Environmental Economics
MARKETS AND THE ENVIRONMENT

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MARKETS AND THE ENVIRONMENT

Introduction

- The power of markets
- Market failure
- Market Incentives for environmental protection

MARKETS AND THE ENVIRONMENT
Introduction

What is a "market"

- In everyday language, a market is a place. For economists, it is a **voluntary exchange mechanism** regulated by competition.
- A market can be physical or online: what matters is the exchange mechanism.
- Trade creates value because **buyers and sellers** both benefit.

MARKETS AND THE ENVIRONMENT
Introduction

Markets and value creation

- Markets have existed for a **very long time** and are a stable part of human life.
- Markets arise because people have incentives to find **trade opportunities for scarce resources**.
- Prices help decide **what** and **how much** to trade.
- Value grows when resources move from **low-value uses** to **high-value uses**.

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Introduction

Prices as signals

- Prices are a **communication channel**: they carry information about value and scarcity.
- They help coordinate **decentralized** decisions: what to trade and how much.
- A market works well when prices reflect true **trade-offs** and resources go to the **highest-valued use** in society.

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Introduction

Why markets fail

- Markets fail when prices send **inaccurate** signals about true scarcity, or when a **market does not exist** (too costly to build).
- Then markets can create **too much environmental "bad"** (pollution) and **too little environmental "good"** (quality), if they ignore impacts on health and ecosystems.
- This creates a **gap** between individual goals and social goals.

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Introduction

A typical failure: public good in private hands

- Protecting **endangered species** on private land is a typical failure: benefits are widespread, but costs are concentrated: benefits go to many people, but costs fall on landowners who must change production decisions.
- If land prices do not include social benefits, we get less protection than society wants.

MARKETS AND THE ENVIRONMENT
Introduction

Markets as part of the solution

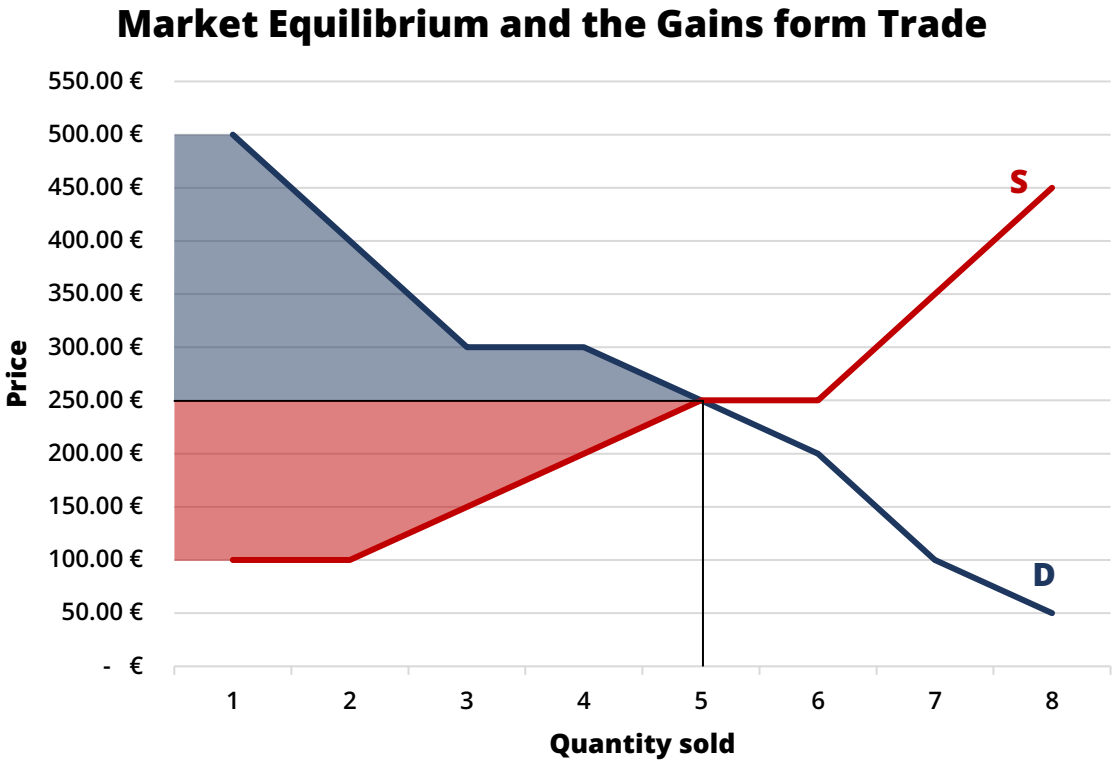
- Even when markets fail, they can be part of the solution: we can **fix** a market or **create** a new one.
- Example solution: **cap-and-trade** creates a permit market to pollute under a fixed **cap,** with rules on **property rights, liability, and information.**

MARKETS AND THE ENVIRONMENT
The power of markets

Buyers	WTP	Sellers	WTA
B4	500,00 €	S6	100,00 €
B7	400,00 €	S8	100,00 €
B1	300,00 €	S3	150,00 €
B5	300,00 €	S7	200,00 €
B6	250,00 €	S1	250,00 €
B2	200,00 €	S5	250,00 €
B8	100,00 €	S2	350,00 €
B3	50,00 €	S4	450,00 €

Consumer surplus

Producer surplus



TOTAL GAIN = 950 €

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The power of markets

Markets create value and coordinate decisions

- A market serves society by **creating value** through **trade**.
- **Prices** communicate wants and limits in a complex society.
- Decisions can be **decentralized**: no “all-powerful planner” is needed.
- Under some conditions, **self-interest + competition** can help society.

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The power of markets

Specialization and comparative advantage

- You have **comparative advantage** if your **opportunity cost** is lower (what you give up).
- Trade creates value because people **specialize** and then **trade** to get what they want.

Market efficiency and Pareto

- If trade creates value, economists call this **market efficiency**.
- A change is **Pareto efficient** if at least one person is better off and no one is worse off.
- Some trades are “win-win”.

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The power of markets

The work that needs to be done at the writer's home: shovel the snow

The writer

5.000 – 40 = 4.960 €

The teenager

40 – 20 = 20 €

- If the writer shovels, he spends 2 hours and loses the chance to write an essay that would earn € 5.000.
- If the teenager shovels, it takes 4 hours and the writer pays € 40. The teenager's cost of giving up 4 hours of PlayStation is € 20.

Both are better off
→ "win–win"
(Pareto improvement).

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The power of markets

Accurate price signals: property rights

- Efficient markets need **accurate price signals**.
- There's a key: **well-defined property rights**.
- Property rights are **entitlements** that define **privileges and obligations** to use a resource or an asset.

MARKETS AND THE ENVIRONMENT
The power of markets

4 features of property rights

- **Comprehensive**: resources are owned; entitlements are defined and enforced.
- **Exclusive**: benefits and costs go to the same owners.
- **Transferable**: rights can be transferred by voluntary exchange.
- **Secure**: rights are protected from seizure or encroachment.

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Market failure

Market failure

- A market is “ideal” when it captures **all gains from trade**.
- Markets can fail: trade may **not maximize social value** and may **not protect the environment**.
- **Market failure can happen when**:
  1. **too much or too little trade,**
  2. trade **worsens perceived inequality** or social order,
  3. pollution creates **real health risks** and **lowers environmental quality,**
  4. **public goods are not provided** (benefits cannot be fully captured),
  5. **weak or missing property rights,**
  6. **hidden actions or hidden types** send wrong signals necessary to protect the environment.

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Market failure

Environment and property rights

- In the environmental context, market failure often happens when society does **not define** (or defines poorly) **property rights**.
- Markets fail when we cannot:
  1. **transfer** rights freely,
  2. **exclude** others from benefits/costs,
  3. **restrict encroachment** on the environmental asset.
- **If "everyone" owns the right** (e.g., clean air, biodiversity), **then in practice "no one" owns it** in a tradable way: the market does not form.

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Market failure

Why markets fail to protect the environment

1. **Externalities**
   "*An action creates costs/benefits for others without compensation; the market price ignores them*"
2. **Public goods**
   Benefits are widespread and hard to exclude. Private actors cannot capture all benefits, so supply is too low**.**
3. **Open-access common property**
   Shared resource with weak exclusion. Each user takes "a bit more", leading to overuse.
4. **Hidden information**
   Quality, risks, or actions are not fully observable. Prices/contracts/regulation give wrong signals.

MARKETS AND THE ENVIRONMENT
Market failure - Externalities

> *Effect - **positive** or **negative** - generated by one agent's production and consumption activity on another agent's production and consumption activity, for which **no monetary compensation** is provided.*

MARKETS AND THE ENVIRONMENT
Market failure - Externalities

Externalities

1. **Externalities are everywhere**: you often enjoy benefits or suffer costs without paying or being compensated.
2. In these cases, **the market price (or production cost) "excludes" the social impact**: part of costs/benefits falls on third parties.
3. The market fails because **these markets are "missing"**: there is no exchange institution where people pay for extra benefits or receive compensation for extra costs.

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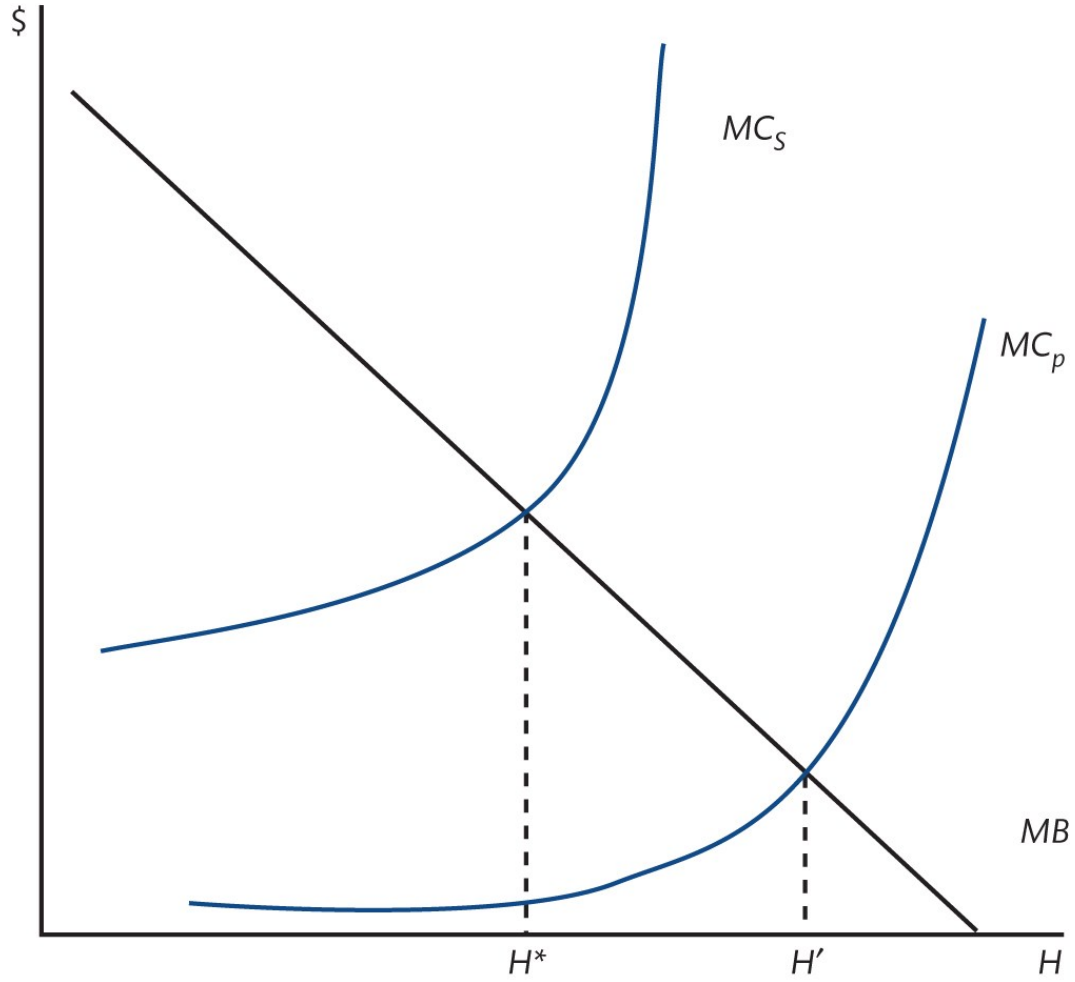
Market failure - Externalities



Marginal benefits and marginal costs: private and social.

1. Marginal Benefit (**MB**): the extra benefit when the activity level (H) increases.
2. Private marginal cost (**MC_p**): the extra cost considered by the decision-maker.
3. Social marginal cost (**MC_s**): it also includes costs imposed on others (the externality), so it lies "above" MC_p.
4. **Private choice**: MB = MC_p → level H′ (higher).
5. **Social optimum**: MB = MC_s → level H* (lower).

In general H′ > H* when external costs exist.

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Market failure - Externalities

Ecosystem externalities and feedback

1. **Some externalities are indirect and "hidden"** in the network of an ecosystem: damage is not immediate, but travels through ecological chains.
2. **People affect nature, nature affects people**: when feedback exists, both ecological outcomes and human behaviour change.
3. To understand them, we need **integrated ecological–economic models** and collaboration between economists and natural scientists.

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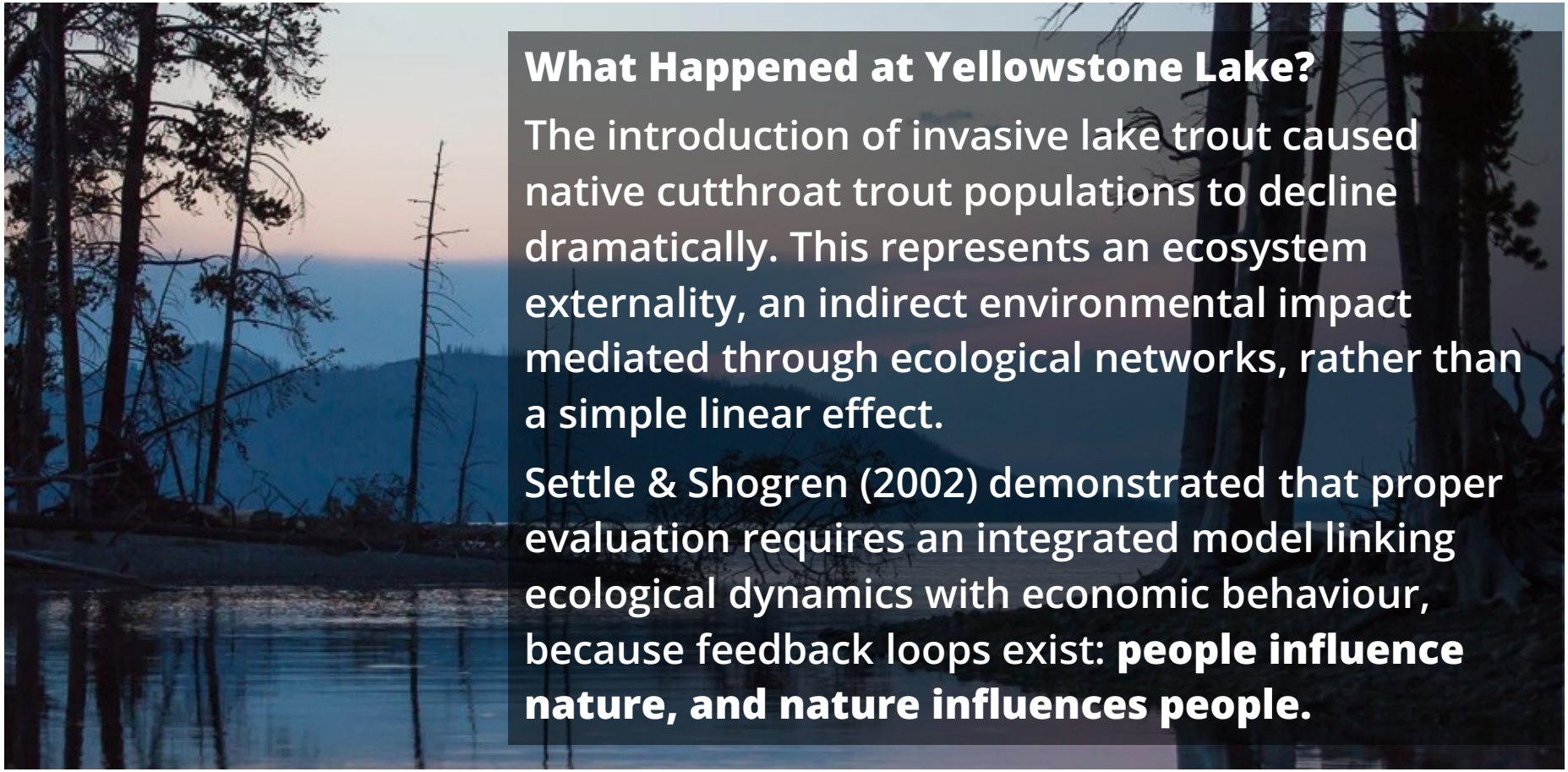
Market failure - Externalities



What Happened at Yellowstone Lake?

The introduction of invasive lake trout caused native cutthroat trout populations to decline dramatically. This represents an ecosystem externality, an indirect environmental impact mediated through ecological networks, rather than a simple linear effect.

Settle & Shogren (2002) demonstrated that proper evaluation requires an integrated model linking ecological dynamics with economic behaviour, because feedback loops exist: **people influence nature, and nature influences people.**

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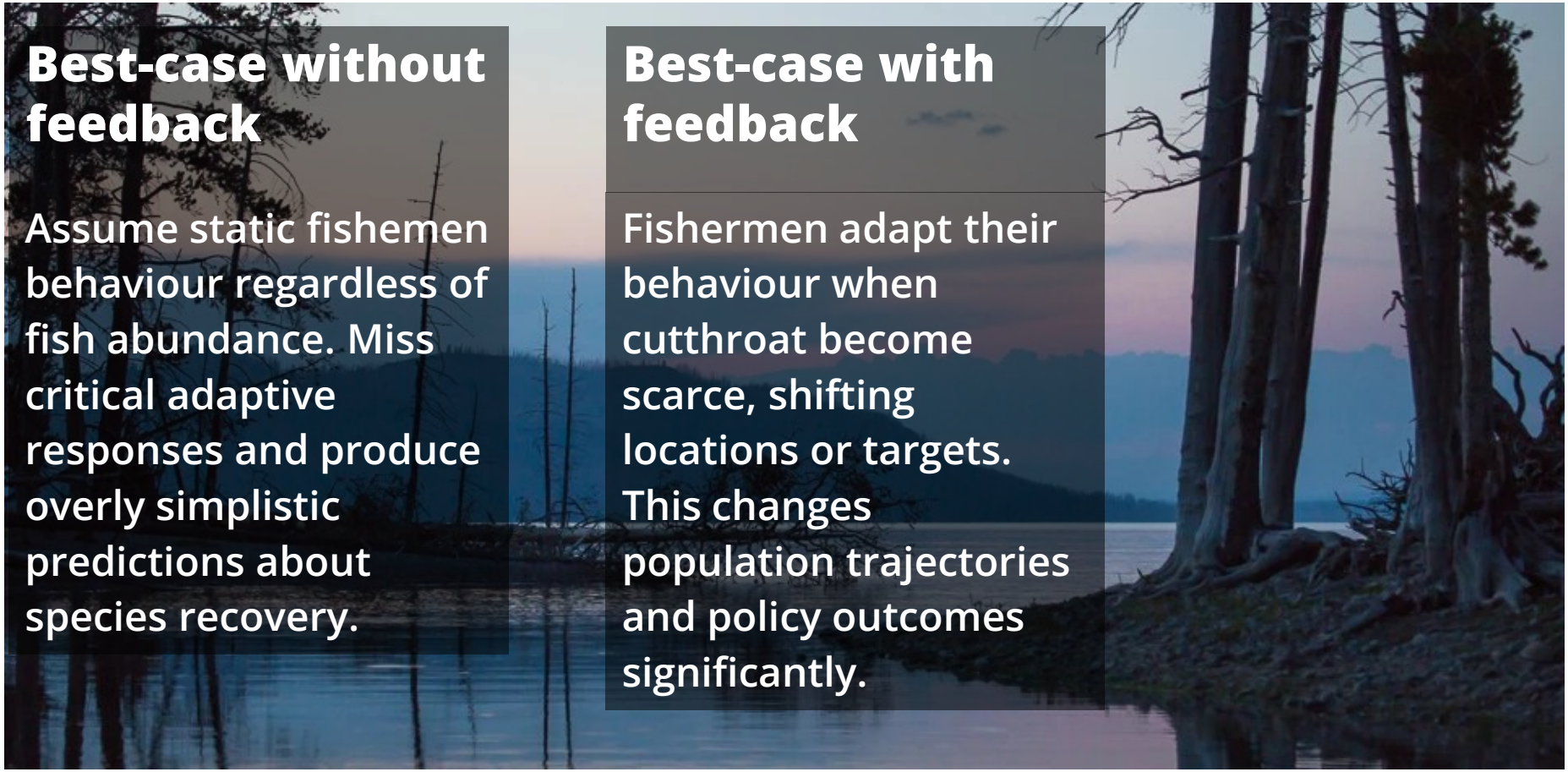
Market failure - Externalities



Best-case without feedback

Assume static fishemen behaviour regardless of fish abundance. Miss critical adaptive responses and produce overly simplistic predictions about species recovery.

Best-case with feedback

Fishermen adapt their behaviour when cutthroat become scarce, shifting locations or targets. This changes population trajectories and policy outcomes significantly.

Best-case scenario: lake trout removed immediately and without cost.

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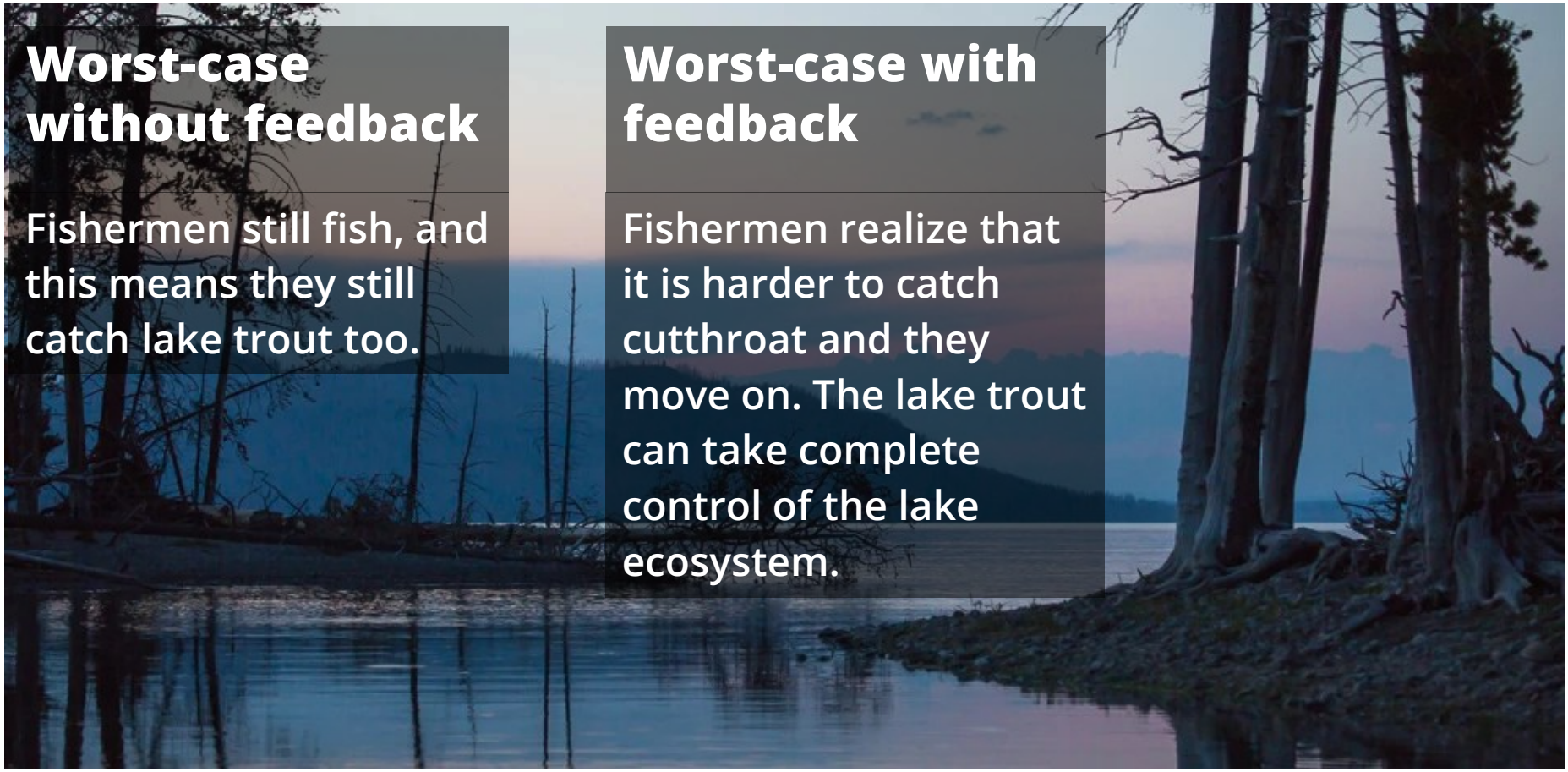
Market failure - Externalities



Worst-case without feedback

Fishermen still fish, and this means they still catch lake trout too.

Worst-case with feedback

Fishermen realize that it is harder to catch cutthroat and they move on. The lake trout can take complete control of the lake ecosystem.

Worst-case scenario: lake trout are ignored by the National Park Service.

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Market failure - Externalities

Type of effect			Nature of the externality	
			Positive	Negative
Technological	Source	Production	Reuse of waste materials (or by-products)	Pollution from production waste
		Consumption	Improvements generated by private interventions on one's own property	Waste dumping; Congestion
	Type of use	Rival (exhaustible)	Recycling of waste materials by private parties	Dumped waste requiring collection
		Non-rival (non-exhaustible)	Non-obsolescent goods that improve environmental quality	Brownfield sites; Degraded neighbourhoods
Pecuniary			Rents accruing to landowners	Higher raw-material costs due to competing uses

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Market failure – Public Goods

Consumption		Type of good
Rival	**Excludable**	
yes	yes	Pure private good (pasta, gasoline, etc.)
	no	Commons (groundwater, marine resources, etc.)
no	yes	CLUB good (cinemas, uncongested toll roads and paid parking, etc.)
	no	**Pure public good** (landscape, knowledge, air quality etc.)

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Market failure – Public Goods

Club and non-excludability

- If markets fail to generate the optimal level of a public good, one option is to build a **club**:
  - beneficiaries organize, pay, and benefits are (partly) **restricted to members**.
- Limitation: **non-members also benefit** from environmental preservation because non-excludability does not disappear.

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Market failure – Public Goods

Open Access Common Property

- An **open access commons** exists when:
  - people cannot be **excluded** from access, but
  - each person's use reduces what is left for others (**rivalry**).
- Economic incentive: "rush in" and capture benefits before others → **overuse and inefficiency**.

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Market failure – Public Goods

The tragedy of the Commons

TED Ed
LESSONS WORTH SHARING

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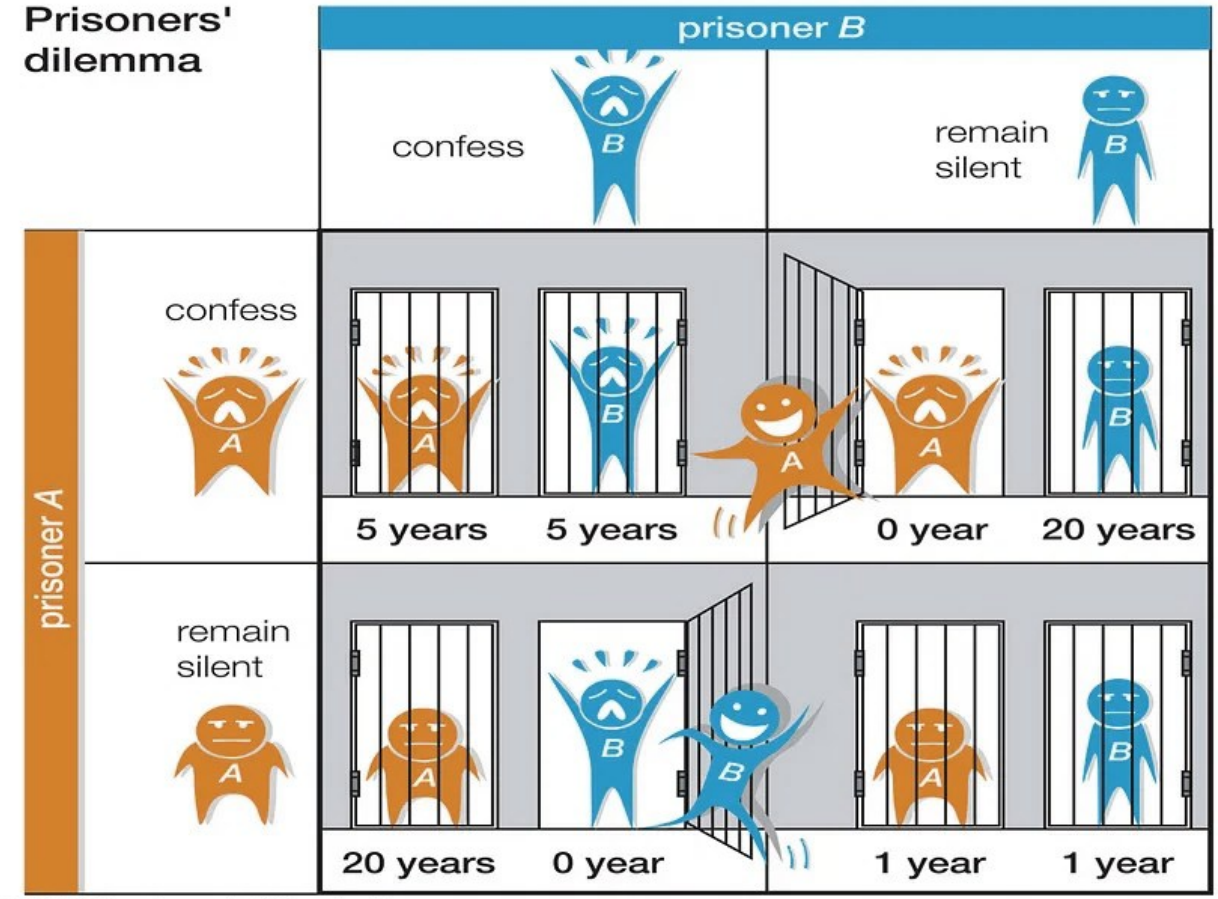
Market failure – Public Goods



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Market failure – Public Goods

When commons do not “fail”

- **Open access ≠ well-managed common property**. Many real commons have a (formal or informal) system of rights and rules.
- Documented cases show self-governing commons work better when they have **sharing rules, exclusion principles, enforcement, and sanctions.**

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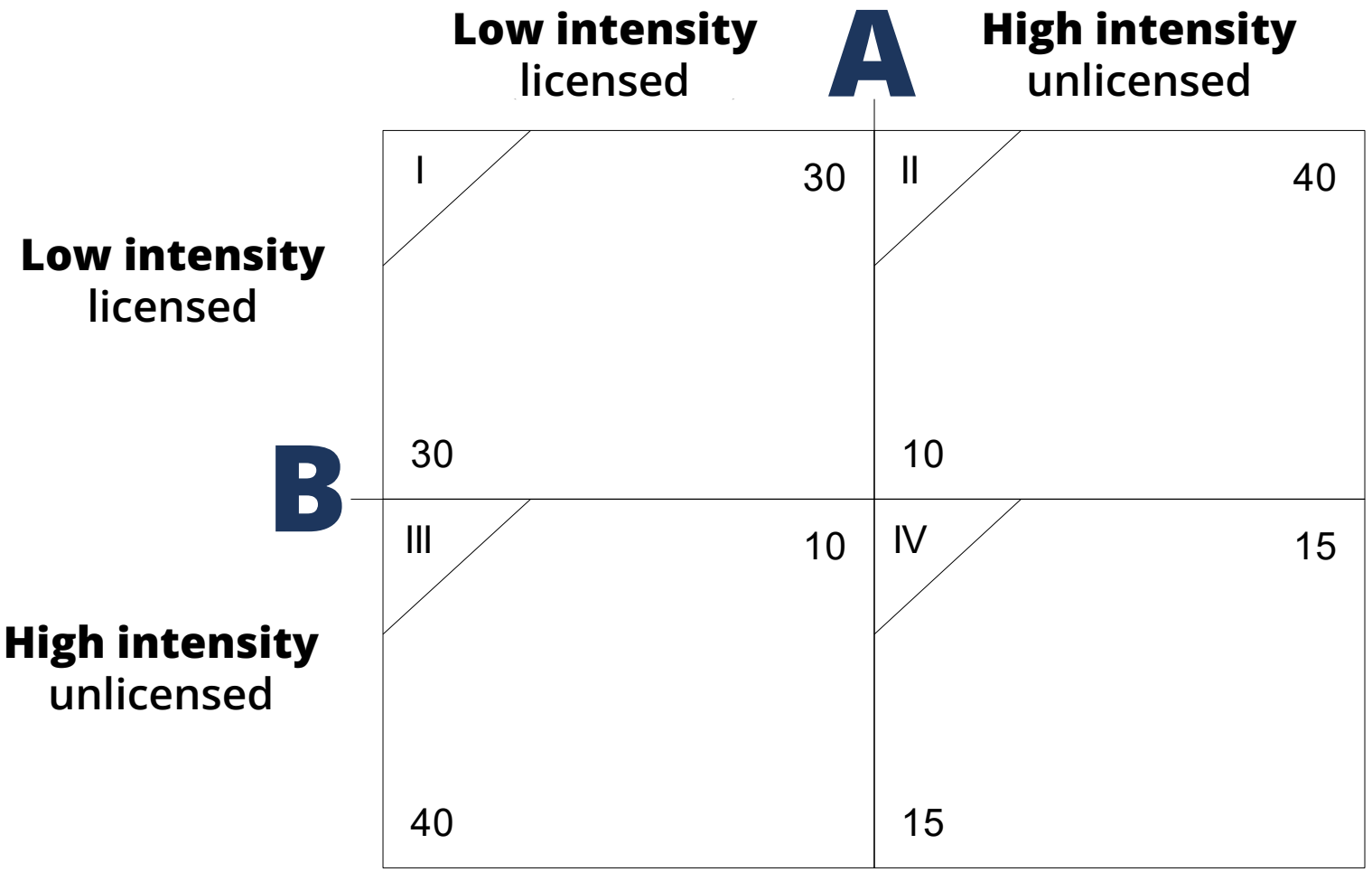
Market failure – Public Goods



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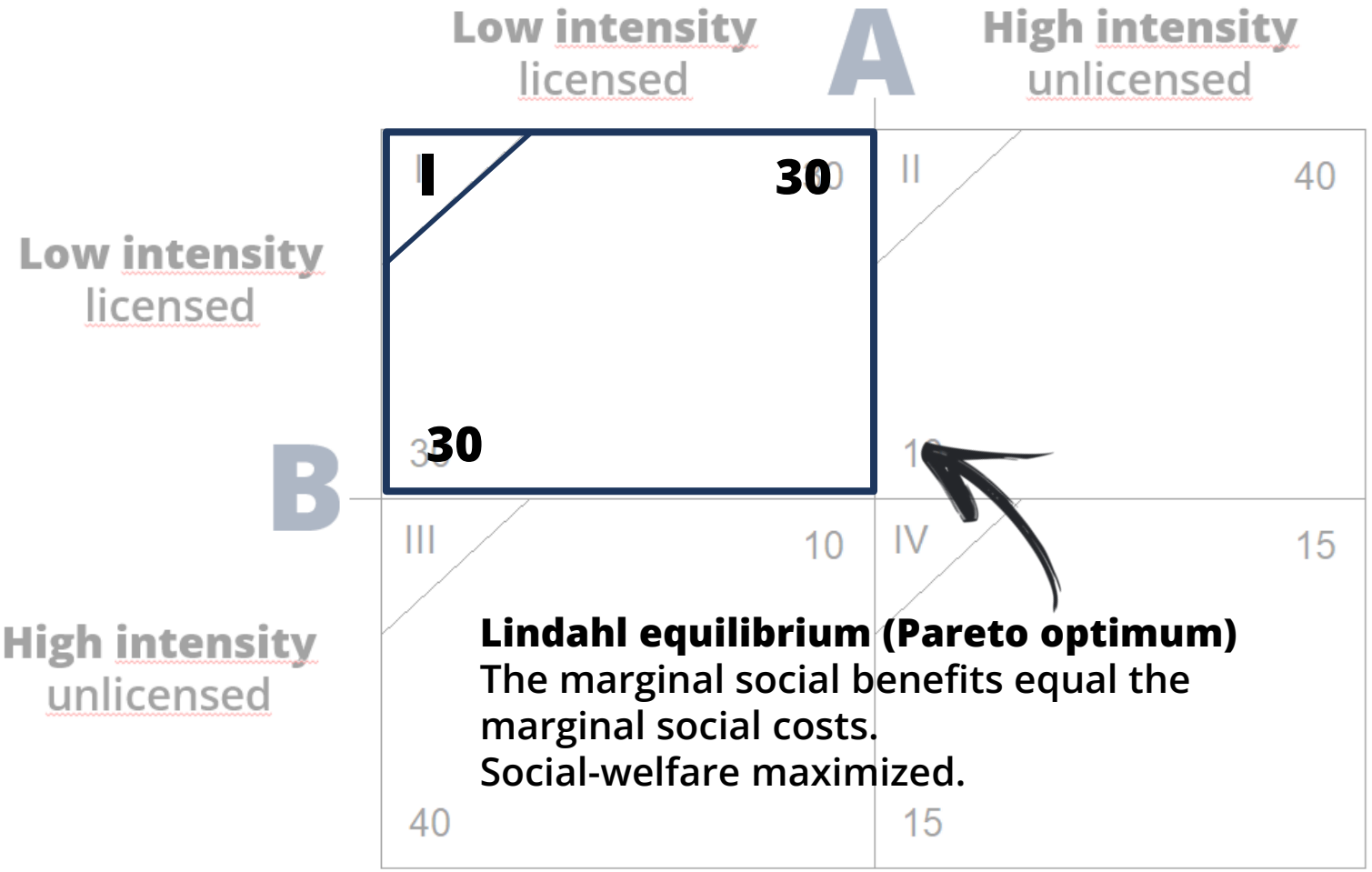
Market failure – Public Goods



Lindahl equilibrium (Pareto optimum)
The marginal social benefits equal the marginal social costs.
Social-welfare maximized.

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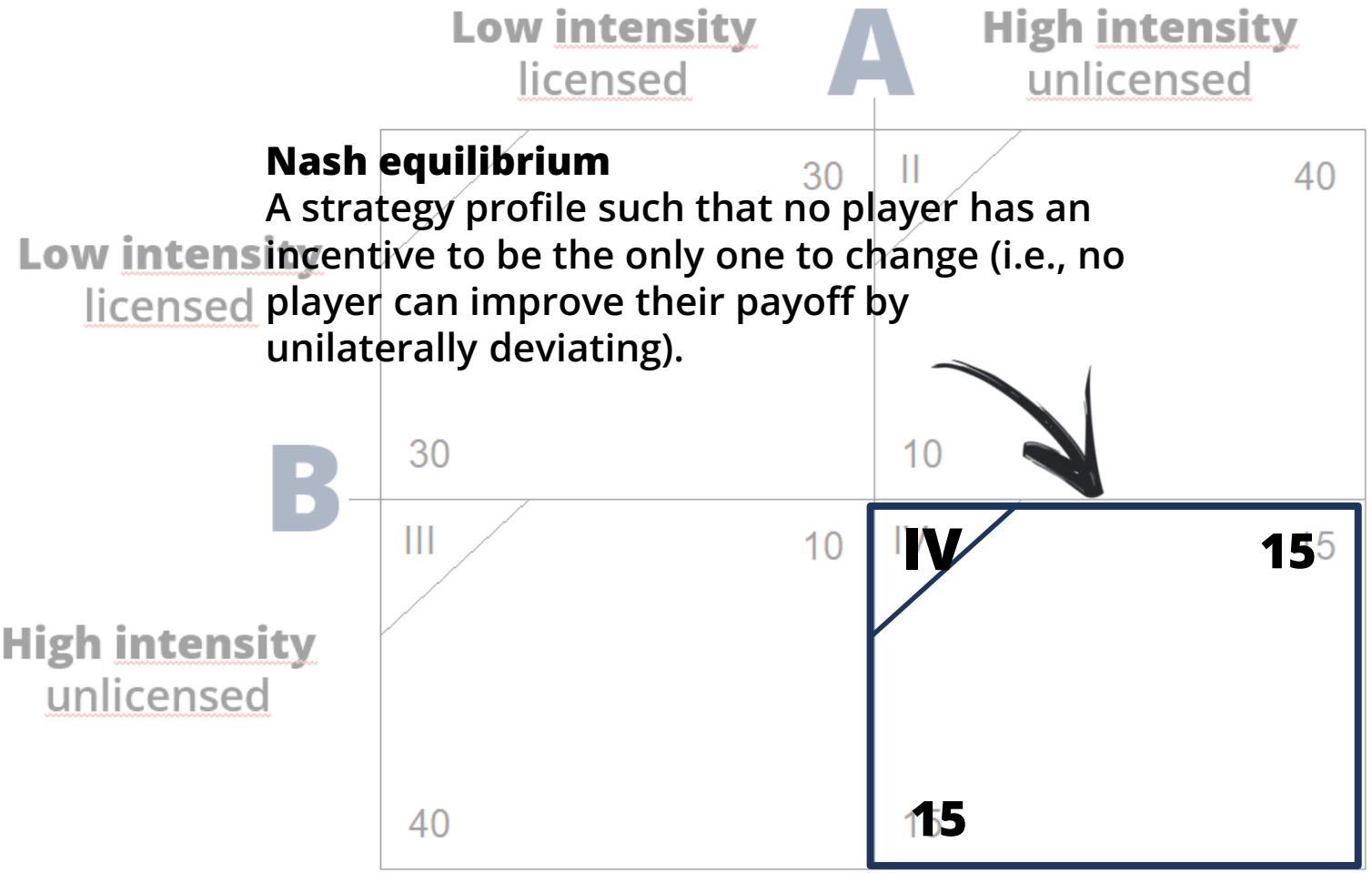
Market failure – Public Goods



Nash equilibrium
A strategy profile such that no player has an incentive to be the only one to change (i.e., no player can improve their payoff by unilaterally deviating).

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Market failure – Public Goods

Hidden information

"A gap appears between perceived and actual benefits/costs".

- Two forms:
  1. **Moral hazard**: hidden actions or actions that are costly to observe.
  2. **Adverse selection**: hidden type/quality

SOIL ASSOCIATION ORGANIC

GB-ORG-05
UK Agriculture

MARKETS AND THE ENVIRONMENT
Market Incentives for Environmental Protection

Introduction

- **Market failures** create environmental problems.
- Market prices that **do not reflect non-market values** won't create decentralized opportunities that supply enough environmental protection.
- We can still use the **ideas behind markets and market exchange** to create new decentralized solutions for environmental problems.
- Governments and people can create **new markets** and **revised market prices** to capture non-market values currently missing from existing markets.
- These market-based policies are an alternative to **technocratic dictates** or stakeholder processes (which have their own successes and failures).

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Government Intervention Failure: The Common Agricoltural Policy - CAP

CAP is a **European policy** which involved:

- Setting **minimum prices** for many agricultural products,
- Setting **import tariffs** to protect from cheap imports,
- **EU purchases of surplus food** to maintain minimum prices.

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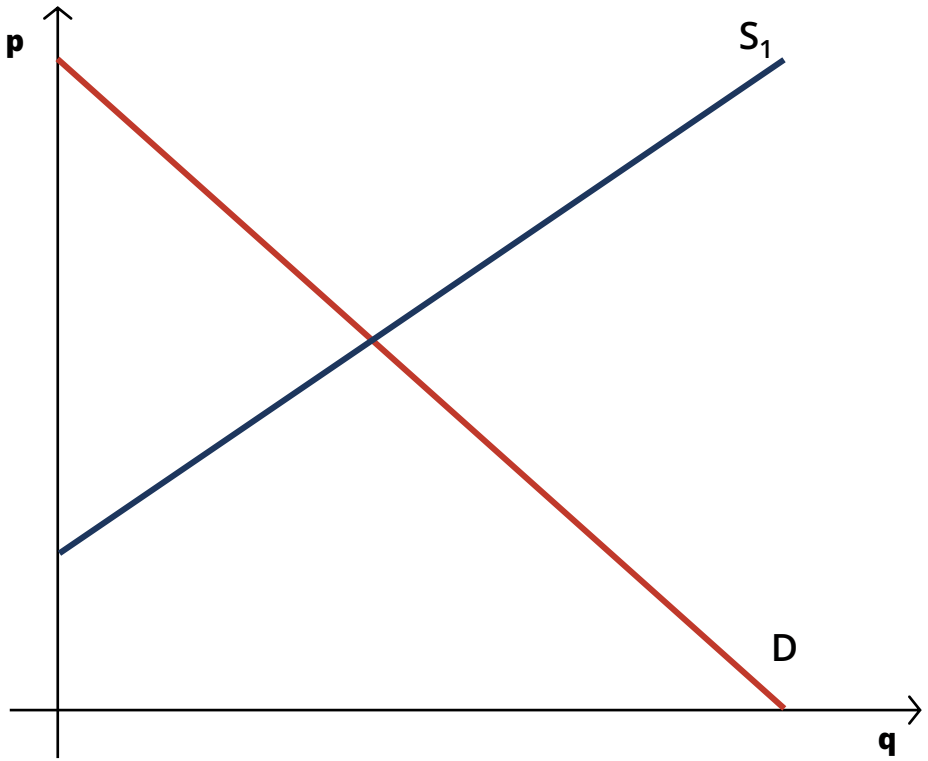
Government Intervention Failure: The Common Agricoltural Policy - CAP

Short term effect



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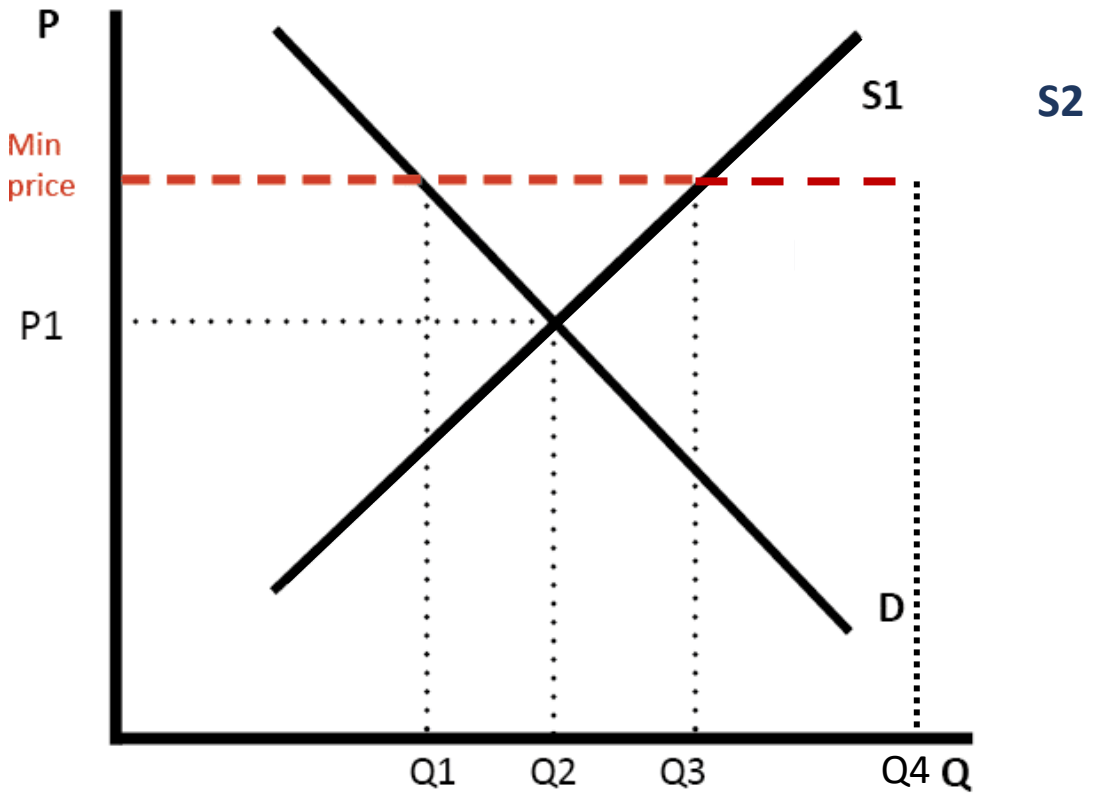
Government Intervention Failure: The Common Agricoltural Policy - CAP

Long term effect



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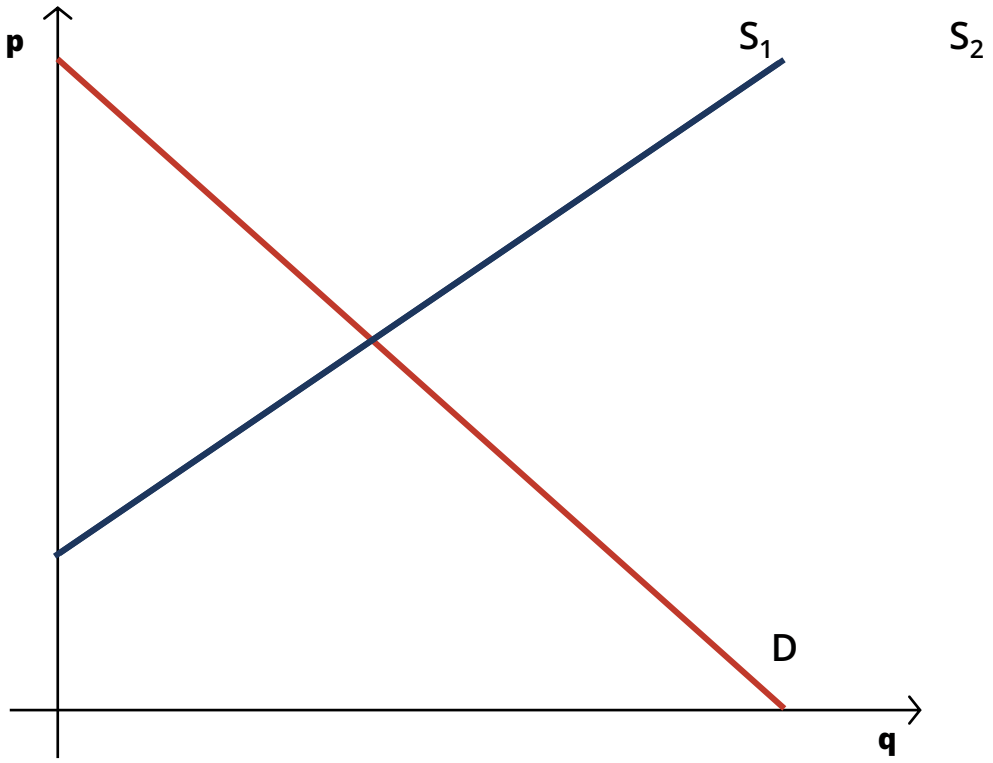
Government Intervention Failure: The Common Agricoltural Policy - CAP

Long term effect



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Coasean Bargaining

- Ronald Coase proposed the idea of **property rights assignment** and **bargaining** (Coase, *The Problem of Social Costs*, 1960).
- Legal rules should be considered within economics when **correcting market failures**.
- The "**Coase Theorem**": key assumption
  - Clearly defined property rights,
  - Zero or very low transaction costs,
  - Perfect information,
  - No income (wealth) effects,

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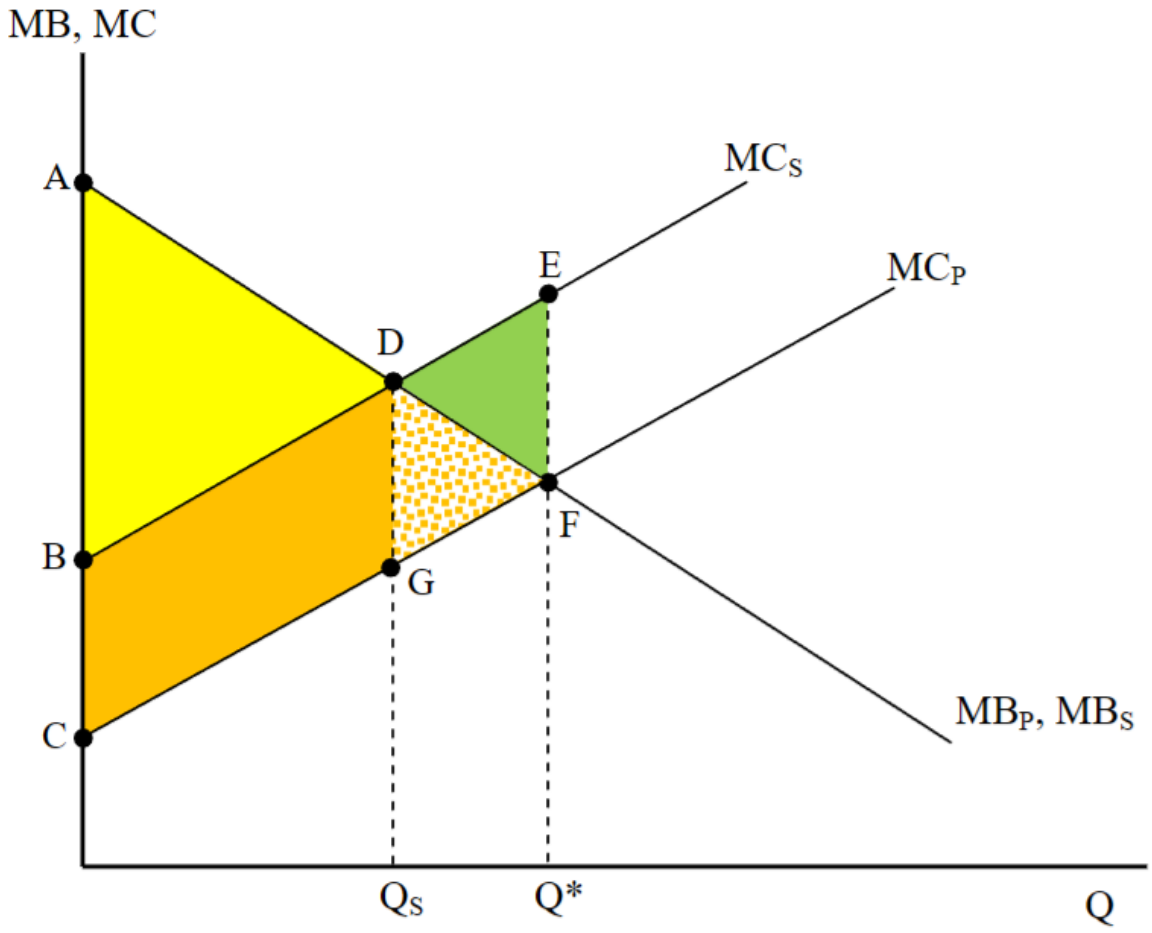
Coasean Bargaining



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Coasean Bargaining, Limits in practice

- High transaction costs
- Incomplete information
- Assignment of rights
- Redistribution and fairness

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Coasean Bargaining, The example from the book

1) **Assign the property right to enable trading**

2) **Bargain to a socially efficient outcome**

3) **When bargaining works (and when it fails)**

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Green taxes (Pigovian taxes)

- **Alfred Pigou** promoted the idea that we can "fix" market failure through **taxation**: we tax pollution.
- A **Pigovian tax** (or **green tax**) puts a price on the non-market social damages caused by pollution.
- The tax reflects the social damage the marketplace misses and is **added** to the price of goods/services known to pollute.
- Each unit purchased costs more: firms and consumers should reduce pollution/consumption and **no longer treat the environment as a free good**.

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Green taxes (Pigovian taxes)

- Economists like Pigovian taxes because changing prices to reflect social damages can **change behavior**.
- They also like the idea that a "good" Pigovian tax raises revenue to reduce "bad" taxes like the income tax.
- This swap is called the "**double dividend**":
  1. a green tax reduces the amount of pollution emitted;
  2. the revenues raised by the taxes are used to offset distortionary taxes (e.g., income or capital gains taxes).

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Green taxes (Pigovian taxes), The cost of protection and Second-Best

- Even though the **green tax** helps protect the environment, this extra protection **comes at a cost**: it raises market prices, increases the cost of living, and reduces disposable income.
- The green tax can look like a **second labour tax** added to an already distortionary income tax: the worker has an additional reason to reduce labour supply → **less labour, less wealth created**.
- Moral of the "double dividend" story: when two things are broken, correcting one does not guarantee well-being increases; it can make the other problem worse (**Theory of Second-Best**).

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Green taxes (Pigovian taxes) in practice

- Historically, many green taxes have been used **to raise revenue**, not to induce large pro-environmental behavior changes; they were often set too low to trigger big reductions.
- The politics of using green taxes has changed over the last three decades with awareness of **climate change risks**.
- Today **carbon taxes** are used by over 40 countries and over 20 cities/states/regions (e.g., the United Kingdom, many EU countries, Norway, Canada); many others are exploring adoption.

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Green taxes (Pigovian taxes) Baumol and Oates approach

- **Baumol and Oates** show that if society wants to hit an emissions-reduction target, an emissions tax is the lowest-cost way relative to command-and-control approaches (design standards or a performance standard).
- To understand this, we introduce the ***marginal abatement cost curve*** **MAC**.
- Abatement costs are ***the price to reduce emissions***. polluters can reduce emissions by:
  - installing end-of-pipe treatment plants;
  - changing processes (cleaner inputs or recycling);
  - reducing output.

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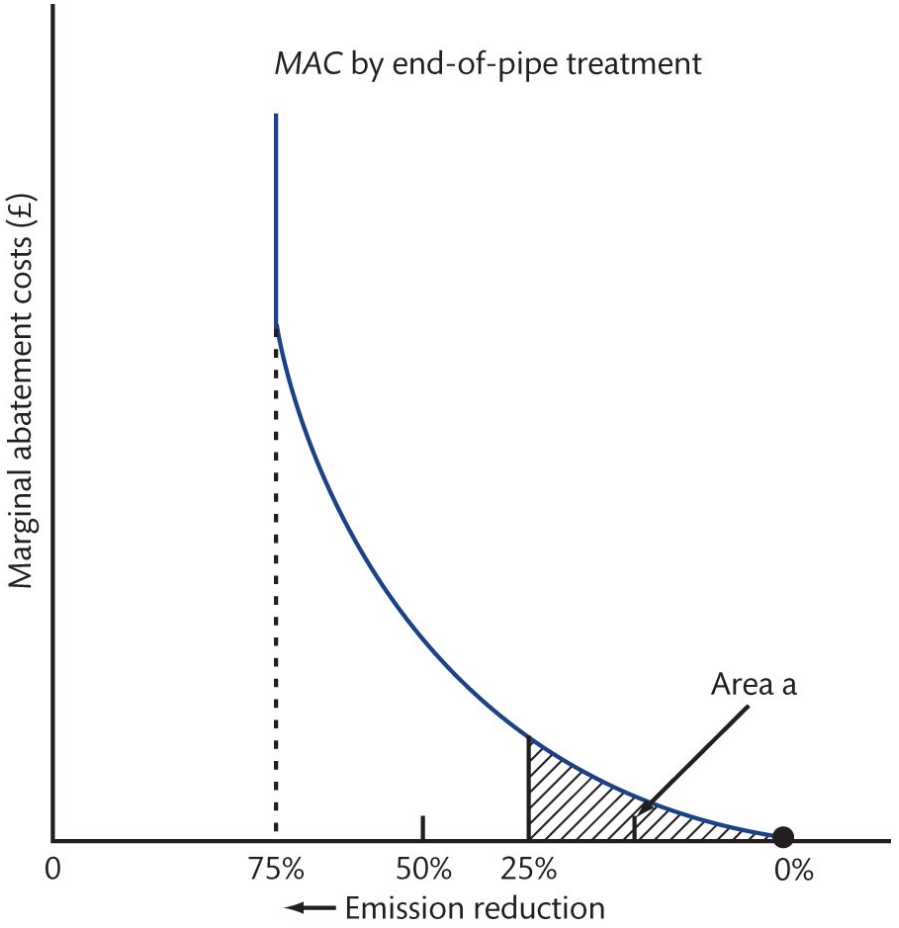
Green taxes (Pigovian taxes) Baumol and Oates approach



A *MAC* curve for reducing emissions by installing end-of-pipe treatment.

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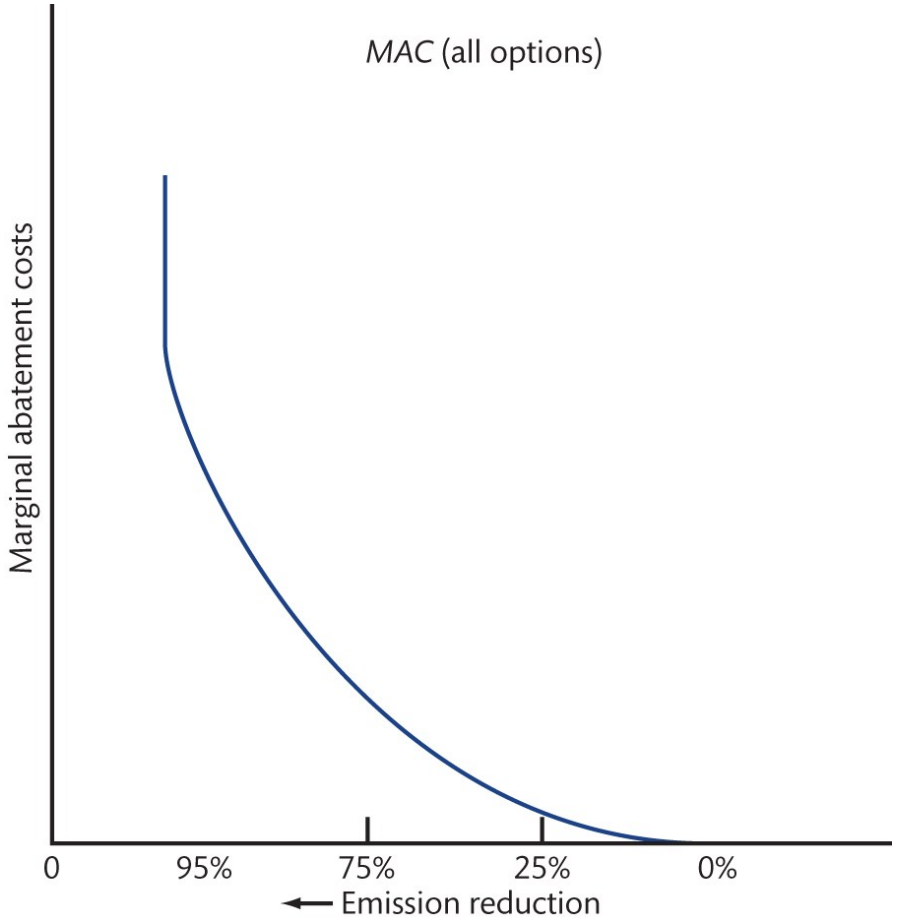
Green taxes (Pigovian taxes) Baumol and Oates approach



A *MAC* curve defined across all emission reduction options.

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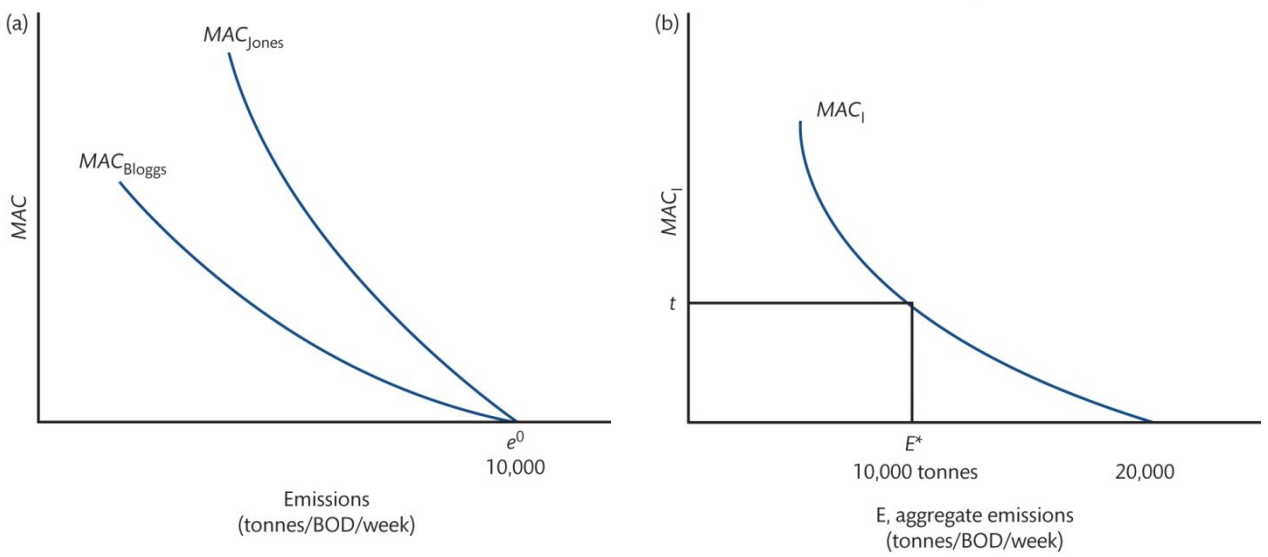

From firm's emissions to aggregate emissions.

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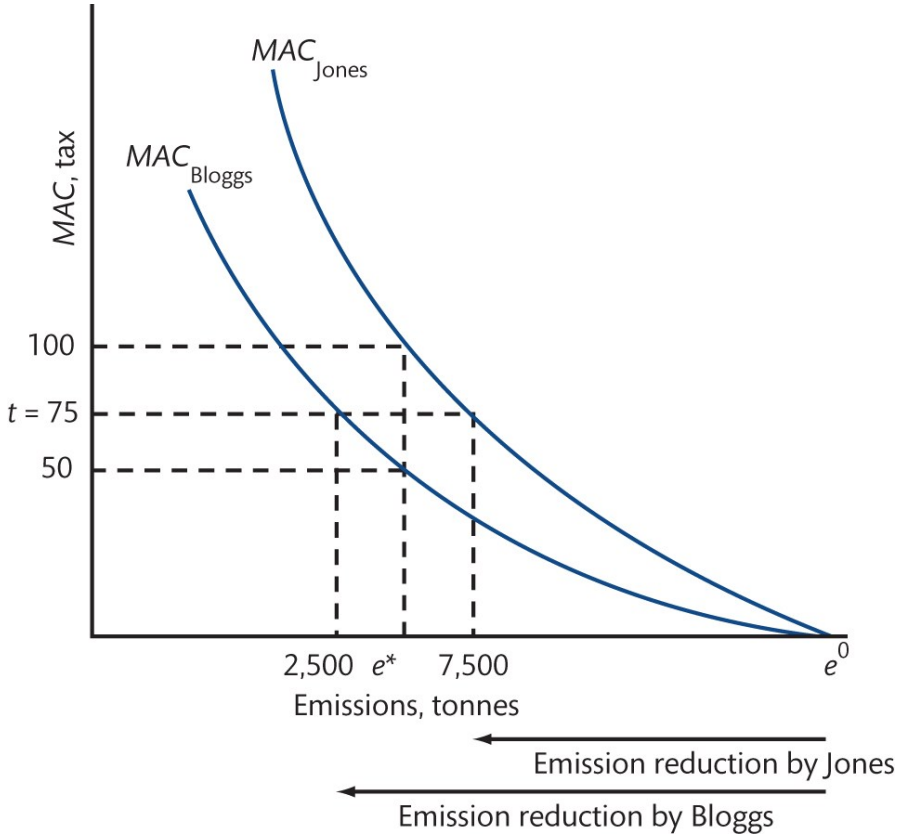

Pollution taxes as the least-cost solution

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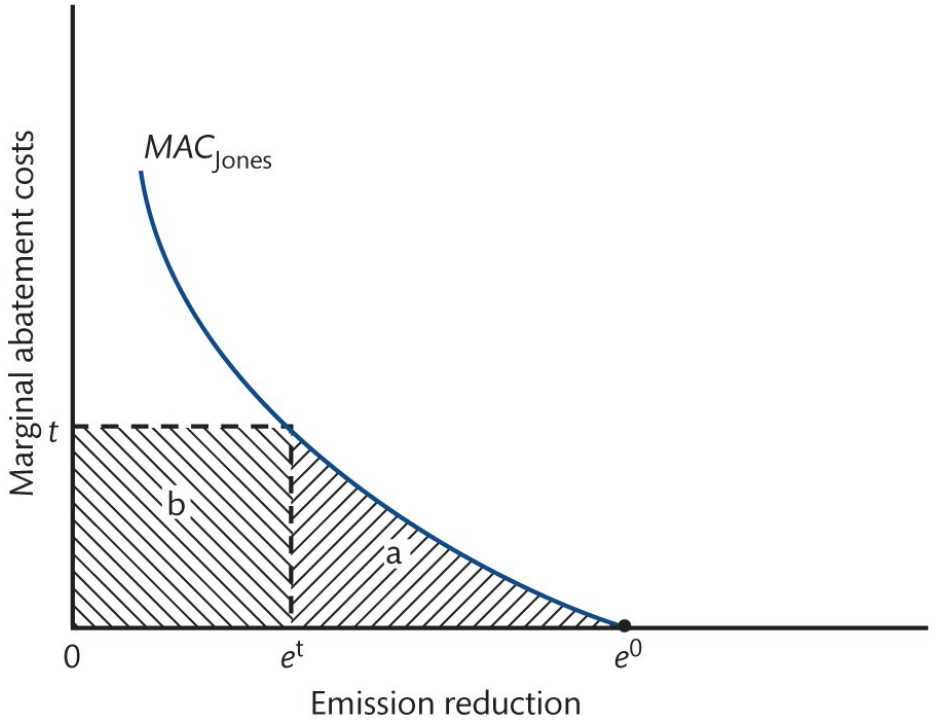
Green taxes (Pigovian taxes) Baumol and Oates approach



The impact of a water pollution tax.

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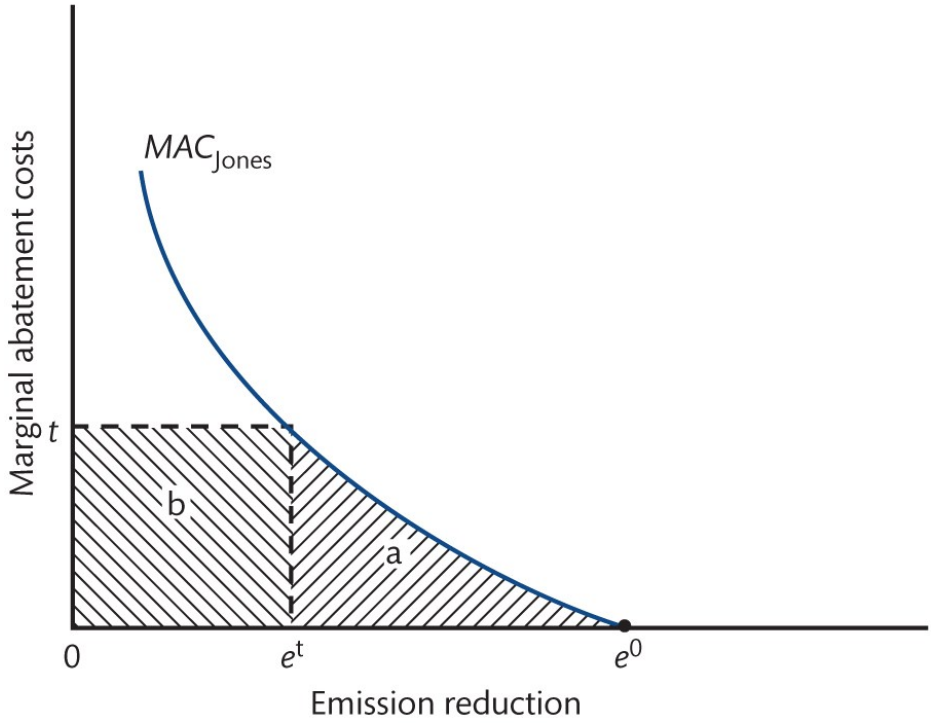
Green taxes (Pigovian taxes) Baumol and Oates approach



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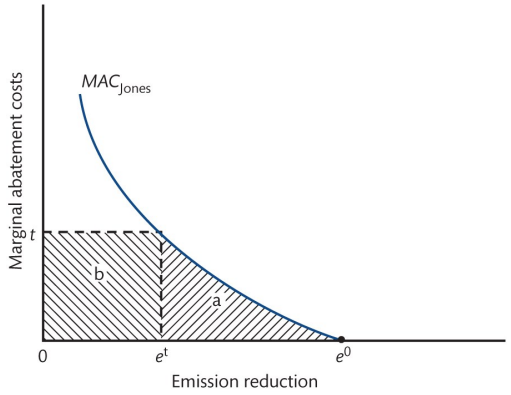

- Pollution taxes are preferred to mandates because they have the **least-cost** property (Baumol and Oates, 1988).
- They also have one big additional advantage: each unit emitted now costs the firm money in tax payments.
- Therefore firms have greater Incentives to invest in **cleaner**, **greener** technology than under regulation.
- This is the **dynamic efficiency** property, viewed as the most important feature in the long run.

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Green taxes (Pigovian taxes) Baumol and Oates approach

Problems with pollution taxes:

1. When pollutants are not "uniformly mixed," a single tax rate is not efficient.
   - Reason: the tax is levied on **emissions**, not on **environmental impact**.
   - Implication: firms causing more damage per unit of emissions should be taxed at a higher rate than firms causing lower per-unit damage.
2. The EPA often has **insufficient information to set the tax** rate t correctly.

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Cap-and-Trade

- The economist's favourite alternative to a green tax is **cap-and-trade**, or a system of tradable pollution permits.
- The idea is straightforward: **create a pollution market** by setting the level of pollution (the **cap**), distributing permits, and letting people buy and sell them (the **trade**).
- Society sets a strict **limit** on the amount of pollution; then it **sells** or **hands out** permits to polluters who must not exceed this limit.
- Letting permits be traded generates a **market price** for pollution that drives choices.

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Cap-and-Trade

- Permit markets work by assigning **property rights to pollute** to firms, governments, and people.
- These rights **create and add value** to something that would otherwise be a “free” good (like clean air or water).
- Many champion cap-and-trade as the most cost-effective approach: costs fall when people can trade; low-cost abaters sell to high-cost abaters and **both gain**.

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Cap-and-Trade, How it works

1. The regulator selects a fixed quantity of pollution and sets the number of permits available for trade accordingly.
2. Permits are allocated to polluters in the affected area.
3. Those who keep pollution/development below their allotment can sell or lease surplus permits.
4. Those who exceed their allocation must buy permits from those who either produce less or use less-polluting technologies.

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Cap-and-Trade, Operational conditions

- Permits must be **well defined** and **scarce**, so their value can be estimated accurately.
- **Free trade** should dominate the permit market.
- Government intervention, bottlenecks, and **transaction costs** that limit trading should be minimal.

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Cap-and-Trade, Operational conditions

- Permits should be **bankable**: flexibility to save and spend permits as market conditions fluctuate.
- People should be allowed to keep any **profits** they earn from permit trading.
- **Penalties** for violating a permit must exceed the permit price, to ensure rule compliance.

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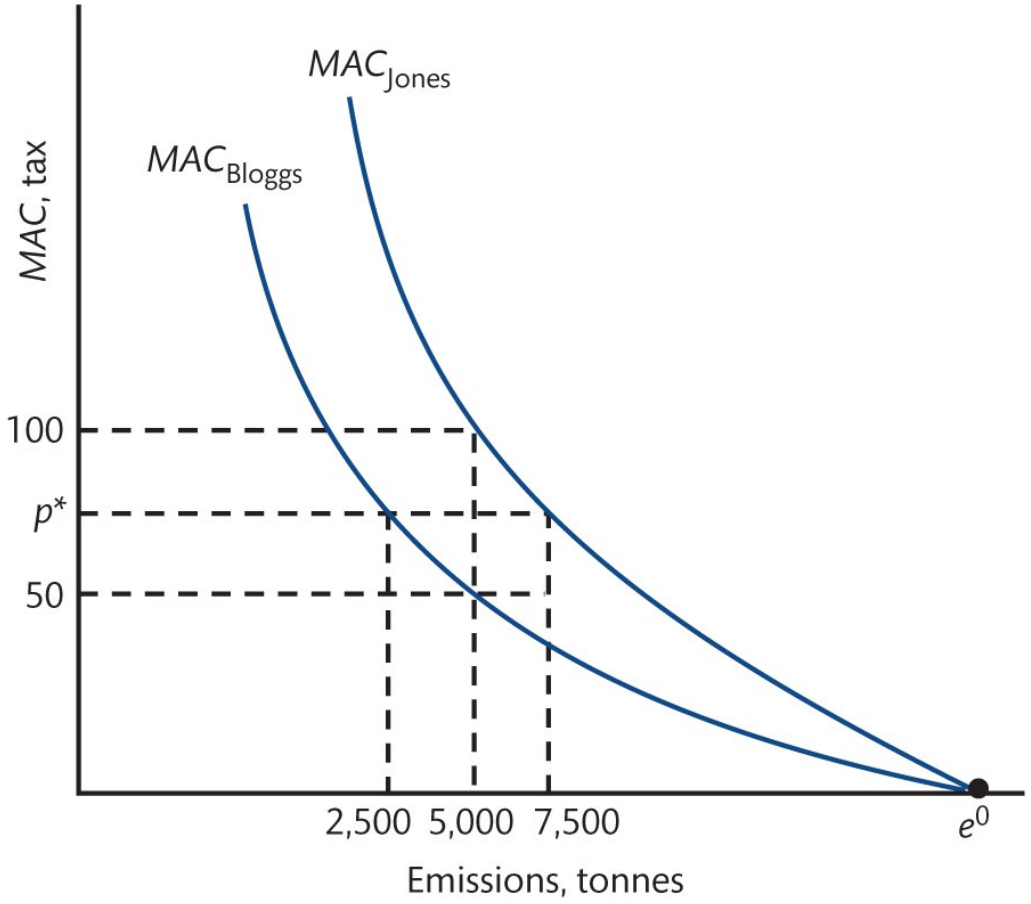
Cap-and-Trade



Tradable permits as the least-cost solution.

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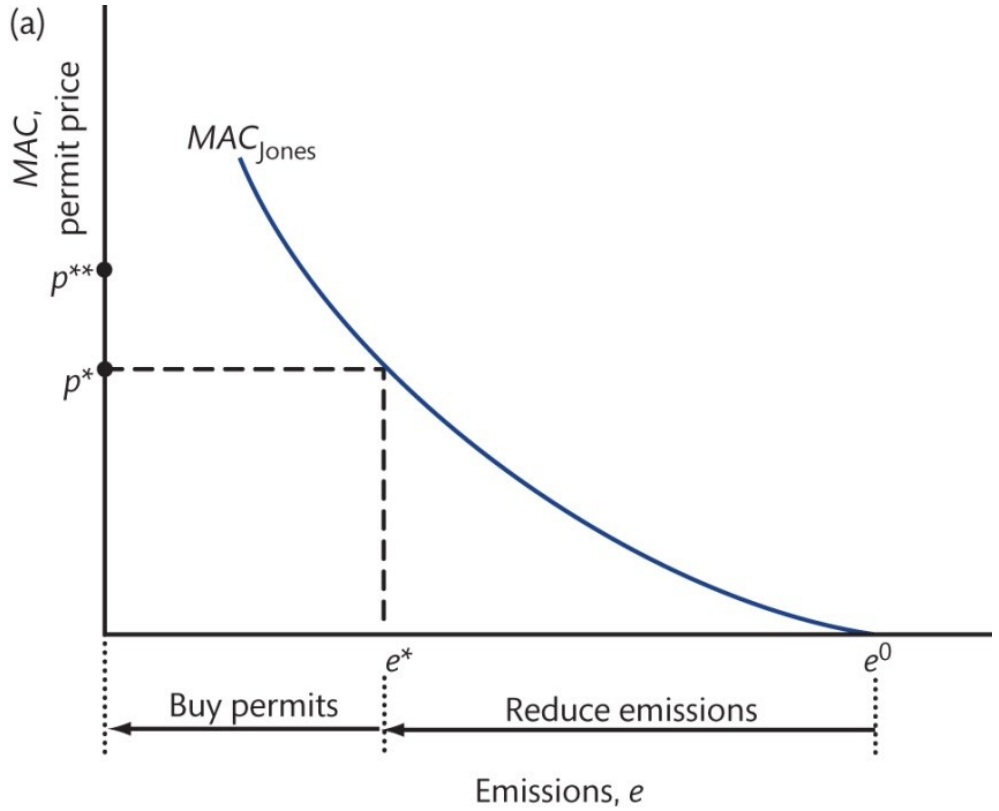
Cap-and-Trade



Prices in the permit market (a) individual.

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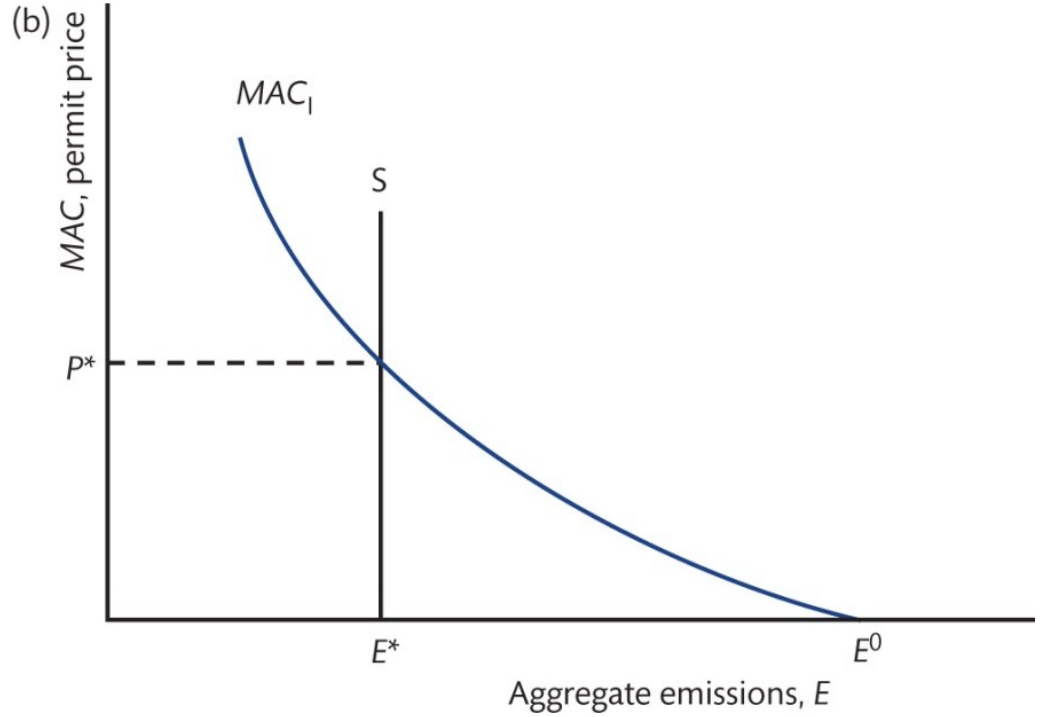
Cap-and-Trade



Prices in the permit market (b) aggregate.

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Cap-and-Trade, Impementing permit trading

- Two practical approaches: **auctioning** permits or **free allocation** (“grandfathering”).
- After initial allocation, firms can **trade** permits **over time** (conditions and costs change).
- Permit prices reflect bargaining and trading: they are market outcomes.
- Non-industrial actors (e.g., environmental groups) may **buy** permits **and retire** them to reduce the maximum legal emissions.
- Firms’ overall burden includes: **real abatement costs + net payments** for permits.

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Cap-and-Trade, Transaction costs and imperfect competition

- **Transaction costs** (searching for counterparties, bargaining, contracting) can reduce trading → efficiency losses.
- Complex schemes raise transaction costs; **digital trading** platforms can reduce them.
- With **few firms**, the market may be less competitive: **market power risk**.
- A large seller (or buyer) may **withhold permits** to keep prices high → lower efficiency.
- Less trading means some potential **cost savings** remain **unrealized**.

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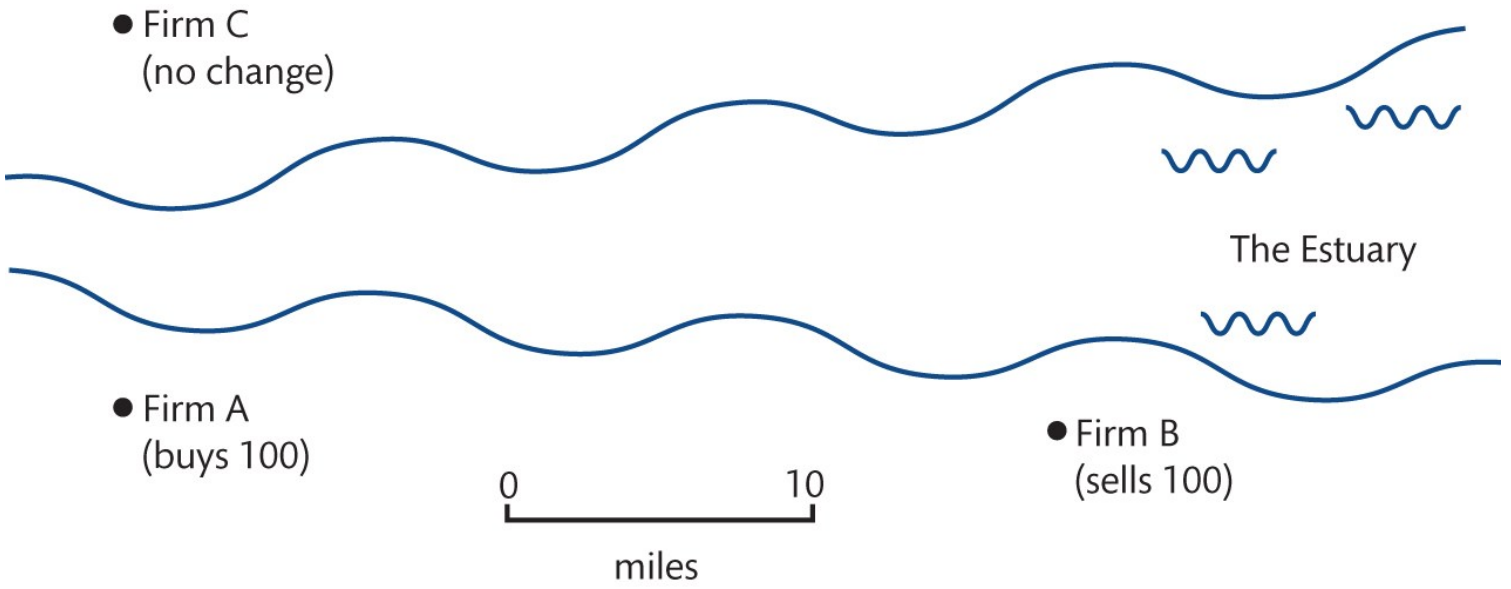
Cap-and-Trade, The hot spot problem



Permit trading in an estuary

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Cap-and-Trade, Advantages relative to a tax

- To set up the system, the regulator must decide **how many permits** to issue (the cap) and how to enforce rules.
- Detailed **knowledge of** each firm's **MAC curves is not required** to set the cap.
- If abatement costs change, **permit demand** and thus the price **adjust** without needing to "update" the instrument.
- Under a **cap**, actual emissions cannot exceed the legal maximum (quantity certainty).
- **Simple and transparent rules** support an effective cap-and-trade system.

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Cap-and-Trade in practice

- A heavily studied case is the **US program** reducing sulphur dioxide (**SO_2**) associated with acid rain.
- In climate policy, a central reference is the **European Union Emissions Trading System** (**EU ETS**), a regional market for emissions (mainly carbon dioxide (**CO_2**) and other greenhouse gases).
- **Performance** depends on: reliable emissions data, monitoring and enforcement, clear trading rules.
- A well-functioning market can cut costs versus command-and-control, but **cap design is crucial** (an overly loose cap → weak price).

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Summary

- **Markets can fail** when development choices devalue the natural world.
- They fail when they cannot address: **externalities**, **public goods**, **open-access common property**, **hidden information**.
- Rather than rejecting markets, we can **harness their power** for environmental protection.
- **Three market-like tools discussed**: Coasean bargaining, Pigovian taxes, cap-and-trade systems.
- **Markets do not substitute for good environmental policy**: they can make it more effective and cheaper through flexibility and cost-effectiveness (“markets work for us”).

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Discussion

1. Is it immoral to buy and sell the rights to pollute?
2. Can policymakers really collect all the needed information to implement 'first-best' Pigovian taxes?
3. Are markets the problem or the solution to dealing with both prosperity and pollution?