

Technological solutions to climate change are great ...

- ... but my house has
 - a wood fireplace;
 - a fireplace with a gas insert;
 - a gas water heater; and
 - a gas furnace.



- Likewise, my car is 8 years old, but runs great and only has 90K miles.
- I'm not paying thousands of dollars to change any of that (especially with natural gas so cheap), and that's probably true for most people.
- The punchline: technological solutions are a key facet of climate change mitigation, but not in the short-run.

Economics gives us a short-run solution.

“Suppose a politician promised to reveal the details of a simple proposal that would, if adopted, produce hundreds of billions of dollars in savings for American consumers, ... major improvements in urban air quality, large reductions in **greenhouse gas emissions**, and substantially reduced dependence on Middle East oil. The politician also promised that the plan would require no net cash outlays from American families...

[A] policy that would deliver precisely the outcomes described could be enacted by Congress **tomorrow**...

(Frank 2006)

Economic drivers and incentives for managing global climate change

Carson Reeling

Department of Economics

Institute for the Environment and Sustainability

New Report Finds Climate Change Caused By 7 Billion Key Individuals

NEWS

November 22, 2013

VOL 49 ISSUE 48

Science & Technology ·
Weather



Experts say the acceleration of global warming is directly tied to the actions of 7 billion main culprits.

WASHINGTON—In a landmark report experts say fundamentally reshapes our understanding of the global warming crisis, new data published this week by the Intergovernmental Panel on Climate Change has found that the phenomenon is caused



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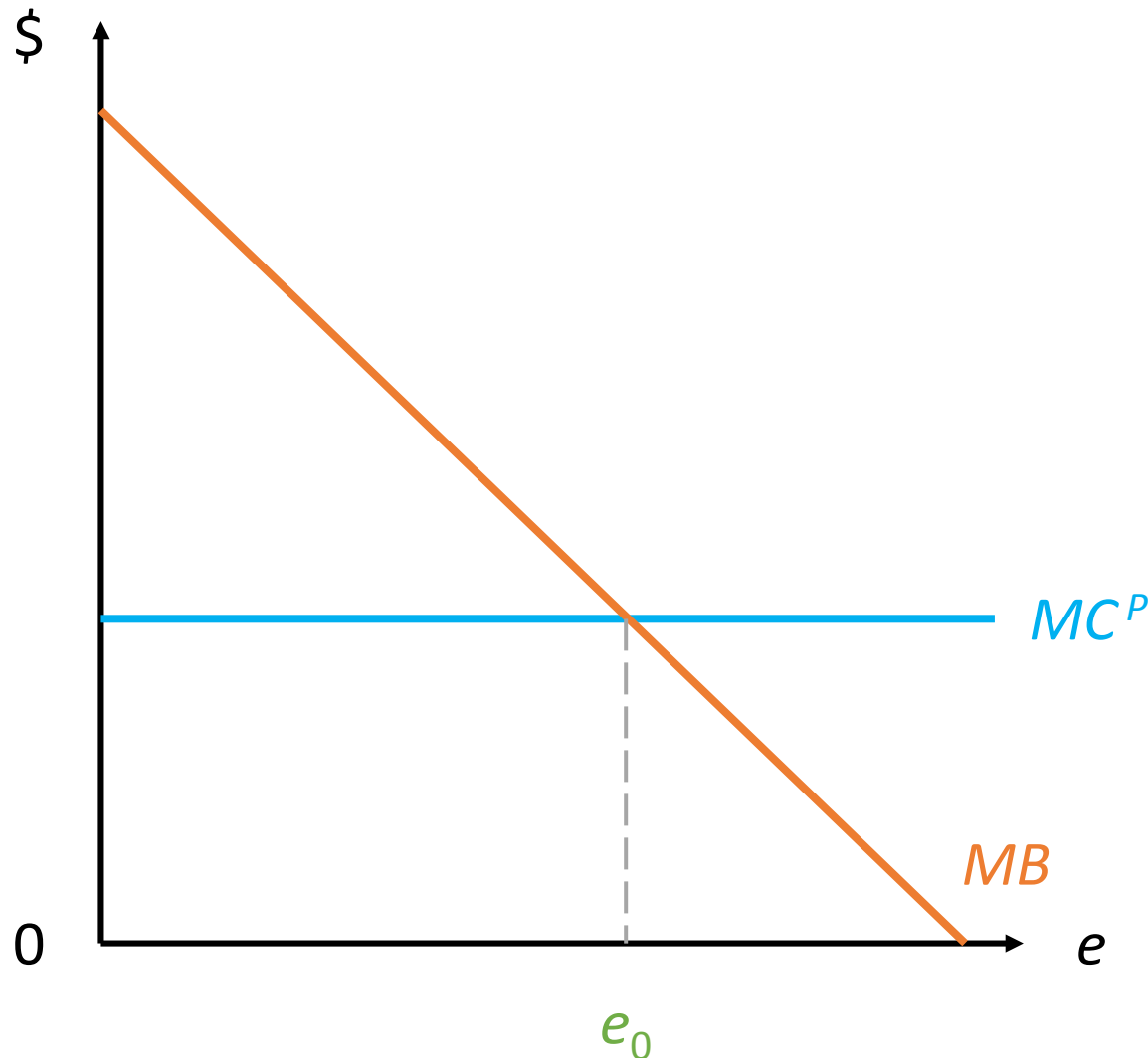
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Shimmering Immaculate Republican

- **Defⁿ:** Economics is the study of the allocation of goods and services *under conditions of scarcity*
 - Behavior driven by desire to maximize our own well-being given limits on resources (typically income)
 - Special emphasis on:
 - 1. Tradeoffs:**
 - a. How do we balance benefits, costs of certain activities, and what does this mean for our personal GHG emissions?
 - b. How do our privately-optimal emissions compare with the efficient level?
 - 2. Incentives:**
 - a. What are different approaches for incentivizing efficient GHG emissions?
 - b. What are the pros and cons of each approach?

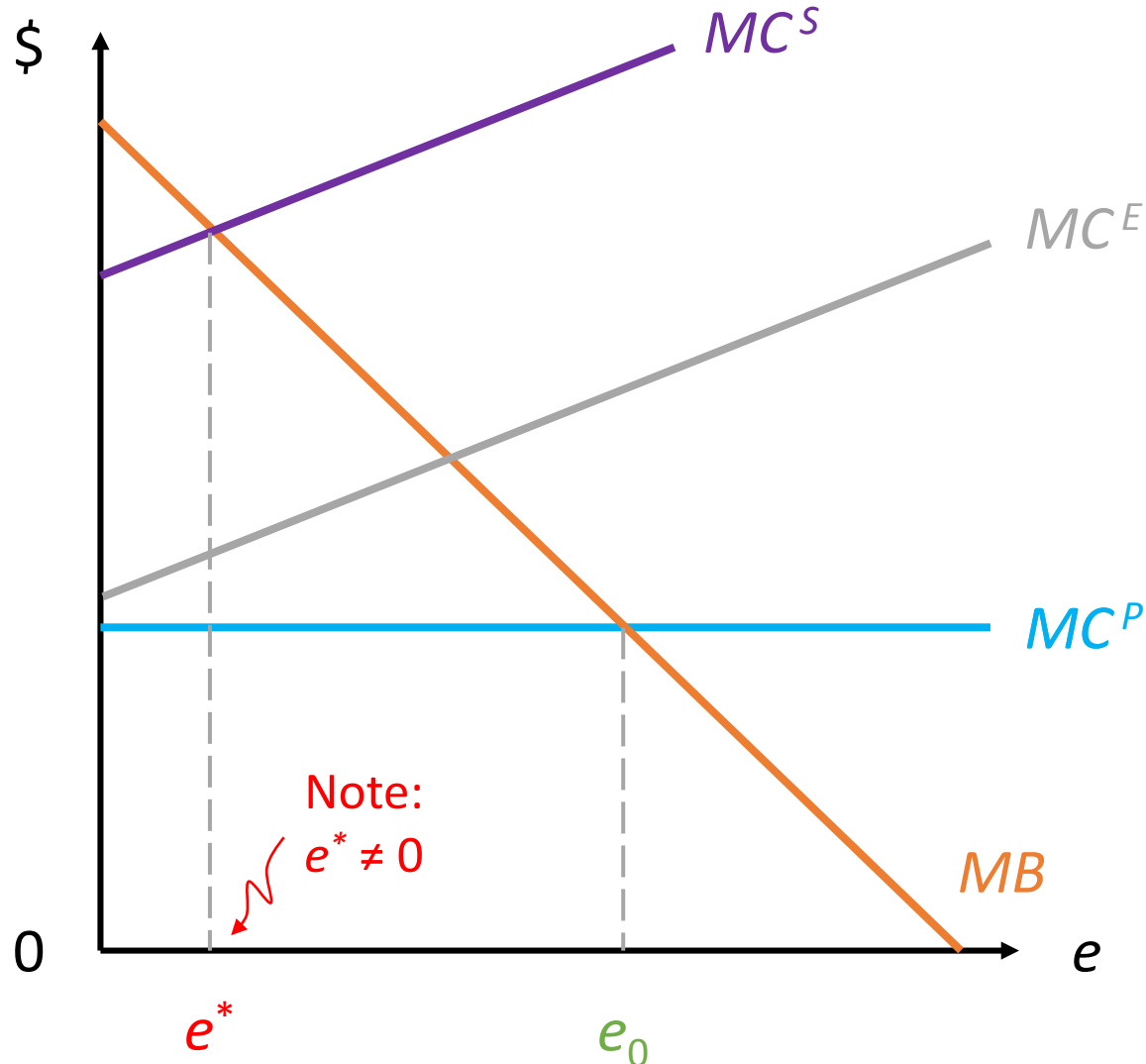
Part 1: Tradeoffs

Consumer choice: max private net benefits



- Suppose the good in question is emissions (from driving, say)
 - MC^P is the **private** cost of each additional ton emitted
- We also get benefits from emitting
 - MB is the benefit we get from each additional ton emitted
 - Benefits decline as we emit more and more...
- The **privately-optimal** number of emissions occurs at e_0 , where $MB = MC^P$
 - Just **trading off** the benefits, costs of driving that last ton of emissions

Social choice: max net benefits for all



- Of course, private costs aren't the only costs from emitting

- Extreme weather
 - Disease
 - Sea level rise
- } Marginal "external" costs (MC^E)

- Marg. **social** costs:

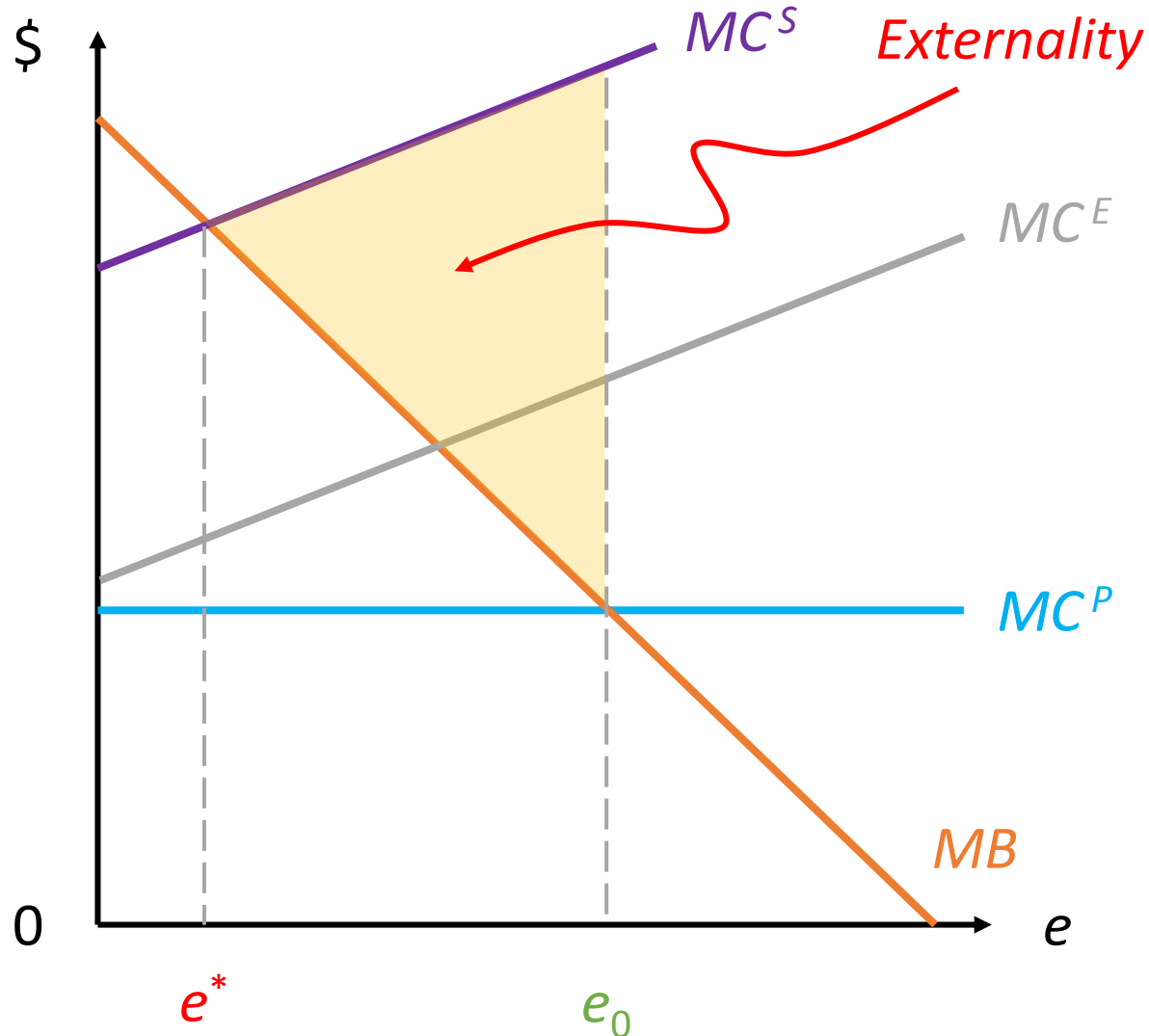
$$MC^P + MC^E = MC^S$$

- By same logic as before, **efficient** miles = $e^* < e_0$

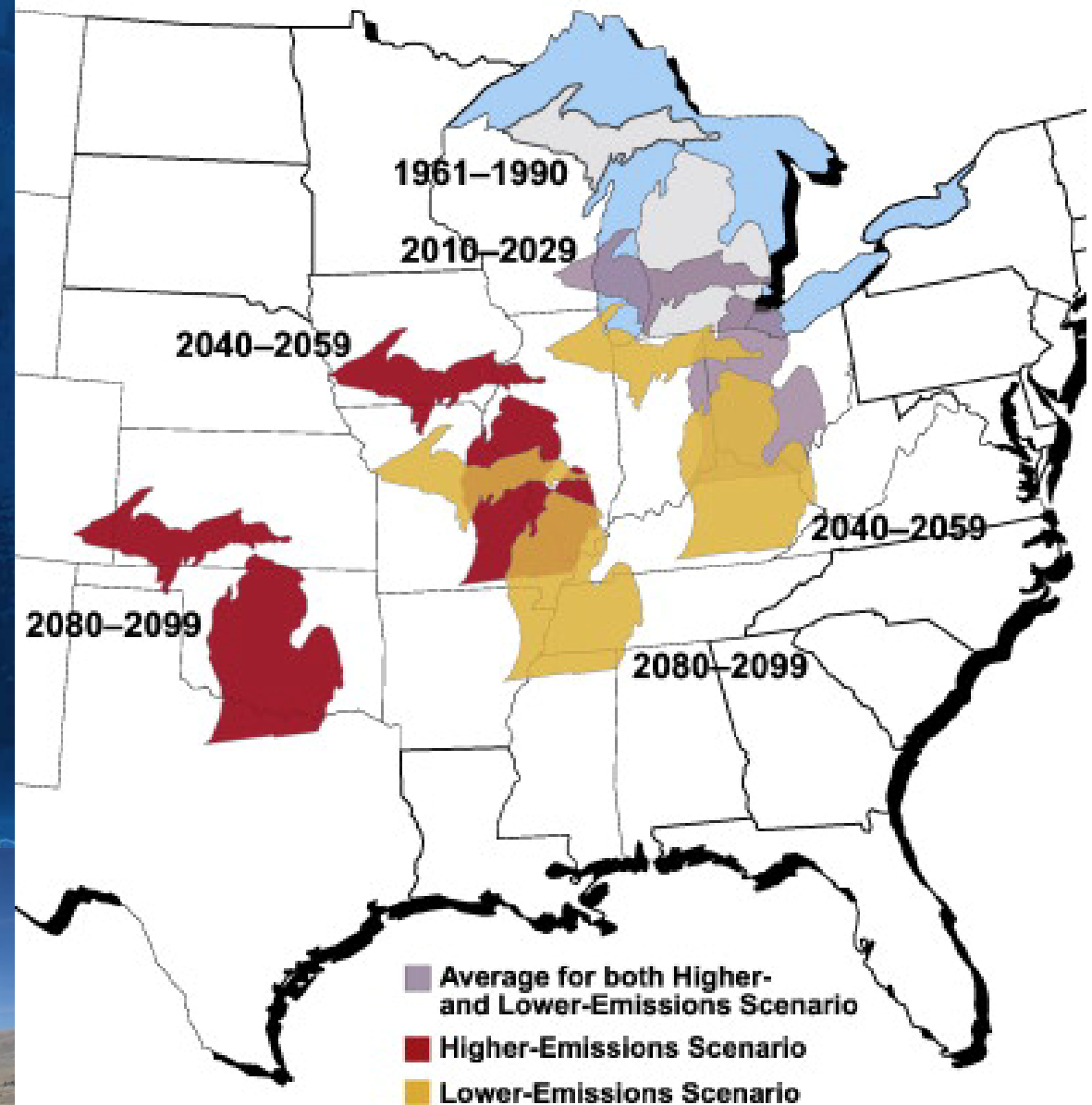
By definition, I don't
pay the external costs,
so I just keep on
emitting at e_0 ...



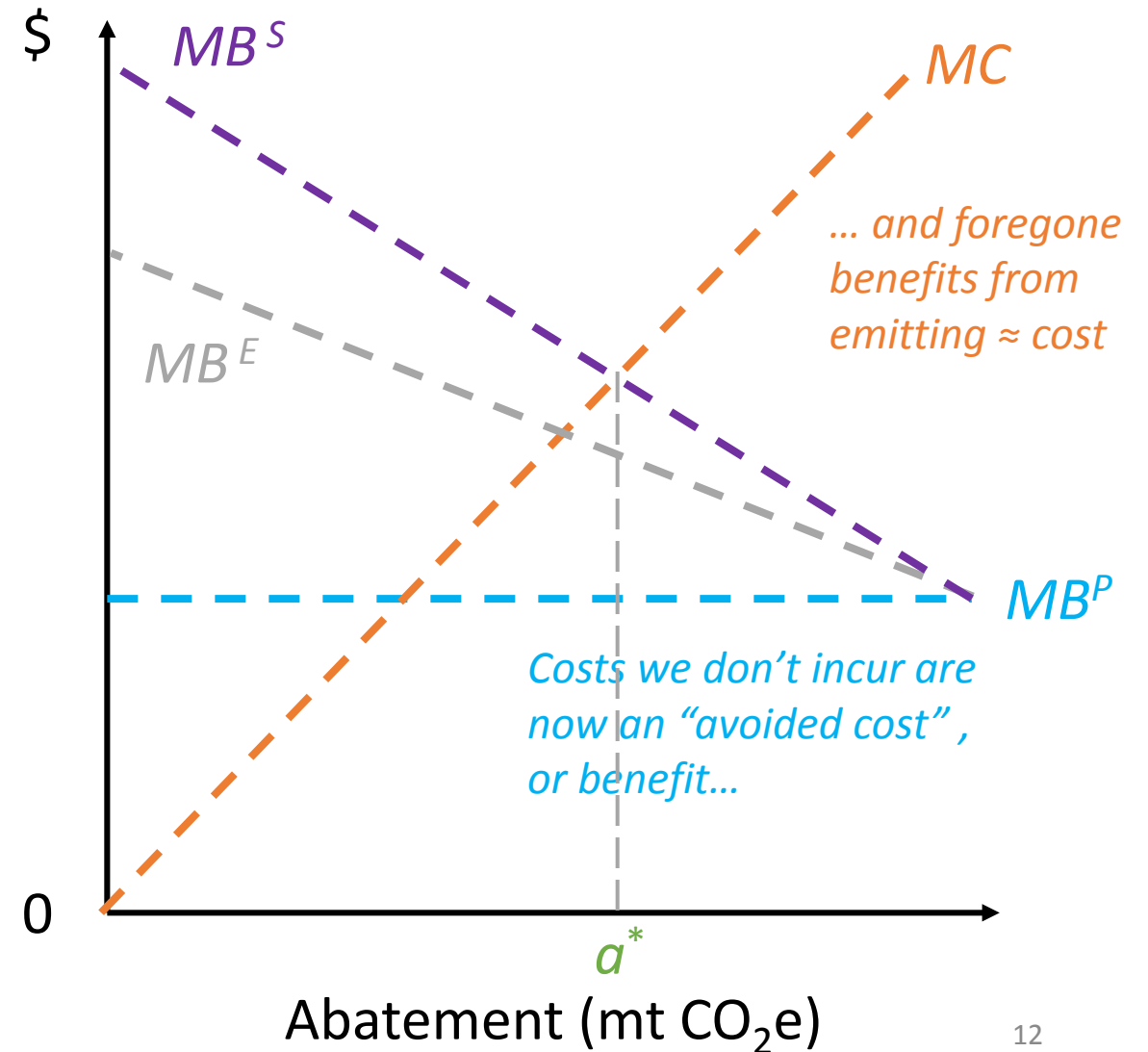
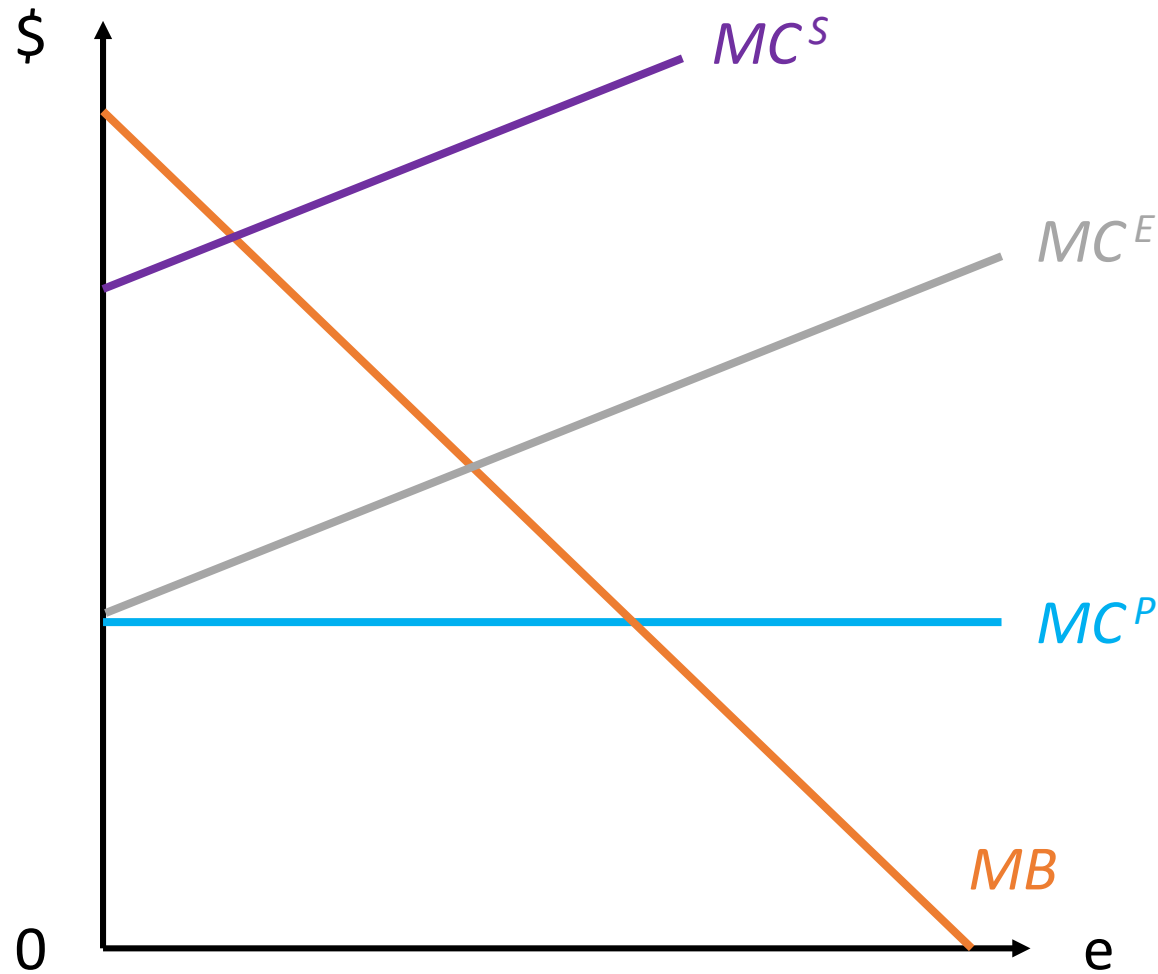
Externalities



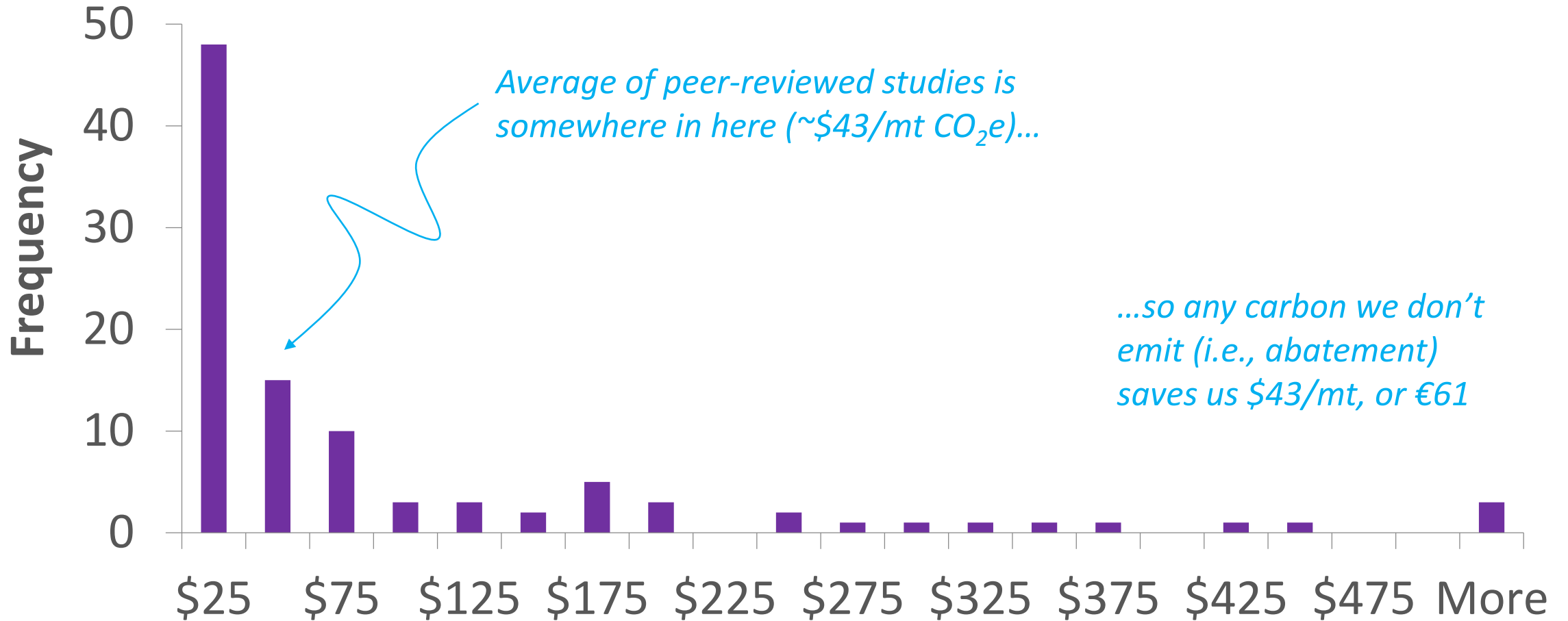
- By ignoring the external costs, I generate an **externality** on others
 - *Defⁿ*: An effect, other than a change in prices, of a market transaction on a nonparticipant in the market
- Externalities—and figuring out ways to “internalize” them—are a primary reason economists are interested in climate change

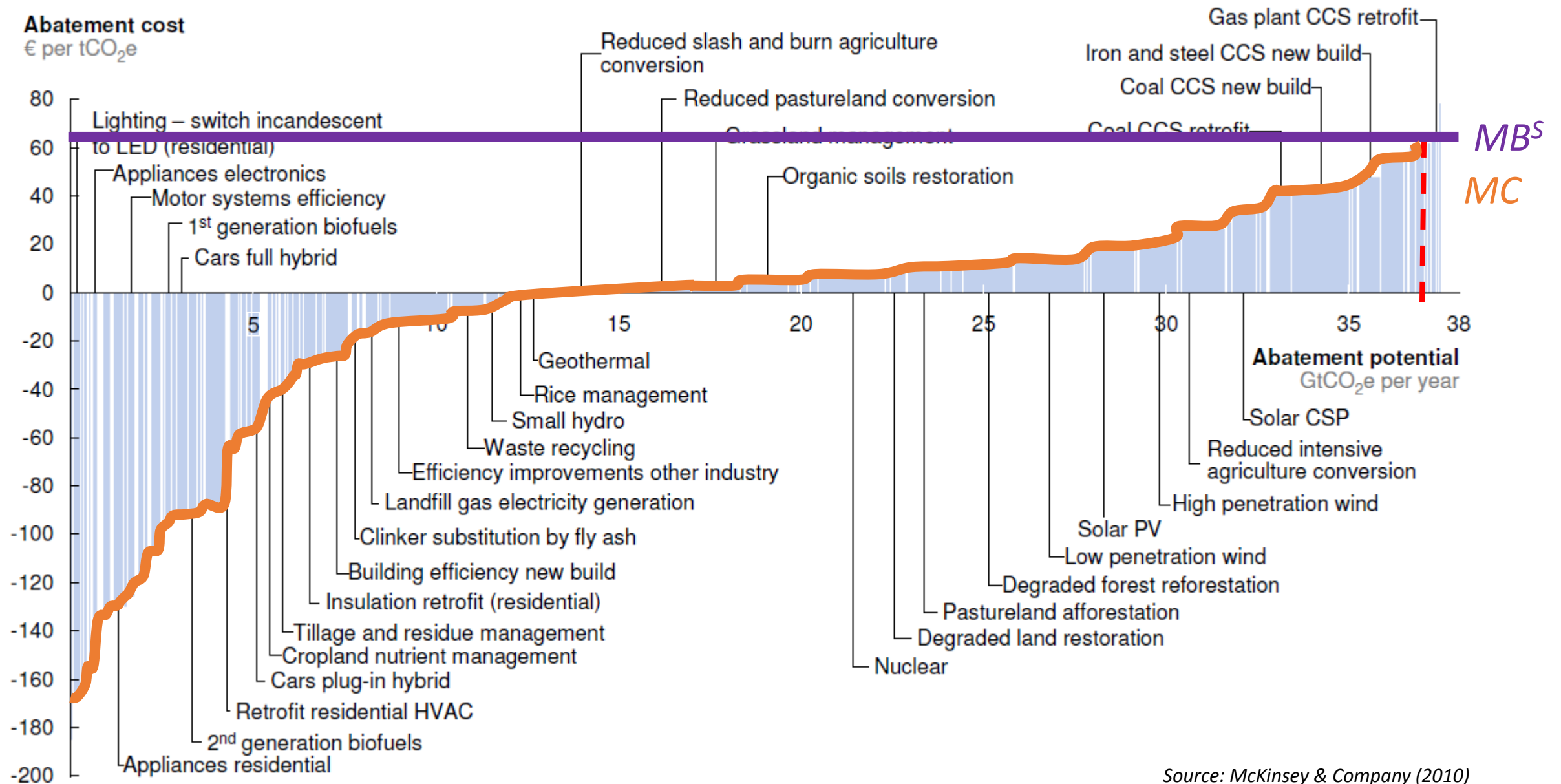


Reframing the problem: abatement (emissions not generated)



Marginal social benefits from emissions abatement (\$ mt CO₂e⁻¹)





Source: McKinsey & Company (2010)

To recap:

- We emit too much carbon because we ignore *external costs* when trading off our own private benefits and costs from polluting activities
- The efficient outcome:
 - Equates our benefits from carbon with the social costs
 - Maximizes the net benefits to society from carbon
 - Is controversial because it doesn't account for fairness/equality/sustainability and also weights up-front mitigation costs more than future benefits

Questions?

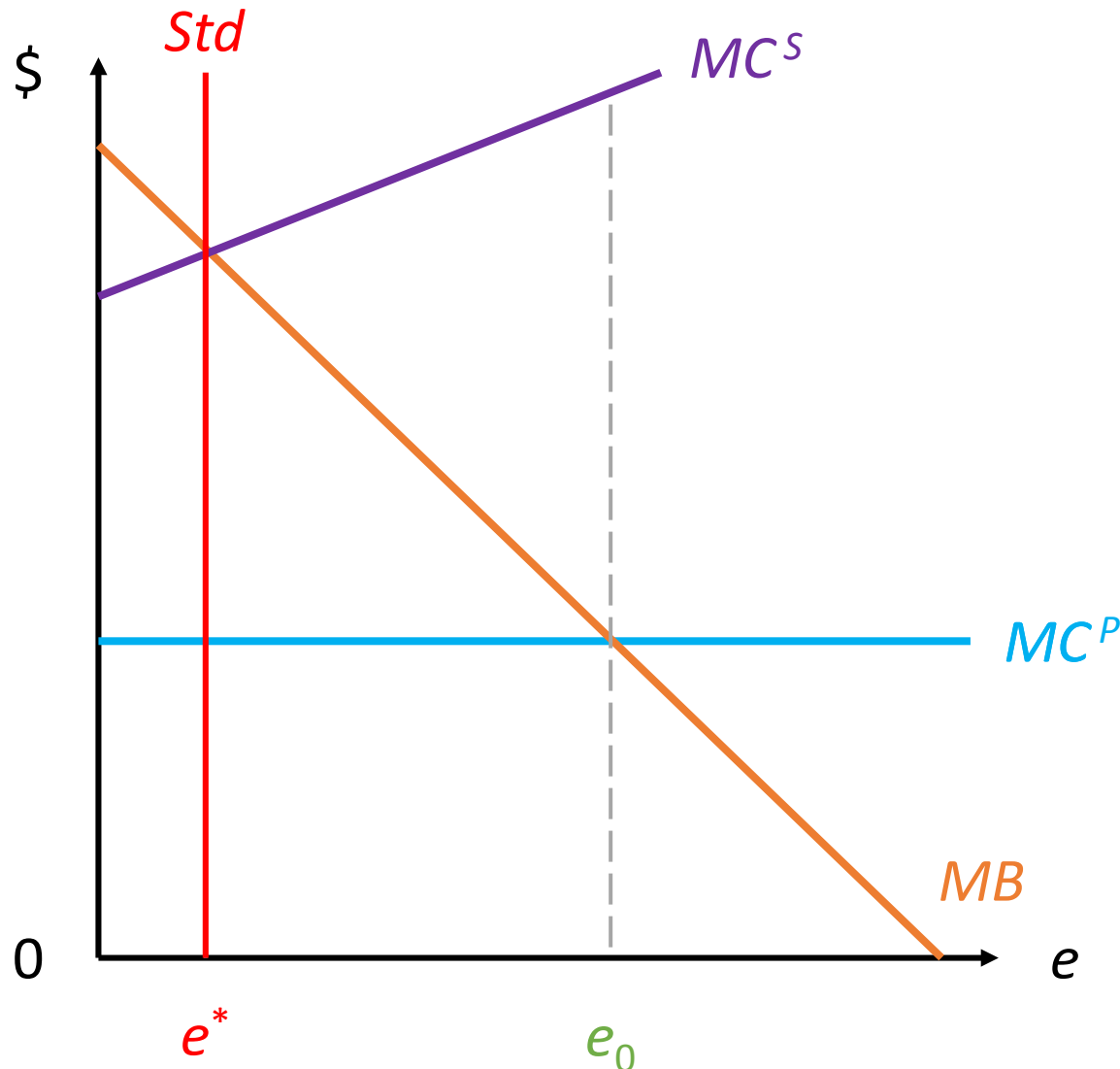


Part 2: Incentives

Policy instruments

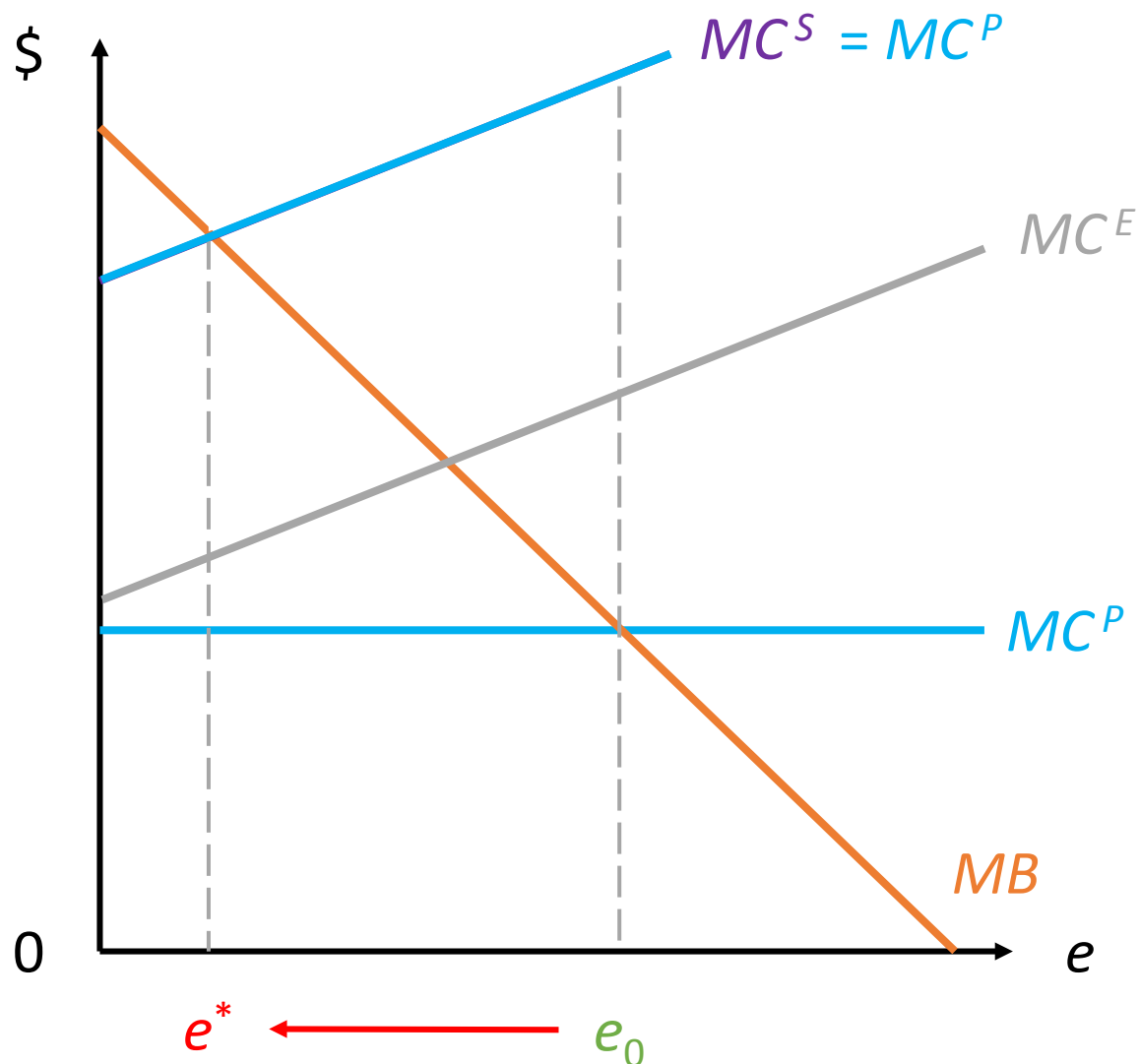
- Two types:
 1. “Command-and-control” instruments
 - Standards
 - Quotas
 2. Market-based instruments
 - Taxes
 - Permit markets

1. Command-and-control instruments (C&C)



- C&C is efficient if
 - i. We know marginal benefits/costs;
 - ii. All polluters are the same; and
 - iii. We can perfectly enforce emissions limits.
- Problem: (i) and (ii) are almost never true, and (iii) is iffy.
 - See Volkswagen's 2015 debacle

2. Market-based instruments: (Pigouvian) taxes

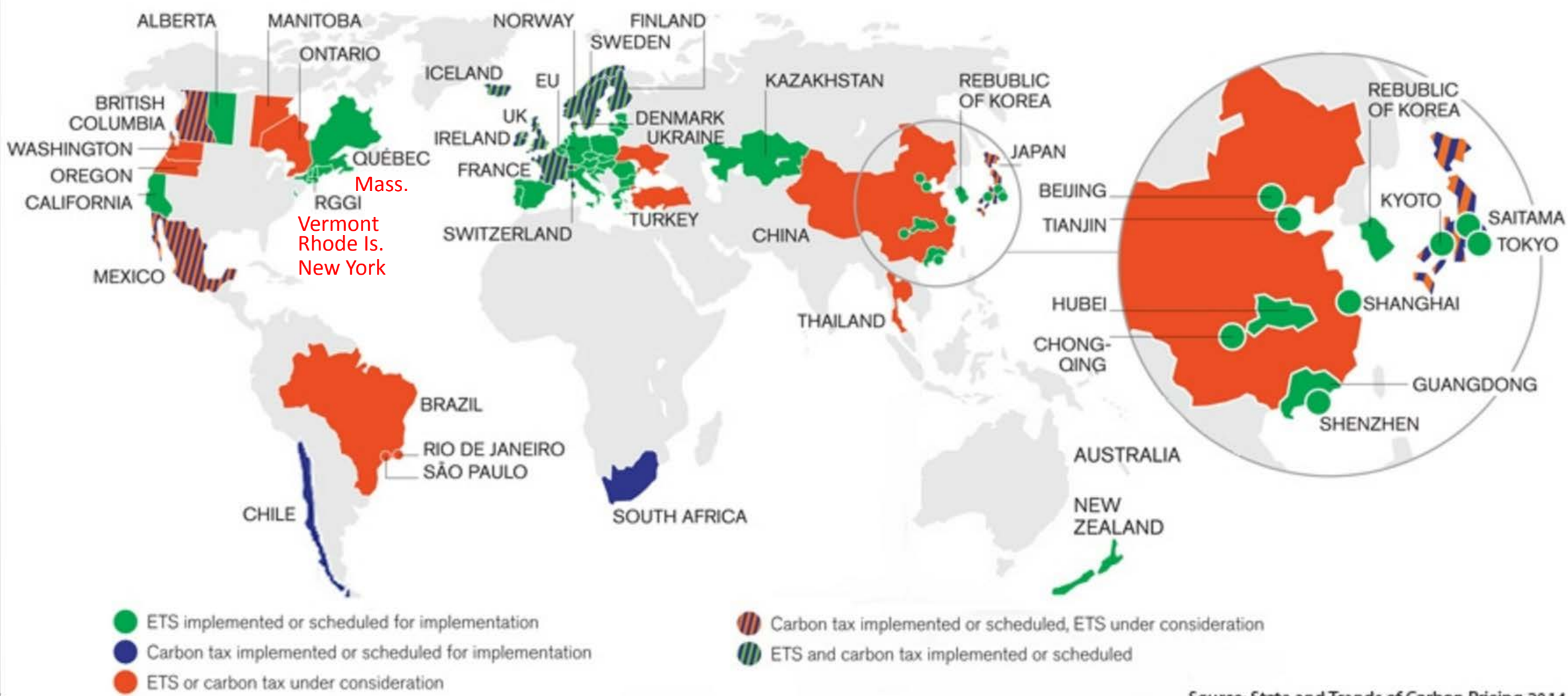


- Named for A.C. Pigou, who suggested taxing polluters at a rate equal to their marginal external costs
- Suppose we tax polluters an amount MC^E for each ton emitted
 - Cost of emitting \uparrow , so I emit less
 - Privately-optimal choice: e^*

Advantages of taxes over C&C

- Encourages innovation
 - I can come up with new means of abatement to avoid taxes
 - Incentives for innovation don't arise under some standards
- Relatively simple

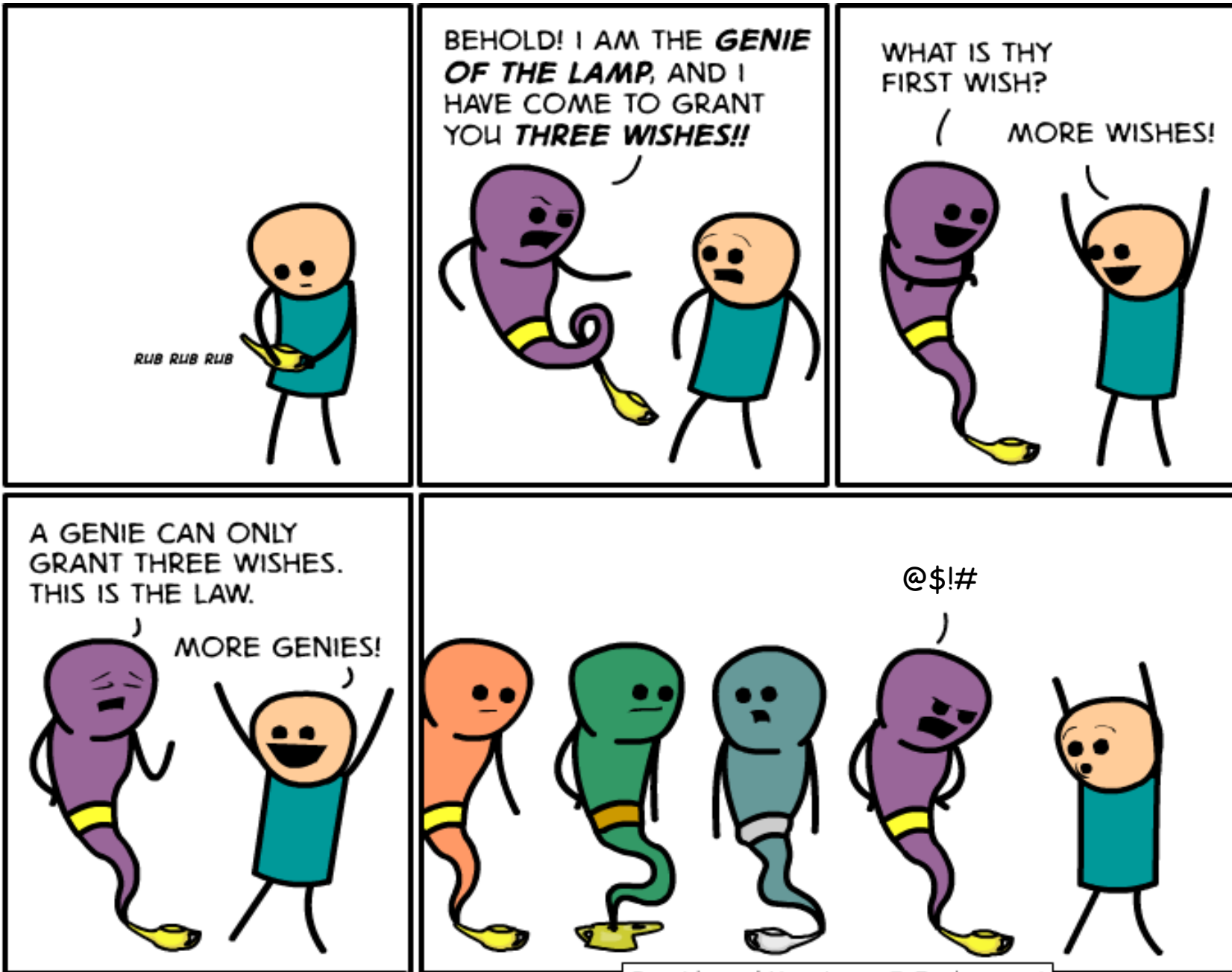
Locations of Existing, Emerging & Considered Carbon Pricing Instruments



Source: State and Trends of Carbon Pricing 2014

Problems with taxes

- Who likes taxes?
 - Can increase costs, prices
 - Unlikely to earn broad political support
 - No such thing as cost-free redistribution \Rightarrow deadweight loss
- Who gets the tax revenue?
 - We don't typically want to compensate victims of pollution
 - No incentive for them to avoid harm if we're made them whole \Rightarrow greater social harm
 - Recent proposals want to give revenues back *to the polluters*
 - We'll see why this works in a little bit.



Further, they only limit the emissions of each polluter...

... but the **number** of polluters is important too.

2. Market-based instruments: trading “property rights”

- *Defⁿ*: *Property rights* endow an individual with
 - i. ownership and
 - ii. transferabilityover land, personal possessions, and tangible/intangible goods
 - Examples:
 1. I have property rights over my house/phone/car because I can keep you out of it and I can sell it/give it to someone else.
 2. Likewise, stop signs give me property rights over an intersection
 - Order at which we arrive gives me ability to enter intersection (and you have to stay out of it), or I could wave you on ahead of me (that is, I transfer “ownership” to you)
- We can arrive at the efficient outcome by assigning property rights over emissions, a result due to...

“The Coase Theorem”:

In the absence of transaction costs, the efficient outcome will arise regardless of the initial distribution of property rights.

- Canonical example: a farmer and rancher
 - Share neighboring land
 - Rancher’s cows eat farmer’s corn
 - No initial property rights
- Who gets the rights?



Case 1: Farmer has property rights

Herd size (steers)	Annual crop loss (\$)	Crop loss per additional steer
1	1	1
2	3	2
3	6	3
4	10	4

- Suppose Farmer earns \$2 in profit from raising crops
- Suppose rancher maximizes profit at \$4 by running 2 steers
 - Rancher pays \$3 in damage to farmer
 - Farmer earns $\$2 - \$3 + \$3 = \2
- Room for a “Coasian bargain”:
 - Farmer would be willing to accept any payment greater than \$2 to not plant at all
 - Rancher would be willing to pay up to \$3 for farmer not to plant at all
 - Negotiation \rightarrow social net benefits = $(\$4 - \$3) + (\$0 + \$3) = \$4$

Case 2: Rancher has property rights

Herd size (steers)	Annual crop loss (\$)	Crop loss per additional steer
1	1	1
2	3	2
3	6	3
4	10	4

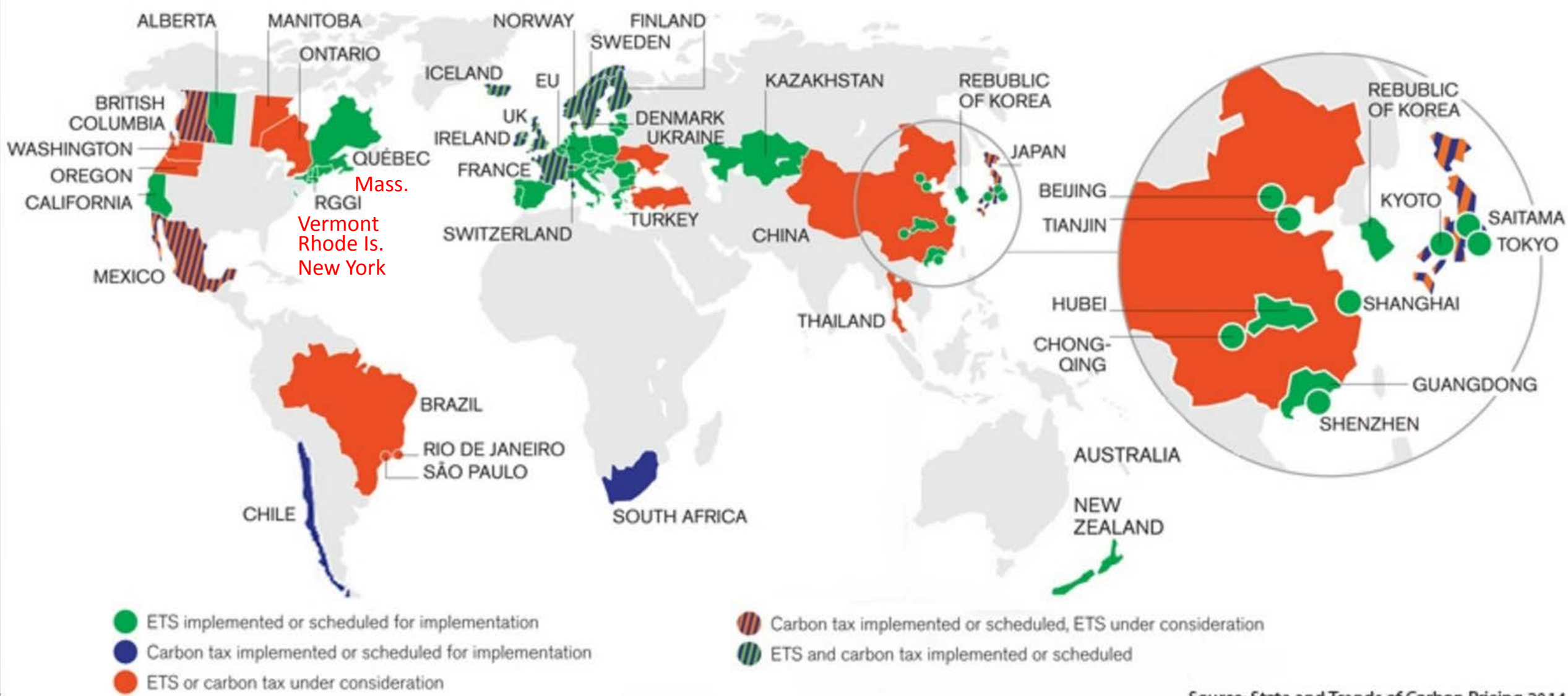
- Rancher maximizes profit with 2 steers so profit = \$4
- Farmer earns $\$2 - \$3 = -\$1$
 - Actually, he'd earn \$0 since he'd just go out of business to avoid a loss
- $SNB = (\$4) + (\$0) = \$4$
- **Punchline:** The social net benefits are both maximized at the same value in each case: it doesn't matter who gets "property rights"—the only difference is how the benefits are divided up.

So what does the Coase Theorem have to do with climate policy?

- Economists recognized that we need not limit ourselves to cows, corn, etc.; we can also assign property rights over *emissions*
- Suppose a regulator limits the total emissions allowed by an industry
 - He/she could then give out permits, each of which gives the permit holder *the right* to emit a certain quantity of emissions
 - Excess emissions would have to be abated:
 - If I can abate cheaply, I sell my rights (permits) to someone who is willing to pay for them
 - If it's expensive for me to abate, I can purchase the rights (permits) from a cheap abater
 - As long as trading is free, we negotiate according to our benefits and costs (Coasian bargaining), and we arrive at the efficient level of emissions

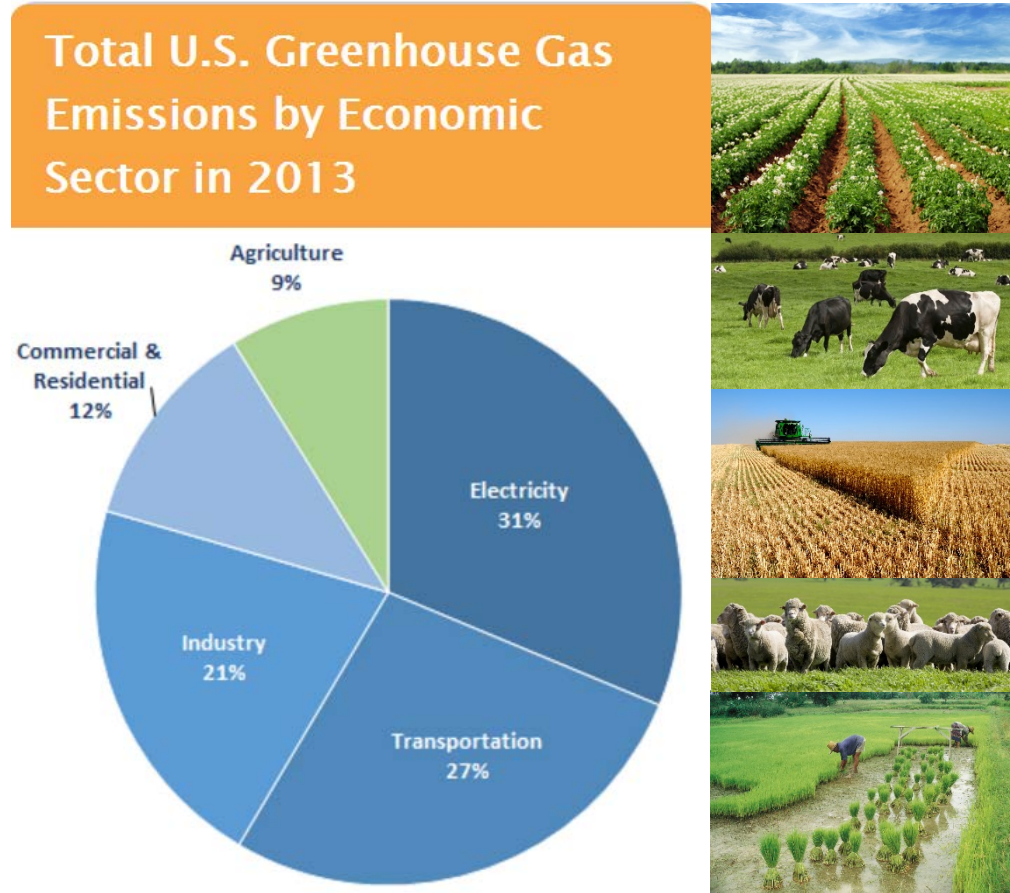
*Emissions permit markets (i.e., cap-and-trade)
are the embodiment of the Coase Theorem*

Locations of Existing, Emerging & Considered Carbon Pricing Instruments



Source: State and Trends of Carbon Pricing 2014

Advantages to markets over taxes



- Regulation is costly... but low-cost abaters gain under markets
 - ↑ political support
- Institutional constraints limit taxing every emitter (e.g., row-crop ag, other “nonpoint sources”)
 - Can bring unregulated sources into markets via offset programs

Part 3. Trends in Climate Policy Incentives

Part 3. Trends in Climate Policy Incentives

- A global cap-and-trade style market is likely off the table
 - Local markets still a viable option, with a few examples in U.S.
 - Regional Greenhouse Gas Initiative (RGGI) – New England
 - California's Cap-and-Trade Program
- Increasing momentum behind “revenue-neutral taxes”
 - Press has long favored taxes over markets (e.g., Thomas Friedman, NYTimes)
 - Even the oil and gas industry has, at times, floated these taxes

What is a revenue-neutral tax?

- In short, it's a tax on carbon emissions where proceeds are refunded to the emitters.



This sure sounds like hocus pocus:



If you charge me more
for emitting carbon...



...but give me money back at
the end of the year...



...then why wouldn't I emit as
much as I did in the first place?

Washington State tried it recently

- Initiative 732 would have implemented the country's **first** carbon tax
 - ~\$35/ton tax on emissions, mostly from electrical generation and gasoline
 - Expected revenues: \$2 billion annually
 - Revenue would be returned to consumers and businesses in the form of lower sales taxes and individual/business tax breaks
- This policy (and others like it) received widespread (and strangely bi-partisan) support from
 - Leonardo DiCaprio
 - The Audubon Society
 - Gregory Mankiw
 - Robert Frank

} Enviro. groups

} Ivy-league economists

 - Jimmy Carter
 - George Shultz
 - Hank Paulson, Jr.
 - Rex Tillerson

} Prominent politicians (R & D)

} ExxonMobil CEO

Washington State tried it recently

- Despite this, I-732 was defeated at the polls in November '16 due to:
 - The usual opposition from Big Oil and the Koch brothers...
 - ... but also a lack of support from environmental groups, including
 - Sierra Club
 - Washington Environmental Council
 - Union of Concerned Scientists
 - Climate Solutions
 - 350Seattle.org



Washington State tried it recently

- Primary argument was the same, hocus pocus one
 - Shouldn't give money back to those who cause the problems
 - Instead, give money to clean energy groups, poor communities to mitigate/adapt to climate change... yada yada yada.



Do these things actually work?

There's a sound economic argument to be made here.

- Suppose we have a choice between a polluting product and a “clean product”
- Next, suppose the polluting product gets more expensive
 - → We'll buy more of the cheap product
- Finally, give us more money
 - We can afford more of both goods (“**income effect**”)
 - But, the clean product is still relatively cheaper, so we still buy more of that, despite having more money (“**substitution effect**”)

Do these things actually work?

- Yes – and they have received support from major economists since at least 1970

In fact, this is what I quoted at the beginning:

“Suppose a politician promised to reveal the details of a simple proposal that would, if adopted, produce hundreds of billions of dollars in savings for American consumers, ... major improvements in urban air quality, large reductions in greenhouse gas emissions, and substantially reduced dependence on Middle East oil. The politician also promised that the plan would require no net cash outlays from American families...

[A] policy that would deliver precisely the outcomes described could be enacted by Congress tomorrow—*namely, a \$2 a gallon tax on gasoline whose proceeds were refunded to American families in reduced payroll taxes.*”

(Frank 2006)

Do these things actually work?

- Yes – and they have received support from major economists since at least 1970
- It's important to not let the perfect be the enemy of the good (or even just workable) with climate policy
 - We haven't been good at giving people incentives to make the right climate tradeoffs
- Economic policies can potentially generate huge reductions in GHG emissions *in the short run* (tech. improvements can't, or at least won't)
 - Important not to trip over ourselves: an “imperfect” policy – or, at least, one that doesn't match your ideals – is still progress.

Links for further information:

- Resources for the Future: Economic Analysis of US Carbon Policy

<http://www.rff.org/research/subtopics/carbon-tax>

- New York Times: A Conservative Case for Climate Action

<https://www.nytimes.com/2017/02/08/opinion/a-conservative-case-for-climate-action.html>