REMI Guest Webinar

Potential Energy Market and Economic Impacts of CES

Clean Energy Standard

FTI CONSULTING™

Tuesday, March 9, 2021 and Thursday, March 11, 2021

FTI Overview

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Disclaimer

The views in this presentation do not reflect the views of FTI Consulting. The analysis contained in this presentation are for illustrative purposes only and are subject to uncertainty.

FTI Consulting | Overview

FTI Consulting ("FTI") is an independent global business advisory firm dedicated to helping organizations manage change, mitigate risk, and resolve disputes. Due to our unique mix of EXPERTISE, CULTURE, BREADTH OF SERVICES, and INDUSTRY EXPERIENCE, we have a tangible impact on our clients' most complex opportunities and challenges.

Definitive Expertise

- **Who's Who Legal: Consulting Experts (Most Recognized),** *Law Business Research Ltd.* (2016 – 2019)
- **Best Of National Law Journal: Hall of Fame** *National Law Journal* (2017 – 2019)
- **#1 Restructuring Advisor,** *The Deal* (2007 – 2019)
- **Gold SABRE Award, Healthcare Providers,** *The Holmes Report* (2019)

A Culture That Delivers

- **Practical** in our communication and approach to outcomes
- **Judicious** in complex, multi-party situations
- **Collaborative** with clients and colleagues
- **Professional** in our commitment to work with the highest caliber

5,700+ Employees	**570+** SMDs	**$4.7B** Market Cap.[1]
82 Cities		**27** Countries
Advisor to **96** of the world's top **100** law firms	**53** of Fortune Global **100** corporations are clients	Advisor to **8** of the world's top **10** bank holding companies

Comprehensive Services

- Financial
- Operational
- Reputational

Industry Experience

- Aerospace & Defense
- Agriculture
- Automotive
- Construction
- Energy, Power & Products ("EPP")
- Environmental
- Financial Institutions
- Healthcare & Life Sciences
- Hospitality, Gaming & Leisure
- Insurance
- Mining
- Public Sector & Government Contracts
- Real Estate
- Retail & Consumer Products
- Telecom, Media & Technology
- Transportation

Economic Impacts Group ("EIG") | Overview

EIG is a functional group within FTI Consulting that answers "What If?" questions about the economy and public policy. We prefer to use third-party, documented models, not proprietary tools.

ECONOMIC IMPACTS GROUP OVERVIEW

- EIG examines how the wider economy and markets react to changes in public policy:
  - **Economy** – employment, business sales, gross product, household income, government tax revenues, demographics, and cost of living
  - **Markets** – impacts to supply, demand, prices, profitability, and rates of growth
- Our deliverables formulate clients' strategic plans and educate stakeholders, including policymakers, regulators, the media, and the public

MARKET AND ECONOMIC IMPACT MODELS

- Input-output model showing linkages across 550+ sectors including households and governments down to the zip code level.
- Long-term computable general equilibrium (CGE) model of demand and supply for labor and commodities as well as demographics.
- Commodity and sectoral CGE model of production, consumption, and international trade and financial transactions.

ISSUE AND SECTORAL COVERAGE

- Agriculture and Resources
- Banking and Finance
- Construction
- Demographics
- Energy and the Environment
- Fiscal Policy
- Healthcare
- Insurance and Pensions
- International Trade
- Manufacturing
- Retail and Wholesale
- Transportation and Infrastructure

Energy Markets Advisory Team | Overview

The Energy Market Advisory team is part of FTI's Energy, Power & Products group, providing the analytical insights required to make the right strategic decisions in business planning, disputes, policy design, and transactions.

OVERVIEW

- Team with extensive biofuels, electricity, coal, oil & gas, renewables, and emissions expertise
- Clients range from law firms, trade associations and think tanks to merchants, utilities, shippers, and renewables offtakers
- Deliverables often are data intensive and include an expert report, market report, or presentation
- Recent projects include:
  - Economic harm if a pipeline were to cease operation
  - U.S. market landscape study for biomass with carbon capture
  - White paper on the closure of two coal-fired plants in NJ
  - Independent market report for a wind farm sale in SPP

ENERGY MARKET MODELS

PLEXOS BY ENERGY EXEMPLAR — Electricity & Coal

- Unit generation, emissions, additions, and retirements
- Zonal energy, REC, and capacity prices
- Zonal transmission/ interchange flows
- Coal basin production, transport, and prices

PLEXOS BY ENERGY EXEMPLAR — Global Gas & LNG

- Represents more than 20 supply countries
- Includes more than 20 demand regions / countries
- Accounts for long-term contracts
- Simulates monthly LNG trade and prices

ENELYTIX

- Cloud-based, nodal security-constrained economic dispatch model
- Simulates day-ahead and real-time nodal, hub, and zonal prices and transmission flows

SERVICES PROVIDED

Business Strategy

Emissions Forecasting

Energy Policy Studies

Expert Testimony

Market Landscape Studies

Monte Carlo Modeling

Price Forecasting

Resource Planning

Revenue Due Diligence

Scope 1, 2, and 3 Accounting / Strategy

Stochastic Modeling

Supply and Demand Forecasting

Methodology and Approach

Clean Energy Standard | Definition and History

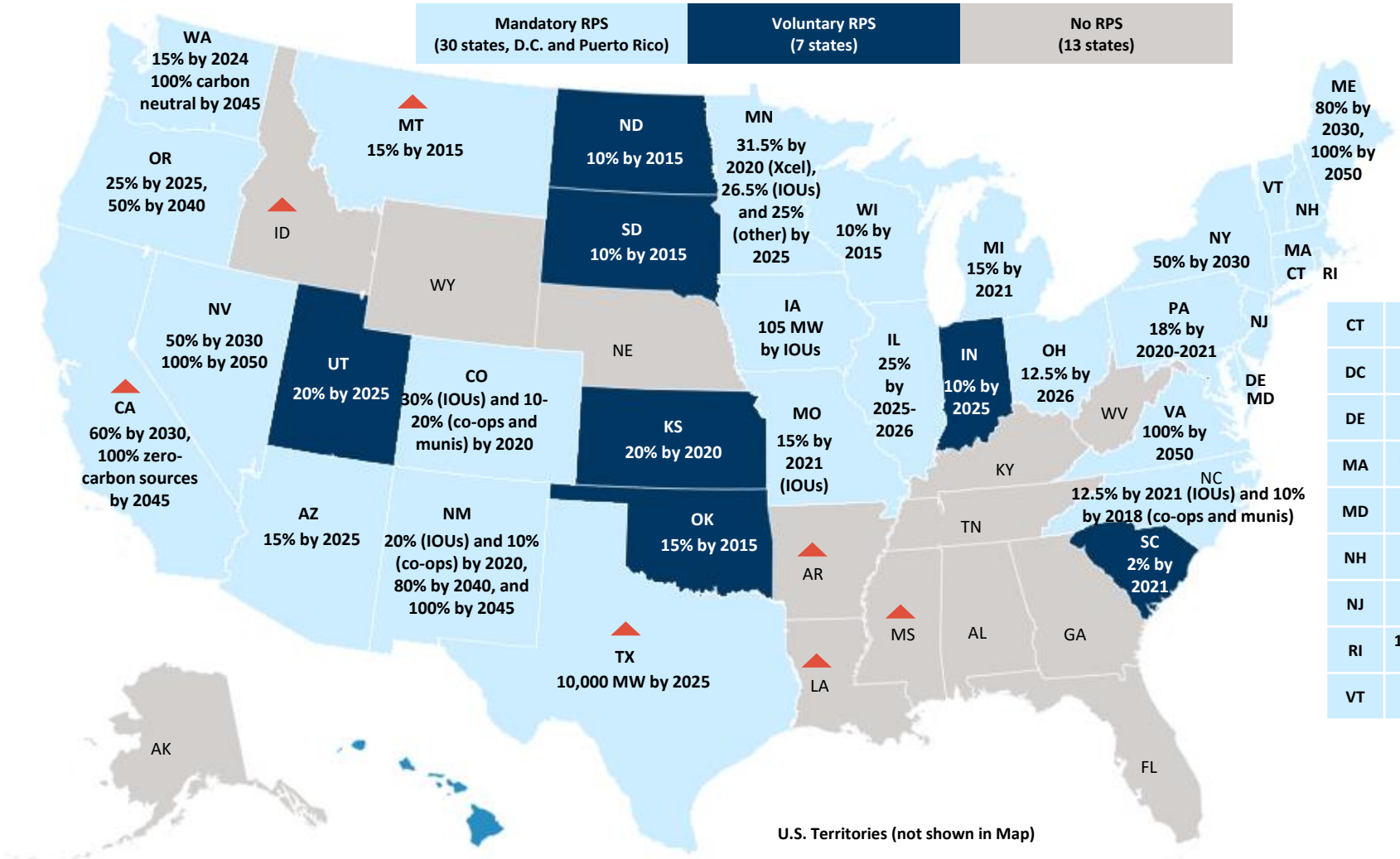
WHAT IS A CLEAN ENERGY STANDARD?

- A **Clean Energy Standard ("CES")** is a policy to **reduce greenhouse gas emissions** by requiring a certain share of electricity sales come from low- or zero-carbon sources
- **CES is "technology-neutral,"** meaning electricity produced by wind, solar, hydroelectric dams, nuclear power plants, and fossil power plants with carbon capture, storage, and utilization ("CCUS") could possibly qualify as "clean energy" under the CES
- RPS is **generally more restrictive** about the technologies that can qualify for it, such as only including wind and solar renewables and not nuclear or hydroelectricity

LEGISLATIVE HISTORY OF A FEDERAL CES

- Clean Energy Standard Act of 2010 (50% of electricity sales by 2050)
- Clean Energy Standard Act of 2012 (84% of electricity sales by 2035)
- **CLEAN Future Act (80% of electricity sales by 2030, 100% by 2035)**

(State) Renewable Portfolio Standards



CT	48% by 2030
DC	100% by 2032
DE	25% by 2025-2026
MA	35% by 2030 + 1% each year after
MD	50% by 2030
NH	25.2% by 2025
NJ	50% by 2030
RI	14.5% by 2019, 38.5% by 2035
VT	75% by 2032

U.S. Territories (not shown in Map)

Guam	25% by 2035
Northern Mariana Islands	20% by 2016
Puerto Rico	20% by 2016, 100% by 2050
Virgin Islands	20% by 2015, 25% by 2020, 30% by 2025

Methodology and Approach

CES

- 80% by 2030
- 100% by 2035

*A minimum proportion of national generation must come from either **wind, solar, nuclear, hydroelectricity, or fossil plants (mostly coal and natural gas) with CCUS.***

***Assumed a 90% capture rate** and 90% compliance for fossil fuel plants with CCUS.*

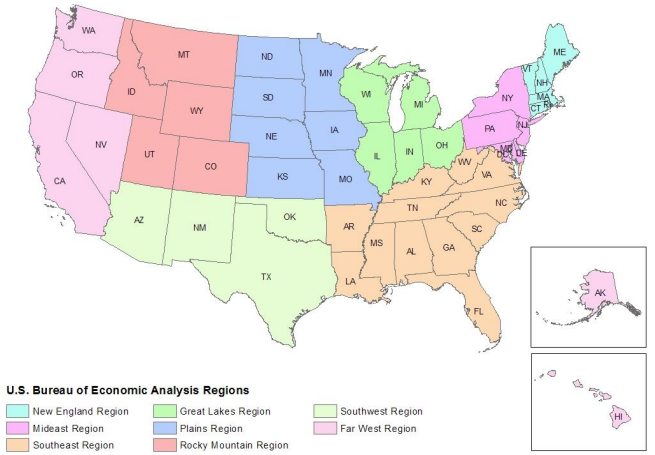
*Requirements for clean generation were the same as the CLEAN Future Act, though this analysis used $100 per MWh as an **alternative compliance payment ("ACP")** instead of the lower amounts in the proposed legislation.*

PLEXOS®

- Zonal capacity expansion and electricity dispatch modeling tool

REMI

- Dynamic economic impact modeling
- 8-regions (BEA)



PLEXOS® Capacity Expansion Model

PLEXOS® is a long-term market model that forecasts regional electricity and capacity prices, generation, new builds, and retirements under various fuel, load, and policy scenarios.

INPUTS

New and Existing Units / Retrofits
- Individual units modeled, not aggregates
- Capital costs
- Variable and fixed O&M
- Efficiencies
- De-rates and uprates
- Availability
- Intermittency generation limits
- Dual-fuel capability
- Regional and national capacity expansion limitations

Fuel
- Gas and fuel oil prices
- Biomass and nuclear prices

Demand
- Peak growth
- Energy growth
- Demand side management and efficiency options

Environmental Regulations
- Existing and future

PLEXOS® MODEL

The PLEXOS® model is an integrated model that optimizes economic generation dispatch, unit commitment, and optimal power flow over a single interval as short as one-minute to daily, weekly, annual and multi-annual periods. In addition, it is run typically in stochastic (probabilistic) fashion. PLEXOS® also offers ancillary services analysis, hydroelectric capacity modeling, and natural gas infrastructure modeling.

Generation

Transmission

Expansion Planning

Hydro Modeling

Ancillary Services

Emissions

Gas Model

Financial

OUTPUTS

Regional Capacity Changes
- New builds by type
- Retirements
- Retrofits

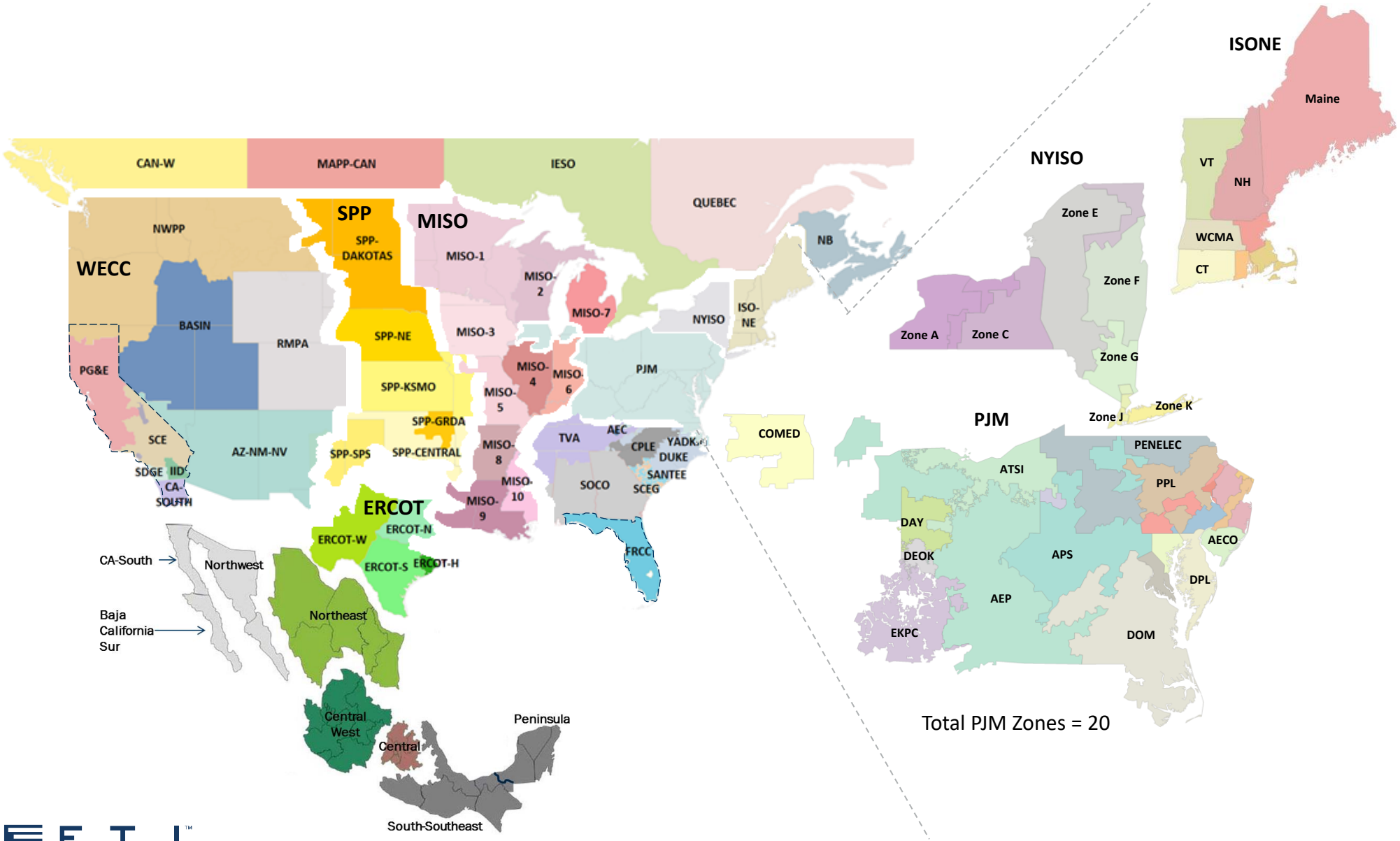
Generator Performance by Unit
- Generation
- Energy and capacity revenue
- Fuel consumption
- Capacity factors
- Emissions
- Cash flows

Market Prices by Region and Node
- Energy and capacity
- Coal prices
- Renewable energy credits
- NOx, SO_2, and CO_2 allowances

Fuel Demand
- Gas, fuel oil, and coal

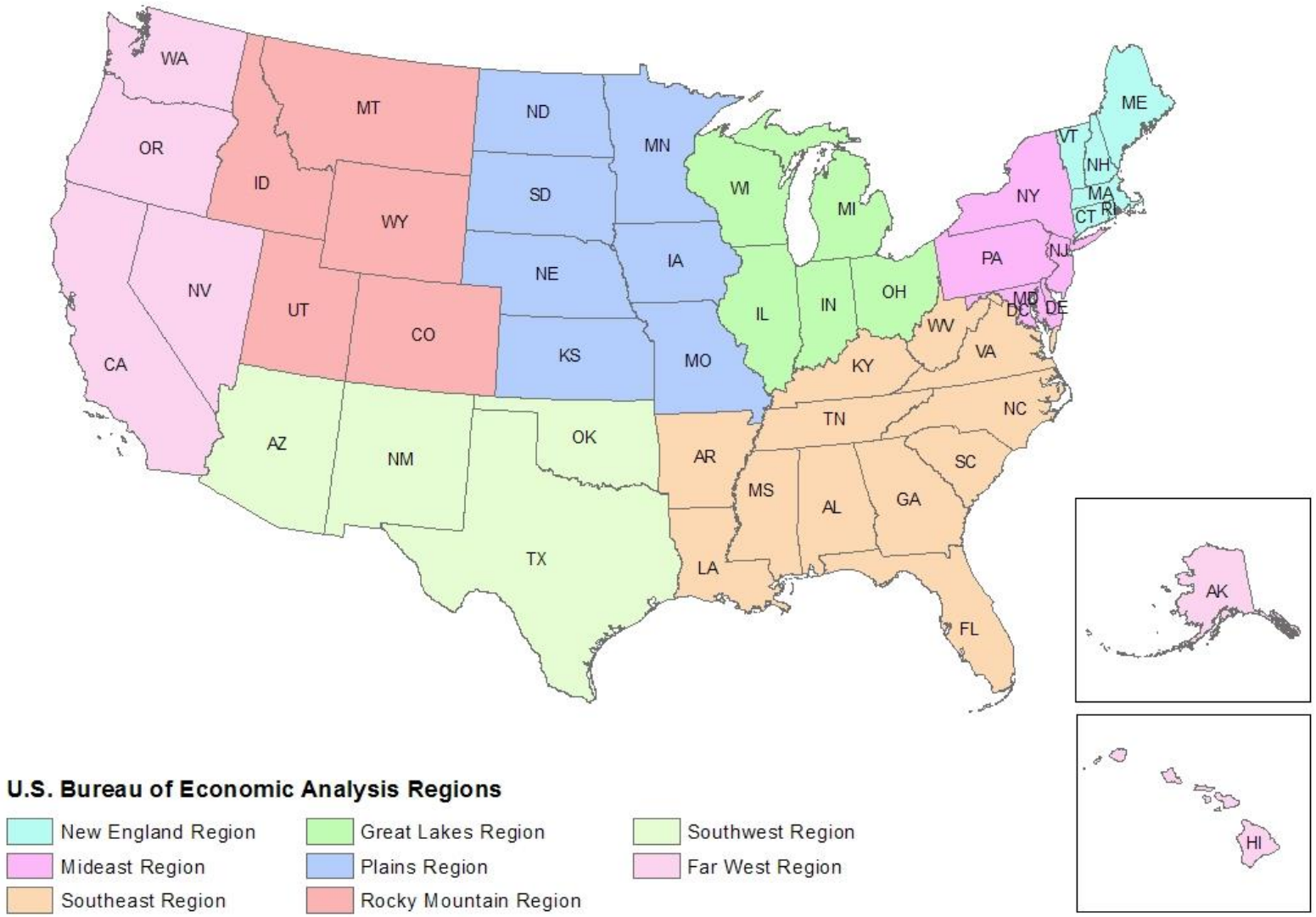
Infrastructure
- Transmission flows
- Coal transport flows

PLEXOS® Model Zonal Map



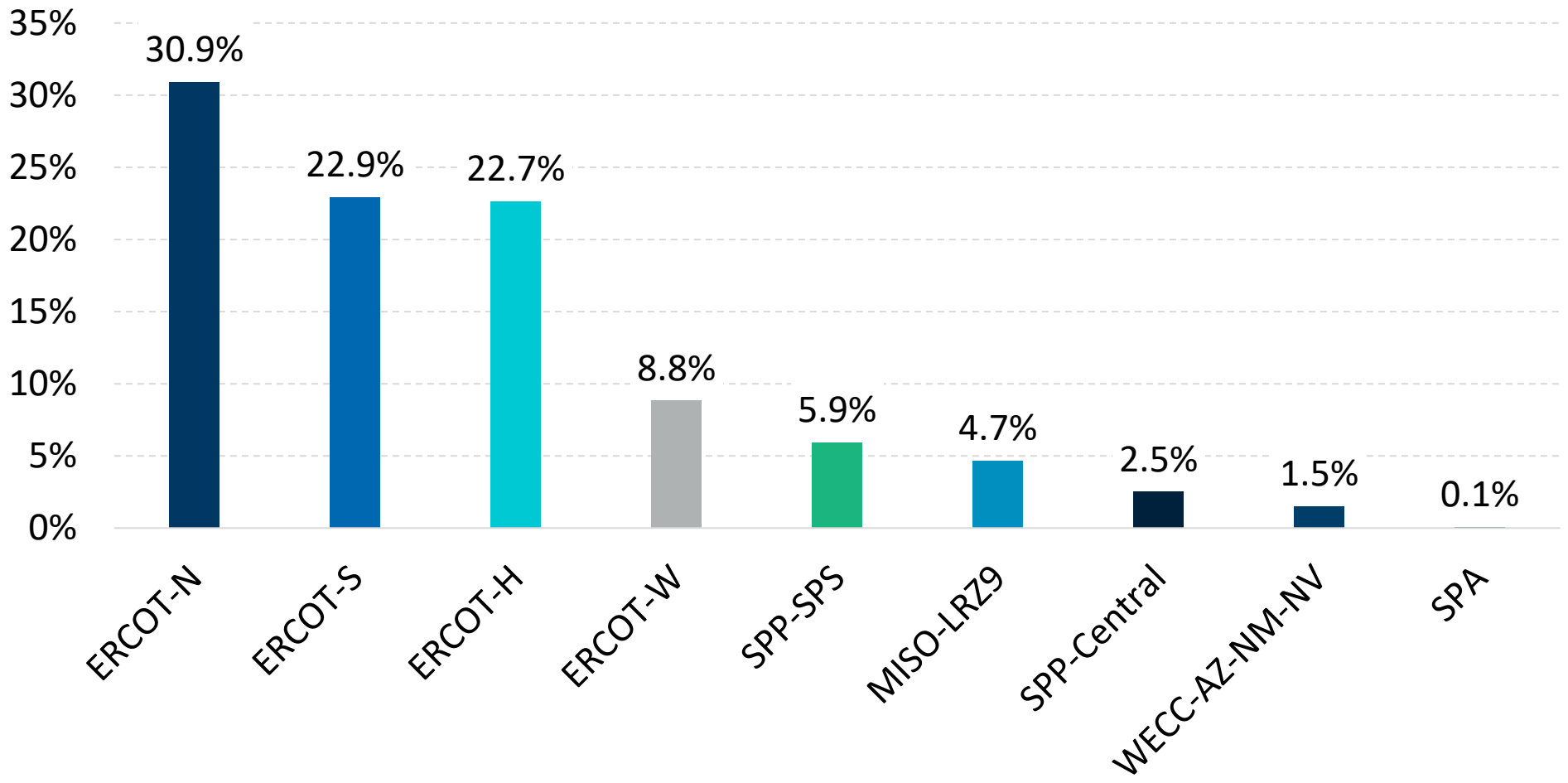
Total PJM Zones = 20

BEA Regions Map



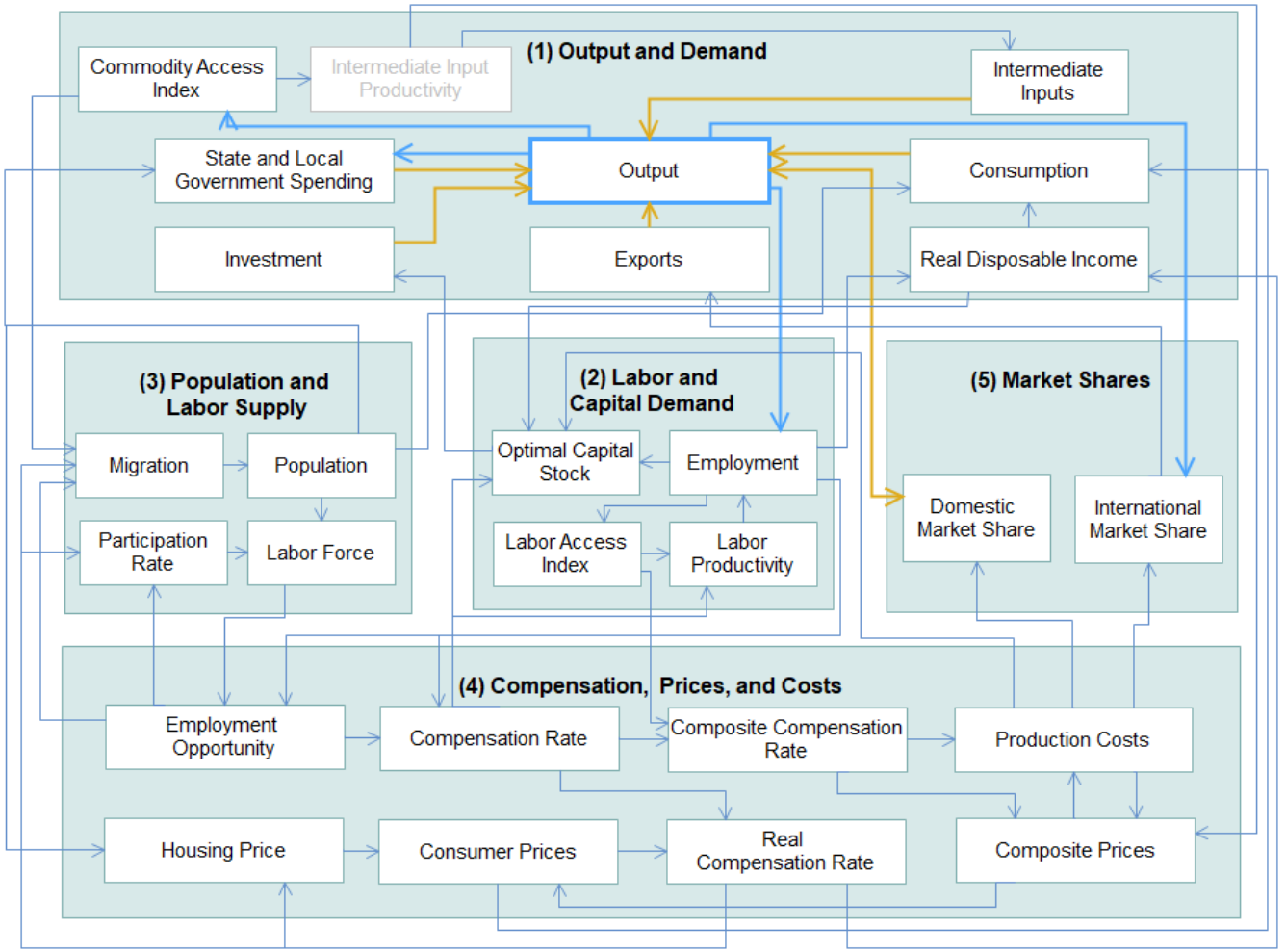
Allocation of PLEXOS Zones to States (in Texas)

Texas is the second-largest state by employment, GDP, and population, and it has one of the largest electricity markets in North America. It is spread across ERCOT, SPP, MISO, and WECC.

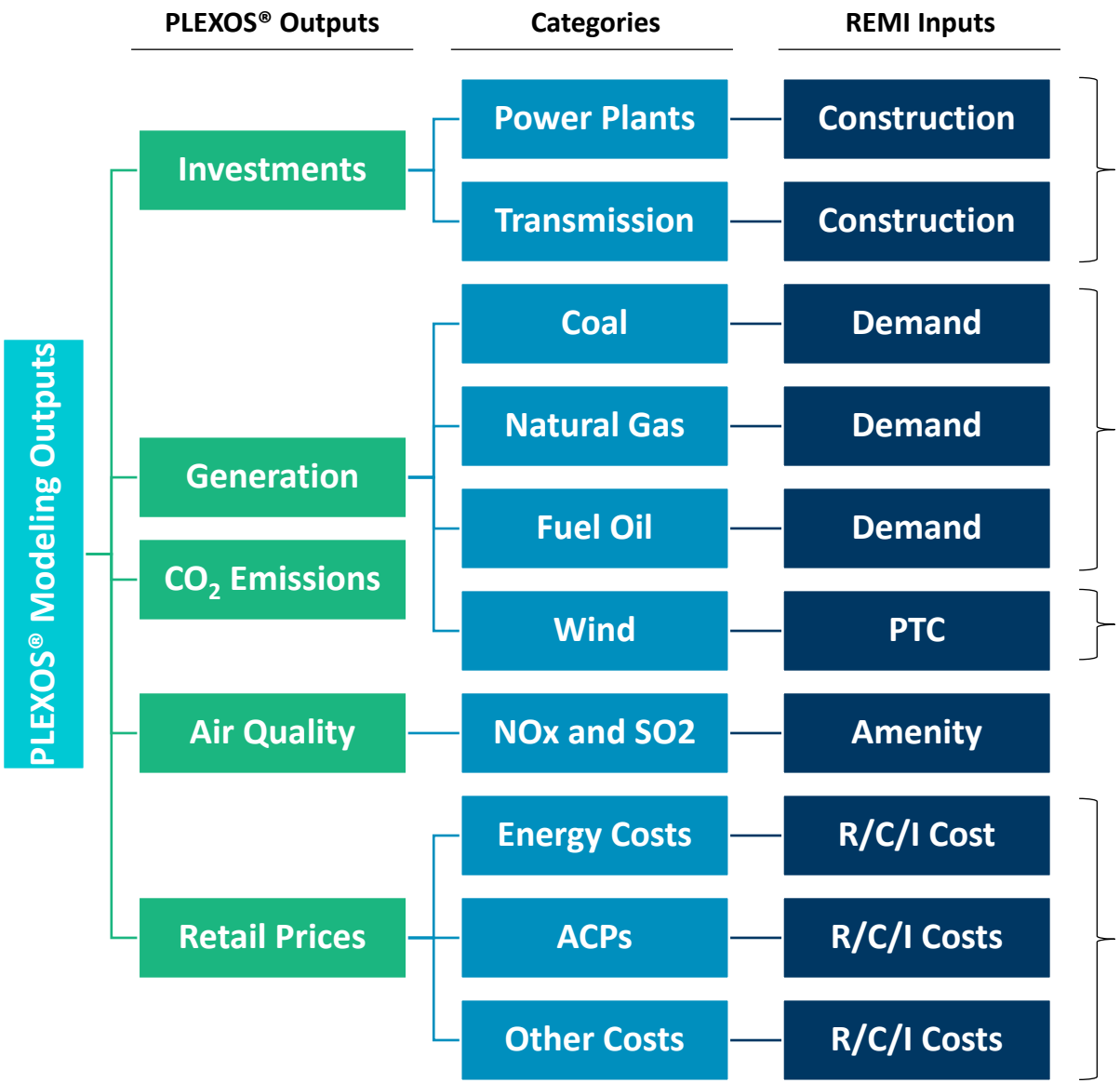


REMI Model Structure

REMI is a dynamic, computable general equilibrium ("CGE") model of regional economies. The outputs of the PLEXOS® modeling became input variables for the REMI model simulations.



Integrating PLEXOS® Outputs into REM



Economic benefits for regions with additional renewable investments, such as wind-heavy midwestern or solar-heavy southwestern states

CES would change generation by technology type, influencing demand for fossil fuel extraction activities

The federal government pays roughly $18 per MWh for wind generation, which would likely increase under a CES and increase these costs

The increase in low- and zero-cost dispatch technology (e.g., wind and solar) would reduce energy costs, though ACPs and other costs would offset this (or more) in some regions of the country in most years

Results

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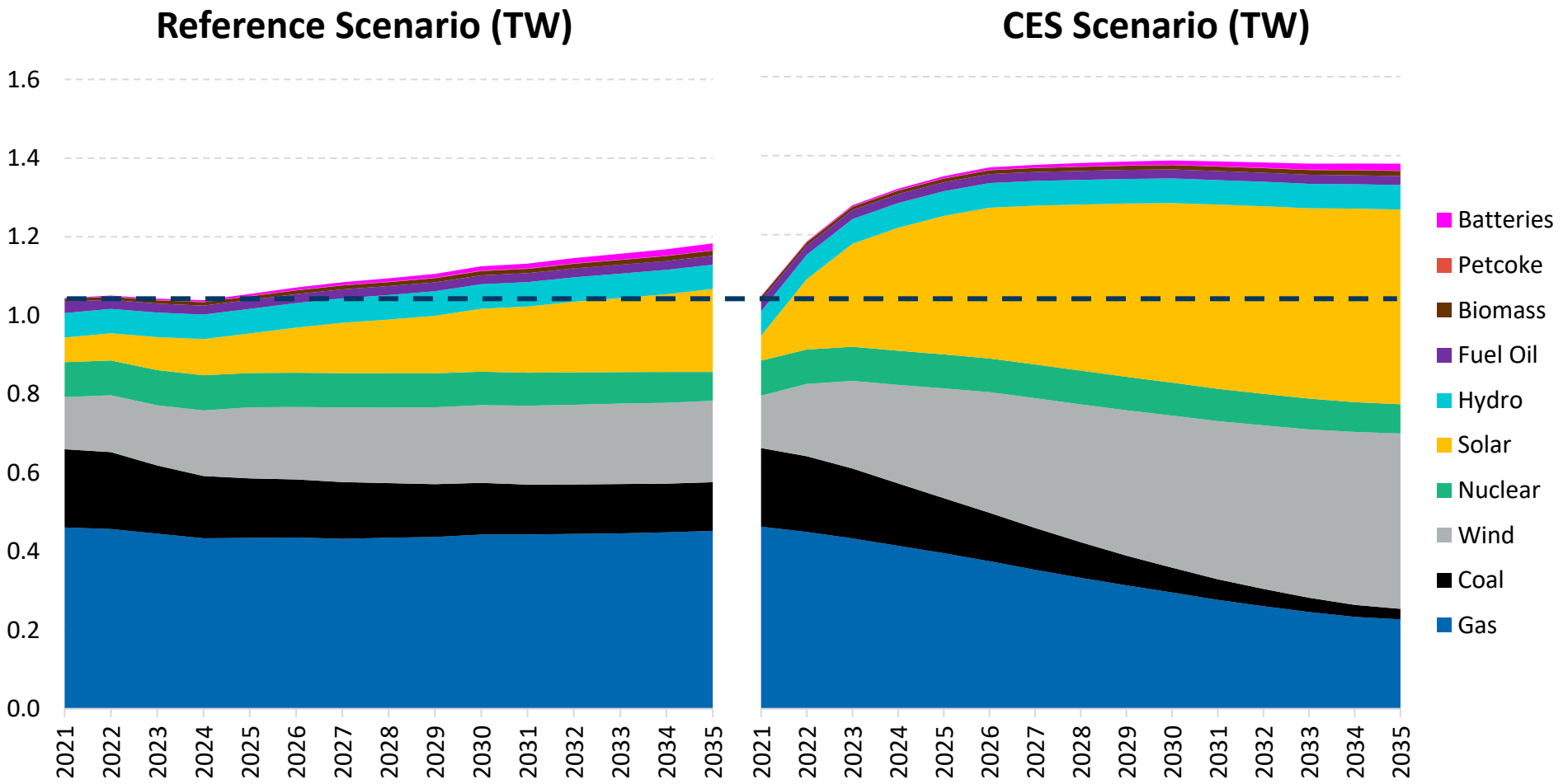
Power Market Modeling Sensitivities

The outcome of modeling the electric power sector is subject to change given numerous uncertainties. The figure below lists out some of the key inputs and assumptions in modeling.

- ACP Costs, Graduations, and Reinvestment
- National and Regional Build Limits
- Carbon Pricing and Climate Policy
- Load Growth and Electrification Assumptions
- Fuel Costs (coal, natural gas, and petroleum)
- Builds' Costs and Performance Characteristics
- Federal and State Subsidies and Regulation
- National or Regional CES Framework

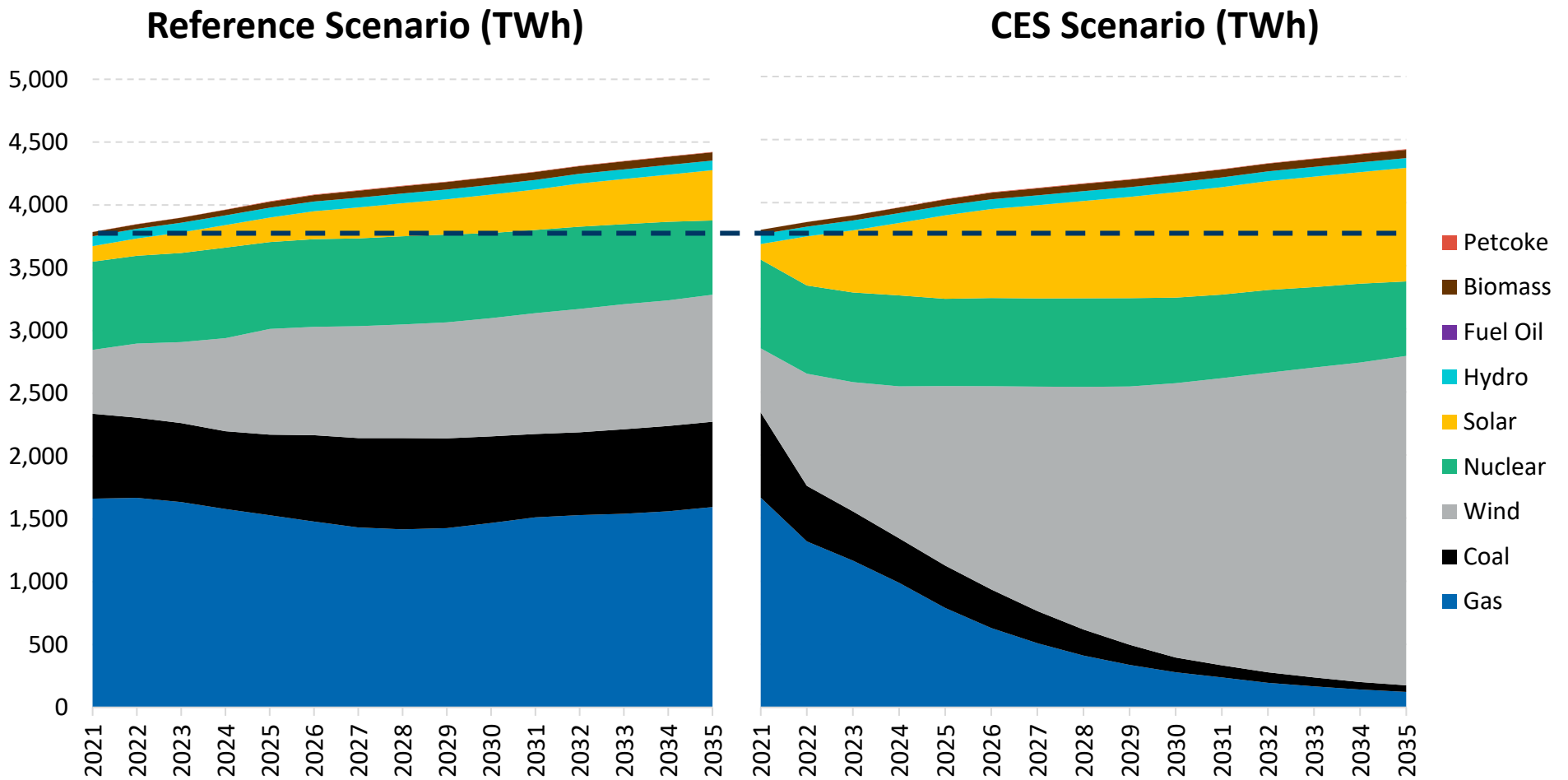
U.S. Power Generation Capacity

Under the CES Scenario, coal and natural gas capacity would decrease by nearly 60% relative to the Reference Scenario, while wind and solar capacity would more than double.



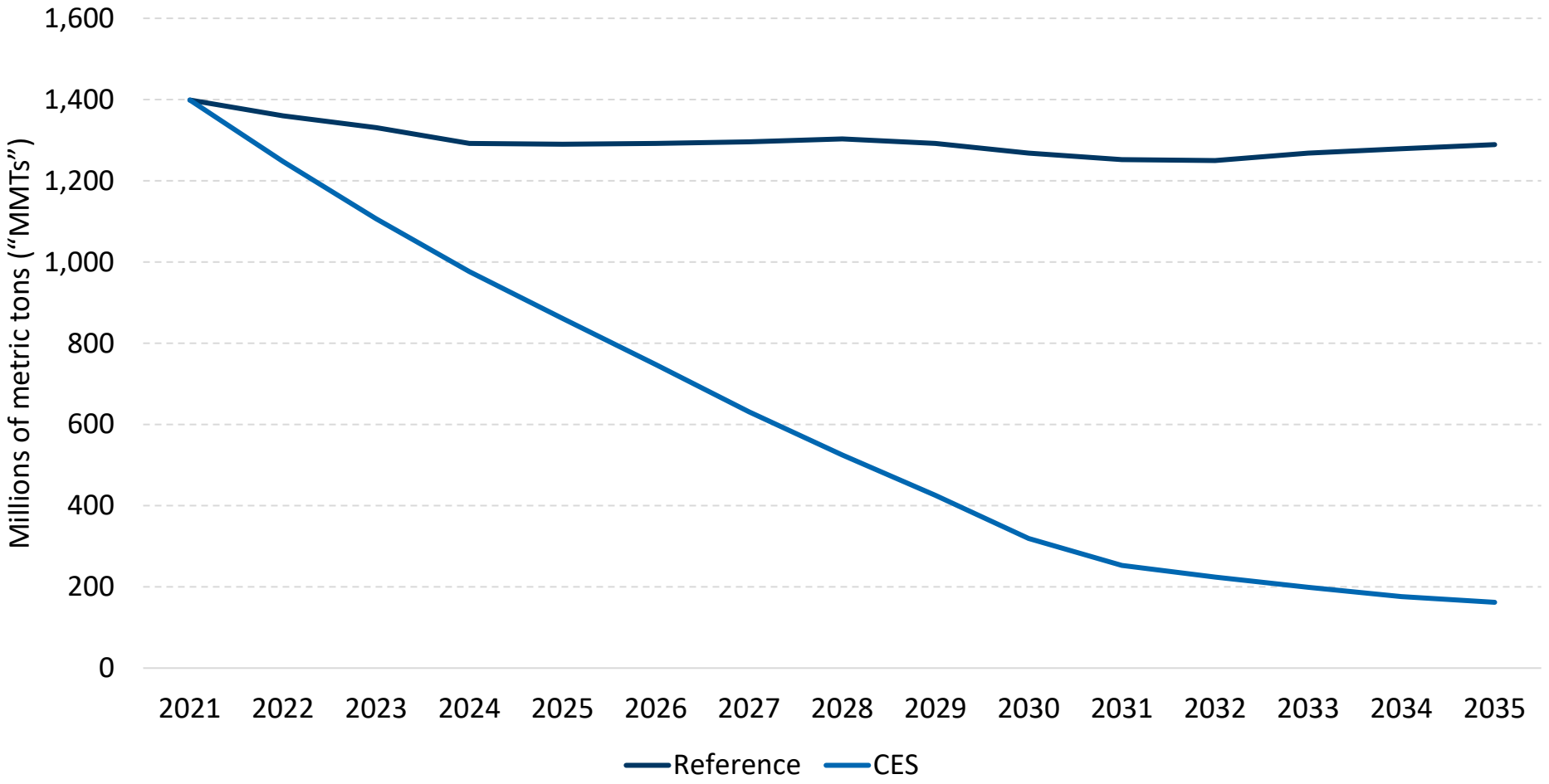
U.S. Power Sector Generation

Generation by technology type would change in the CES Scenario, such as wind and solar generation potentially increasing to provide nearly 80% of U.S. power generation by 2035.



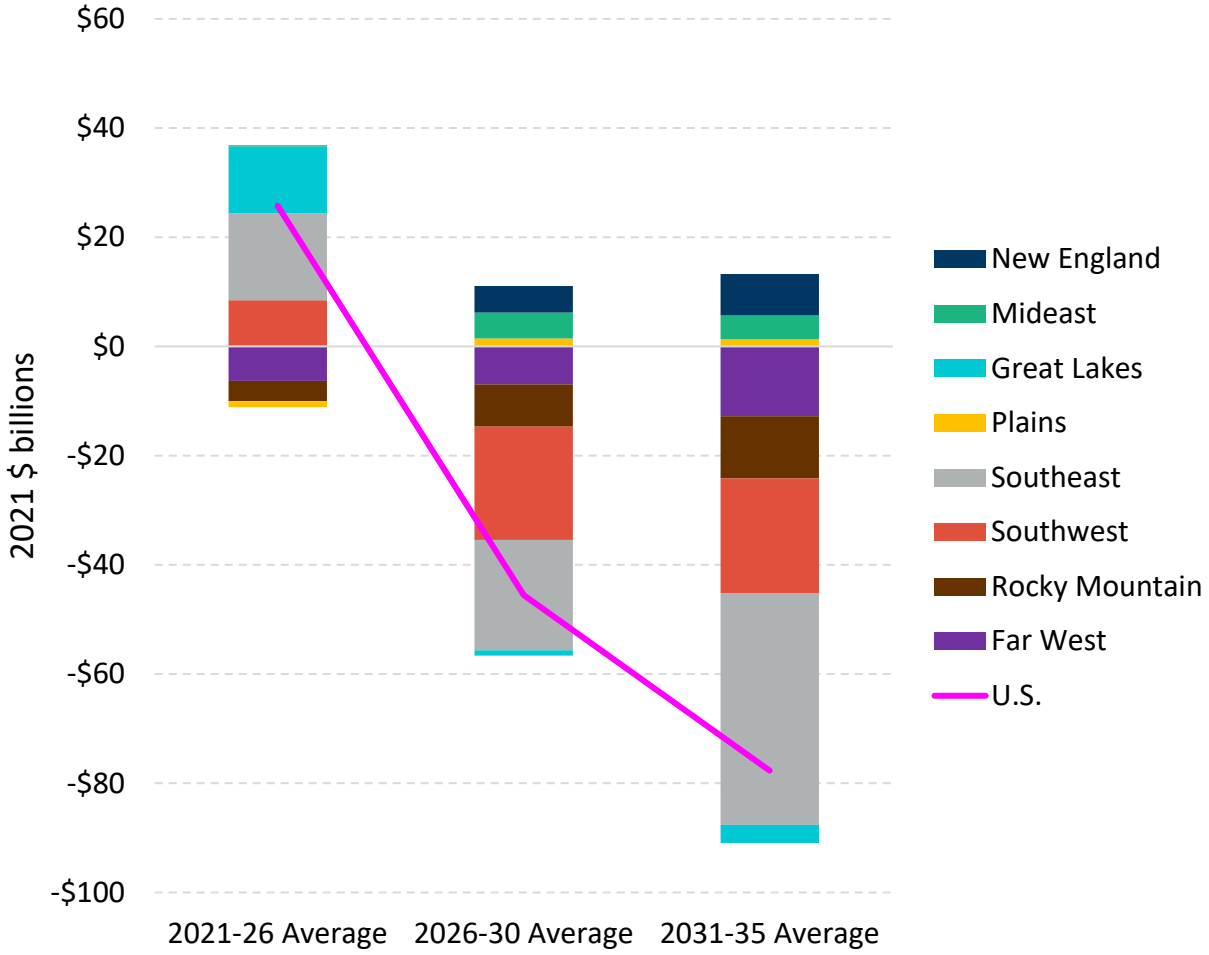
U.S. Power Sector CO_2 Emissions

CO_2 emissions in the CES scenario decrease to 13% of emissions in the reference case by 2035. Emissions do not reach zero because some utilities would choose to make ACP instead.



U.S. and Regional GDP Impacts

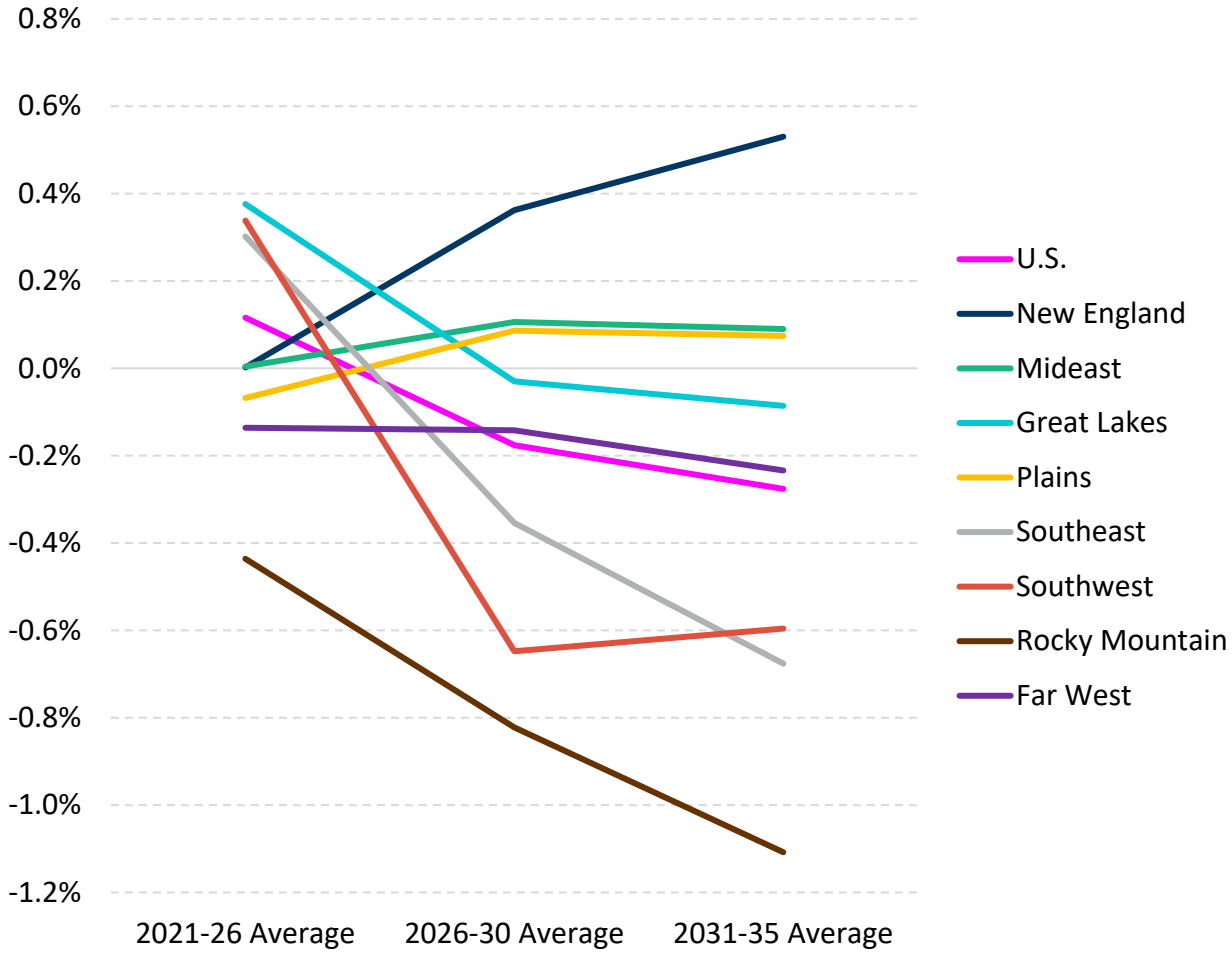
The figure below shows U.S. and regional GDP impacts from the CES. In the short term, renewable builds would dominate the results, while electricity prices are more important in the long term.



- **In the short term**, the regions for the Great Lakes, Southeast, and Southwest would have **large renewable builds**, though fewer builds in the long term
- **In the later years**, renewable builds are stronger in Plains and along the East Coast while the Southeast, Southwest, and the Rocky Mountains **optimize to pay more of the ACPs**
- **Regions with "cleaner" power systems** in New England, the Midwest, and Plains have less of an impact on electricity prices **compared to other regions**

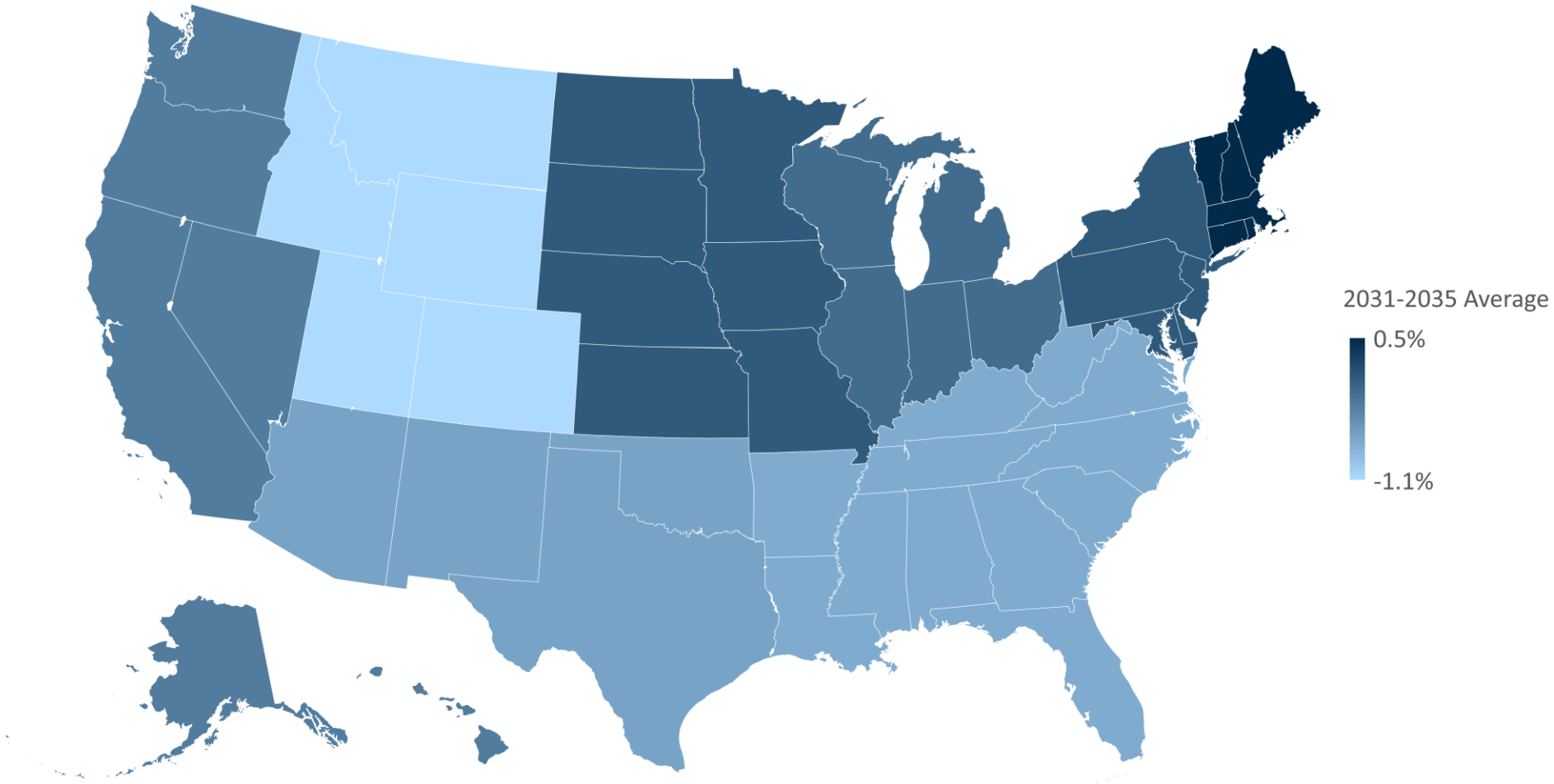
Regional GDP Impact (%)

The previous results showed the absolute impacts on GDP, and these results show the proportional impact to gauge the different regions' sensitivity to this hypothetical CES against one another.



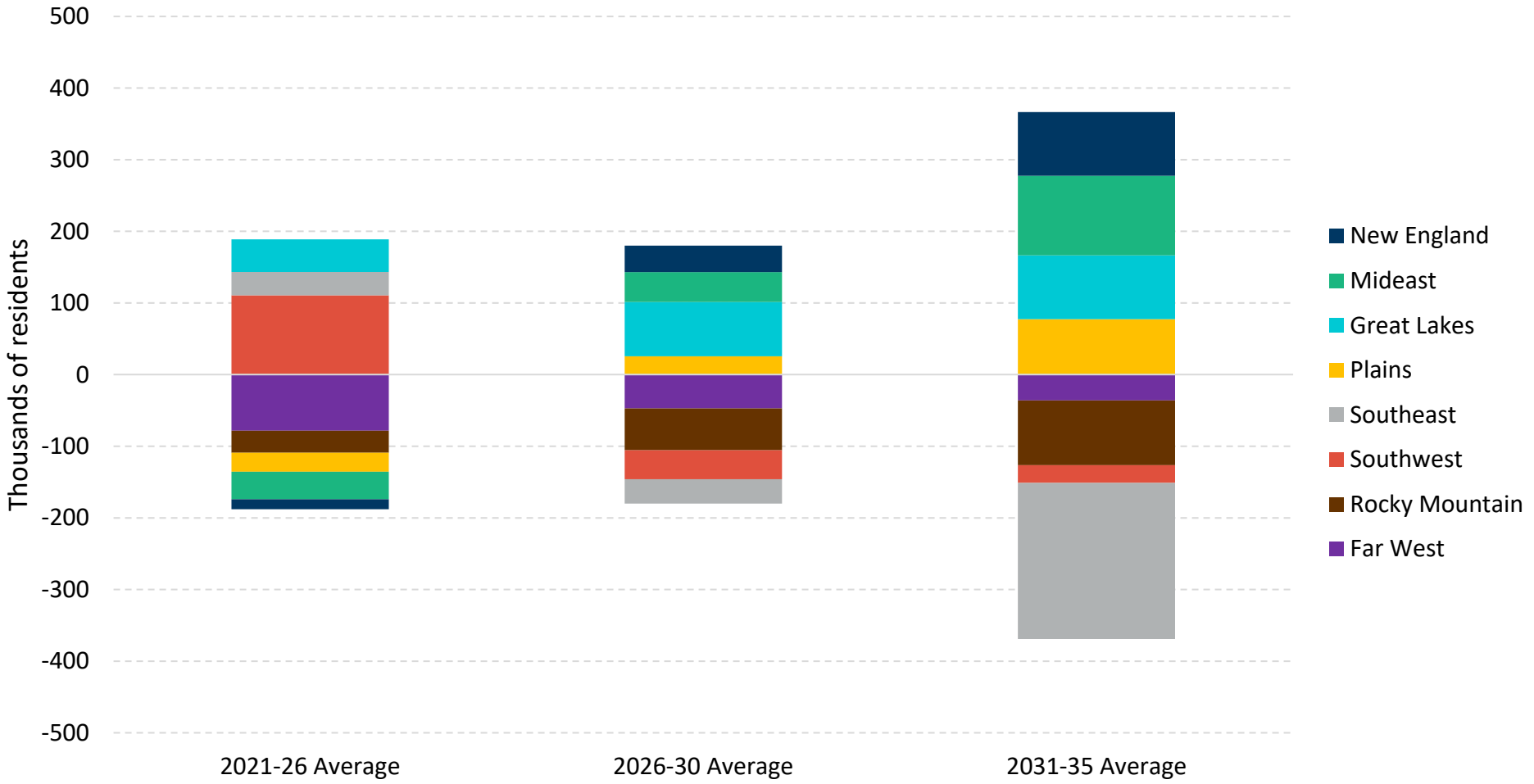
- The impacts in the short term have a different pattern in the long term because of **the large role capacity and transmission investments play in the first five years** compared to the impacts in the **last ten years, which are more about electricity prices for different customers**
- New England, Mideast, and Plains would have the most positive impacts because of their relatively "clean" power systems (e.g., RGGI in the Northeast and wind power in MISO and SPP) **even before the impact of the CES policy**

Regional GDP Impact (%)



Regional Demographic Impact

Through domestic migration, population in the REMI model moves between regions based on employment opportunities, regional cost-of-living, and noneconomic attractiveness (e.g., air quality).



Q&A

FTI CONSULTING™

Scott Nystrom

Senior Director

FTI Consulting

(515) 290-6990

Scott.Nystrom@FTIConsulting.com

Experts with Impact™

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