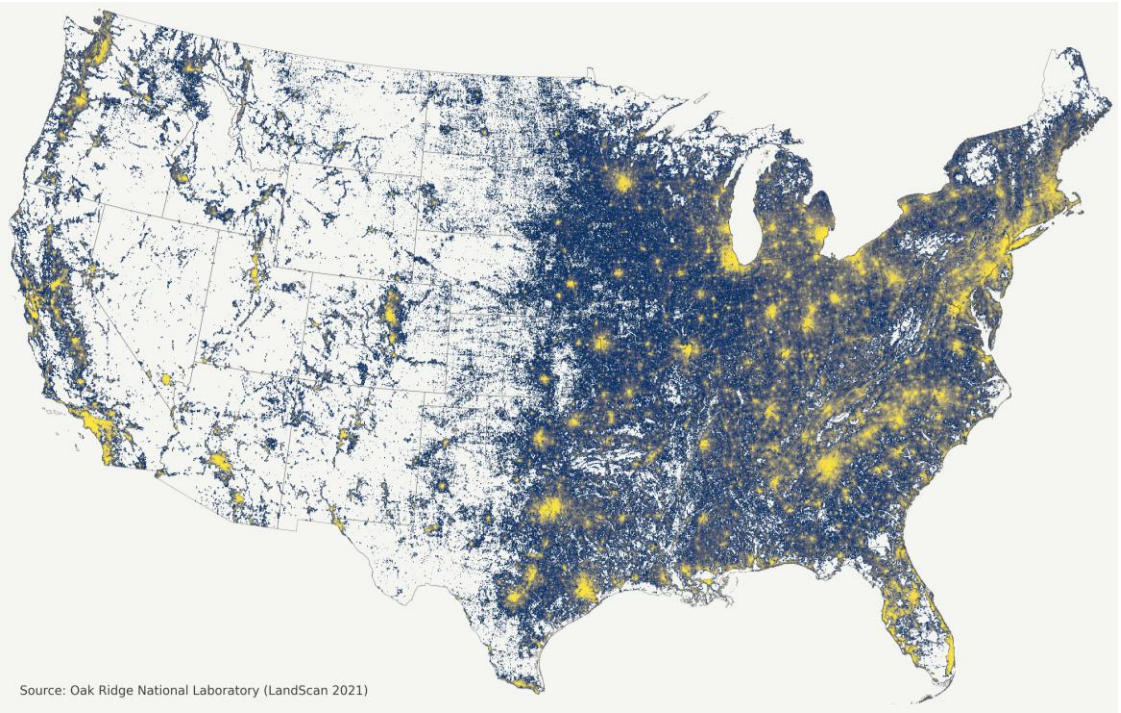
But what are those giant blobs?

From Cheapest to Plausible Sites

Lowest LCOE clusters resources around cities



The fix: population as probability



More physically plausible distribution of resources

Geospatial grounding changes model communication — not just aesthetics

Where This Breaks Down — and Where It's Going

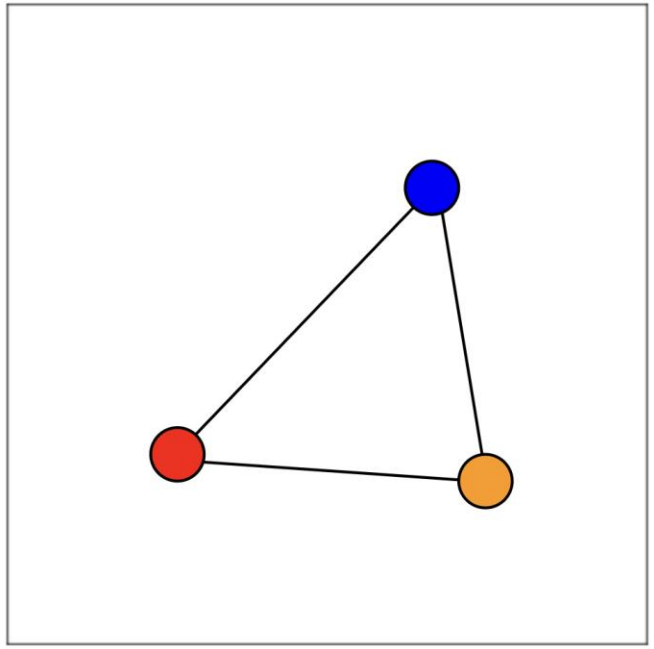
Zonal models cannot

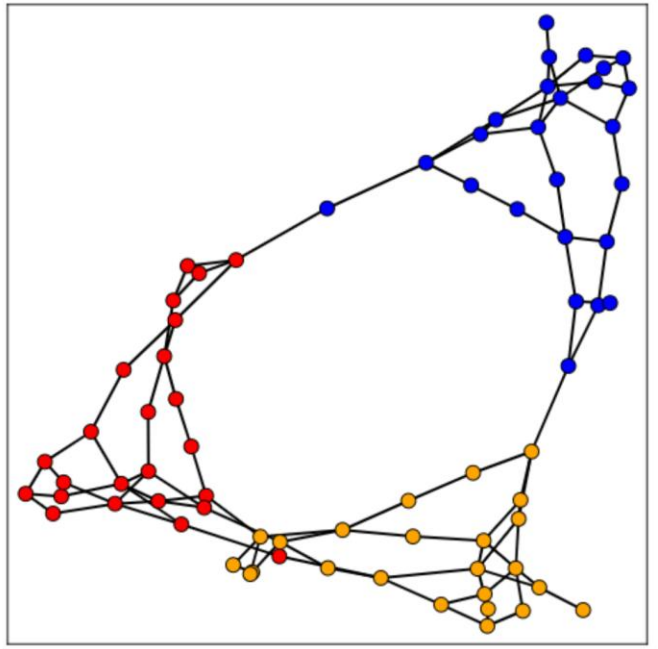
Retain spatial detail

Account for intra-zone transmission

Track where retirements create grid opportunities

Site thermal resources





Geographic details are directly available in nodal models

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ZERO LAB

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