# Lecture 05

## Taxes

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ECON 467

# Roadmap

1. What are the different kinds of price instruments in theory and the real world?
2. What happens under a tax?
3. Why cost-effectiveness requires equimarginal abatement when firms have heterogeneous MACs

# Taxes

# Emission taxes

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It is as if the government claimed the property rights to the air on behalf of the citizens, and then sold the rights to pollute back to the firm at price $\tau$

Solves the two big problems with externalities:

1. Poorly defined property rights (assigned to the regulator)
2. High transactions costs (pay a flat fee)

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We know abatement costs are decreasing in emissions and damages are increasing in emissions

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This means that the regulator's optimal tax is given by:

$$\tau^* = D'(E^*)$$

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The tax actually makes them bear a cost exactly equal to marginal damage

# Emission taxes: graphical
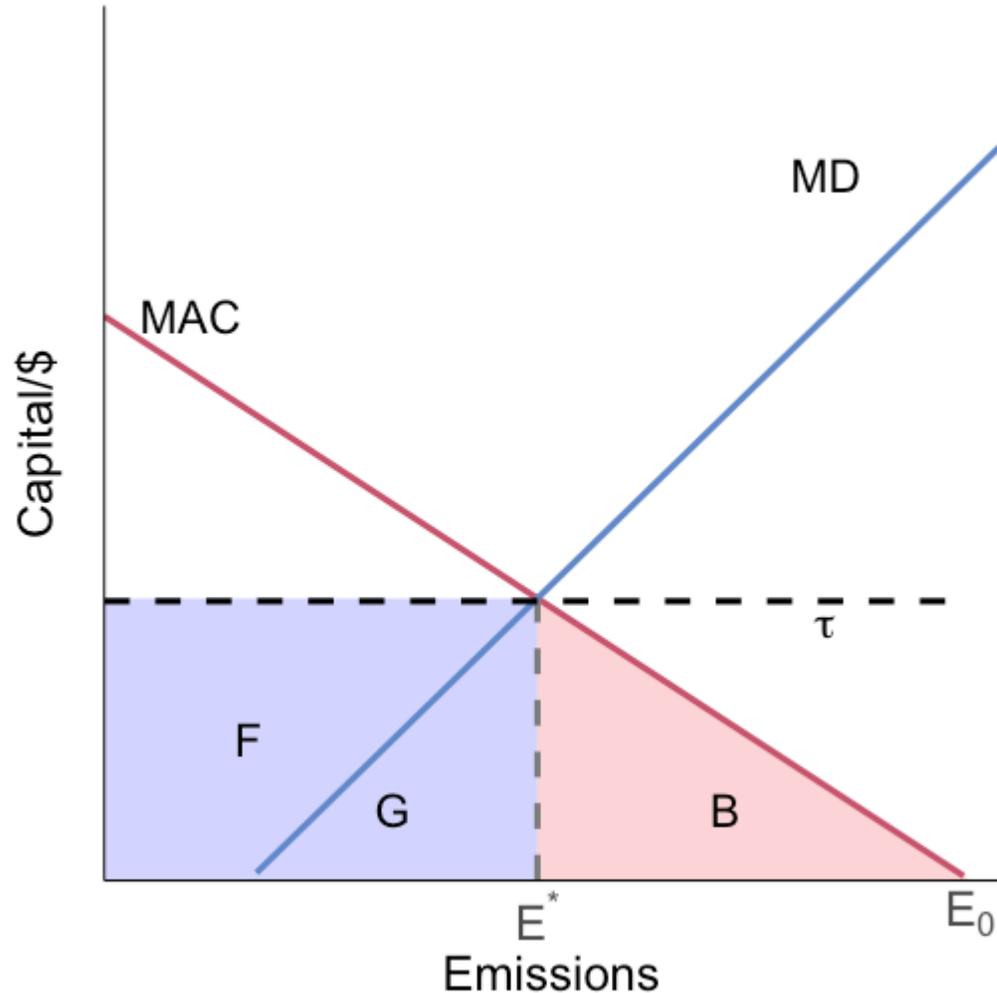


The optimal tax equals MD at $E^*$

You can think of this as the firm being forced to pay for damages equal to the cost of the last unit of emissions

In addition to paying abatement cost equal to the red area $B$, the firm also has a tax payment equal to the blue area $F + G$

# Emission taxes: real world

Australia started carbon tax on July 1, 2012

$23 AUD per ton of carbon emitted for large emitters as a response to the Copenhagen Accord of 2009

Australia hopes to reduce carbon emissions by 80% below 2000 levels by 2050

Started by Julia Gillard government and revoked by Tony Abbott government in July 2014

# Emission taxes: real world

In 2008, the province of British Columbia implemented North America's first broad-based carbon tax

The carbon tax applies to the purchase and use of fossil fuels and covers approximately 70% of provincial greenhouse gas emissions

Beginning April 1, 2018, B.C.'s carbon tax rate is $35 per tonne of carbon dioxide equivalent emissions

To improve affordability, government increased the Climate Action Tax Credit

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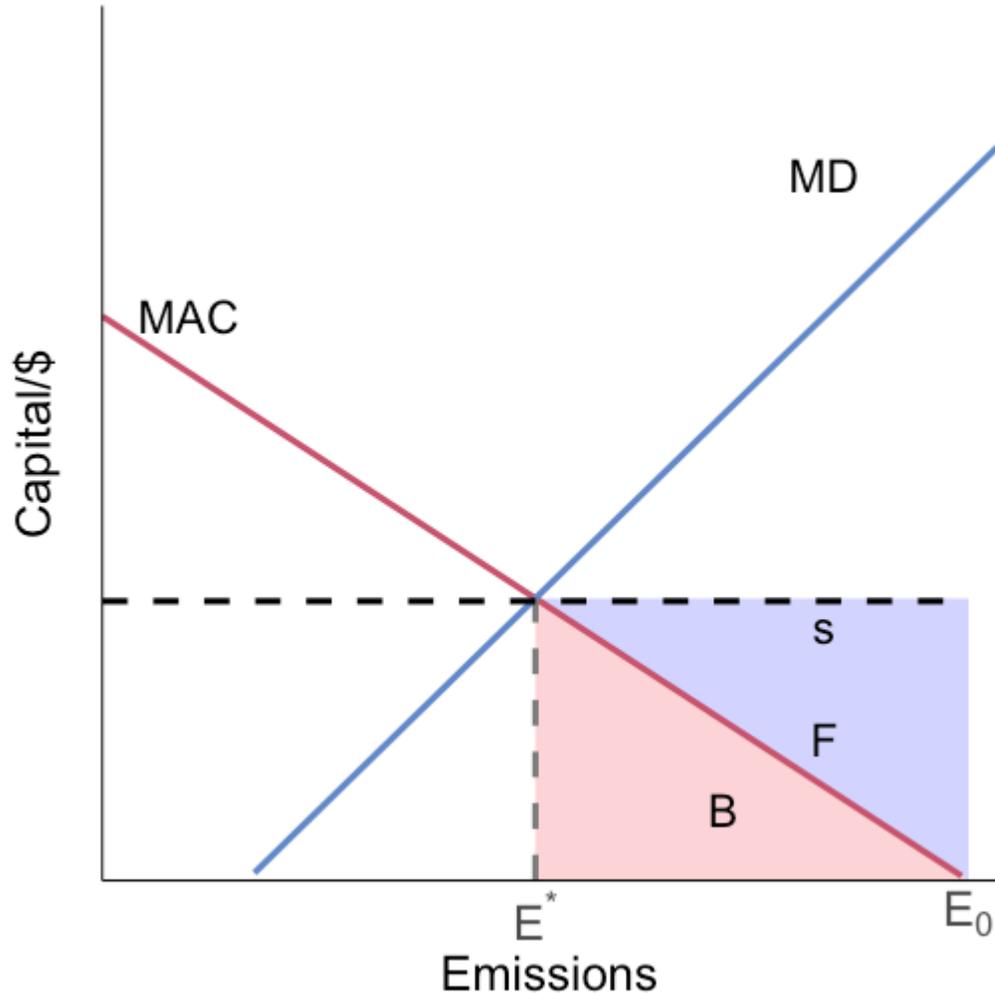


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In addition to paying abatement cost equal to the red area $B$, the firm also has subsidy **revenues** equal to the red+blue area $B + F$

# Abatement subsidies

It is as if the government claimed the property rights to the air on behalf of the firm, and then pays the firm for the right to clean air on behalf of the citizens

# Congestion Pricing

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A toll internalizes these externalities by making drivers pay the social cost of their trips

# NYC congestion pricing

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**How it works:**

- $9 toll for cars entering Manhattan south of 60th Street (peak hours)
- $2.25 for motorcycles, $14.40 for small trucks, $21.60 for large trucks
- Off-peak and overnight discounts
- Exemptions for emergency vehicles, buses, residents below income threshold

# NYC congestion pricing

**Goals:**

- Reduce traffic by 10-15%
- Raise $1 billion annually for MTA public transit improvements
- Faster bus and emergency vehicle travel times
- Improved air quality in Manhattan

# NYC congestion pricing explained

# NYC congestion pricing: one year later

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(a) ATT on log speeds: road segments
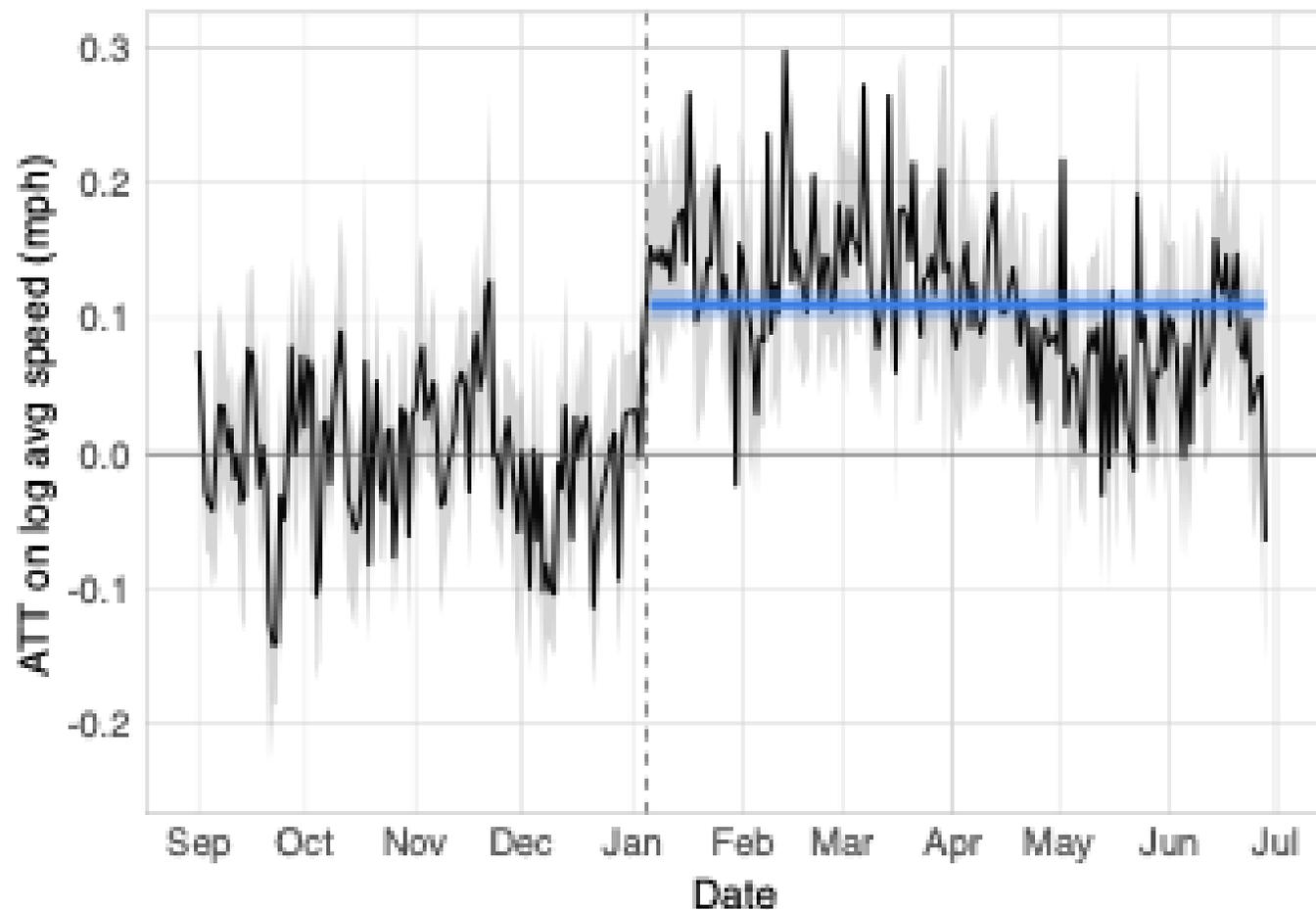
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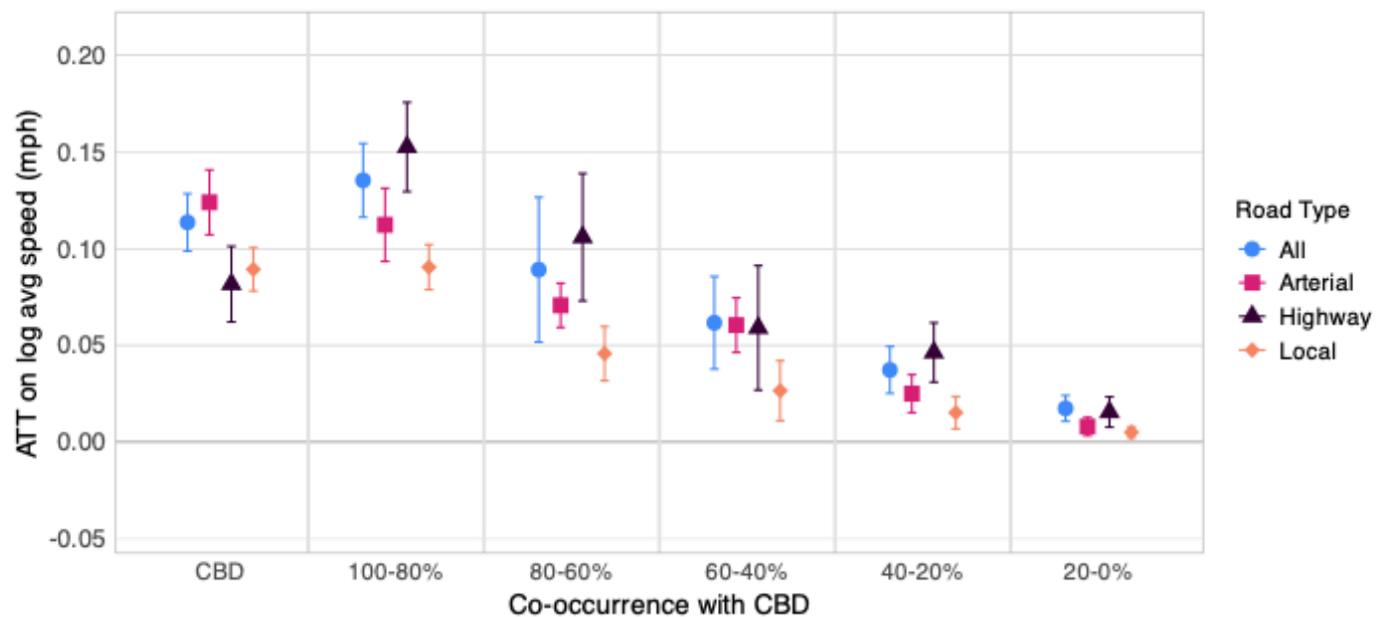


(c) Average segment speeds by hour of day
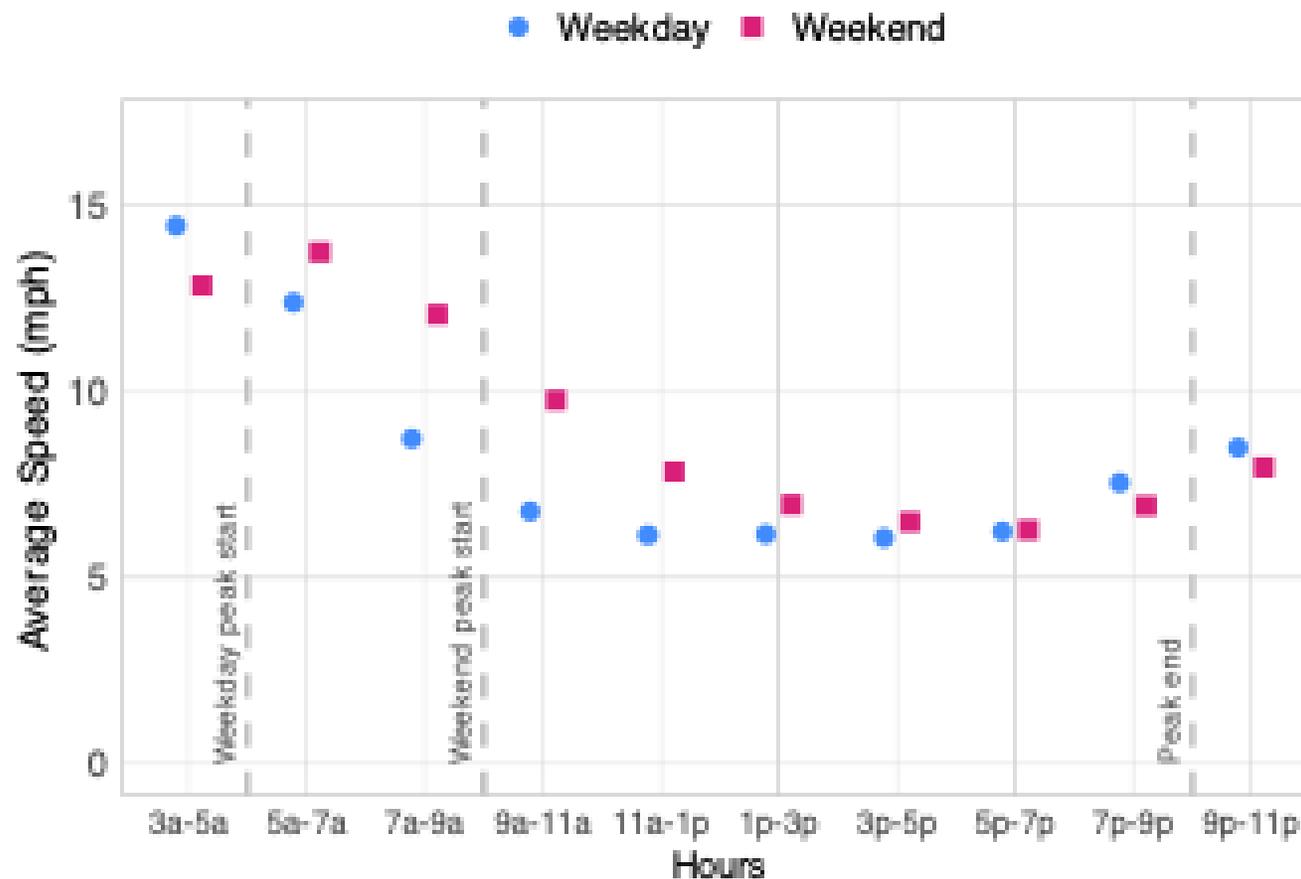
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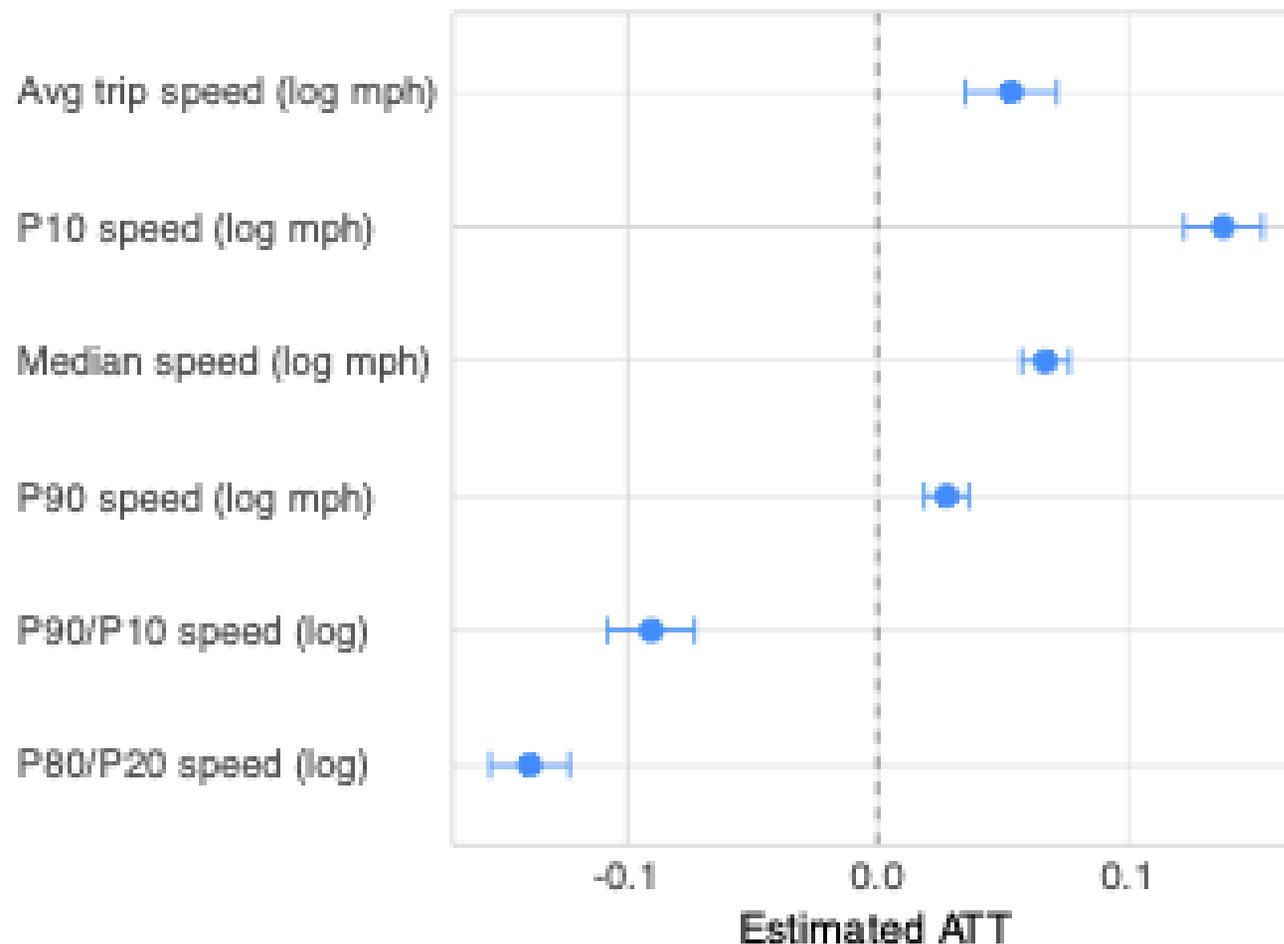


(d) ATT on log speeds: hour of day
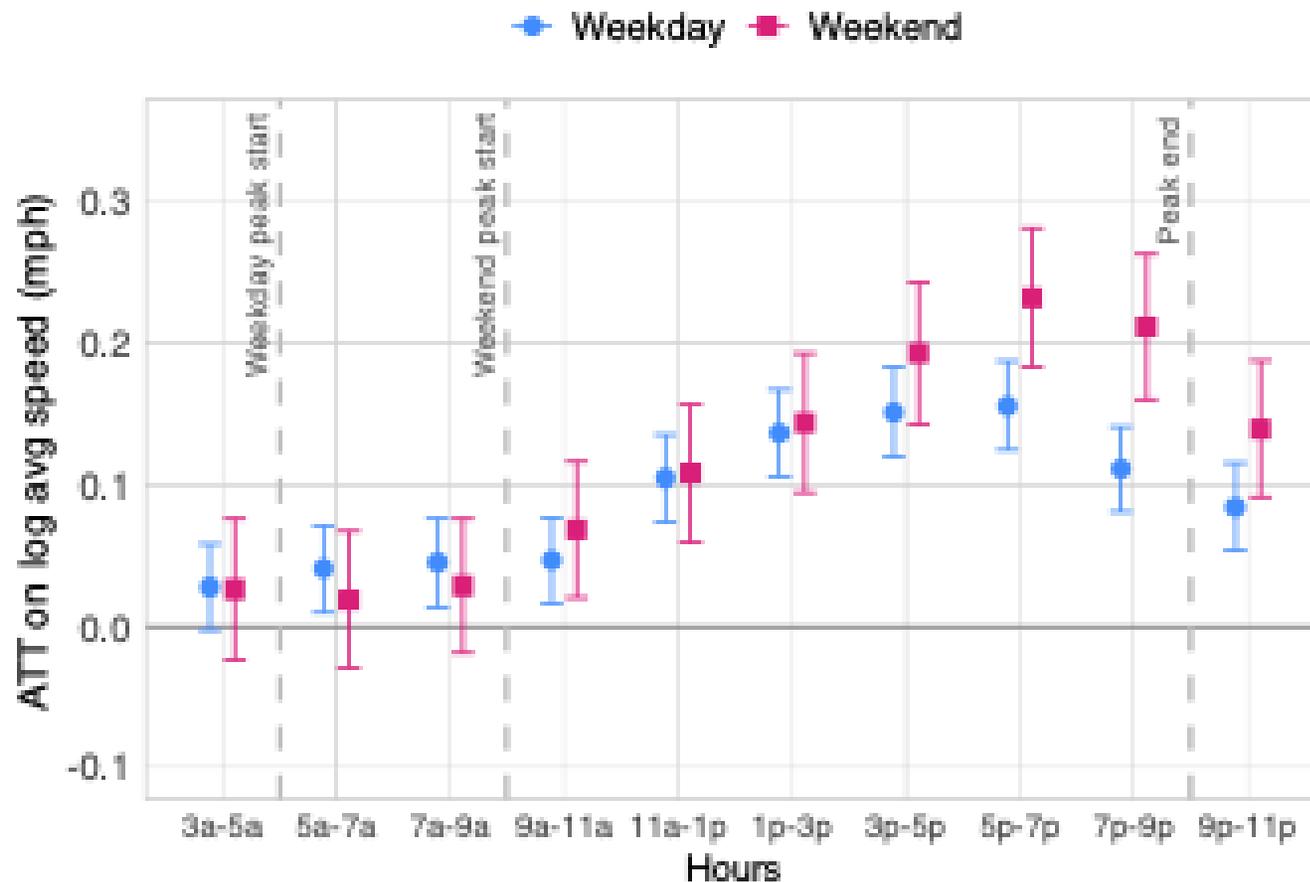
# NYC congestion pricing: one year later



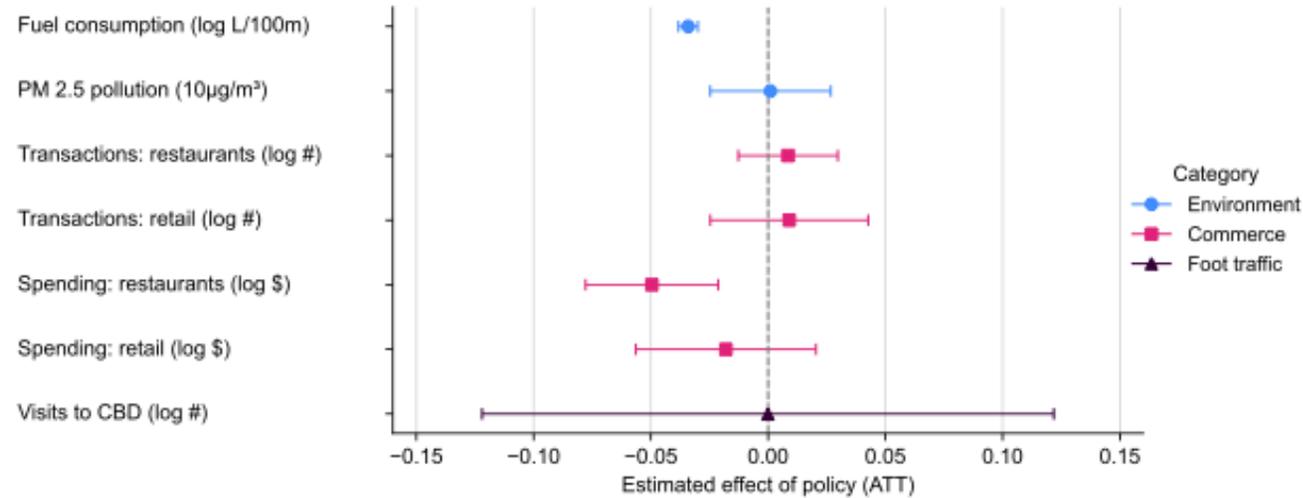Figure 4: Effect on Speeds by Co-Occurrence and Road Type

# NYC congestion pricing: one year later



(b) ATT on other traffic outcomes

# NYC congestion pricing: one year later



Figure 3: Effects on Other Outcomes in the CBD

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The response: **Yellow Vest protests** (Gilets Jaunes)

# France's Yellow Vest protests

**What happened:**

- 300,000+ protesters across France
- Blocked roads, occupied roundabouts
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**Why?**

- Rural and suburban households depend on cars
- Tax seen as burden on working class while wealthy unaffected
- "End of the world vs end of the month"

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NYC's congestion pricing includes income-based exemptions for this reason

# Optimal policy with multiple firms
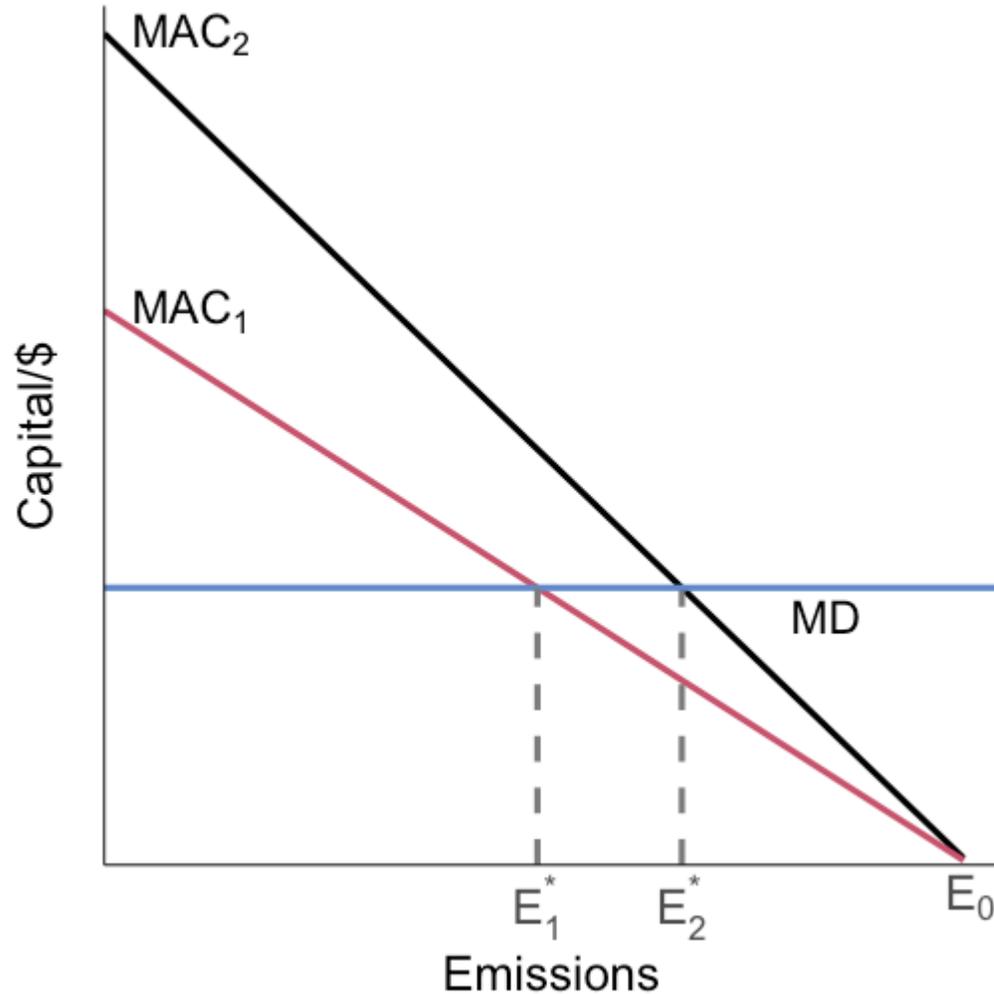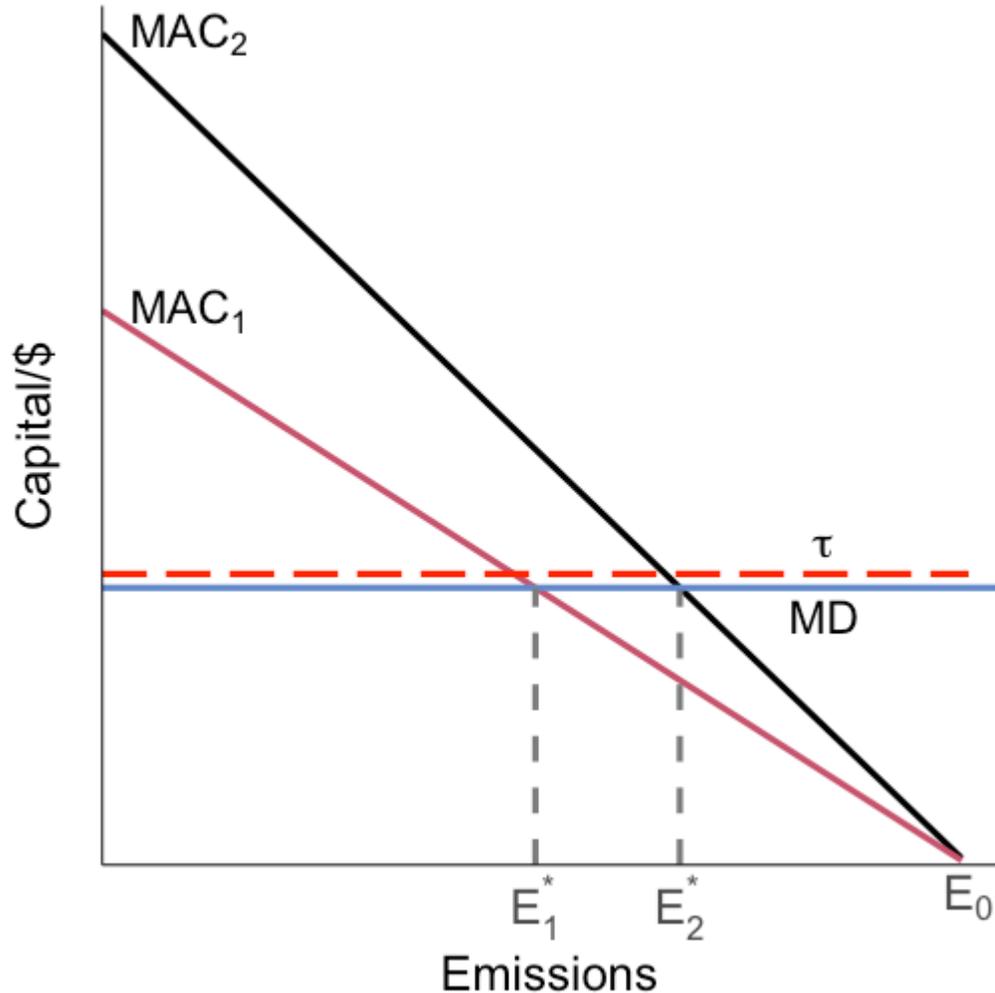


Firm #2 is 'dirty': has higher MAC

Firm #1 is 'clean': has lower MAC

If we use a regular emission standard: it has to be firm-specific!

Mandate $E_1^*$ for 1 and $E_2^*$ for 2

This requires **a lot** of info and political capital on behalf of the regulator

# Optimal policy with multiple firms



Regulating multiple heterogeneous firms with a tax can be easy:

If MD is constant, then since firms select MAC = $\tau$, as long as we set $\tau = MD$, we can achieve the efficient outcome (MAC = MD) without knowing anything about the firms!

# Optimal policy with multiple firms

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Let's see why

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Write down the regulator's problem

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Solve the constraint for $E_2 = \bar{E} - E_1$ so we have a simpler problem:

$$\min_{E_1} C_1(E_1) + C_2(\bar{E} - E_1)$$

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$$\min_{E_1} C_1(E_1) + C_2(\bar{E} - E_1)$$

Take the first-order condition to find what is necessary for a cost minimum:

$$C_1'(E_1) + C_2'(\bar{E} - E_1) \times (-1) = 0$$

# Optimal policy with multiple firms

This gives us:

$$\underbrace{-C_1'(E_1)}_{\mathrm{MAC}_1} = \underbrace{-C_2'(\overbrace{\bar{E} - E_1}^{E_2})}_{\mathrm{MAC}_2}$$

The marginal abatement costs across the sources must be equal at the cost-effective pollution level

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This is called the **equimarginal principle**

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Even if we don't set the tax equal to MD, whatever emission reduction we get will be as cheap as possible
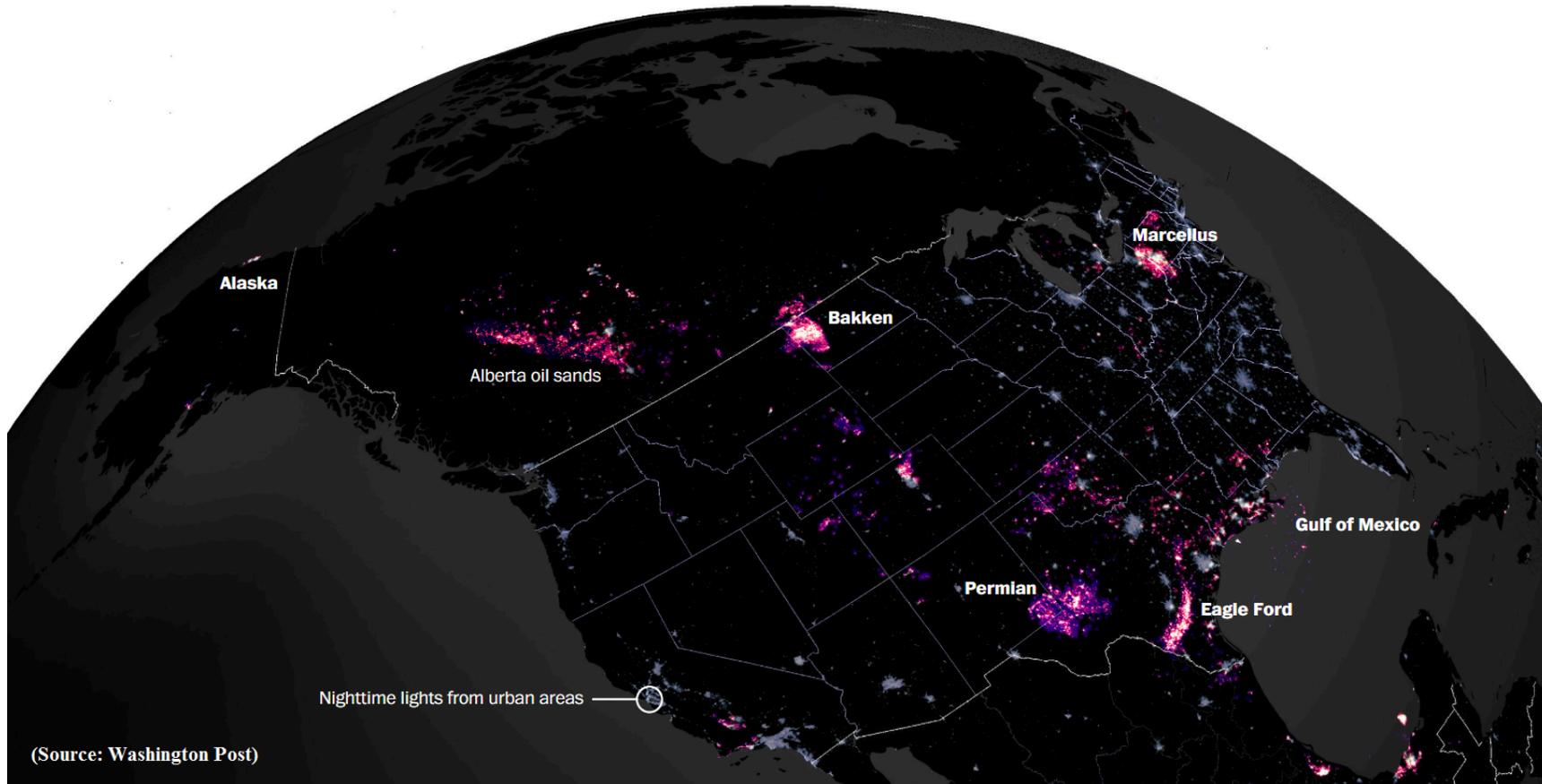
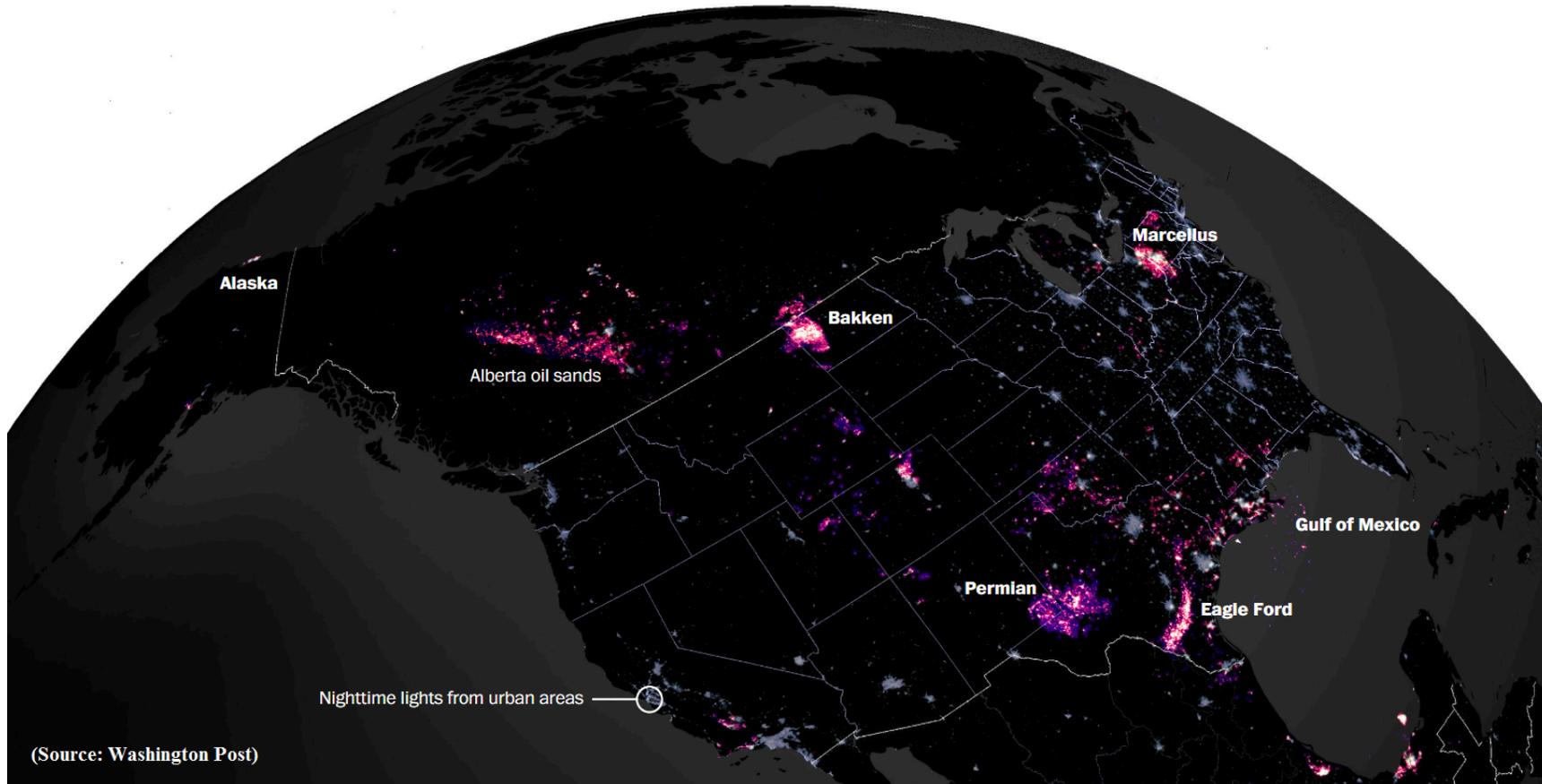# Optimal policy with multiple firms
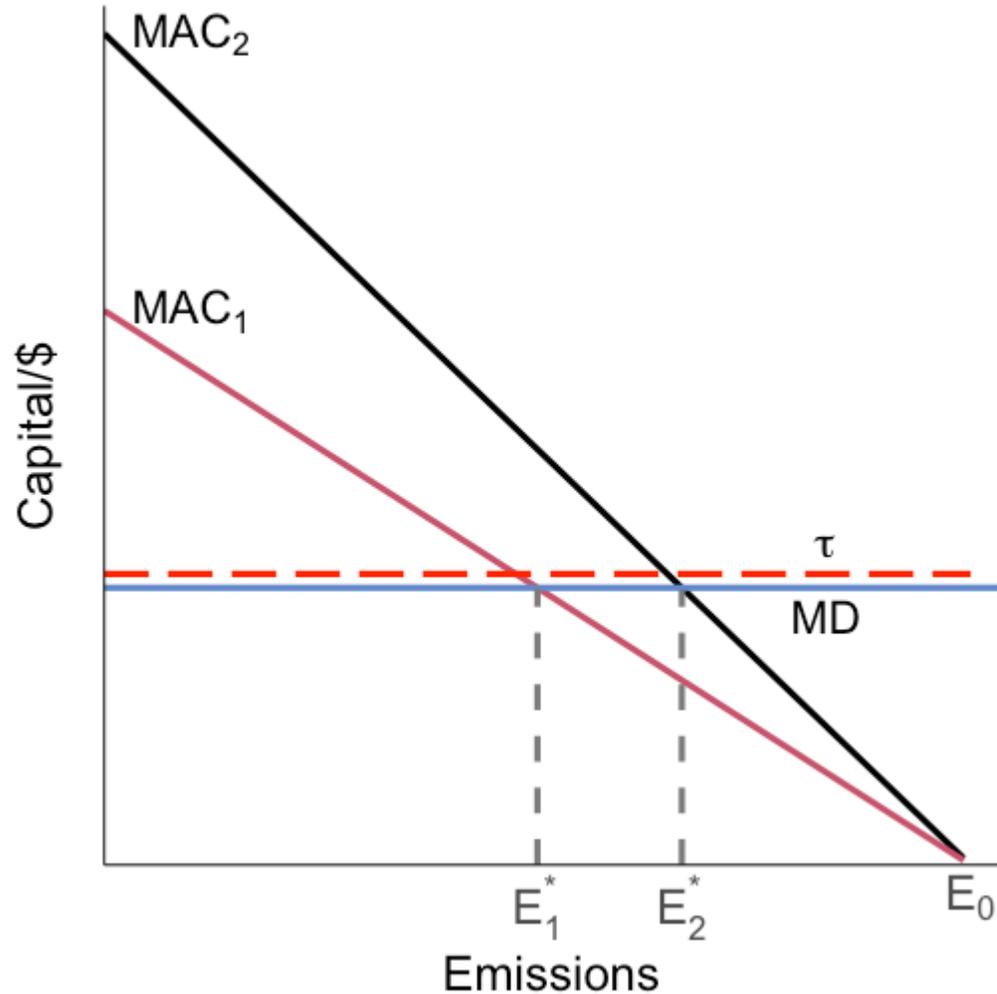


If standards are applied uniformly across heterogeneous firms, costs are not minimized

If firms face a common emissions price, abatement is reallocated toward low-MAC sources

# Taxes vs Standards



(Source: Washington Post)

# Taxes vs Standards



(Source: Washington Post)

# Emission taxes

# Unconventional oil



(Andrew Burton/Getty Images)

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(Andrew Burton/Getty Images)

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(Andrew Burton/Getty Images)

# Flaring regulations in North Dakota

North Dakota Industrial Commission established firm-level flaring limits beginning in October 2014

## North Dakota Industrial Commission Order 24665 Policy/Guidance
### Version 041718

**Policy Goals:**
1) reduce the flared volume of gas
2) reduce the number of wells flaring
3) reduce the duration of flaring from wells

The Commission establishes the following gas capture goals:
74% October 1, 2014 through December 31, 2014
77% January 1, 2015 through March 31, 2016
80% April 1, 2016 through October 31, 2016
85% November 1, 2016 through October 31, 2018
88% November 1, 2018 through October 31, 2020
91% beginning November 1, 2020

# Flaring regulations in North Dakota

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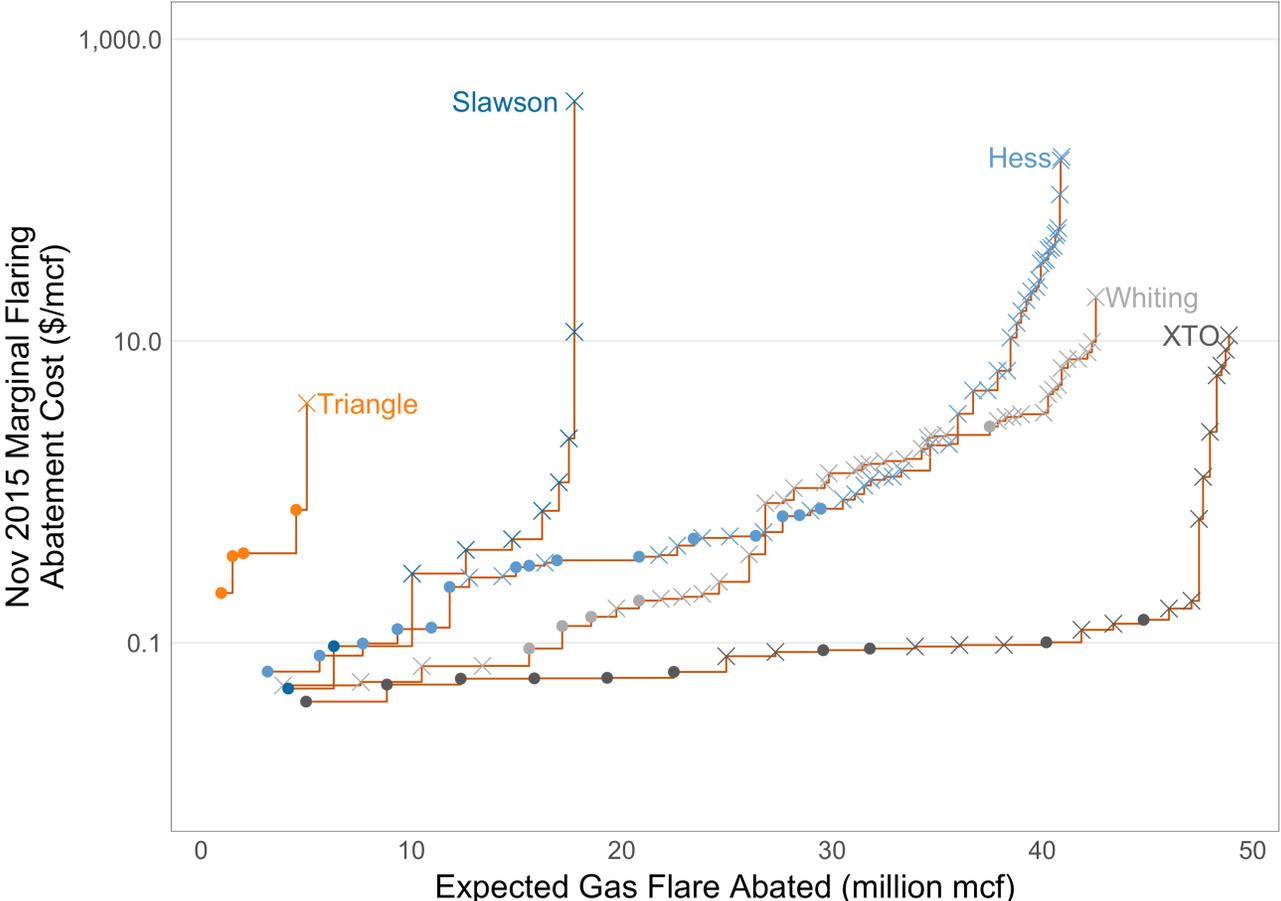# Flaring regulations in North Dakota

This is a **standard**: a mandate on the quantity of gas captured

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So with heterogeneous MACs, this generally violates the equimarginal principle and is not cost-effective
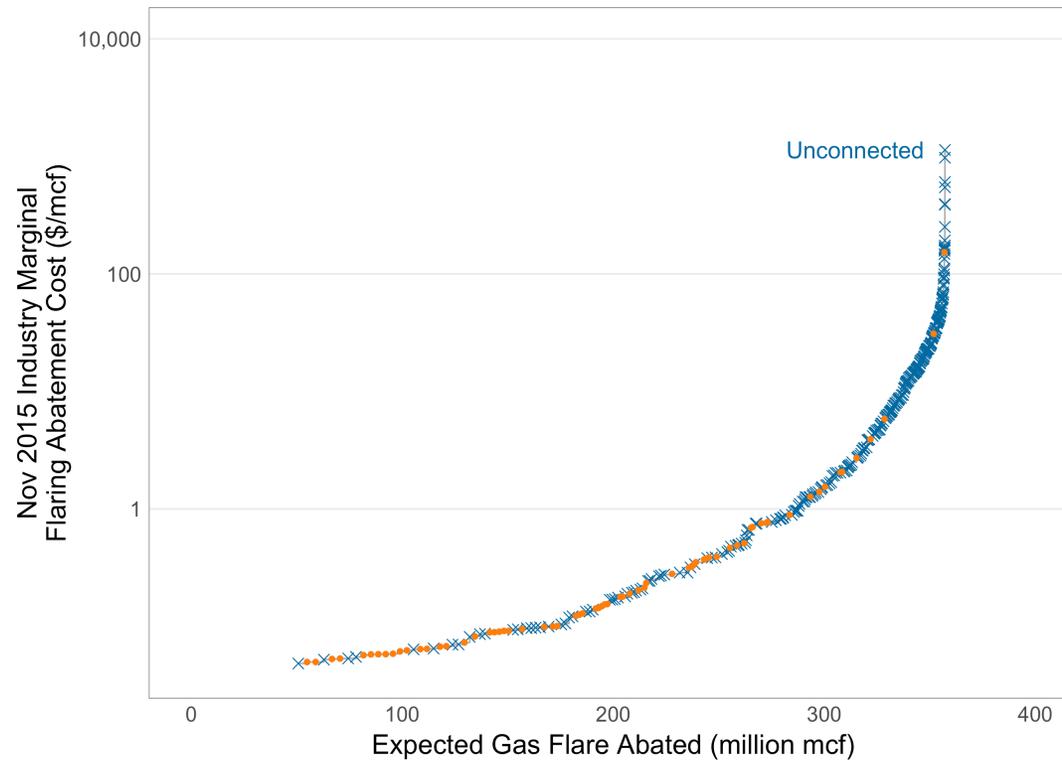
# Real world MACs

Firms appear to be cost-minimizing to comply

# Real world MACs

If we add up the MACs to the market-wide MAC, we aren't always abating at the cheapest wells (because the standard is uniform across firms)

# What if we used a tax?

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Suppose we just used the existing *public* lands royalty rate

We could capture 99% of the gas as the regulation, but 50% of the cost

# Almost everyone is better off

The majority of firms are better off with a tax