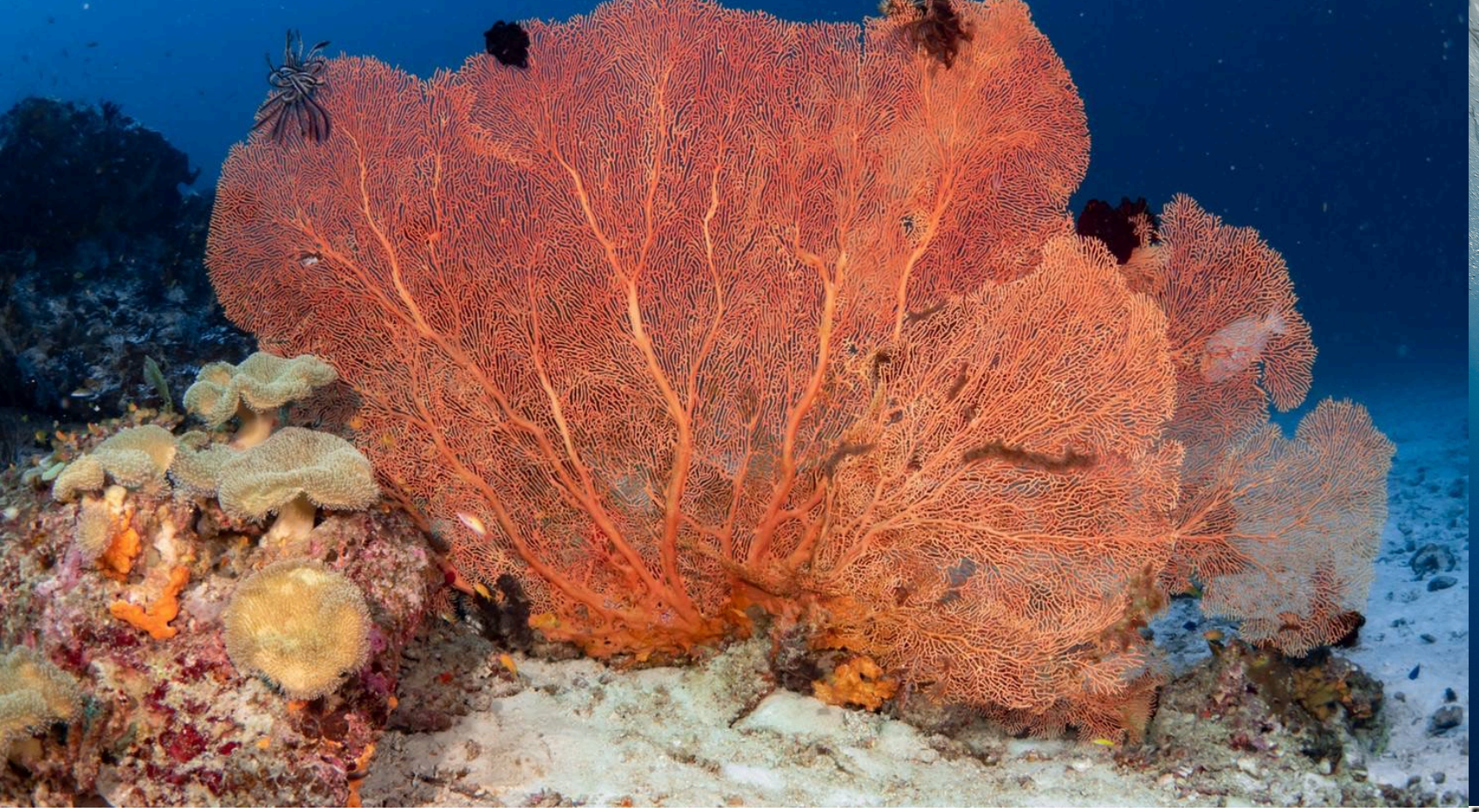
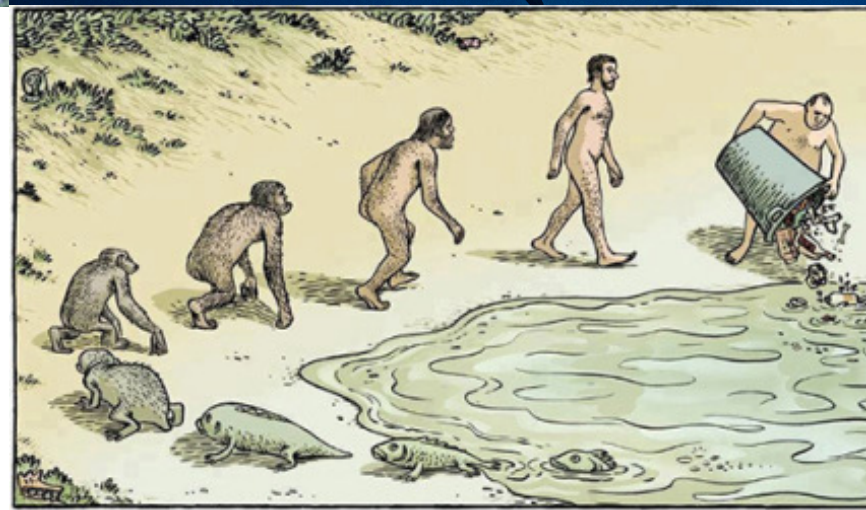


EE476
Environmental Economics

Lecture 6

2022



Standards : drawbacks

- Treat all sources alike and to lock in certain technologies.
- Unable to take advantage of the private information that polluters have about means and procedures they could use to reduce pollution.

Incentive-based policies

- Authorities first set overall objectives and rules ➔ commercial incentives will lead to the adoption of cost-effective pollution-control procedures and technologies.
- rely on flexible firm responses to attain efficient pollution control.
- There are basically 2 types of incentive policies:
  1. Charges (taxes) and subsidies
  2. Market-based systems. (transferable discharge permits)

Emission Charges or Taxes

- "You may discharge any amount of residuals you wish, but your emissions will be measured and you will be required to pay a certain charge for every unit (e.g., ton) of effluent you discharge."

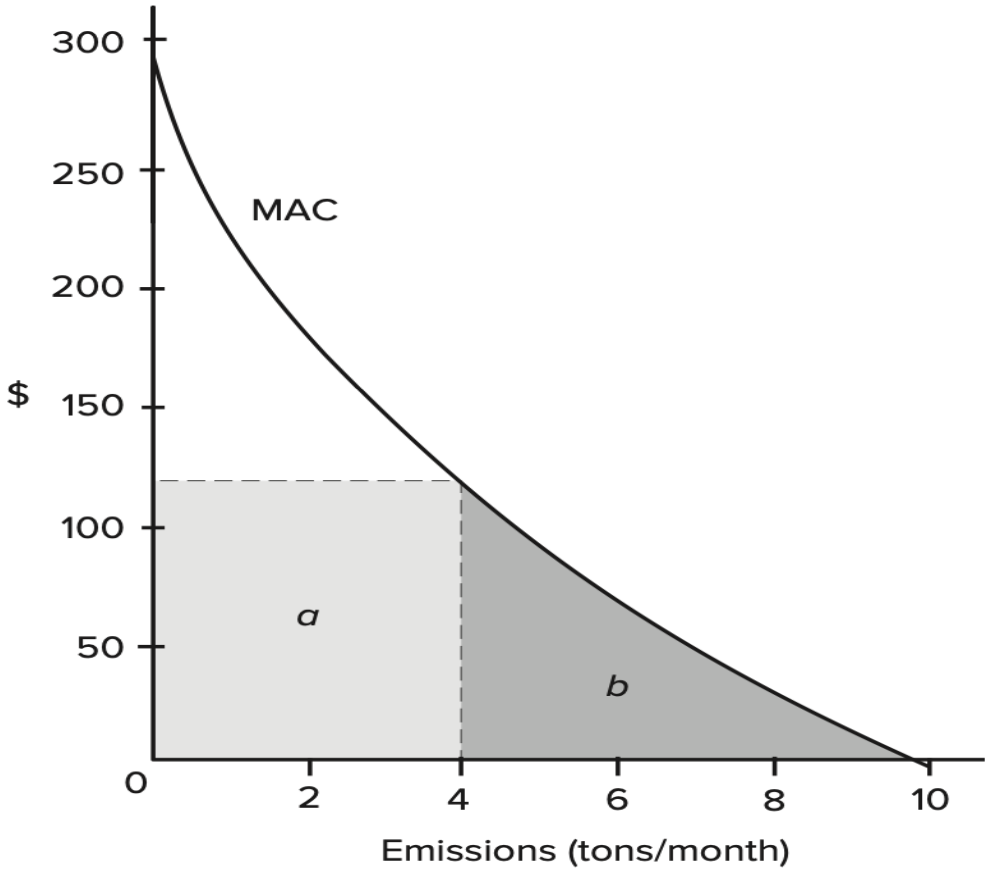
Environmental Taxes in Europe EXHIBIT 12.1

Charge or Tax	Description
French aircraft noise charges	TNSA (Tax sur les nuisances sonore aériennes) charged at 11 busiest airports, based on maximum take-off weight, certified noise performance, and time of day
Czech Republic air pollution charges	Charges on power plants, covering SO_2, NO_x, particulate matter, and VOCs (excluding methane)
Plastic bag tax in Ireland	Charges on all plastic bags (biodegradable or not) except bags used for fresh meat and fruits
Pesticide tax in Norway	Tax on pesticides based on their components, a registration fee, a fee to fund efficiency and residue trials, and risk to environment and human health
Landfill tax in U.K.	Tax has two rates: a local rate on less polluting wastes (e.g., rocks and soils) and a higher rate for everything else
Water taxes in Denmark	Consisting of a water supply tax and a waste tax based on discharge of nitrogen, phosphorus, and organic matter
Swedish carbon tax	The first country to introduce a tax on CO_2 emissions, offset by a reduction in personal income taxes
Energy tax in the Netherlands	A "downstream" tax applying to energy products used for heating and electricity generation in households and small and intermediate-sized businesses
Natural resource tax in Latvia	Covers extraction of natural resources, waste disposal, hazardous goods, and air and water emissions

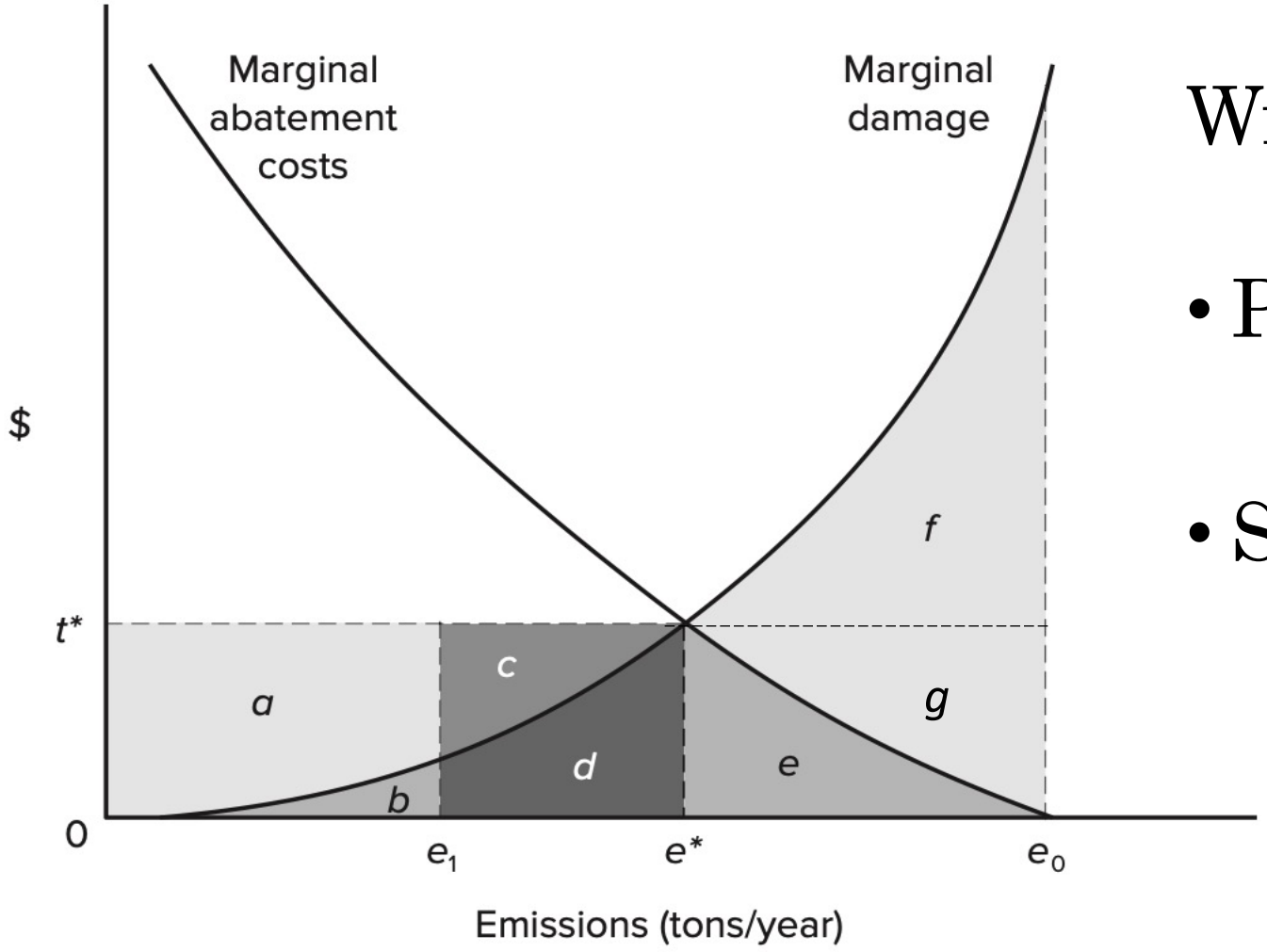
Source: Institute for European Environmental Policy, *Environmental Tax Reform in Europe: Opportunities for the Future*, Annexes to Final Report, Brussels, May 2014.

The Economics of an Emission Tax

Emissions (tons/month)	Marginal Abatement Cost	Total Abatement Cost	Total Tax Bill at $120/Ton	Total Costs
10	0	0	1,200	1,200
9	15	15	1,080	1,095
8	30	45	960	1,005
7	50	95	840	935
6	70	165	720	885
5	95	260	600	860
4	120	375	480	855
3	150	525	360	885
2	185	710	240	950
1	230	940	120	1,060
0	290	1,230	0	1,230



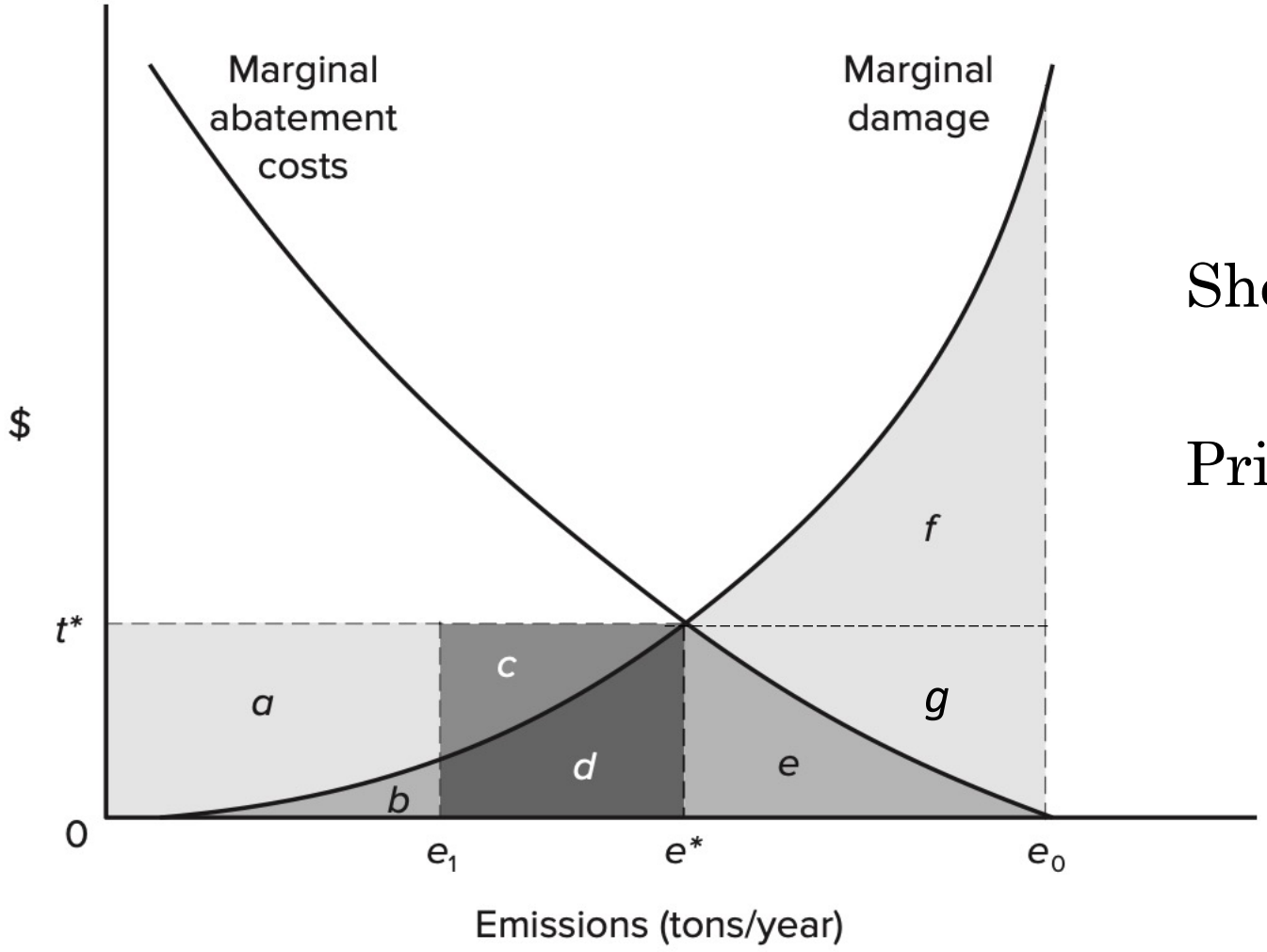
The Economics of an Emission Tax



Without tax e = ...

- Private cost = ...
- Social cost = ...

The Economics of an Emission Tax

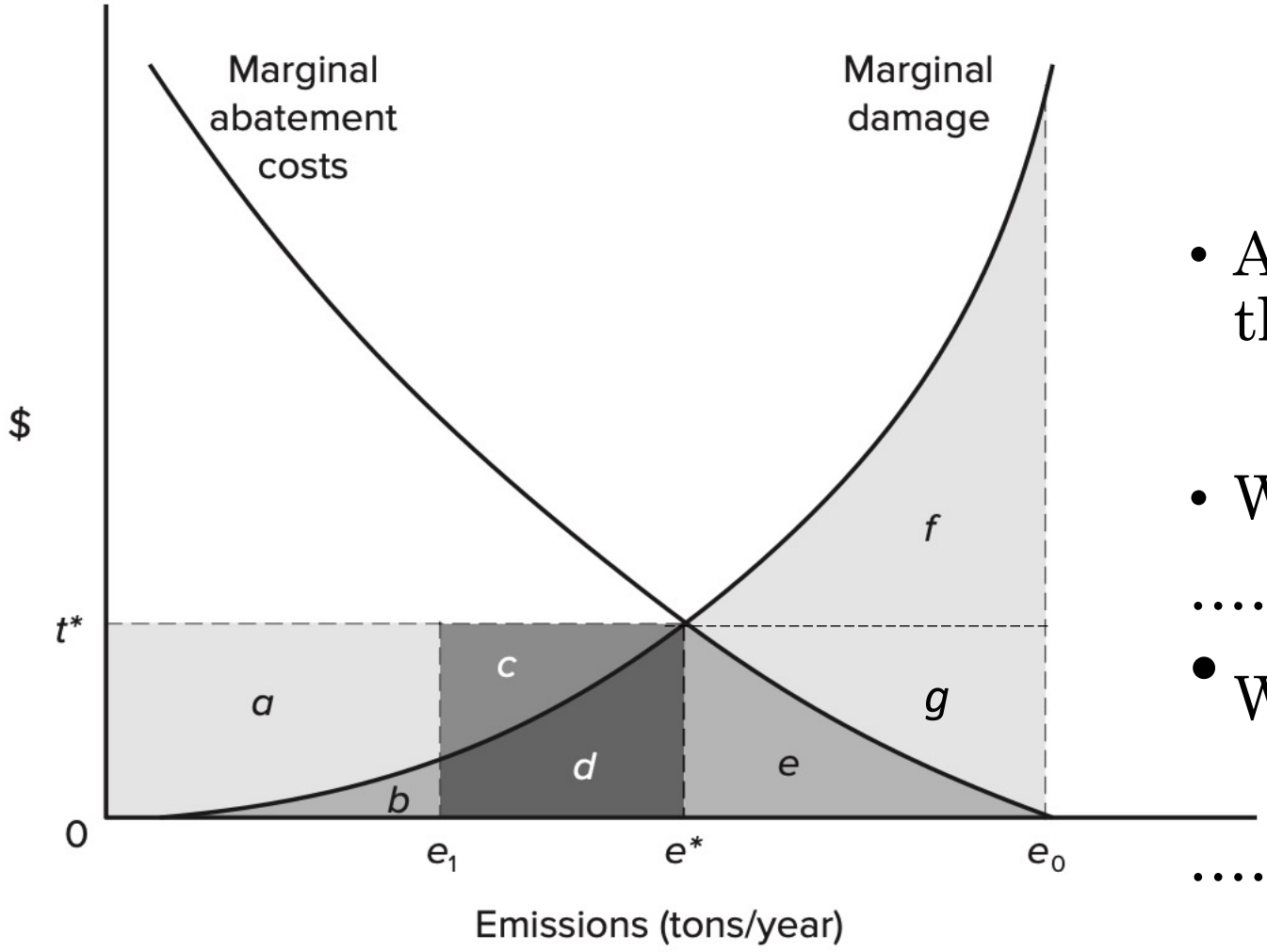


With Tax = t^*

Should firm stay at e_0? .....

Private cost at e_0 is .....

The Economics of an Emission Tax



With Tax = t^*

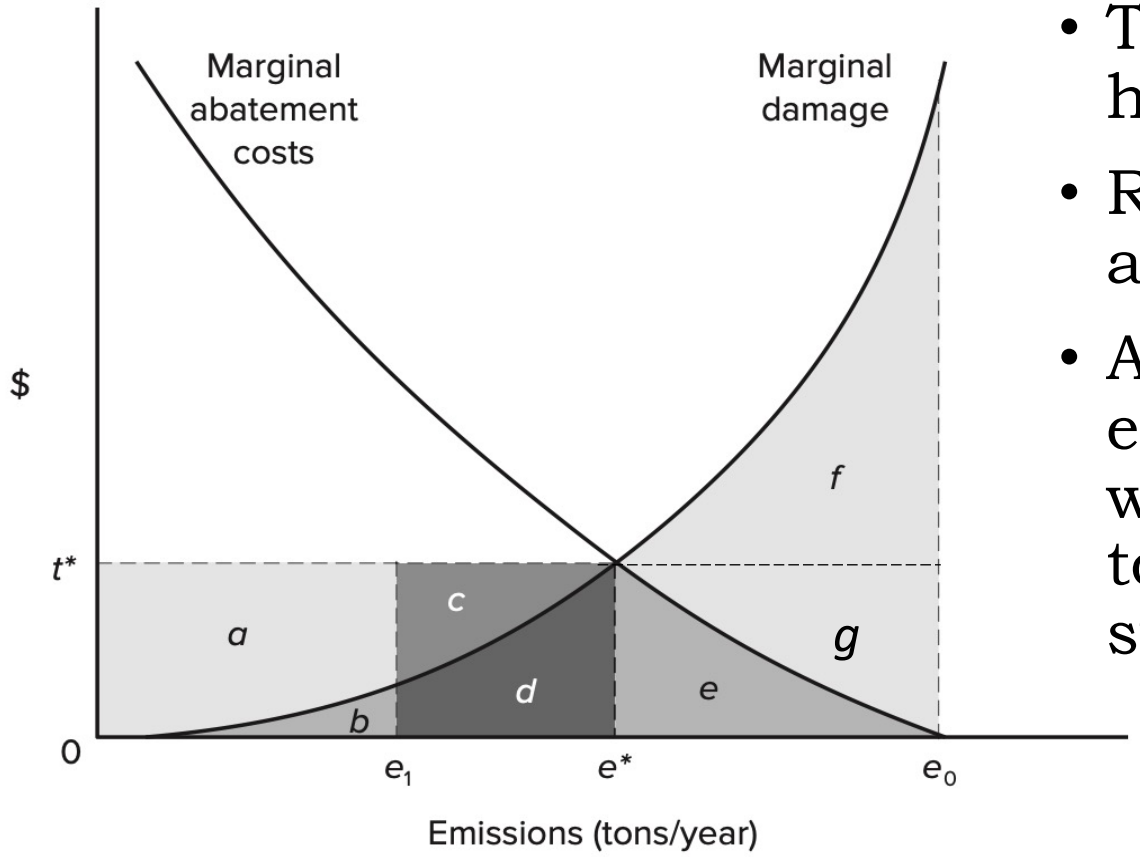
- Any other "e" with lower private cost than at e_0 ? .....
- Which "e" yields lowest private cost?

.....

- What is the total damages?

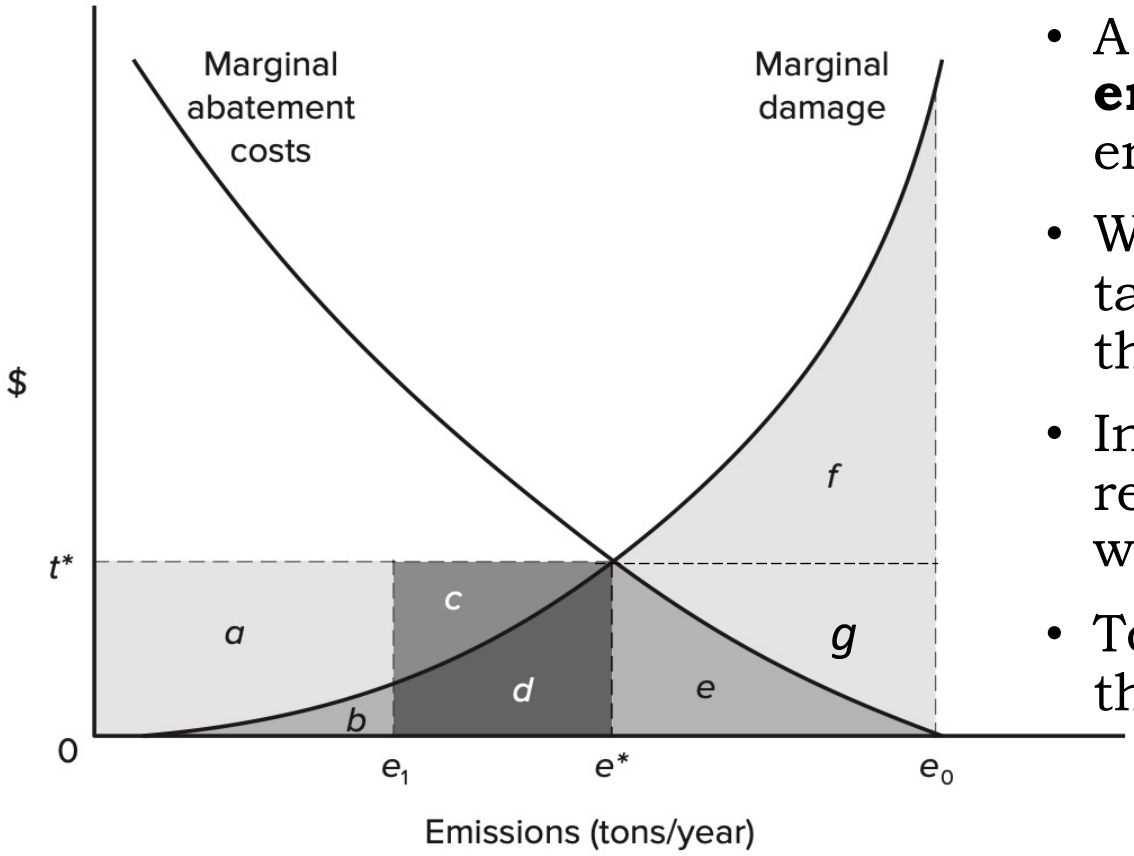
.....

The Economics of an Emission Tax



- The reduction of emissions from e_0 to e^* has eliminated damages of …….
- Remaining damages are …….an amount less than the firm pays in taxes.
- A “flat tax” like this (one tax rate for all emissions) has been criticized because it would often lead to situations where the total tax payments of firms would substantially exceed remaining damages.

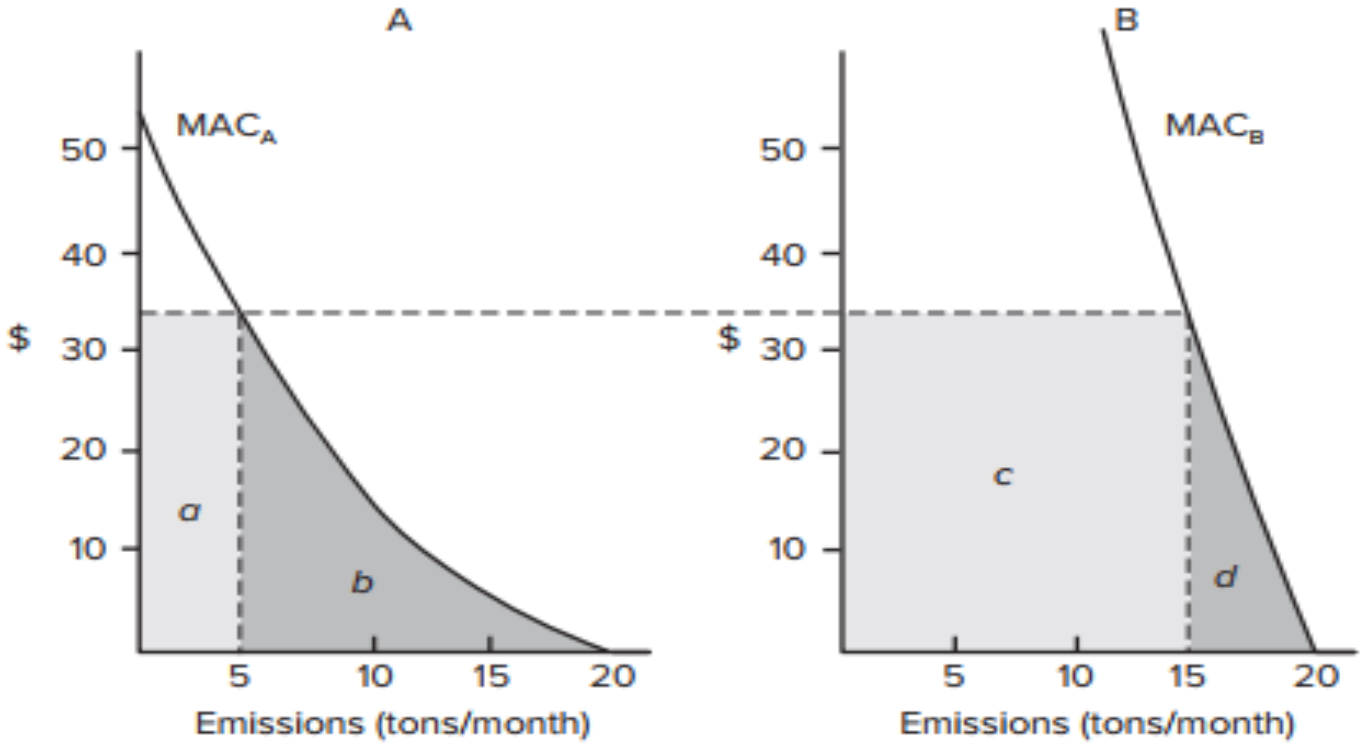
The Economics of an Emission Tax



- A way around this is to institute a **two-part emission charge.** We allow some initial quantity of emission to go untaxed.
- We might allow the firm e_1 units of emissions free of tax and apply the tax rate of t* to anything over this.
- In this way the firm would still have the incentive to reduce emissions to *e**, but its total tax payments would be only ……
- Total abatement costs, and total damages caused by the *e** units of emissions, would still be the same.

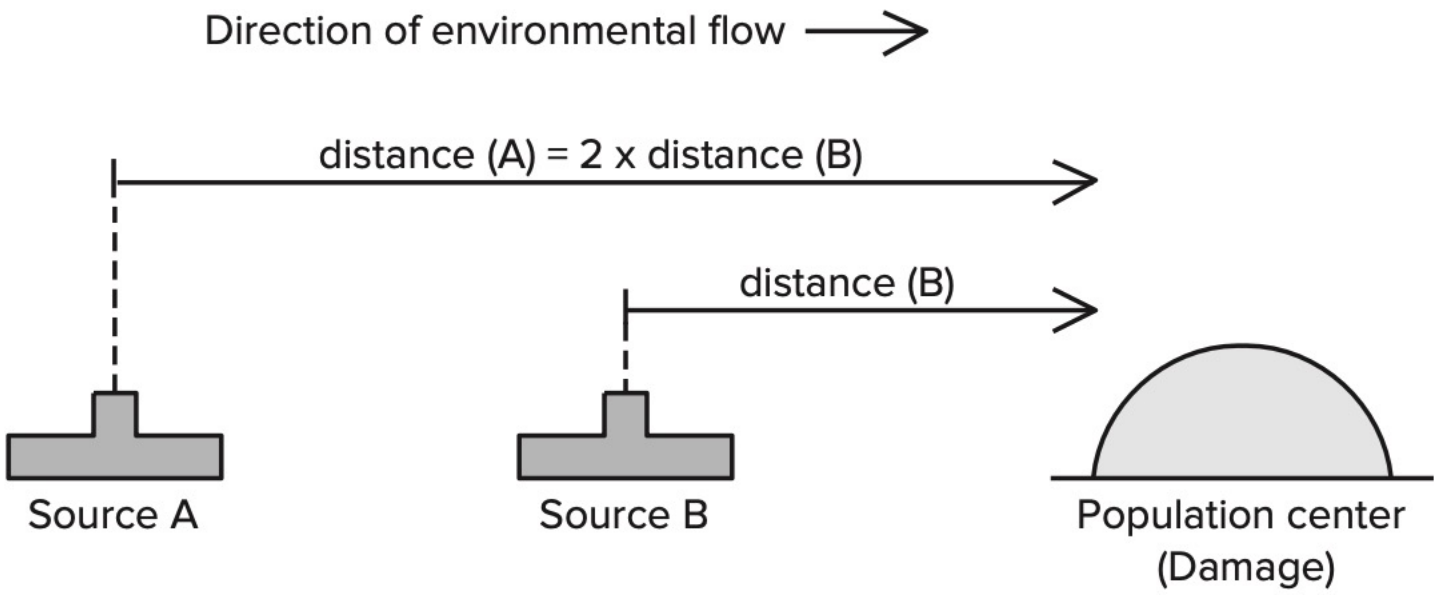
Cost Effectiveness ➔**equi-marginal principle**

- The marginal abatement costs of Source A increase much less rapidly with reductions in emissions than do those of Source B.
- The emissions tax leads to larger proportionate emission reductions from firms with lower marginal abatement costs.



"the efficiency results of the emission charge approach are achievable even though the administering agency knows nothing about the marginal abatement costs of any of the sources."

Non-uniform emissions



- emissions from Source A do not produce as much damage in the urban area as emissions from Source B.
- A single charge addresses only the problem of differences in marginal abatement costs, not differences in damages caused by the emissions from different sources

Non-uniform emissions

- Suppose emission reductions at Source B are twice as effective at reducing damages as reductions in emissions at Source A .
- This means, in effect, that the effluent tax paid by Source B must be twice as high as the effluent charge paid by Source A.
- Thus, after adjustment to these tax levels the marginal abatement cost of Source B would be twice the marginal abatement cost of Source A. But the damage reduction *per dollar spent in reducing emissions* would be equalized across the two sources

Emissions from Different Sources Can Produce Very Different Damages — EXHIBIT 12.2

Different sources with the same type and quantity of emissions may be very different in terms of the damages they cause. Two economists estimated source-specific damages from emissions of major pollutants from power plants in the United States. They used a large-scale model that tracks the consequences of emission through air quality changes, exposure levels, dose-response information, and the valuation of resulting health impacts on affected populations. Some results are shown in the following table. Results are in the form of "trading ratios," which is the number of tons of pollutant emitted from the power-plant stack that causes the same amount of damage as would 1 ton emitted at ground level at the same site. The results shown are for fine particulate matter ($PM_{2.5}$) and sulfur dioxide (SO_2). The top four power plants are near urban areas and the bottom four are in rural locations.

For the urban power plants, note the differences for the Con Edison plant in New York: it would take 11 tons of $PM_{2.5}$ emitted from the stack to produce the same damage as 1 ton emitted at ground level. For SO_2 it would take 8 tons coming out of the stack to generate the same damages as 1 ground-level ton. For the rural plants, the results are very different; here the stack and ground-level emissions produce the same levels of damage.

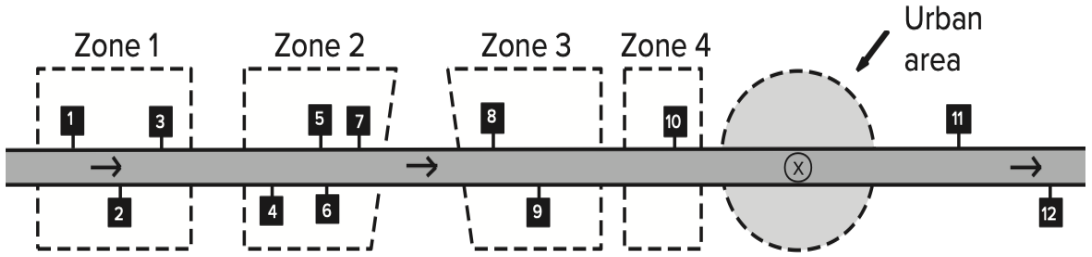
What these results show is that there can be very substantial differences between sources in terms of damages produced by the same pollutant.

Ground Source (city, state)	Power Plant (firm, facility)	Stack Height (feet)	Trading Ratios $PM_{2.5}$	Trading Ratios SO_2
New York, NY	Con Edison, 74th Street station	495	11:1	8:1
Washington, D.C.	Potomac Power Resources	400	23:1	8:1
Atlanta, GA	Georgia Power Co.	835	19:1	5:1
Houston, TX	Texas Genco, Inc. W.A. Parish	600	17:1	10:1
Grant Country, WV	Dominion, Mount Storm Station	740	1:1	1:1
Rosebud County, MT	PPL Montana, Colstrip Steam Elec	690	1:1	1:1

The trading ratio is the number of tons emitted from the stack of a power plant that would cause the same damage as 1 ton from a ground source at the same site.

Source: Nicholas A. Muller and Robert Mendelsohn, "Efficient Pollution Regulation: Getting the Prices Right," *American Economic Review*, 99(5), 2009, pp. 1714–1739.

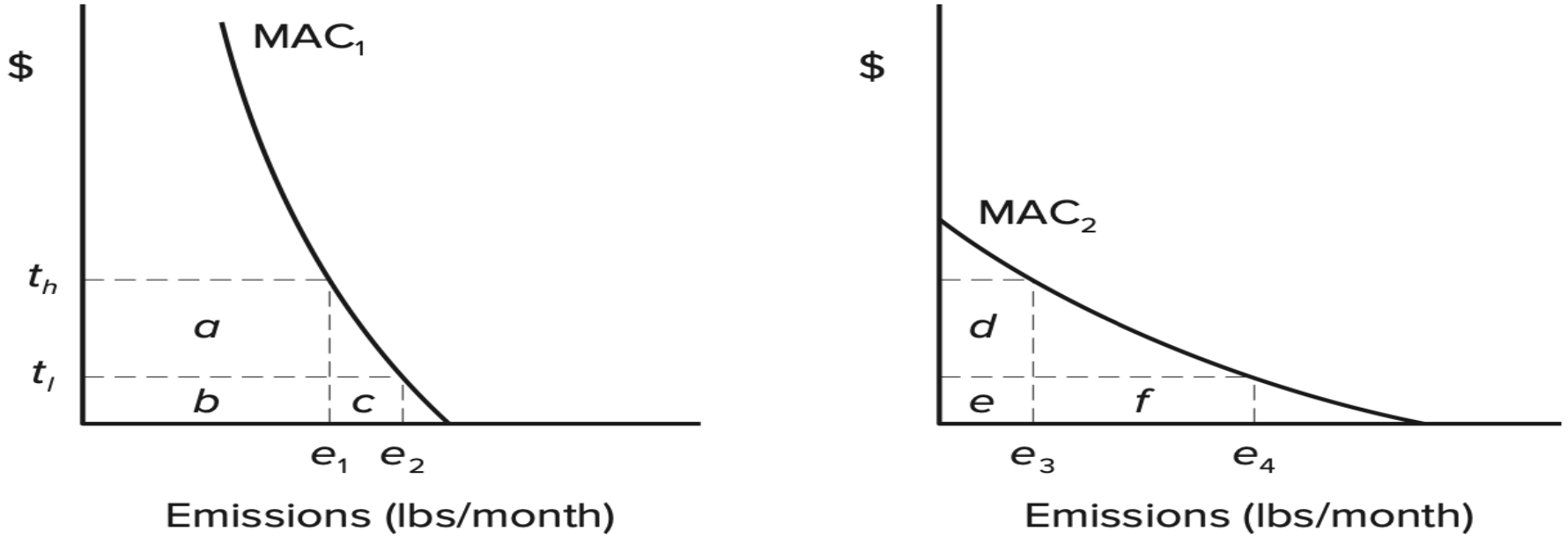
Zonal Emission Charge



Key: 1 Emission sources

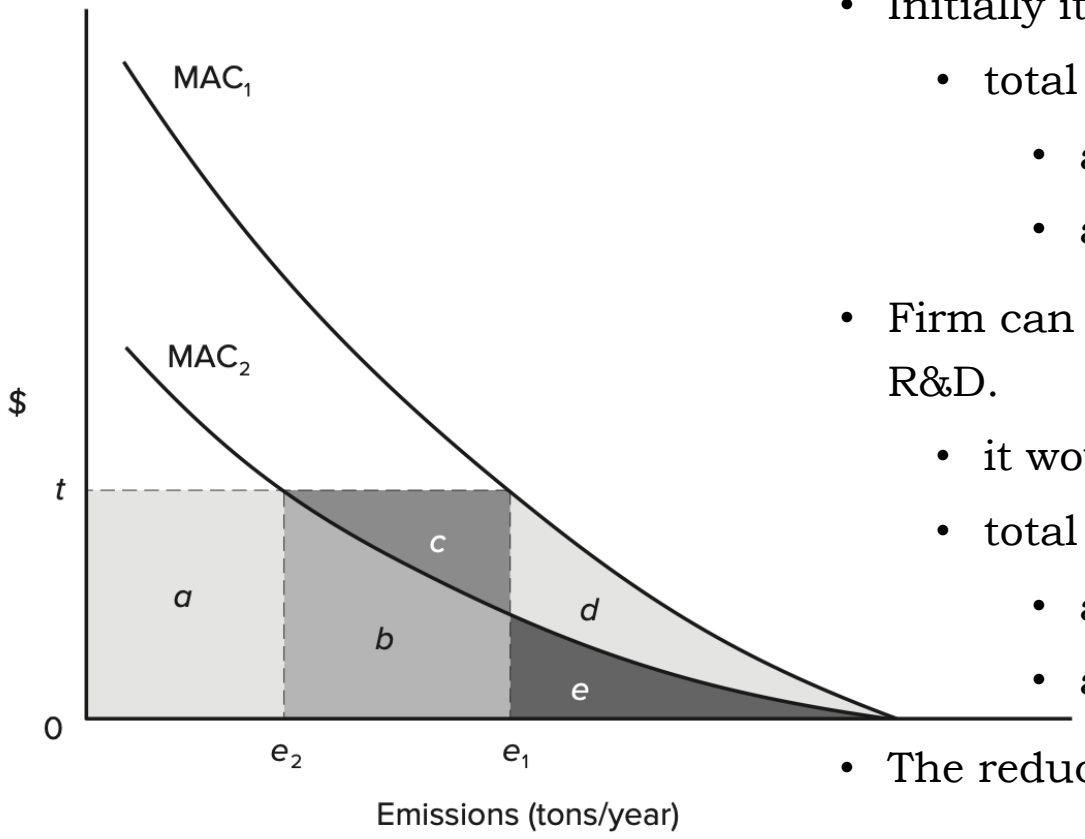
X Water-quality monitoring station

Emissions Charges : uncertainty and revenue



- when administrators set taxes at certain levels, they normally will be uncertain about how much emission reduction will ensue
- that depends on how sources respond to the tax. (drawbacks of emission charges)
- marginal abatement cost functions, a steep one (MAC_1) and one that is much less steep (MAC_2). The less steep one is more responsive to tax changes. Exact knowledge of marginal abatement costs is often lacking.
- Revenue from environmental tax can be used to reduce other distort tax such as income tax.

Emissions Charges : Incentives to Innovate



- firm is subject to an effluent tax of t/ton of emissions.
- Initially it will reduce emissions to ……
  - total pollution-related costs will consist of
    - abatement costs of ……and
    - a tax bill of ……
- Firm can lower its marginal abatement cost curve to MAC_2 through the R&D.
  - it would then reduce its emissions to ……
  - total pollution-related costs will consist of
    - abatement costs of ……
    - a tax bill of ……
- The reduction in total costs has been ……
- If the firm had instead been faced with an emissions standard of e_1, its cost savings with the new technology would have been only d.

Emission Charges : Enforcement Costs

- If emissions are to be taxed, they must be measurable at reasonable cost.
- rules out most nonpoint-source emissions because they are spread over a wide area in a way that makes them impossible to measure.
- agency would require information on cumulative emissions from each source ➔ to have permanent monitoring equipment that measures emissions
- **monitoring requirements** of an emissions charge policy are more stringent than those for the typical standards program.

Emissions Charges VS Standard

- A firm's R&D efforts will lead to a bigger reduction in its pollution control- related costs (abatement costs plus tax payments) than under a standards approach.
- A firm would automatically reduce its emissions as it found ways to shift its marginal abatement cost function downward, whereas under the standard no such automatic process would result.
- Polluters must pay for emissions as well as for abatement costs, whereas with standards they only need to pay abatement costs.
- Potential cost savings from new pollution-control techniques are much larger under the charge program.

Abatement Subsidies

- **subsidy** on emission reductions.
- A deposit-refund system is essentially the combination of a tax and a subsidy. For example, a subsidy (the refund) is paid to consumers when they return an item to a designated collection point. The purpose of the subsidy is to provide the incentive for people to refrain from disposing of these items Iin environmentally damaging ways. The funds for paying the subsidy are raised by levying taxes (the deposit) on these items when they are purchased.

A deposit-refund system

- Essentially the combination of a tax and a subsidy.
- For example, a subsidy (the refund) is paid to consumers when they return an item to a designated collection point.
- provide the incentive for people to refrain from disposing of these items in environmentally damaging ways.
- The funds for paying the subsidy are raised by levying taxes (the deposit) on these items when they are purchased.

Abatement Subsidies

Types of Environmentally Related Subsidies — EXHIBIT 12.3

Subsidies in the Form of	Example(s)
Tax benefits	Tax exemptions for pollution-control equipment or recycling equipment Exemptions of ethanol-blended gas from federal taxes
Reduced environmental fines	Reductions in normal fines if firms undertake extensive pollution-control plans
Public grants to encourage environmental programs	EPA grants to communities to fund "brownfields" programs[1]
	Grants to farmers to adopt conservation practices
	Grants to businesses or communities to establish recycling programs
Development rights purchase programs	Public purchases of agricultural development rights to maintain land in agriculture or open space
Public support of environmental market development	Public rules on procurement of products made from recycled materials
	Cash payments for people who turn in old, high-emitting automobiles
Cost-sharing grants	Grants made to localities to cover a portion of the cost of building wastewater treatment facilities

[1]Brownfields are contaminated industrial sites that pose relatively low risks, but may be avoided by private developers because of potential liability problems.