EPRI

P201 Back Pocket Insights

KEY INSIGHTS

• **Decarbonization opportunities and costs vary significantly between global regions and within the U.S.** due to relative differences in endowments (e.g., wind and solar resource quality) and future low-carbon alternatives.

• **Climate policy design can shape regional decarbonization outcomes**, including power sector capacity and generation mixes, transition costs, energy system growth, and emissions pathways.

• **Understanding regional decarbonization opportunities is important for informed policy design, company strategy, and stakeholder engagement**, including greenhouse gas target setting, transition risk assessment, and cost-effective decarbonization.

This brief is based on the EPRI deliverable "Differences in Regional Decarbonization Opportunities, Uncertainties, and Risks" (2023)

Differences in Regional Decarbonization Opportunities and Risks

by Steven Rose and Anahi Molar-Cruz

Using existing global and U.S. modeling, this study evaluates differences in regional decarbonization opportunities, uncertainties, and risks.

Countries, subnational jurisdictions, and companies are trying to understand potential decarbonization opportunities and risks. Evaluating differences and similarities in regional mitigation pathways and costs is essential for developing practical, viable, and cost-effective policies and strategies. This study relies on global emissions pathways evaluated by the Intergovernmental Panel on Climate Change (IPCC) in their recent Sixth Assessment Report, and decarbonization pathways for U.S. regions based on EPRI's Low-Carbon Resources Initiative (LCRI) U.S. economy-wide net-zero CO_2 pathways analysis.

The study finds that decarbonization opportunities and costs vary significantly between global regions and within the U.S.
Power sector emissions reductions in 2035 and 2050 vary widely across regions and differ from national rates—with the individual regional pathways and range dependent on technological costs and availability (Figure 1):

- **Net-Zero All Options (NZ-A):** In pursuing a U.S. economy-wide net-zero target by 2050, it could be cost-effective for some regions to have power sector emissions below net-zero CO_2 in 2050 and some above (Figure 1, left). Carbon removal

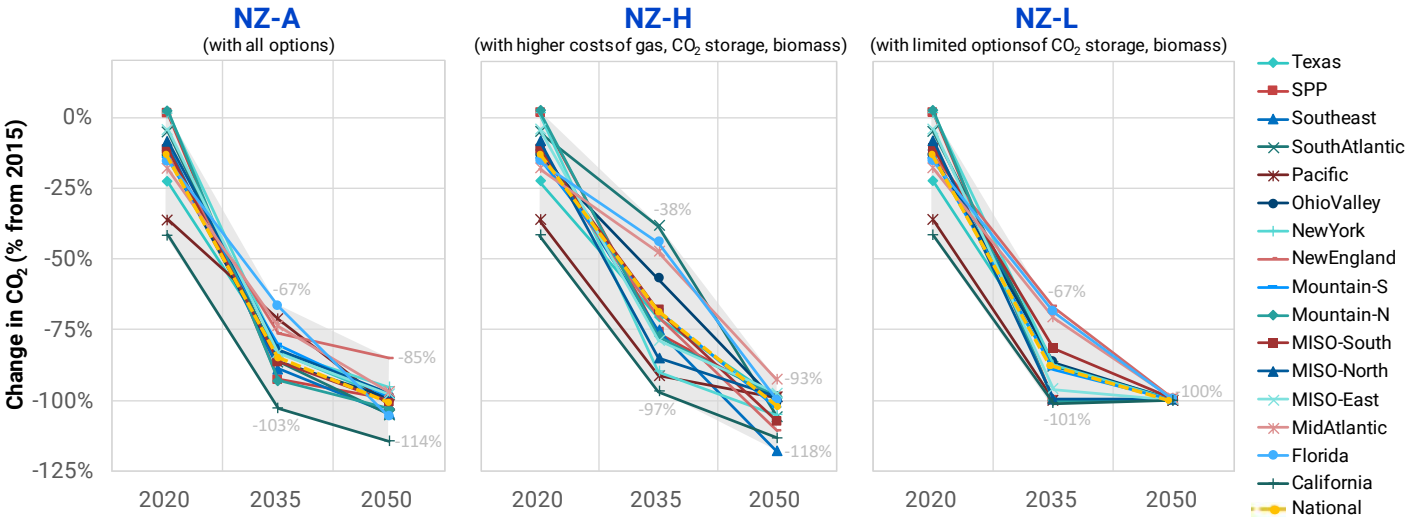

Figure 1. Power sector net CO_2 reduction (% reduction from 2015 levels) by region across net-zero scenarios. All scenarios assume a national economy-wide net-zero CO_2 target by 2050 with regional flexibility.

technologies are balancing residual emissions, where the balance between positive and negative CO_2 reflects tradeoffs between marginal costs of direct mitigation, mitigation in other regions, and carbon removal.

- **Net-Zero Higher Costs (NZ-H):** With higher cost assumptions for natural gas, CO_2 storage, and biomass, the competitiveness of resources, cost-effective decarbonization rates, and regional roles shift (Figure 1, middle).
- **Net-Zero Limited Options (NZ-L):** Without carbon removal and limited biomass, regional transitions shift again to steeper power emissions reductions and 100% reductions in all regions in 2050 (Figure 1, right), with notable supply mix and cost implications.

Policy design can shape regional decarbonization transitions, not only in power sector CO_2 reductions but also:

- **Power system generation and capacity mixes:** Electric sector transition pathways vary significantly between regions, as shown in the capacity mixes in Figure 2. Wind and solar capacity additions are largest in regions with greater relative resource availability and quality—the Midwest and Southwest. Regions with lower renewable potential—in particular the South—have the greatest additions of CCS-equipped gas, especially under the all options scenario (NZ-A).
- **Costs:** In all regions, electricity prices increase, and more so in the more constrained conditions (NZ-H & NZ-L), with large regional variation in transition costs.
- **Energy system growth and composition:** Load growth and capacity additions are highest under the NZ-L scenario due to the absence of CO_2 storage and more limited role of fossil fuels resulting in greater electrification and increased electrolytic hydrogen production. The role of natural gas is very sensitive to policy design, with regional gas consumption potentially increasing or decreasing depending on the regional and policy environment.
- **Transmission and trade:** Inter-regional transmission capacity additions increase most under constrained scenarios. Policy design also shapes the magnitude and

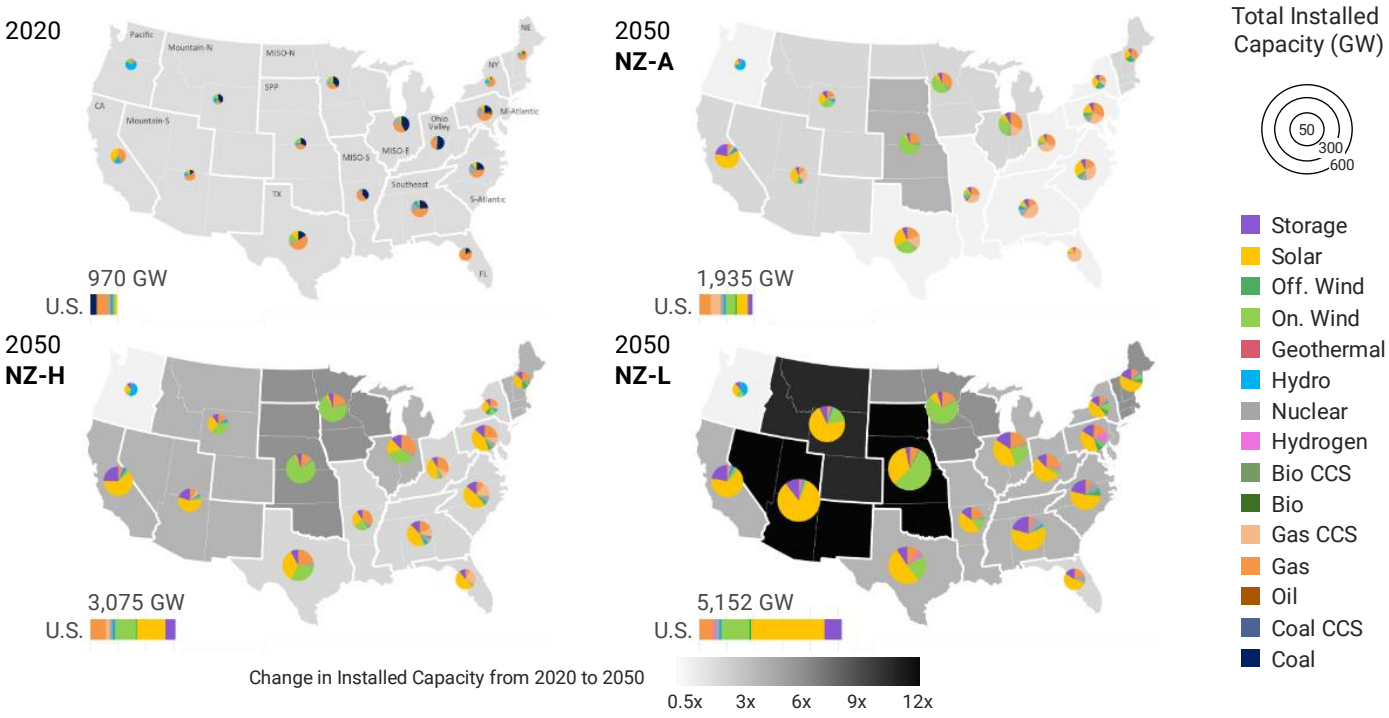

Figure 2. Regional installed generation capacity in 2020 and in 2050 across net-zero scenarios. The size of circles is proportional to total installed capacity.

direction of electricity exports and imports across regions. Power trade could potentially facilitate cost-effective regional power system balancing and lower decarbonization costs elsewhere across the country.

Differences in decarbonization opportunities and risks are primarily due to the relative differences in endowments and future low-carbon alternatives. Key endowment differences include wind and solar resource quality, CO_2 storage, inter-regional transmission, and gas systems. Current conditions, however, are not a reliable indicator of decarbonization opportunities or risks. R&D, markets, and policies can determine if and how regions can take advantage of their endowments in future decarbonization, which can help with managing societal transition-related tradeoffs (e.g., costs, resource adequacy, reliability, local development, equity).

Understanding regional decarbonization opportunities is important for informed policy design, company strategy, and stakeholder engagement, including discussions regarding greenhouse gas target setting, low-carbon transition risk assessment, and cost-effective decarbonization. However, transition risk is greater than shown in this study's results. Uncertainties in local policy design as well as non-policy conditions represent transition risks for companies, and tailored company-specific analyses are needed.

FOR MORE INFORMATION

This study is part of EPRI's suite of resources associated with climate risk and greenhouse gas target setting. See the ESCA website (link) and SMARTargets (link) for more.

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