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Managing Carbon without Cap-and-Trade

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Cap-and-trade vs. CES and RES: How Cost-effective 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

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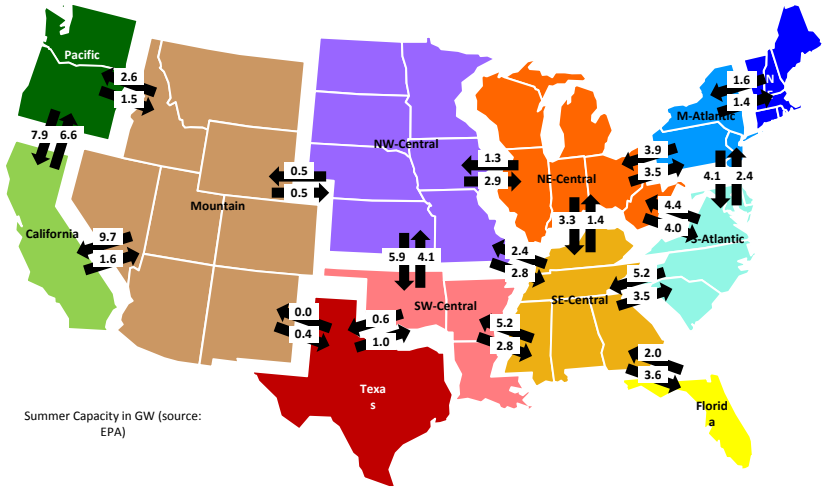
Analysis Based on REGEN, a New and Advanced Model of U.S. Electric Sector

- 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

REGEN Optimization



Mix of generation and transmission investment and operating decisions to minimize cost of electricity

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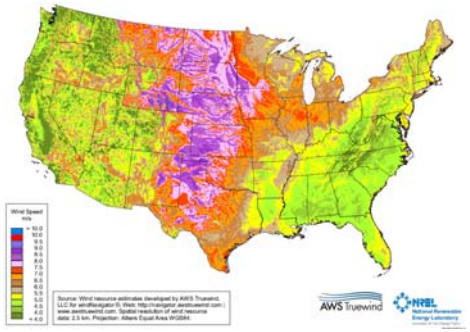
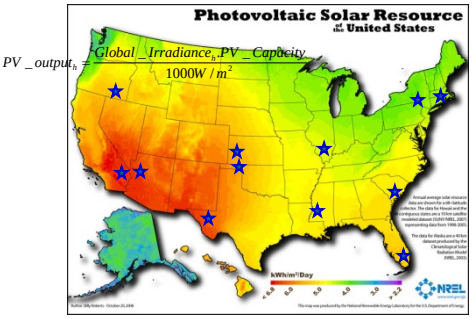
EPRI's REGEN Model Designed to Appreciate Nuances of Carbon and Clean Energy Policy

Wind

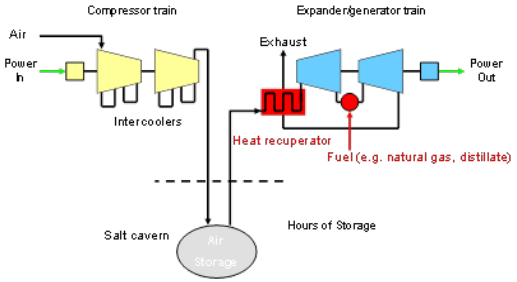


Solar



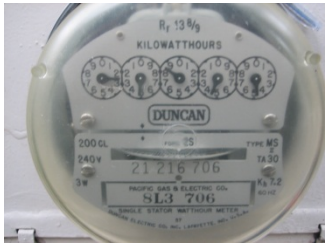
Bioenergy

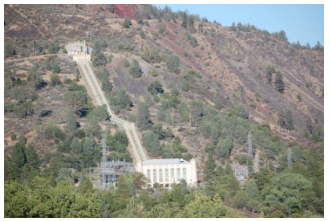
CAES Storage



New Interregional Transmission

8,760 Hourly Loads





Hydro

Nuclear

Gas CTs & CCs

Coal

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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

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Numerical Assumptions in Future Year

- 19% load growth since 2007 (4,646 TWh retail)
- $6.27/MMBtu natural gas price (AEO 2011)
- $2.35/MMBtu coal price (AEO 2011)
- 2,477 mmt (million metric tons) CO_2 emissions in reference case
- Zero price elasticity (demand impacts modeled directly through energy efficiency scenarios to isolate effect)

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Goal is to Compare Three Policy Mechanisms

- CO_2 cap-and-trade approach directly caps emissions
- Clean energy standard (CES) requires weighted sum of clean generation to meet goal, with weights based on emissions/MWh reduced if used to back out coal
- Renewable energy standard (RES) requires sum of wind, solar, and bioenergy generation to meet goal (equal weights)

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Example: 50% Clean Energy Standard Goal

1.0 x (wind + solar + bioenergy + nuclear + hydro)

+ 0.9 x (coal CCS – 90% capture)

+ 0.9 x (gas CCS – 80% capture)

+ 0.5 x (gas)

≥ 50% x (total load)

- Units in MWh
- Applies to new and existing capacity
- FYI, reference year CES mix approximately 40% of load
- Binding CES goal creates CECs (clean energy credits)

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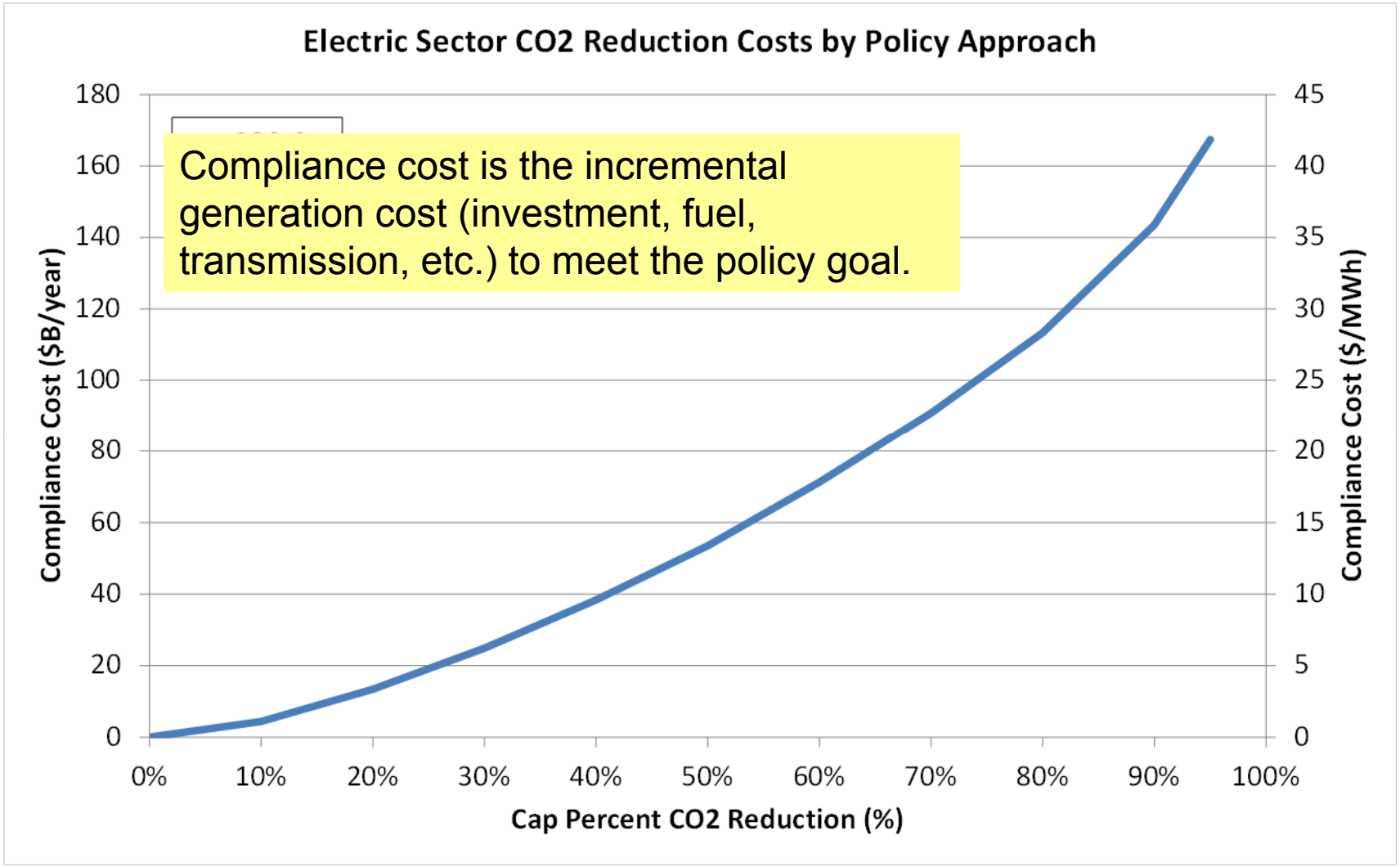
Cost of CO_2 Reductions with CO_2 Cap



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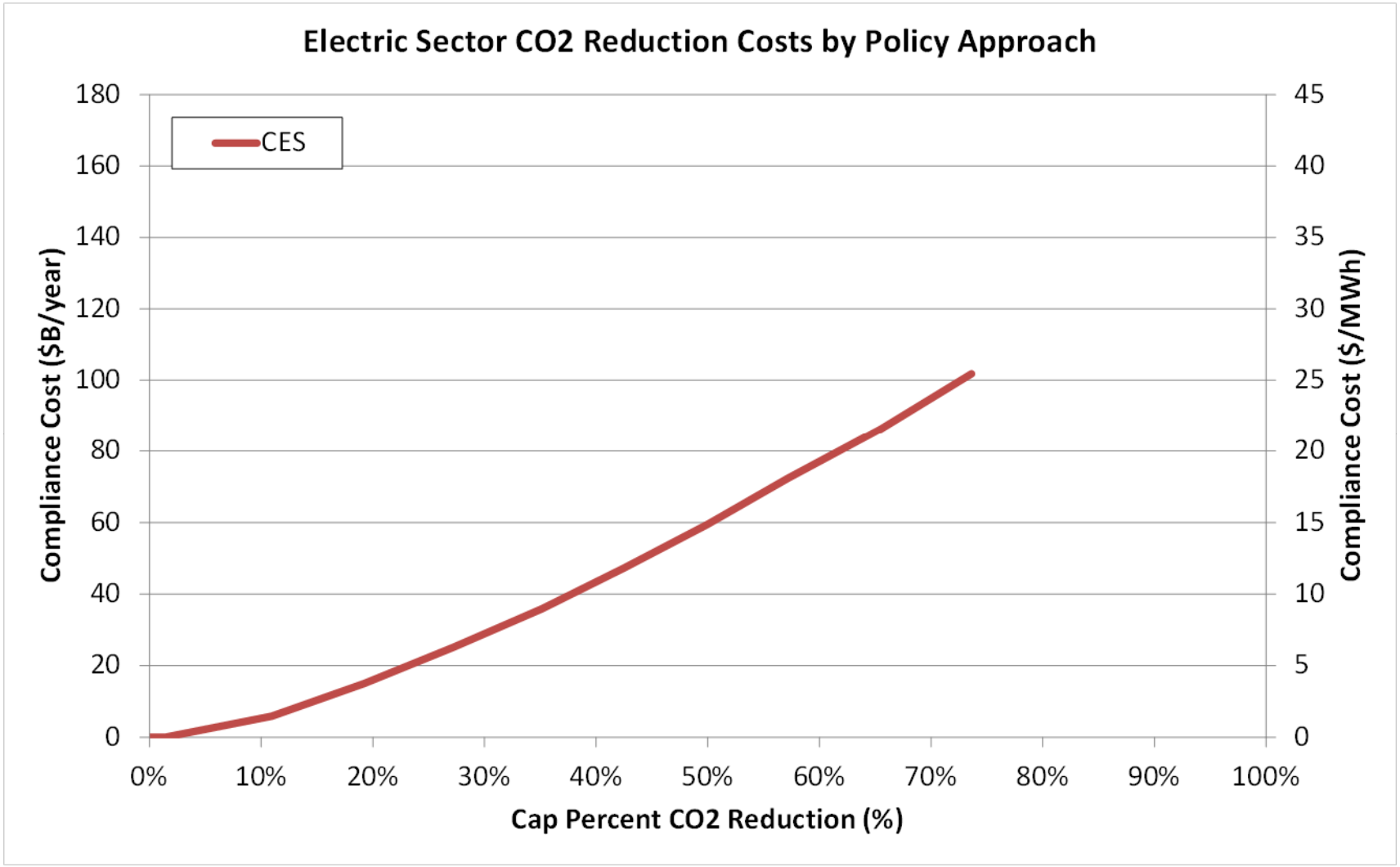
Cost of CO2 Reductions with Emission-focused Clean Energy Standard



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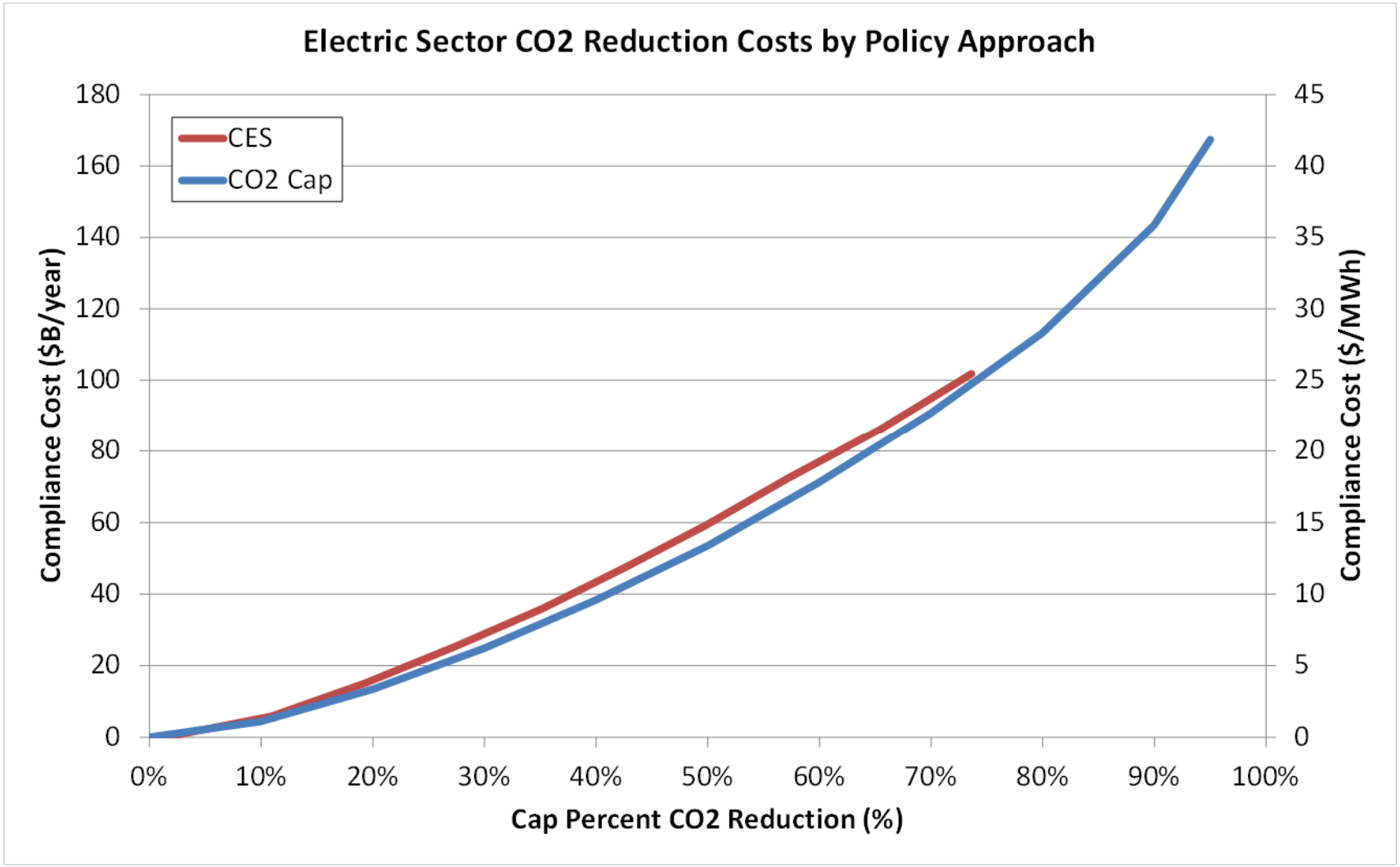
CES not a Bad 2nd Best in Cost-effectiveness



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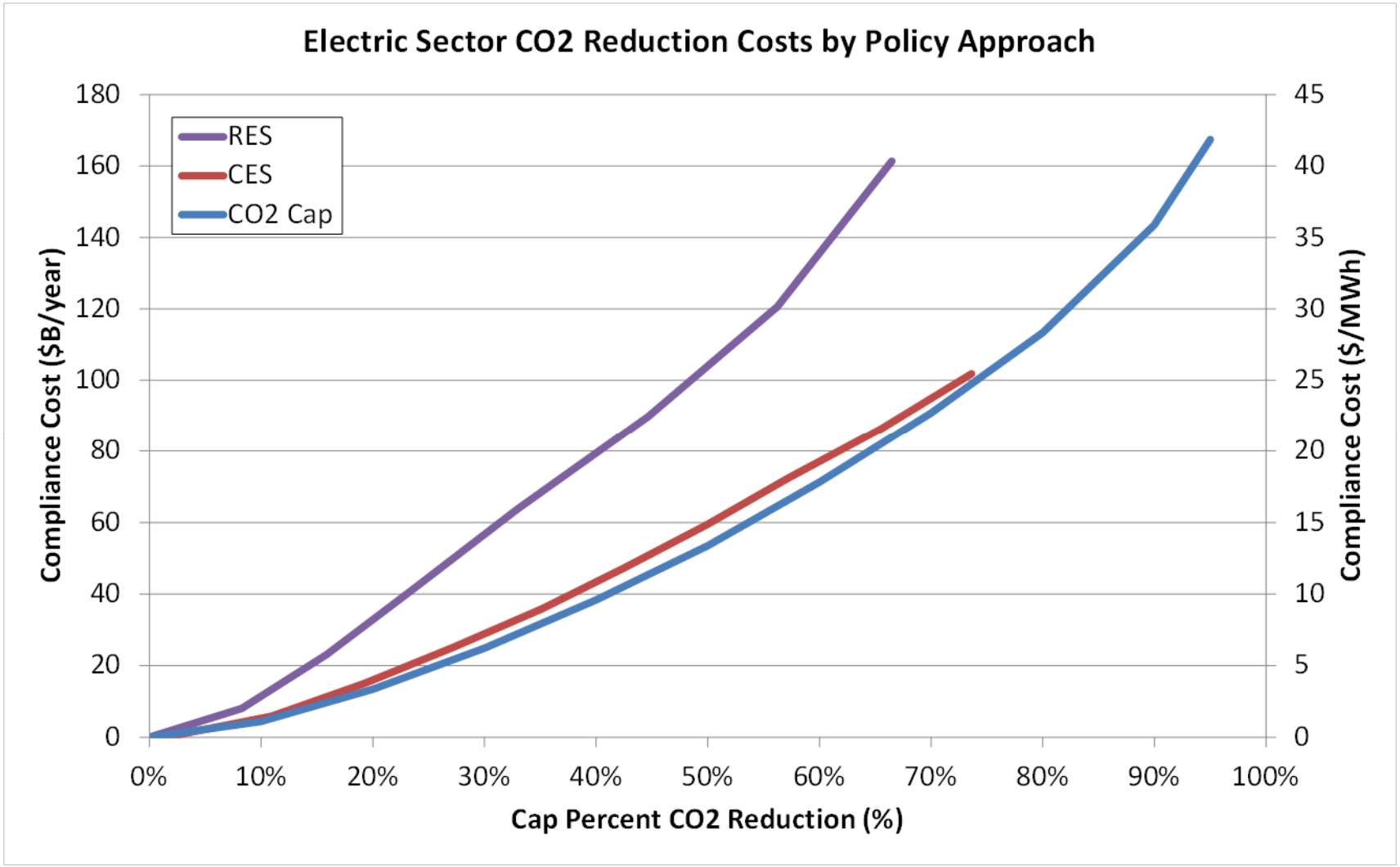
RES Cost-effectiveness Comes in a Distant 3rd



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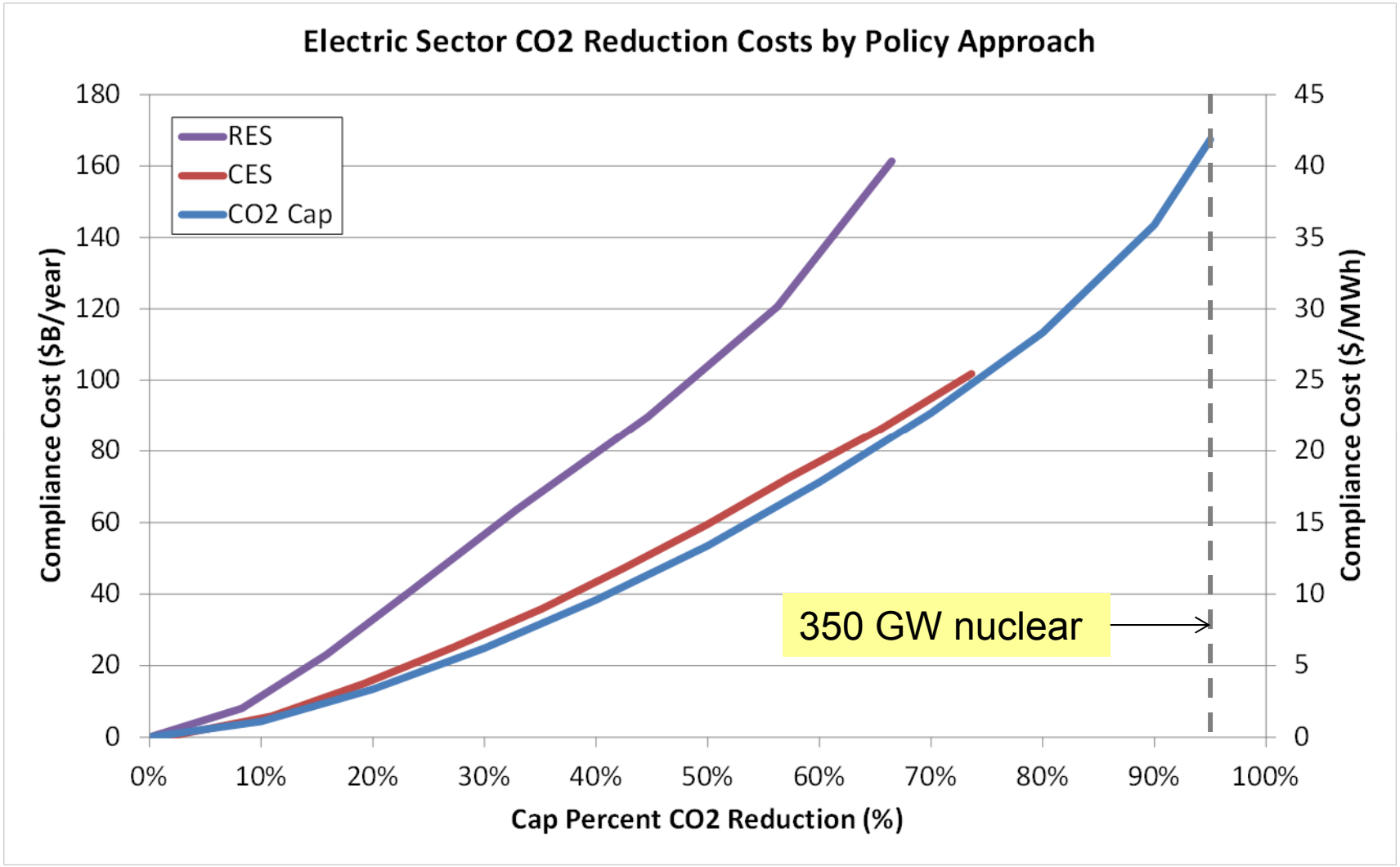
Challenges



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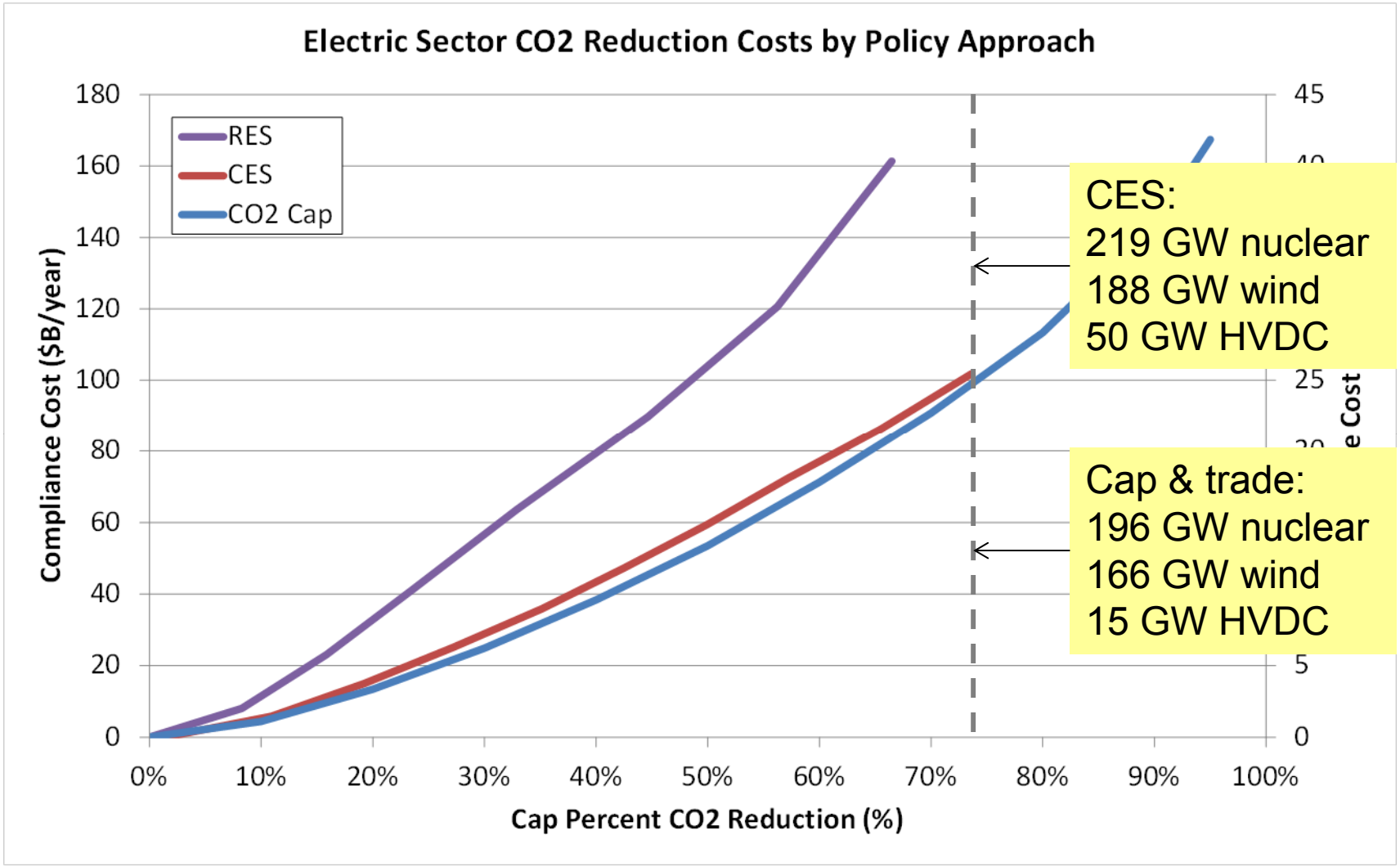
Challenges



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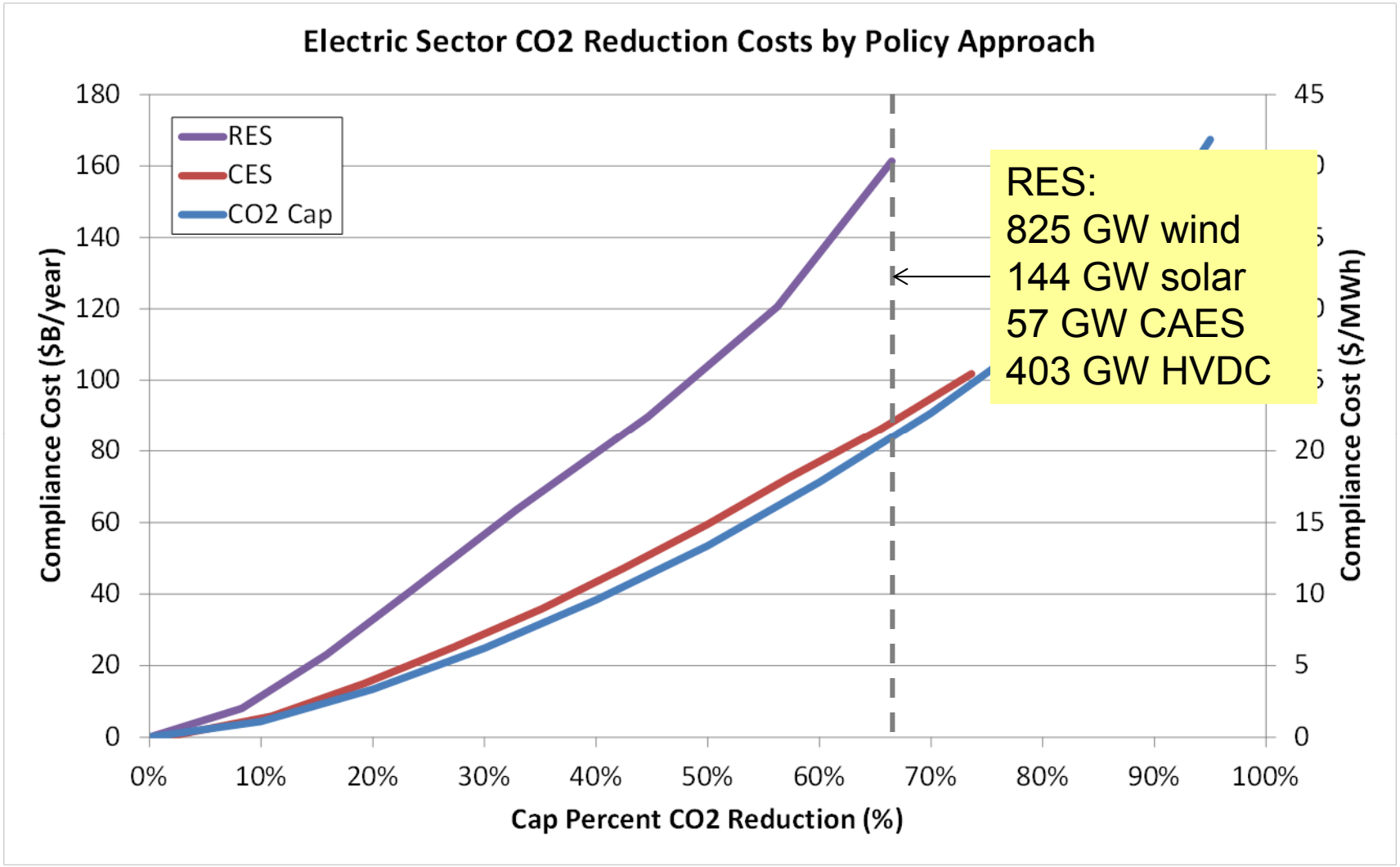
Challenges



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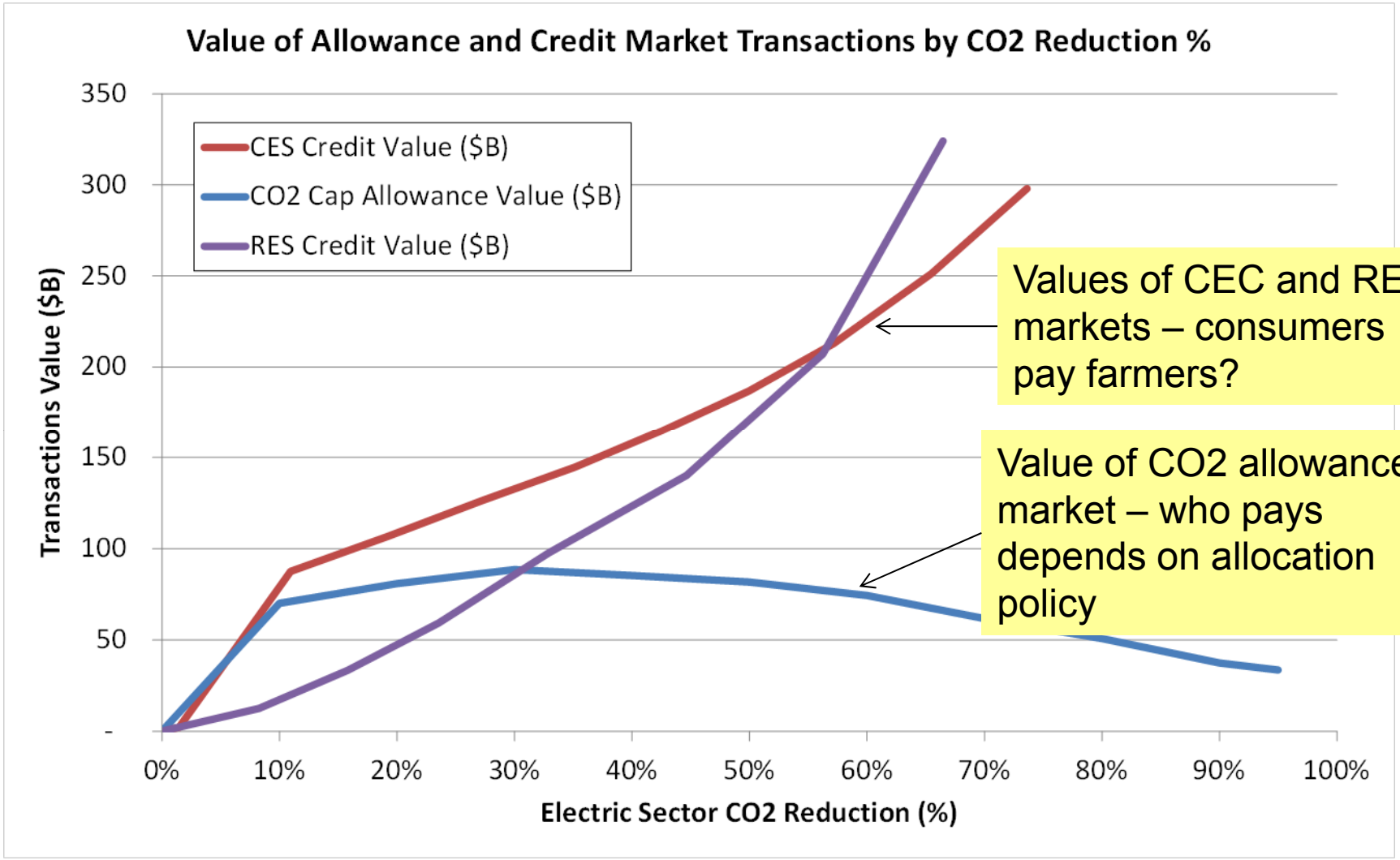
Volumes of Transfers May be Show-stopper for CES and RES



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Observations

- 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
- RES economics depend on wind and large-scale deployment of new interregional transmission
- Transfers may swamp cost-effectiveness in policy debates

- Nobody's perfect

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