



**UCLouvain**  
**Changements climatiques: impacts et solutions**  
**Louvain-la-Neuve, 29 avril 2019**

**Economics and Climate Policy**  
**Focus on EU Emissions Trading System**

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**MOTTO:**

*Prefer to speak true words receiving blame,  
above deceiving advice in soliciting praise*



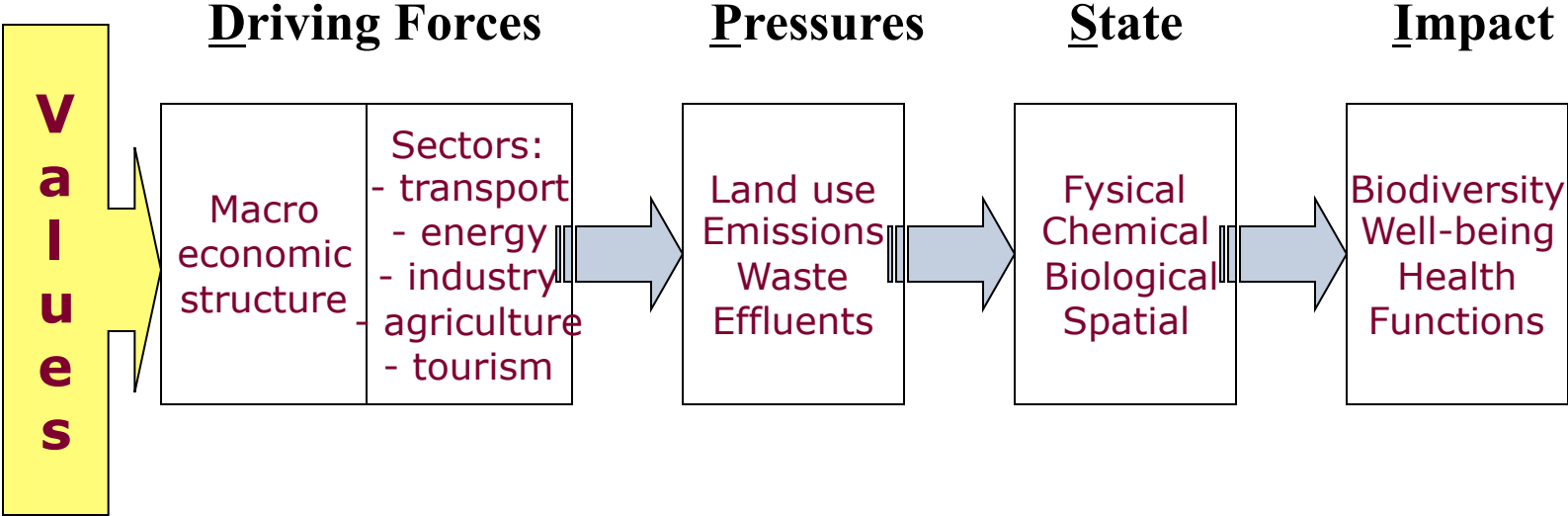
## Overview Lecture (+39 slides)

### **Framework for addressing environmental issues +4**

- 1. Benefits-Costs economics (basics) +5**
- 2. Anatomy of EU ETS (economic instrument) +14**
- 3. Learning (US SO<sub>2</sub> policy; EU's Tradable Green Certificates) +3**
- 4. Reality check on carbon prices +10**
- 5. Evaluation & Future +3**

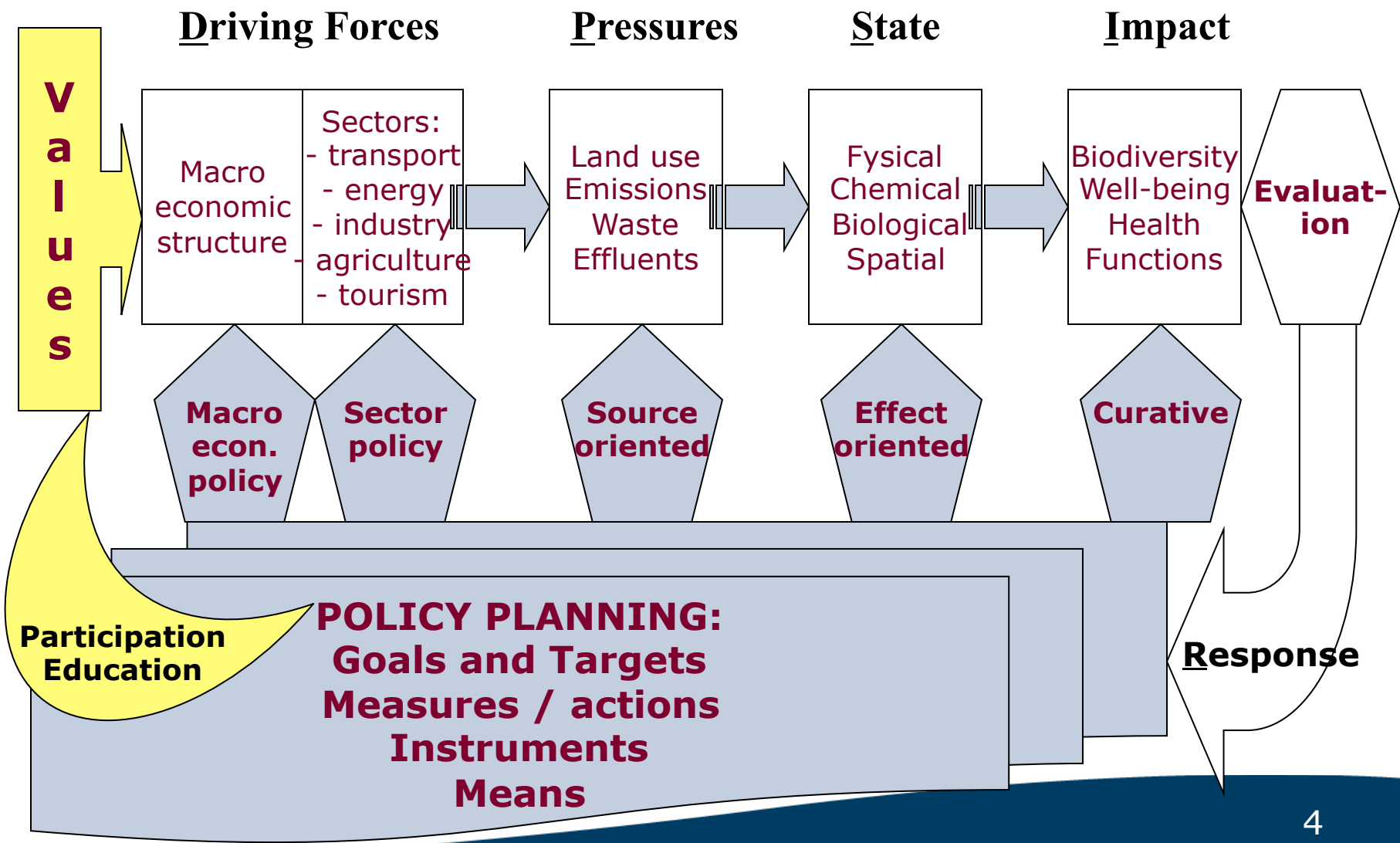


Causal logic D-P-S-I

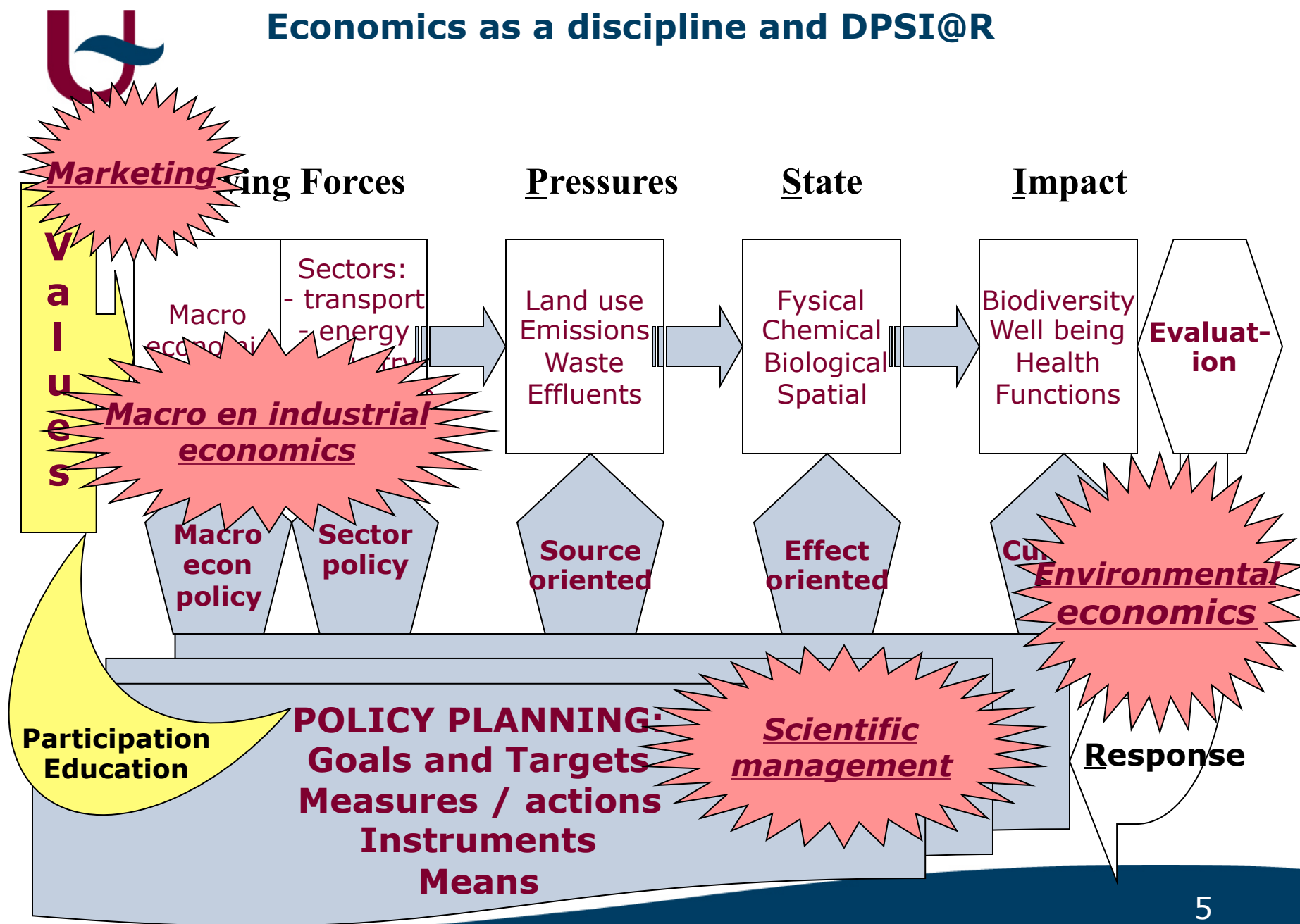




# Closing the cycles DPSI@R

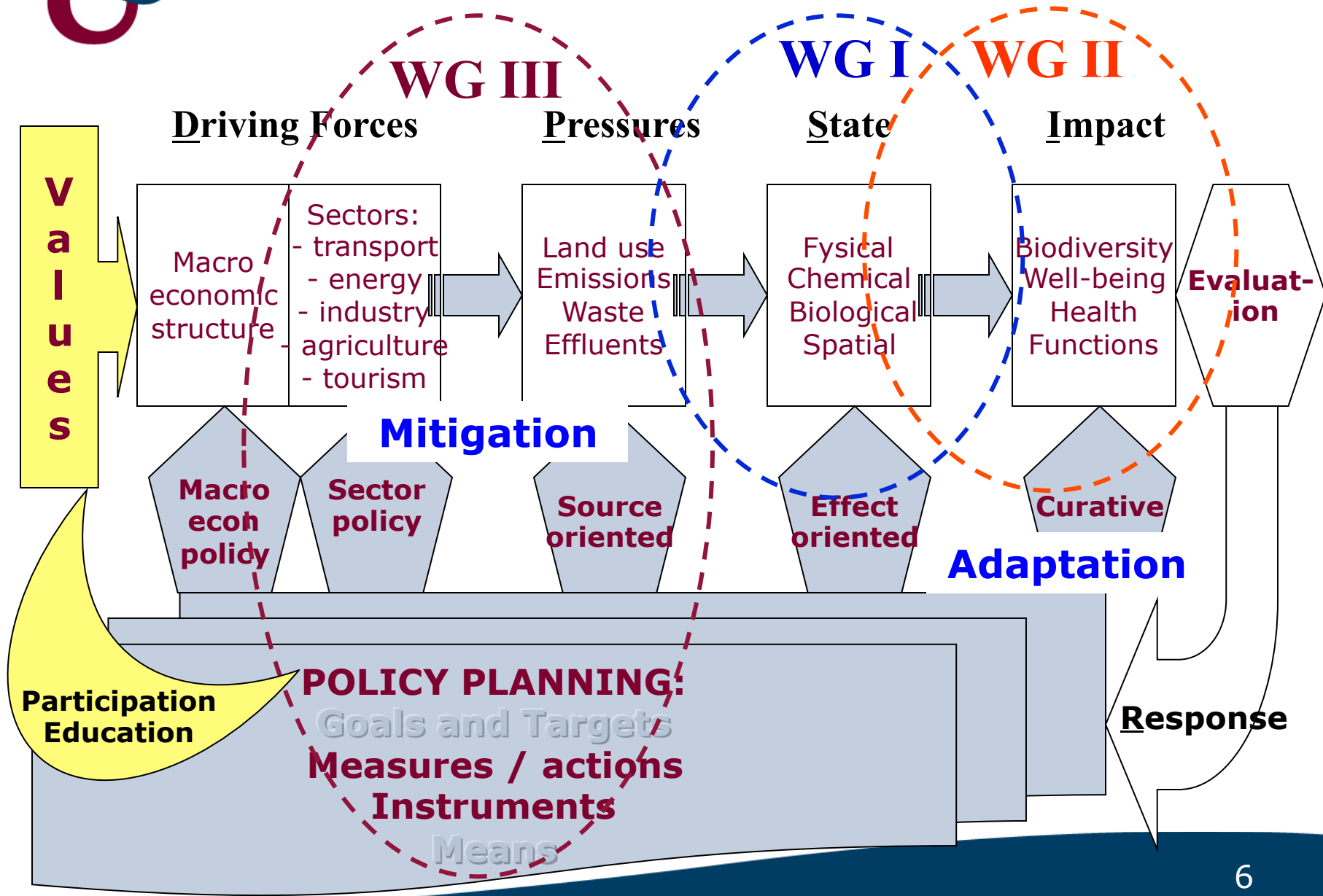


# Economics as a discipline and DPSI@R

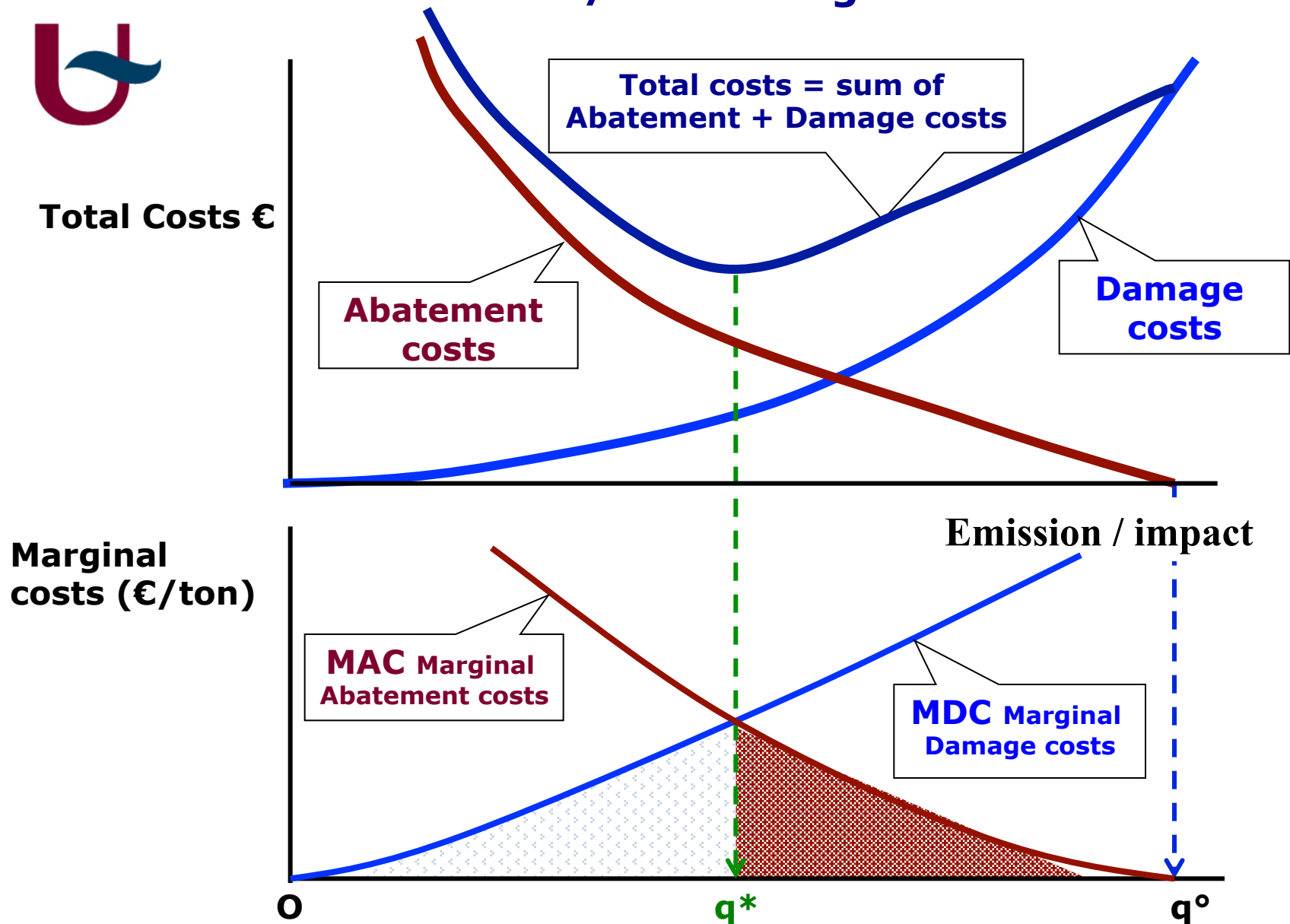




# IPCC and climate DPSI@R



## Cost/Benefit logic dominates





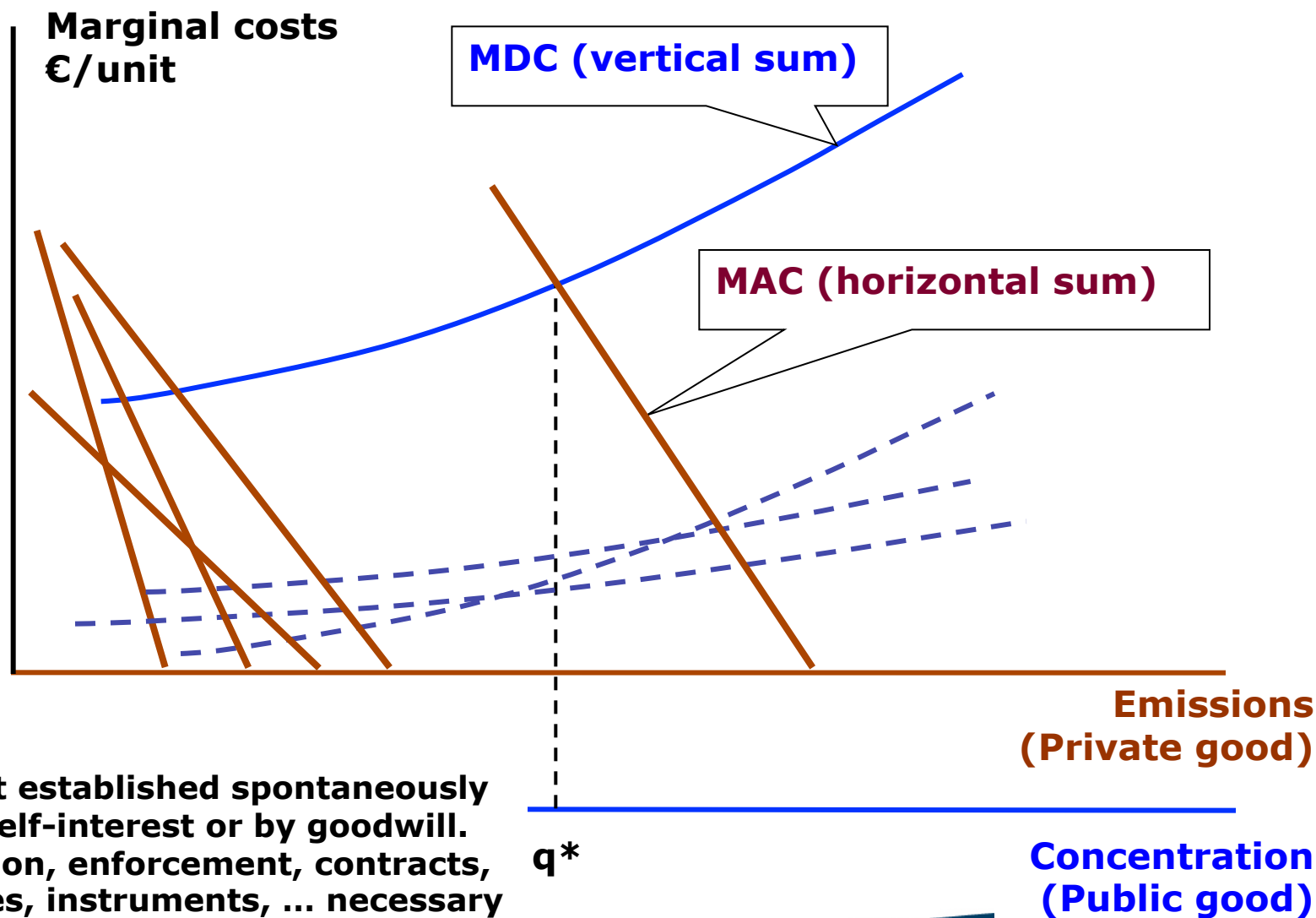
## Abatement (private) ⇔ Damage (public)

- **Abatement (mitigation, compliance)**
  - Investment in emission reduction technology
  - Operational costs of installations
  - Transaction costs
  - Fuel and material substitution
  - Loss in output➤ with reduction of emissions ( $q^0 - q$ ) tons
- **Damage costs ← reduced damage = benefits**
  - Loss of amenities, well-being, beauty
  - Material damage to buildings, crops, etc.
  - Health impacts and risks (mortality, morbidity)
  - Loss of nature, biodiversity
  - Cost of protection and compensation
  - Adaptation costs➤ with higher concentration of GHG (ppm)

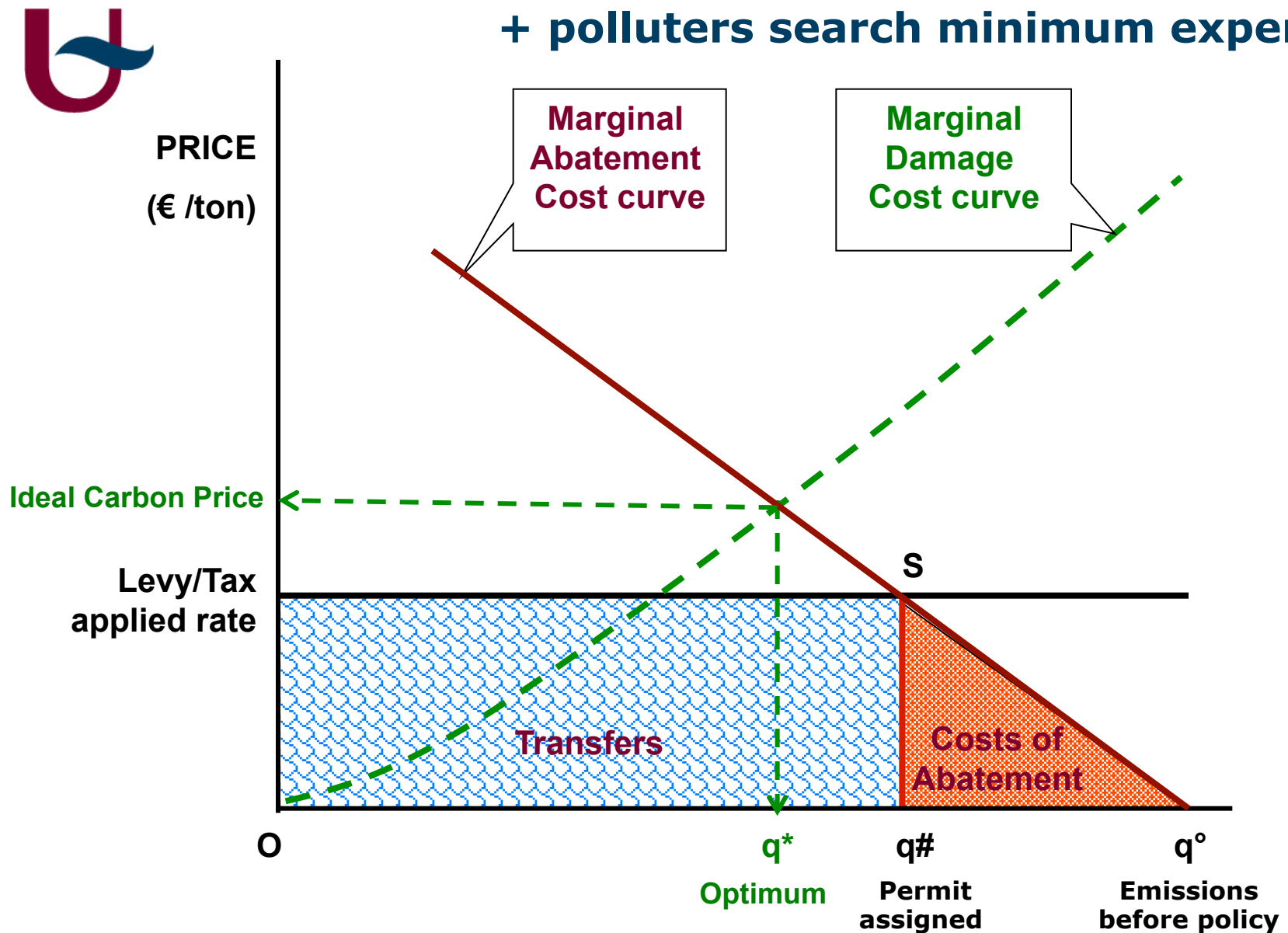




## Matching abatement & damage: conceptual + practical challenging



# Cost-benefit: least-cost emission level $q^*$ + polluters search minimum expenses





Minimize total expenses for all 11,500 main polluting installations, under the EU-wide CAP  
= find 11,500  $q_i^*$  emission quantities;  $\sum_i q_i^* = \text{CAP}$

€/unit

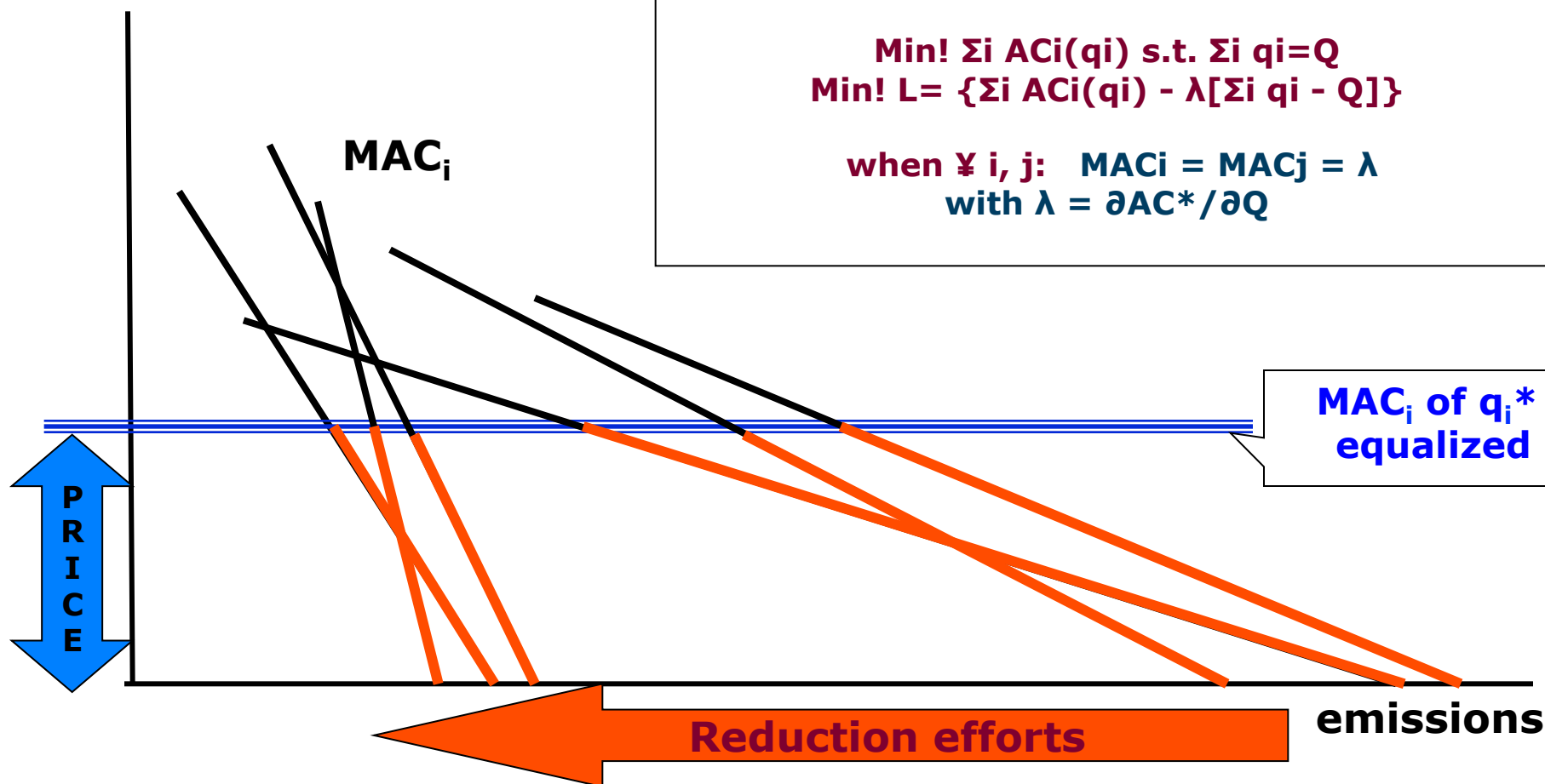
$\text{MAC}_i$

Mathematical rule (Lagrange): minimum expenses *iff* the 11,500  $\text{MAC}_i(q_i^*)$  are equal

$$\begin{aligned} &\text{Min! } \sum_i \text{AC}_i(q_i) \text{ s.t. } \sum_i q_i = Q \\ &\text{Min! } L = \{ \sum_i \text{AC}_i(q_i) - \lambda [\sum_i q_i - Q] \} \end{aligned}$$

when  $\forall i, j$ :  $\text{MAC}_i = \text{MAC}_j = \lambda$   
with  $\lambda = \partial \text{AC}^* / \partial Q$

$\text{MAC}_i$  of  $q_i^*$   
equalized





### EU ETS cradle [Reading time: 40"]

At COP3 (Kyoto, Dec. 1997), the EU reluctantly accepted emissions trading as a climate policy instrument.

Soon, DG Environment minds were reprogrammed: *emissions trading markets would innovate mitigation solutions to save the climate.*

Spurred by energy corporates & neoclassical economists, the EC freshmen believed in the superiority of ETS .

From economics textbooks + superficial scan of the US SO<sub>2</sub> program, a too ambitious, simplistic 'cap-and-trade' market design emerged.

In reality, free permits, fraud, rent skimming, absent innovation, ... turned the dream in a nightmare, covered by deceiving discourses.

More clarity about concepts, components, relations, mechanisms, influencing, etc. is necessary. Clarifying the anatomy of ETS is an important step.



### ETS debate: issues & choices

- ❑ **Economics & benefits-costs frame dominates**
  - ❑ 'Money makes the world go round'
  - ❑ **Price everything – only what is priced, is relevant**
  - ❑ **Based on aggregates/averages – hides inequality, diversity**
  - ❑ **Assumes unlimited substitutability – hides irreversibility**
- ❑ **Urgency of action & results**
  - ❑ **Atmosphere & Climate disruption is irreversible**
  - ❑ **No time for lenient experiments, 'global carbon trading'**
- ❑ **ETS debate is unwieldy**
  - ❑ **Non-economic views neglected**
  - ❑ **Facts obscured – next phase will be better** (remind atoms)
  - ❑ This lecture addresses the economics core of ETS, i.e.:
    - \* pricing GHG (carbon) emissions
    - \* price induced innovation (IPCC WG3 IAM)



## 2. Anatomy of ETS

**Merriam Webster's Collegiate Dictionary:**

**Anatomy:** *'the art of separating the parts of an organism in order to ascertain their position, relations, structure and function'* (mostly, pictures support the descriptions).

**An ETS holds 4 constituent parts:**

- [i] Policy goals
  - [ii] Costs of GHG abatement (mitigation, compliance)
  - [iii] Carbon emissions prices
  - [iv] Allocations of tradable emissions permits
- 
- every part = range of options (within constraints)
  - assemblage of particular options = ETS exemplar



### Component [i] Two major policy goals for EU ETS

#### **A-goal - Atmosphere**

**= pursue Atmospheric stability and cleanness**

**> emitting (industrial) activities**

**> carbon emissions down 80-95%**

**> by the nearest date (before 2050)**

**+ induce disruptive de-carbonizing innovations**

**++ higher carbon emissions prices as inducing force**

#### **II-goal – Profit / Protection of industries**

**= maintain/expand EU's industrial activities**

**> businesses, employment**

**>> profits**

**+ avoid 'carbon leakage'**

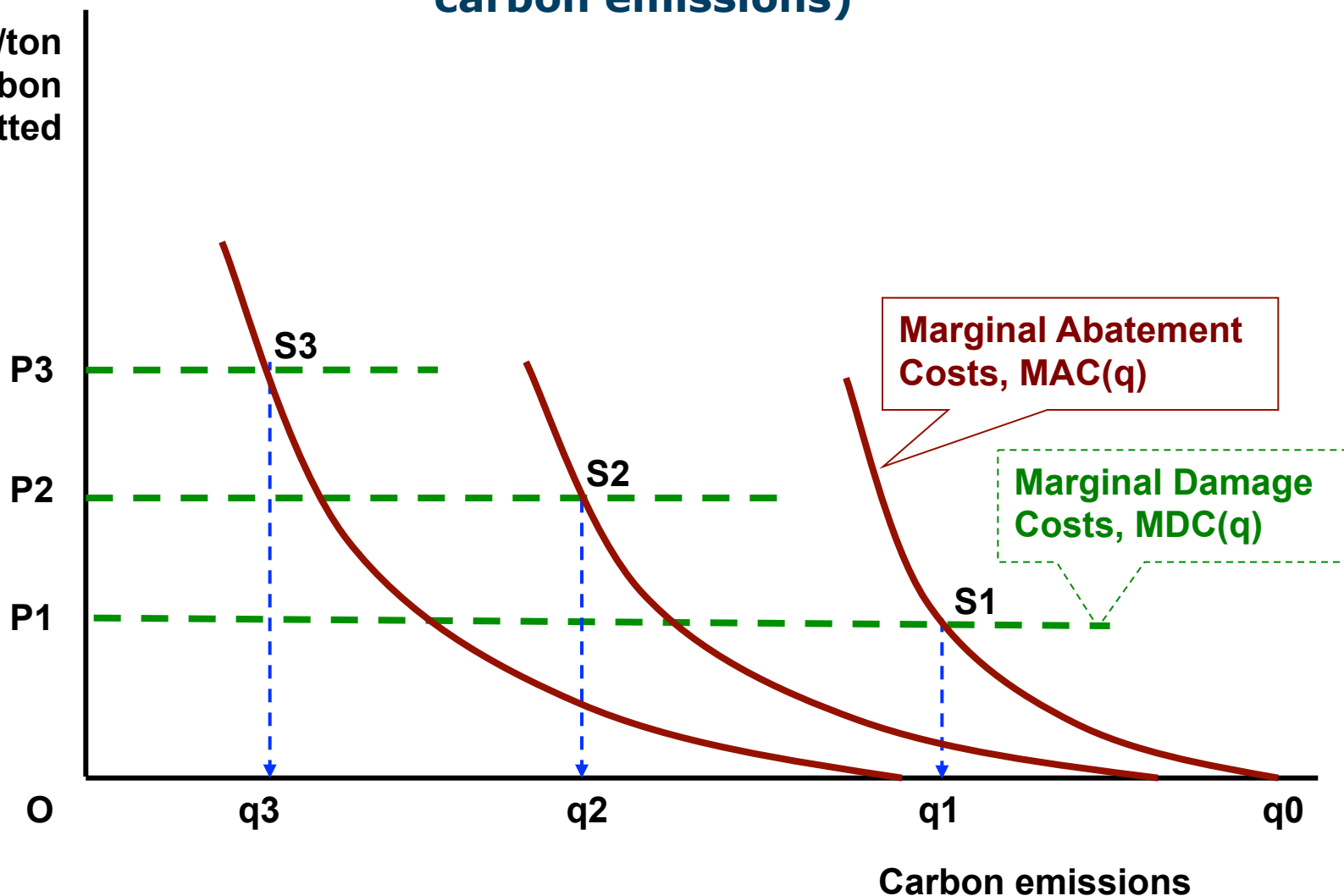
**++ no € burdens on Emissions-Intensive Trade-Exposed (EITE) industries**

**Are the two goals reconcilable?**



Price €/ton  
carbon  
emitted

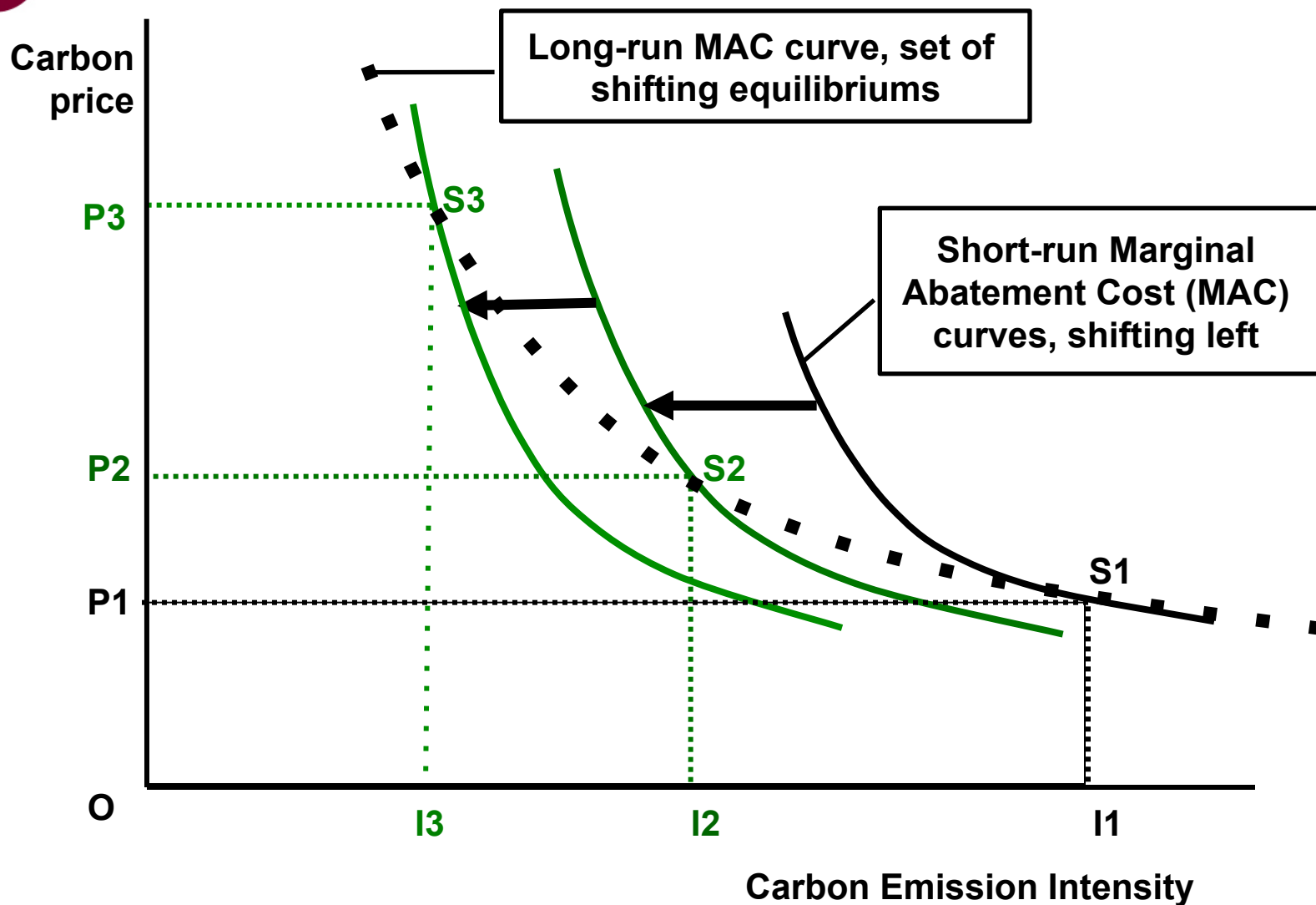
### Component [ii] Costs of compliance (abatement, mitigation of carbon emissions)





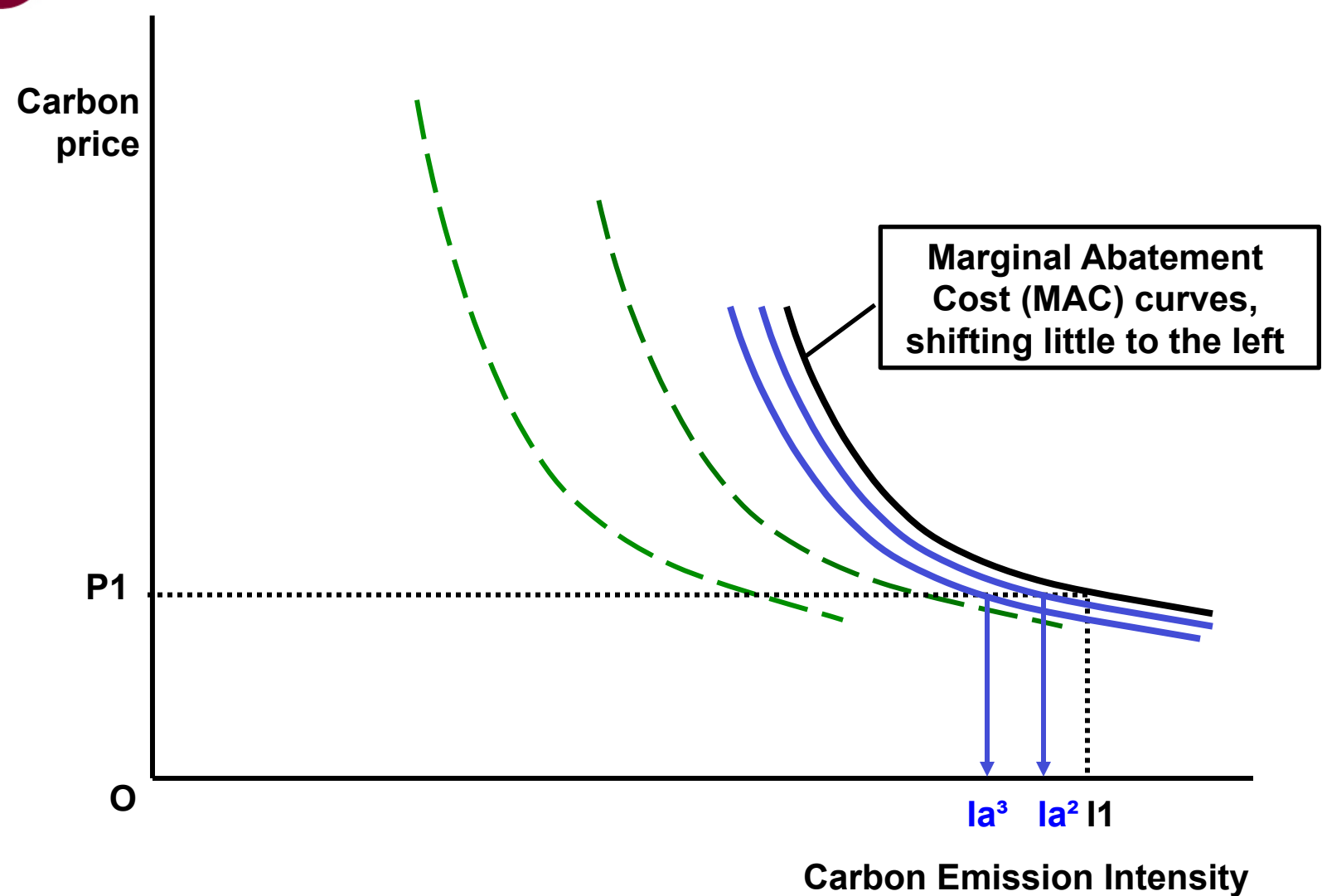


# Innovations in compliance, induced by high Carbon prices, shift cost curves and reduce optimal Intensities

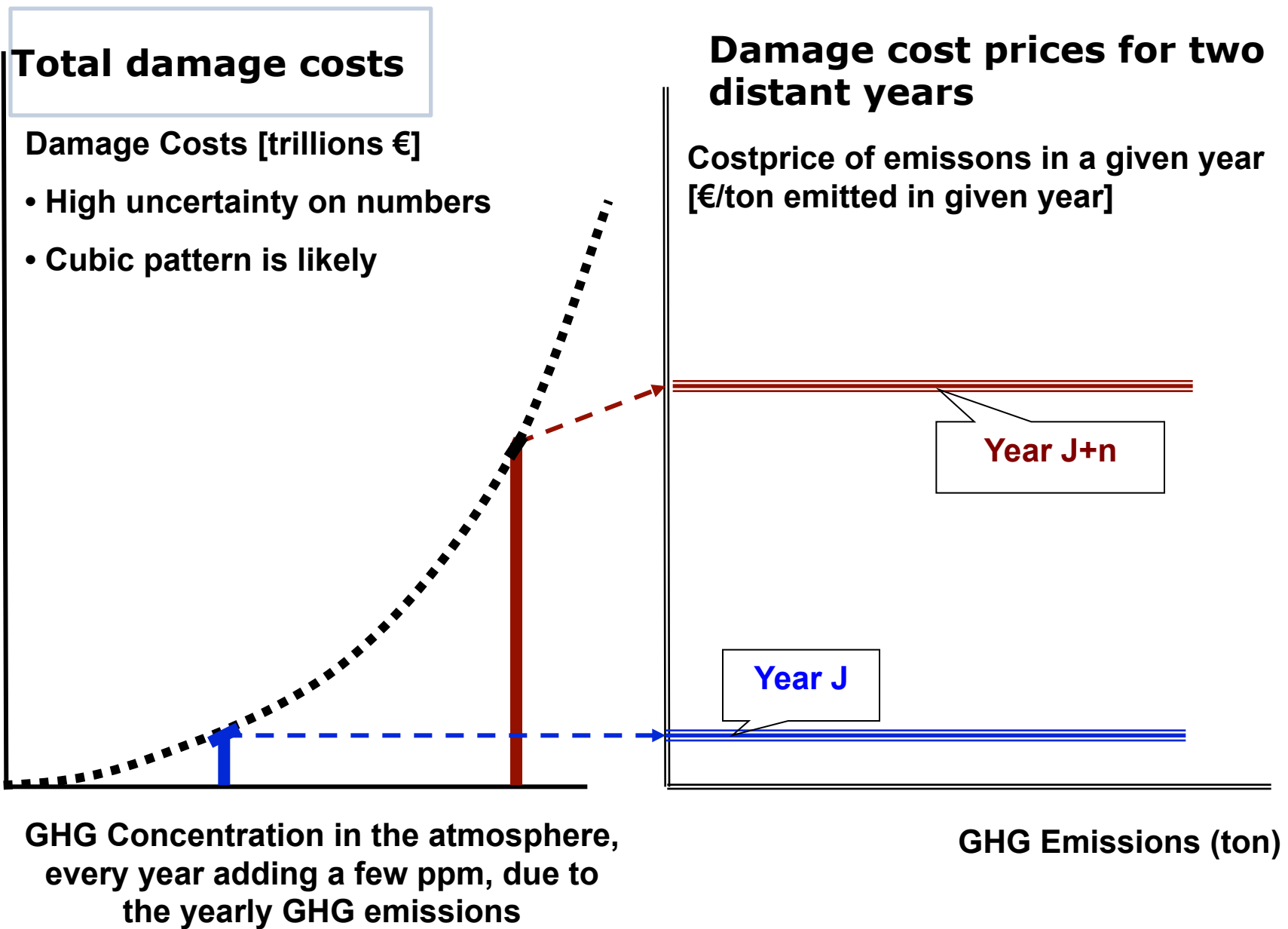


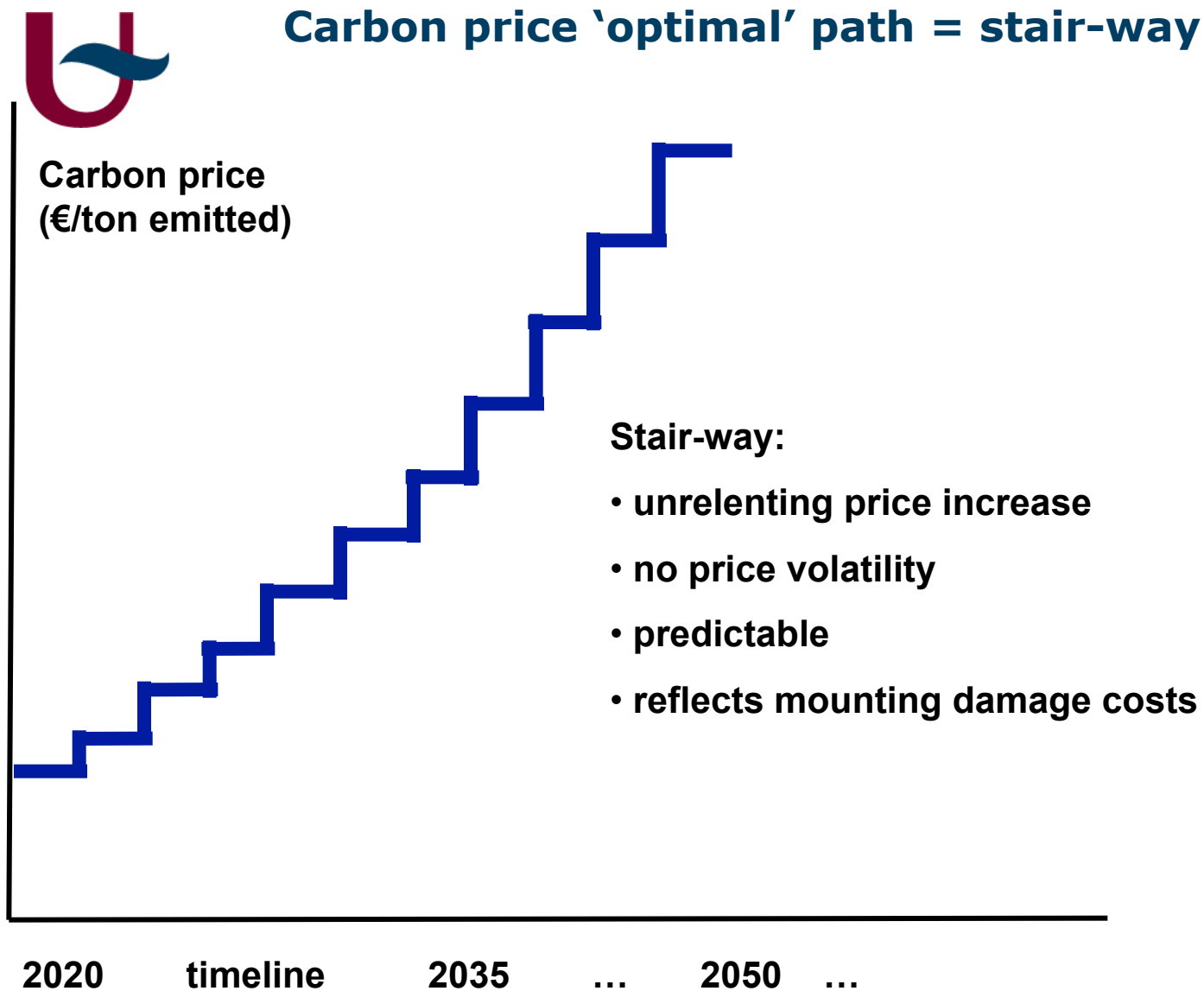


Without inducing carbon prices: autonomous innovations  
(ceteris paribus, other innovation drivers excluded)



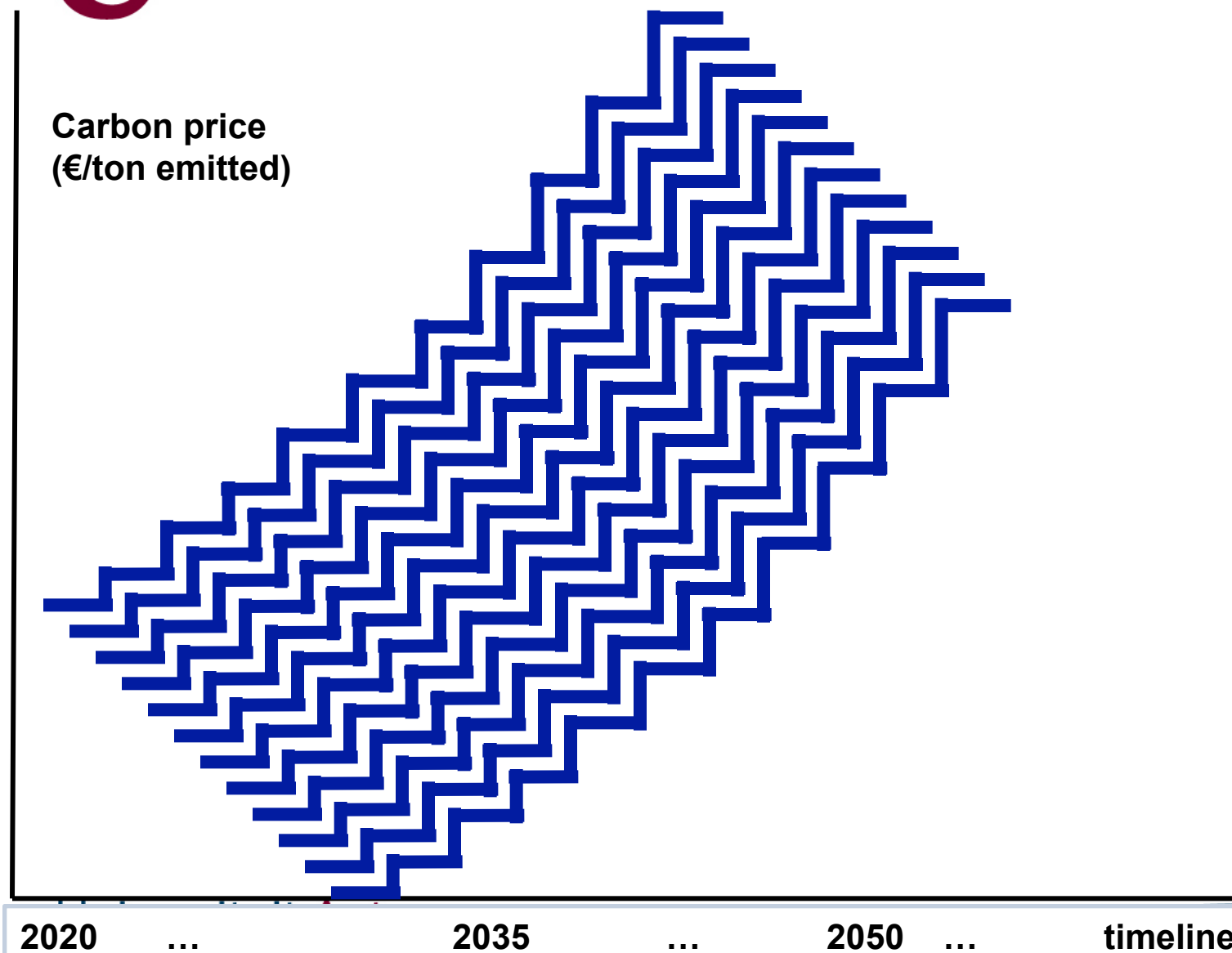
# Component [iii] Carbon emissions pricing







### Carbon price stairs evolving over time (specific outcomes depend on start year, height & gradient)



### Component [iv] Allocation of tradable emissions permits

ETS is a levies-permits hybrid  $\searrow$  permits allocation

#### LEVIES

- Yearly auctioning of shrinking year quota
- Auctioning of quota for a trade period of a few years
- Auctions spread over years, following the demand for permits
- Partial auctioning, partial free gifts
- Assign permits to the principle  $MAC_i = \lambda$
- Assigning expected BAT emissions
- Grandfathering

#### PERMITS

**[i] Goals of EU policy**

**Atmosphere A-goal:**  
all industrial activities  
without carbon  
emissions (by 2050?)

**[ii] Costs of Compliance**

**Innovation of products,  
services, technologies**

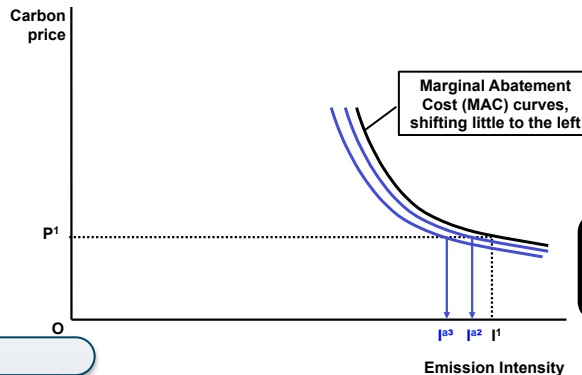
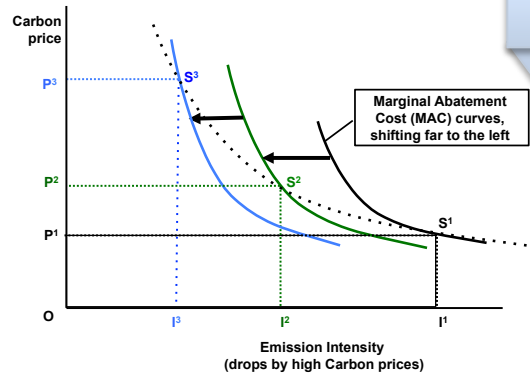
**[iii] Carbon emissions  
Prices**

**Carbon emissions  
price stair**

**[iv] Allocations of tradable  
emissions permits**

**Levies-permits hybrid  
↘ permit allocation**

**Induced  
Innovation**



**Autonomous  
Innovation**

**Profit  $\pi$ -goal:**  
maintain, expand  
EU's industrial  
activities, business,  
employment

Antw

**No leakage  
by  
carbon price**

**carbon  
price stair  
is not  
climbed**

**LEVIES**

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**PERMITS**

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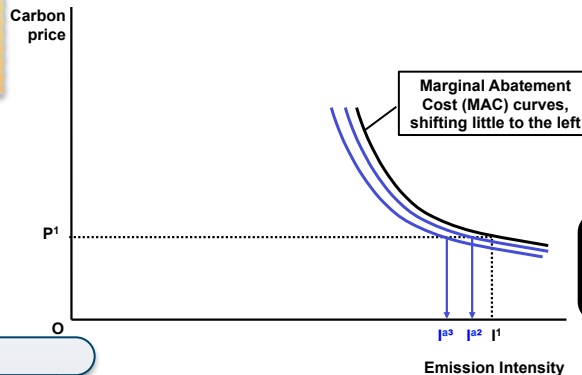
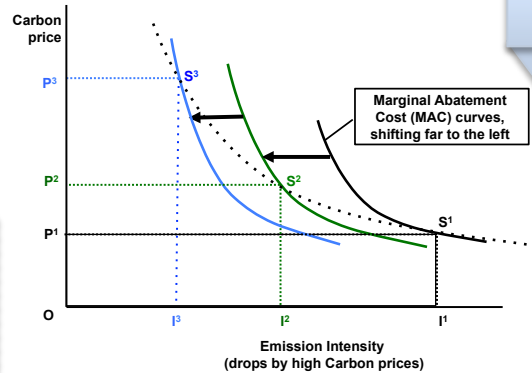
[ii] Costs of Compliance

[iii] Carbon emissions  
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**Atmosphere A-goal:**  
all industrial  
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2050?)

**Induced  
Innovation**



**Autonomous  
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**Profit  $\pi$ -goal:**  
maintain, expand  
EU's industrial  
activities, business,  
employment

**Conflicting  
goals.  
Not attainable  
both with one  
instrument**

**LEVIES**

- Yearly auctioning of shrinking year quota
- Auctioning of quota for a trade period of a few years
- Auctions spread over years, following the demand for permits
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**PERMITS**





### Findings from Anatomy study

- . ETS exemplars depend on assembled selection of component options
- . Conflicting goals require different exemplars
- . EU ETS successful in protecting (serving) the interests of EU's large industries
- . High-price [*with high-cost for industry*] EU ETS exemplar is unlikely [*the more sticky MACs are*]



## Characteristics of US SO<sub>2</sub> program

- ❑ **Single segment of acid pollution**
  - ❑ SO<sub>2</sub> from USA coal fired power stations, production tech fully known
  - ❑ NO<sub>x</sub> regulated in separate segments
  - ❑ Leakage not an issue
- ❑ **Low abatement expenses**
  - ❑ Mainly low-sulfur coal substituted for high-sulfur coal
  - ❑ Mature add-on technologies (scrubbers)
  - ❑ Lousy cap did not need advanced scrubbers
- ❑ **Rich regulatory bequest at the start in 1990**
  - ❑ Sector regulated by state PUCs, coordinated by NARUC
  - ❑ EPA since 1970: capable, diligent, informed, ...
- ❑ **Stringent EPA policy making above market functioning**
  - ❑ Free permits; 2.8% of cap auctioned + return of revenues
  - ❑ Banking of permits as extra flexibility
  - ❑ Few trade across non-affiliated companies



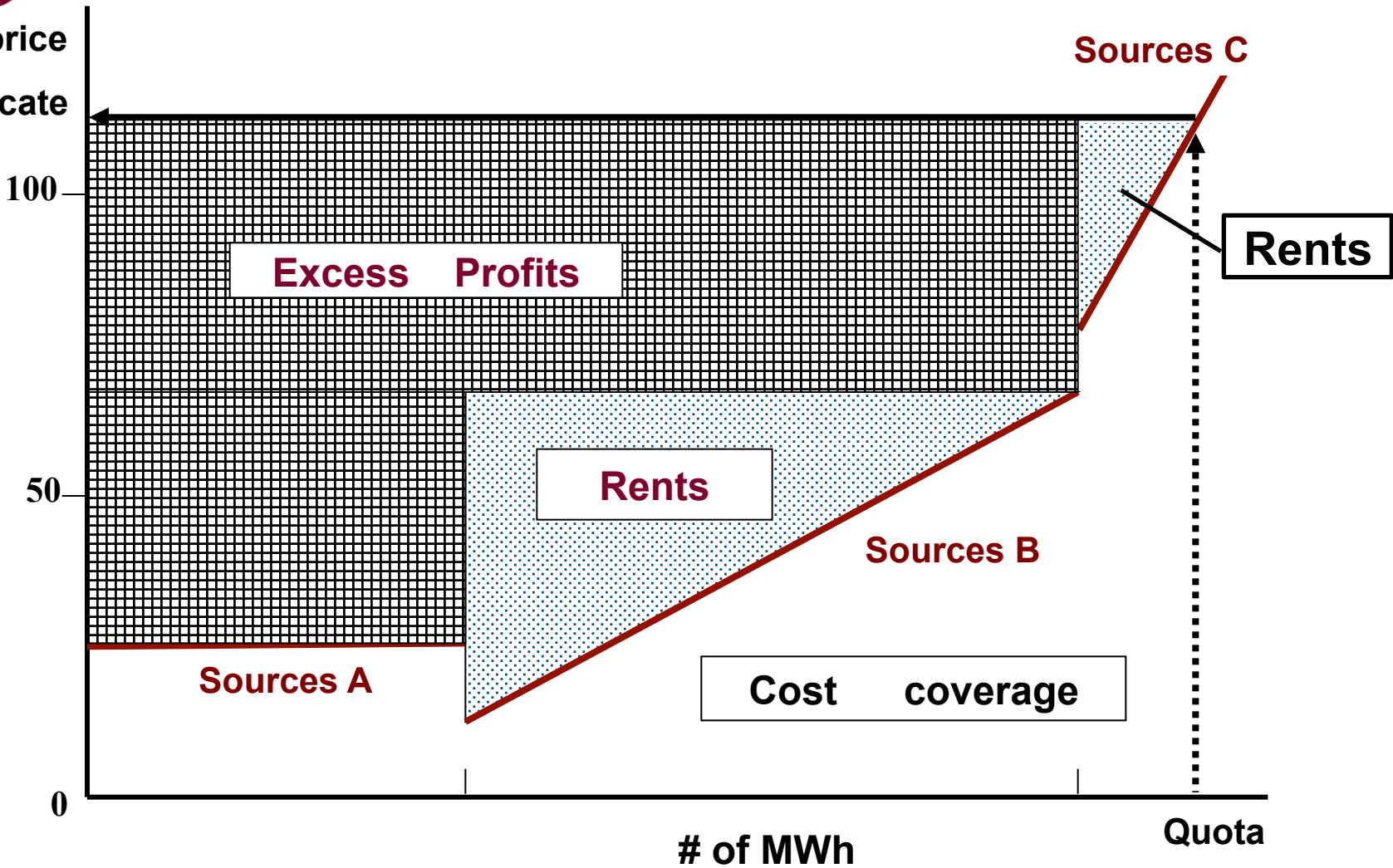
## EU's Tradable Green Certificates (TGC)

- ❑ **1999:EC promotes TGC for pan-European RE support**
  - ❑ Germany resisted and saved Feed-In Tariff (FIT) support
  - ❑ A few TGC were set-up: Frehsmen Flanders exemplary
- ❑ **Salient attributes & results of TGC**
  - ❑ Amalgamate all RE supplies {source x technology}
  - ❑ Single price per certificate (= per MWh generated)
  - ❑ Huge excess profits (euphemism: 'windfalls')
  - ❑ No technological innovation
  - ❑ 'Market' metamorphosed in ruling *à la tête du client*
- ⇔ **Technology specific FIT support for solar PV + wind**
  - ❑ **Affordable, fast, deep, tech. development success**
  - ❑ **Economists: 'FIT expensive', 'perverse effects on ETS'**



# Cost coverage, Rents and Excess Profits in Tradable Green Certificate systems

Uniform price  
per certificate  
€/MWh





## 4. Reality check

**Mission of Climate Policy**  
**Purpose of policy instruments (ETS):**  
**Deep De-Carbonization**

**Innovation is the magic key to**  
**\* low-costing abatement, mitigation**  
**\* new products, practices, institutions, ...**

**ETS '*price induced innovation*' credo =>**  
**➤ Hammering on high carbon prices**  
**➤ Shifts in Marginal Abatement Cost curves**

**We investigate**  
**Carbon prices & MAC shifts**



# Carbon price or prices

- ❑ **Holy grail of neo-classical (neoliberal) economists**
  - ❑ Either 'harmonized global CO<sub>2</sub>-eq levy/tax rate' (fixed)
  - ❑ Or: 'uniform ETS permit prices' (volatile)
- ❑ **'Money makes the world go round' affects all people**
  - ❑ Maximize Benefits (revenues) + Minimize Costs (expenses)
  - ❑ Self-interest keeps economic order ( $\approx$  gravity in physics)
  - ❑ Movement = overcoming gravity & short-near self-interest
- ❑ **Confusion price (€/unit)  $\otimes$  bill (quantity of €)**
  - ❑ If one unit (house, car): price = bill
  - ❑ If many units (kWh, ton CO<sub>2</sub>): price  $\ll$  bill
  - ❑ Real economic decisions are based on bills, not on prices (see: 'capital budgeting' for business investments )

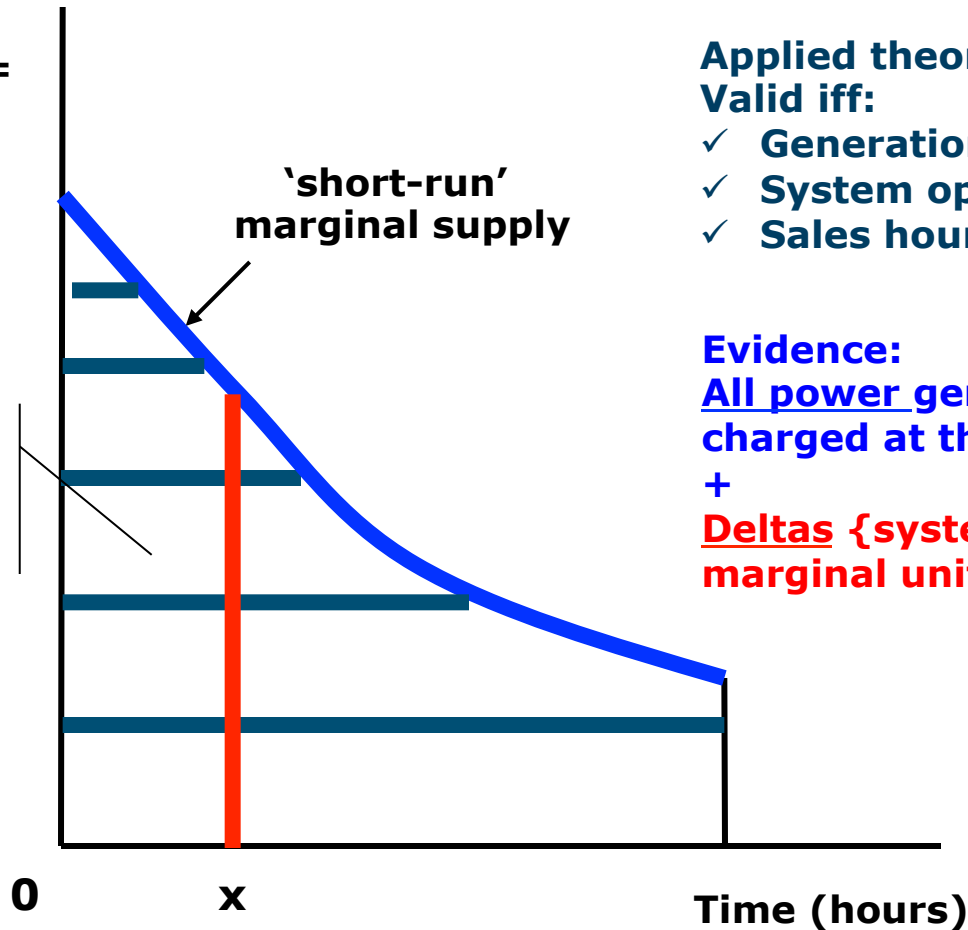
## 4. Reality check



### Economics Theory: welfare maximum by Short-Run Marginal Cost (SRMC) pricing [Ramsey – Boiteux – Steiner]

Electric loads =  
generated  
(kW)

Power plants  
stapled  
in SRMC  
Merit order



Applied theory: power generation  
Valid iff:

- ✓ Generation units on command
- ✓ System optimally composed
- ✓ Sales hourly measured & billed

Evidence:

All power generated during hour x is  
charged at the system  $SRMC(x)$

+

Deltas {system  $SRMC(x)$  –  $SRMC$  infra-  
marginal units}, cover fixed costs



# EU ETS in practice

- Free Permits up to 'benchmarked' emission levels
  - Permit price = penalty on emissions beyond
  - No trade in permits, but trade in penalties
- ETS advocates' discourse: 'Tail wags Dog'
  - ✧ ⇔ Marginal is derivative of total (not the reverse)
  - ✧ ⇔ MC-pricing optimal IFF all submarginal units also pay the system marginal cost

## Trivialities about Price • Quantity • Bills ⌘ Values

P=Price s=sufficient amount f=fringe amount V=Value/unit

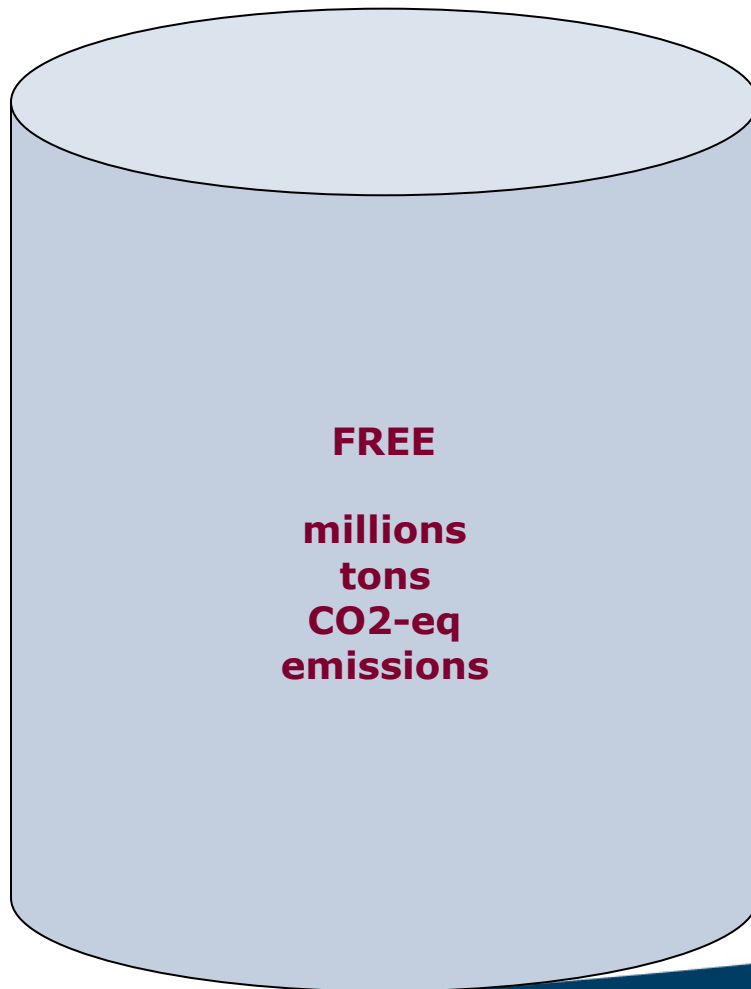
Applied Price	Received Quantity	Paid Bill	Bill-Value link	Obtained Value
P	0	0	=	0
P	1	P	≈	V
P	s	s.P	≈	s.V
0	1	0	<	V
0	s	0	<<<<<	s.V
P	f	f.P	<<<<	(s+f).V





## Tail wags dog

Free barrels & Trade in cups: short  vs. long 

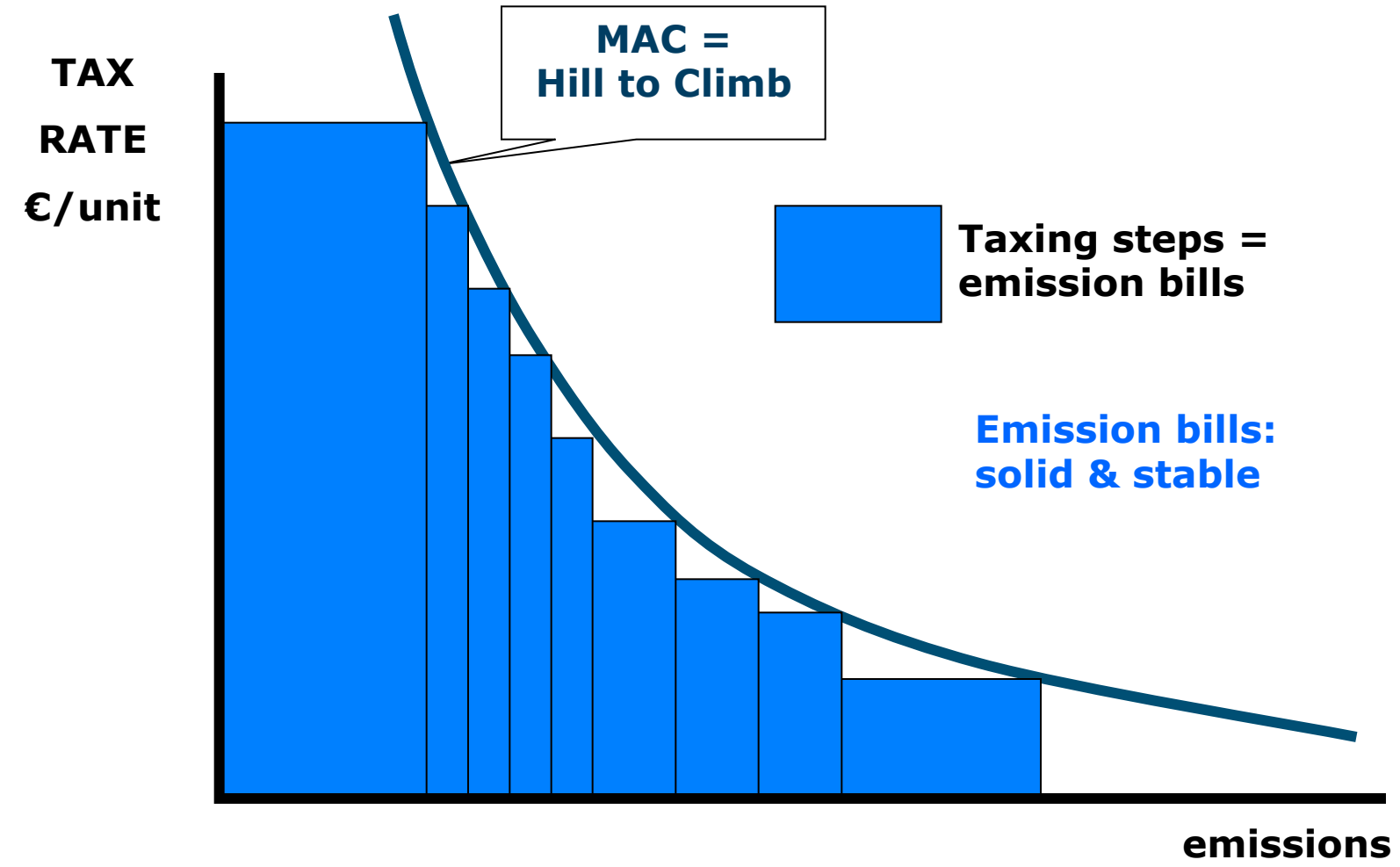


**'Tail wags dog':** CP = price on the emissions  
*fringe* of installations is believed to incentivize  
emissions reductions + carbon innovation

- ⇔ Firms trade hoarded and surplus permits
- ⇔ Source of excess (windfall) profits
- ⇔ Actual emissions bill of firms  $\approx$  € 0
- ⇔ Deceiving CP concept

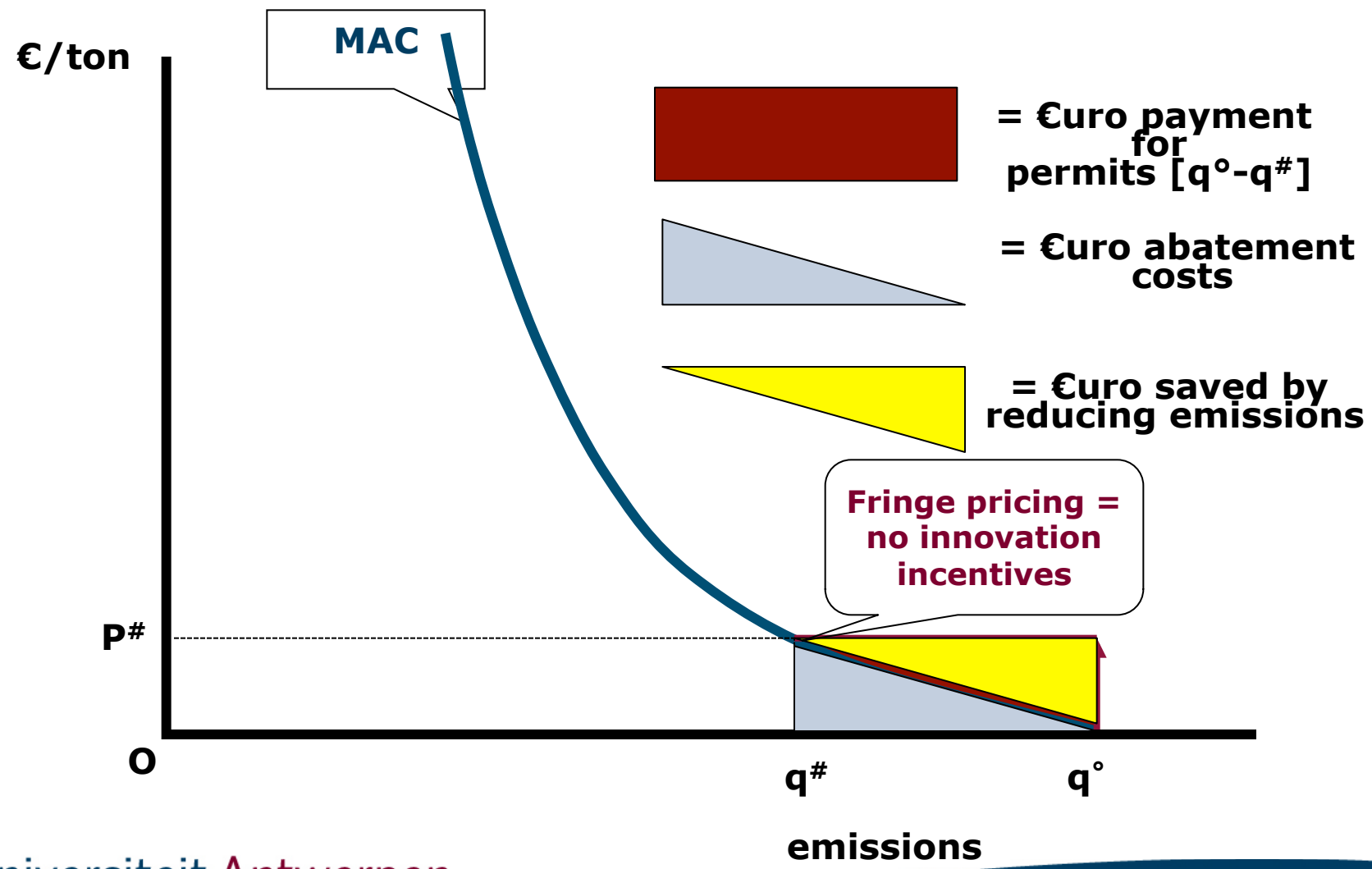


# Climbing the Emissions Reduction Slope via Interior Stair



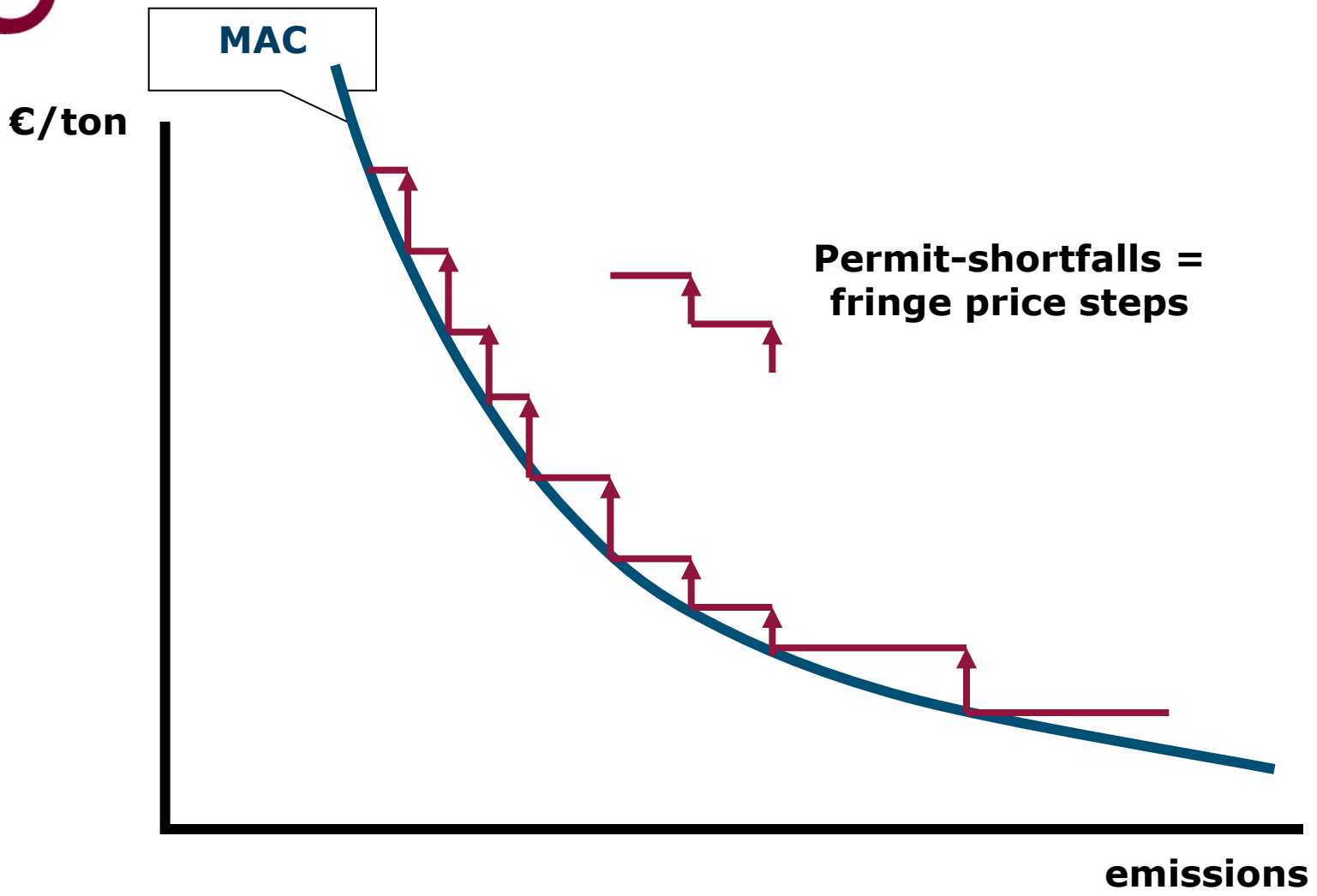


# Free quota + fringe pricing of permit-shortfalls. The economics logic of a rational polluter





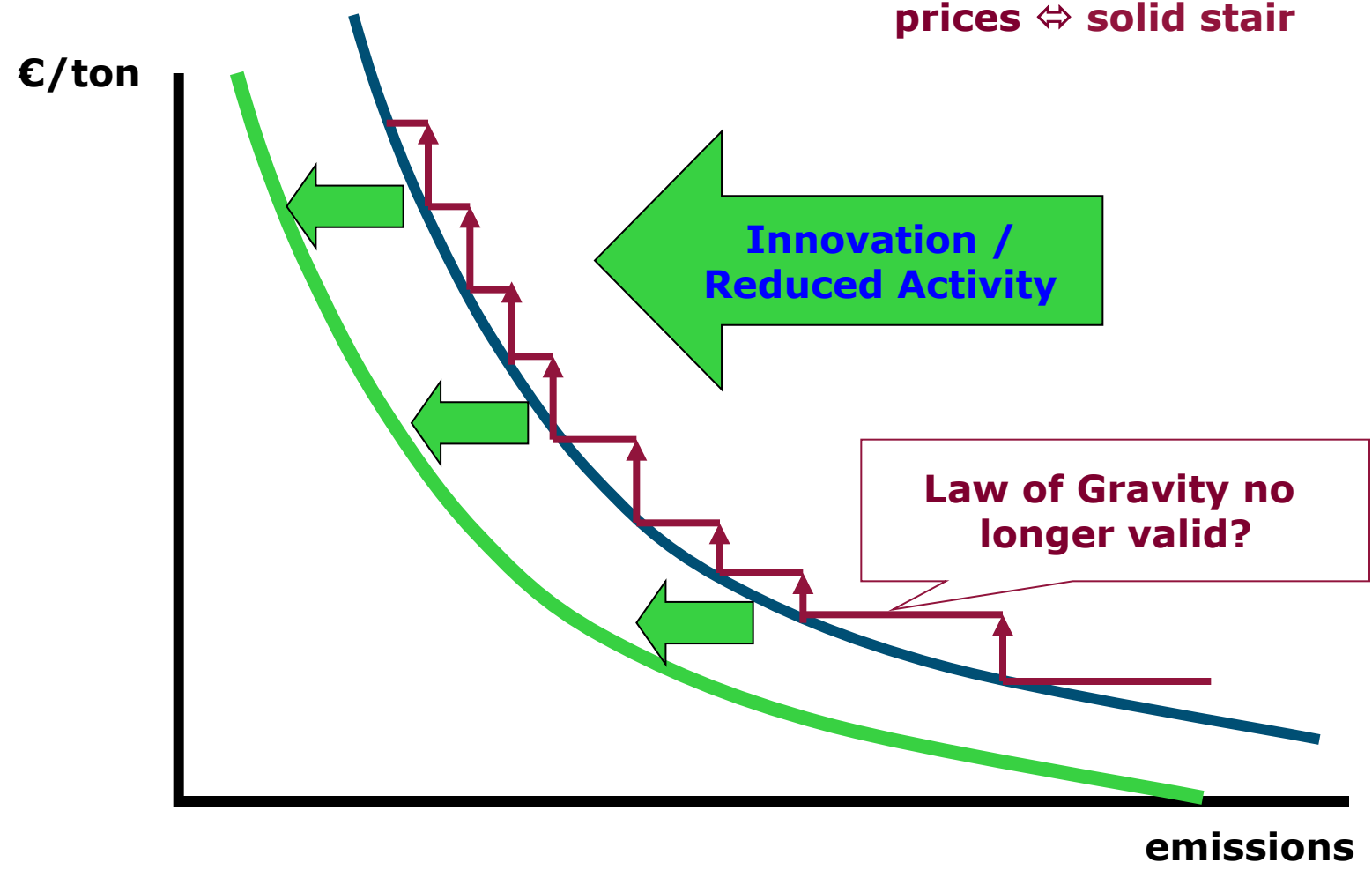
# Free quota + fringe pricing of permit-shortfalls = Exterior stair





# Exterior stair = unstable construction

Trade in penalties: volatile prices ↔ solid stair





# Dubious ETS Carbon Prices

## ❑ ETS permit prices

- ❑ Fringe price  $\neq$  marginal price
- ❑ ETS unique selling point 'uniform carbon price sets  $MAC_i$  equal = minimum total AC' is hollow
- ❑ Phase 1 & 2 [2005-2012]: 98% of permits free + banking into Phase 3: 2.3 billion permits hoarded + windfalls, fraud
- ❑ Phase 3: auction for power generators (prices €5 to €8) + EITE activities get free permits (bill  $\approx$  0)

## ❑ Who pays the ETS bills?

- ❑ Electricity consumers are charged the ETS bills
- ❑ However, governments (UK, Germany, Belgium, ...) reimburse EITE 75-85% the ETS driven costs on their electricity bills
- ❑ Finally: non-ETS electricity consumers pay the ETS
- ❑ A considerable price increase = huge profits on the hoarded permit stock in 2018, before the MSR starts in 2019



## ETS posted prices 2009-2019

(Source: Market Insider, 19 April 2019)

Significant increase since last two years: from €6 to €25/permit





# ETS helpful for climate policy?

## ❑ **Untill today?**

- ❑ **After 2005: RWE, EON, GDF-SUEZ started construction of large scale coal plants in the Netherlands, Germany, ...**
- ❑ **ETS has not pulled decarbonization innovations**
- ❑ **Almost 20 precious years have been irrevocably lost, causing more irreversible losses to the globe's climate**

## ❑ **Phase 4 [2020-2030]**

- ❑ **In 2019: metamorphosis from cap-and-trade to a collar (bottom & ceiling) price control (Market Stability Reserve)**
- ❑ **Otherwise, no major changes**
- ❑ **One more decade lost?**





### Can ETS survive high permit prices?

#### ☐ Yes

- ☐ When roll-of mechanisms persist: the non-ETS electricity consumers pay the bill
- ☐ However, pivotal role of electric power corporates may be undermined by fast growth in solar & wind supplies

#### ☐ No, when prices are charged on industrial emissions

- ☐ Industries cannot, will not, pay twice: a yearly permits bill + investments in de-carbonizing innovations, i.e.
- ☐ price induced innovation is mostly fiction; the more fictitious, the more sticky the MAC curves are
- ☐ Carbon leakage is then likely to occur
- ☐ More likely is that industry will quit (blow-up) the ETS



# Has GHG emissions trading a future?

## Prerequisites:

- ❖ 'Diversity & Segmented' substitutes for 'Amalgamation & Uniform' in handling emission sources & applying economic instruments.
- ❖ Submit Policies & Instruments to Sustainability Assessment
- ❖ Accord with stimuli for decarbonization innovations, which are more important than market mechanisms
- ❖ Revise belief in uniform price induced innovation

## ☐ Yes, GHG emissions trading may play a role

- ☐ When organized per industrial sector / subsector
- ☐ On a global scale, e.g, all cement plants (> some size) to preclude leakage
- ☐ Foster flexibility above permit trade

The EU ETS being a scam, generates two feelings:

- **Relief:** better climate policy is feasible after breaking the deception
- **Responsibility:** find new effective, efficient and fair policies