MIT Energy Initiative

MIT CEEPR
MIT Center for Energy and Environmental Policy Research

Massachusetts Institute of Technology

Future Energy Systems Center: Decarbonization and Policy

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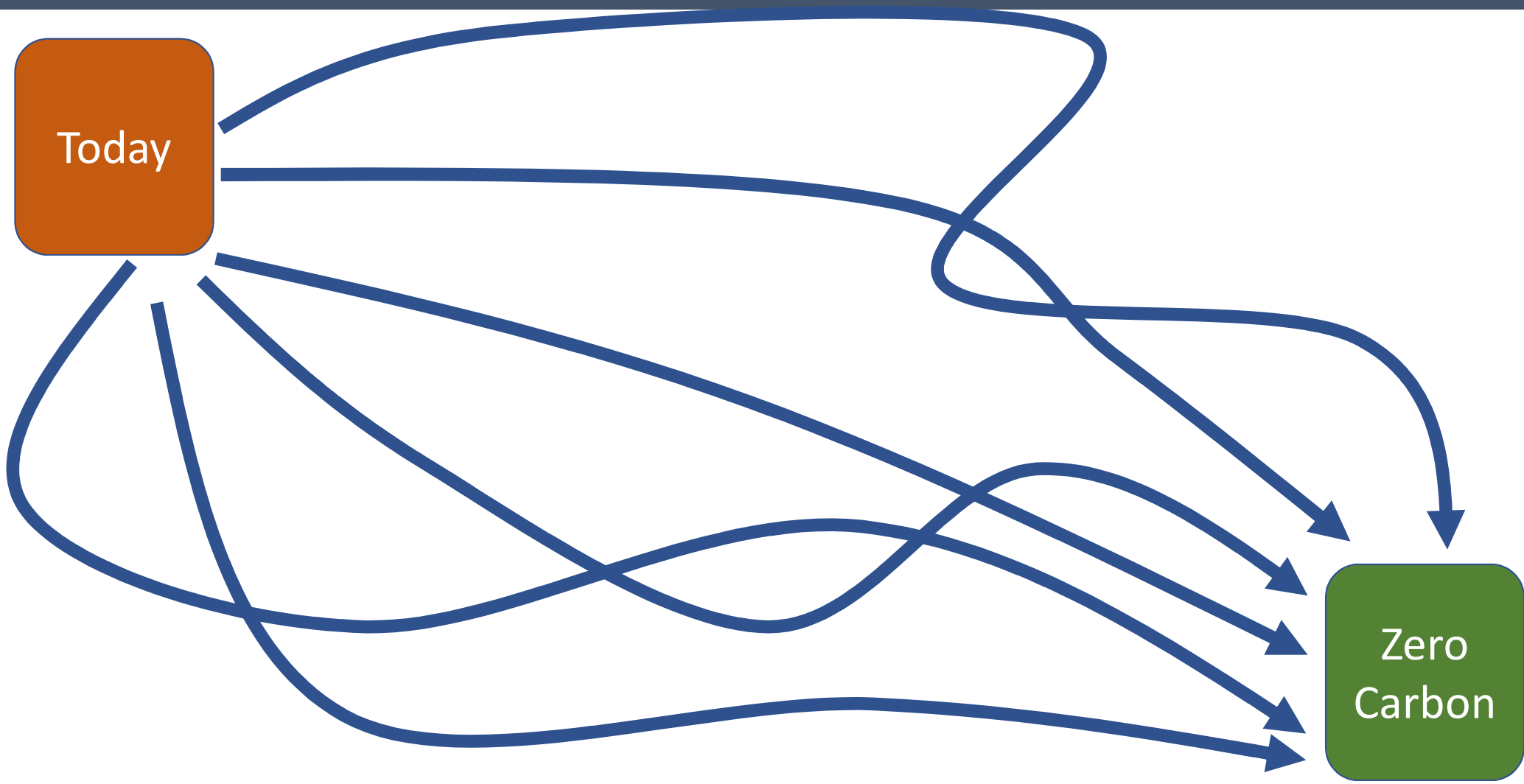
Future Energy Systems Center – Motivation

- Climate change mitigation will fundamentally change how energy is supplied and used
- The path for decarbonization will impact all industries and businesses with challenges and opportunities for all
- The future energy system will be complex and highly integrated across all sectors including electricity, industry, transportation, and built environment

There are multiple paths to a decarbonized world



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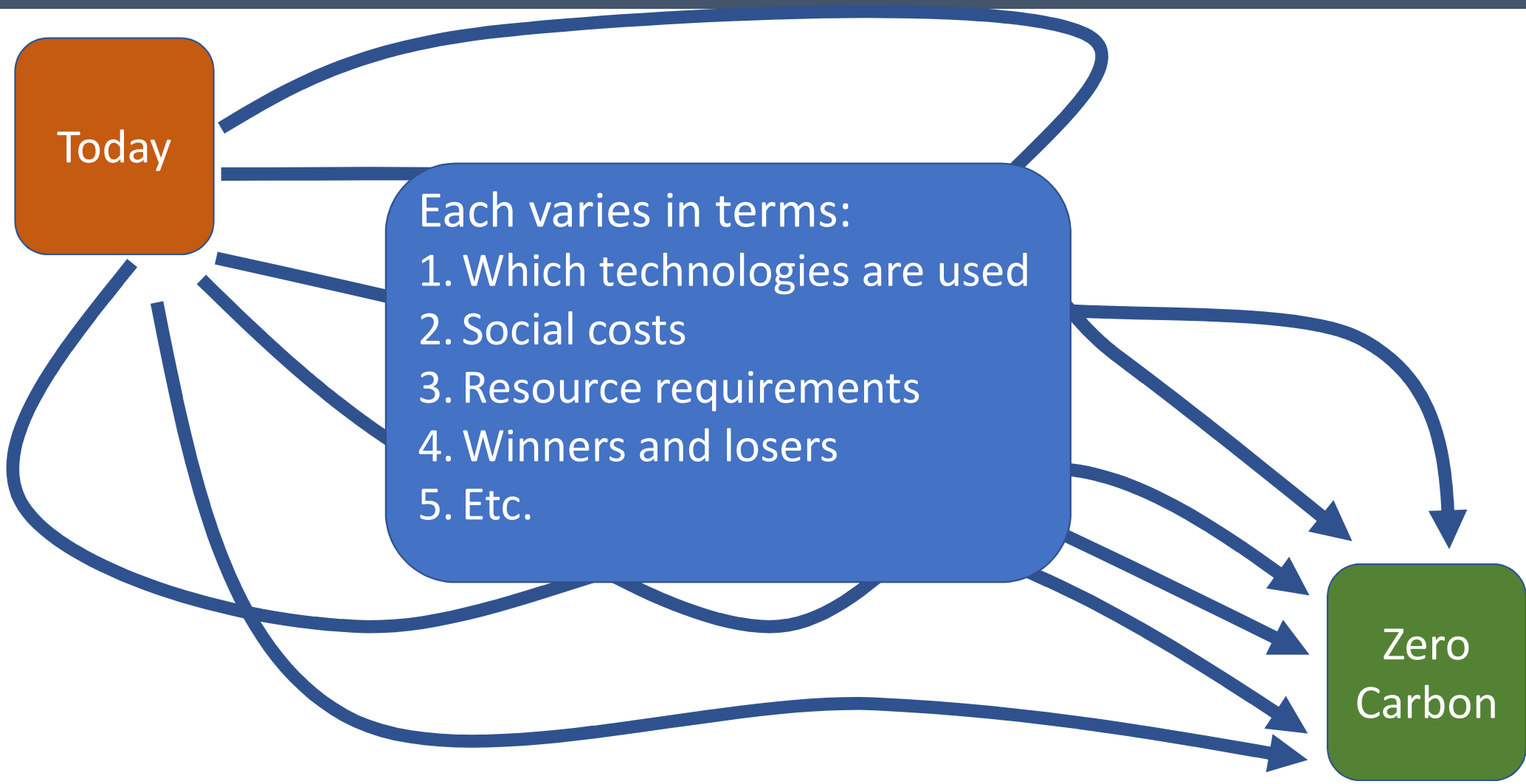

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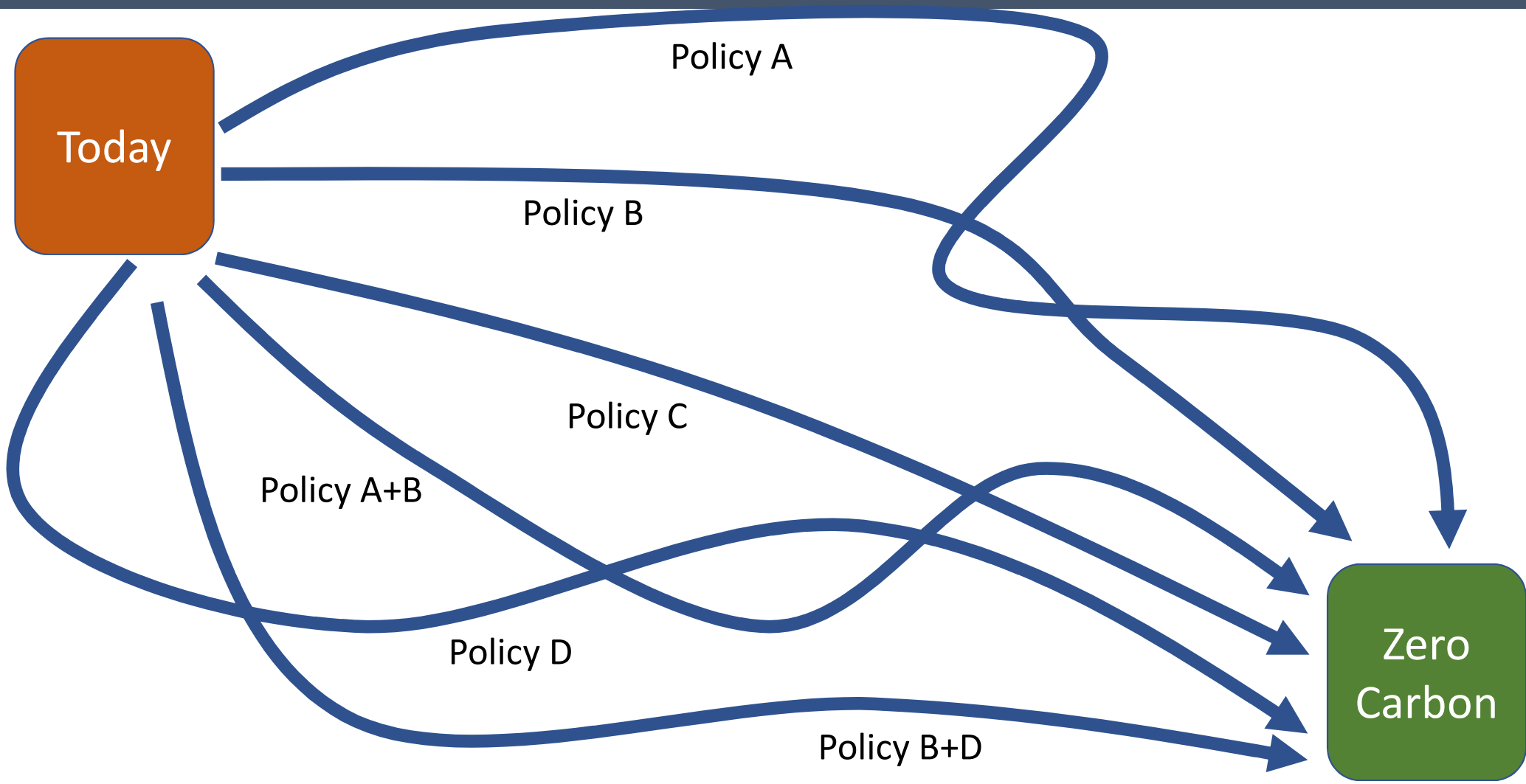
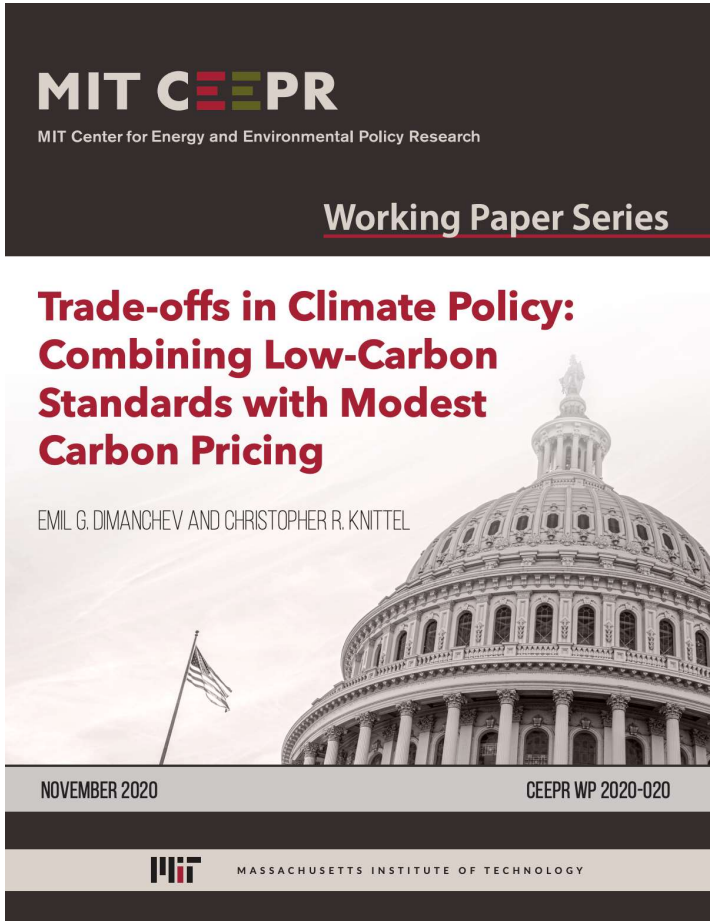
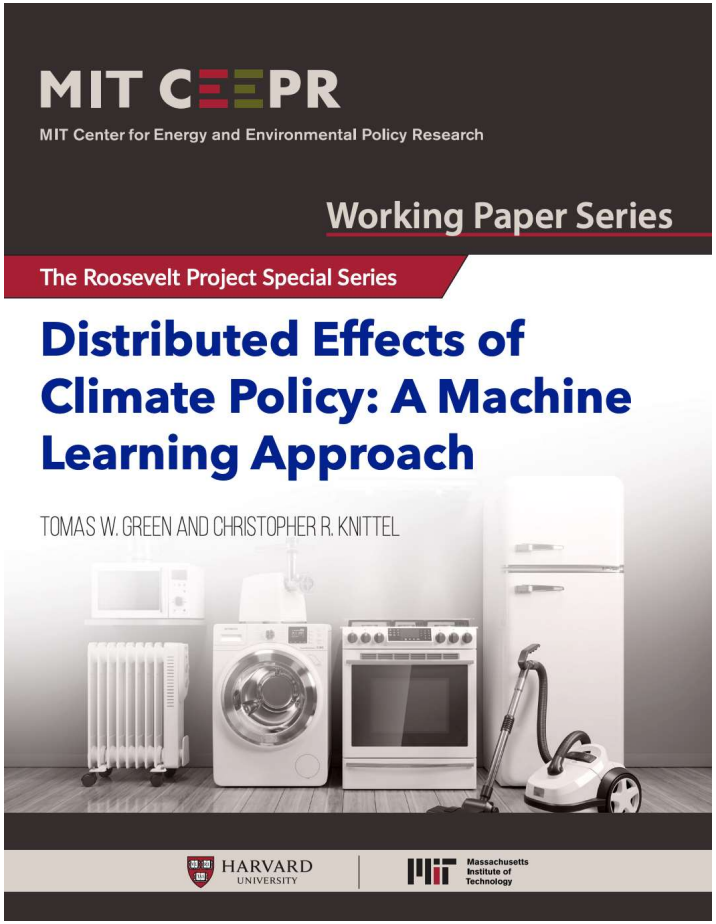


Future Energy Systems Center – Policy

- The goal behind the FESC is to understand not just the technology, but also how those technologies will interact in the market place
- AND, to understand how different polices affect this
- Will draw on the economics strength of the Center for Energy and Environmental Policy Research (CEEPR) and the Joint Program of the Science and Policy of Global Change (JP)

References





http://ceepr.mit.edu/

What does the economic literature tell us

- Efficiency:
  - Theory and simulations suggest costs of "standards" as much as 10x more costly (see, Holland, Hughes, and Knittel (2009), Jacobsen (2013), Nath and Greenstone (2020))
  - Data suggests same thing:
    - CA LCFS Credit Price: $195.39
    - CA CAT Credit Price: $23.22
- Distributional effects:
  - Carbon taxes generate money!

But first, I get the politics

- Politics!
  - AOC: “We’ll pass a wimpy carbon tax and our kids are doomed”

- Salience:
  - Carbon taxes are visible
  - The alternatives are complicated and the price impacts are muted
  - Wait….fuel economy standards are free, right?

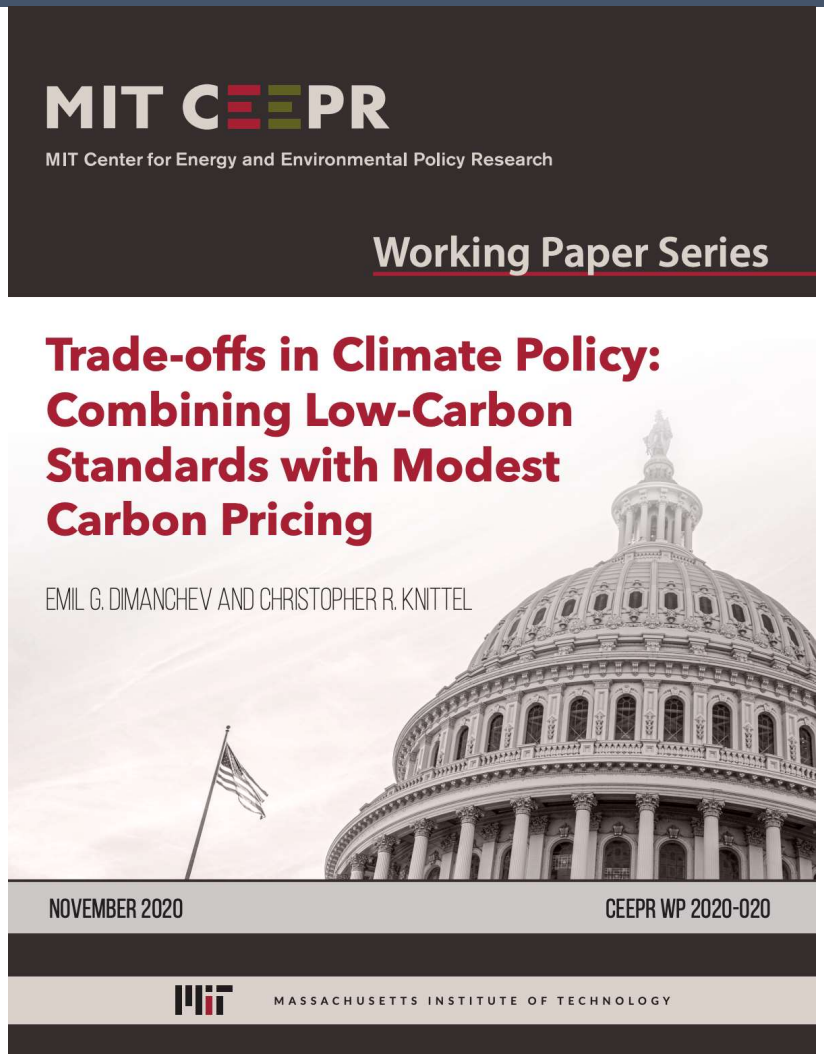
ENERGY & ENVIRONMENT

Why greens are turning away from a carbon tax

Putting an economic price on greenhouse gases is proving a hard sell with the public, even as time to head off climate change shrinks.

By **ZACK COLMAN** and **ERIC WOLFF** | 12/09/2018 07:02 AM EST

But first, I get the politics



Can we combine a modest carbon tax with other stuff?

- Most (all?) of the existing literature has analyzed carbon pricing **or** regulatory standards
- My subjective probabilities:
  - P(only standards) > P(standards + carbon tax) > P(only carbon tax)

- We want to understand the benefits of going from **Standards Only** => **Standards + Carbon Tax**

Our thought experiment

- Think of a continuum of policies to completely decarbonize:

Standard Only.....Carbon Tax Only

$10X $???X $X

How we do this

- Use two MIT models of economic activity and emissions
- First, the Joint Program's EPPA model (Emissions Predictions and Policy Analysis)
  - Large-scale computable general equilibrium integrated assessment model
  - All sectors, course resolution on the electricity sector
- Second, MIT's GenX model (Optimal Electricity Generation Expansion)
  - Highly resolved capacity expansion model that includes one-year's worth of hourly electricity load
  - New England version

Where are the cost savings coming from?

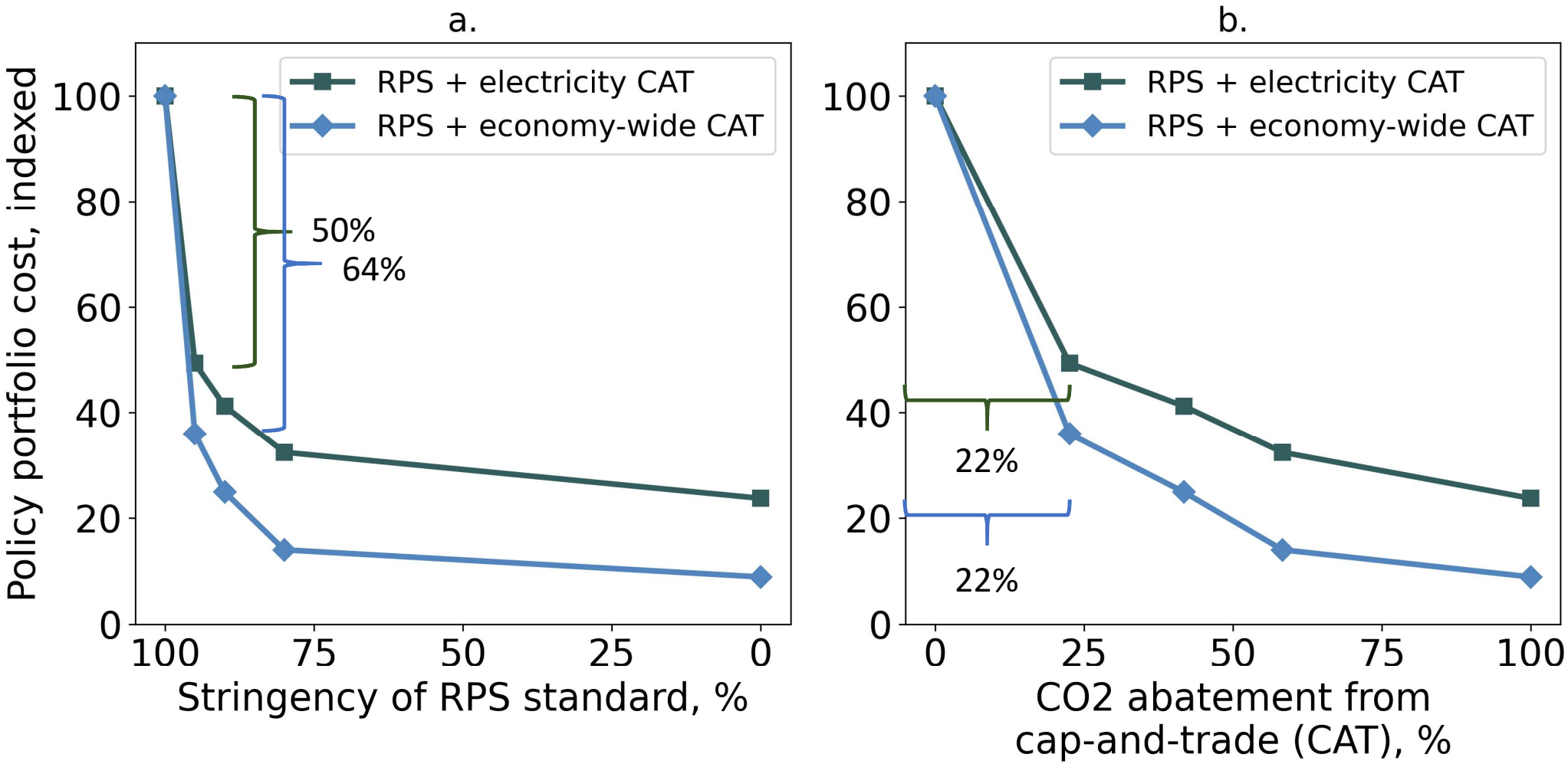
- Three sources of cost savings
  - **First**, under EPPA we model an **economy-wide** carbon tax
  - By relying less on standards, the carbon tax is able to find more cost-effective carbon reduction in other sectors
    - Some might call this “cheating”
  - **Second**, demand reductions and the nature of the marginal cost curve for renewables
    - As decarbonization goals ramp up the marginal cost of renewables becomes very steep
    - The carbon tax is able to reduce demand keeping you from having to go up that steep marginal cost curve
  - **Third**, The carbon tax can also bring in other technologies not allowed in an RPS

Our scenarios

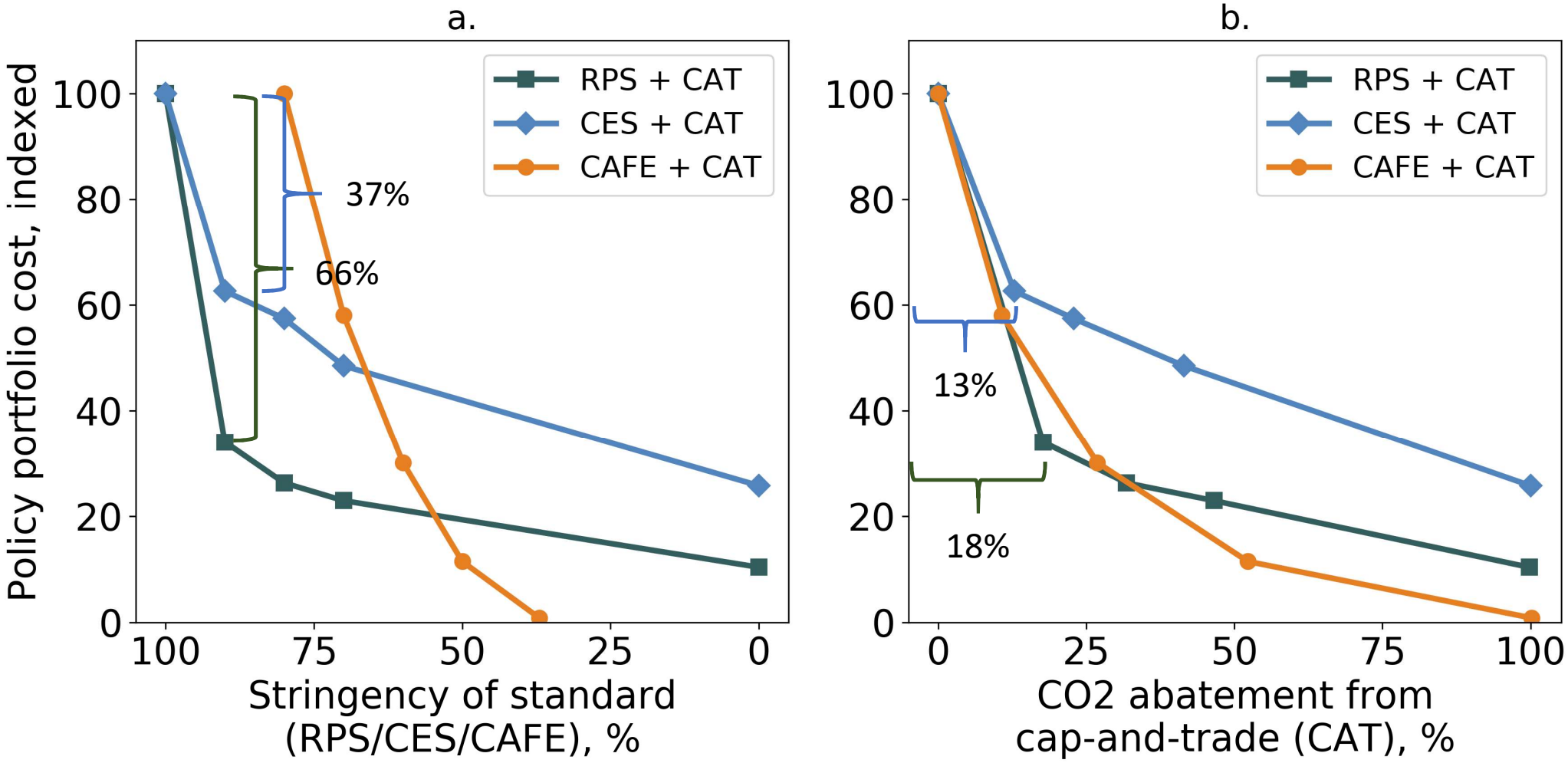
	EPPA scenarios			GenX scenarios	
Policy scenario	RPS-based policy	CES-based policy	CAFE-based policy	RPS-based policy	RPS-based policy
1	RPS 100%	CES 100%	CAFE 80%	RPS 100%	RPS 100%
2	RPS 90% + CAT*	CES 90% + CAT	CAFE 70% + CAT	RPS 95% + electricity CAT	RPS 95% + economy-wide CAT
3	RPS 80% + CAT	CES 80% + CAT	CAFE 60% + CAT	RPS 90% + electricity CAT	RPS 90% + economy-wide CAT
4	RPS 70% + CAT	CES 70% + CAT	CAFE 50% + CAT	RPS 80% + electricity CAT	RPS 80% + economy-wide CAT
5	CAT	CAT	CAT	Electricity CAT	Economy-wide CAT
Emission reductions for each mix 1-5	Equivalent to RPS 100%	Equivalent to CES 100%	Equivalent to CAFE 80%	Equivalent to RPS 100%	Equivalent to RPS 100%

*All CAT scenarios in EPPA are economy-wide

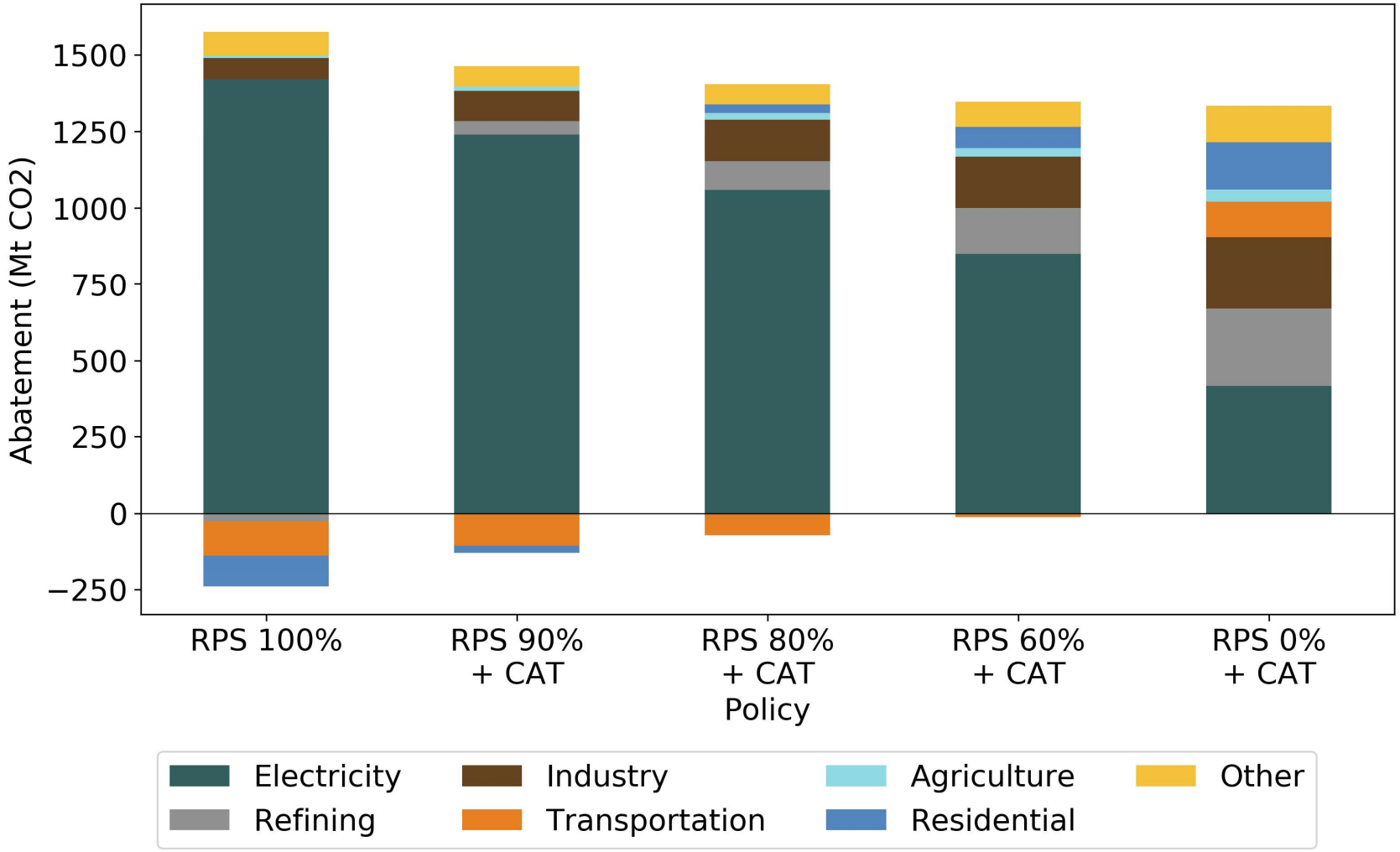
GenX results



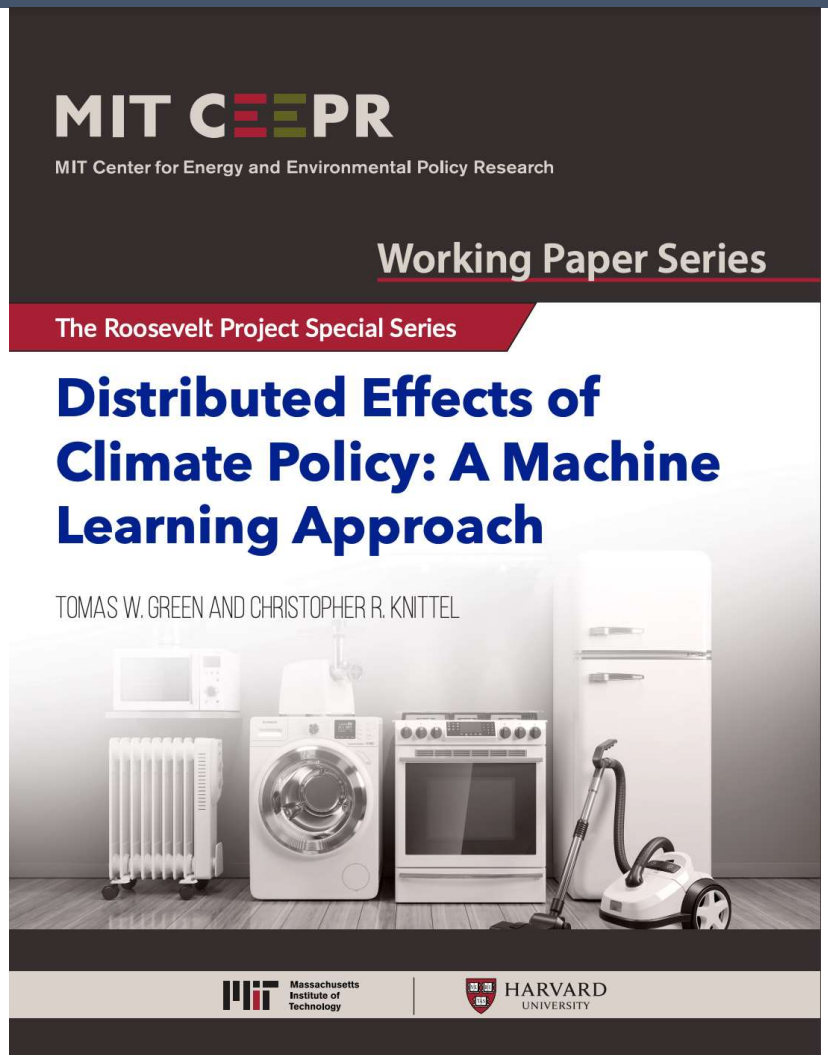
EPPA results



What is going on in EPPA?



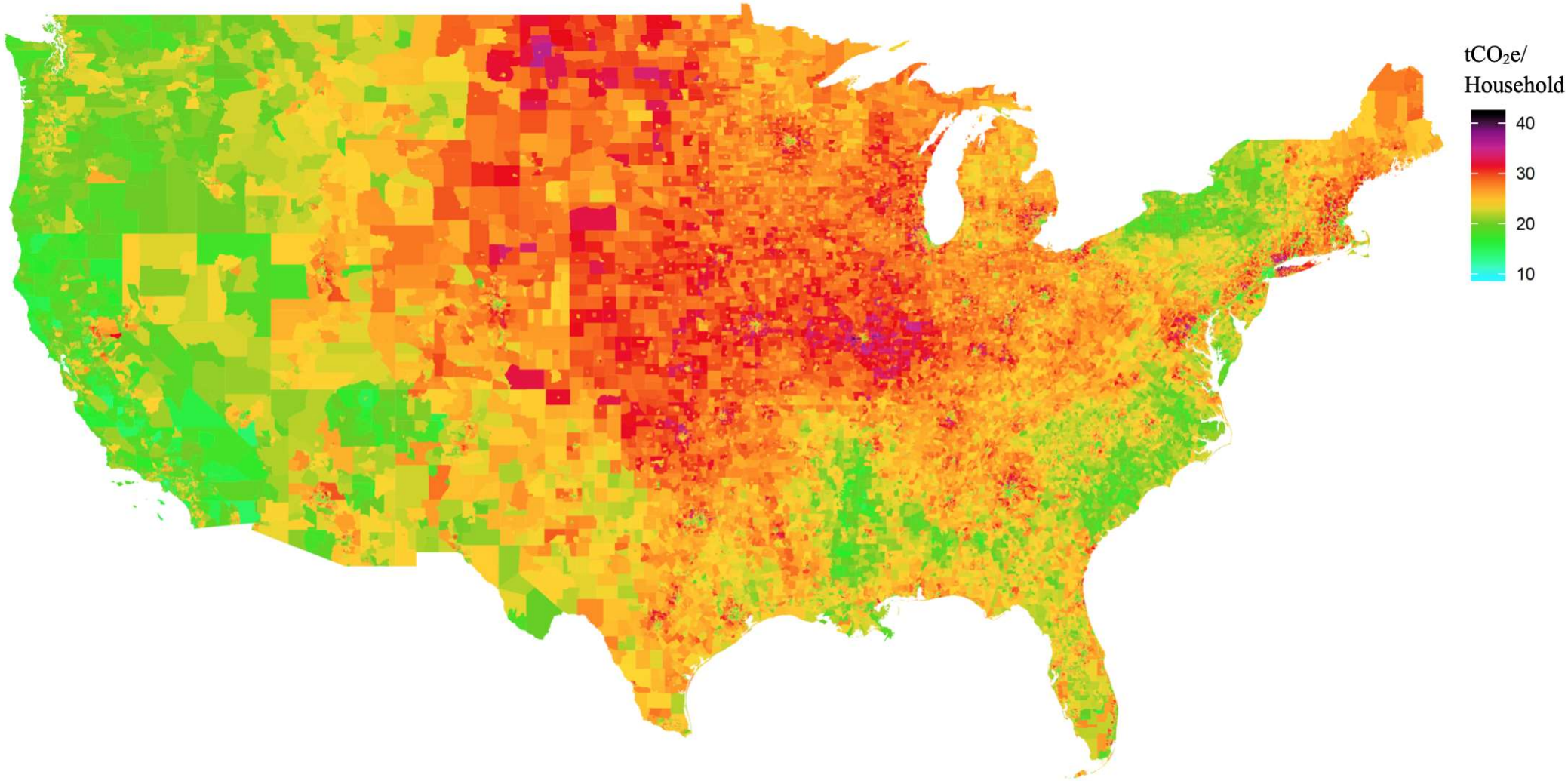
Policies matter for households too!

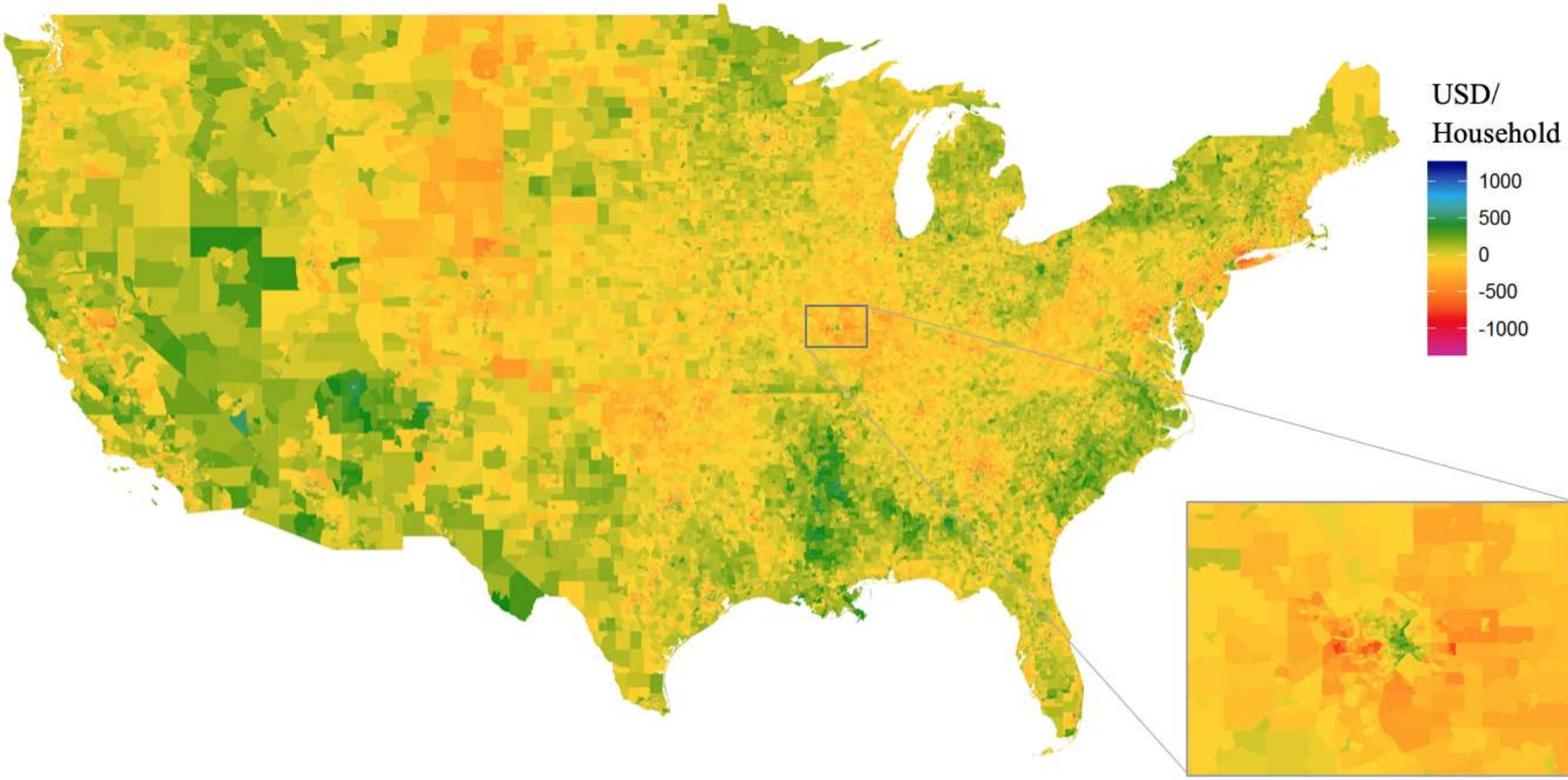


What do we do?

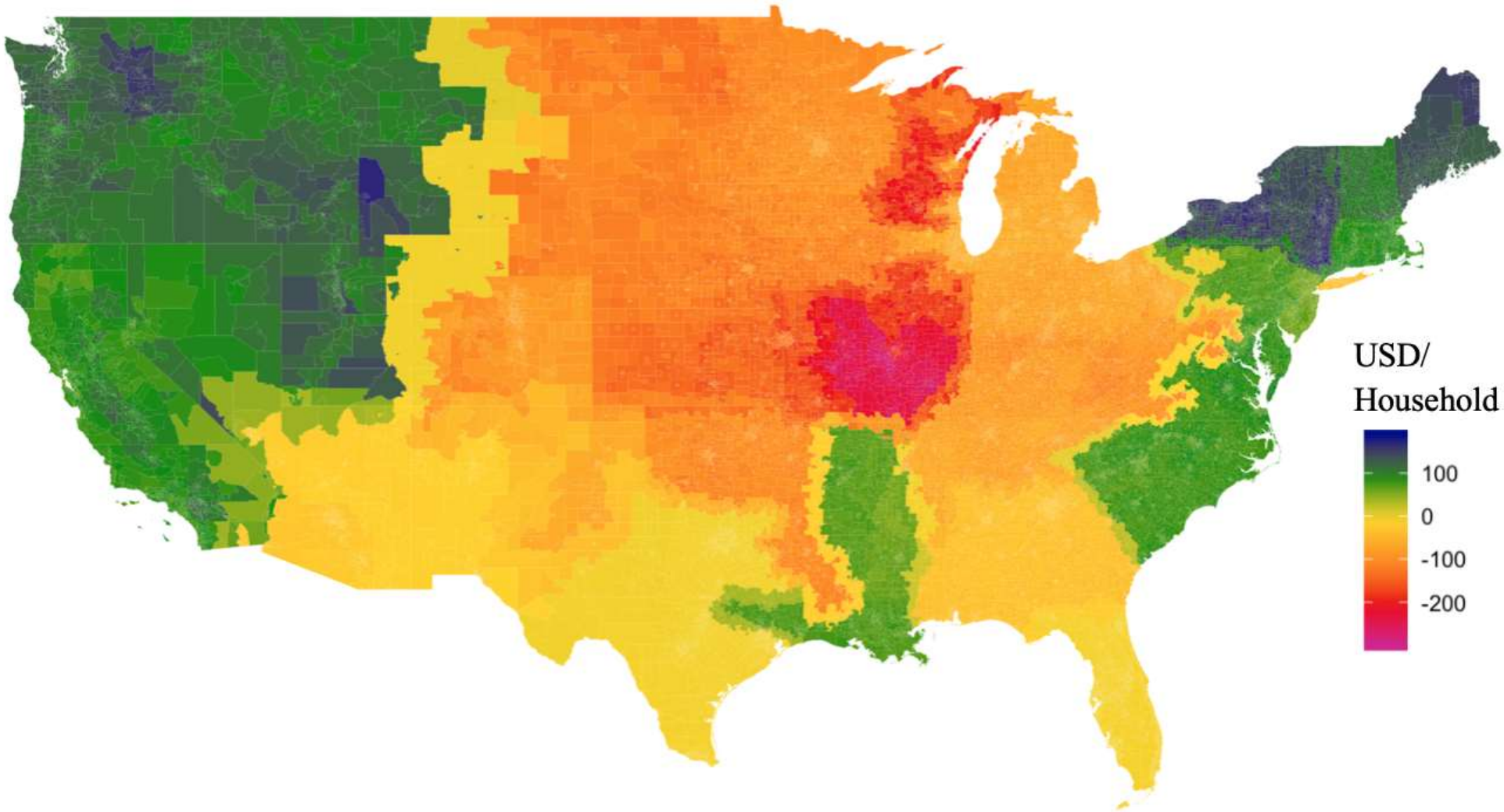
- We use machine learning techniques to measure household level all the way down to the Census tract level (~75,000 of them)
- We split into the footprint's components (e.g., electricity, natural gas, gasoline, etc.)
- We then use these footprints to think about who are the winners and losers from different policies

Household carbon footprints





Carbon tax



Clean Energy Standard

Wrapping up

- Decarbonization is a collection of potential outcomes
- What will drive which path we take?
  - Technology costs, of course
  - But more
- Policy choices will drive outcomes and who wins and loses from those outcomes
  - They can also have HUGE impacts on the costs associated with decarbonization