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How Bad is Second Best? An Initial Comparison of Trading Approaches to Achieve Carbon Mitigation

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on GHG Emission Trading**

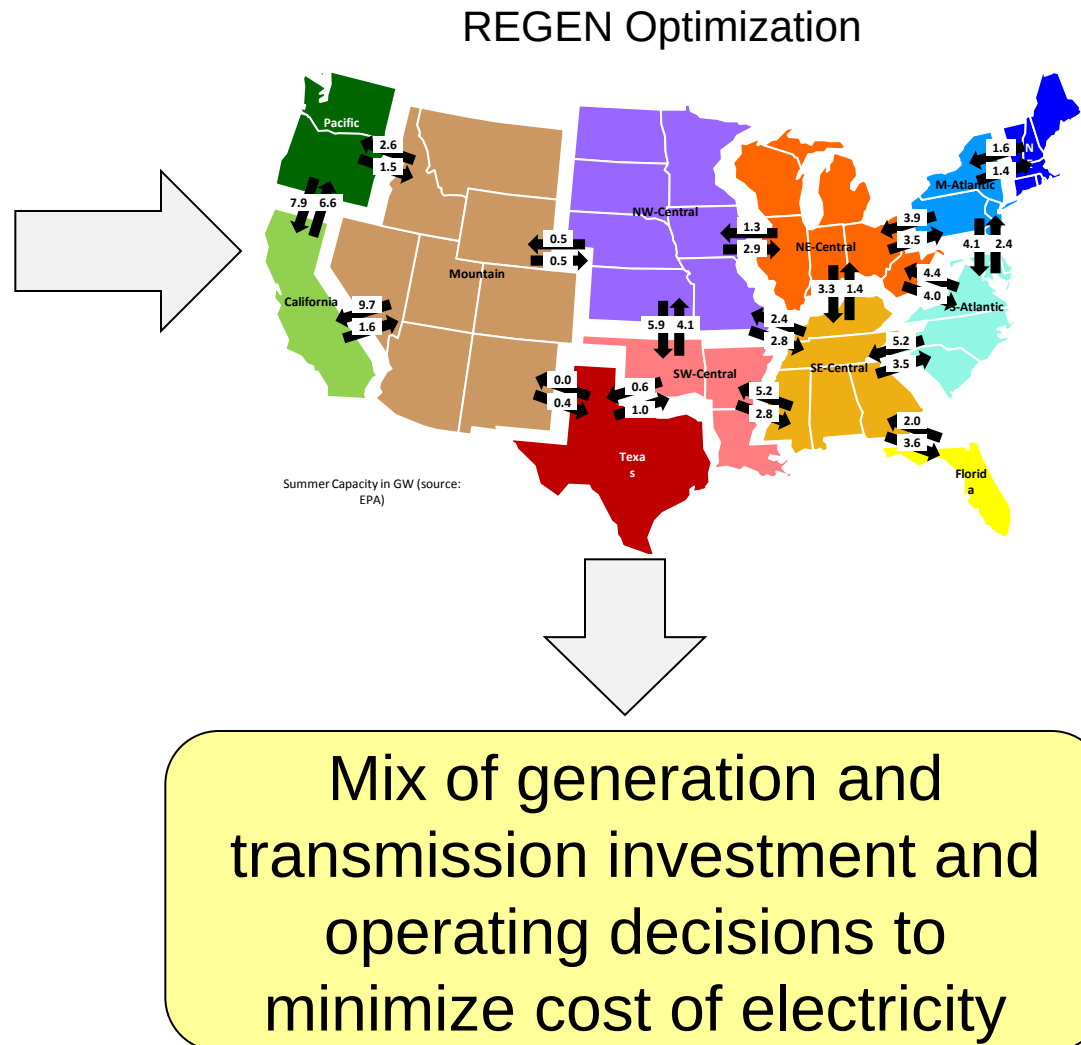
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Market vs. Non-Market Approaches: How Cost Effective is a CES in Cutting CO2?

- Despite current political/cultural impasse key long-term issue for U.S. power sector is climate policy
- Many expect policy of decarbonized electricity by 2050
- How and at what cost?
- EPRI investigating implications of alternative policy approaches
- Analysis comparing policies forcing renewables (RES), or clean energy (CES) which includes nuclear and CCS, or market-based CO2 caps/taxes
- All policies have market elements, but can differ greatly in cost effectiveness

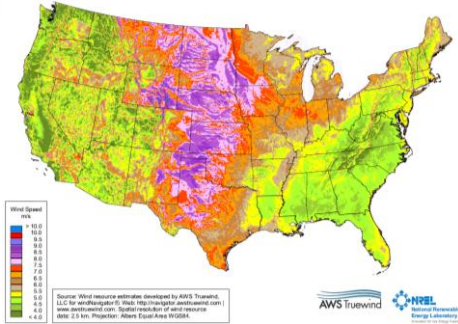
EPRI REGEN Model Used to Compare Alternative CO2 Mitigation Policies

- Simultaneous regional 8760 hourly loads and wind/solar/bioenergy potential
- Existing mix of generation and transmission capability
- New generation costs
- Future year fuel costs
- Policy options

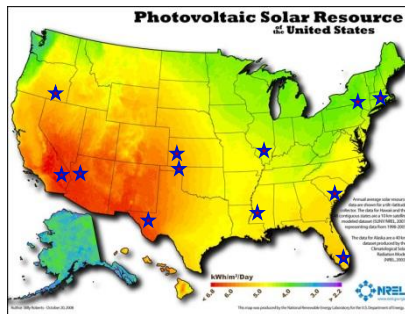


EPRI's REGEN Model Designed to Appreciate Nuances of Carbon and Clean Energy Policy

Wind



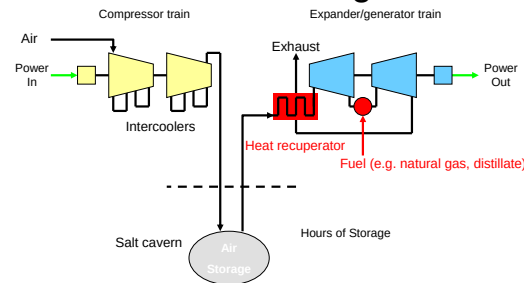
Solar



Bioenergy



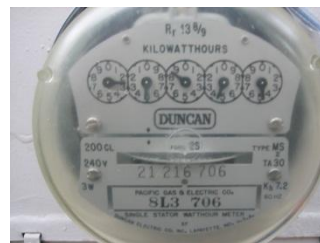
CAES Storage



New Interregional Transmission



8,760 Hourly Loads



Hydro



Nuclear



Gas CTs & CCs



Coal

Analysis Overview and Caveats

- Static analysis captures electric system in approximation of long-run equilibrium for a hypothetical “future” year
- Shows minimum-cost mix of generation and transmission investment and operating decisions needed to meet load
- Powerful approach for
 - Assessing fundamental economic trade-offs in meeting policy objectives
 - Identifying competitive potential and market niches of different energy technologies
 - Understanding the implications of key uncertainties
- Important to recognize that this static approach is not intended to be a policy analysis

Analysis Compares Three Policy Mechanisms

- CO2 tax puts direct price on CO2
 - Many similarities to cap-and-trade with 100% auction
- Clean energy standard (CES) requires sum of weighed “emission-focused” MWh generation to meet goal
- Renewable energy standard (RES) requires sum of wind, solar, and bioenergy to meet goal (equal weights)

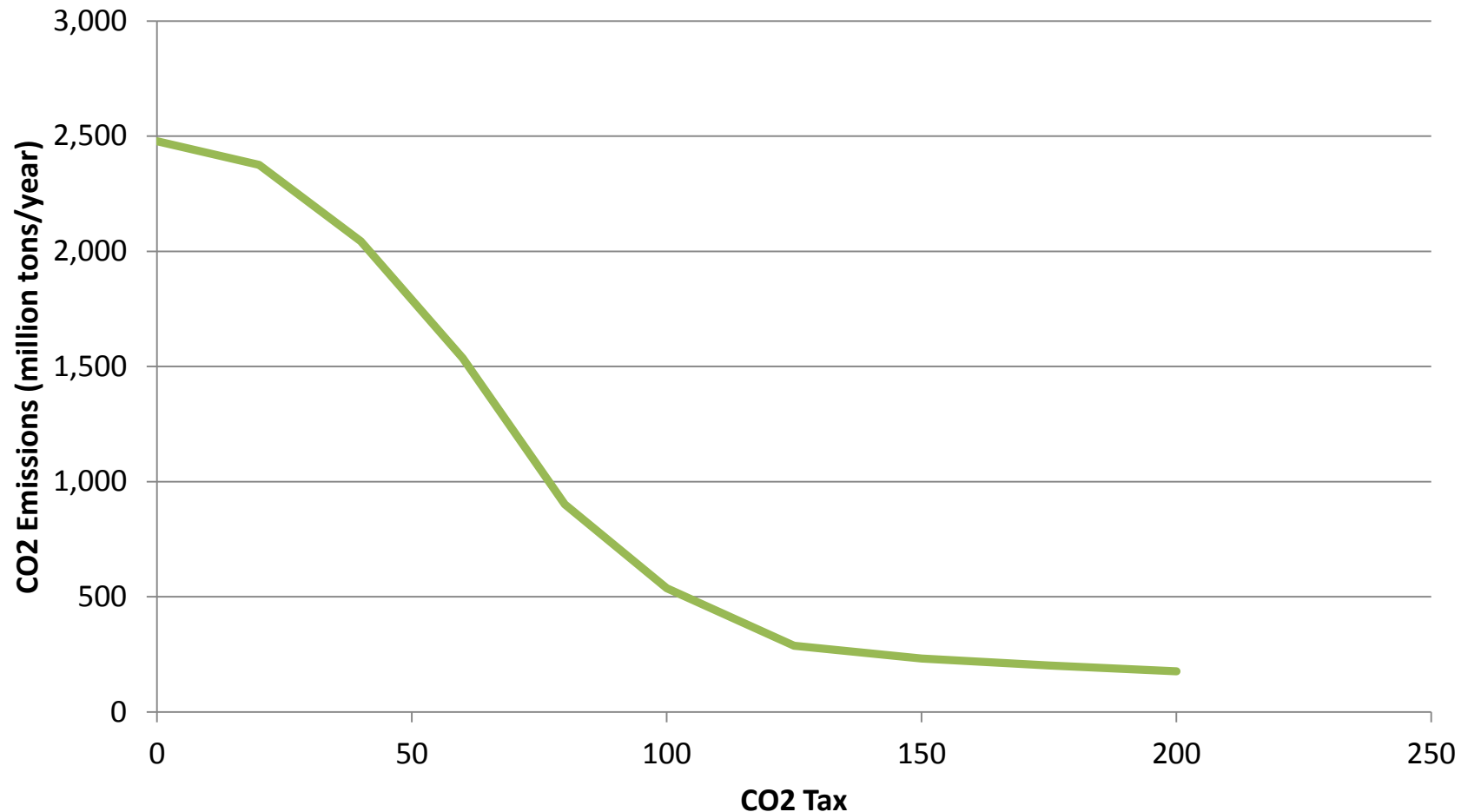
Example: CES goal of 50%

$$\begin{aligned} &1.0 \times (\text{wind} + \text{solar} + \text{bioenergy} + \text{nuclear} + \text{hydro}) \\ &+ 0.9 \times (\text{coal CCS}) \\ &+ 0.95 \times (\text{gas CCS}) \\ &+ 0.5 \times (\text{gas}) \\ &\geq 50\% \times (\text{total load}) \end{aligned}$$

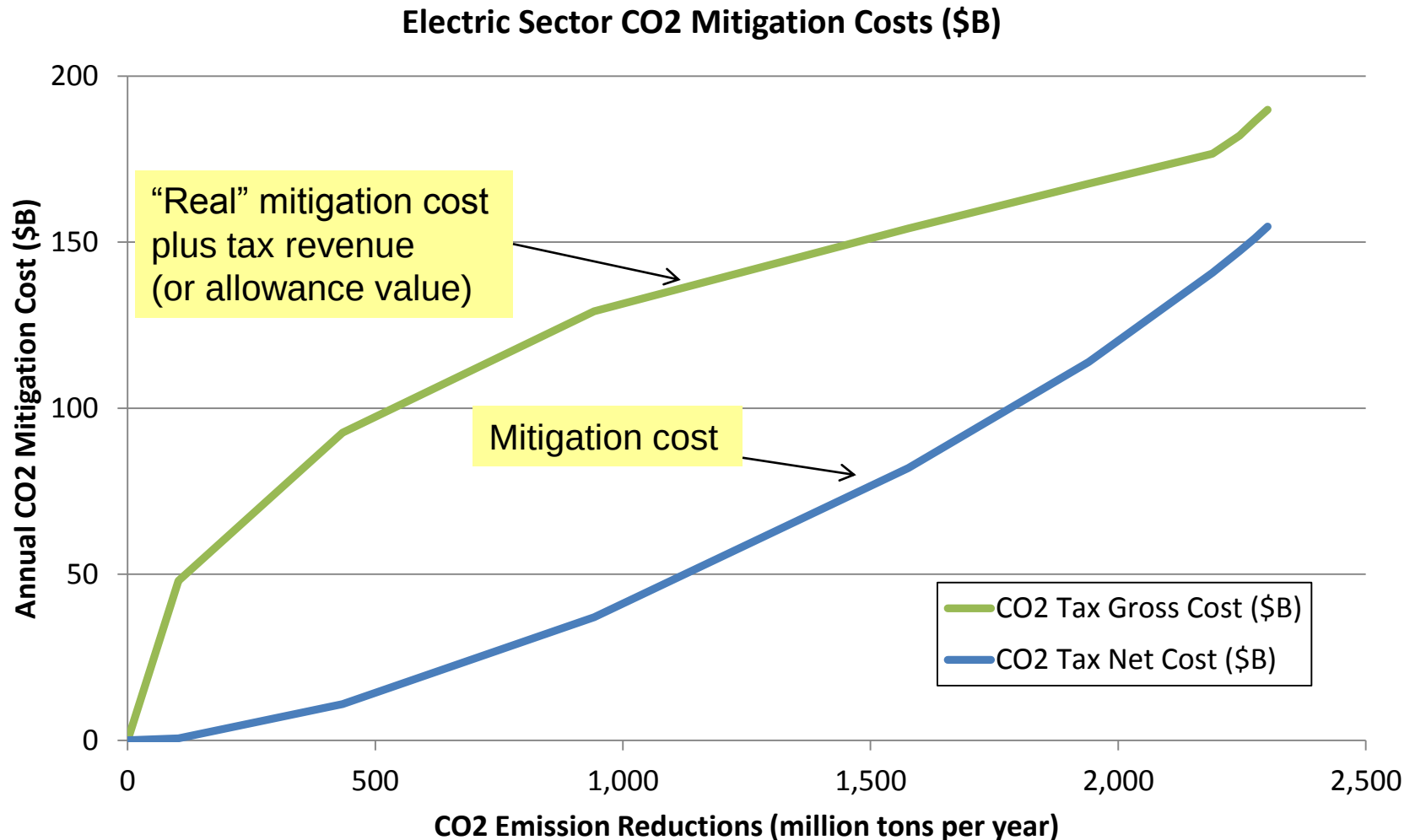
- Units in MWh
- Applies to new and existing capacity
- FYI, current CES mix approximately 40% of total load

CO2 Emissions Drop Dramatically as Price on CO2 Increases

Emissions by CO2 Tax Level

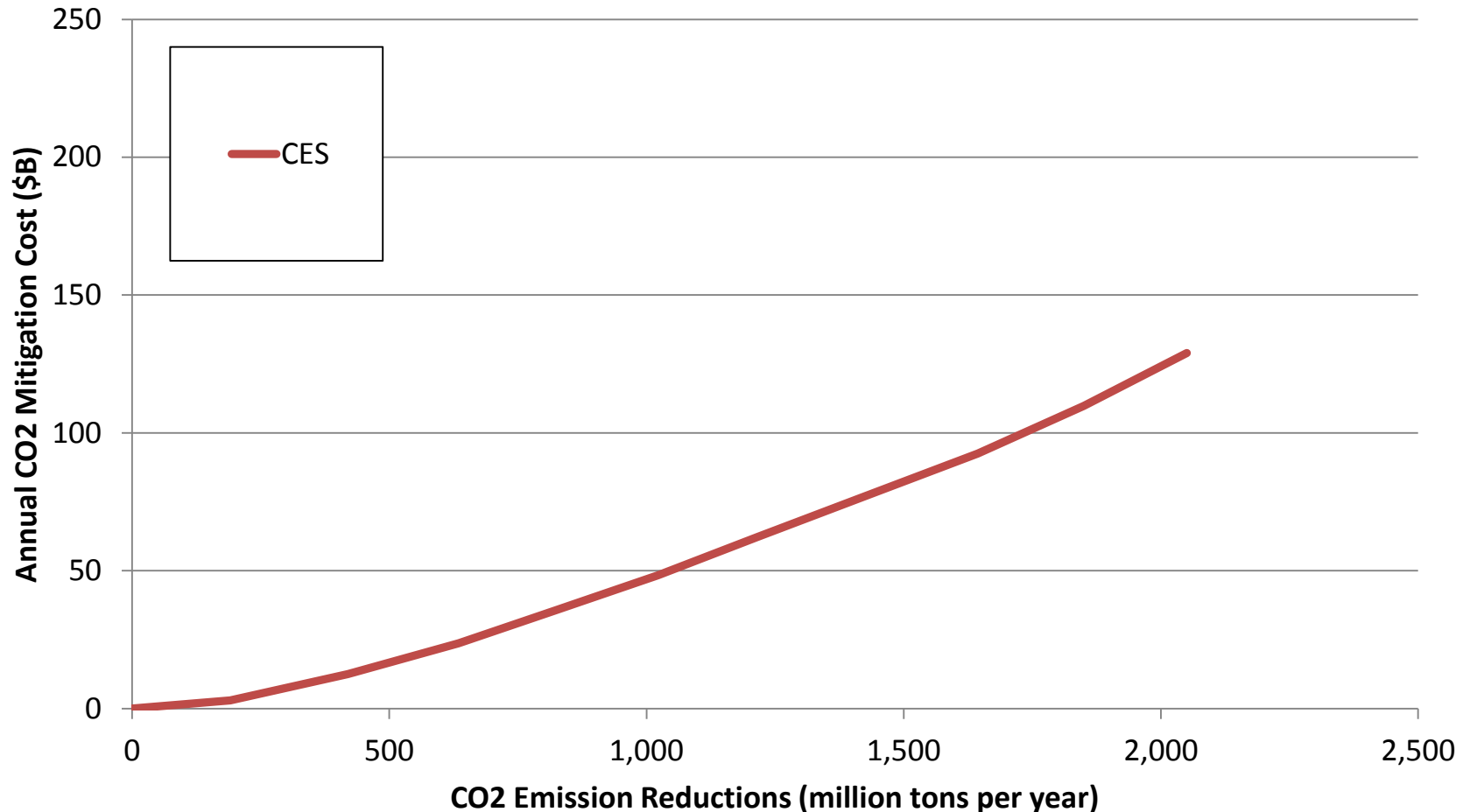


Cost of CO2 Mitigation with CO2 Tax

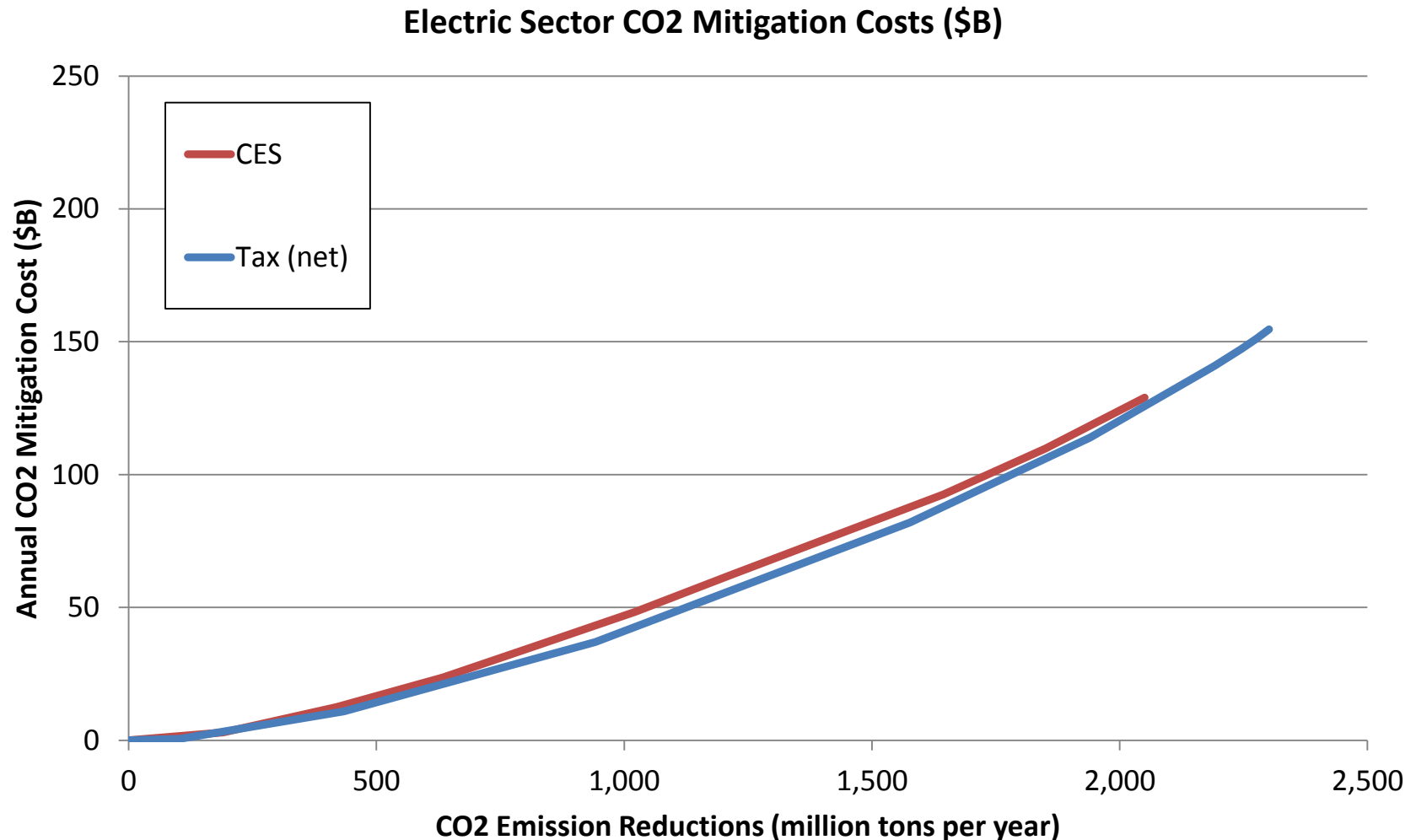


Cost of CO2 Mitigation with Emission-focused RES Policy

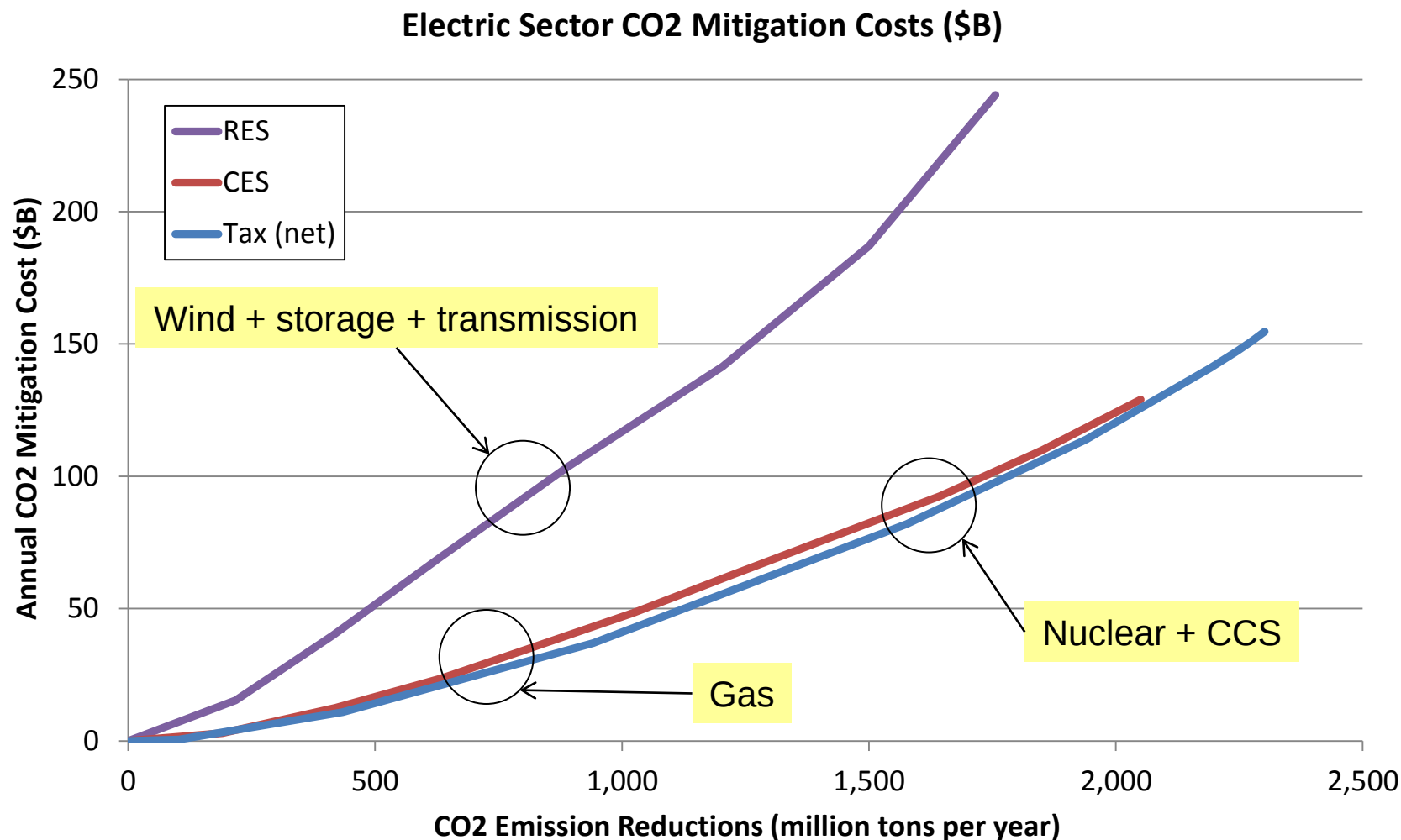
Electric Sector CO2 Mitigation Costs (\$B)



Cost Effectiveness of CES Nearly Matches that of CO2 Tax (or cap-and-trade)



RES Approach Comes in a Distant 3rd



Observations on 2nd Best

- Pure CO2 market provides lowest cost CO2 mitigation
- Emission-focused CES may be a very close alternative
- RES is a distant 3rd in CO2 mitigation cost-effectiveness
- Advantage of Tax and CES depends on option to deploy nuclear, CCS, and natural gas
- Tax and CES economics depend on nuclear and CCS
- RES economics depend on wind and large-scale deployment of new interregional transmission
- Nobody's perfect

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