

First thing first: getting all prices right (fix the negative externalities before inventing new technologies)

EPFL

If we want more healthy foods, cleaner energies, plastic-free products, a healthy ocean – we need to put a price on the “social/environment” costs of bad foods, dirty energies, plastics, maritime activities

Stratégies de Spécialisation Intelligente

Outline

EPFL

- What is a negative externality
- Remedies
- The tragedy of the commons

Negative externalities

- Many actions of agents have harmful side-effects to others who have not been part of the production or consumption decision
- These effects are not nor paid neither compensated
- Side-effects without compensation are called negative externalities (some costs are not *internalized*)
- Side-effects with a compensation are NOT a negative externality

Negative effects with compensation (firm pays a tax, pollution cost is **internalized**)

Negative effects without compensation (the pollution cost remains **external**)

Short run	Pollution	Pollution
Long run	Problem fixed innovation	Pollution



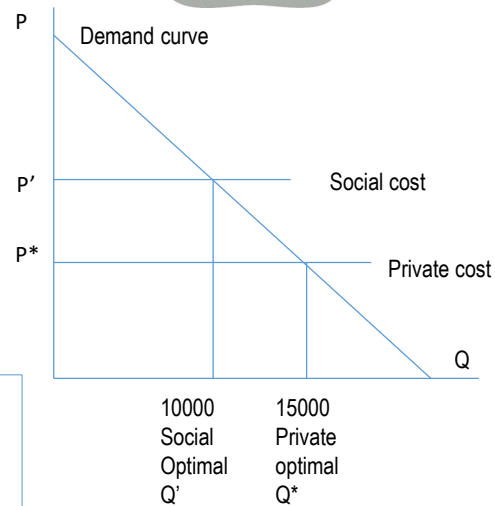
A negative effect which is not paid by the one generating it and not compensated for those who are suffering from it: the effect remains "external"
Why perfect internalisation does not happen spontaneously?

- **A car factory generates toxic discharges** - All resources used to produce cars (steel, labour, machineries) have a price as they are traded on a market – the factory has the correct incentives to economize on them.
 - It can economize on people (automation), on steel (process innovation), on energy (process efficiency & optimization)
- One resource 'used' has no price; hence there is no incentives to economize it: **clean air (an open access resource)**
- The factory consumes the resource – clean air – but does not pay for it
- This means that the factory will not consider the full cost of its activity – one cost is external (it is transferred to society)
- Hence the firm will not try to correct the problem through innovation and will prefer the status quo : a situation where its private cost is lower (the cost of clean air destruction is not included) than the full social cost it generates

- The market for cars in presence of a negative effect (car's factory produces toxic discharges)
- The **social cost** of producing a car is **higher than the private cost**
- **If all costs are internalized**, the price should be $> P^*$ and the quantity $< Q^*$
- The socially optimal quantity is 10000 cars not 15000 cars (which is the privately optimal quantity when some costs are not internalized)
- Unless corrections are done (for example taxing the pollution), the market fails to provide the optimal quantity: **overprovision**



EPFL

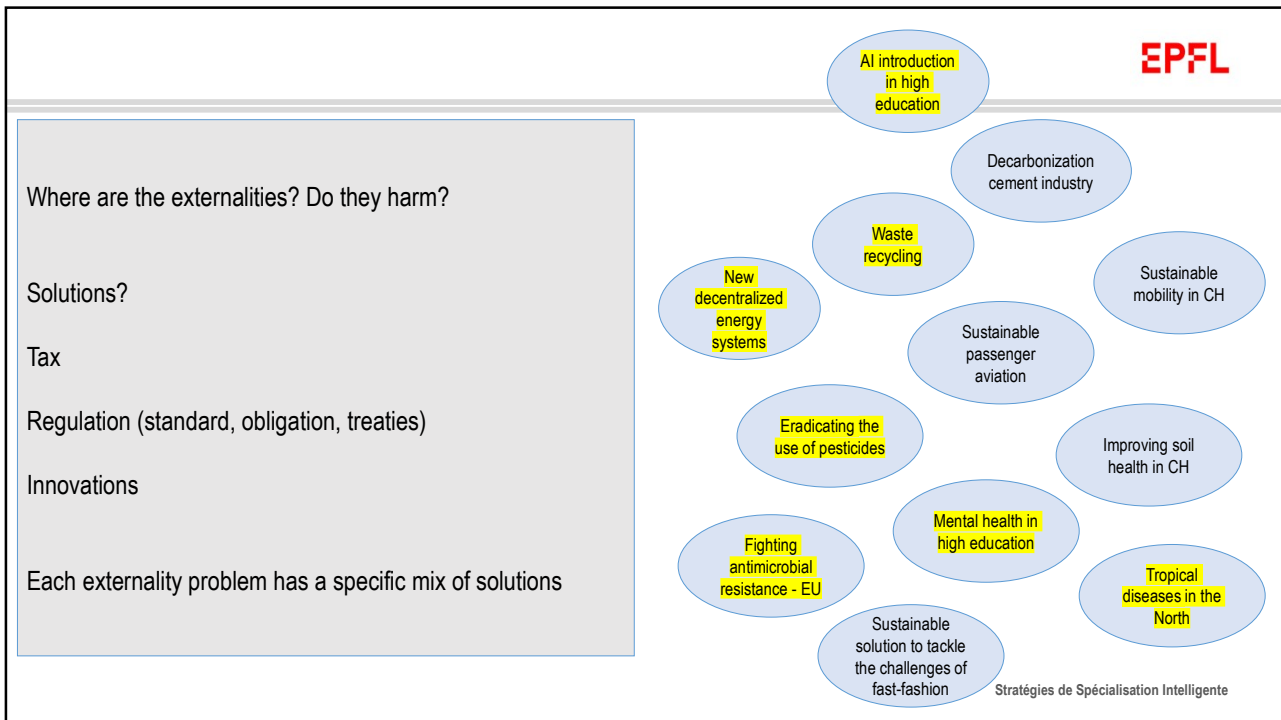


The equilibrium price P^ doesn't reflect social marginal cost and thus send a wrong signal about some resources destructions*

EPFL

- Negative externalities means: a fraction of the cost is not internalized by the firm or the individuals– only perfect internalization generates the right incentives – ‘perfect’ is an important qualification!
- In presence of negative externalities – incentives are distorted :
 - Who generates negative externalities doesn't consider the harm the action imposes to others (e.g. the full costs) and will not invest to minimize the negative effect
- If the firm has to pay to compensate the side effects – there is no longer an externality and therefore the side effect is expected to decrease in the long run because incentives go the right direction
 - It becomes costly to pollute – so the firm will reduce activity or **invest in clean tech**
 - The firm will make a trade off between compliance cost (pay the tax) and abatement cost (decrease pollution through **green innovation**)
 - This is why we say: « first condition for **achieving a mission related to environment, biodiversity, human health, etc..** is that all prices are right – they reflect the full cost of the activity »

Stratégies de Spécialisation Intelligente

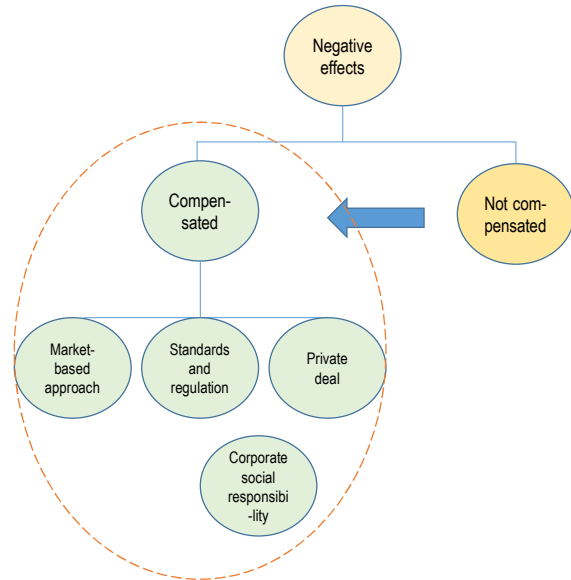


Why perfect internalisation does not happen spontaneously?

Missing markets

- Many resources cannot be subdivided into individual property rights they are non excludable – clean air, safe environment, ecosystems, quiet night: **it is technically impossible to differentiate people according to their decisions of selling or not selling their « right »** to clean air (pollution), to a quiet night (noisy car) or to a safe place (nuclear) – hence no market for trading the externality
- **Markets don't exist because the relevant interactions take place over large distances** (the effects of deforestation in Latin America on climate in Africa)
- **Markets don't exist because relevant interactions are separated by large temporal distance** (the effects of pesticides on pollination and later on the survival of critical ecosystems or of emissions on the disappearance of glaciers)
- For all these reasons: no price on the externality which remains external

- In many cases – there is a negative effect of an activity and this negative effect is an externality because it is not paid and compensated – a negative effect which is compensated is NOT an externality and this creates a better prospect to solve the problem **through the re-direction of innovation**
- Absence of compensation in most cases is due to the fact that – for technical reasons – there is no market for the externality
- Remedies
- Externalities are not only difficult to measure but even to observe – remedies can work only when the effect is observable, verifiable
 - Scientific ignorance is a key issue: the case of asbestos



Outline

- What is a negative externality
- Remedies
- The tragedy of the commons

Negative externalities and remedies - 1

EPFL

- Various approaches to internalize costs - Each approach has merits and drawbacks
- **Private deals** – if private parties can bargain in a simple way on the compensation for the negative effect, they can solve the problem of externalities on their own. Why not encouraging private agents – the provider and the free rider to get together and form a club to internalize the external costs or benefits?
- Best solution for numerous insignificant externalities

solution known as Coasean arrangement from the famous economist Ronald Coase

*A group of students organizing a party in a flat – which will make a lot of noises (negative externalities).
Before the party – they visit neighborhood, advise people, offer a bottle of wine – one neighbour asks for finishing the party at midnight – etc..
This is a bargaining process which if successful internalizes the externality at **low transaction cost** – more efficient than trying to calculate the detailed cost for each neighbor and provide the adequate compensation!*

Negative externalities and remedies - 2

EPFL

- In many cases private agreements don't work (geographical or temporal large distance, high number of parties are concerned)
- **Market-based** – giving the private agent an incentive, via prices, to limit pollution
 - Taxes - Pigou
 - Tradeable pollution permits : a limited number of licenses to emit a specified pollutant are issued. Companies can trade these licenses according to their costs and incentives. This produces the same incentives as taxes with the price of licenses effectively serving as tax on pollution
- **Government-based** – deciding rules that prohibit or at least limit behaviors that impose especially high costs on others
 - Standards, regulations
- **Market-based versus Government-based**
 - **Pay a tax and pollute – not healthy deal** : Pollution should be treated like a crime rather than something you have the right to do so long as you pay enough – (the kindergarden story – next slide) ->
 - Market-based are considered as more efficient by letting firms to optimize their strategies
 - In some cases – such as car-emissions – it is easier and more effective to impose emission standards on all cars rather than charging each car owner a fee proportional to the emissions produced (depending upon driving style, etc..)

Stratégies de Spécialisation Intelligente

Does taxing encourage pollution?

- Introducing economic incentives/punishments might have unintended consequences
- “A fine is a price” (Gneezy & Rustichini, 2000)
- Fining delay of parents in childcare center increased their tendency to be late

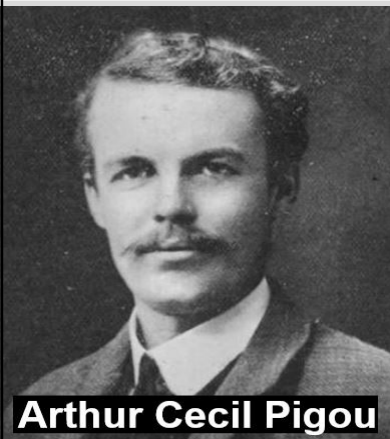


Transitions and technology policy - Charles Ayoubi

EPFL

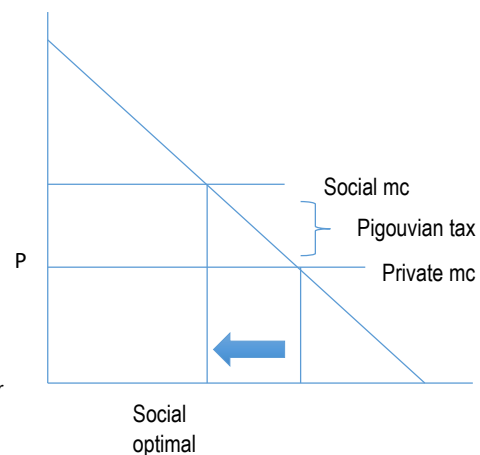
Externalities and remedies

EPFL



Arthur Cecil Pigou

« Economic activities that impose unrequited costs on other people should not always be banned but should be discouraged. And the right way to curb an activity, in most cases, is to put a price on it. »



Stratégies de Spécialisation Intelligente

Environmental taxes



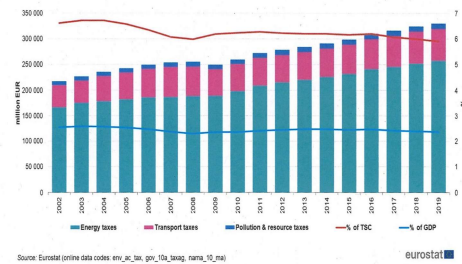
- Emission or carbon tax: on quantity of emissions
- Energy tax: on energy consumption
- Transport tax (e.g. registration of a car)
- Resource tax (e.g. on waste)

	corporations	households	Non-residents
Energy taxes	50.4	45.4	3.9
Transport tx	32.4	67	0.4
Pollution & ressources tx	42.2	55.4	1.0
Total	46.7	49.9	3.2

Environment tax revenues by tax payer – 2018 - % across – EU 27

Environmental tax revenues by type of tax

Total amount and share of TSC and GDP, EU 27, 2002-2019

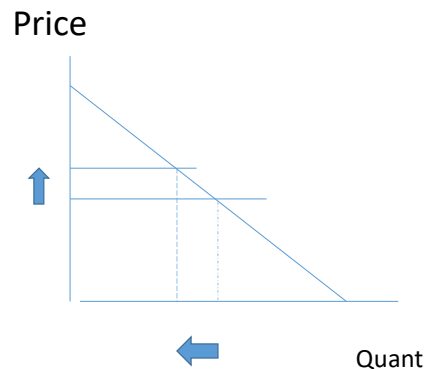


Source: Eurostat (primal data codes: env_at_tax_gpc_10a_bsig_name_10_m)

TSC = total government revenue from taxes and social contribution

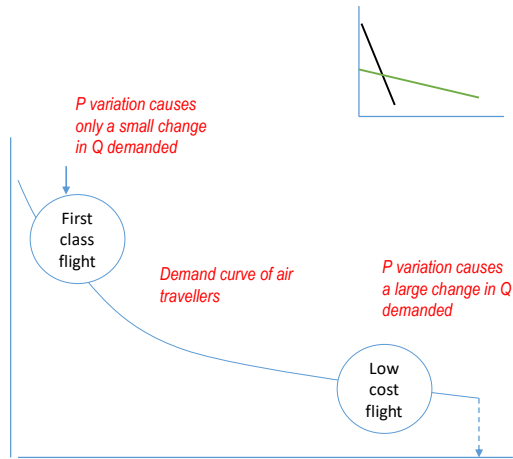
The risk of inefficient and/or unfair tax – the case of air transportation

- Increase price hence reduce quantity (even a low tax will have a modest effect) the low cost issue
- Accelerate substitution (need to be very high)
- But should be done carefully
 - Consider demand elasticity (next slide)



Demand curve and price elasticity

EPFL



- Price elasticity »: **the % change in the quantity demanded following a 1% change in price**
- Some products are barely affected by changes in prices: lifesaving drug
- For others, a small change in price can make a big difference: a seller trying to charge even a little more than the going spot price for oil would have no takers

Stratégies de Spécialisation Intelligente

The effect of a tax – the case of air transportation

- Increase price hence reduce quantity (even a low tax will have a modest effect) the low cost issue
- Accelerate substitution (need to be very high)
- But should be done carefully
 - Consider demand elasticity
 - Think of specific cases: grand parents *versus* serial travellers
 - However – private information is not observable
- Avoid too high taxations (which will destroy a fundamental achievement) and complement with subsidies for tech promotion and actions on social norms (chapter 3)

How to calculate the monetary equivalent of the externality?



- The tax should be equal to the by-product damage the action confers on others – two ways:
- Calculate the monetary equivalent of the negative effect; convert the externality into monetary terms as:
 - Avoidance costs – costs of preventing pollution by avoiding the release of an additional unit of pollutant
 - Damage costs – costs incurred by the pollution – agricultural production loss due to a decrease in crops yields
 - Abatement costs – the costs of reversing the damage caused by the pollution, such as healthcare spending
- Create a market for pricing the externality (ETS)

Stratégies de Spécialisation Intelligente

The external costs of pesticides – France -annual



- Type of “social” costs
- Costs related to public health (abatement): treatment costs for some cancers
- Costs related to the effects on the environment (damage)
- Amount of public subsidies
- Costs of regulation (avoidance)
- Attribution factor: whether the full cost can be attributed to pesticides or not

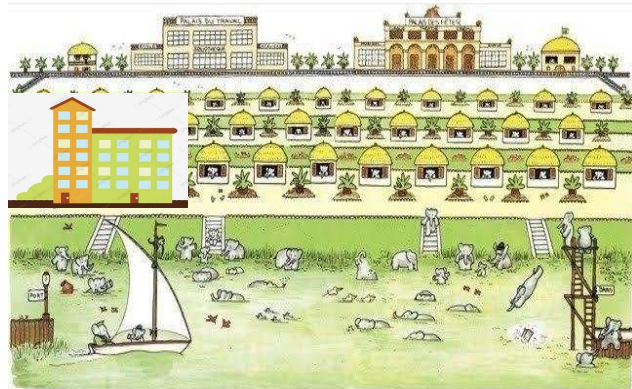
Public health	48,5 M EUR
Environment – water & emission	290 M EUR
Public subsidies – to agro-chemical industry	0.4 M EUR
Plan Ecophyto	32 M EUR
Total	371 M EUR

But a lot of data are missing – what has not been quantified is not taken into account
 Effect on health not considered if not professional diseases (not estimated for the whole population)
 Effect on biodiversity
 Larger public policy such as European agricultural policy (10 Billions) which subsidizes essentially conventional methods
 The external costs are between 371 M and 8,2 Billions!

How to measure negative externalities? Hedonic method

EPFL

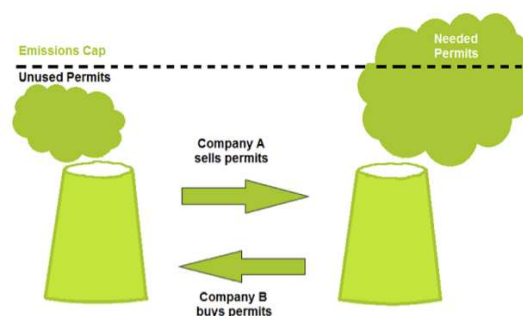
- Assume a city with standard houses (all similar) but a few are close to the airport and a few close to the polluting factory
- It is possible to measure the social cost of the airport (noise) and of the factory (pollution)
- If the estate market works well and consumers have perfect information about the negative effects – the difference in houses' prices should reflect how people value the quietness or the clean air of their area : even if clear air or quietness have no price – the prices' differences for « similar goods » help to know how people value social costs
- But there is no ideal cities with perfect similarity of houses!
- ..and econometric methods to isolate the influence of pollution on prices



Emission Trading Scheme (ETS): principle

ETS is a market of tradable pollution permits

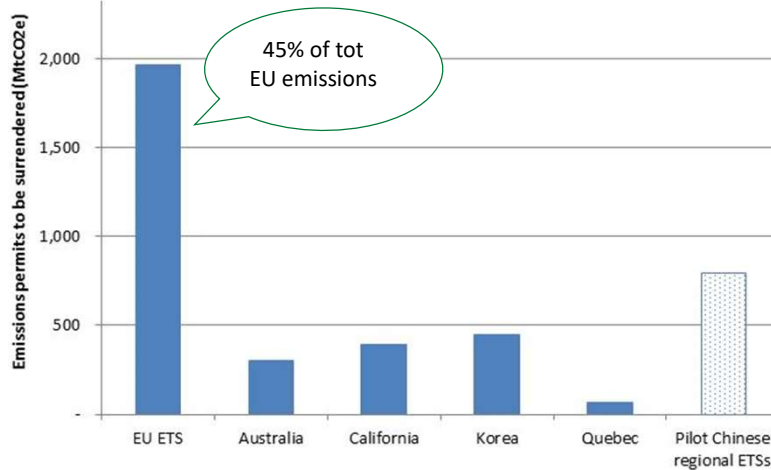
1. Emissions cap on quantity
 - Permits to pollute
2. Trade
 - Market price determination



Trading brings flexibility that ensures **emissions are cut where it costs least to do so**: firms can optimize strategies according to their specific circumstances: cutting emissions through innovations (and perhaps selling permits later) or buying permits

EPFL

Emission Trading Scheme (ETS) : some examples



EPFL

The EU ETS - coverage

- Covers around 45% of the EU's greenhouse gas emissions.
- Transport excluded except for aviation (3.4% of EU 28 emissions) since 2012.
- Households excluded
- Sectors covered: electricity and heat generation, energy-intensive industry sectors (oil refineries, steel works, and production of iron, aluminium, metals, cement, lime, glass, ceramics, pulp and paper, cardboard, acids and bulk organic chemicals)
- Gases covered: carbon dioxide (CO₂), nitrous oxide, perfluorocarbons (PFCs)
- Participation criteria: sector of activity and plant size
- Operates in all EU countries plus Iceland, Liechtenstein and Norway
- Limits emissions from more than 11,000 heavy energy-using installations (power stations & industrial plants) and airlines operating between these countries

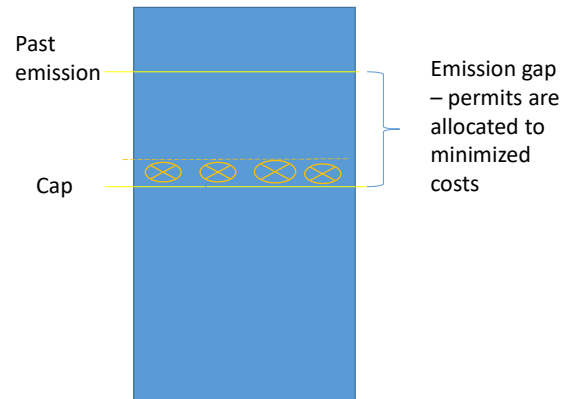
Sources: http://ec.europa.eu/clima/policies/ets/index_en.htm

EUTL registry: <http://ec.europa.eu/environment/ets/welcome.do?languageCode=en>

EPFL

The EU ETS - implementation

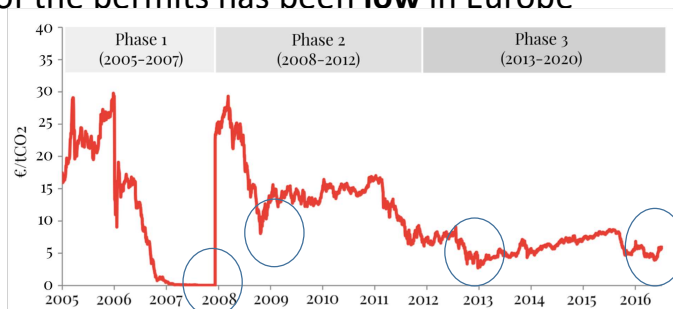
- Period 1 – 2005 - 2008
- Initial allocation of pollution permits – according to the cap and to the past emissions (“grandfathering”) – and emission permits are handed free of charges
 - Grandfathering + free allocation of permits made the process very “smooth”. This was done to minimize compliance costs (buy more permits) and abatement costs (reduce pollution with innovation)
 - Firms have incentives to overestimate past emissions
- Transactions
- Verification of compliance



EPFL

The EU ETS

Price of the permits has been **low** in Europe



Source: Frontier economics

Low price: means **excess of** permits over demand
Because of...
Economic crisis? (2009 – 2012)
Grandfathering?
Green tech/clean energy?

EPFL

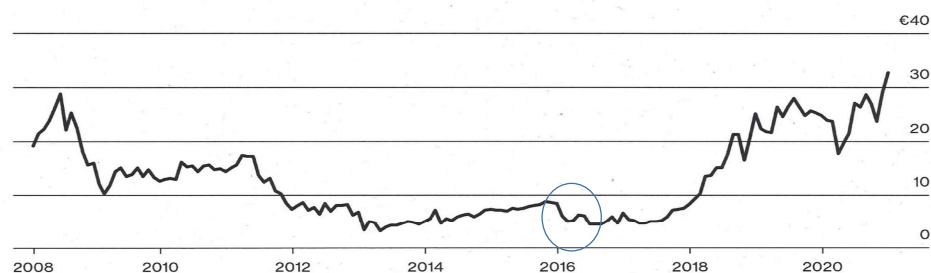
The EU ETS - implementation

- Period 1 – 2005 - 2008
- Initial allocation of pollution permits – according to the cap
- Free allocation and “grandfathering” – minimize costs of compliance and of abatement –
- the supply of permits is too high and the price falls dramatically
- Next periods – redesigning the market
- On the demand side: The cap is decreased over periods – more constraining
- On the supply side: permits are no longer free but are acquired through auctioning –firms anticipate their capacity to become cleaner and thus their role on the secondary market
- On the supply side: market stability reserve (adjustment mechanism to correct excess of supply: a portion of permits is set aside before the initial allocation to insure a ‘price floor’)
- 2021-2030 price incentive is back for the moment
- An interesting economic experiment: how to design a market!

EPFL

Price in the EU ETS market

Price of the permits has been **low** in Europe: excess of permits?



Data: Compiled by Bloomberg

Market starts to work in a more efficient way
Carbon price is the outcome of two forces:

- *The economy is greening (innovation)
 - *Caps are constantly decreasing
- Price increase means that the greening is not fast enough to compensate for cap decrease

Transitions and technology policy

Claudia Pellegrin

14

EPFL

Summary on policies to fix externalities

EPFL

- What is the difference between?
 - A negative externality (the firm pollutes and doesn't pay for the externality)
 - A negative effect which is compensated (the firm pays, e.g. buys the right to pollute)
 - In both cases, we suffer from the negative effect!
- We want to move from an *externality* context (the situation is not going to change) to a context of *negative effect with compensation*
 - the compensation creates a dynamic force to solve the problem or at least decrease the effect – but how effective will be the situation depends greatly from how high will the compensation (whether the amount paid achieves perfect internalisation – e.g. the failure of the ETS initial phase in the EU)
- Regulating the economy means in this case the creation of compensation mechanisms (eg tax equivalent to the social cost) so that the problem **will be solved** based on rationale decisions by who is at the origin of the effect
- A key mechanism **to solve** the problem then is **re-directing innovation**

Stratégies de Spécialisation Intelligente

Outline

EPFL

- What is a negative externality
- Remedies
- **The tragedy of the commons**

Tragedy of the commons (as an extreme case of negative ext.)



Tragedy of the commons (Hardin, *Science*, 1968)

- Common pool of exhaustible resources for which users compete (rival goods)
 - Public hunting areas, fishing zones, natural water, communal grazing, public zones (where people put garbages or spatial debris)
- There is no fees for hunting, fishing, using water, grazing, putting garbage; every one can access to the resource to pursue her private interest
- When too many people have these rights the resource is likely to be overused leading to depletion, natural disaster, etc..
- This problem applies when
- The resource has two properties ...
 - It is a non excludable and exhaustible good = common pool resources
 - Non excludable means – nobody can't be excluded to use it (unless some rules or property rights are established)
 - The good can be exhausted through excessive use
- ..and the social cost (resource depletion) is the result of an aggregate of a myriad of small decisions (the tyranny of small decisions) – in such case, fixing the problem is more difficult than if there is just one big agent
 - A big agent who is the only user (for example of fishing zone or a mining area or a tropical rain forest) has private interest to manage the commons

- The case of communal grazing
 - Each herdsman seeks to maximise his gain
 - What is the utility to me of adding one more animal to my herd?
 - This utility has one negative and one positive component (μ^- and μ^+)
 - (μ^+) is a function of the increment of one animal (the herdsman receives all the benefits from sale of an additional animal ($\mu^+ = +1$))
 - (μ^-) is a function of the additional overgrazing created by one more animal. But the negative effects of overgrazing are shared by all herdsman, the negative utility for any herdsman is only a small fraction of (μ^-)
 - The origin of a universal problem – benefit is private, cost is social = benefit > cost for one individual
 - The rational herdsman adds the component partial utilities and concludes the best strategy is to add another animal to his herd and another and another
- But wait a minute: is communal grazing really a non excludable good? No - then property rights can be a way to fix the problem

The Enclosure Movement



Fixing the tragedy of the commons

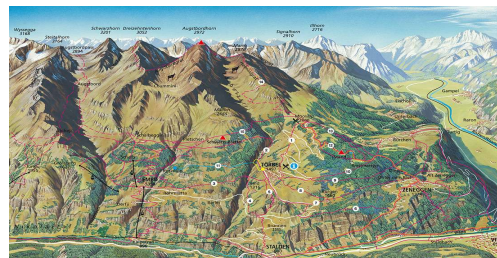
- A push in the 18th to take land that had formerly been owned in common by all members of a village – or at least available to the public for grazing animals – and change it to privately owned land, with walls, fences around it
- Rationale – higher productivity, avoiding tragedy of commons
- But another consequence: social eviction
- The *microeconomic* problem and solution has not only consequences in terms of efficiency but has distributive effects



She got the Nobel Memorial Prize in Economic Science «*for her analysis of economic governance, especially the commons*»

Governing the commons – E. Ostrom

- **Common Pool Resources institutions**
- *Törbel (Haut-Valais): Wintering rule -no citizen could send more cows to the alp than he could feed during the winter*
- *Adherence to this ‘wintering rule’ was administered by a local official*
- *This form of managing the commons was relatively easy to monitor and enforce*
- *Bisses in Valais*
- *But these are local commons*
- *What about global ones?*



Governing global public goods

We don't pay for global commons as open seas or tropical rain forests

Open oceans are open access that lie beyond exclusive (national) economic zones

Tragedy of the commons (overfishing); high stress inflicted by transportation, cruises and pollutants emanating from land
Need for remedies to reduce pressure on them

Regulations : protected zones – can be reached by international treaties - but oceans are mobile and zones which need protection can move

Tax: need for institutions to monitor and charge for the use of high seas: (taxing ocean transportation, deepsea fishing, and the refuse that is deposited into them by nations)
But to implement it requires an international agency

Innovation: influence direction; e.g. towards ecological fishing instead of industrial fishing (using giant trawling)



Summary

EPFL

- In many cases – there is a negative effect of an activity and this negative effect is an externality because it is not paid and compensated
- Absence of payment and compensation in most cases is due to the fact that – for technical reasons (non excludability) or “distance” reason– there is no market for the resource which is degraded by the concerned activity
- A negative effect which is paid (tax, regulation) is NO LONGER an externality and creates incentives to **innovate in the right direction**
- When non excludability (open access) combines with potential exhaustion of natural resources, private actors decisions can lead to a tragedy of the commons (benefit of an additional action is private, the cost of potential depletion is shared)
- Remedies : regulating the economy

