Natural Resource Economics & Management

Οικονομικά και διαχείριση φυσικών πόρων

Lecture 2

The Economic Approach: Property Rights, Externalities, and Environmental Problems

Chapter 2 The Economic Approach: Property Rights, Externalities, and Environmental Problems

- The Human-Environment Relationship
- Environmental Problems and Economic Efficiency
- Property Rights
- Externalities as a Source of Market Failure
- Improperly Designed Property Rights Systems
- Public Goods
- Imperfect Market Structures
- Government Failure
- The Pursuit of Efficiency
- An Efficient Role for Government

Introduction

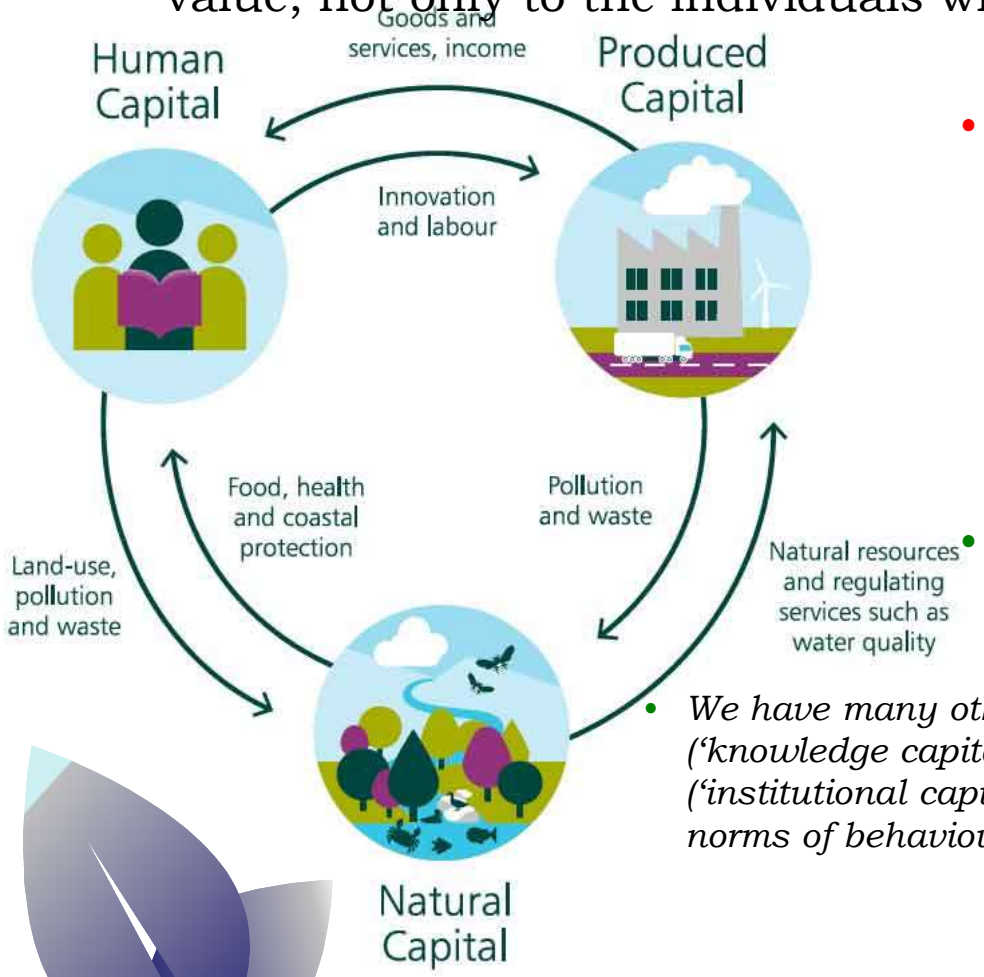
- This chapter introduces the general conceptual framework used in economics to approach environmental problems.

The Human—Environment Relationship

- The Environment as an Asset
  - Closed system vs. Open system
    - Closed system: A system where there are no inputs and no outputs of energy and matter from outside the system
    - Open system: A system which imports or exports energy or matter from outside

The Human—Environment Relationship

- Types of capital: (A) *Produced capital:* (α) assets that are material (tangible) and alienable (i.e. whose ownership is transferable), including roads, buildings, machines and ports; (β) intangible and alienable assets such as patents held by a firm which are part of the firm's asset base and they appear in its balance sheet. *(B)Human capital:* which includes intangible and non-alienable assets such as health, education and skills for which we have discovered ways to measure its value, not only to the individuals who acquire it, but also to society at large.



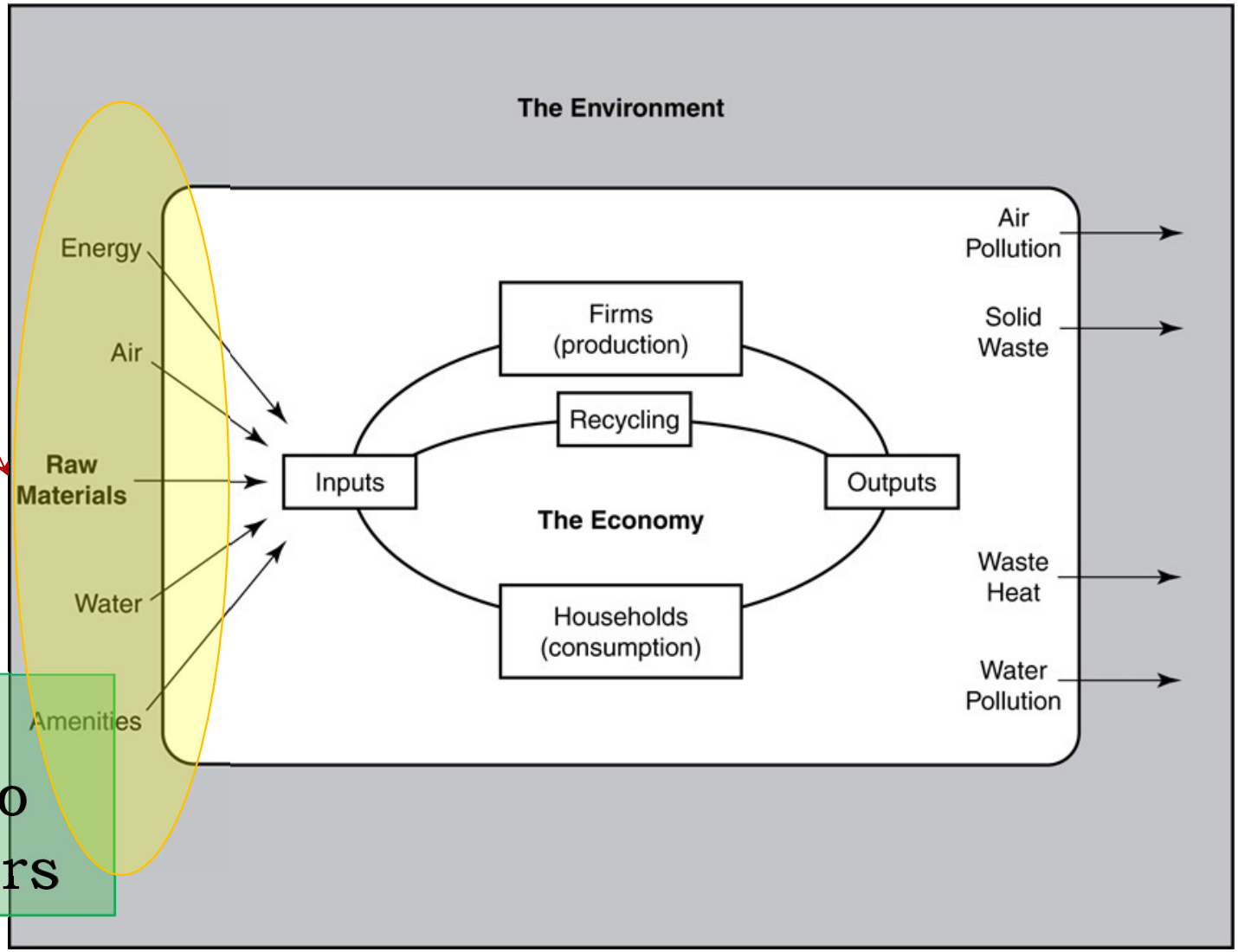
- *(C) Natural capital:* which include various categories with different methods for measuring the values individuals place on them, such as, plants (tangible and alienable), pollinators (tangible and often non-alienable), the view from one's sea-front home (intangible and alienable) and the global climate (intangible and non-alienable).

- Interactions among produced, human and natural capital are depicted in the Figure .

- *We have many other types of capital goods, including public knowledge ('knowledge capital'); the law, the market system, and financial institutions ('institutional capital'); mutual trust and solidarity ('social capital'); culture and norms of behaviour ('cultural capital'); and even religion ('religious capital')./*

The Economic System and the Environment

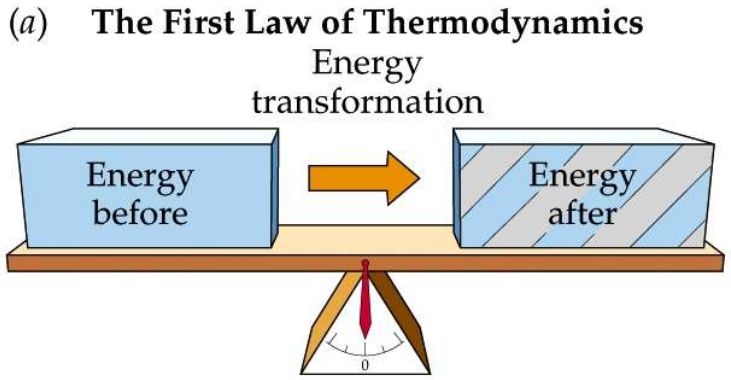
Closed system: all inputs received within the system



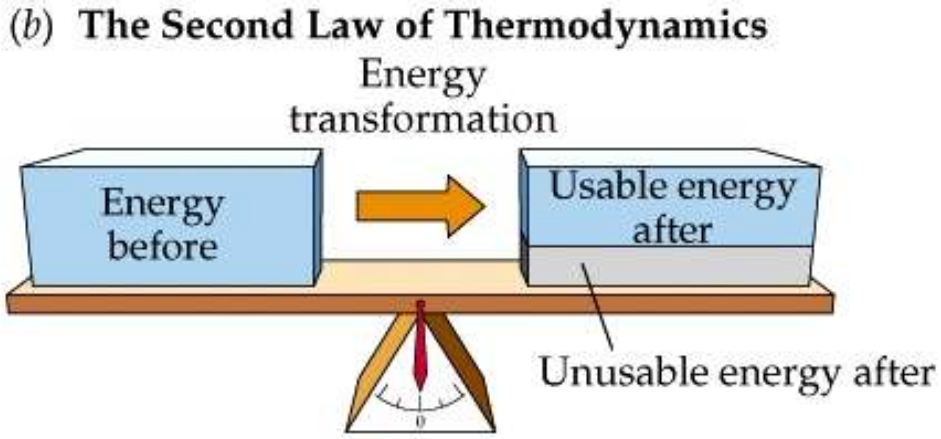
Services directly to consumers

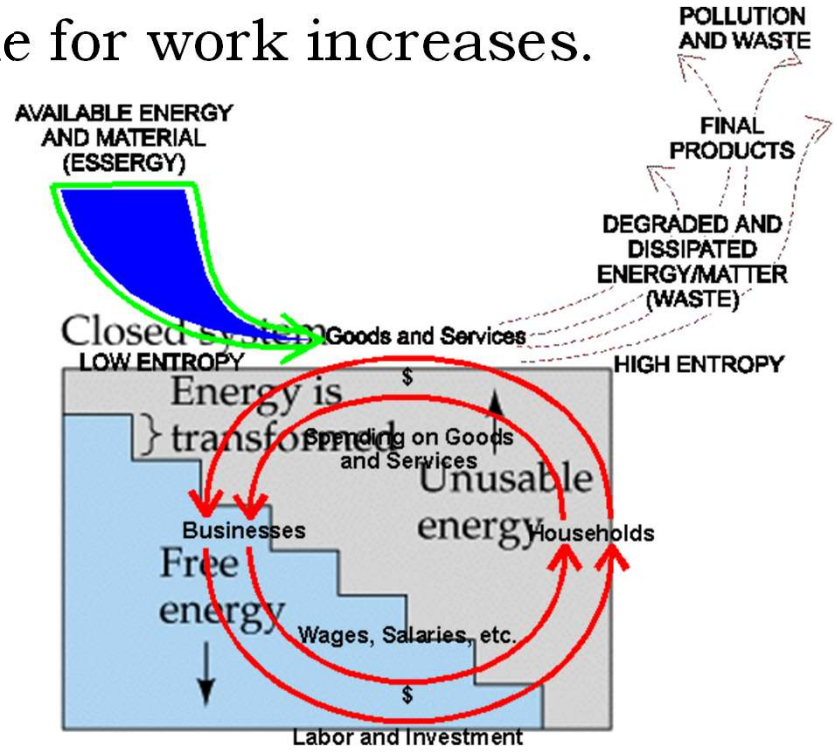
The Human—Environment Relationship

- The first law of thermodynamics
  - Energy and matter can neither be created nor destroyed.



- The second law of thermodynamics
  - The amount of energy not available for work increases.
  - It is also called as entropy law.





The Human—Environment Relationship

- The Economic Approach
  - Positive Economics
    - Describing what is, what was and what will be
  - Normative Economics
    - Attempting to answer what ought to be

Environmental Problems & Economic Efficiency

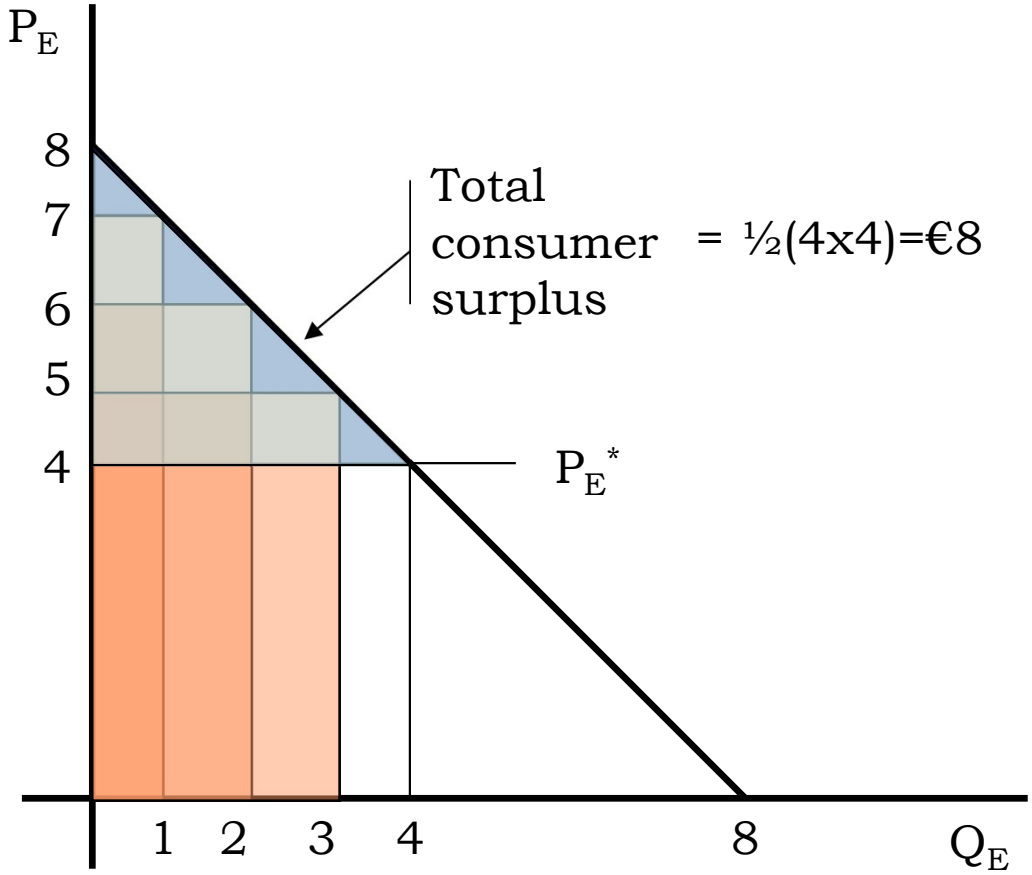
- Static Efficiency
  - Economic surplus is the sum of consumer's surplus plus producer's surplus.
  - An allocation of resources is said to satisfy the static efficiency criterion if the economic surplus derived from those resources is maximized by that allocation.

The Consumer's Choice

– Consumer surplus
  - Consumer surplus is the value that consumers receive from an allocation minus what it costs them to obtain it.

- Market demand representing consumers' willingness to pay

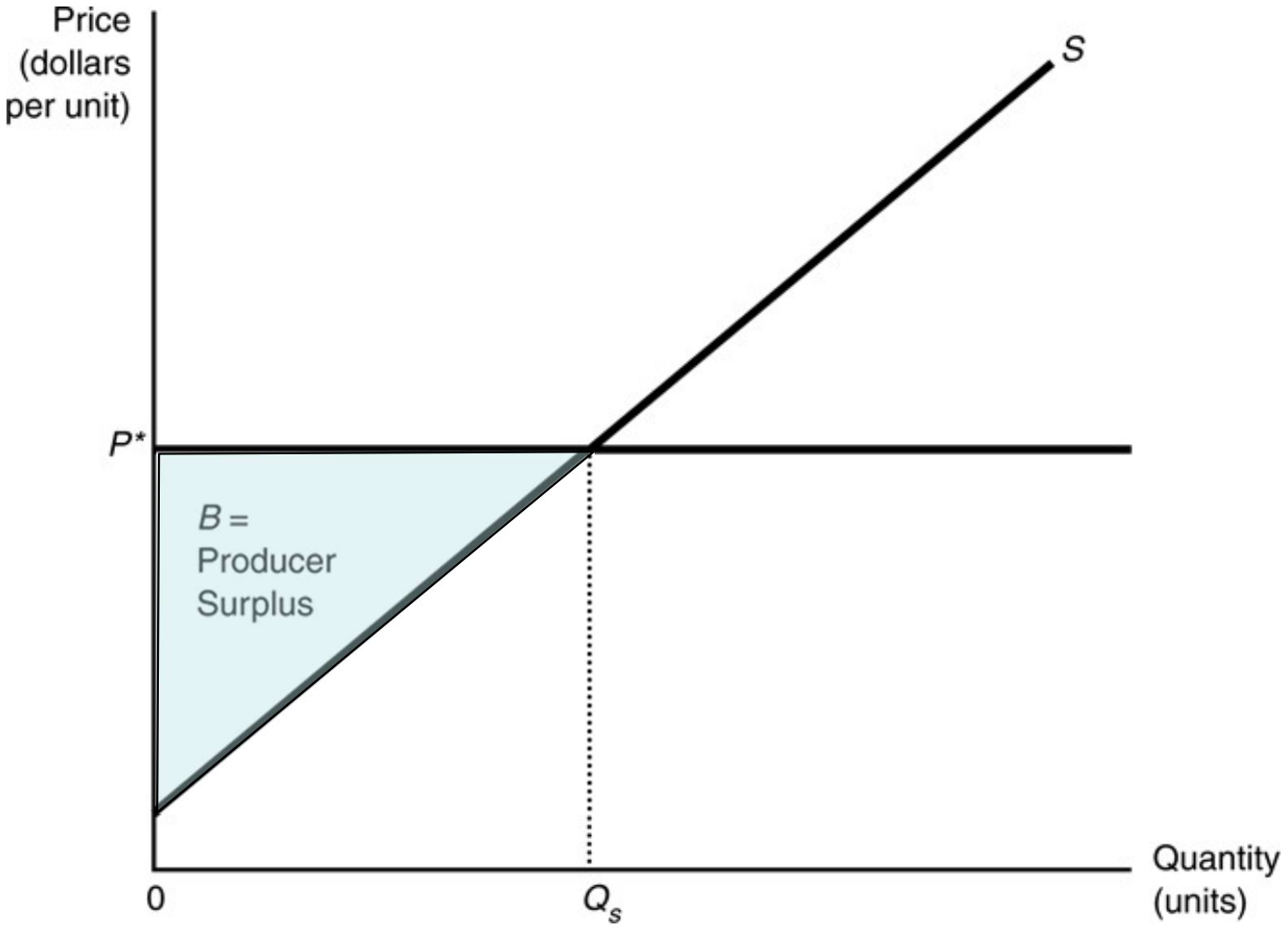
  Consumer surplus is the excess benefits that consumers receive when purchasing a certain quantity of a product at a certain price



The Producer's Choice

– Producer surplus

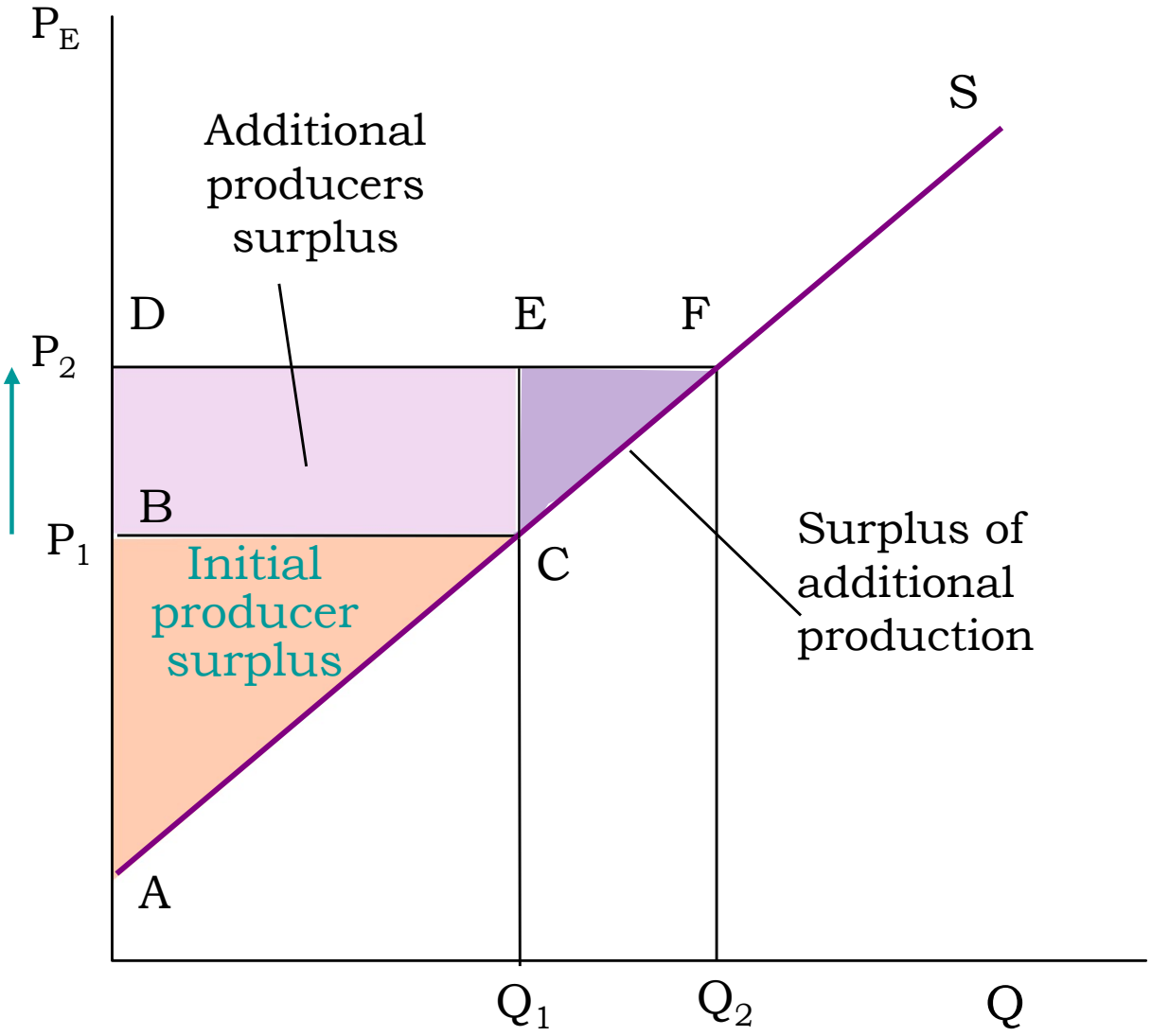
- Given price P*, the seller maximizes his or her own producer surplus by choosing to sell Qs units.
- The producer surplus is designated by area B, the area under the price line that lies over the marginal cost curve, bounded from the left by the vertical axis and the right by the quantity of the good.



The Producer's Choice

- Market supply representing producers' willingness to supply

Producer surplus is the firm's total revenue (*TR*= *PQ*) net of costs (*VC*, area under the curve)



Property Rights

A bundle of entitlements defining the owner's rights, privileges, and limitations for use of the resource.

Property Rights

- Property Rights and Efficient Market Allocations
- Efficient Property Right Structures
  - Exclusivity—All the benefits and costs should only accrue to the owner.
  - Transferability—Property rights should be transferred to others.
  - Enforceability—Property rights should be secure from seizure or encroachment.

Market Equilibrium

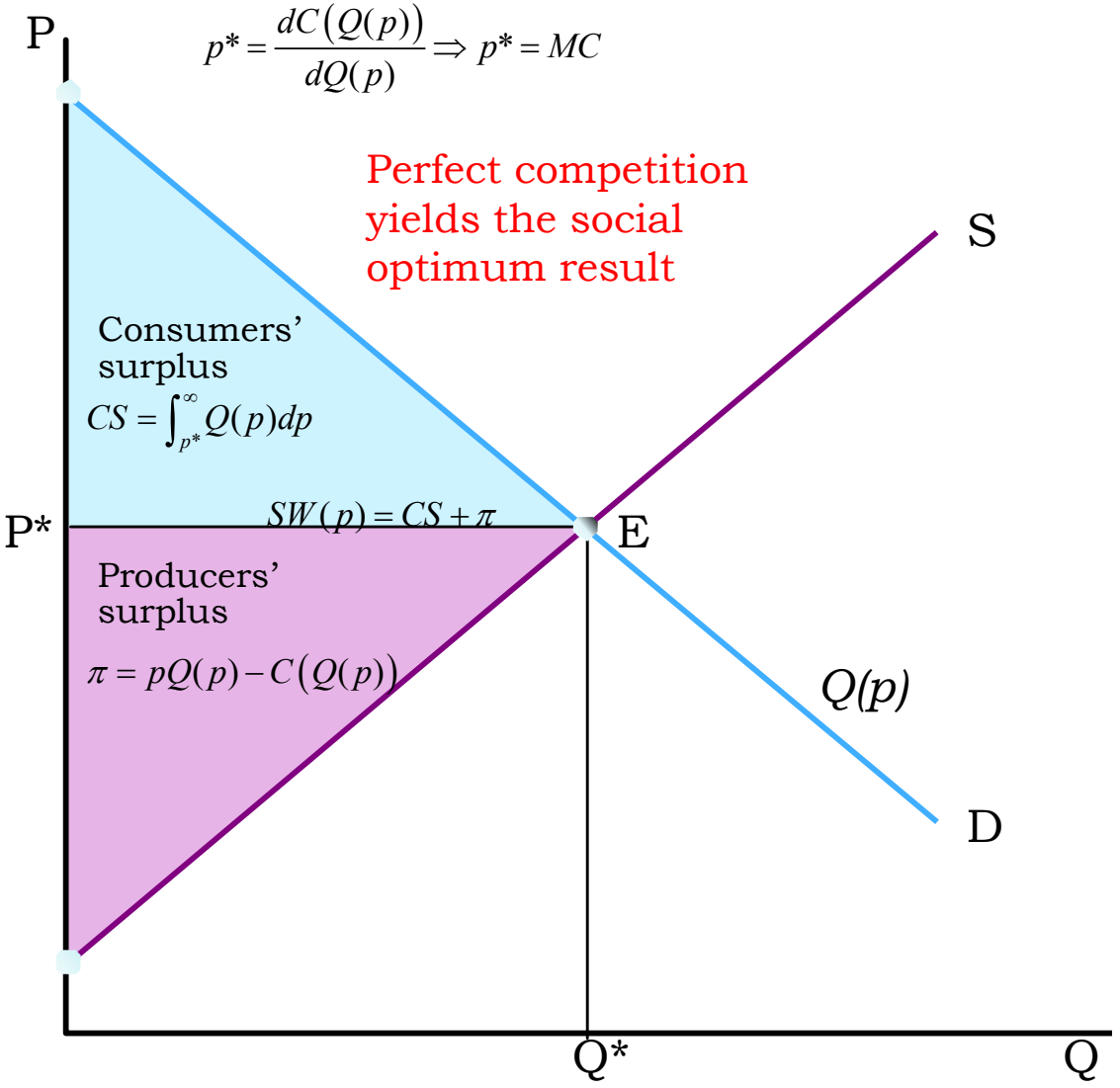
- Competitive equilibrium

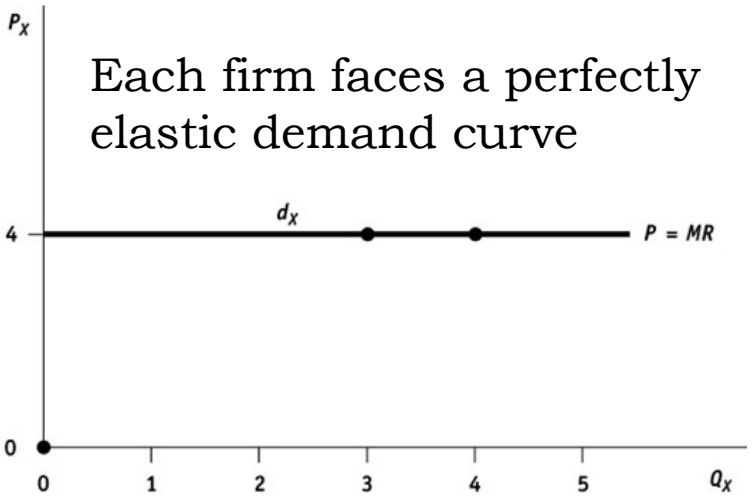
Under perfect competition, no seller or buyer has the power to influence the price, thus, each takes the price as given

$$\frac{dSW(p)}{dp} = \frac{dCS}{dp} + \frac{d\pi}{dp} = 0 \Rightarrow$$

$$-Q(p^*) + Q(p^*) + p^* \frac{dQ(p)}{dp} - \frac{dC(Q(p))}{dQ(p)} \frac{dQ(p)}{dp} = 0 \Rightarrow$$

$$p^* = \frac{dC(Q(p))}{dQ(p)} \Rightarrow p^* = MC$$





Property Rights

- Producer Surplus, Scarcity Rent, and Long-Run Competitive Equilibrium
  - In the short run, producer surplus = profits + fixed cost.
  - In the long run, producer surplus = profits + rent.
  - Under perfect competition, long-run profits equal zero and producer surplus equals rent.
  -
- Scarcity Rent (return to scarce inputs)
  - Scarcity rent is the producer surplus which persists in the long-run competitive equilibrium.

Externalities as a Source of Market Failure

- The Concept Introduced
  - Externalities exist whenever the welfare of some agent depends not only on his or her activities, but also on activities under the control of some other agent.

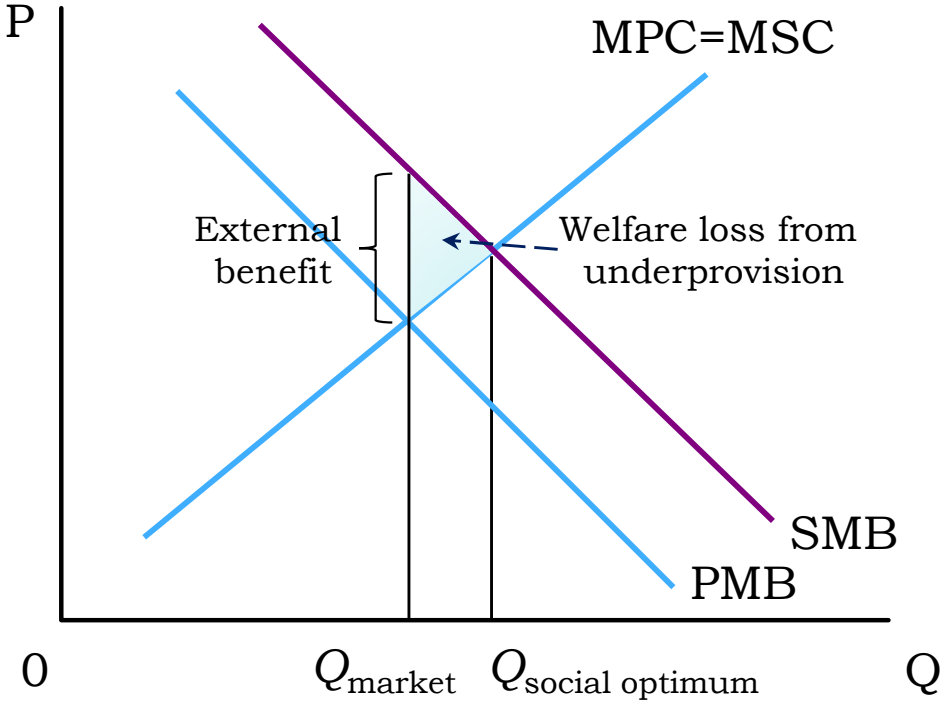
Externalities

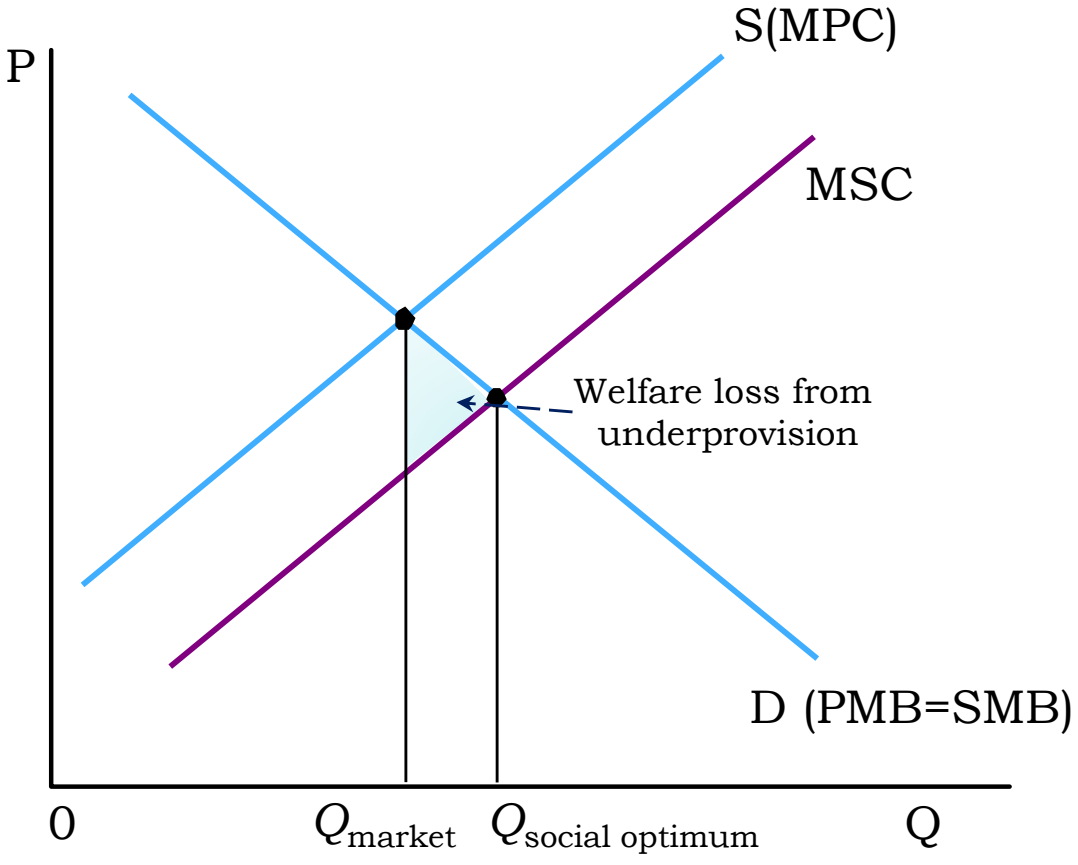
In economics, an externality (or transaction spillover) is a cost or benefit, not transmitted through prices.

An economic agent, whose actions affect other agents' utility (positively or negatively) does not bear the full cost of its actions.

Thus, its actions are based on its private and not the social cost (or benefit) and thus, yield higher or lower levels relative to the social optimum.

Positive externalities (markets underprovide the good)

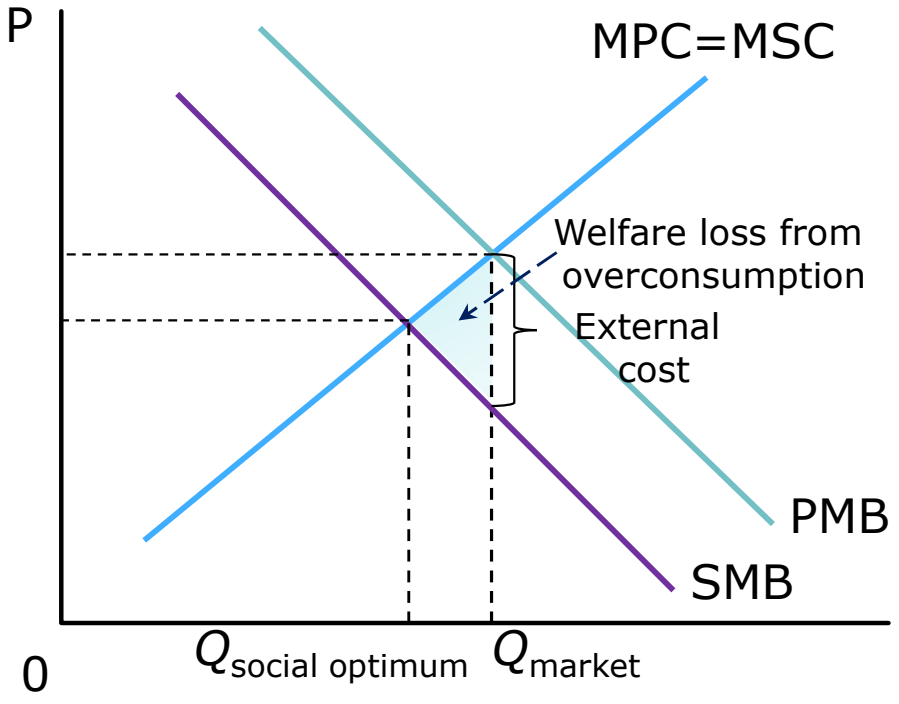


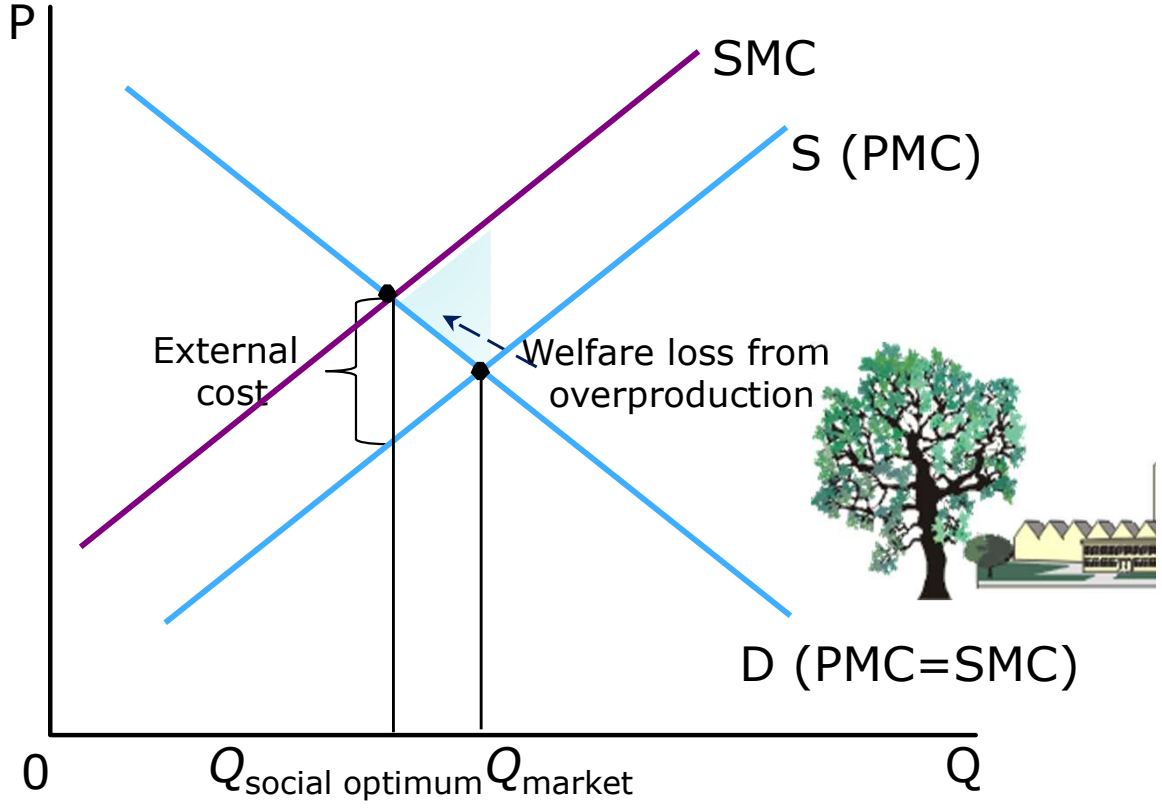


Externalities

Competitive markets consider the private costs (or benefits) of supplying a good, and thus, the equilibrium output will higher than the social optimum. In consequence, the markets fail to provide the proper price signal and they use scarce resources in an inefficient way.

Negative externalities
(markets overprovide the good)





Internalizing externalities

In order to internalize externalities, government intervention is required. This intervention can take a number of forms.

Taxonomy of regulatory instruments (policies):

		Price	Quantity	Technology
Incentive (economic)	Direct	Emission tax	Tradable emission permits	Technology tax on presumed emission
	Indirect	Fuel tax	Tradable production permits	Subsidise R&D, fuel efficiency
Non-incentive (regulation)	Direct	–	Emission standards	Technical standards
	Indirect	–	Product standards, bans, quotas	Efficiency standards

Source Levinson and Shetty (1992)

One should also consider policies that aim at changing consumers' choices (public advertisement)

Direct Regulatory approach (command and control)

Direct regulation of economic activities in order to reduce emission levels at the social optimum level. These policy instruments are usually referred to as command and control instruments, since the government sets rules detailing the acceptable behavior and then monitors economic agents compliance, threatening with penalties.

Types of direct regulation:

- Ambient air quality standards
  (ambient air quality standards specify the upper limit of concentrations of pollutants in a specific area)
- Industrial emission standards
  (specify the maximum limits of pollution from industrial activities and are specified for each type of activity and pollutant)
- Process / performance standards
  (specify the minimum performance requirements)
- Fuel quality standards
  (specify the minimum quality of fuels)

Improperly Designed Property Rights Systems

- Other Property Rights regimes
  - Private property regimes
    - Individuals hold entitlements.
  - State-property regimes
    - Governments own and control property.
  - Common-property regimes
    - Property is jointly owned and managed by a specific group.
  - Res nullius or open access regimes
    - No one owns or exercises control over the resources.
  - Common pool resources— characterized by non-exclusivity and divisibility.

Spectrum of goods

Exclusivity?	Rival in consumption? (jointness of supply): Yes	Rival in consumption? (jointness of supply): No
Yes	Pure private goods • Oil, gas electricity • Clothes, food, etc • Congested roads with tolls	Quasi public (natural monopolies) • Private beach • Satellite TV • Non-congested roads with tolls
No	Quasi private (Common Property Resources) • Fish stocks, ground water • Oil reservoirs • Congested roads without tolls	Pure Public Goods • National defense, police • Flood control systems, street lighting, air(?) • Non-congested roads without tolls

Consumption of a good is rival when its consumption by one does not leave others to consume the same. Jointness of supply is related to the cost of supply of a good. Once a good is made available, if an additional unit can be supplied at no additional cost (i.e. the marginal cost of supply is zero), the good is said to be non-rival or joint.

Exclusivity on the other hand relates to the possibility of excluding potential consumers, often through pricing mechanism. The source of this problem is often technological (with the available technology it may be extremely costly to exclude potential consumers). But there are cases where it may be impossible to do so. For example, it is impossible to exclude someone from breathing air.

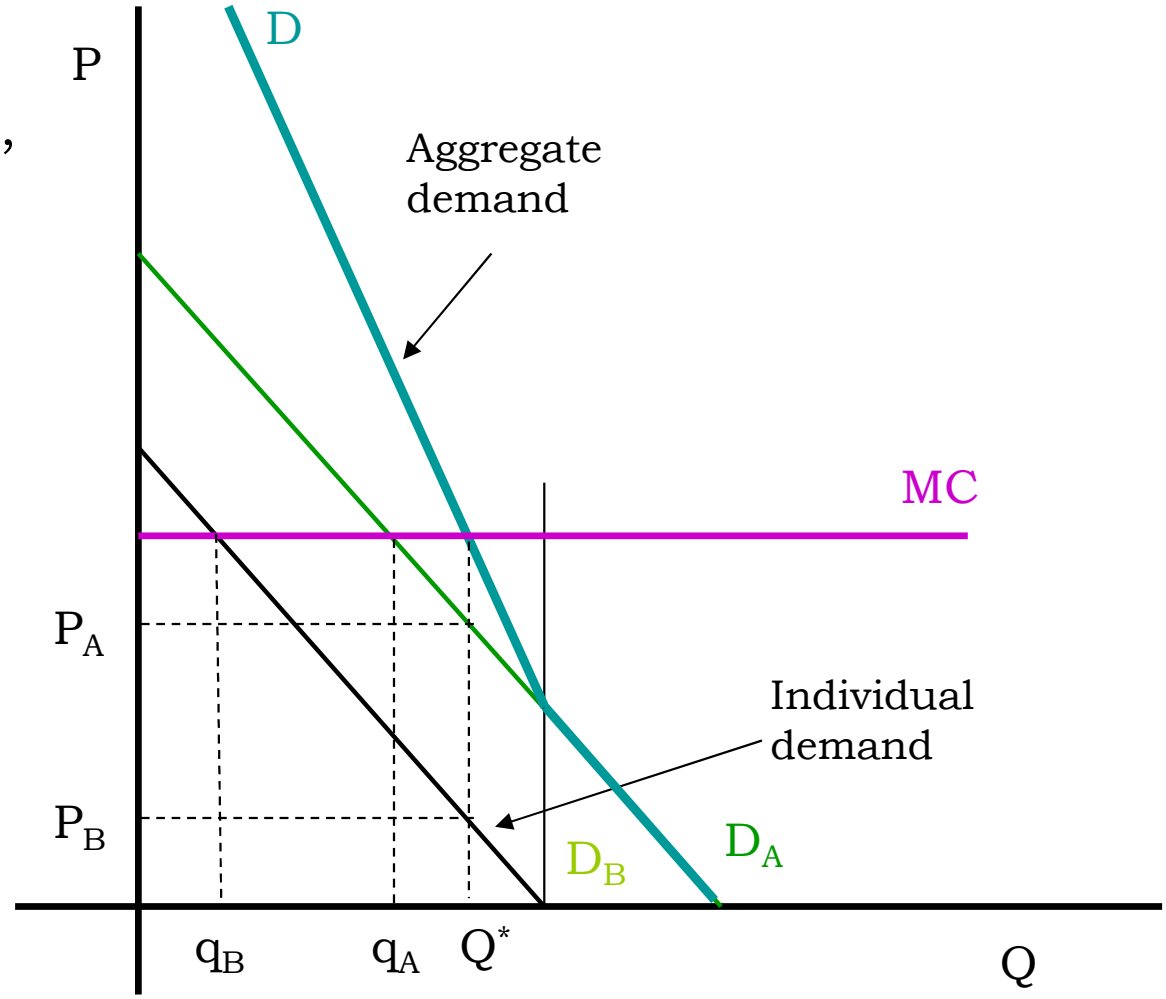
Pure public goods

- Since they are non-rival in consumption and non-exclusive, it is impossible to provide them through the market.

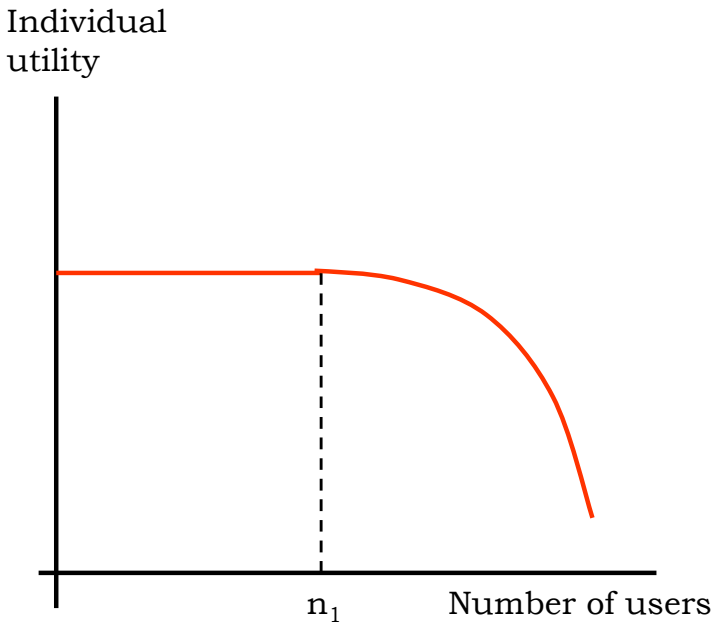
  – A good or service that has value it cannot be priced. Since nobody can be excluded from using the good or service, people derive benefits without paying (free-riding).

  – Thus, no private firm has any incentive to provide these goods and services.

  – The government should step in to provide pure public goods when benefits exceed costs.



Pure and quasi private goods



Semi-non-rival: Pure public good up to n_1 but after that is subject to congestion

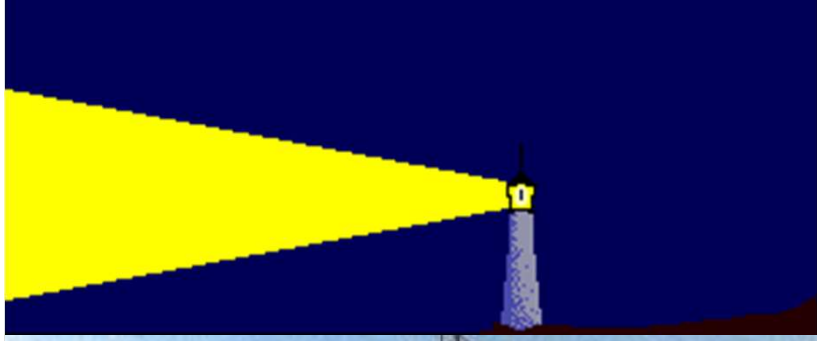
The graph shows the utility an individual derives from a good as the number of users increases.

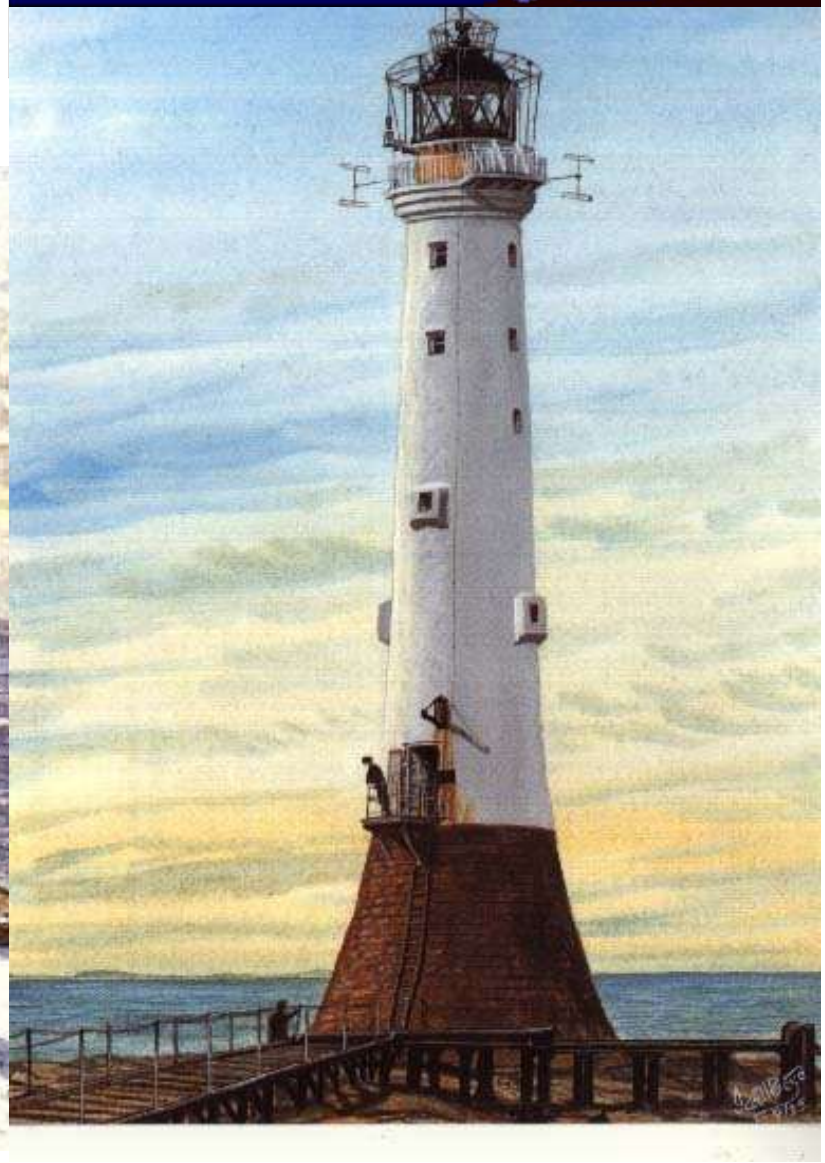
Up to a number of users n_1, this good is a pure public good, in the sense that individual utility is constant as n increases (non-rival in consumption).

However, if the number of users increases further, the good gets quasi private characteristics (common property resource) and it will be overconsumed if its price remains zero.

Example: up to a point, extra consumers using a park, beach or road do not reduce the amount of the product available to other consumers. Eventually additional consumers reduce the benefits to other users. Beaches become crowded as do parks and other leisure facilities.

Are lighthouses pure public goods?



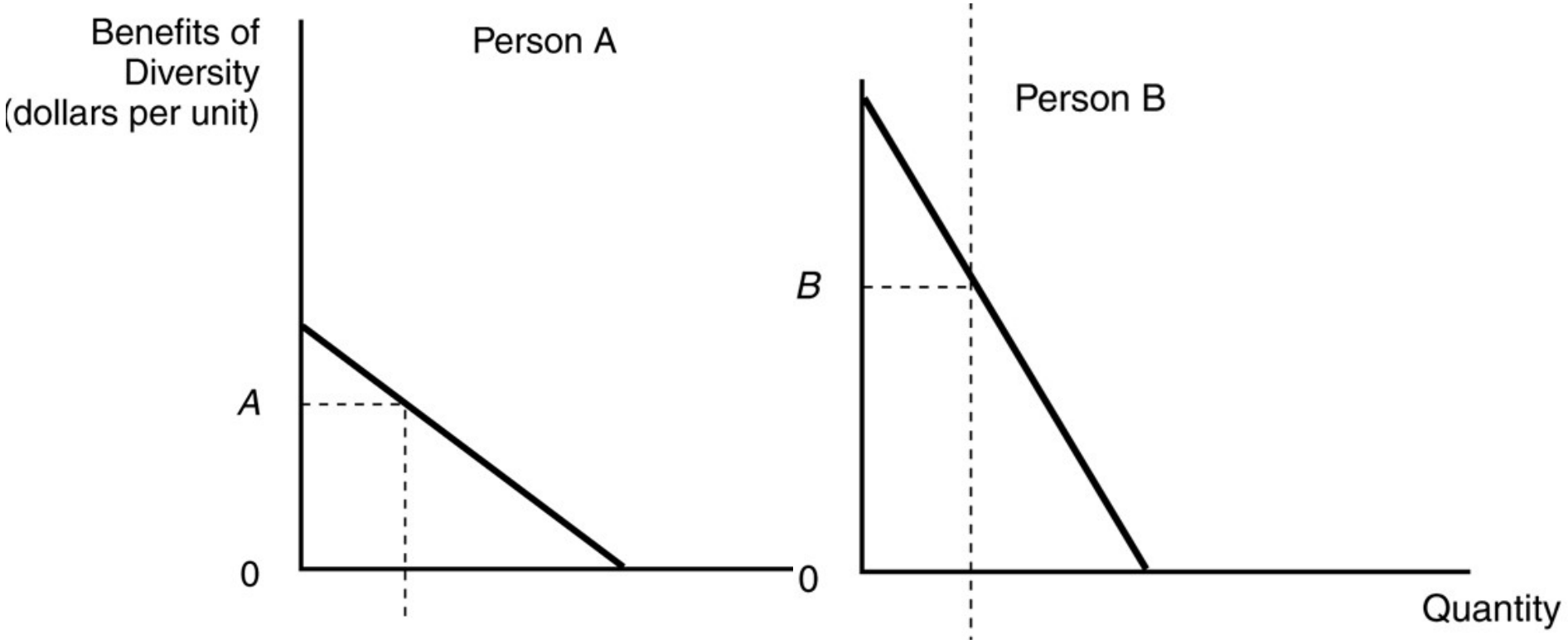


Public bads

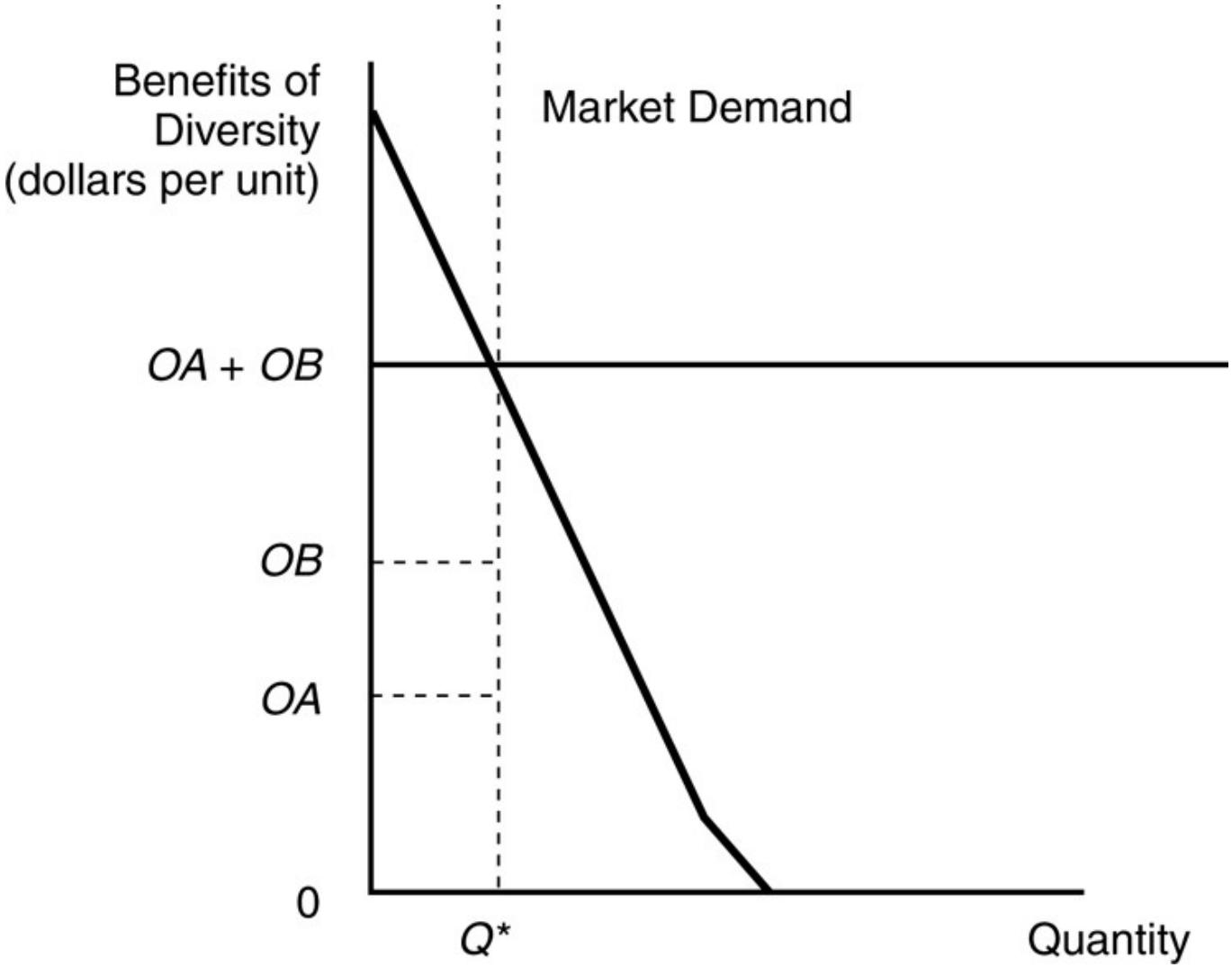
- A public bad is the opposite of a public good – it provides disutility or dis-satisfaction to people when consumed and therefore reduces our economic welfare. A good example to look at would be the disposal of household and commercial waste.
- People are normally prepared to pay a price for their household waste to be collected and disposed of in a safe and non-polluting way. But if waste was charged for according to how much had been generated, then some people would find an incentive to dump their waste on other people's property and thereby avoid direct charges.

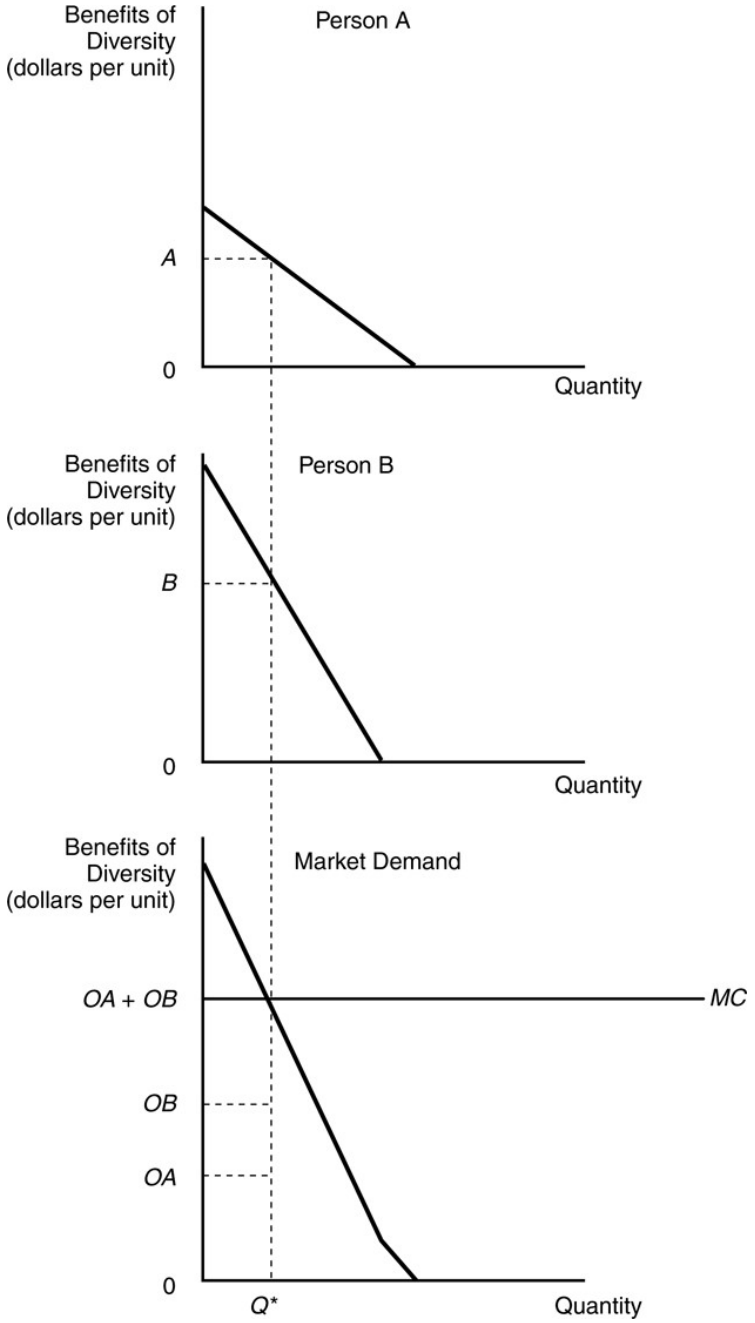
- "…Public-goods governance certainly had its moment. … Today, however, a new frontier of public policy, characterized by the mitigation of public bads, has emerged. Governments have shifted their attention away from building highways … to protecting us from harming one another… More than ever, governments supervise and referee a variety of interpersonal behaviors and public transactions that were once governed solely by the self-restraint of personal courtesy and social mores. … In fact, the increased public demand for reducing negative externalities … is altering the role of government and the public's understanding of that role."
- Badlands, by Thomas Schaller, http://economistsview.typepad.com/economistsview/2007/12/public-goods-an.html

Efficient Provision of Public Goods



Efficient Provision of Public Goods





Public Goods

- Efficient level of diversity
  - The efficient allocation maximizes economic surplus, which is represented geometrically by the portion of the area under the market demand curve that lies above the constant marginal cost curve. The allocation that maximizes economic surplus is Q*, the allocation where the demand curve meets the marginal cost curve.

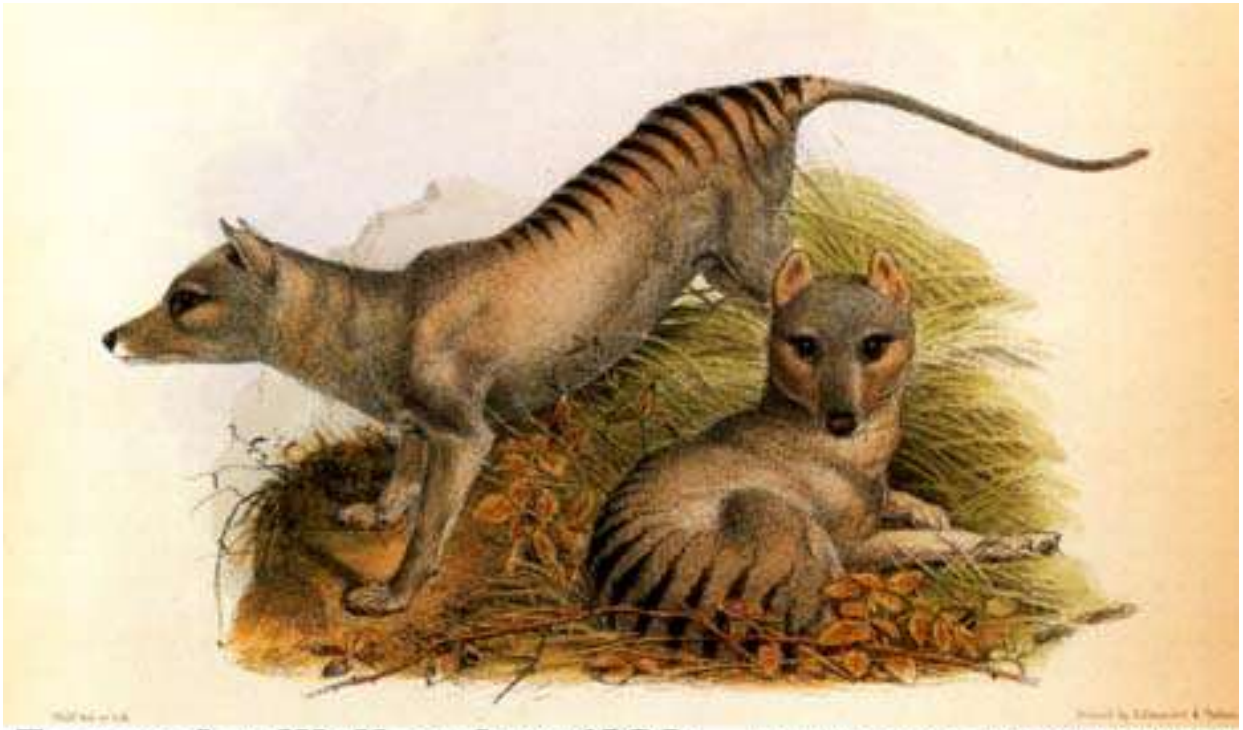
Common property resources

- Common property resources, are non-excludable, so anybody can use them freely, leading to overconsumption.
- However, these resources are also rival in consumption, which implies that as one person uses the resources, it decreases the utility of the rest of the people.
- This situation has been termed as the "tragedy of the commons" Garrett Hardin, *Science*, 162 (1968), 1243-1248.

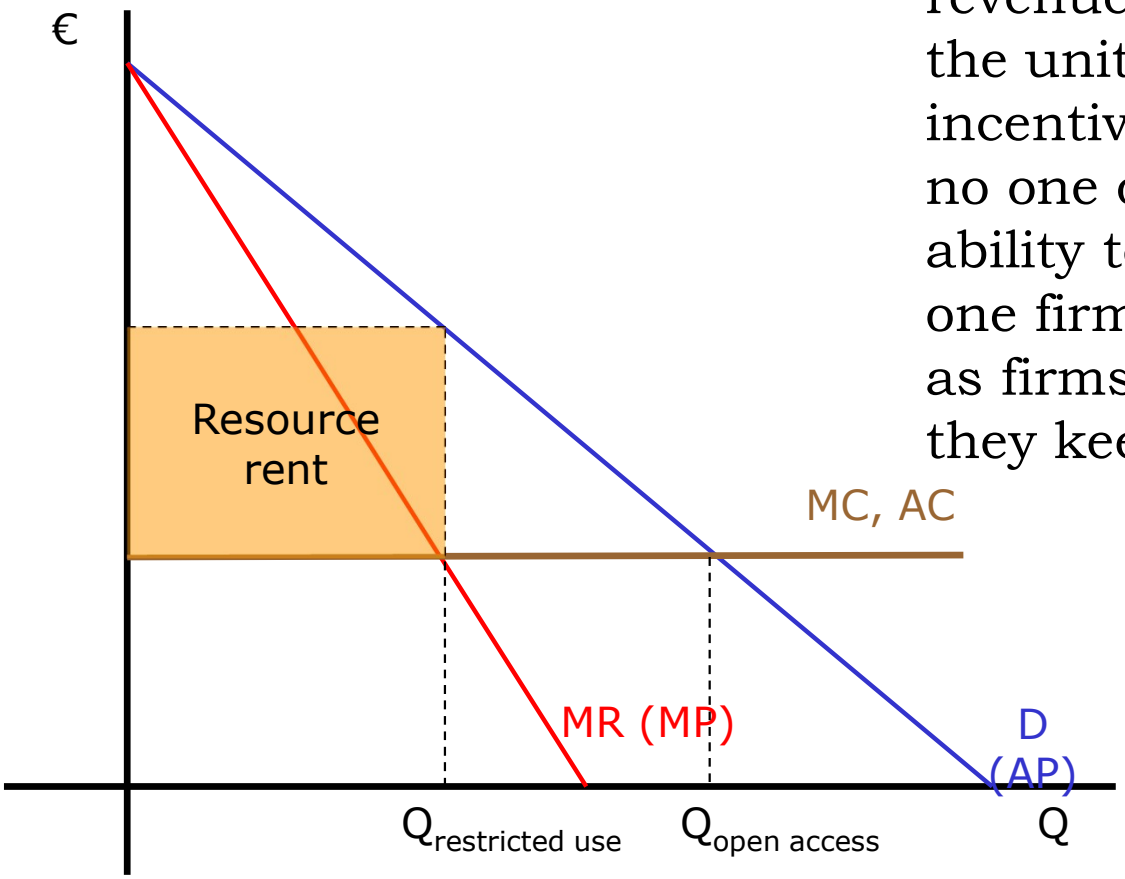
- At the root of the tragedy is the unrestrained self-interest of some individuals. The underlying reasoning is that if the commons is eventually going to be used up, whoever effects the greatest use stands to benefit the most. Under this circumstance, it is seen that the benefit/cost ratio is astronomical: While the benefits accrue solely to the user, the costs are spread among all others sharing the commons.

- The government should step in and define property rights, or directly manage the resource.

Why are cows not endangered?



Property rights



Competitive firms will extract from the resource to the point where the average revenue product of extraction effort equals the unit cost of effort. There is no incentive for any firm to conserve, since no one owns the resource or has the ability to exclude others from it; whatever one firm leaves the next will take. As long as firms can cover their harvesting costs, they keep on harvesting.

- Allocation of property rights restricts the use of the resource and creates resource rents

Responses to challenges

- It is clear that the unprecedented pressures on natural resources and the environment briefly described above, have to be alleviated if we are to sustain a viable future for next generations.

  The necessary actions involve both consumers and producers. At the business level, some voluntary actions are taken, but unilateral voluntary actions are limited since they involve costs and could decrease firms' competitiveness. For the major changes needed, government intervention is necessary and it can take main different forms, considerably affecting the operation of business.

- The society could promote firms' environmentally friendly practices by choosing "greener" products and services, that is, products and services that use environmental management.

  In order to verify the "greenness" of a production process, a number of tools have been created, such as the Eco-labels (for example the EU Ecolabel), and the Environmental Management Standards (for example the ISO 14000 and the EMAS).

The Pursuit of Efficiency

- Private Resolution Through Negotiation
  - The simplest means of restoring efficiency

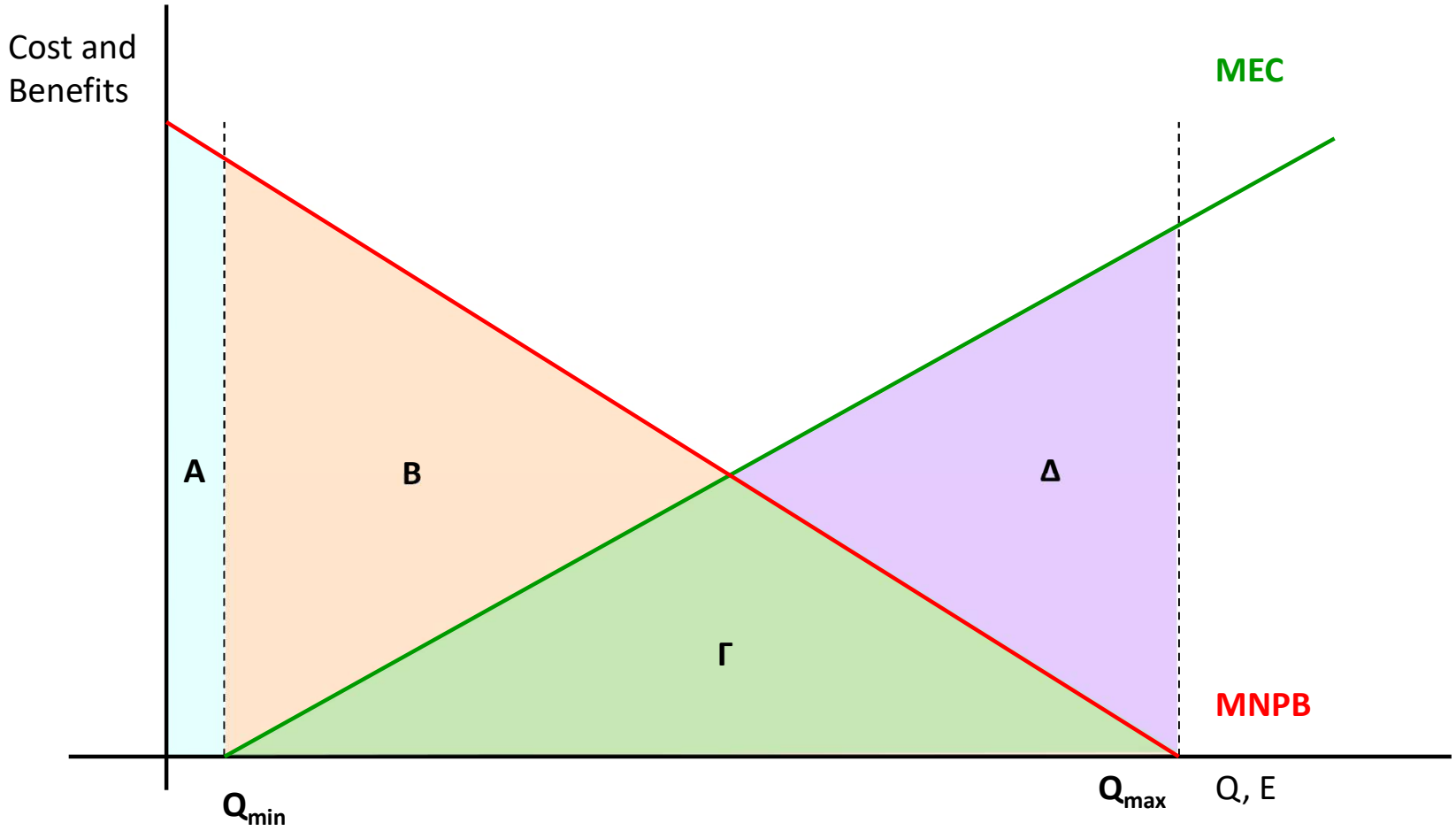
- The Courts: Property Rules and Liability Rules
  - Not well-defined property rights corrected by courts
  - The Coase theorem

The Pursuit of Efficiency

- The Coase Theorem
  - When negotiation costs are negligible and affected parties can freely negotiate, the entitlement can be allocated by the courts to either party and an efficient allocation will result. Only the distribution of costs and benefits among the effective parties is changed.

The Pursuit of Efficiency

- The Coase Theorem



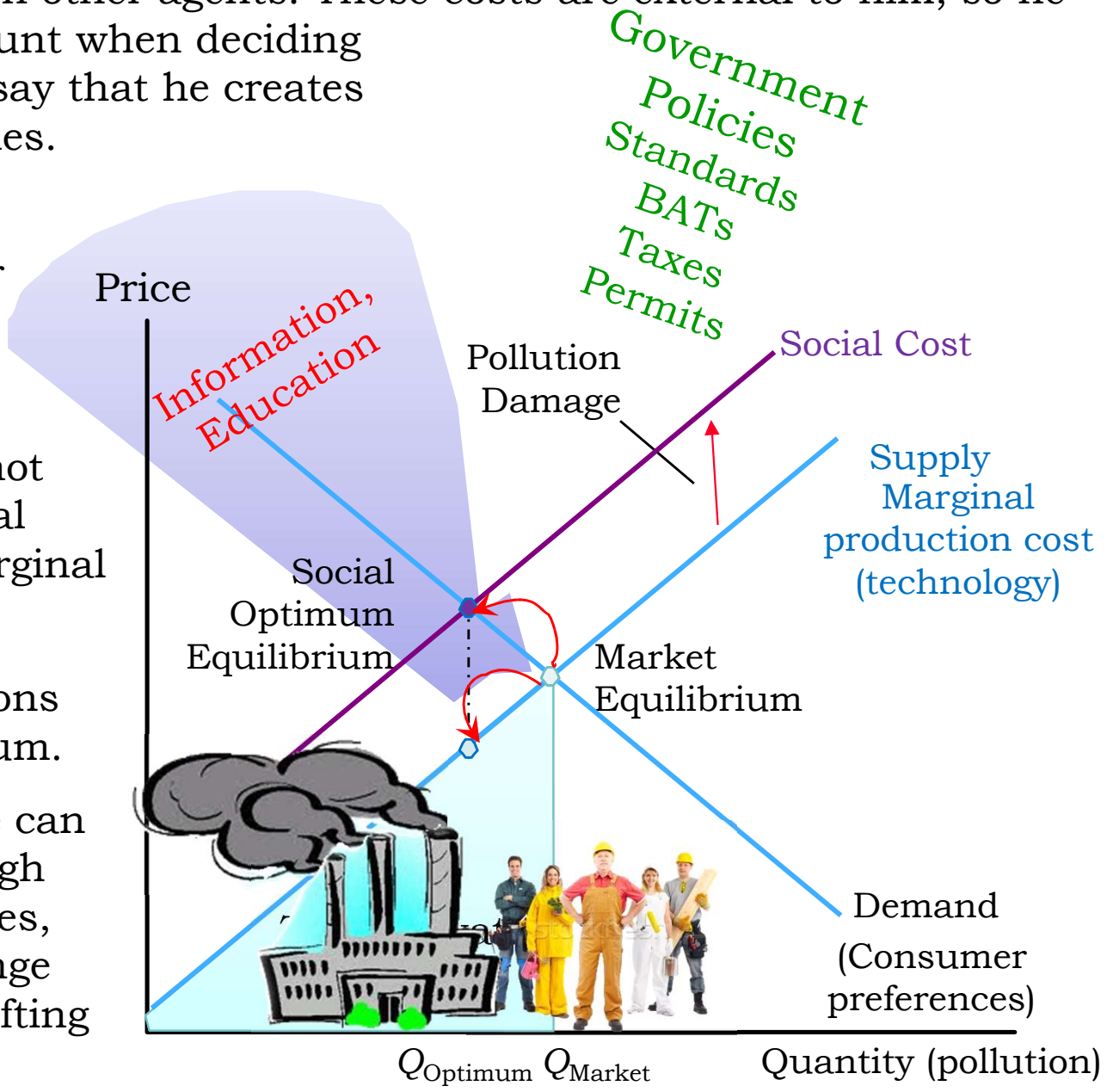
Environmental policies

- From an economic point of view, pollution is a problem whereas an agent, through his actions, imposes costs on other agents. These costs are external to him, so he doesn't take them into account when deciding the level of his actions. We say that he creates external costs, or externalities.

- The result of an externality is that either the demand or the supply (that represent the private marginal benefit (MB_P) and private marginal cost (MC_P) respectively) do not represent the social marginal benefit (MB_S) and social marginal cost (MC_S).

- Thus, private market decisions do not achieve social optimum.

- To reach social optimum we can either change supply (through direct limits, standards, taxes, permits, etc) or we can change consumers' preferences, shifting thus the demand curve.



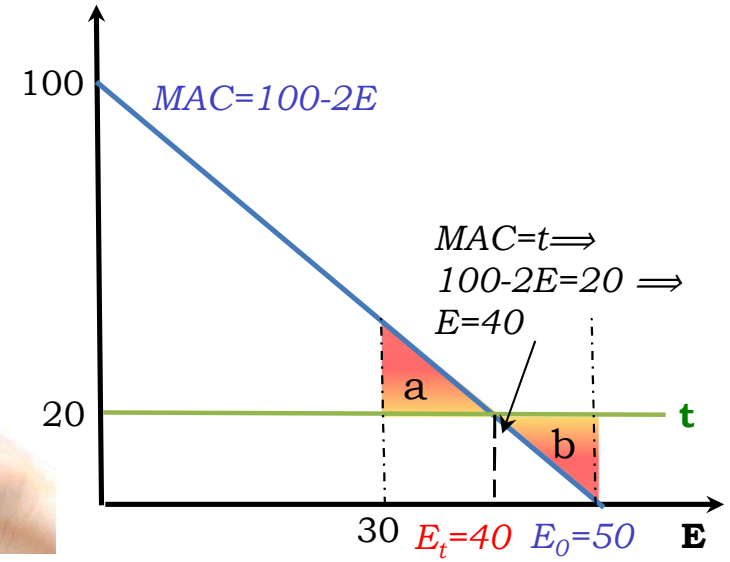
Environmental policies

- Command and Control policies (standards)
- The government directly regulates the level of emission in the economy by setting a target level.
- Types of standards:
  - Ambient Standards: A never-exceed level of pollution in the ambient environment.
    e.g. air pollution in large metropolitan areas
  - Emission standards: A never-exceed level of pollutants emitted from the source.
  - Technology standards: Setting rules about the technology to be used
    - BAT *best available technology*
    - BPT *best practicable technology*
    - BATEA *best available technology economically achievable*

- Advantages
  - Simple and direct.
  - Clearly specified targets.
  - Immediate reduction in emissions
  - Satisfy the public's moral sense (pollution is bad and needs to be controlled).
- Problems
  - Arbitrary allocation of emission's reduction effort among firms.
  - Firms can emit (the amount they are allowed) free of cost (they ignore the damage).

Environmental policies

- Environmental taxes
- The most direct way to control pollution using economic incentives is the use of a tax per unit of pollution (alternatively the use of a subsidy per unit of reduced pollution).
- By levying a pollution tax, the government allows firms to discharge any amount of pollution, but the pollutant has to pay an amount equal to the product of the tax times the units of pollution discharged. (example: a tax per unit of CO_2 emissions).
- An environmental tax forces the firms to acknowledge the cost their pollution imposes on the society and in response reduce the level of its pollution.
- Example: consider a firm that emits $E_0=50$ units of a pollutant that generate social damages. The firm has the option of reducing its emissions at a cost that is increasing the higher is the reduction effort. The cost of each additional unit of abatement is illustrated by the *MAC* line in the graph. Without any government intervention the firm will emit 50 units to minimize costs. If the government imposes a tax $t=20€$, the firm will abate 10 units. This is because it decreases its tax payments by $10x20=200€$, spending $½(10x20)=100€$ in abating these 10 units of emissions. Thus, in the face of a tax, reducing emissions by 10 units saves the firm $100€$ (area b in the graph). There will be no further reduction since it does increase firm's costs.

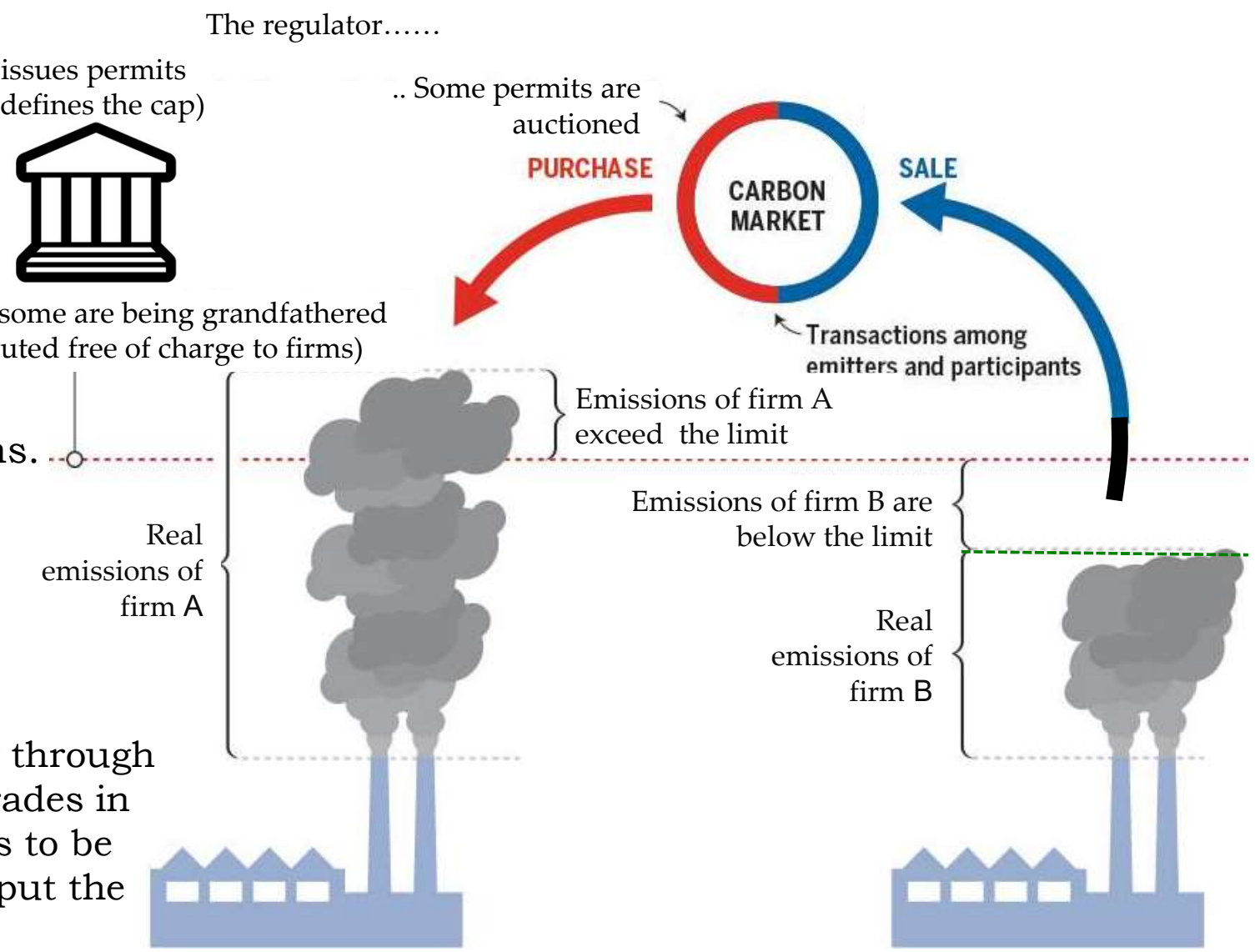


- Advantages
  - Simple and direct.
  - Satisfy the public's moral sense
  - Generates public revenues
- Problems
  - Difficult to determine the tax level

Environmental policies

- Emission Trading Schemes (ETSs)

A Cap and Trade system works as follows: the regulatory authority first specifies the range of activities and the specific installations to be regulated, defines their total level of allowable emissions, assigns allowances to them (specifying the amount of emission per permit) and then distributes them (either free of charge (grand-fathering) or through an auction) to regulated installations. Allowances (permits) can subsequently be traded among installations.

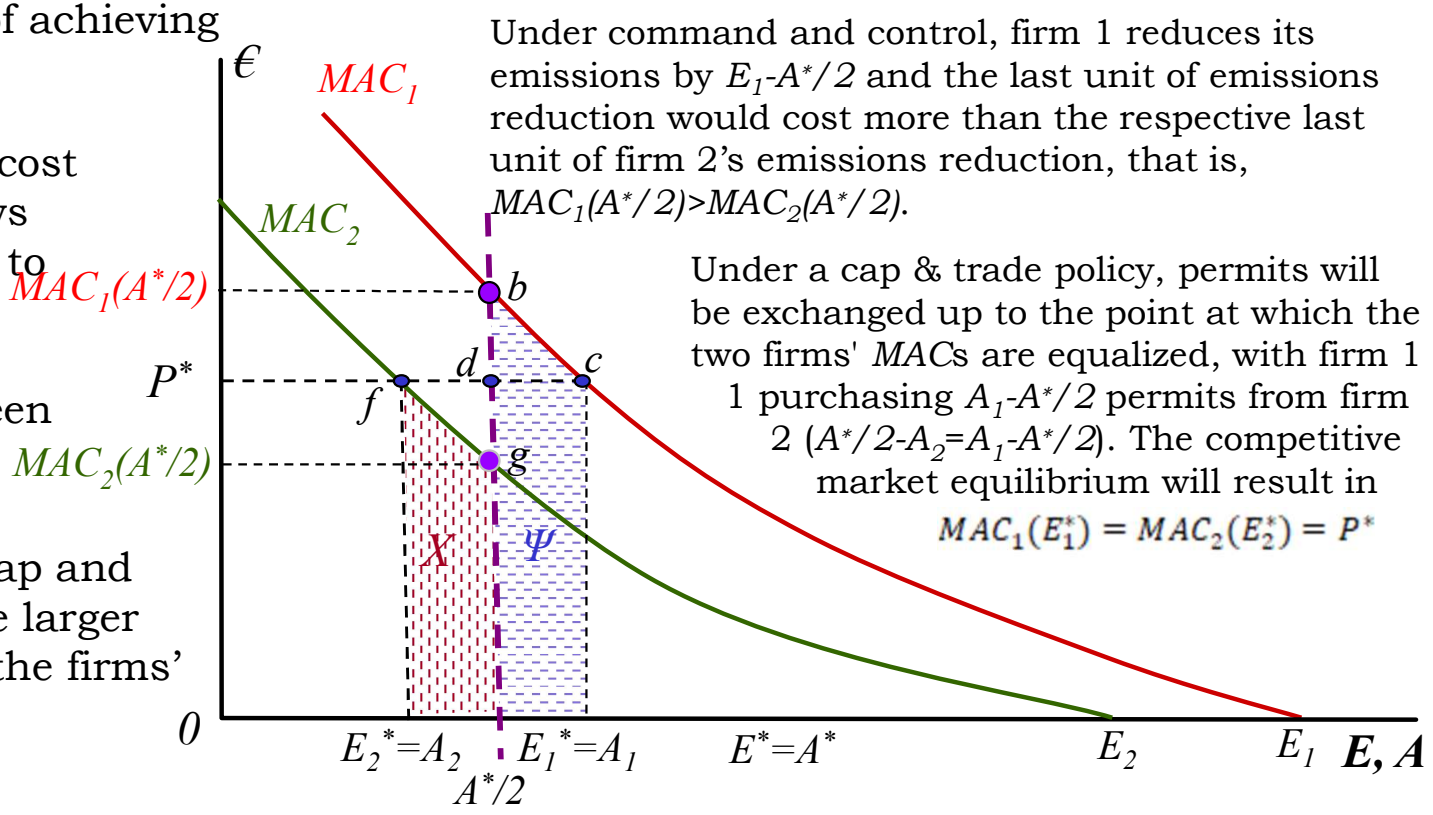


- Efficiency:

trading of permits, either through the auction or through trades in the market, leads permits to be used by the firms which put the highest value on them.

Environmental policies

- Cost efficiency of environmental taxes and cap and trade systems.
- Firms' marginal cost of abatement, $MAC_i(E_i)$, increase as firms engage in higher levels of abatement. Firm 2 is assumed to be more efficient in abating emissions relative to firm 1 (its cost is lower at every level of emission reduction). In the absence of regulation, firms will not engage in abatement and their emissions level will be E_1 and E_2 respectively (at $MAC_i=0$).
- Command and control policy: set emissions limit for each firm at $A^*/2$ units.
- Cap and trade policy: grandfathers $A^*/2$ permits to each firm and allows them to trade them.
- Firm 2 reduces emissions to E_2 freeing up $A^*/2$-A_2 permits at a cost equal to the area X. Firm 1 purchases these permits and decreases its abatement cost by the area Ψ. Since, by simple geometry, $\Psi>X$ (the difference equals the sum of the areas bcd and dfg), it is clear that permits trading reduces the cost of achieving the environmental target.
- Trading permits achieves cost effectiveness since it allows permits to ultimately flow to their highest valued uses. The total efficiency gains equal the difference between areas Ψ and X.
- The efficiency gains of a cap and trade policy are higher the larger is the difference between the firms' cost of abating pollution.



Under command and control, firm 1 reduces its emissions by E_1-$A^*/2$ and the last unit of emissions reduction would cost more than the respective last unit of firm 2's emissions reduction, that is, $MAC_1(A^*/2)>MAC_2(A^*/2)$.

Under a cap & trade policy, permits will be exchanged up to the point at which the two firms' MACs are equalized, with firm 1 1 purchasing A_1-$A^*/2$ permits from firm 2 ($A^*/2$-A_2=A_1-$A^*/2$). The competitive market equilibrium will result in

$$MAC_1(E_1^*) = MAC_2(E_2^*) = P^*$$

The Pursuit of Efficiency

- Legislative and Executive Regulation
  - Several forms taken including taxes and regulatory laws
- An Efficient Role for Government
  - Considering the role of the government in restoring efficiency

The Pursuit of Efficiency

- Efficiency and government intervention
- Can government respond or will rent seeking prevent efficient political solutions?

Government Failure

- Rent seeking
  - Rent seeking is the use of resources in lobbying and other activities directed at securing protective legislation.
  - Examples include agricultural producers seeking price supports and consumer groups seeking subsidies.