

# Valuing Energy Efficiency

Mike Specian, Ph.D.  
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# Energy efficiency will offer value in 3 broad areas

1. Enabling deep decarbonization and addressing climate change
2. Minimizing electricity system costs
3. Mitigating load growth

# Climate-forward efficiency efforts are those that:

- Treat energy efficiency as an intentional driver of GHG reductions;
- Scale to meet the magnitude of the decarbonization goals in policy and utility corporate commitments;
- Leverage energy efficiency as a tool to mitigate and adapt to the impacts of climate change on customers by advancing equity, enhancing resilience, and improving health outcomes;
- Prioritize energy efficiency investments based on their time, seasonal, and geographic impacts; and
- Enable prioritization of investments across fuels, systems, and sectors, particularly from electrification.

# The Need for Climate-Forward Efficiency: Early Experience and Principles for Evolution

MIKE SPECIAN AND RACHEL GOLD

DECEMBER 2021  
ACEEE REPORT

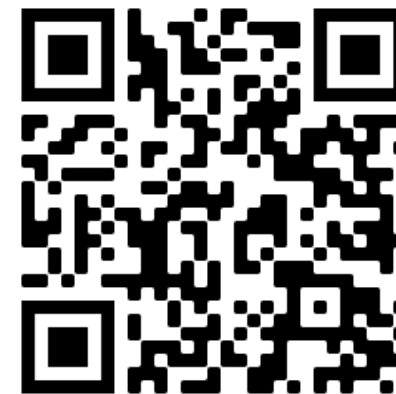
**ACEEE**  
American Council for an Energy-Efficient Economy

# A ROADMAP FOR CLIMATE-FORWARD EFFICIENCY

MIKE SPECIAN, RACHEL GOLD, AND  
JASMINE MAH

**ACEEE**  
Smart Energy. Clean Planet. Better Lives.

<https://www.aceee.org/research-report/u2106>



<https://www.aceee.org/research-report/u2202>





# Energy efficiency affects GHG in 2 ways



Short-run impacts



Long-run impacts

# Emission rates reflect the carbon intensity of electricity

The emission rate (or emission factor) tells us how many greenhouse gases (i.e., carbon dioxide equivalent CO<sub>2</sub>e) are emitted per unit of electrical energy generated.

Typical unit:

[tons of CO<sub>2</sub>e / Megawatt-hour]

$$( \textit{energy saved} ) \times ( \textit{emission rate} ) = \textit{avoided GHG}$$

# Emission rates are described by horizon, type, and time granularity

- Horizon: **short-run** (grid as it exists today) or **long-run** (grid as it will exist in the future)
- Type: **average emission rate** (AER, all operating power plants) or **marginal emission rate** (MER, all power plants operating on the margin)
- Time granularity: time period over which emission rates are averaged (e.g., **annual, hourly**). Low time granularity may bias results if:
  - Carbon intensity of region's electricity is highly variable
  - Hours of energy savings are highly variable
  - Carbon intensity and hours of savings are highly correlated

# Average emission rate (AER) vs. marginal emission rate (MER)

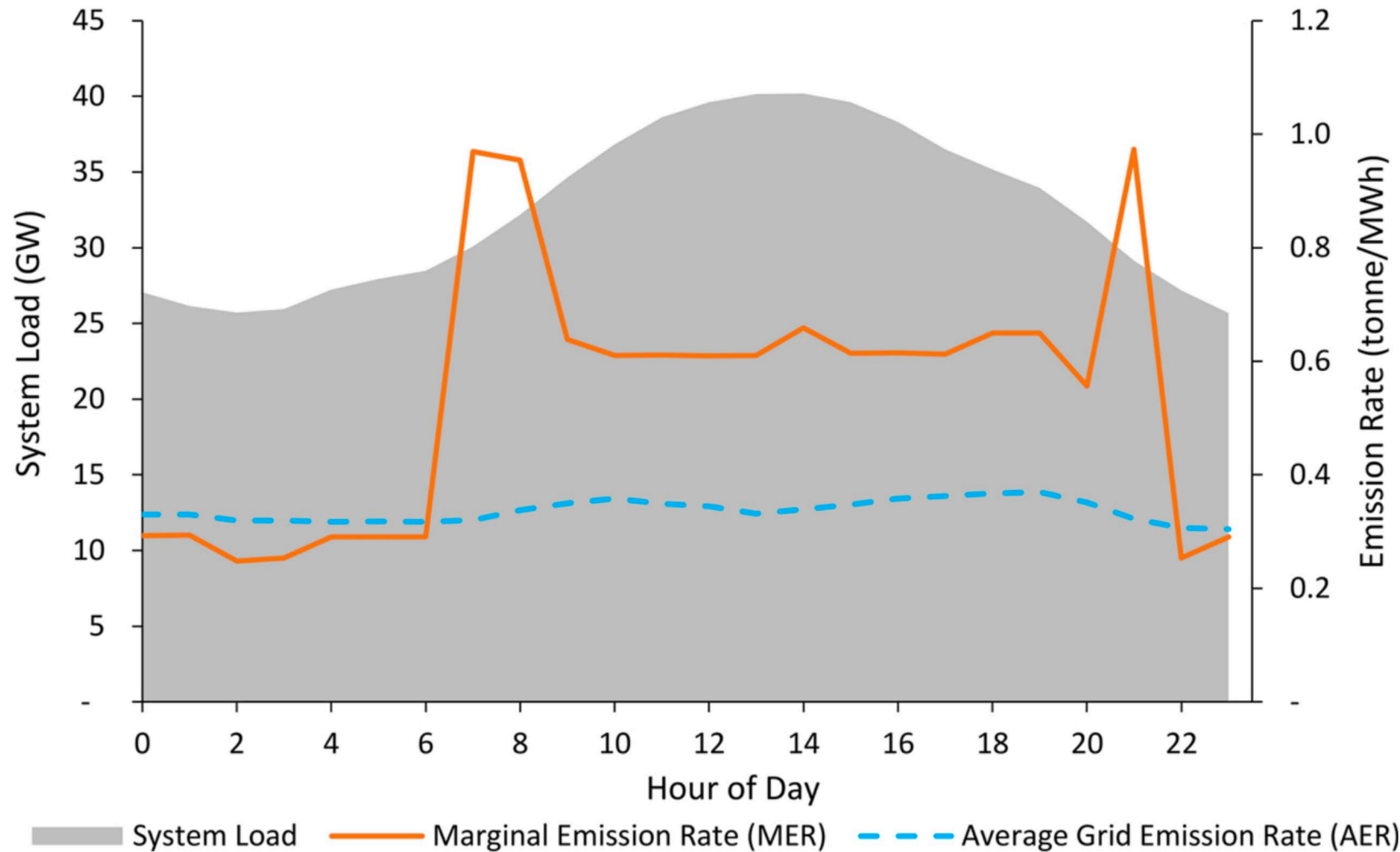
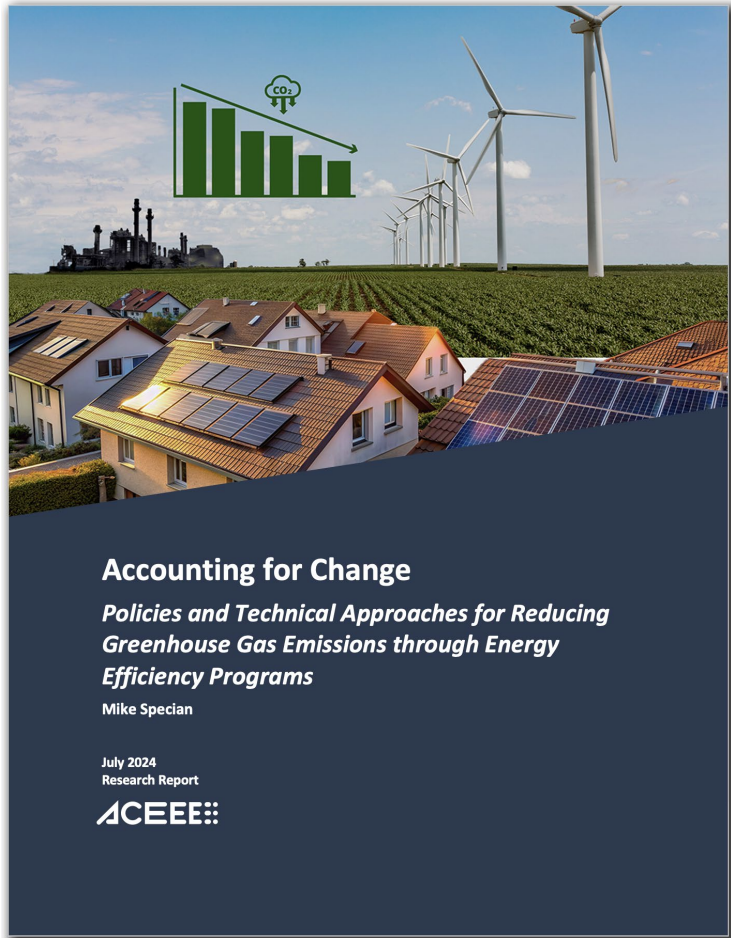


Figure created and originally published by [He et al., 2021](#).



# ACEEE's *Accounting for Change* report



## Key Questions

- 1) How can we measure the greenhouse gas reductions that result from energy efficiency measures and programs?
- 2) How can utility energy efficiency programs set greenhouse gas reduction goals?
- 3) From a policy perspective, what has motivated states to begin utilizing these measures and what policies, programs, and results have we seen thus far from those efforts?

<https://www.aceee.org/research-report/u2401>

# How can we measure the GHG reductions that result from energy efficiency measures and programs?

Our report lays out 6 methods:

1. Consequentialist
2. Marginal emission rate
3. Fuel neutral
4. Economic
5. Average emission rate
6. Proxy metrics

# Accounting Method #1: Consequentialist

This method answers the question:

*What is the difference in GHG emissions in a world with our energy efficiency programs and one without them?*

Advantages:

- Accounts for both the short- and long-term impacts of EE
- Tools exist to help (e.g., Cambium, Avoided Cost Calculator)

Disadvantages:

- Requires modeling that may be complex or opaque

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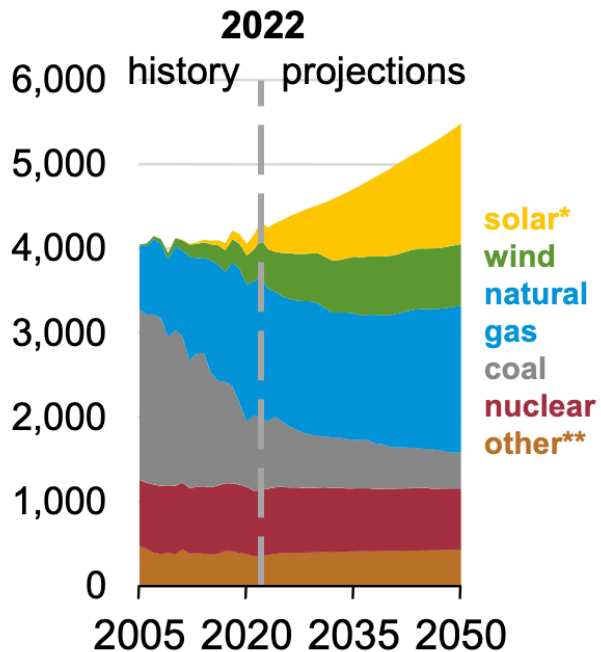


# Renewable energy is growing

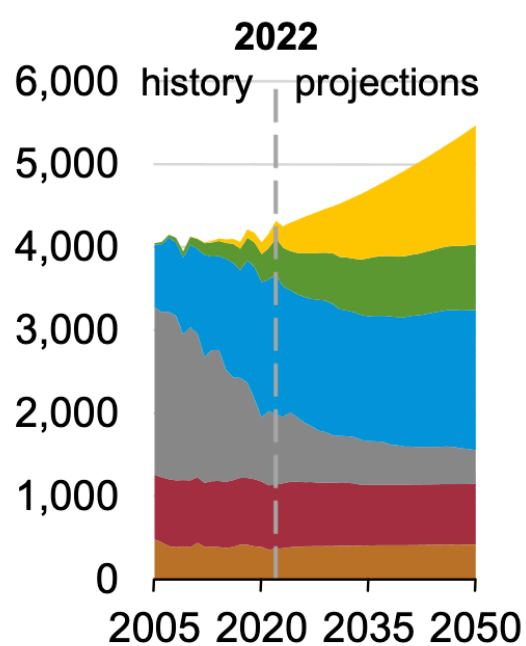


## U.S. net electricity generation by fuel billion kilowatthours

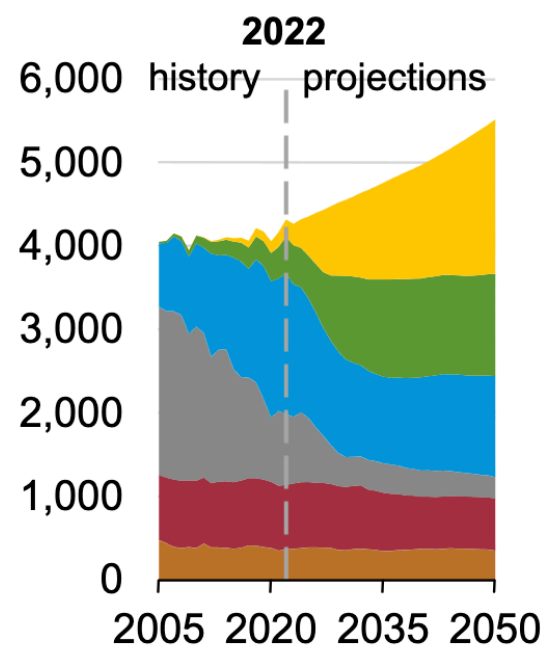
### No IRA



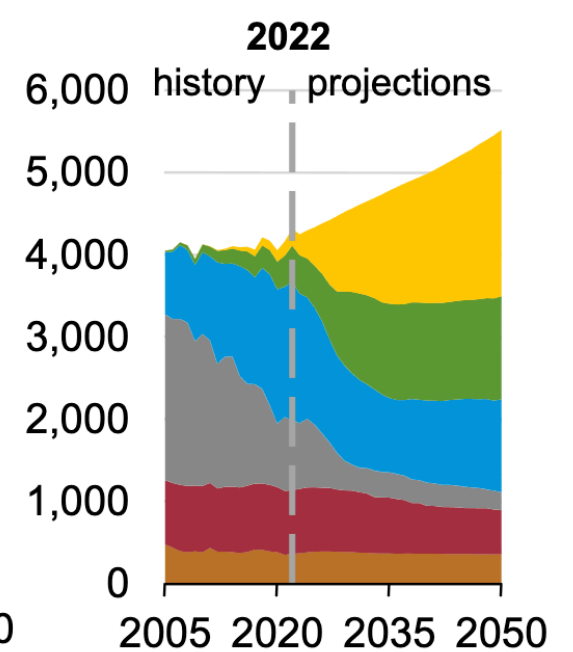
### Low Uptake



### Reference



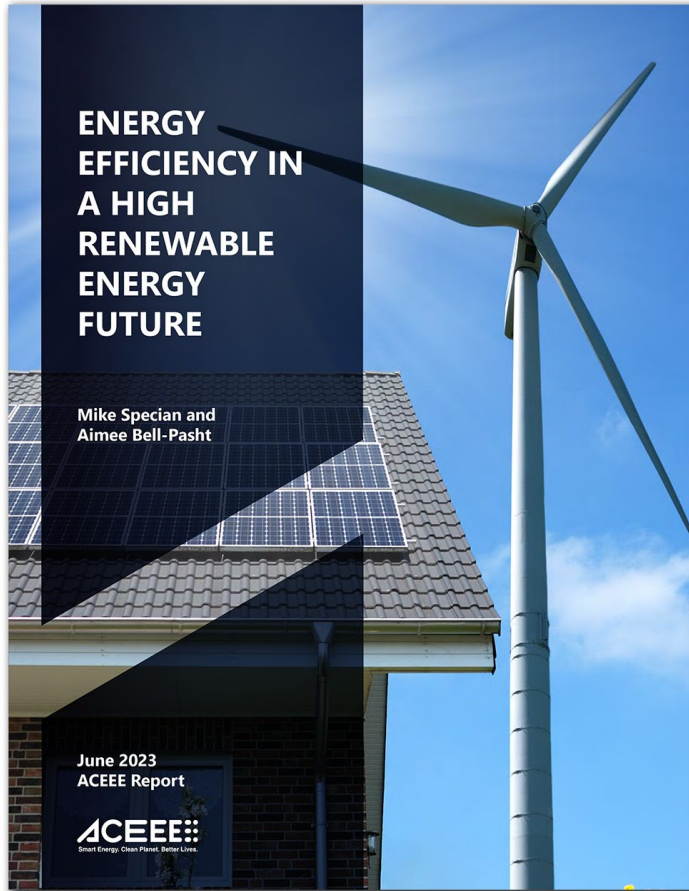
### High Uptake



Data source: U.S. Energy Information Administration, *Annual Energy Outlook 2023* (AEO2023)  
 Note: IRA=Inflation Reduction Act

Source: EIA [Annual Energy Outlook 2023](#)

# The role of energy efficiency in a high renewable energy future



## Key Takeaways

1. Energy efficiency has a crucial role in decarbonizing the electricity system and paving the way for a high renewable energy future.
2. Energy efficiency provides more value the more quickly electricity generation decarbonizes.
3. The energy efficiency measures with the greatest potential to avoid future energy system costs are those that reduce heating and cooling loads.

<https://www.aceee.org/research-report/u2303>

# We consider 12 energy efficiency measures/packages

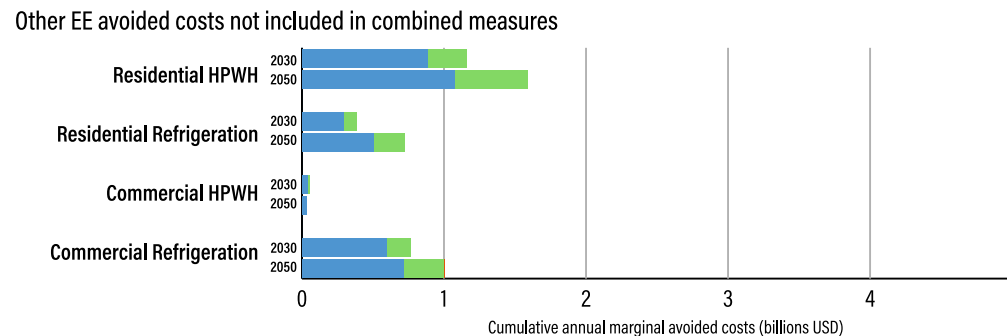
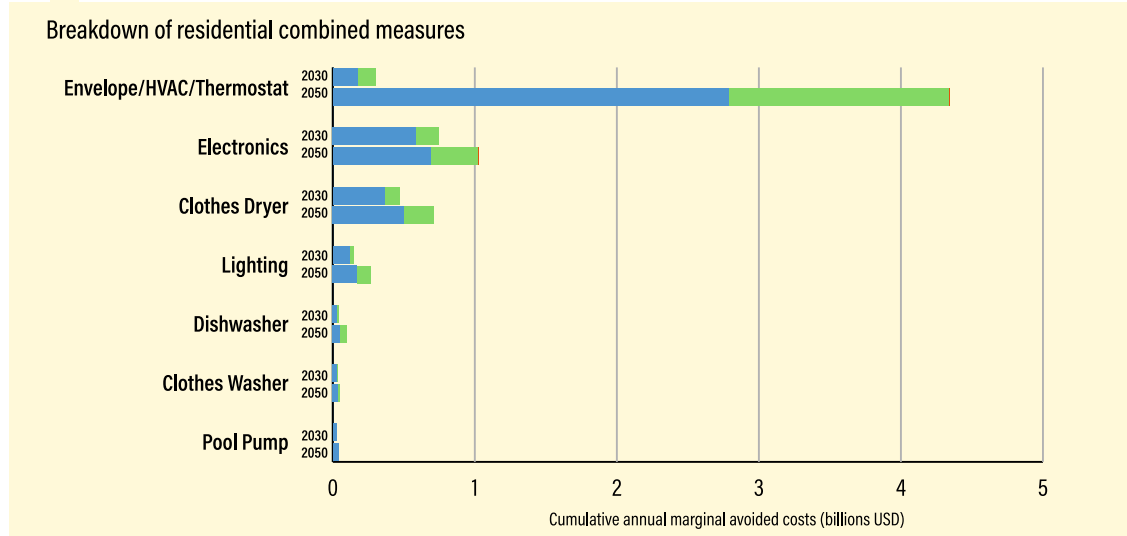
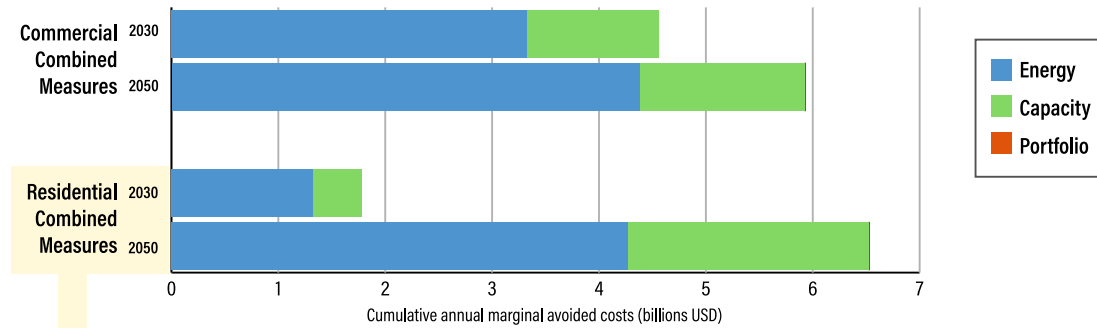
## Commercial

Measure	Definition
Combined (interactive) measures	Combination of envelope, HVAC, lighting, plug load measures
Refrigeration	Various minimum performance levels for reach-in freezers, walk-in freezers, reach-on refrigerators, walk-in refrigerators, and supermarket display cases
Heat pump water heater	Electric heat pump water heater with Btu out/in ratio of 3.9

## Residential

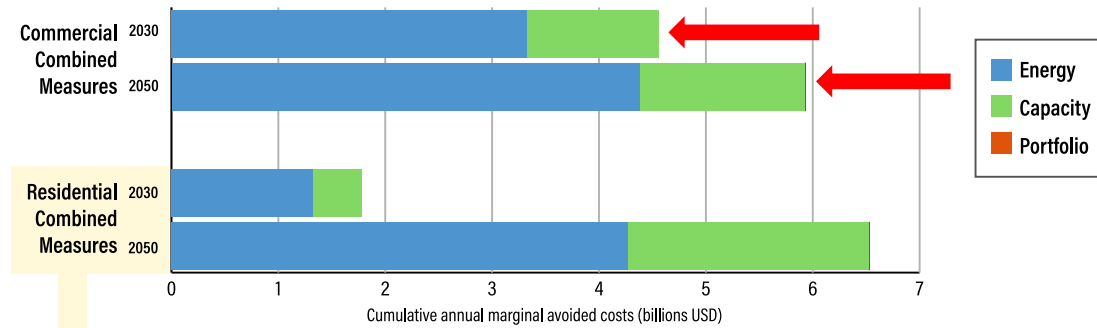
Measure	Definition
Envelope/HVAC/thermostat	Envelope improvements (i.e., wall insulation, foundation insulation, windows), Internet-connected thermostat, plus HVAC upgrade (where applicable)
Heat pump water heater	80-gallon electric heat pump water heater with 2.4 coefficient of performance
Clothes dryer	Ventless heat pump dryer with CEF = 3.65
Electronics	Plug loads usage level halved
Refrigeration	EF 22.2 refrigerator
Lighting	LEDs, 112 lumens/Watt
Pool pump	0.75 horsepower pump with 1,688 kWh annual energy use
Clothes washer	ENERGY STAR Most Efficient (IMEF $\geq$ 2.92)
Dishwasher	Rated 199 kWh/year

# Annual avoided costs in Midwest under 95x2050 scenario

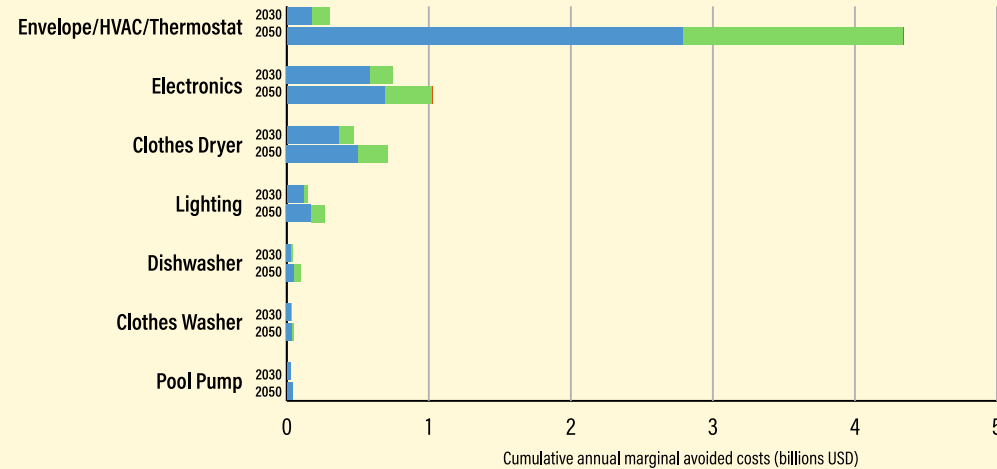




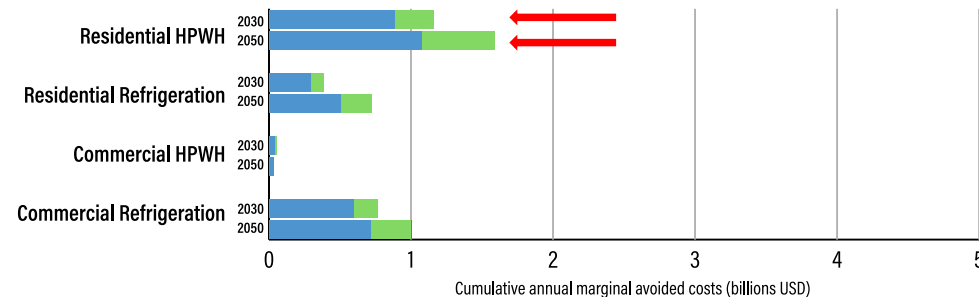
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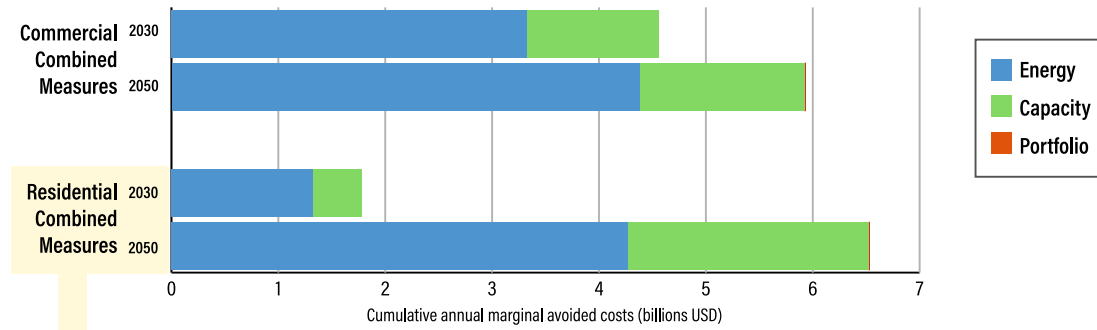
## Breakdown of residential combined measures



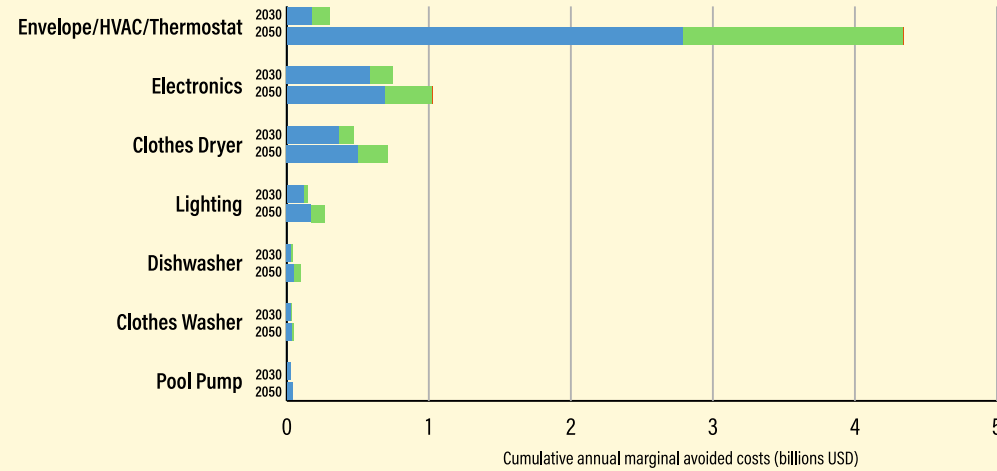
## Other EE avoided costs not included in combined measures



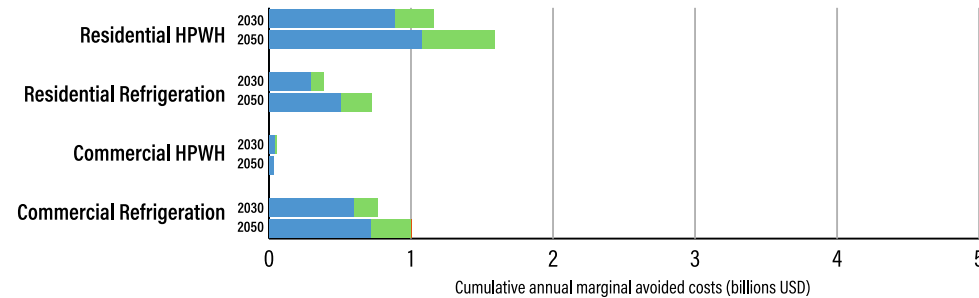
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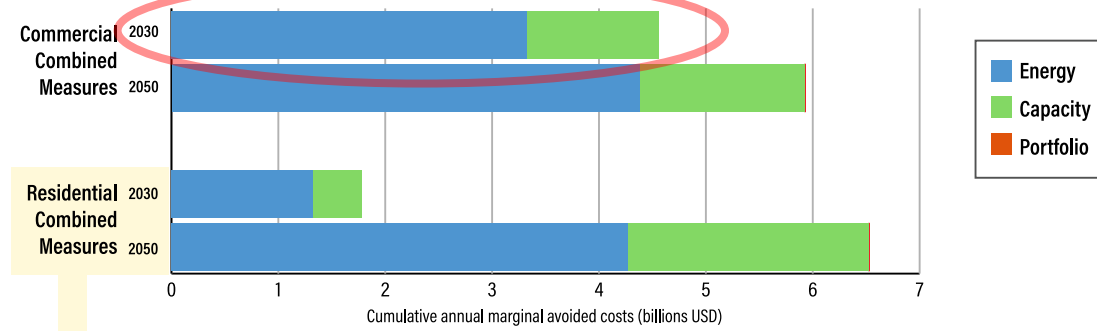
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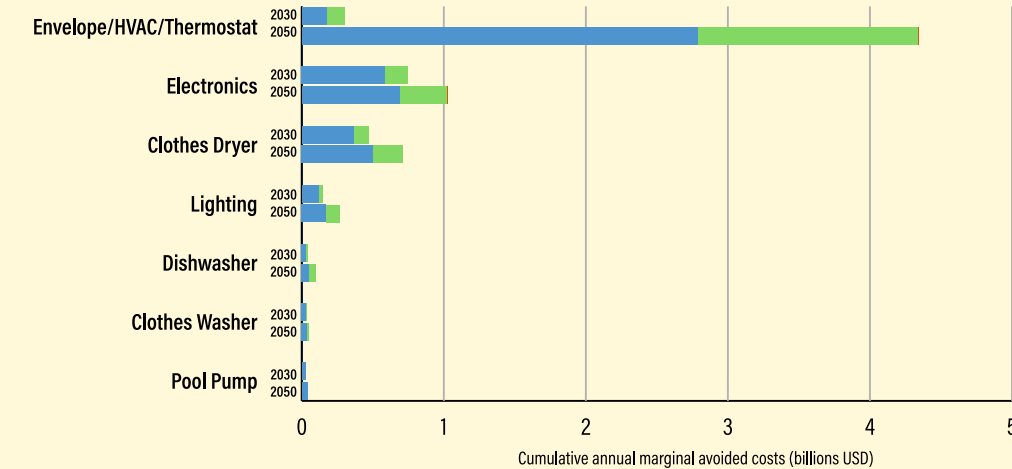
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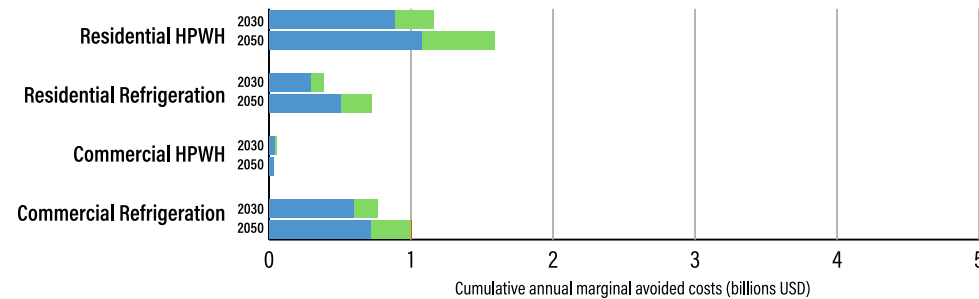
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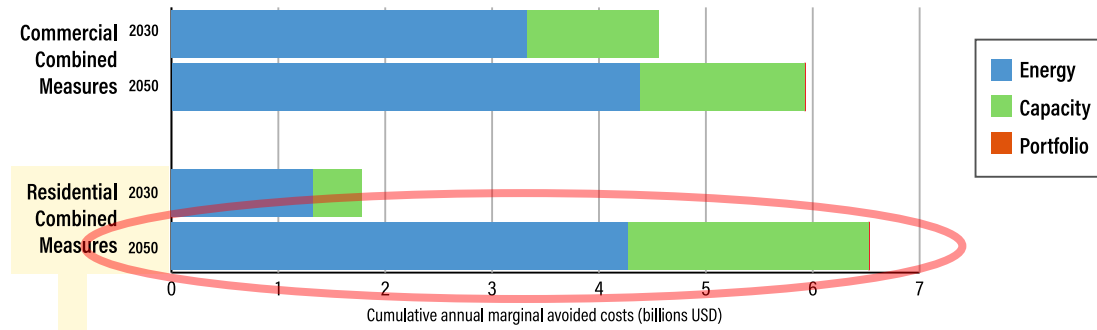
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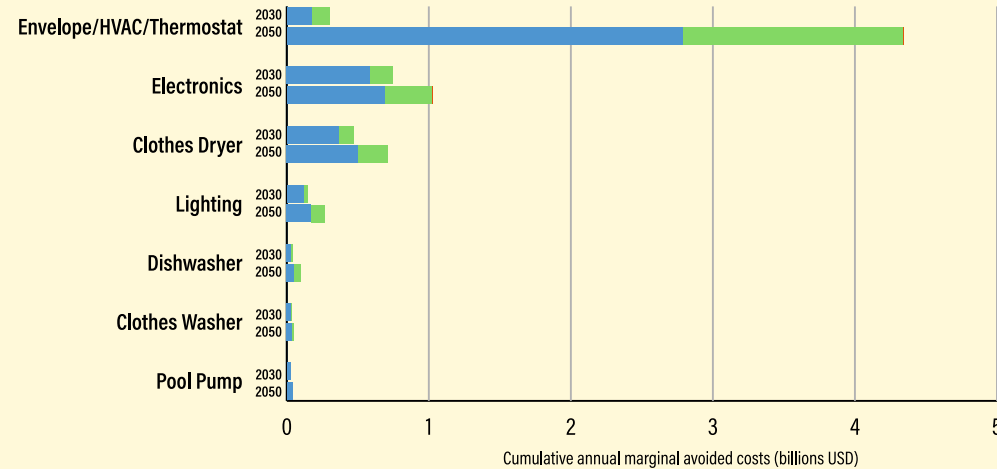
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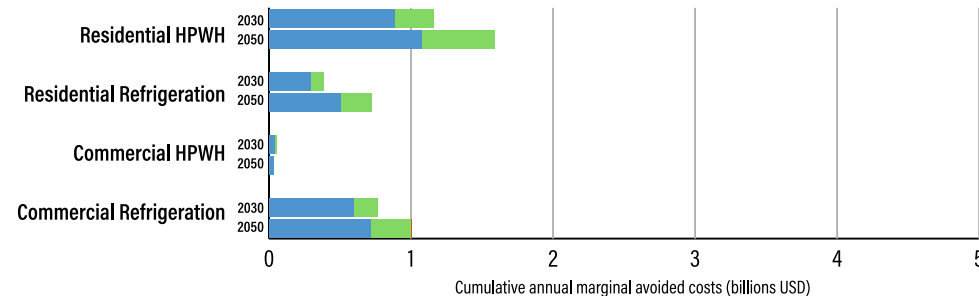
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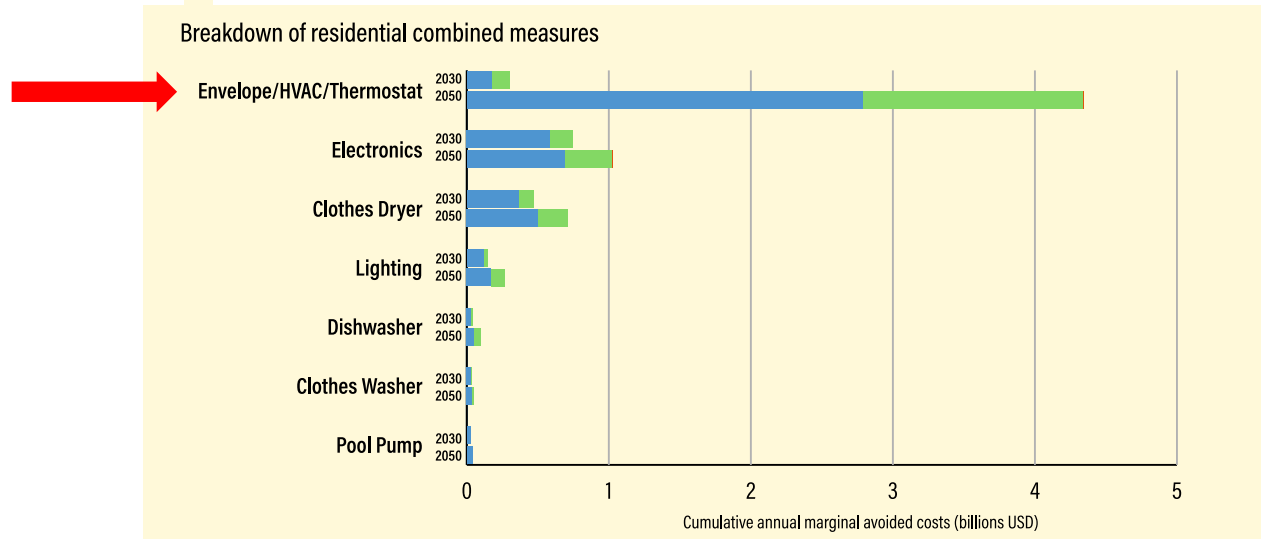
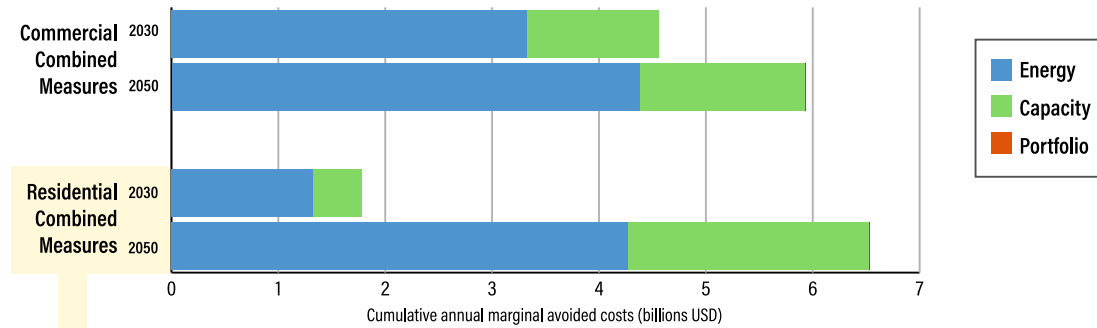


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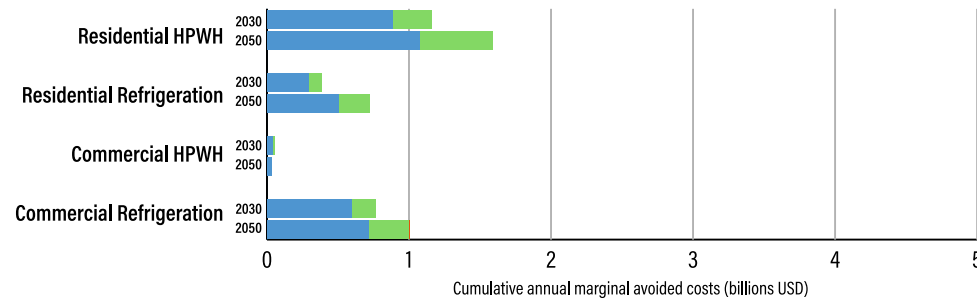




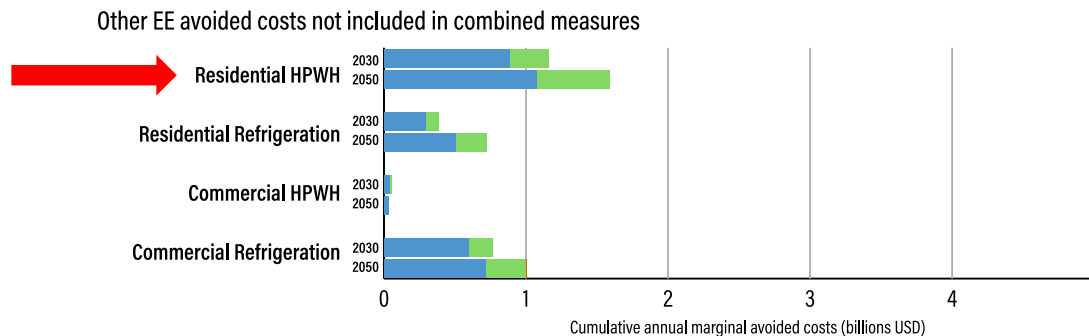
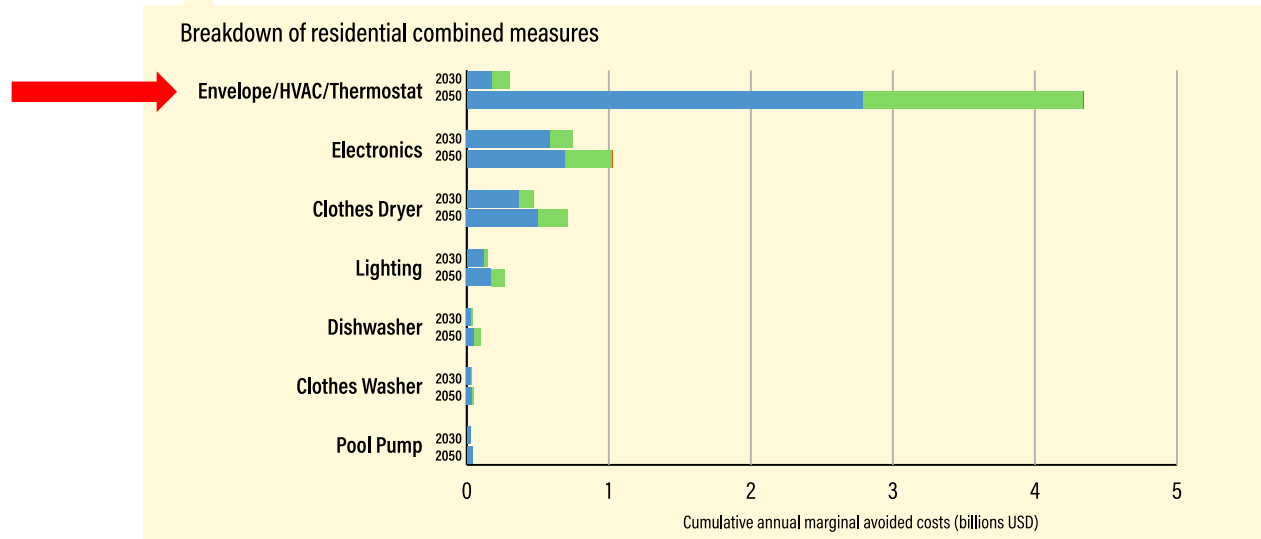
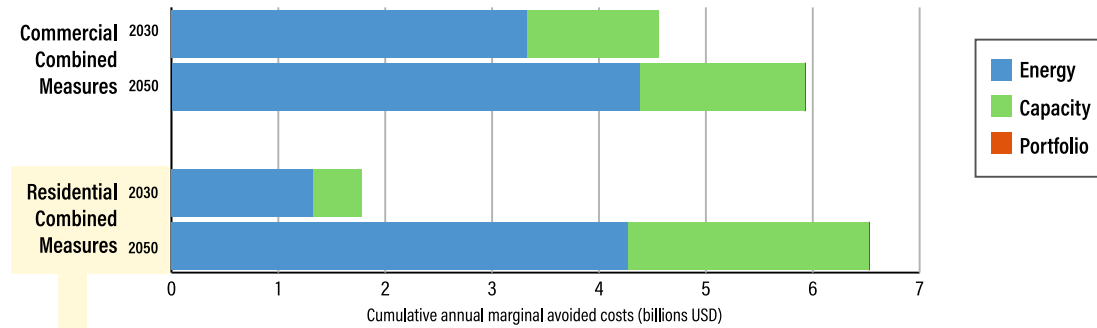
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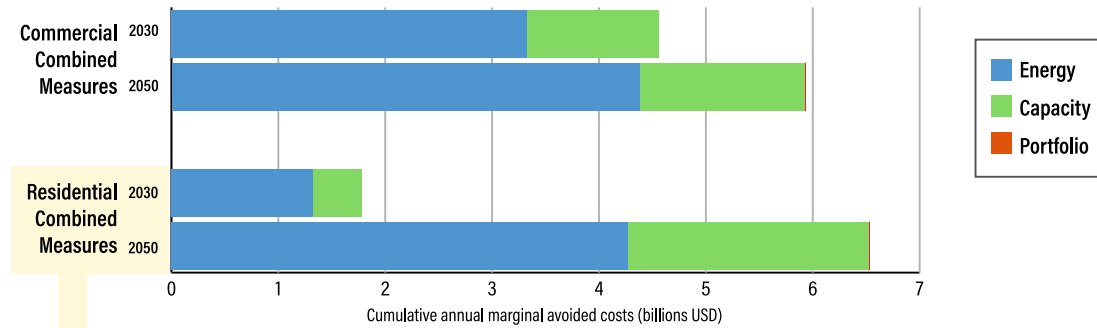
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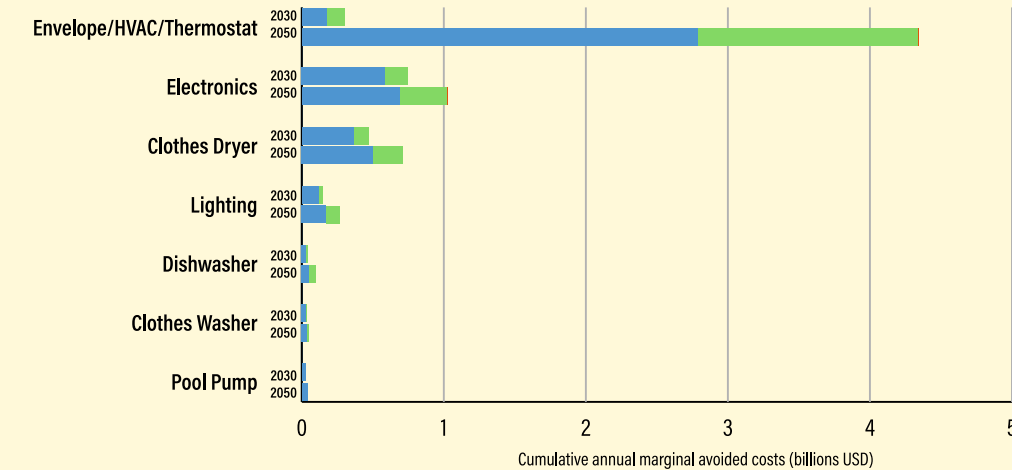
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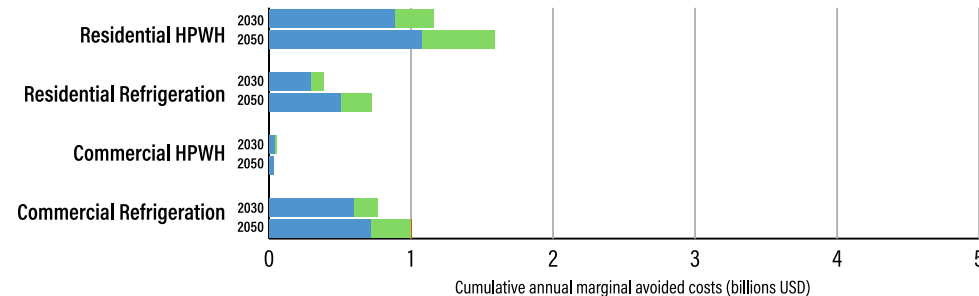
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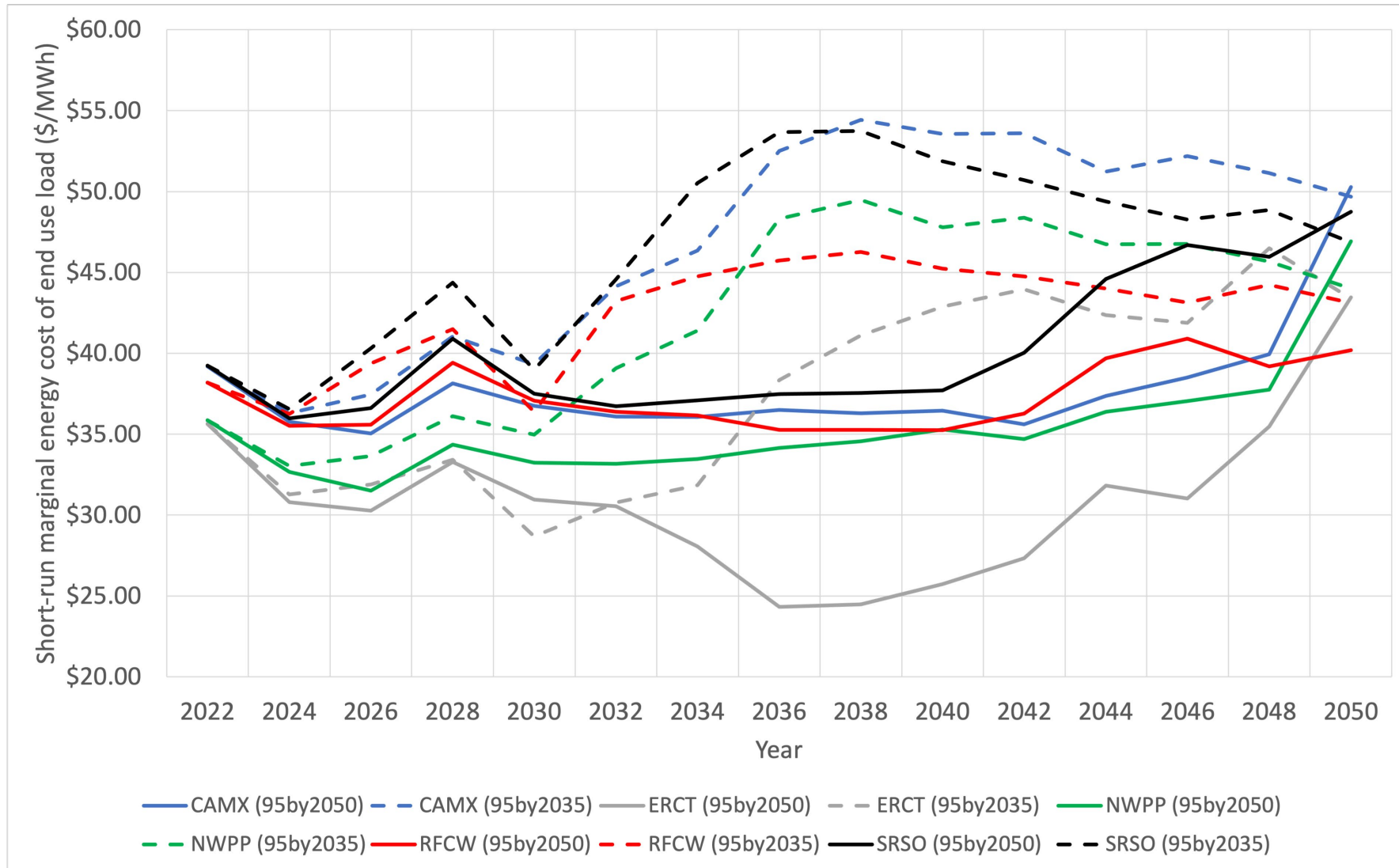
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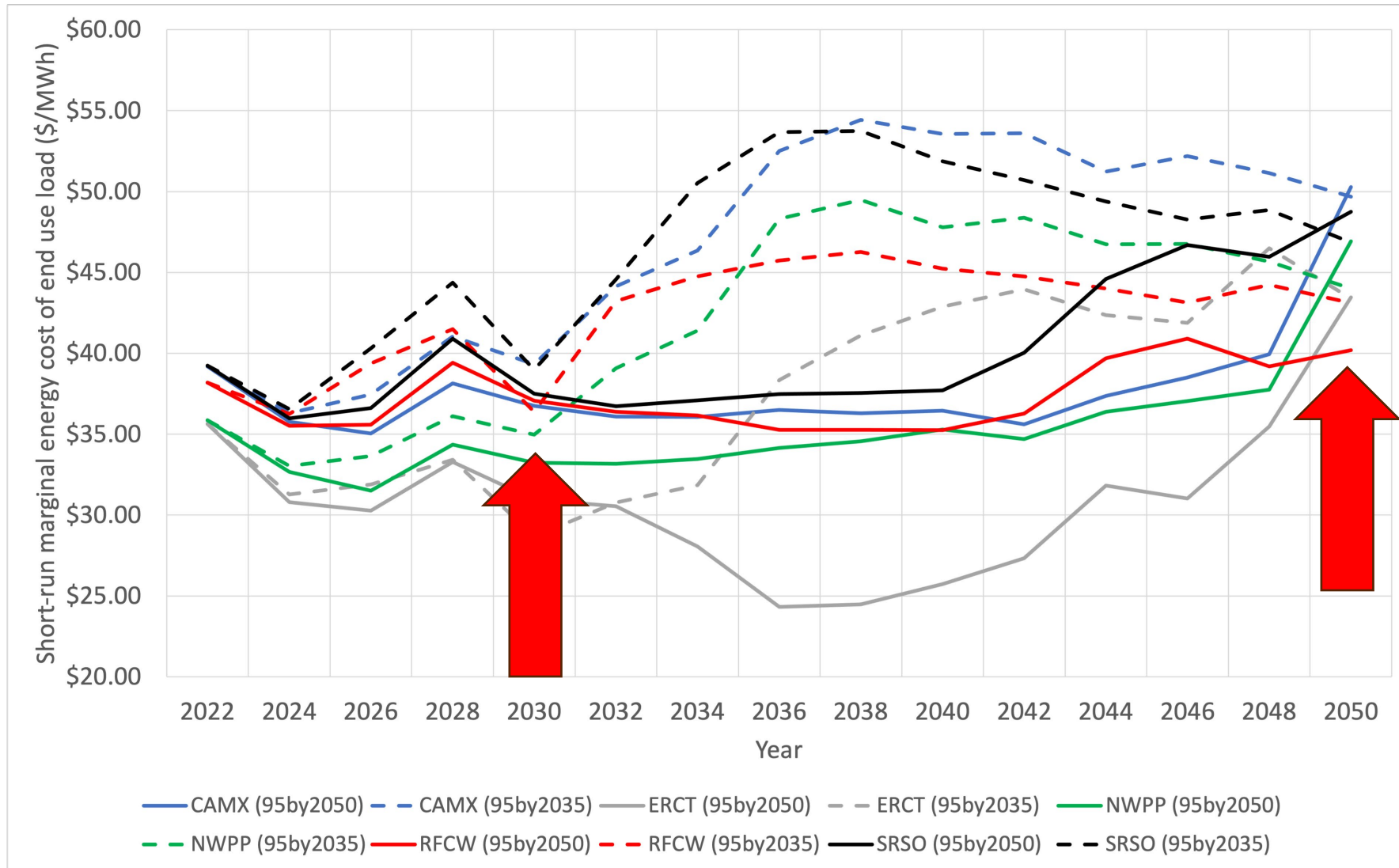


# Energy prices rise more quickly given faster renewable energy deployment

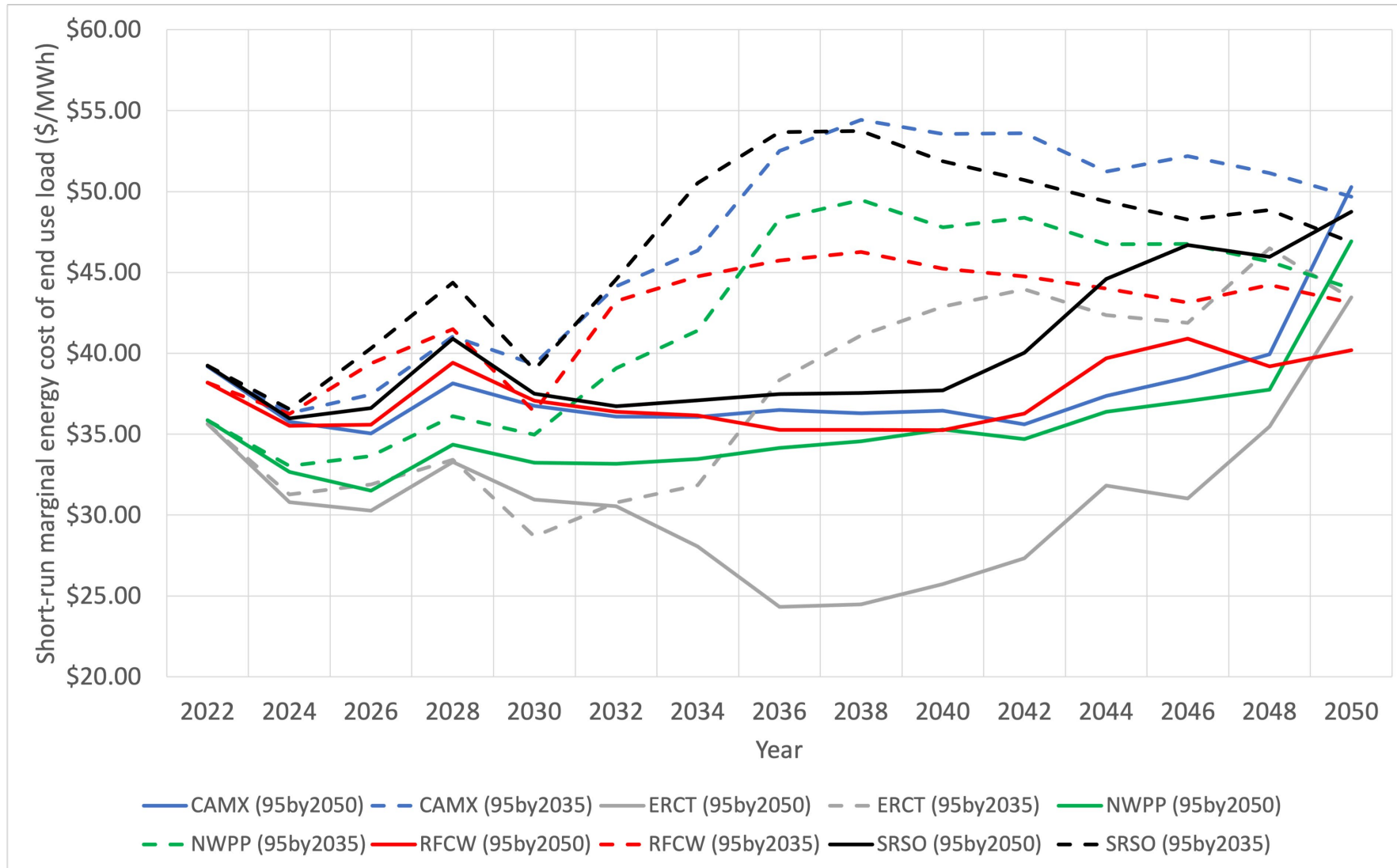




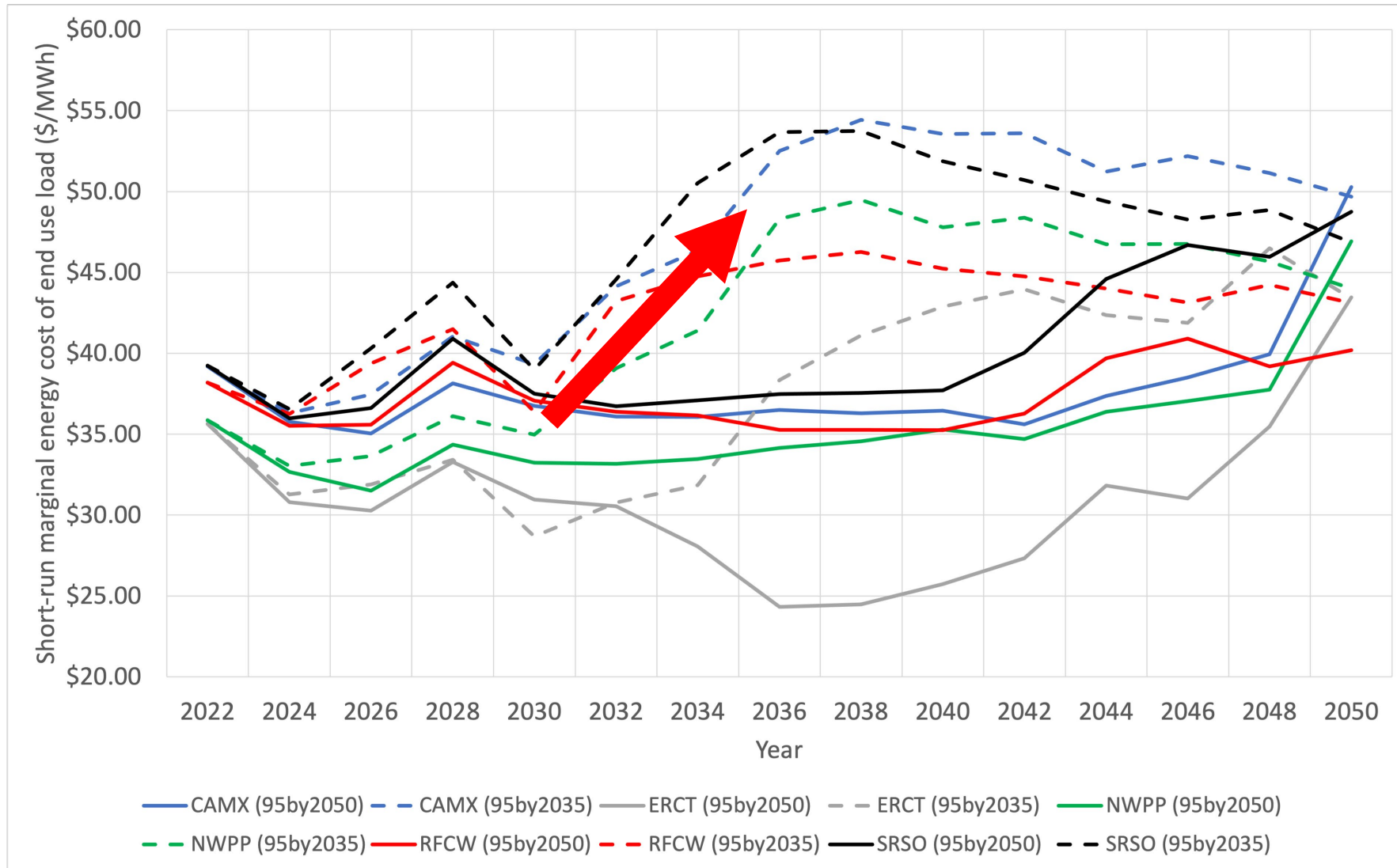
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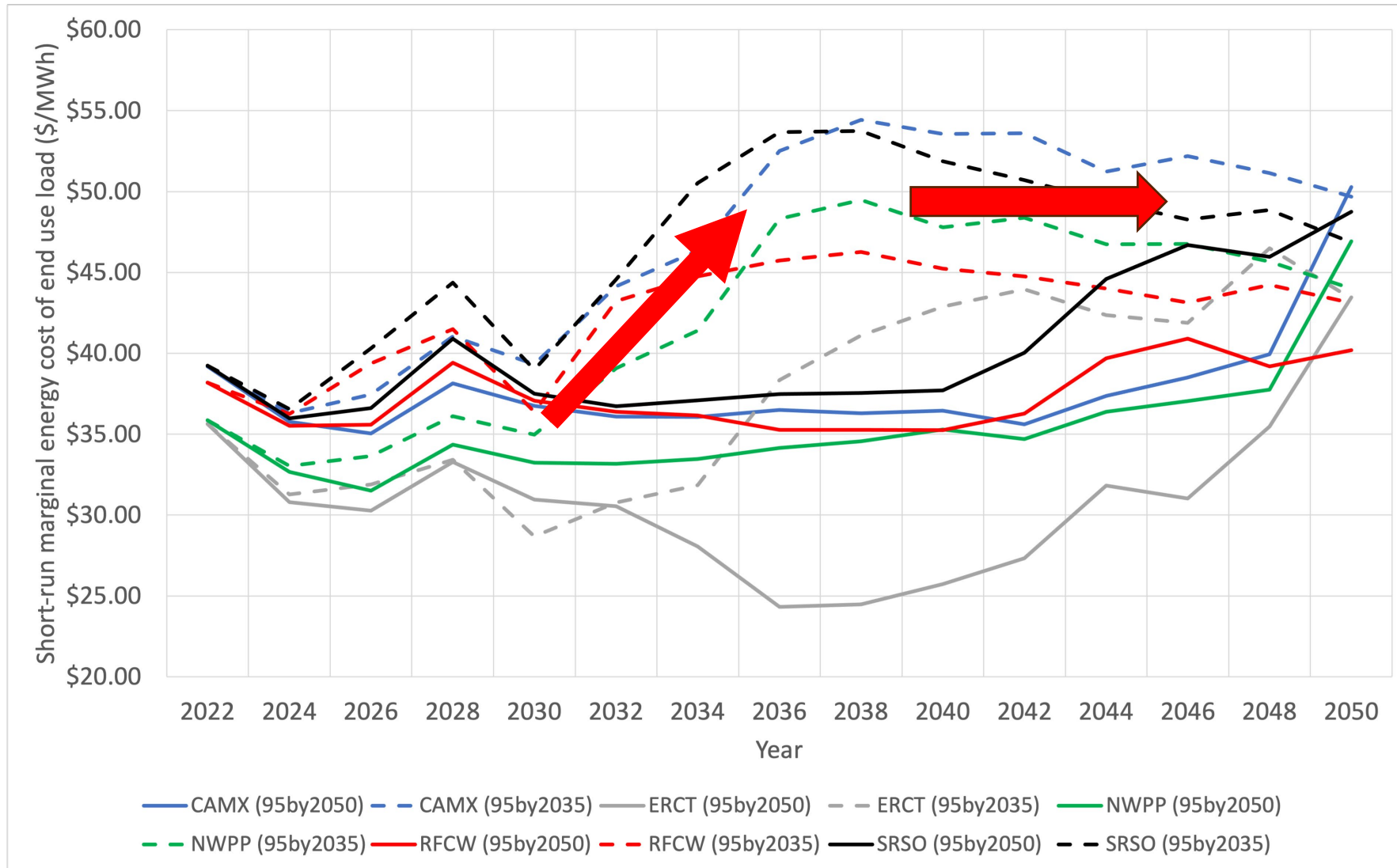
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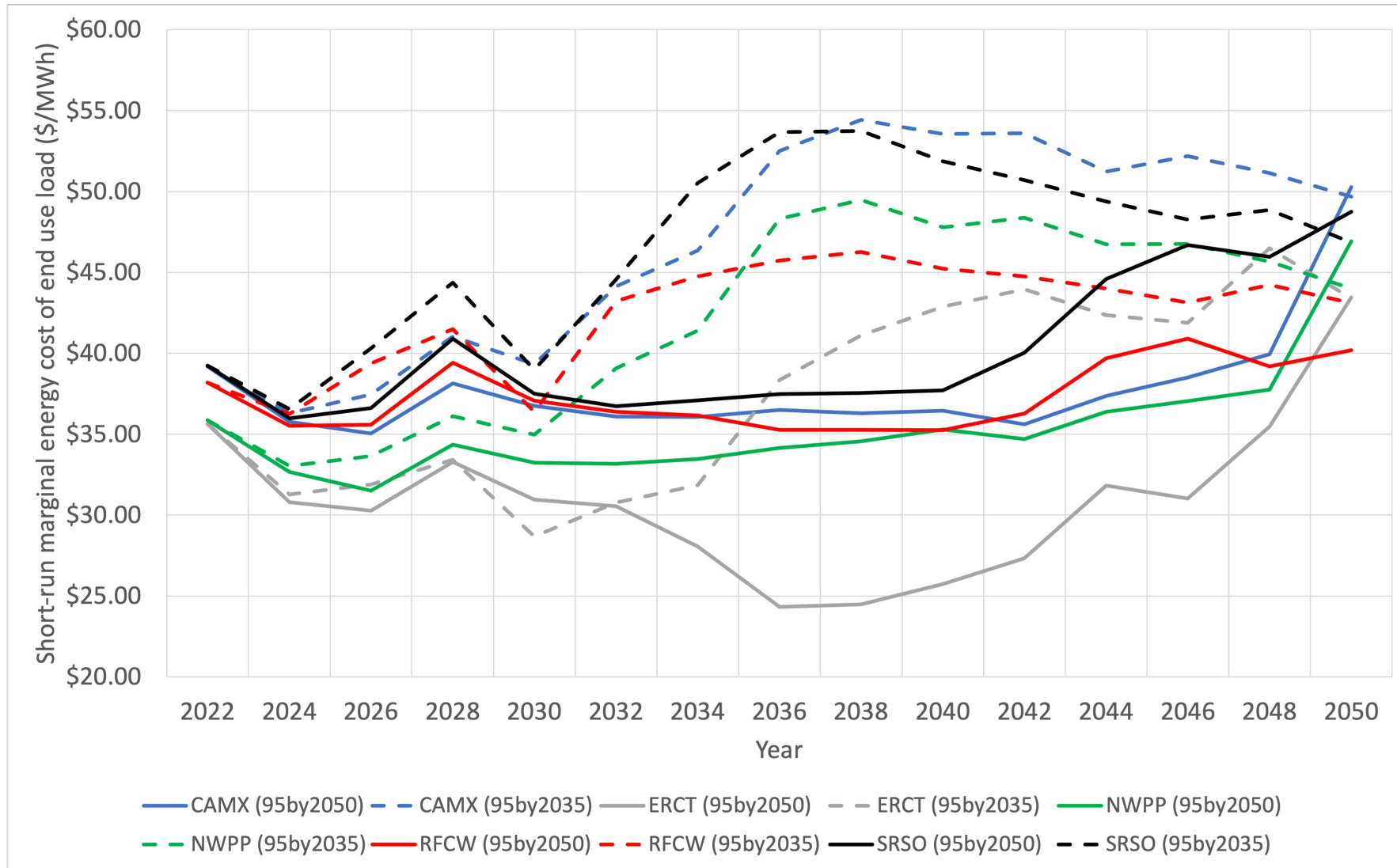
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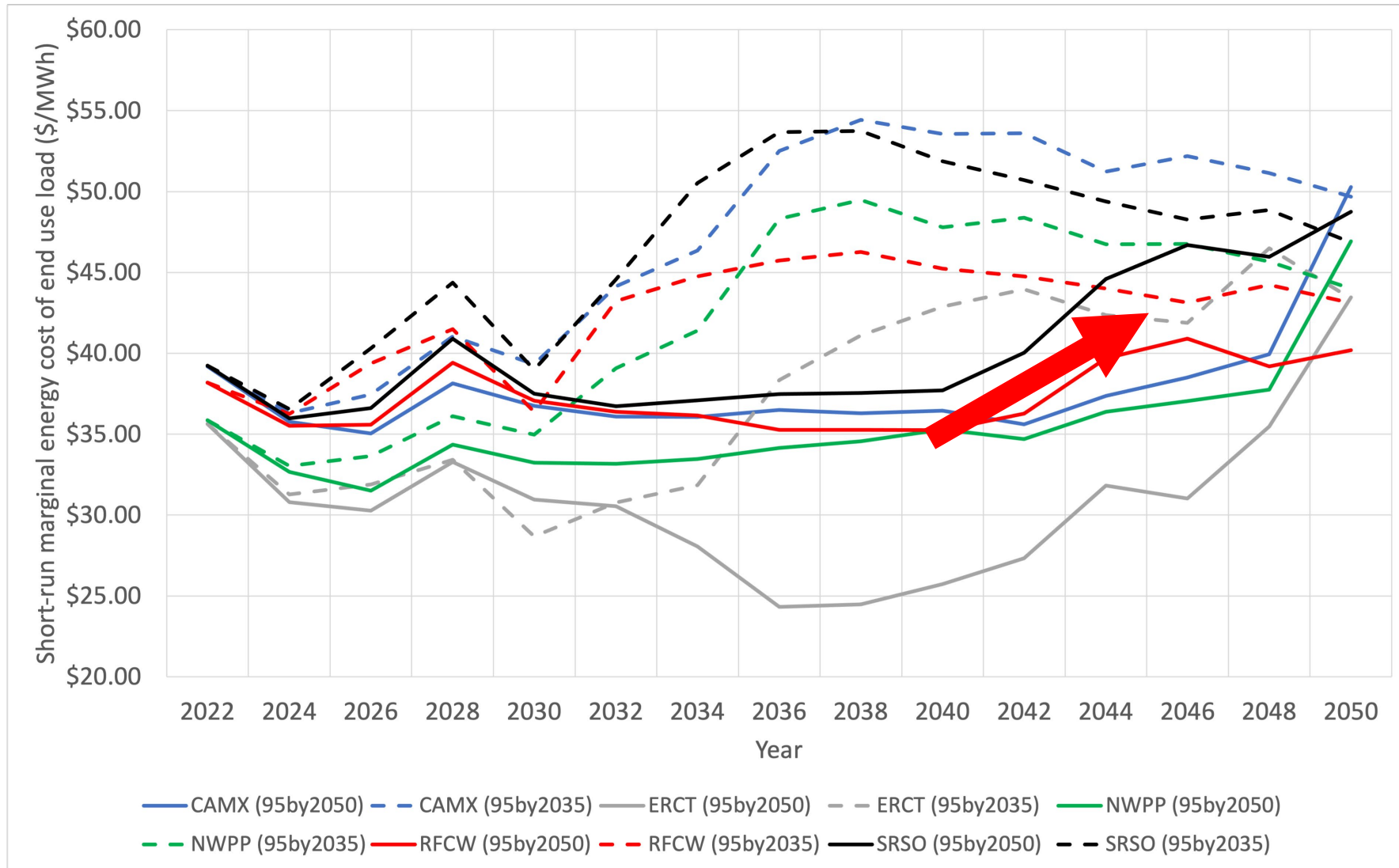
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# Contact

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