RESOURCES for the FUTURE

# Clean Energy Standards and Alternative Policy Mechanisms for Electricity Sector Decarbonization

## An Overview and Comparative Analysis

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# What is a Clean Energy Standard (CES)?

A CES is a power sector only policy based on a similar structure to a traditional renewable portfolio standard (RPS).

Each year, utilities selling electricity must account for a percentage of their electricity sales having come from “clean” energy sources by turning in sufficient ”clean energy credits”.

Clean energy credits are awarded to clean generators for each MWh of clean generation they put on the grid and are tradable in a national market.

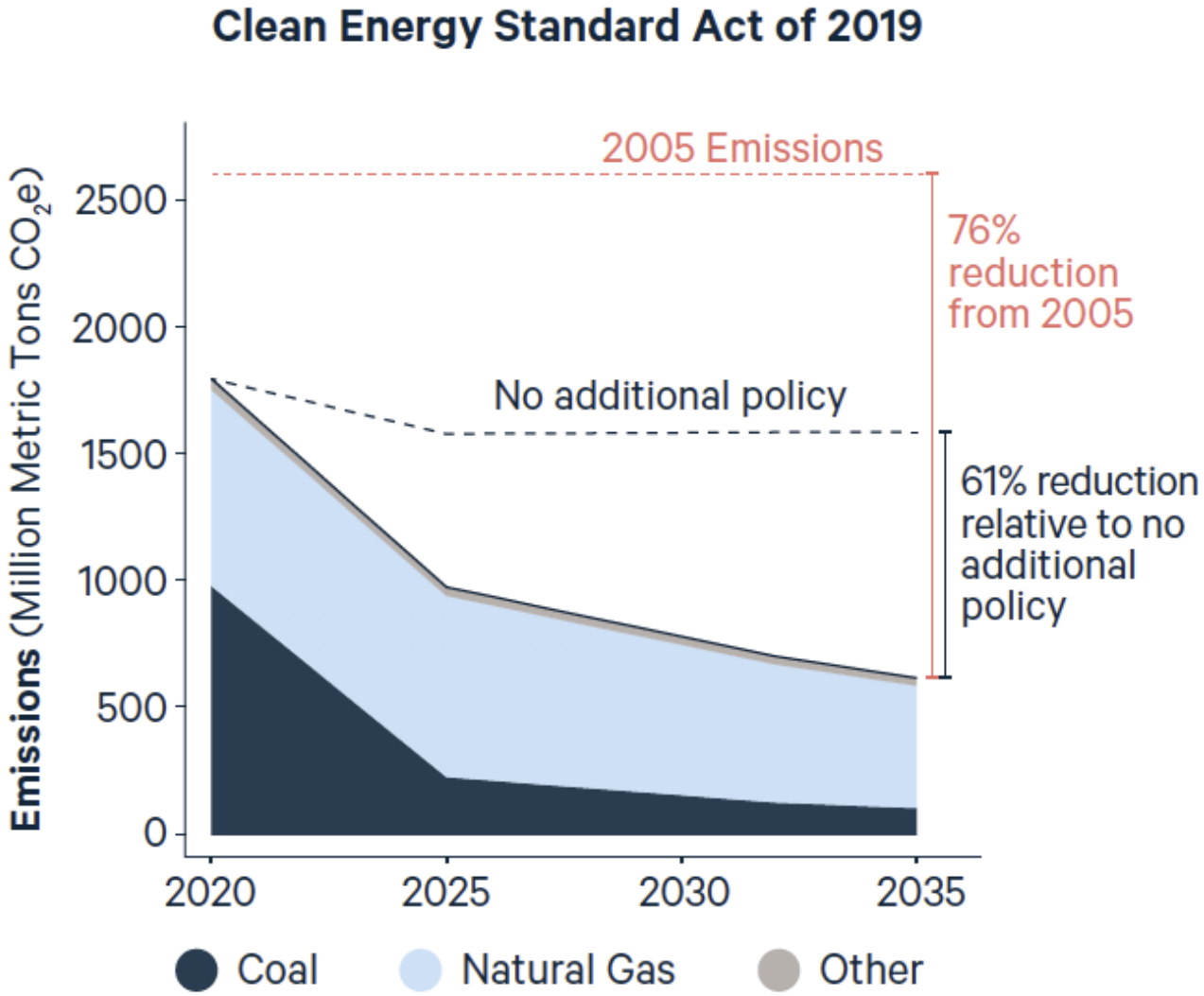
The percentage requirement increases with time, thereby incentivizing a transition to cleaner generation overall.

# Why are CES policies under consideration?

A CES can serve as a transformative federal electricity policy that yields significant emissions reductions.

The broader set of technologies included in a CES allow for greater flexibility, lower costs for the same emissions reductions as an RPS.

Depending on its design, the economic efficiency of certain CESs can approach that of carbon pricing.



# Why are CES policies under consideration?

## Federal Clean Energy Standards have previously enjoyed bipartisan support:

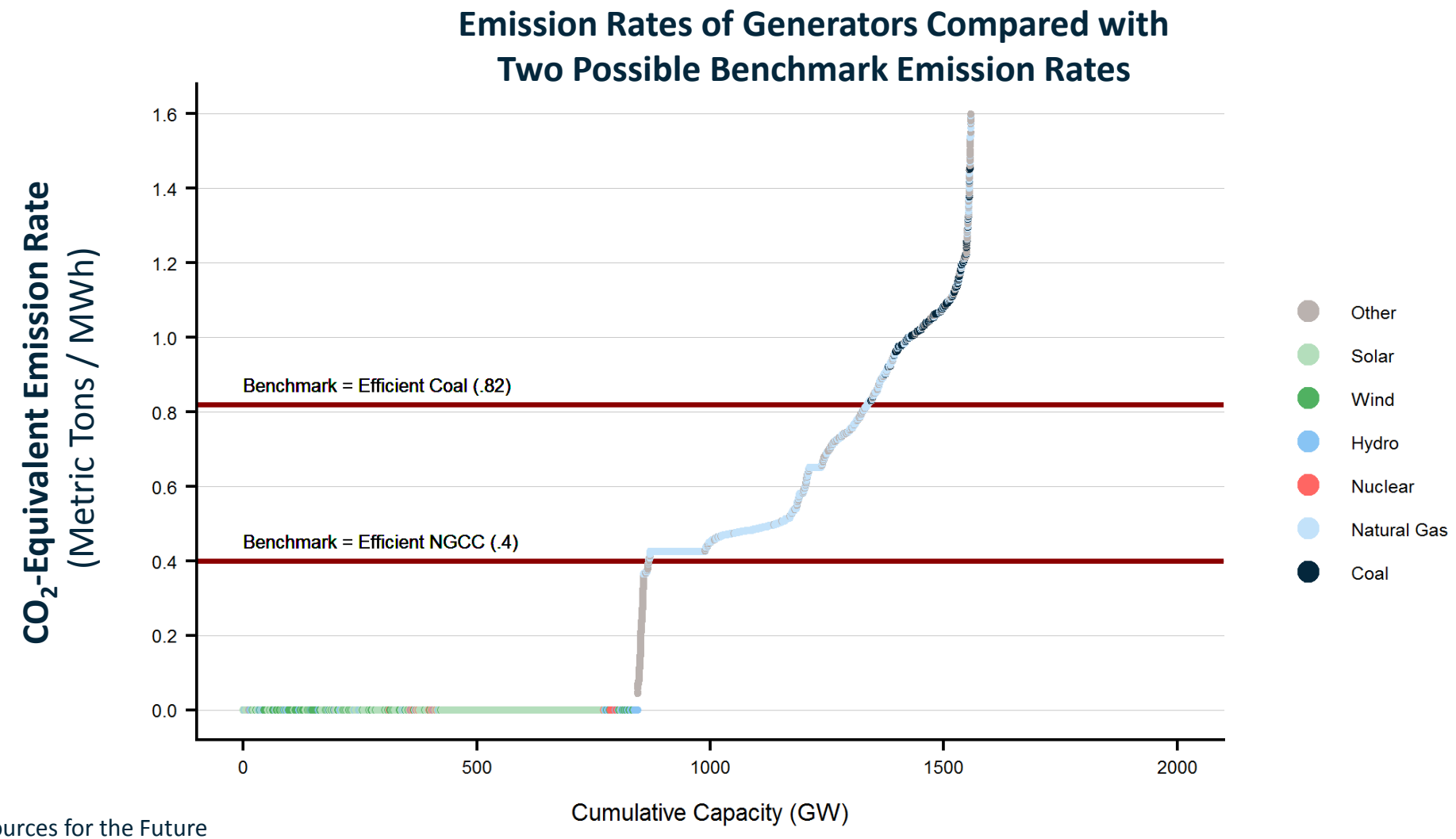
- Sen. Lugar (R-IN): “Diverse Energy Standard”
- Sen. Graham (R-SC): “Clean Energy Standard Act of 2010”
- Sen. Bingaman (D-NM): “Clean Energy Standard Act of 2012”
- Sen. Smith (D-MN) and Rep. Lujan (D-NM): Clean Energy Standard Act of 2019”

## CES policies have drawn support from a broad array of stakeholders, including labor, utilities, and environmental advocates.

# The more broadly and uniformly a climate policy is applied, the more cost effective it is.

1. All generators
    a. Low and high emitting
    b. New and pre-existing
    c. Domestic and foreign
2. All emissions
    a. In distant future and near future. (Start ASAP, allow banking.)
    b. Emission rates should include smokestack, upstream, and downstream emissions
    c. Disincentivize emissions from rest of economy, with policies of similar stringency
    d. Consider allowing offsets

# A Higher Benchmark Emission Rate Incentivizes More Sources of Emission Reductions Under a CES

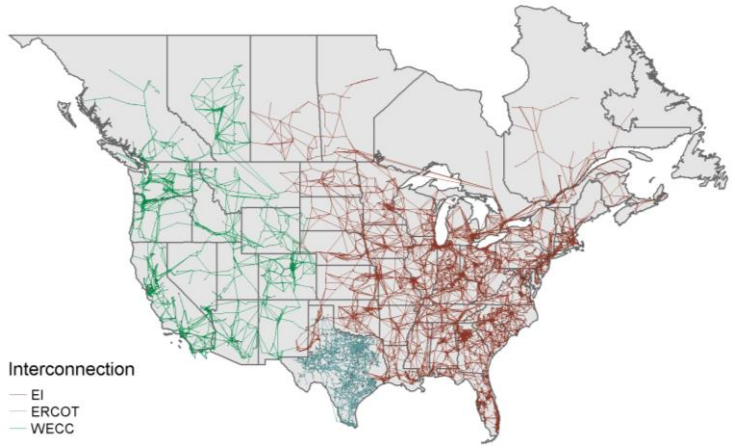


# An Illustrative, Comparative Analysis

# Approach to Evaluating Policy Options

- Employ RFF's **Engineering, Economic, and Environmental Electricity Simulation Tool (E4ST)** to simulate federal policy options for decarbonization of the power sector.

- Estimate effects of each policy:
  - Power plant capacity, generation, emissions mix ($CO_2$, $SO_2$, $NO_X$)
  - Electricity Prices (wholesale and retail)
  - Health effects
  - Benefit-Cost Analysis: Social Welfare Components



# Federal Policy Options Simulated

1) **CURRENT POLICIES:** Business-as-usual reflecting current US policies as of August, 2019.

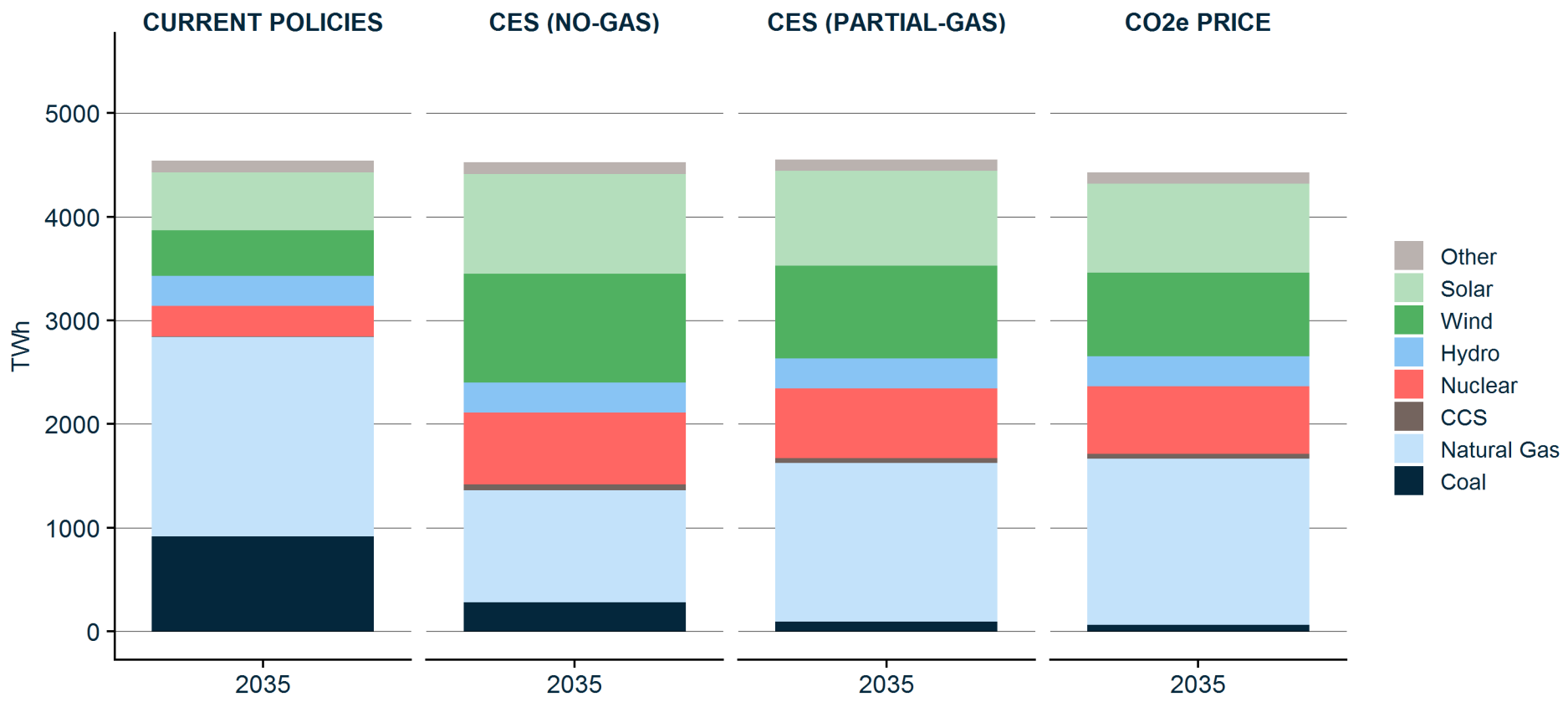
2) **CES (NO-GAS):** A federal CES with a $CO_2e$ emissions intensity benchmark of 0.4 metric tons / MWh (national average requirement of 74% in 2035).

3) **CES (PARTIAL-GAS):** A federal CES with a $CO_2e$ emissions intensity benchmark of 0.82 metric tons / MWh (national average requirement of 84% in 2035).

4) **$CO_2e$ PRICE:** A federal greenhouse gas ($CO_2e$) emissions price of $28 / metric ton in 2035 (with revenue rebated to electricity end-users).

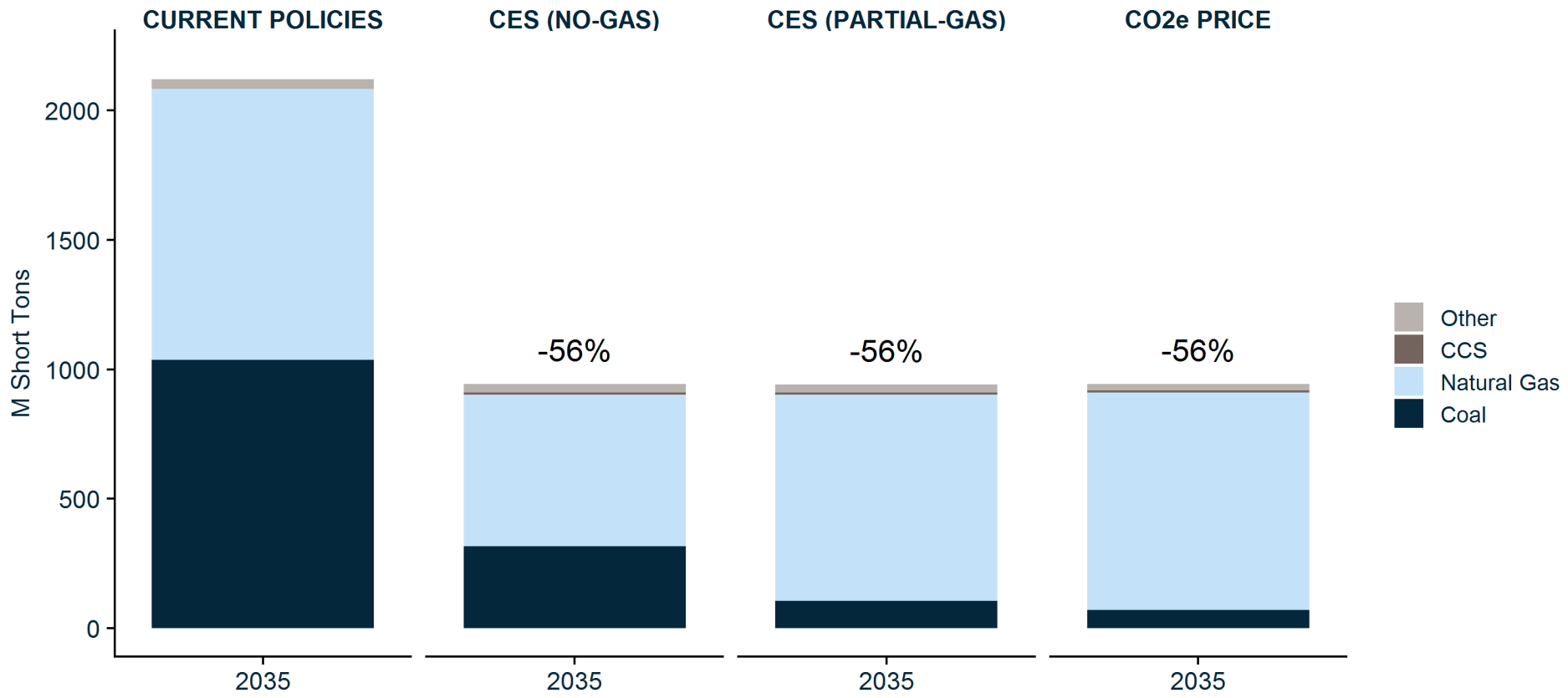
**The stringencies of each policy are calibrated to achieve equivalent emission reductions relative to Current Policies in 2035 (56%).**

# U.S. Generation Mix



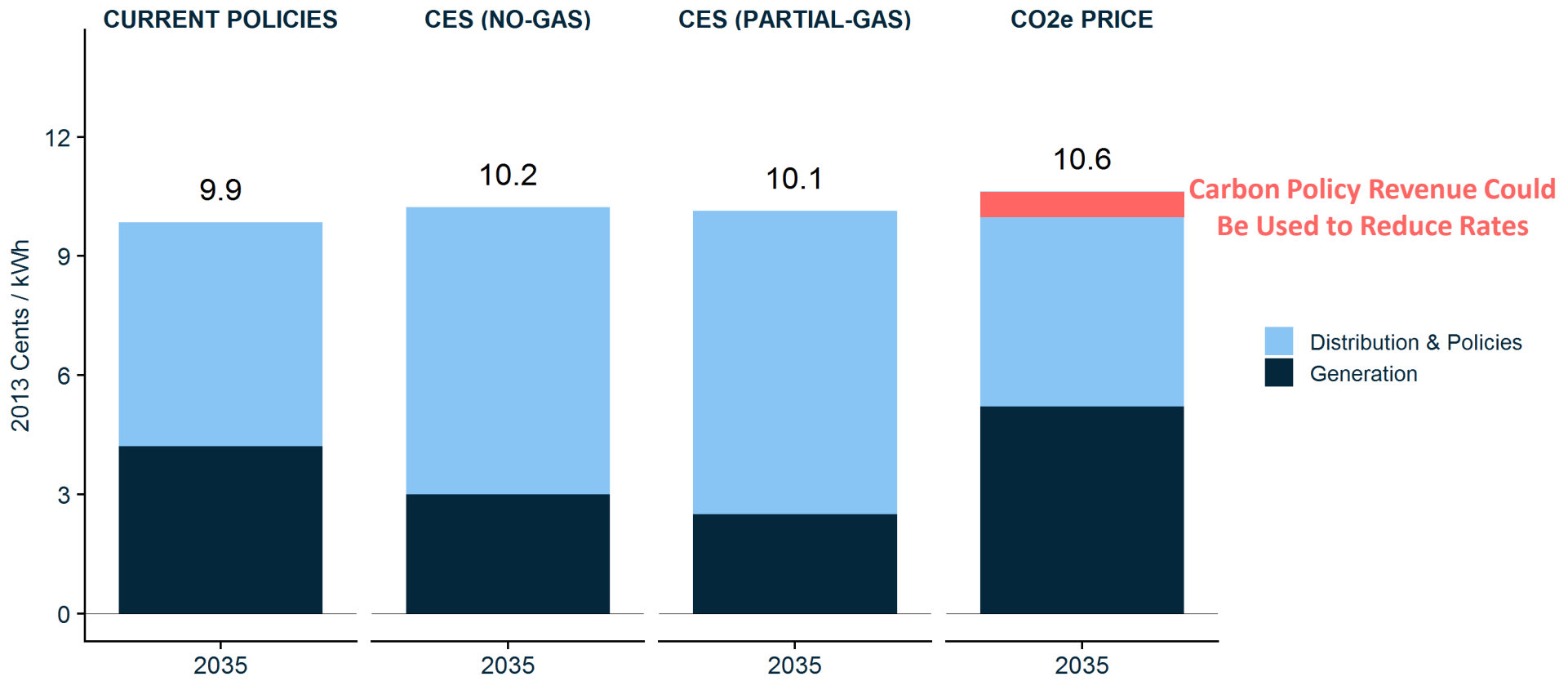

- Each policy promotes significant additional wind & solar, and preserves unprofitable nuclear fleet
- A carbon price and CES crediting natural gas provide a relative incentive for natural gas over coal

# U.S. $CO_2$-Equivalent Emissions Mix



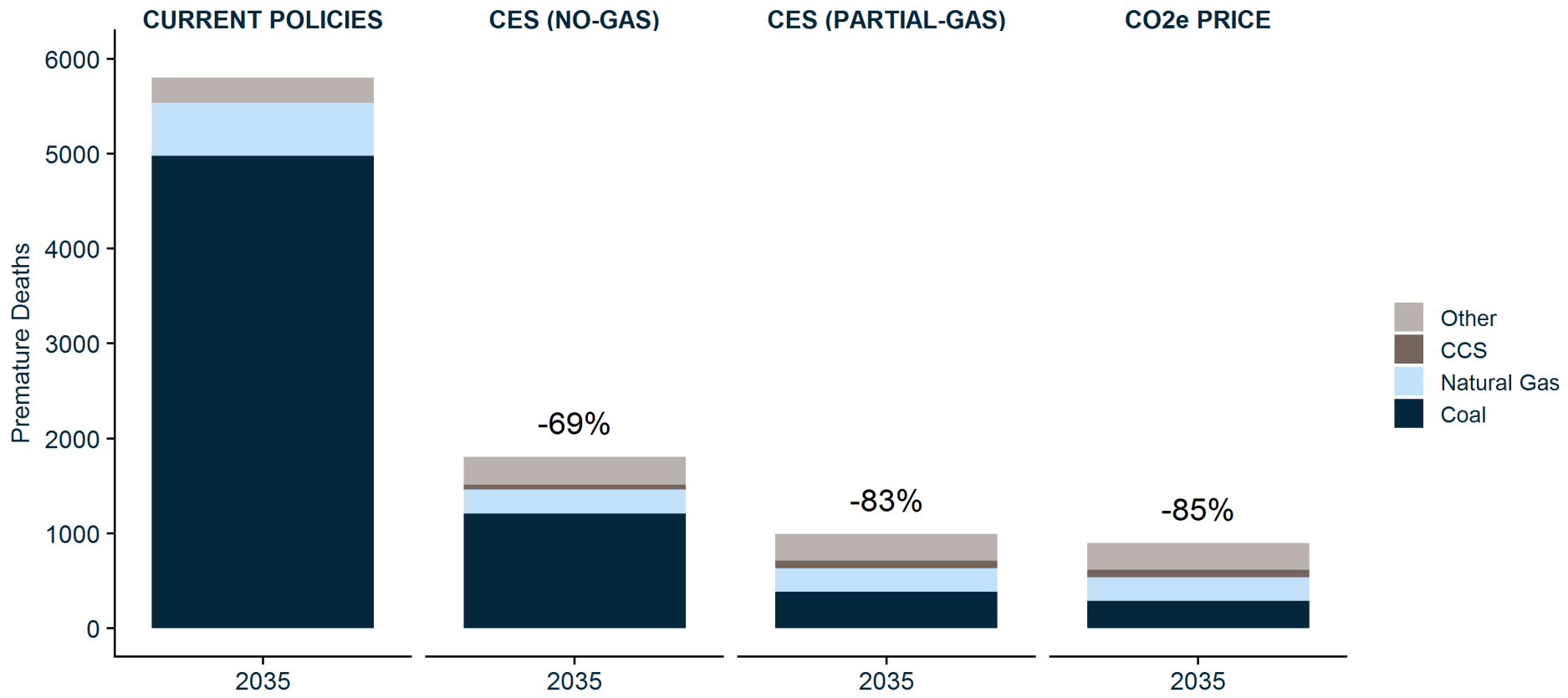

- Equivalent total emissions reductions from $CO_2$ and methane achieved under different generation profiles
- A CES excluding natural gas reduces methane emissions most, but $CO_2$ emissions least

# U.S. Average Retail Electricity Prices



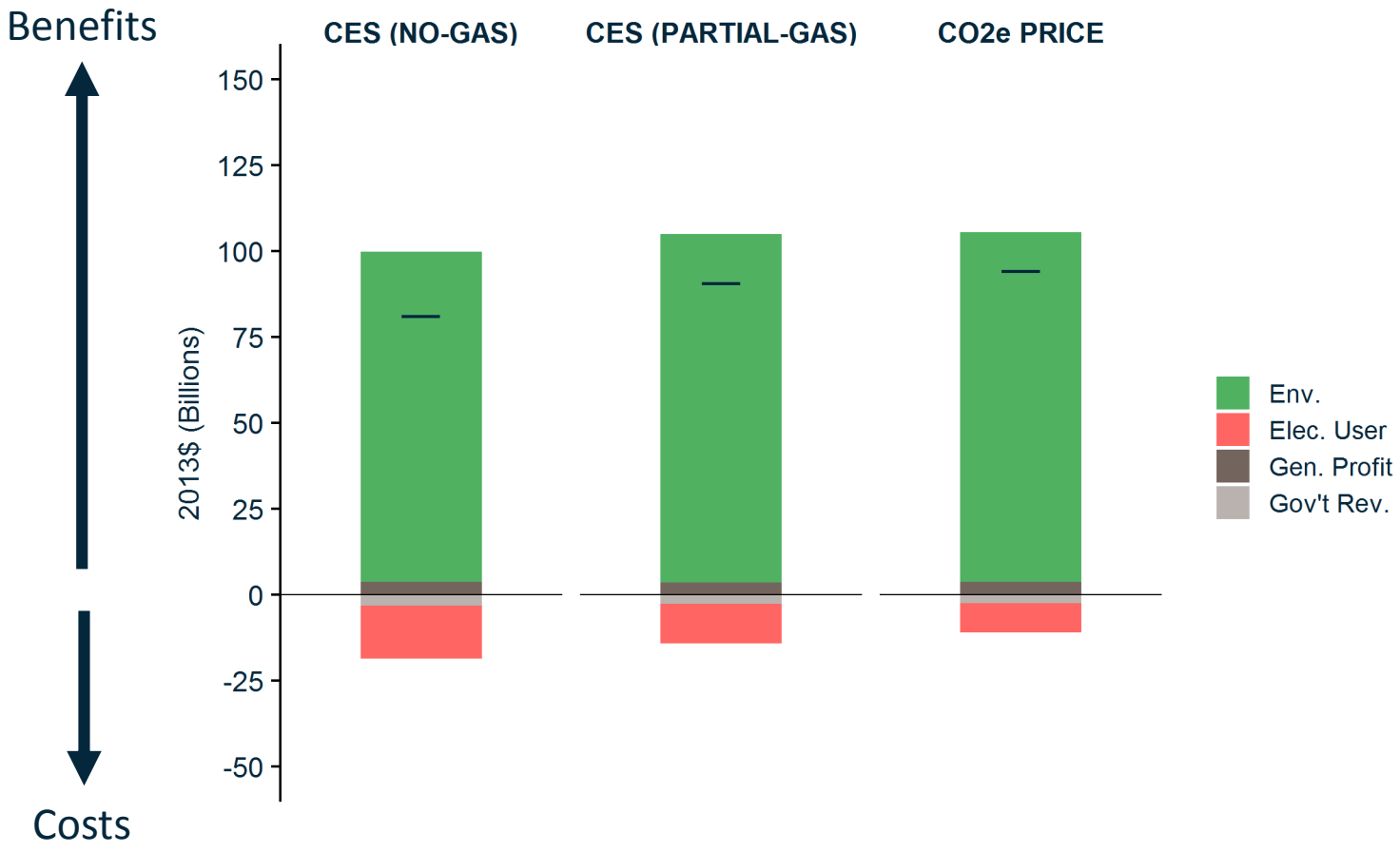

- A CES crediting natural gas reduces emissions at lower cost to end-users than one not crediting natural gas
- A CES (subsidy) reduces generation prices, while a carbon price (fee) increases generation prices

# U.S. Premature Deaths from $SO_2$ & $NO_X$ Emissions




- Significant co-benefits are achieved by reducing emissions from coal-fired generation

# Benefits Relative to Current Policies Scenario, in 2035




## Benefits and Costs

**Environment:**

Climate: Net damages caused by $CO_2$ & methane; Health: Estimated value of the mortality from $SO_2$ and $NO_X$ emissions.

**Electricity User:**

Non-environmental "consumer" surplus of all electricity end-users.

**Generator Profits:**

Generator revenues minus production costs.

**Gov't Revenue:**

Revenues from emission policies, less costs of renewables tax credits.

# Additional factors that make clean energy standards more effective or less costly

1. Avoid loopholes
2. Consider still allowing some emissions
    a. One way is by allowing an alternative compliance payment (price ceiling)
3. Reduce uncertainty about what future prices will be, so companies are willing to invest
    a. With credit price floor
    b. By setting policy far in advance
    c. By setting policy that can survive future Congresses and court challenges

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