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An Economic Perspective on "Negative-Cost" Energy Efficiency Opportunities and Their Policy Implications

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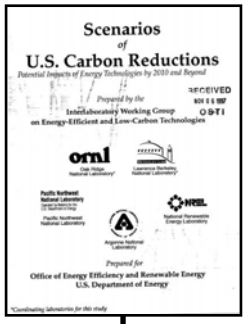
Over the past decade, several studies have claimed that significant opportunities exist for "negative-cost" GHG emission reductions



Department of Energy
"Five-Labs" Study

McKinsey
Study

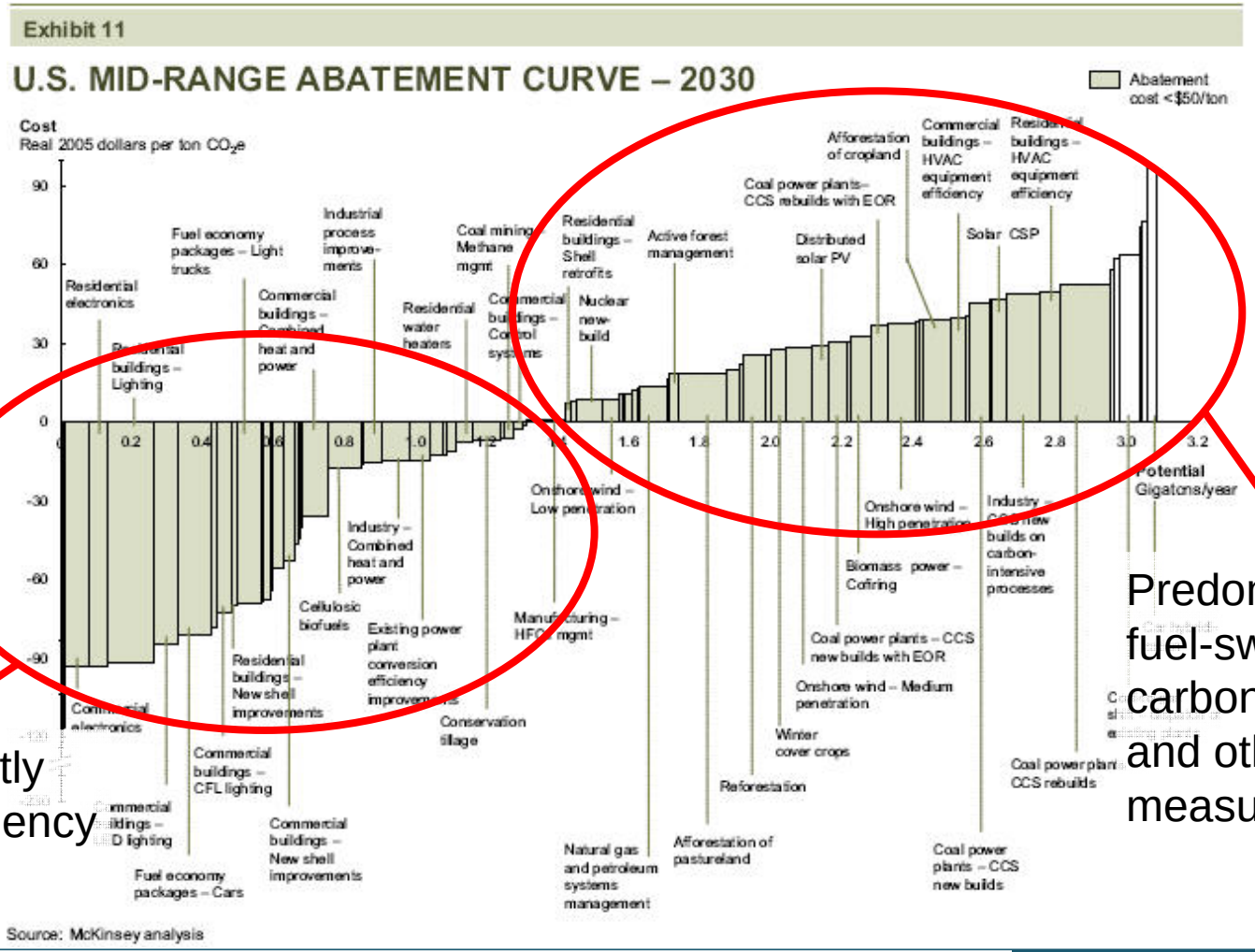
1998 2000 2002 2004 2006 2008

California
Studies

Energy efficiency is at the center of most claims about potential "negative-cost" emission reduction opportunities

- "End-of-pipe" control technologies typically have positive costs (e.g., scrubbers or carbon capture and storage)
  - They introduce additional costs with offsetting benefits that are predominantly environmental (reduced emissions)
- But energy efficiency measures that reduce emissions present the prospect of "negative-cost" emission reductions
  - Energy efficiency measures typically involve upfront capital outlays followed by reductions in future energy expenditures
  - The value of future energy savings from some untapped energy efficiency measures might exceed those measures' initial capital costs
  - Therefore, some untapped energy efficiency measures may be desirable *even without considering the resulting benefits of GHG emission reductions*
    - That is, they may have "negative costs"

McKinsey's cost curve highlights the central role of energy efficiency in generating "negative-cost" reductions



Source: McKinsey analysis

Predominantly energy-efficiency measures

Predominantly fuel-switching, carbon capture, and other measures

Studies finding significant "negative-cost" emission reduction opportunities raise important policy questions

- There will always be debates about the accuracy of cost estimates
- But studies finding substantial opportunities for "negative-cost" emission reductions raise an additional set of issues and questions
- They imply that there are many proverbial $20 bills lying on the sidewalk that we are walking right by
- Such studies raise important policy questions

AGENDA

- How do studies finding significant "negative-cost" emission reduction opportunities compare with other recent studies of climate policy costs?

- Why would "negative-cost" emission reduction opportunities exist?

- Why might studies incorrectly conclude that such opportunities exist?

- What policy lessons emerge from considering the potential for "negative-cost" reductions?

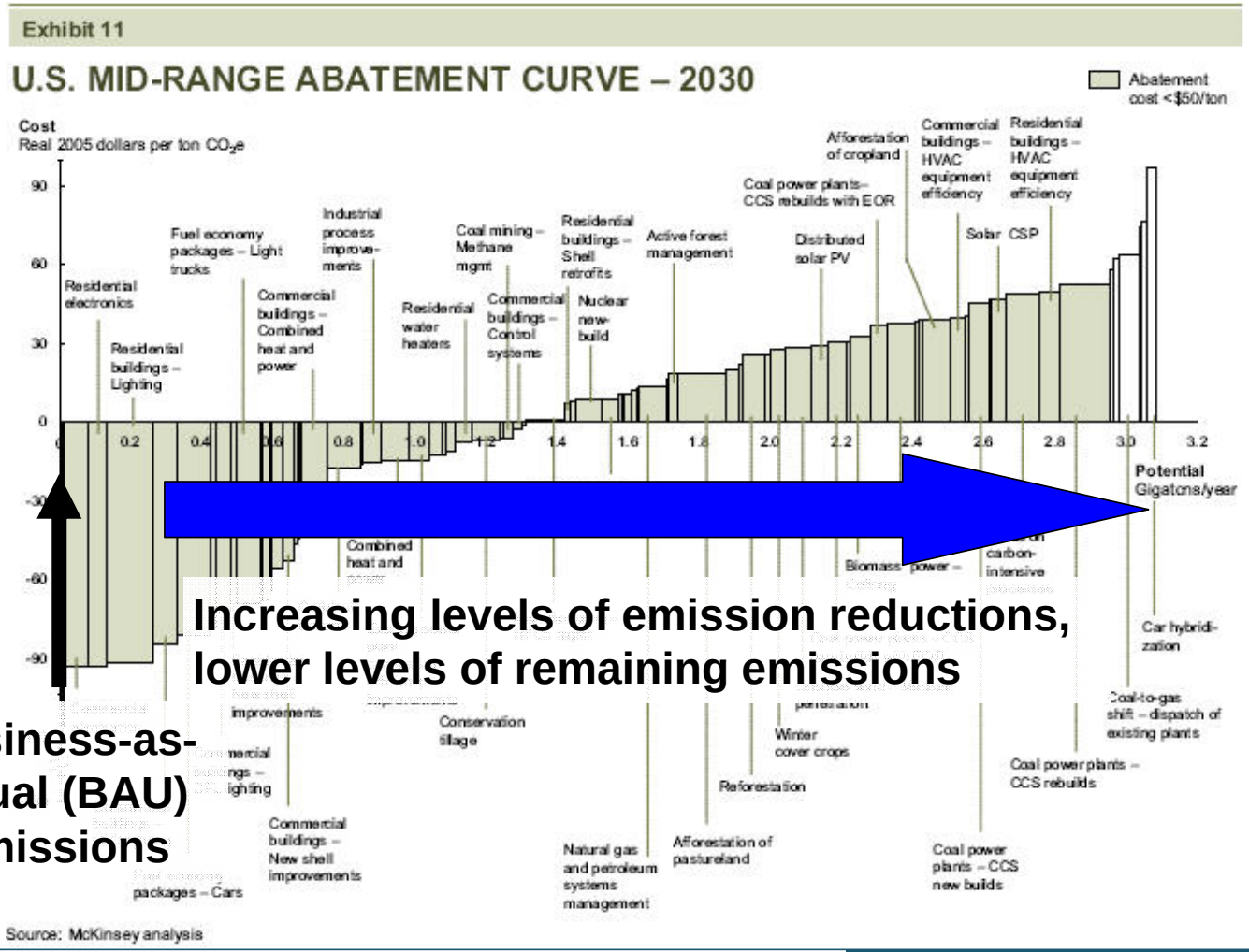
Comparison with other recent studies of climate policy costs

- McKinsey's study is one of several recent assessments of the cost of substantially reducing U.S. greenhouse gas (GHG) emissions
- There have been several analyses of the economic impact of the Lieberman-Warner bill (S. 2191)
  - U.S. Energy Information Administration (EIA)
  - U.S. Environmental Protection Agency (EPA)
  - Massachusetts Institute of Technology (MIT)
  - Clean Air Task Force (CATF)
  - American Council for Capital Formation and the National Association of Manufacturers (ACCF/NAM)
  - National Mining Association and Charles River Associates (NMA/CRA)
- What insights can be gained by comparing these studies?

It is tremendously challenging to make meaningful comparisons across these studies

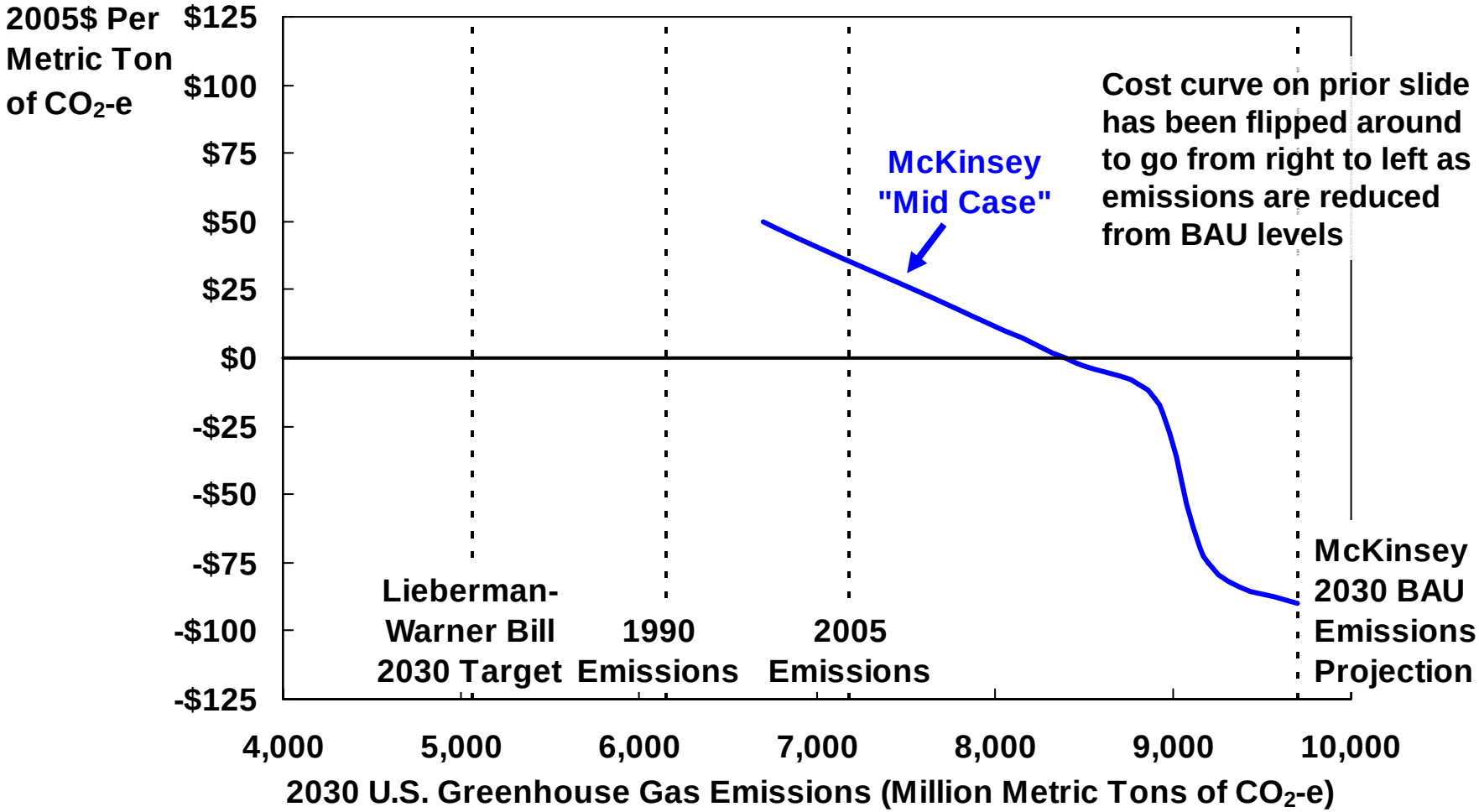
- Differences in key assumptions
  - Projections of business-as-usual (BAU) emissions and fuel prices
  - Availability, costs, and projected reductions in costs of key technologies
- Differences in the characterization of the policies being modeled
- Differences in modeling frameworks
  - "General equilibrium" models (e.g., EPA's) that capture economy-wide interactions
  - "Partial equilibrium" models (e.g., McKinsey's) that do not account for key elements of these interactions
- It is difficult to tease out how much of the differences in studies' results are due to each of these underlying differences
- But with that caveat …

McKinsey's marginal cost curve for reducing greenhouse gas emissions



Source: McKinsey analysis

Comparison of McKinsey, EIA, and EPA Estimates of the Marginal Cost of Emission Reductions to Meet Varying U.S. 2030 GHG Emissions Targets*



* Curves reflect effect of GHG emission reductions and changes in biogenic sequestration.

Sources: McKinsey & Company; U.S. Energy Information Administration and U.S. Environmental Protection Agency analyses of the Lieberman-Warner Bill (S.2191); and Analysis Group calculations.

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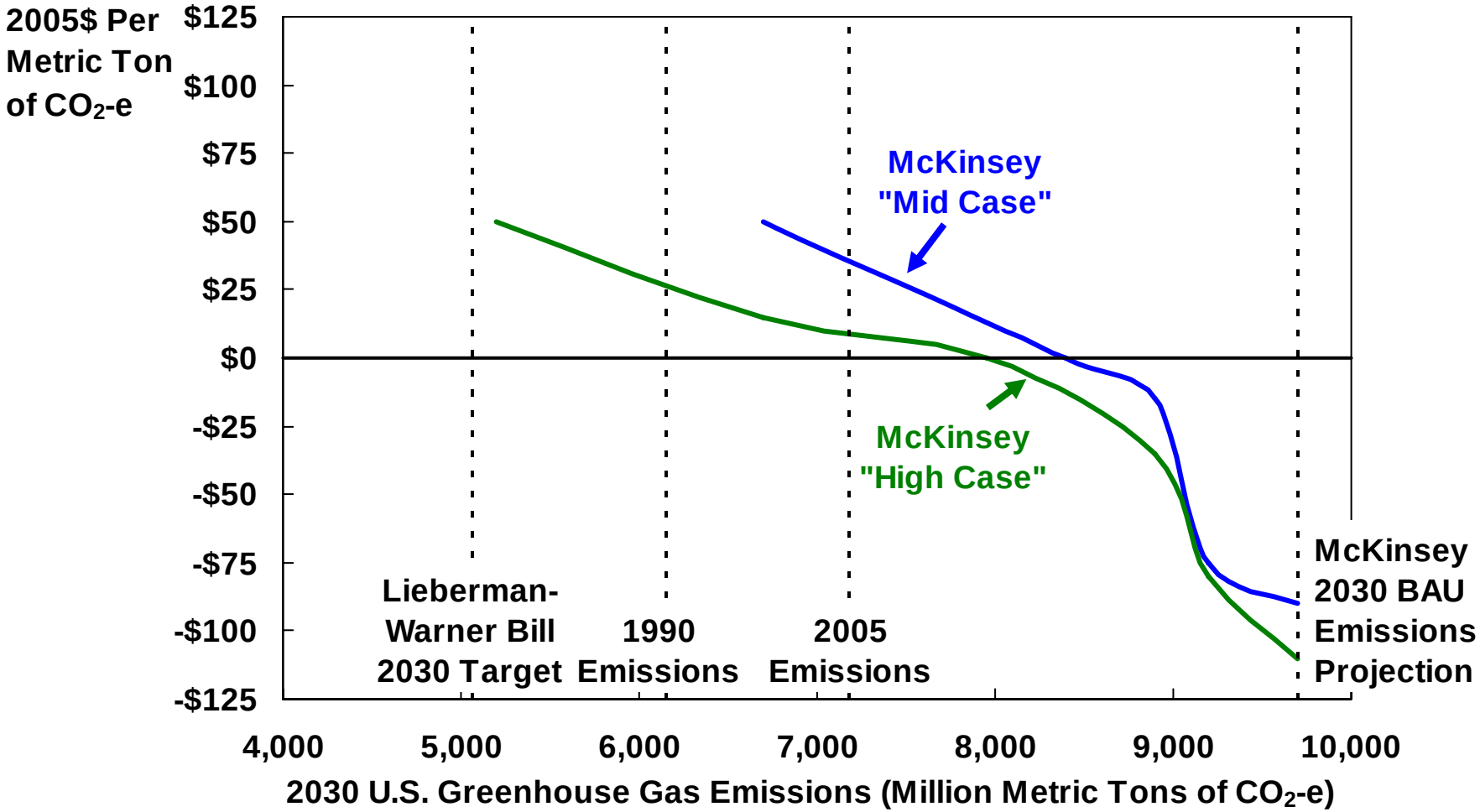

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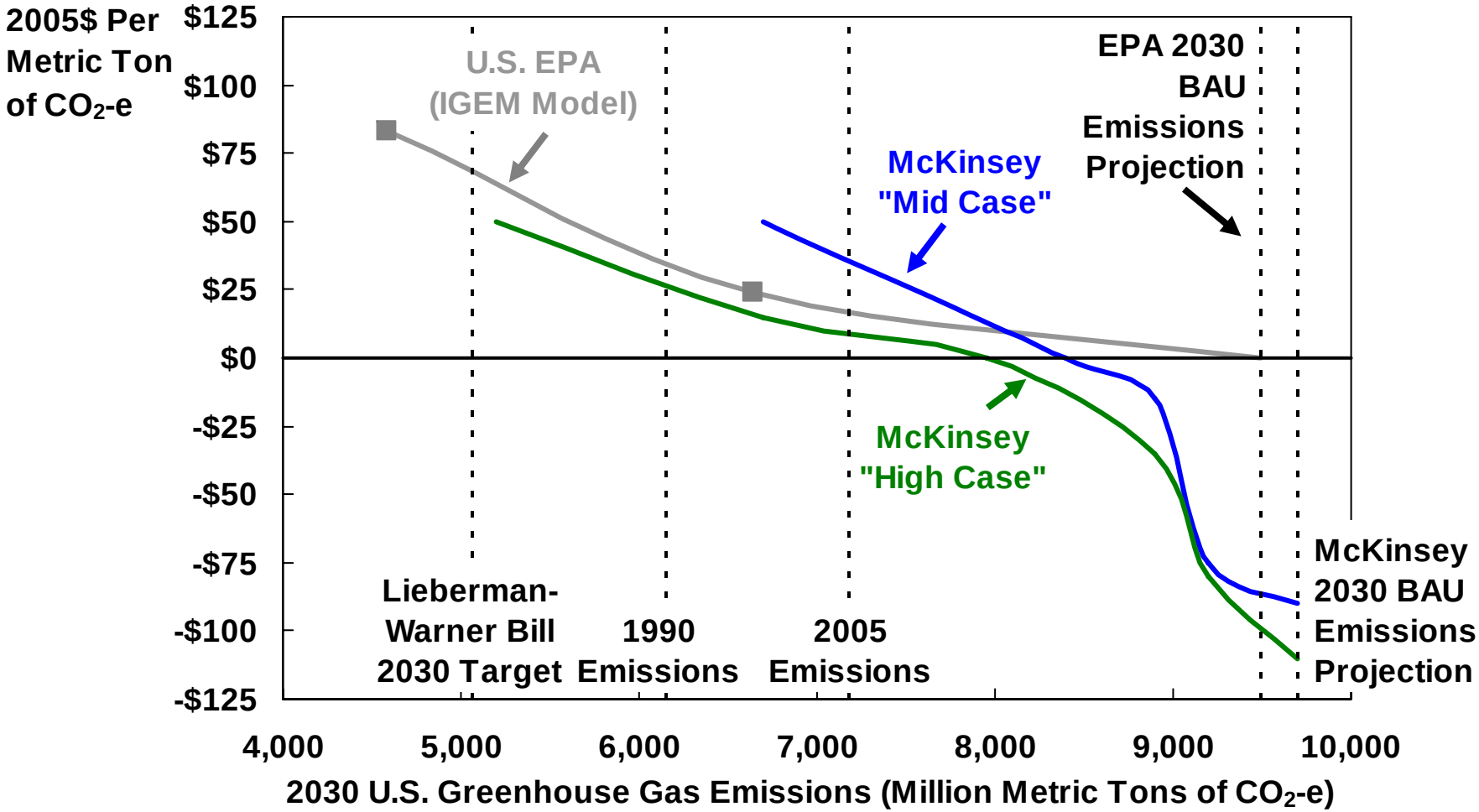

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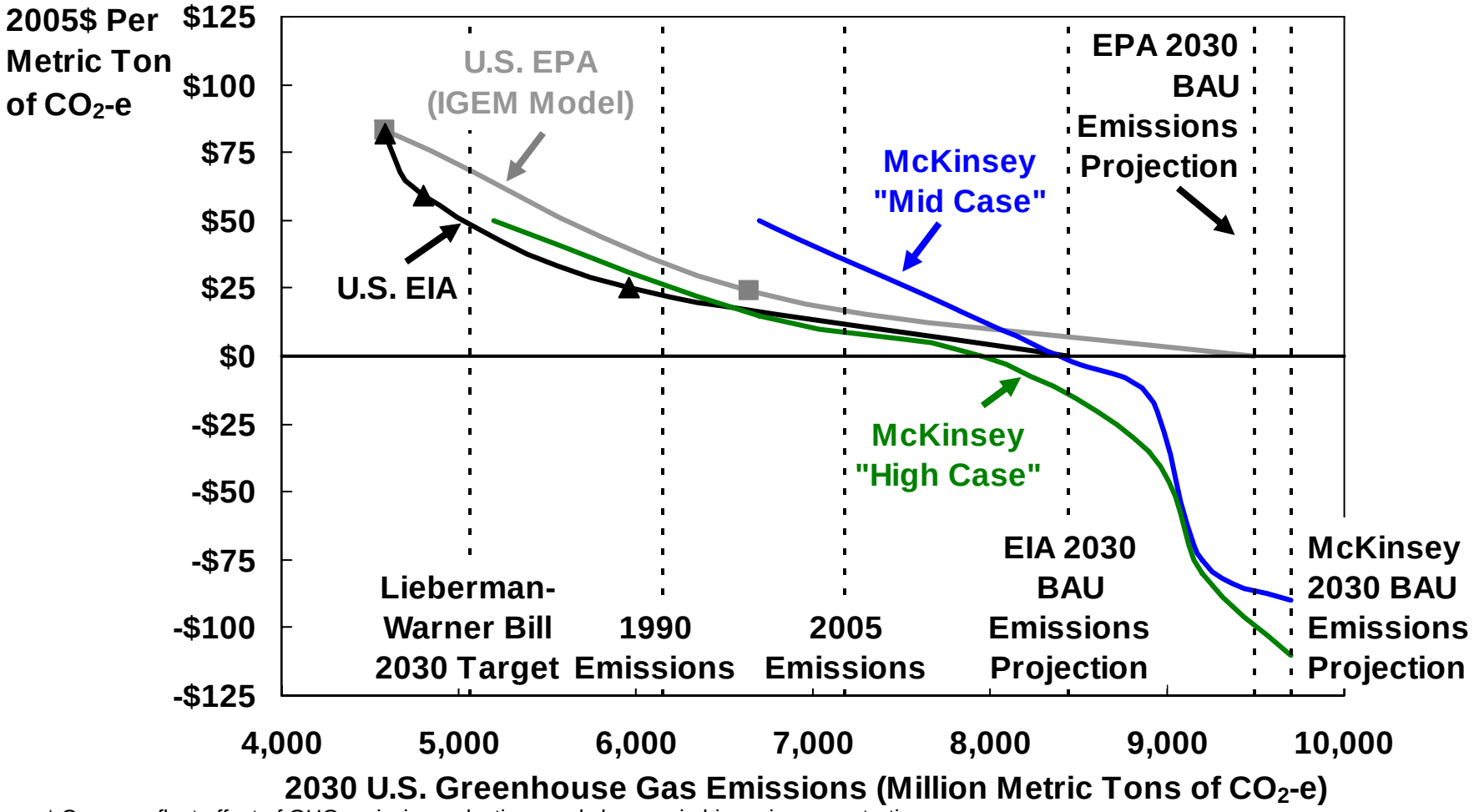

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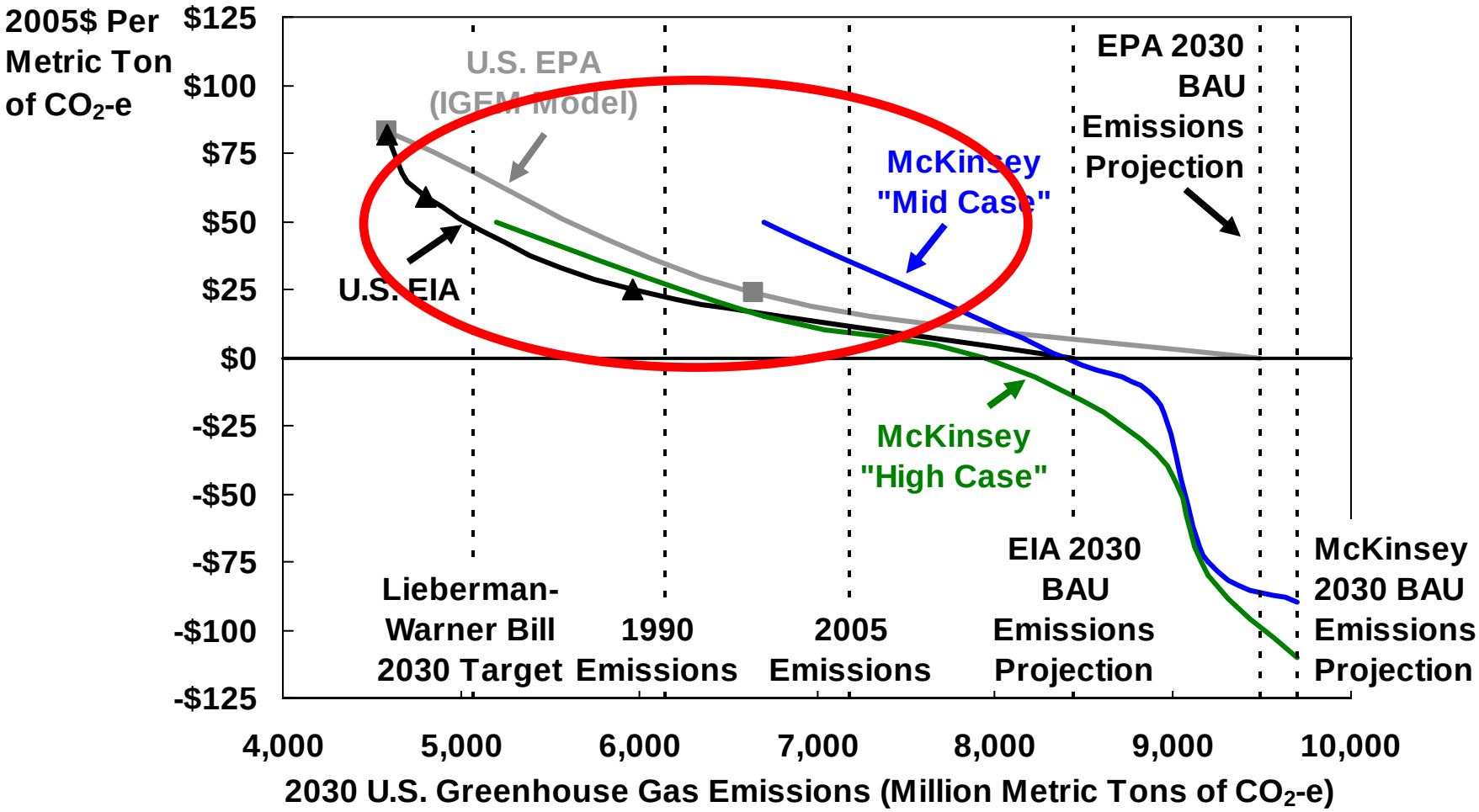
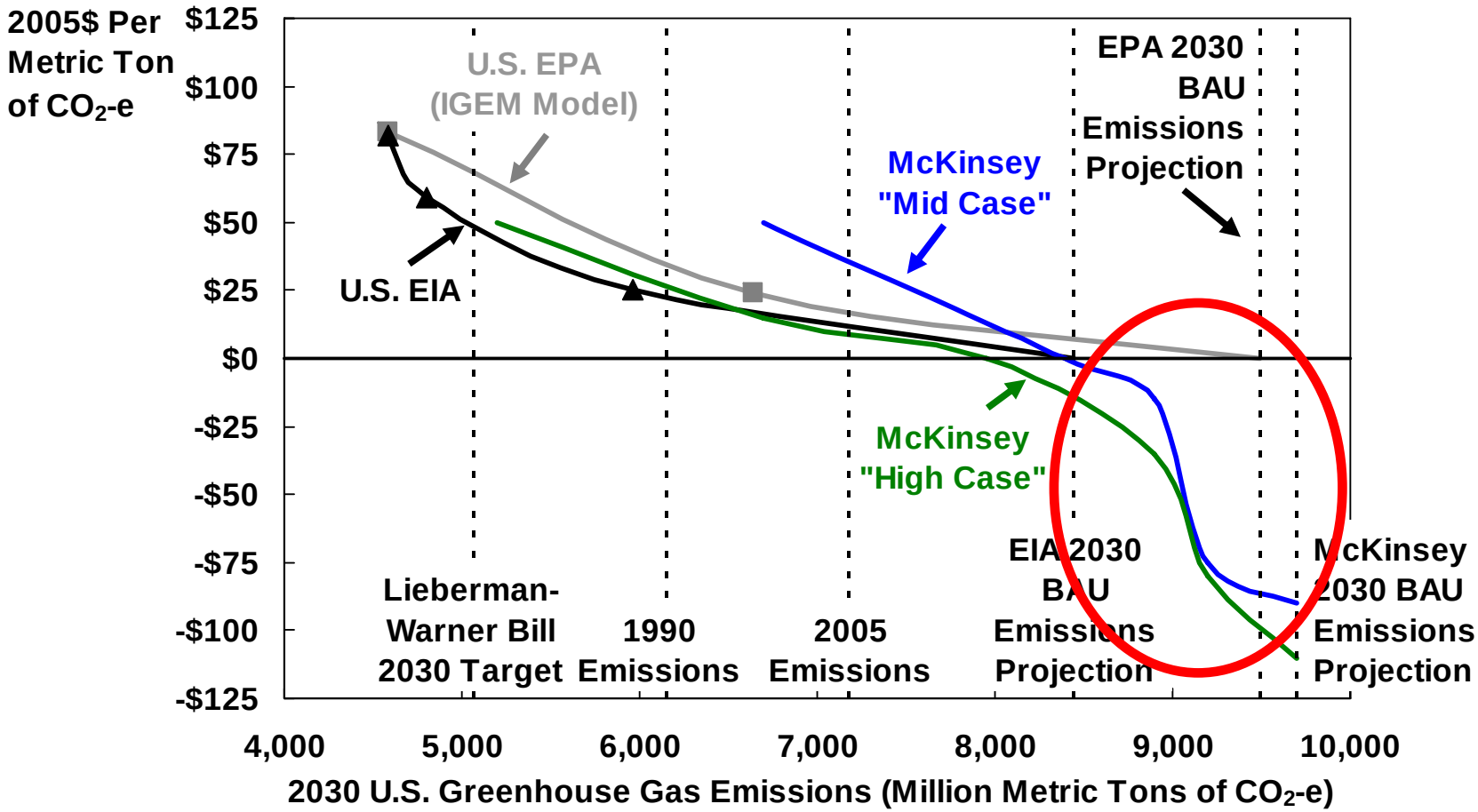
McKinsey's findings are generally consistent with EIA and EPA estimates of the marginal cost of the emission reductions needed to achieve targets like those established in the Lieberman-Warner bill



This general agreement regarding the marginal cost of emission reductions has a few important implications

- Studies like McKinsey's do not necessarily suggest different conclusions about the emission allowance prices that might prevail under a cap-and-trade program like that proposed in the Lieberman-Warner bill
  - Allowance prices are determined by the marginal cost of emission reductions, which is similar across the McKinsey, EIA, and EPA studies
- Therefore, studies like McKinsey's do not necessarily suggest different conclusions about a cap-and-trade system's impact on electricity or other energy prices, or on industrial competitiveness
- Studies like McKinsey's also do not necessarily suggest different conclusions about the appropriate near-term stringency of GHG regulations
  - This stringency should be informed by the marginal cost (not the average cost) of the emission reductions needed to meet a particular target

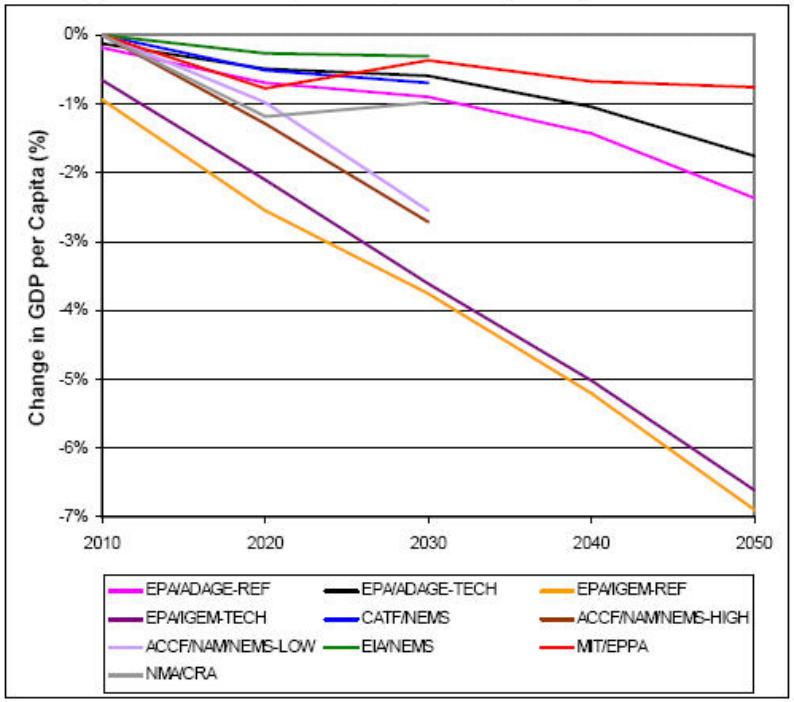
"Negative-cost" reductions are what differentiates studies like McKinsey's from so many other studies of climate policy costs



These substantial "negative-cost" reductions lead studies like McKinsey's to very different conclusions about the total cost of climate policy

Congressional Research Service Summary of Estimates of the Lieberman-Warner Bill's Percentage Impacts on GDP per Capita

Figure 6. Percentage Change in GDP per Capita Under S. 2191



Note: Reductions are relative to each model's reference case baseline.

McKinsey Study

"[T]he sum of the (emission) abatement options with negative … costs would roughly offset the sum of those with positive … costs."

McKinsey concludes that as much as 4.5 gigatons of emission reductions — nearly enough to achieve the 2030 Lieberman-Warner target — could be achieved at roughly no net cost in large part because of cost savings from energy efficiency opportunities

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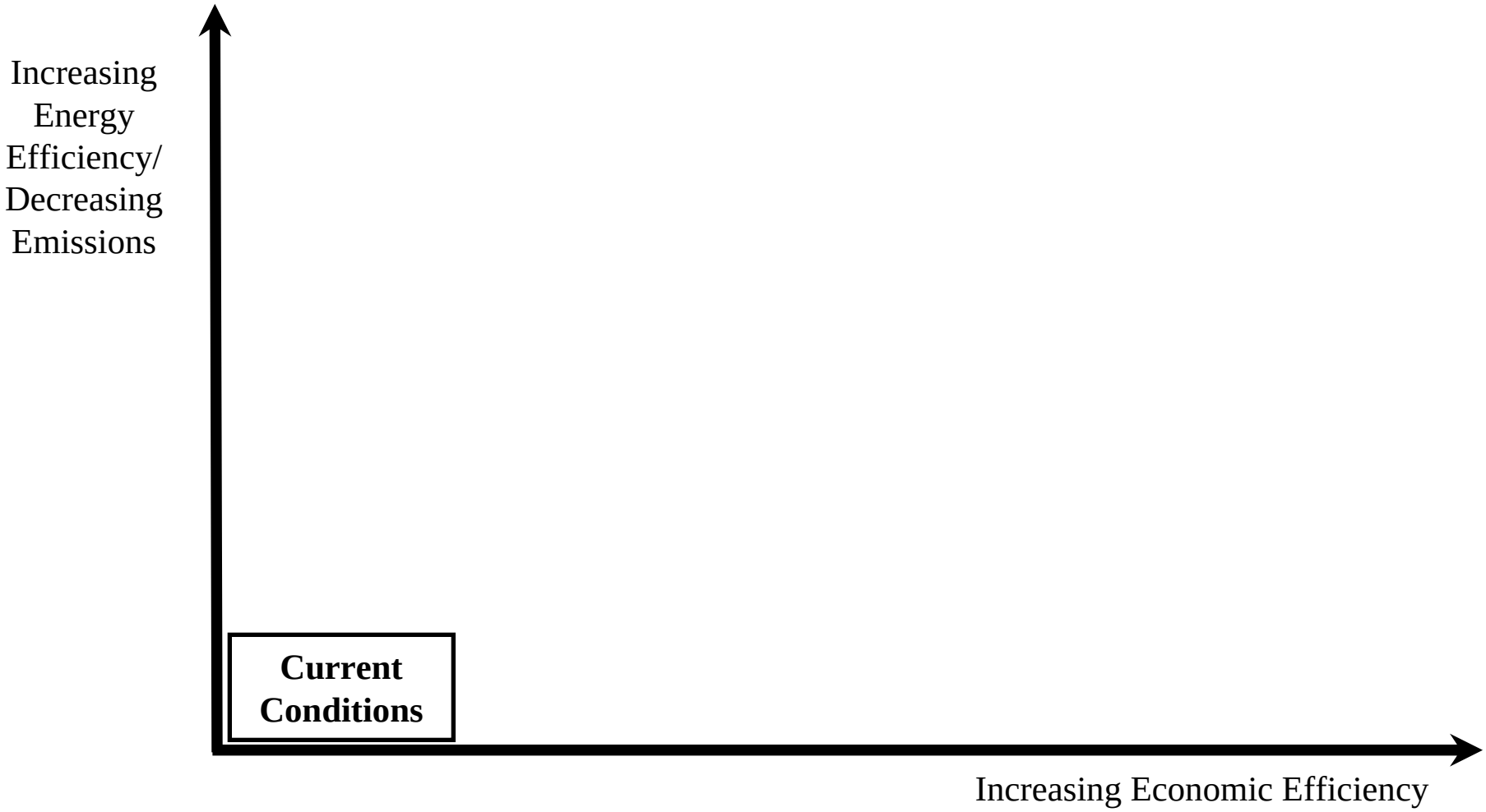
- How do studies finding significant "negative-cost" emission reduction opportunities compare with other recent studies of climate policy costs?

- Why would "negative-cost" emission reduction opportunities exist?

- Why might studies incorrectly conclude that such opportunities exist?

- What policy lessons emerge from considering the potential for "negative-cost" reductions?

A graphical representation of opportunities for energy efficiency improvements



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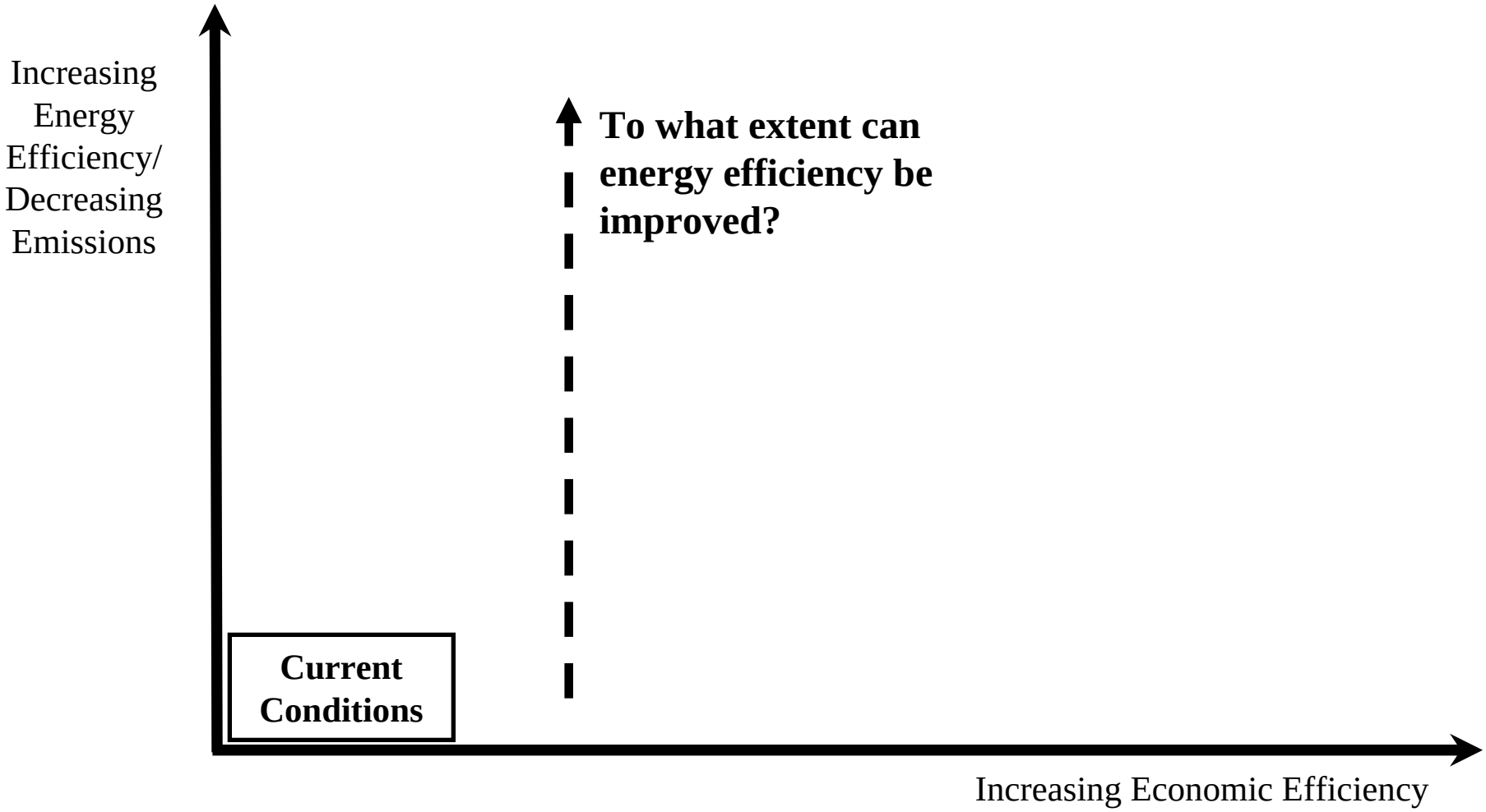

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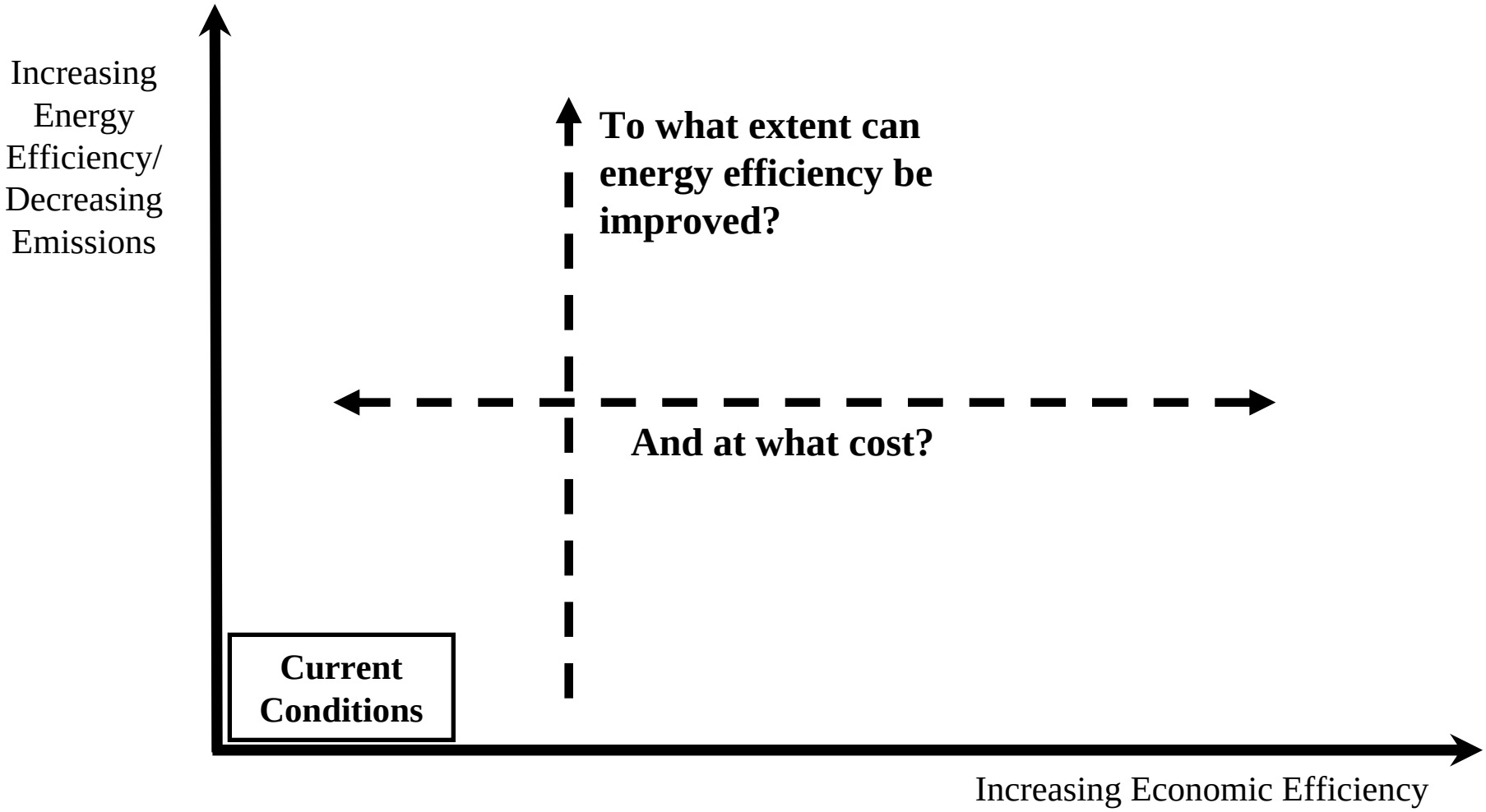
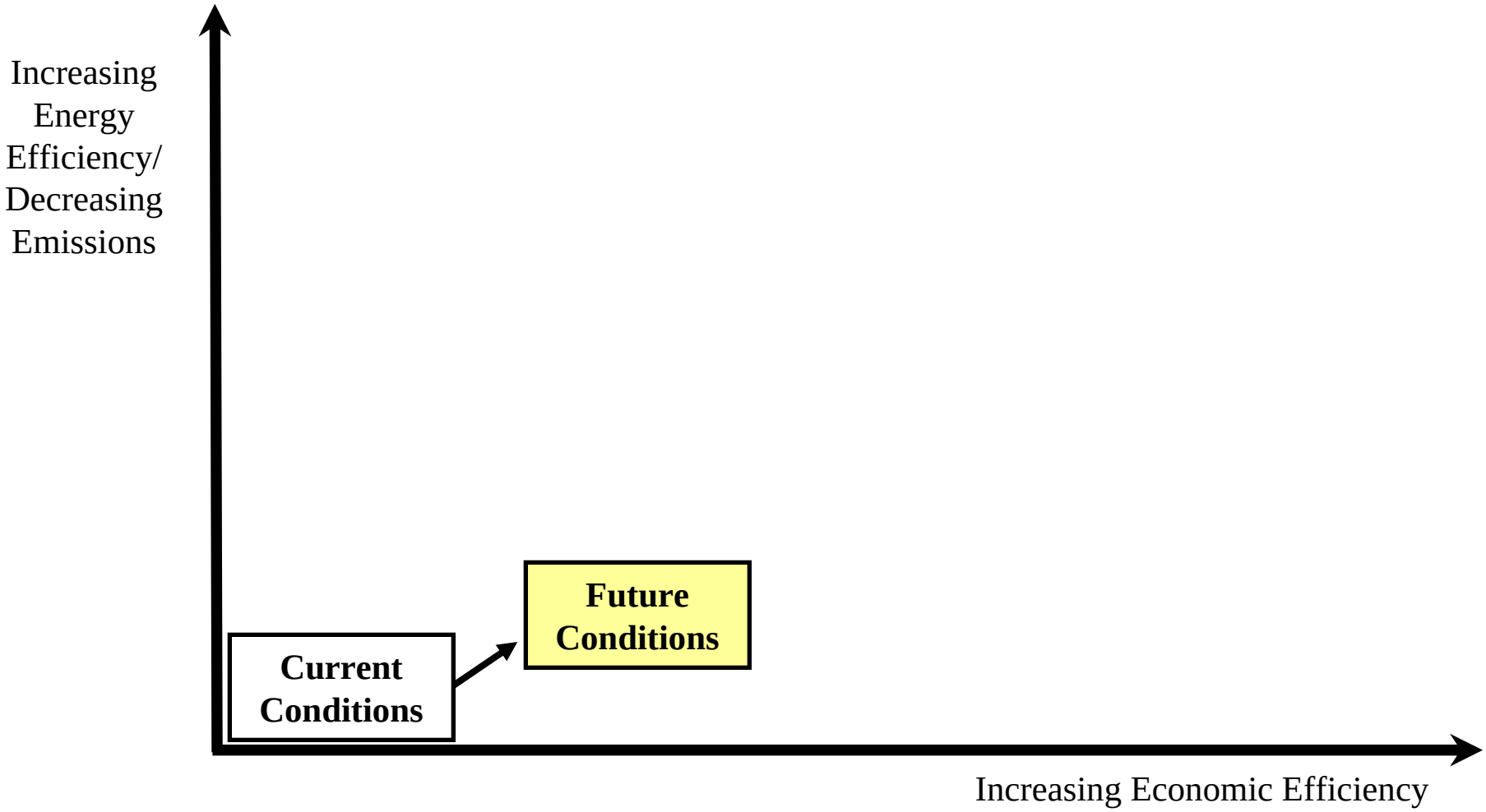


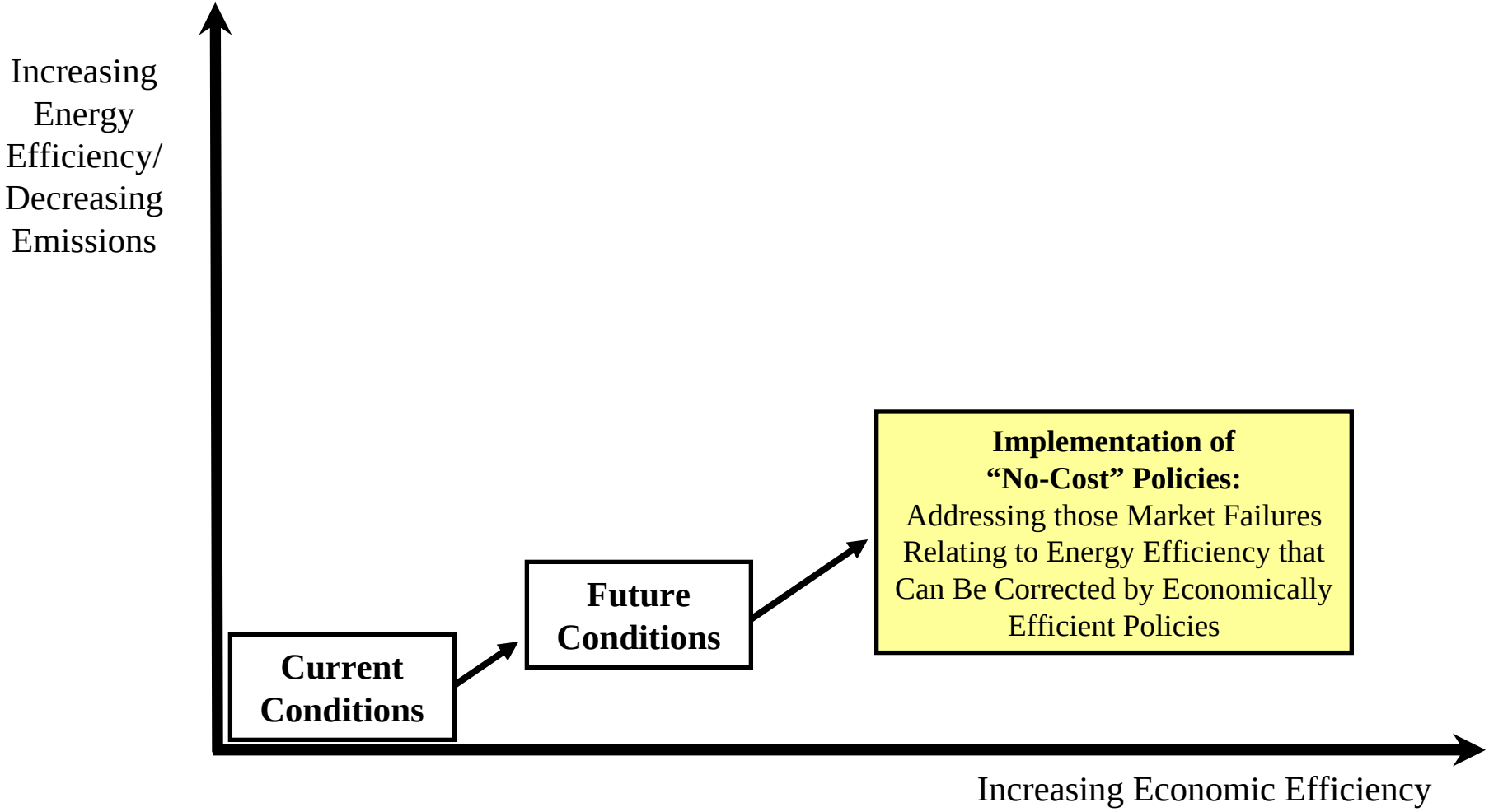
Firms and households will voluntarily adopt many "negative-cost" energy efficiency opportunities on their own



Why might "negative-cost" energy efficiency opportunities remain untapped in the absence of policy intervention?

- No one disputes that "negative-cost" energy efficiency improvements exist
- And there is general agreement that households' and firms' energy efficiency investments are responsive to energy prices
  - Many "negative-cost" measures are adopted even without policy interventions
- But studies like McKinsey's imply *both* that substantial "negative-cost" energy efficiency improvements are available (or on the horizon), *and* that many will not be realized absent some policy intervention
- That is, such studies conclude that households and firms do not respond to energy prices *to the full extent that they should*
  - This **"energy efficiency gap"** implies that a substantial amount of cost-saving energy-efficiency opportunities are being left on the table

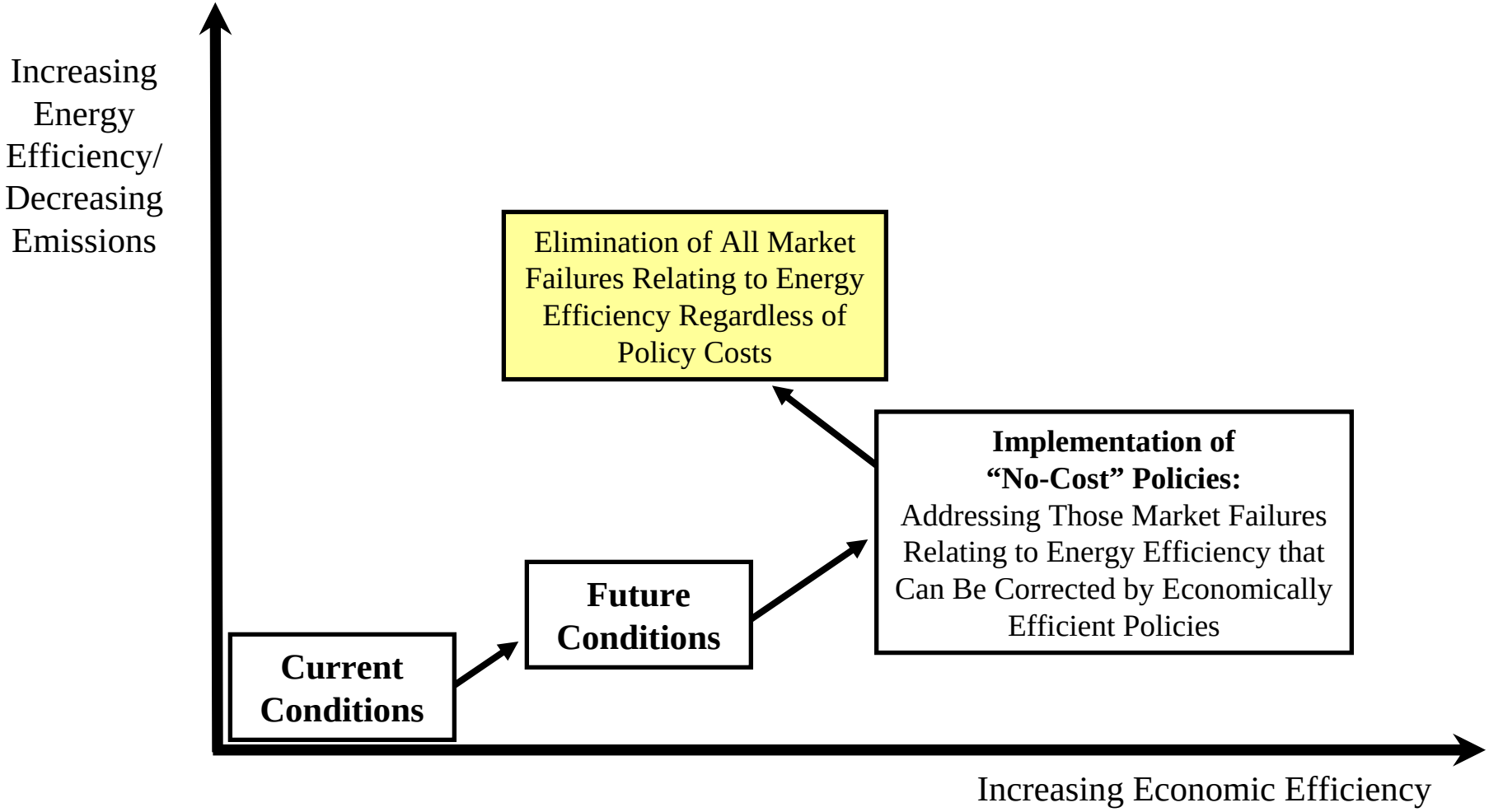
Market failures may offer some opportunities for "negative-cost" energy efficiency improvements …



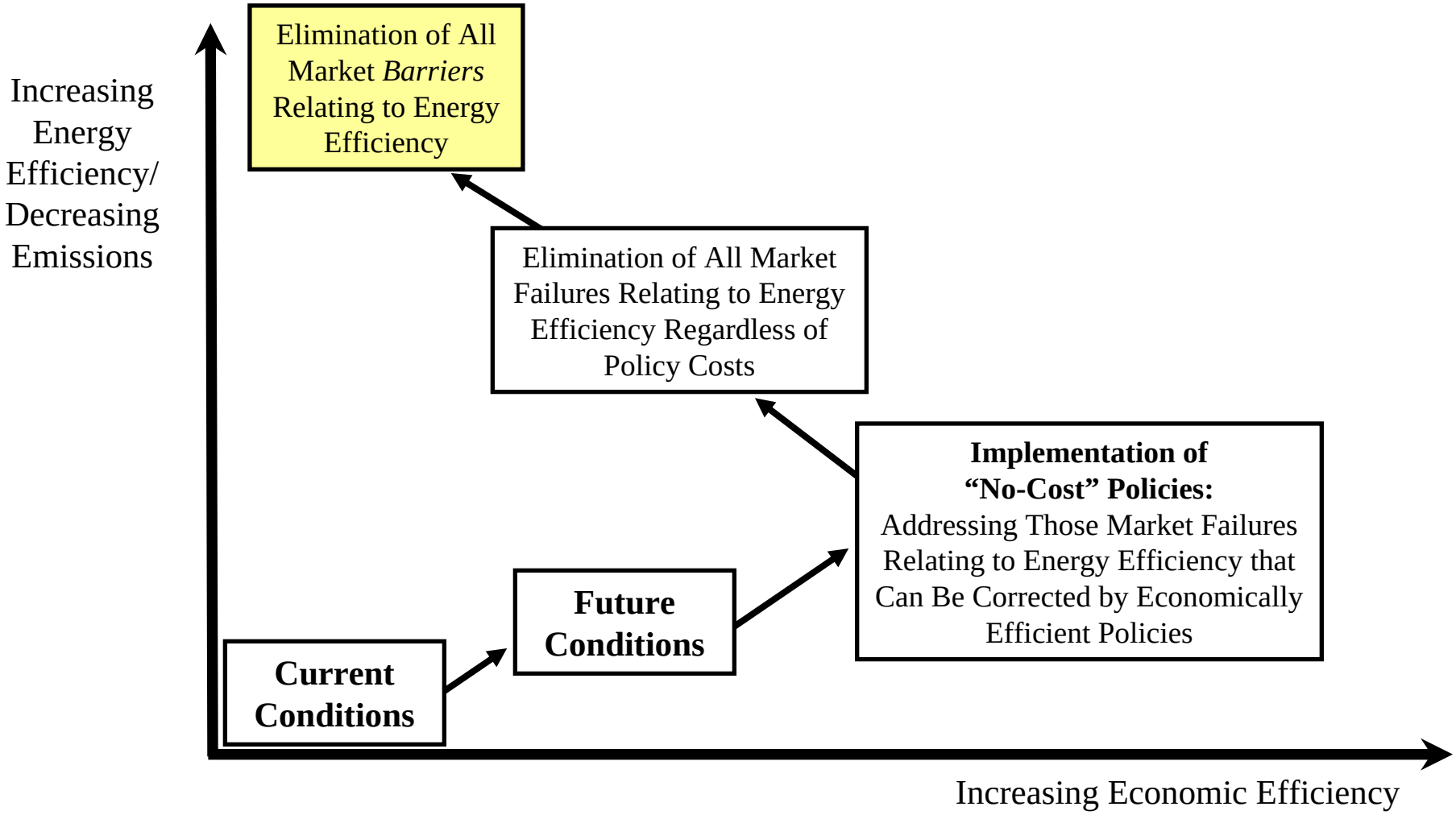
A few "market failures" can explain why some cost-saving energy efficiency improvements may be left on the table absent policy intervention

- Inadequate information about the lifecycle costs of alternative investments
- Agency problems (e.g., the landlord-tenant problem)
- Price distortions (e.g., retail electricity prices below marginal generation costs)
- Irrational decision-making (e.g., with respect to discounting future savings)

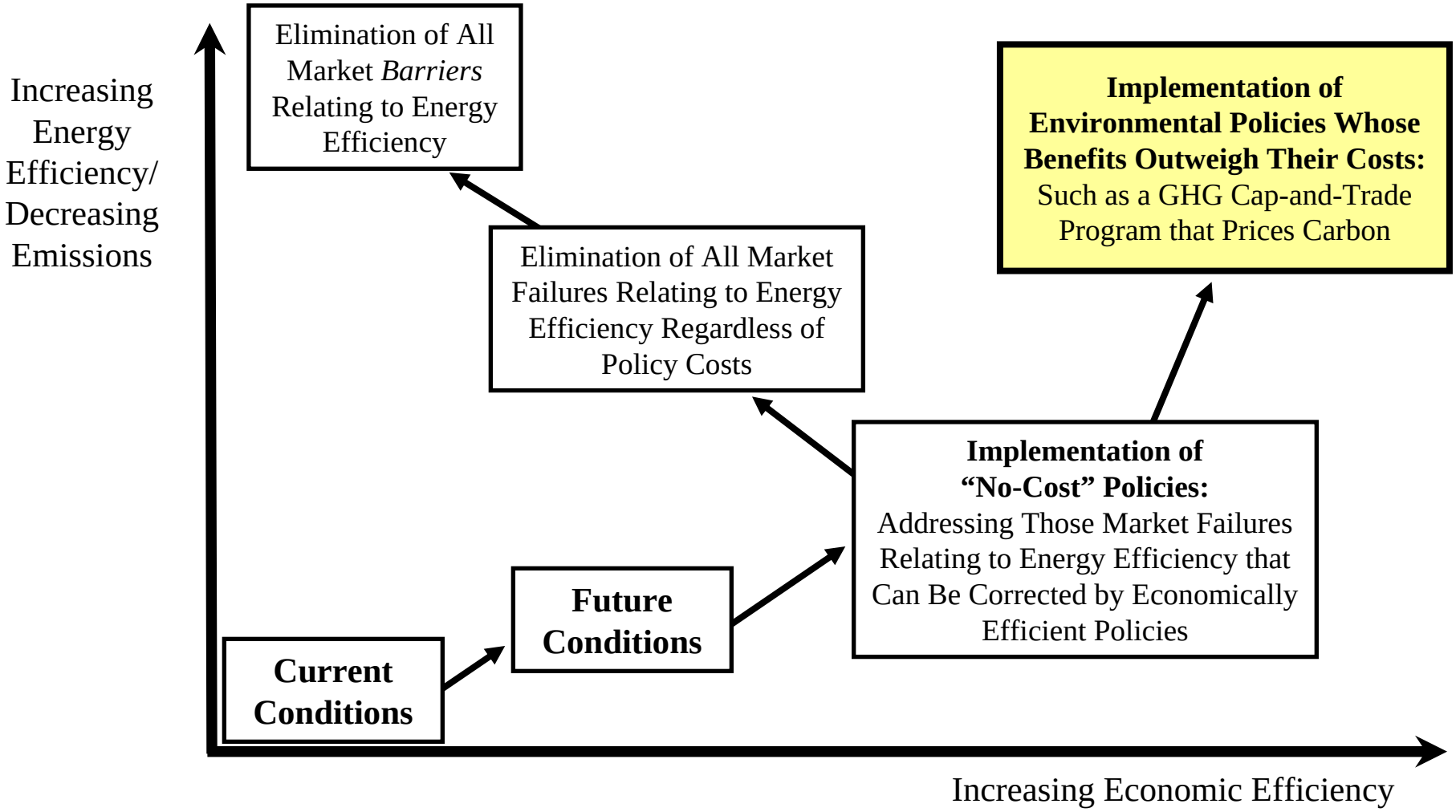
But even some "negative-cost" energy efficiency opportunities may be too costly to achieve through policy intervention



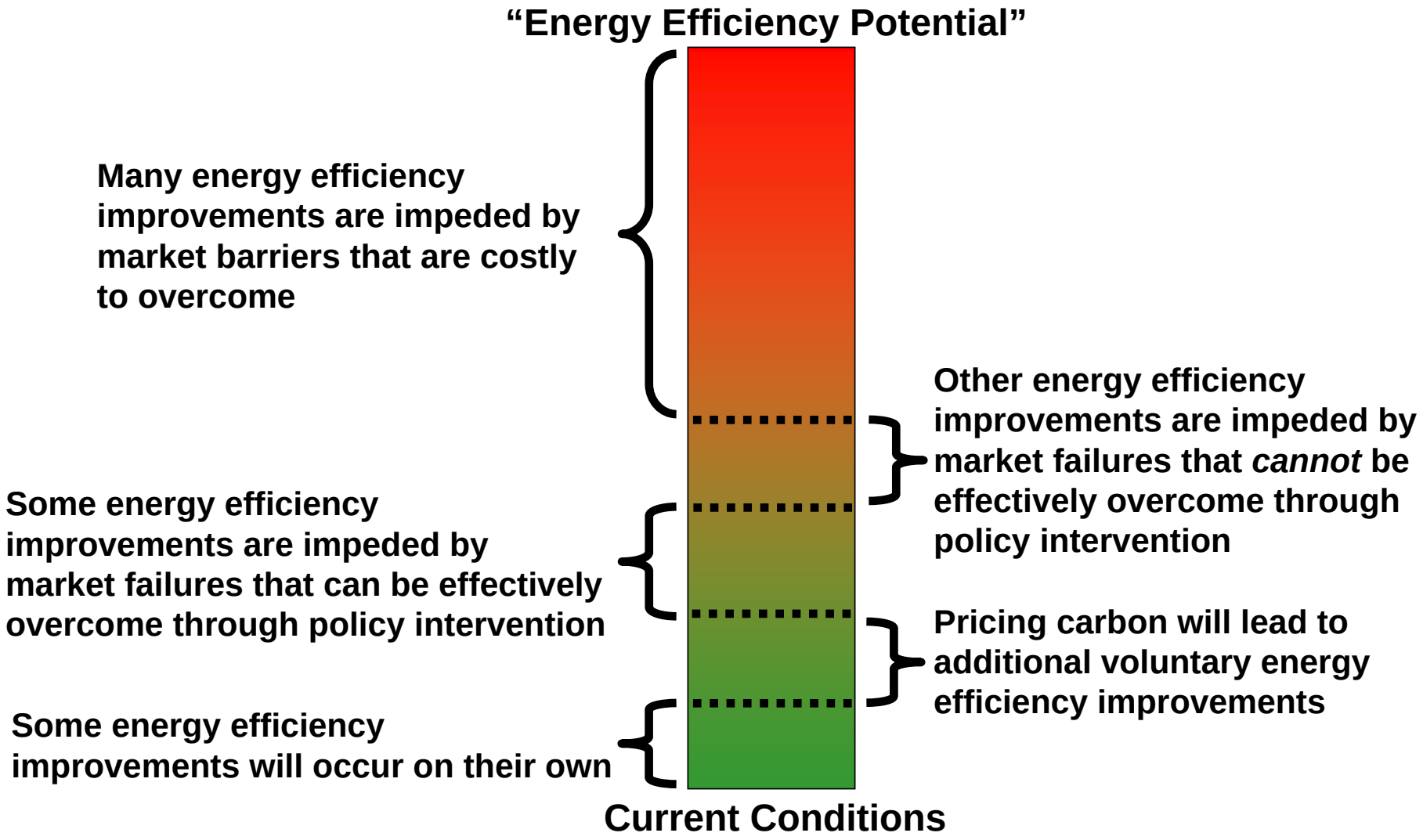
And many barriers to energy efficiency are not market failures, and are costly to overcome



But don't lose sight of the fact that costly measures can still be economically efficient



Deconstructing the "energy efficiency gap"



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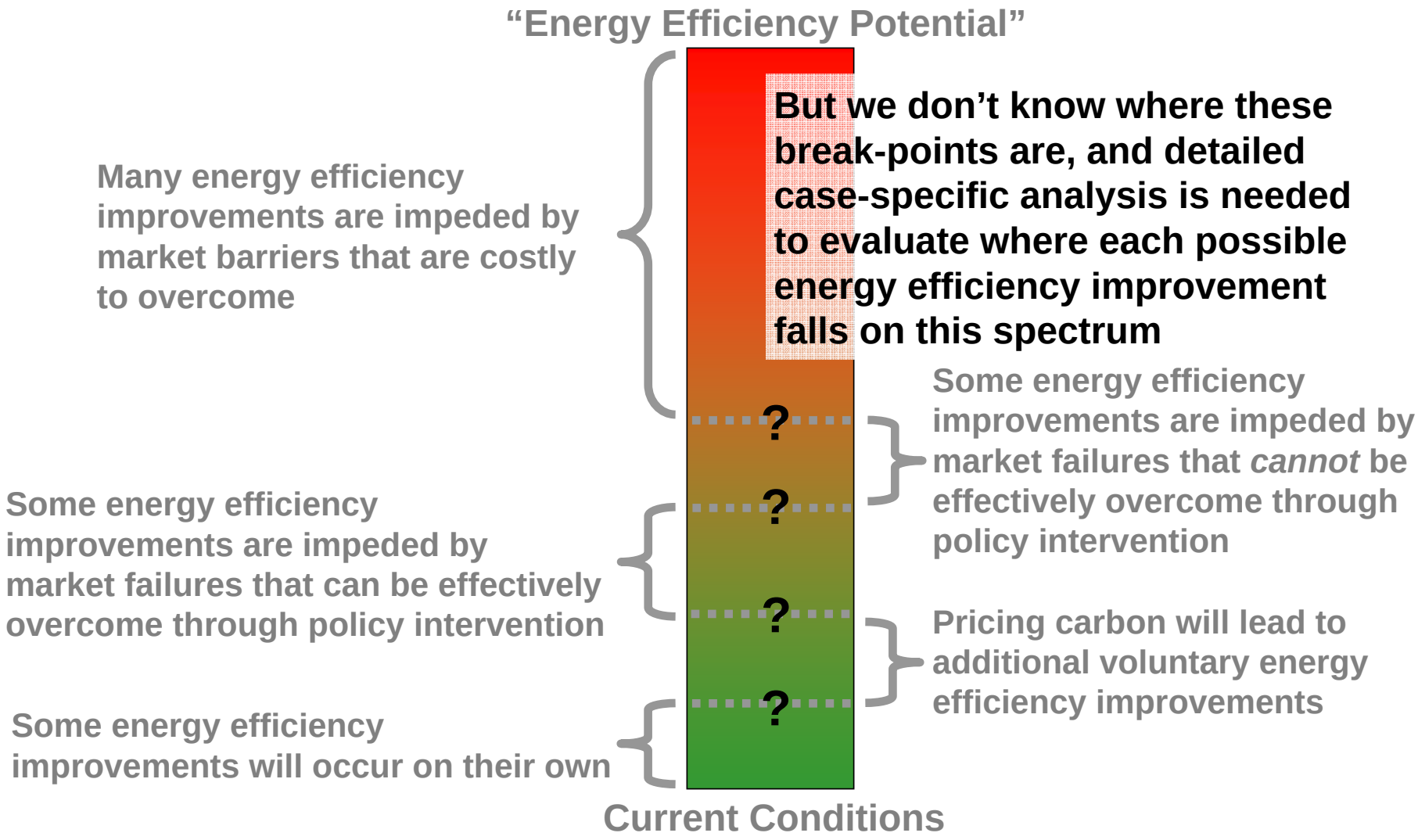

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- Why would "negative-cost" emission reduction opportunities exist?

- Why might studies incorrectly conclude that such opportunities exist?

- What policy lessons emerge from considering the potential for "negative-cost" reductions?

Three conditions must be met for there to be "negative-cost" emission reduction opportunities

1. An emission reduction opportunity must actually offer net savings when one considers its full economic cost

2. There has to be a market failure that is large enough to prevent the realization of that emission reduction opportunity absent a policy intervention

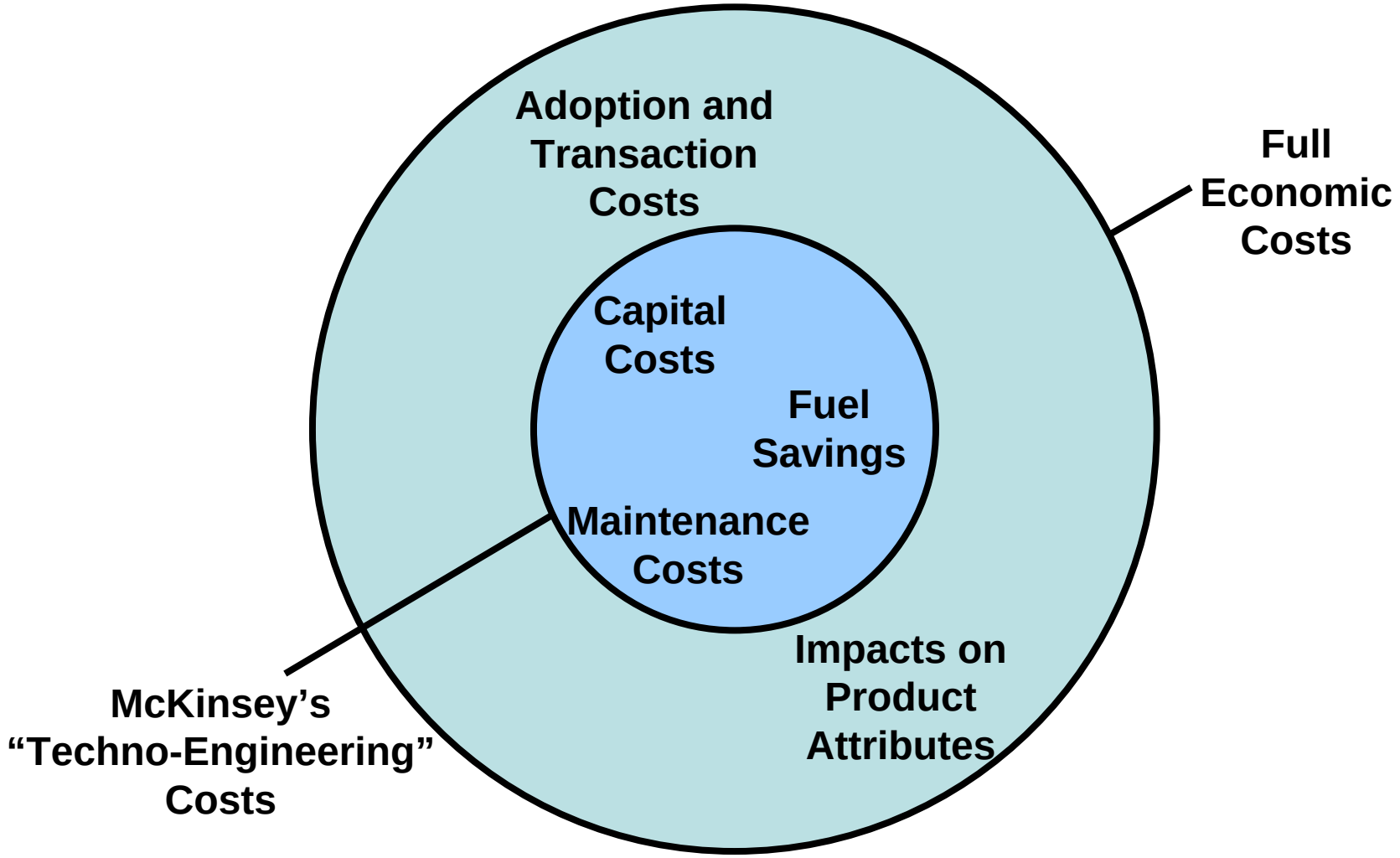
3. That policy intervention must be effective at bringing about the targeted emission reductions without introducing additional costs that outweigh the targeted cost savings

These three conditions suggest the key questions one should ask in evaluating findings of "negative-cost" emission reduction opportunities

A study might incorrectly conclude that a particular energy efficiency investment has "negative costs" by:

- Omitting (or failing to calculate correctly) elements of that investment's full economic cost
- Failing to measure correctly the undiscounted value of future energy savings from that investment
- Failing to apply the appropriate discount rate in comparing future energy savings with upfront costs

The costs captured by many studies finding "negative-cost" energy efficiency opportunities are often just some of the elements of the *full* economic cost of those opportunities



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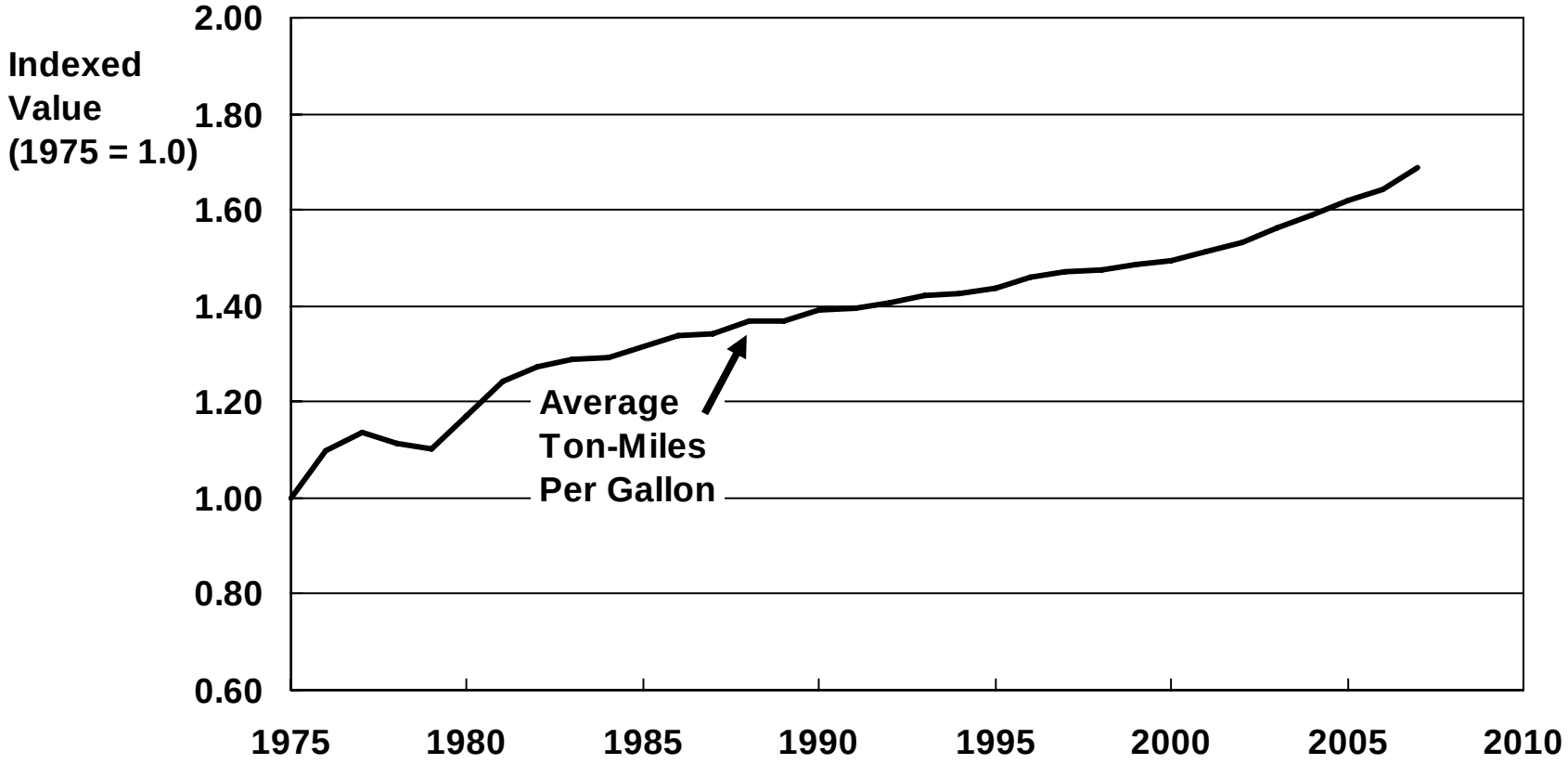
Vehicle fuel economy offers an example of how studies can fail to measure the full economic cost of energy efficiency improvements

Vehicle energy efficiency has increased continuously since the late 1970s …

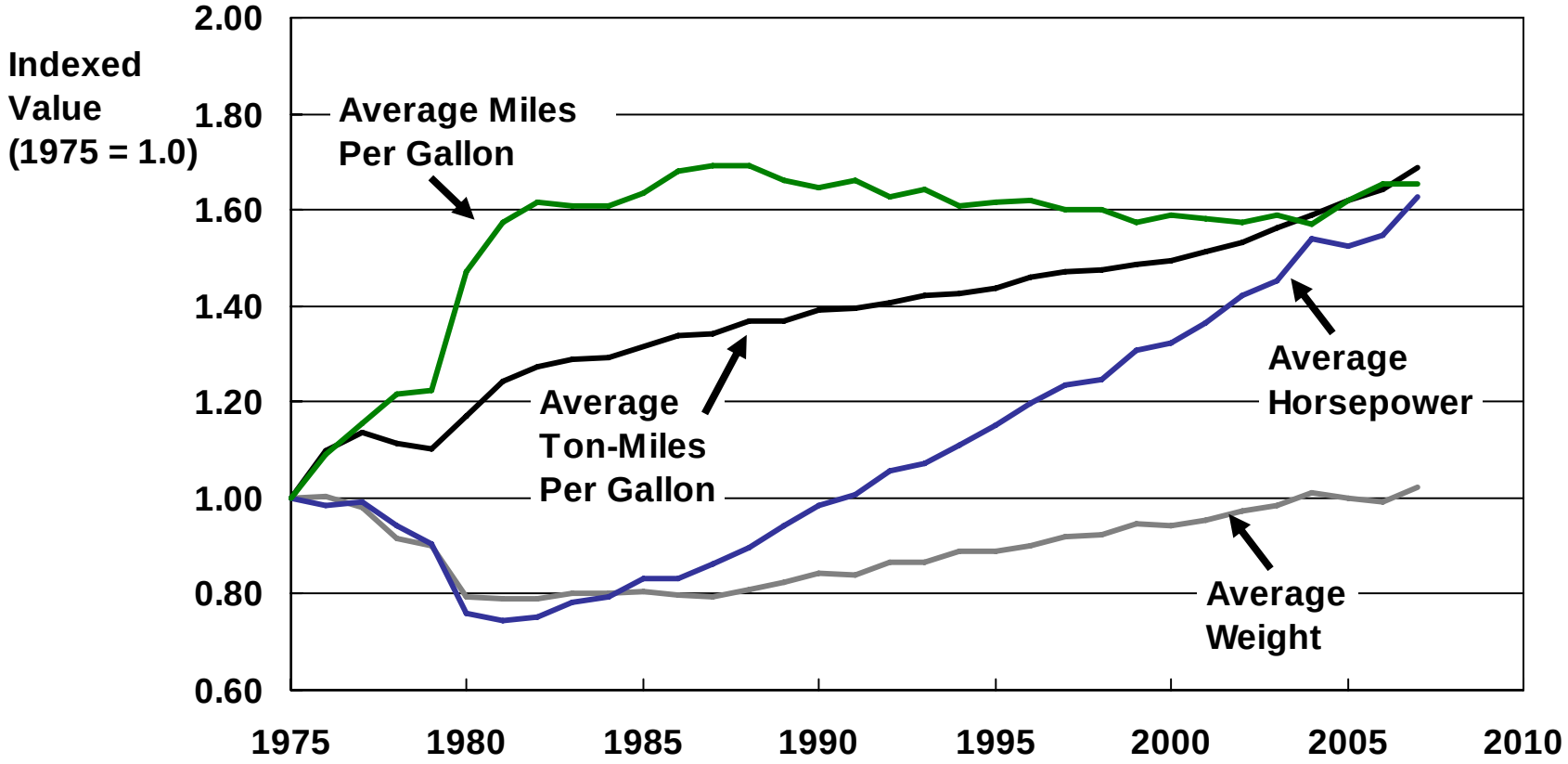
Trends in U.S. Vehicle Energy Efficiency, Fuel Economy, Weight, and Perfomance



Sources: U.S. EPA and Analysis Group calculations.

But, since the early 1980s, this improvement has largely been directed toward increasing vehicle weight and performance … Until recently

Trends in U.S. Vehicle Energy Efficiency, Fuel Economy, Weight, and Perfomance



Sources: U.S. EPA and Analysis Group calculations.

Vehicle fuel economy offers an example of how studies can fail to measure the full economic cost of energy efficiency improvements

- In light of the tradeoffs between fuel economy and other vehicle attributes, studies like McKinsey's fail to consider the full economic cost of fuel economy improvements
- Such studies compare upfront capital costs of fuel economy improvements with resulting fuel savings, holding *constant* other vehicle attributes
- Such studies *do not* examine how fuel economy improvements may limit, or make more costly, *further improvements* in other vehicle attributes that consumers value
- Yet, such impacts on other vehicle attributes can be a significant component of the full economic cost of fuel economy improvements

Studies finding "negative-cost" energy efficiency opportunities may use low discount rates that understate the opportunity cost of devoting capital to energy efficiency investments

- Studies finding "negative-cost" reductions often use real discount rates as low as 5%
- This may understate the cost of capital that companies face in making investments
- To the extent that such investments displace other investments that companies could have made, then such low discount rates may significantly understate the return on the displaced investments that is foregone by instead investing in energy efficiency

Three conditions must be met for there to be "negative-cost" emission reduction opportunities

1. An emission reduction opportunity must actually offer net savings when one considers its full economic cost

2. There has to be a market failure that is large enough to prevent the realization of that emission reduction opportunity absent a policy intervention

3. That policy intervention must be effective at bringing about the targeted emission reductions without introducing additional costs that outweigh the targeted cost savings

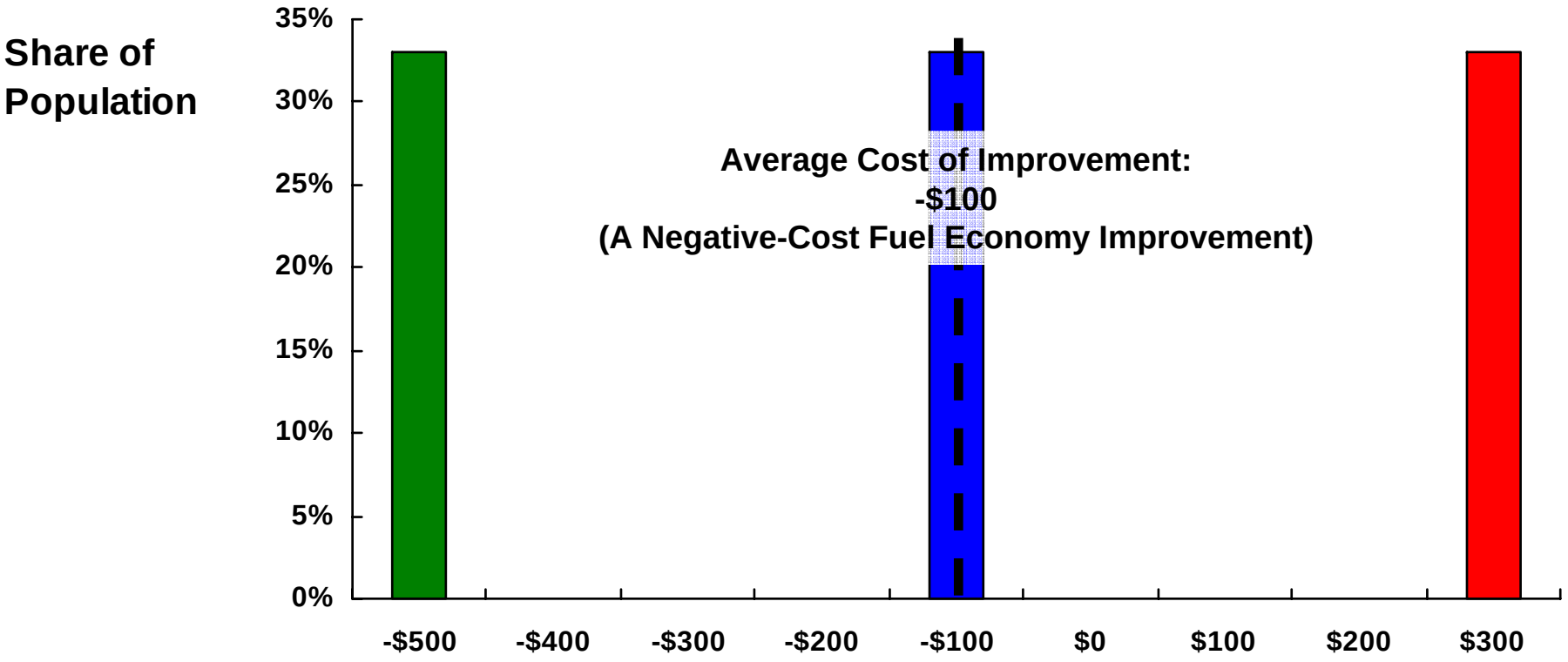
If relevant market failures are poorly understood, a study might incorrectly predict the extent to which "negative-cost" emission reductions would remain untapped absent policy intervention

- For those "negative-cost" energy efficiency improvements that do exist, the key question is:
  - Are the relevant market failures large enough to prevent the adoption of that improvement absent policy intervention?
- A study may *correctly* conclude that particular energy efficiency measures have "negative costs," but *incorrectly* predict the extent to which they would be adopted absent policy intervention

Failure to properly predict "baseline" or "business-as-usual" behavior can lead to significant errors in estimating the costs of particular policies, and therefore in evaluating the wisdom of implementing them

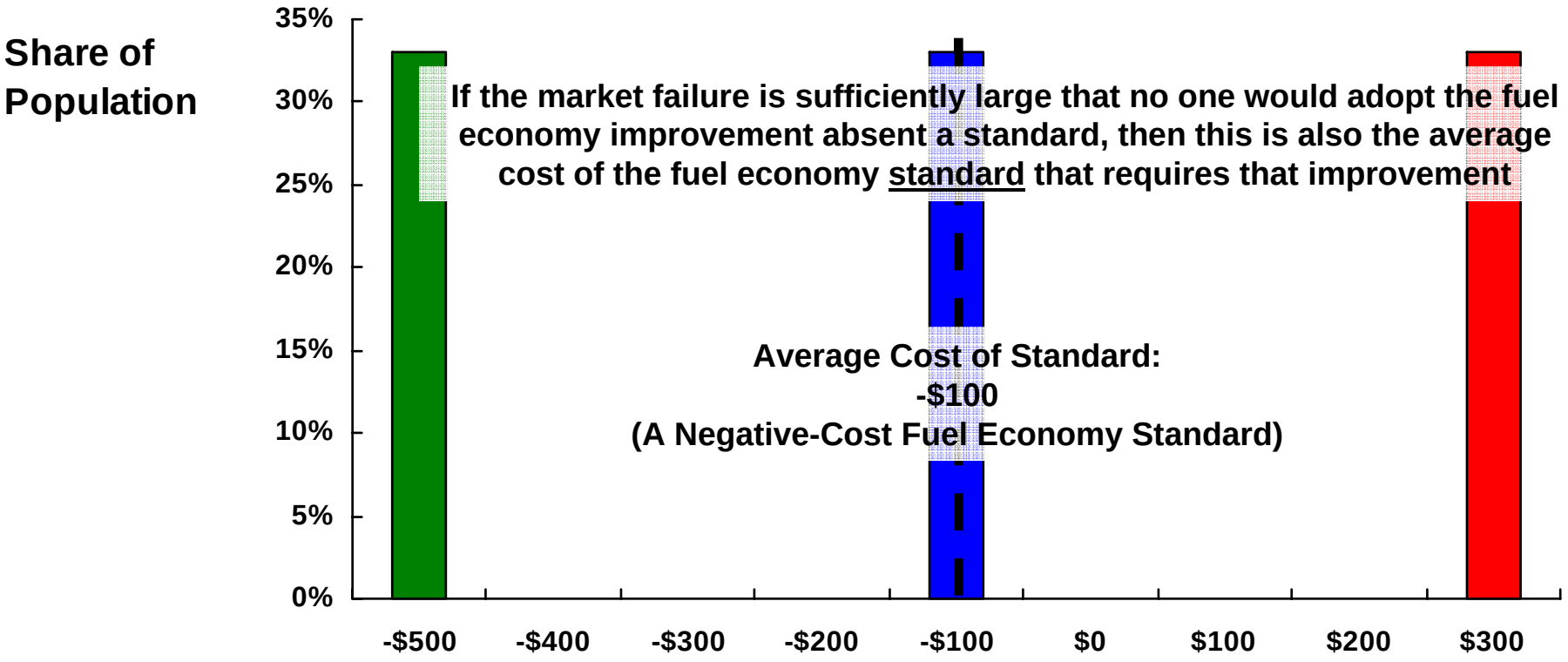
An example of why it is essential to understand the market failures driving "negative-cost" opportunities before implementing policies targeting those opportunities…

Anticipated Annual Per-Vehicle Cost of a Fuel Economy Improvement Across Three Types of Households with Different Driving Habits



A policy targeting a "negative-cost" energy efficiency improvement may not be a "negative-cost" policy if the market failure impeding that improvement is not sufficiently large

Anticipated Annual Per-Vehicle Cost of a Fuel Economy Standard Across Three Types of Households with Different Driving Habits



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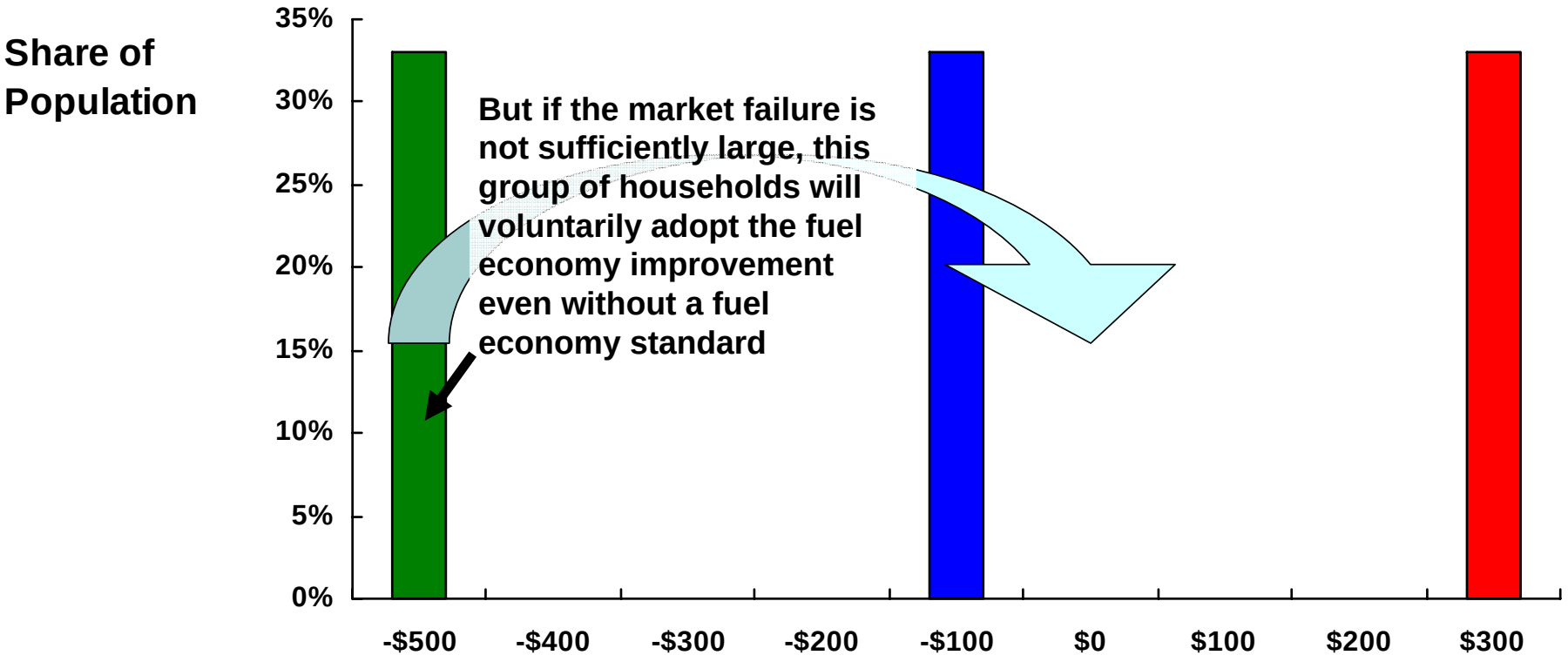

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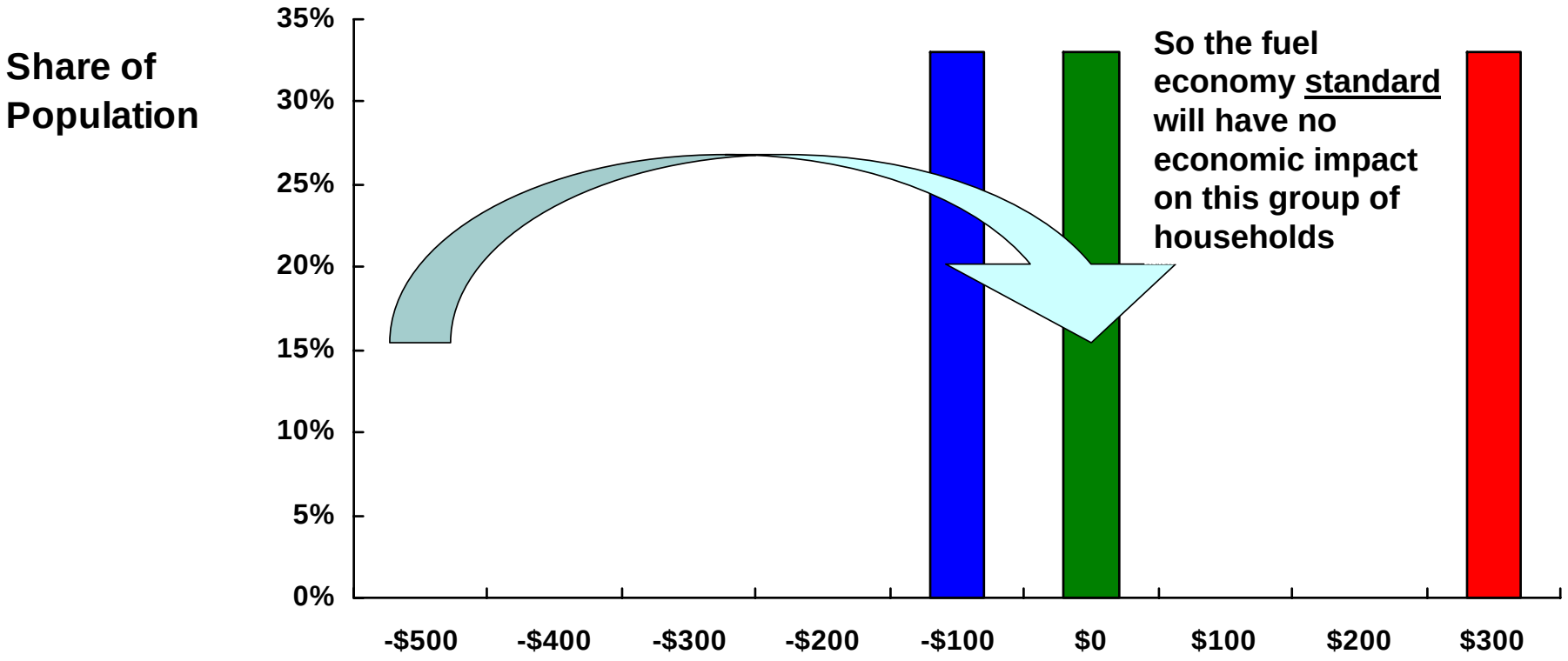

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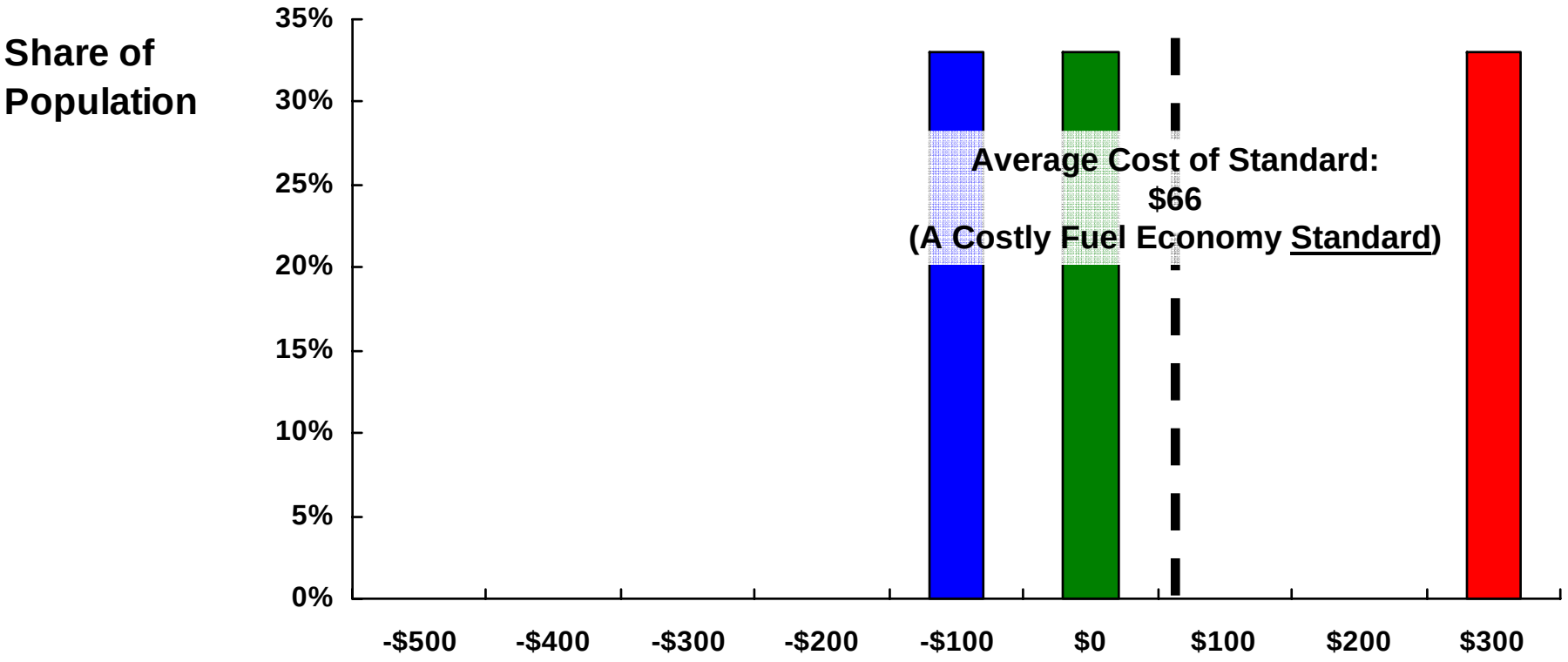

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3. That policy intervention must be effective at bringing about the targeted emission reductions without introducing additional costs that outweigh the targeted cost savings

A study might fail to consider the effectiveness and cost of the policies that are necessary to realize "negative-cost" emission reduction opportunities

- Policies may be ineffective in bringing about some of the targeted emission reductions

- Policies may introduce additional costs above and beyond the cost of the emission reductions themselves

  - Uniform product standards can impose net costs on certain "low-intensity" product users even though they may yield net gains for "high-intensity" users

  - Subsidies may have to pay off a large "base" to change behavior at the margin

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- Why would "negative-cost" emission reduction opportunities exist?
- Why might studies incorrectly conclude that such opportunities exist?
- What policy lessons emerge from considering the potential for "negative-cost" reductions?

Summary regarding "negative-cost" energy efficiency opportunities

- "Negative-cost" energy efficiency opportunities exist, and we should not confuse this point with the debate about "negative-cost" energy efficiency policies
- Economic theory and research suggest that some energy efficiency policies can have "negative costs"
- But, much more thorough analysis is needed to assess the *full* economic cost of such opportunities, and the cost and efficacy of the polices needed to achieve them
  - This needs to be done on a case-by-case basis — the devil is in the details
- While some of the apparent cost-saving opportunities highlighted by studies finding "negative-cost" reductions may pan out, others may simply reflect an incomplete assessment of costs, or may be impossible to target effectively with policy interventions
- But "negative-cost" studies offer a valuable initial screen to identify where businesses and policymakers should start drilling down

Policy lessons

- **An economy-wide carbon price (via a cap-and-trade or carbon tax) should be the core policy instrument used to tackle climate change**
  - We know households and firms respond to energy prices, and energy prices currently do not reflect the social cost of GHG emissions
- **Cost-containment measures are immensely important**
  - The debate about "negative-cost" emission reductions reflects just one element of the substantial uncertainty that surrounds the cost of reducing GHG emissions
- **There is an important place for some carefully targeted *complementary* policies**
  - Various market failures may keep households and firms from responding to changing prices to the full extent that they should, calling for carefully targeted *and carefully vetted* complementary policies (e.g., energy efficiency policies) that are tailored to the market failure at issue
- **We need to better understand the market failures that motivate such policies, and more thoroughly address their implications in policy analysis**

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For more discussion of negative-cost emission reductions, see:

Robert Stavins, Judson Jaffe, and Todd Schatzki, "Too Good to Be True? An Examination of Three Economic Assessments of California Climate Change Policy," AEI-Brookings Joint Center for Regulatory Studies, Related Publication 07-01, 2007. (http://www.reg-markets.org/publications/abstract.php?pid=1151)

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Too Good to Be True?
An Examination of Three Economic Assessments of California Climate Change Policy

Robert N. Stavins, Judson Jaffe, and Todd Schatzki*

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