Centre for Energy and Environmental Markets

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Effectiveness, Efficiency and Equity:

How does the European Emissions Trading Scheme score?

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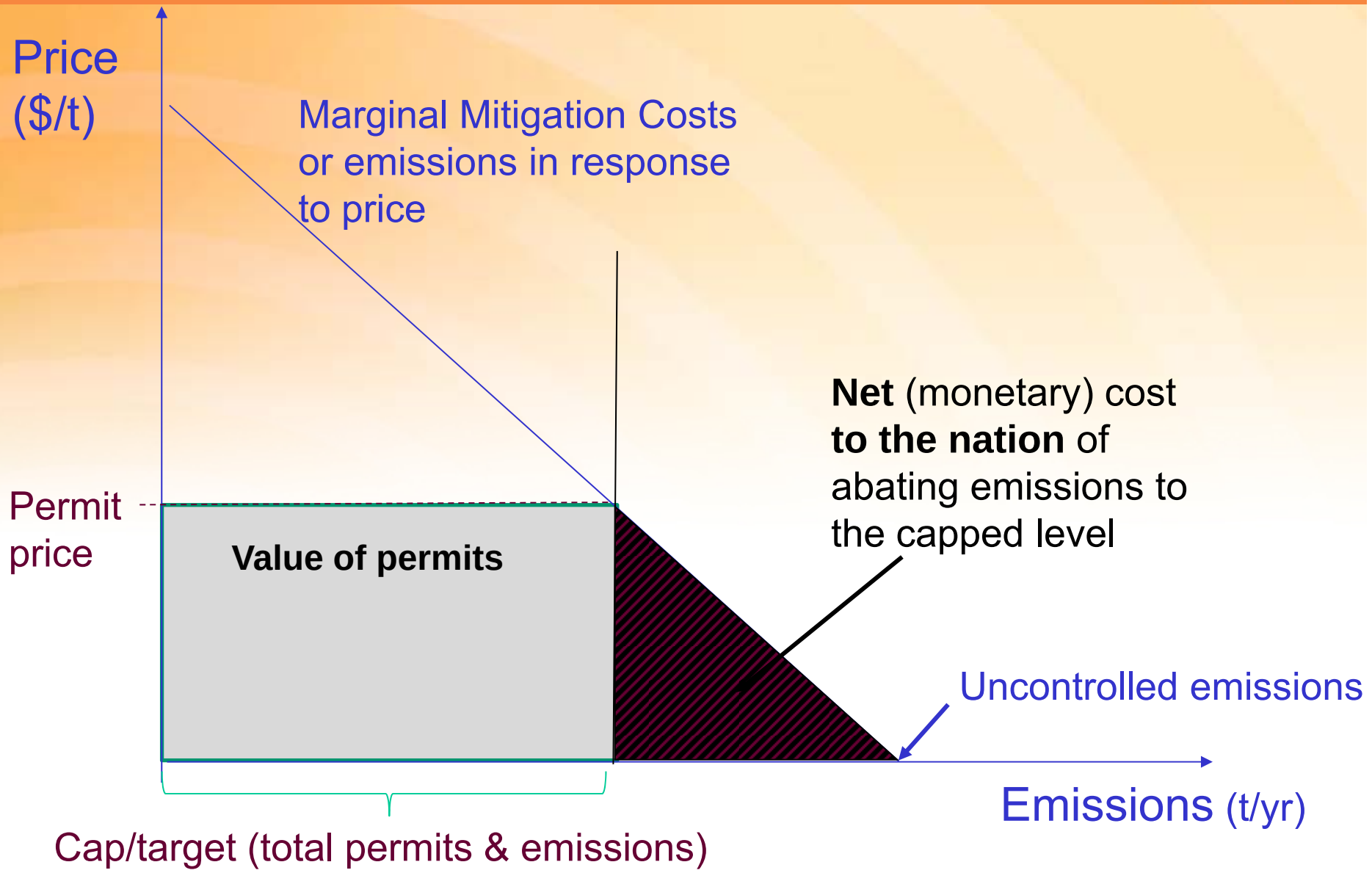
Motivation

- To combat climate change, effective, efficient, and equitable policies are necessary to achieve high reductions (80-95%) in the long run
- Economic textbooks argue that a well-designed Emissions Trading Schemes (ETS) can be an efficient and effective policy instrument
- Emissions trading schemes are designer markets and policy makers have to choose the design...
- More countries are planning to introduce emissions trading schemes in the future: e.g. Australia, Switzerland...
- Important lesson to be learnt from 5 years of operation of the biggest ETS: design affects performance

Methods that help to design and evaluate policy

Approaches	Ex-ante (Design)	Ex-post (Evaluation)
Theory	X	(x)
Modelling	X	(x)
Experiments	X	(x)
Econometrics		X
Interviews	X	X
Case studies	X	X


Price ($/t)
Marginal Mitigation Costs or emissions in response to price
Permit price
Value of permits
Net (monetary) cost to the nation of abating emissions to the capped level
Uncontrolled emissions
Emissions (t/yr)
Cap/target (total permits & emissions)

Key Design features of EU ETS (I)

- **Target**
  - Phase I and II: Cap level left to the Member States (National Allocation Plans), approval by the European Commission
  - Phase III: Harmonised cap determined at European level
  - Full banking within a phase and one year borrowing, no banking and borrowing between Phase 1 and Phase 2
- **30 participating countries (EU-27 and Liechtenstein, Norway and Iceland)**
  - Covers around 50% of Carbon Dioxide emissions (CO_2) of EU
  - Around 40% of total greenhouse gas (GHG) emissions of EU
- **Downstream scheme for CO_2 from stationary sources**
  - Installation-based
  - Power generation & selected industries
  - Phase I cap: 2,082 Mt CO_2 p.a. covered (all GHG in Switzerland are 53 Mt CO_2)
  - Phase II cap: 2,083 Mt CO_2 p.a. extended scope ~ 85 Mt CO_2-e
  - Phase III: 1,930 Mt CO_2-e p.a. further activities and gases (N_2O and PFC) ~ 100 Mt CO2e (2,039 Mt CO_2-e) and ~200 Mt aviation (in 2013)

Key Design features of EU ETS (II)

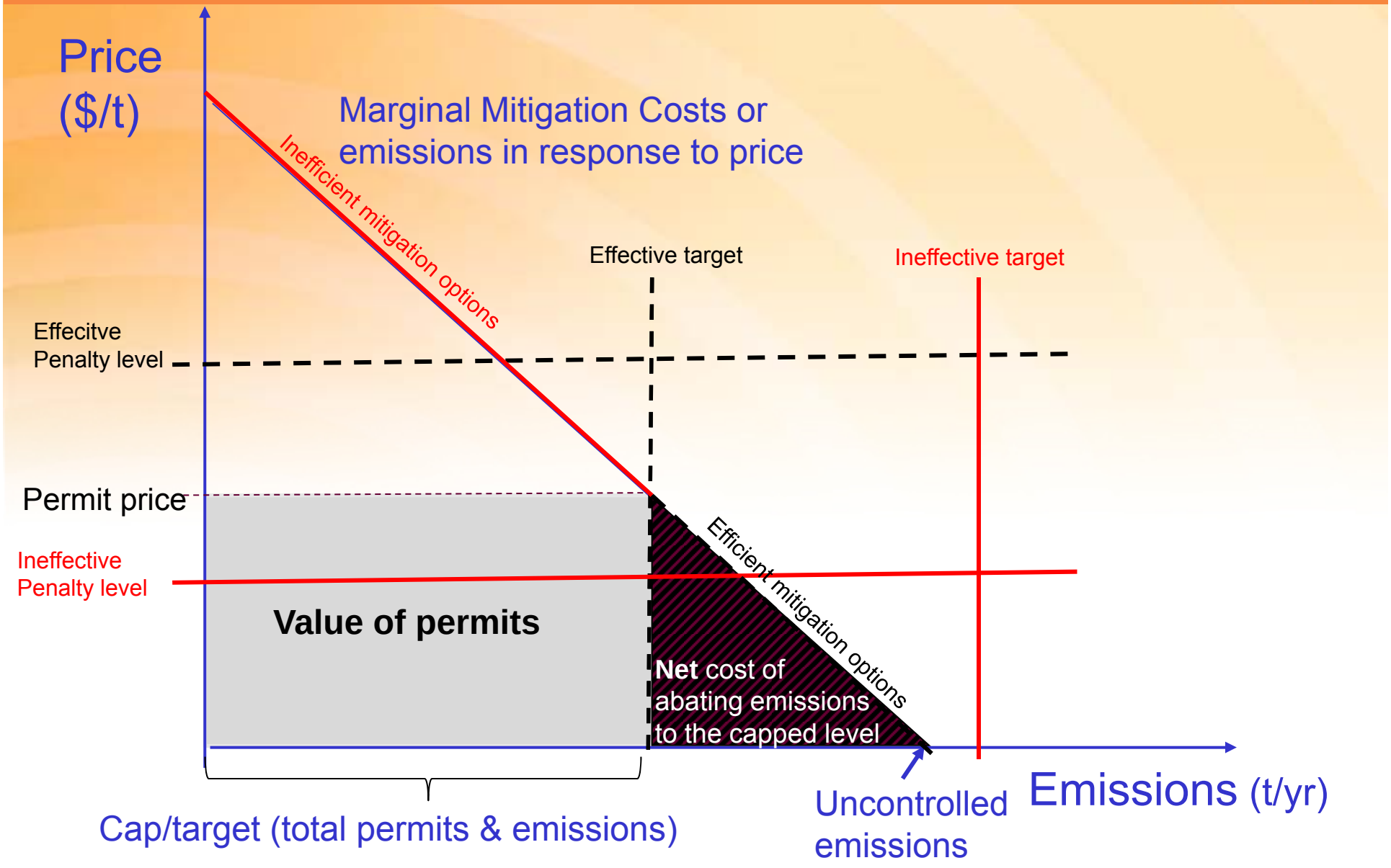
- **Allocation based on National Allocation Plans (NAP)**
  - Allocation left to the Member States, approval by the European Commission
  - Ceilings for auctioning (≤ 5% phase 1, ≤ 10% phase 2, 100% electricity sector phase 3). Actual auction share: Phase 1: 0.13%, Phase 2: 3%, Phase 3: ~ 50%
  - Total amount of allowances to be allocated and amount per installation
  - Policies & Measures for the non-ETS sectors (informative)
- **Sanctions**
  - Penalty of 40 €/t CO_2 (until 2007), 100 €/t CO_2 (from 2008) and make-good provision, no price cap or floor
- **Price Containment Measures:** only indirectly through banking and borrowing
- **Offset Mechanisms**
  - Limited use of Kyoto credits (Clean Development Mechanism (CDM) and Joint Implementation (JI))
- **Technical Aspects**
  - Yearly monitoring (mainly calculation based) and reporting of verified emissions
  - Phase 1 2005-2007, Phase 2 2008-2012 (= Kyoto Phase), Phase 3 2013-2020

Evaluation criteria

- **Environmental Effectiveness**: the extent to which the environmental objective is achieved.
  - Macro Perspective: Does the ETS achieve emission reductions globally?
  - Micro Perspective: Does the ETS achieve the given (ineffective) target?
- **Efficiency**: the extent to which the required objective is met at least cost.
  - Macro Perspective: Does the policy achieve emissions reductions at lower costs compared to other instruments?
  - Micro Perspective: Does the ETS achieve the given target at least cost?
    - Is the ETS designed efficiently?
    - Does it lead to innovation in the long run? (dynamic efficiency)

Relevant design elements

- **Environmental Effectiveness**
  - **Target** — Macro Perspective
  - Leakage — Macro Perspective
  - Offsets — Macro Perspective
  - Sanctions — Micro Perspective
  - Monitoring/Reporting/Verification — Micro Perspective
- **Efficiency**
  - **Coverage** — Macro Perspective
  - **Target** — Macro Perspective
  - **Market (firm decisions)** — Micro Perspective

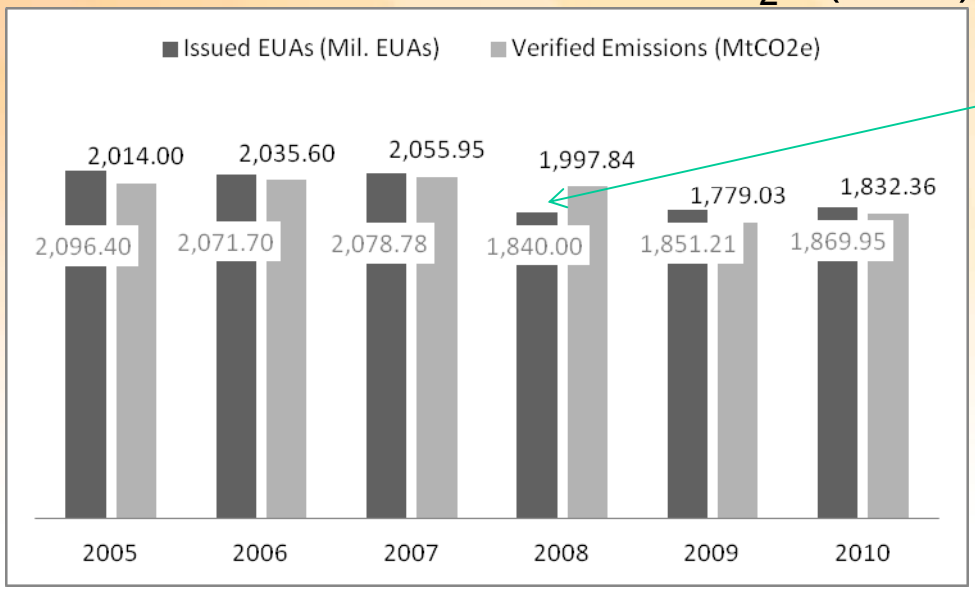

Price ($/t)
Marginal Mitigation Costs or emissions in response to price
Inefficient mitigation options
Effective target
Ineffective target
Effecitve Penalty level
Permit price
Ineffective Penalty level
Value of permits
Efficient mitigation options
Net cost of abating emissions to the capped level
Cap/target (total permits & emissions)
Uncontrolled emissions
Emissions (t/yr)

What are the targets?

Macro
- **Target**
- Leakage
- Offsets

Micro
- Sanctions
- M/R/V

EU25 in $MtCO_2e$ (CITL)



Impact financial crises

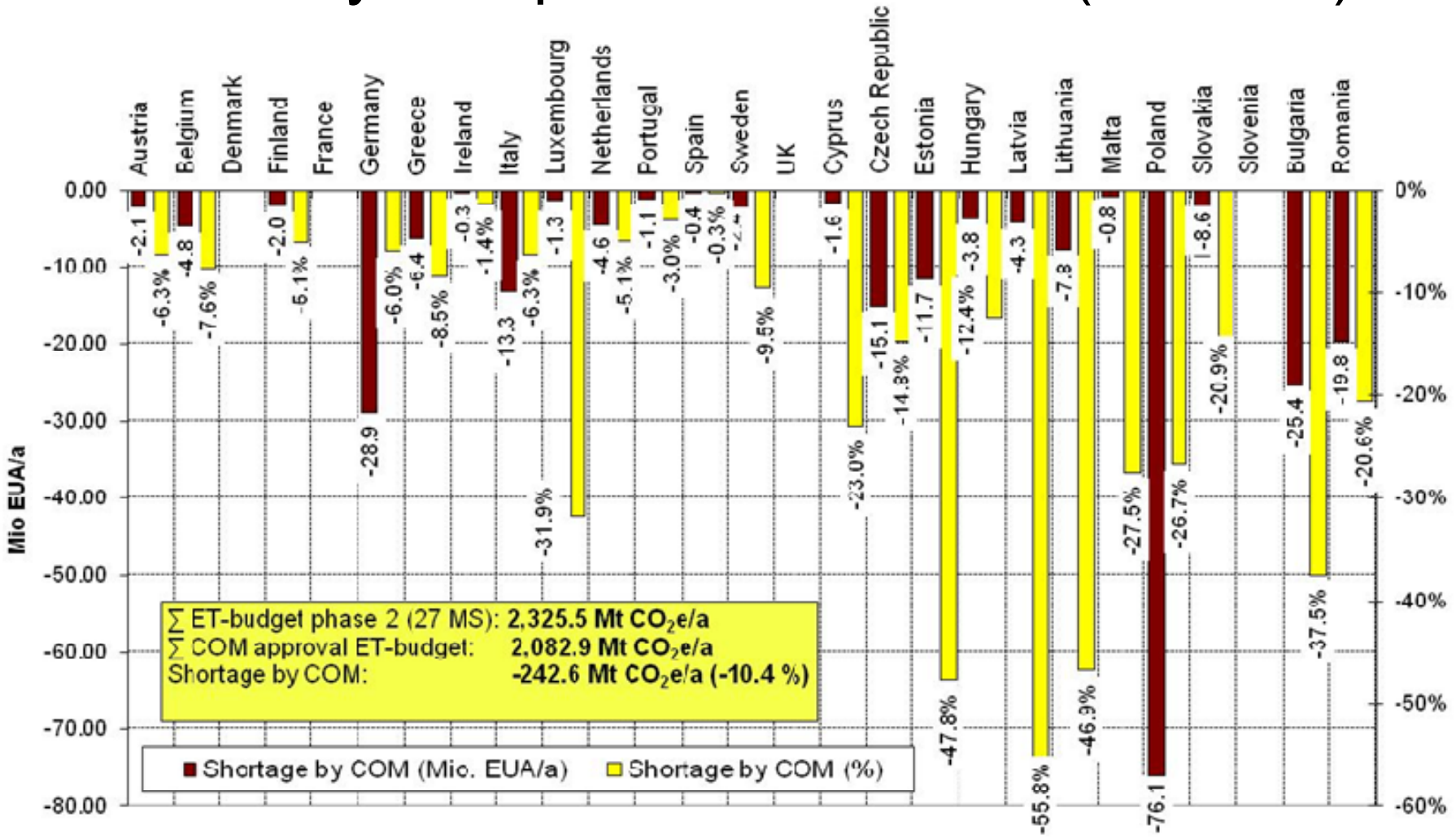
Phase I: EUAs allocation exceeded verified emissions by 141 Mio. tCO_2

Phase II: - Substantially improved by EC decisions (see next slide)
- 5.9% below 2005 verified emissions, 2008-2010 48 Mio tCO_2 below verified

Phase III Proposal: -21% compared to 2005 for ETS sector (11.3% below phase II allocation)

- The targets of the EU ETS are becoming more stringent over time, Commission has a crucial role in target setting

Decision by European Commission (Phase II)



Source: NAPs and Commission decisions

Was the EU ETS achieving emissions reductions?

- To assess emissions reductions a counterfactual has to be calculated
- Different studies with different approaches
  - Ellerman et al (2010) use a simple approach based on GDP intensity and emissions 1990-2007:
    - Phase 1: -210 Mt CO_2 (EU-25)
  - Anderson and Di Maria (2011) include temperature changes ect.

    Net Abatement in Mt CO_2 for EU-25 (Verified emissions – BAU emissions): 2005=84; 2006=62; 2007=28; Total=174 (2.8%)
    Stringency of target: 27.9 Mt CO_2 (0.45%) (Allocation – BAU emissions)

- The EU ETS in Phase 1 did not lead to substantial emissions reductions
- In Phase 2 more substantial reductions are likely

Target setting: Lessons learnt

- High quality data is needed (same monitoring methods and externally verified) otherwise historical inflation of base year emissions has to be assumed
- Coverage has to be clear at the outset
- Target setting based on projections is likely to be inflated
- Small reductions compared to inflated base year emissions are likely to lead to an excess allocation
- Crucial role of the European Commission to limit excess allocation

Cap fixes maximum abatement and no other policies for the same sectors can achieve further reductions!

Is the EU ETS efficient?

Macro
- **Coverage**
- **Target**

Micro
- Market

Coverage: What are the costs and benefits of covering companies in an ETS compared to an alternative policy?
- Efficient coverage depends on stringency of the cap, transaction costs (fixed/variable and depending on policy) and distribution of mitigation costs (Betz/Sanderson/Ancev/2010)
- Simulations show that, given the lax targets of the Phase 1 and 2 of EU ETS, the costs temporarily outweigh the benefits of covering small companies, as transaction costs are largely fixed costs

Target: Was the target set efficiently between covered and non-covered sectors?
- Phase I and II: Most countries did not take marginal abatement costs of covered and non-covered sectors into account in setting the target, as the analysis of National Allocation Plans showed (Betz/Rogge/Schleich 2006)
- Phase III: European Commission did take marginal abatement costs and other policies into account

Coverage: Emissions – Installation relation

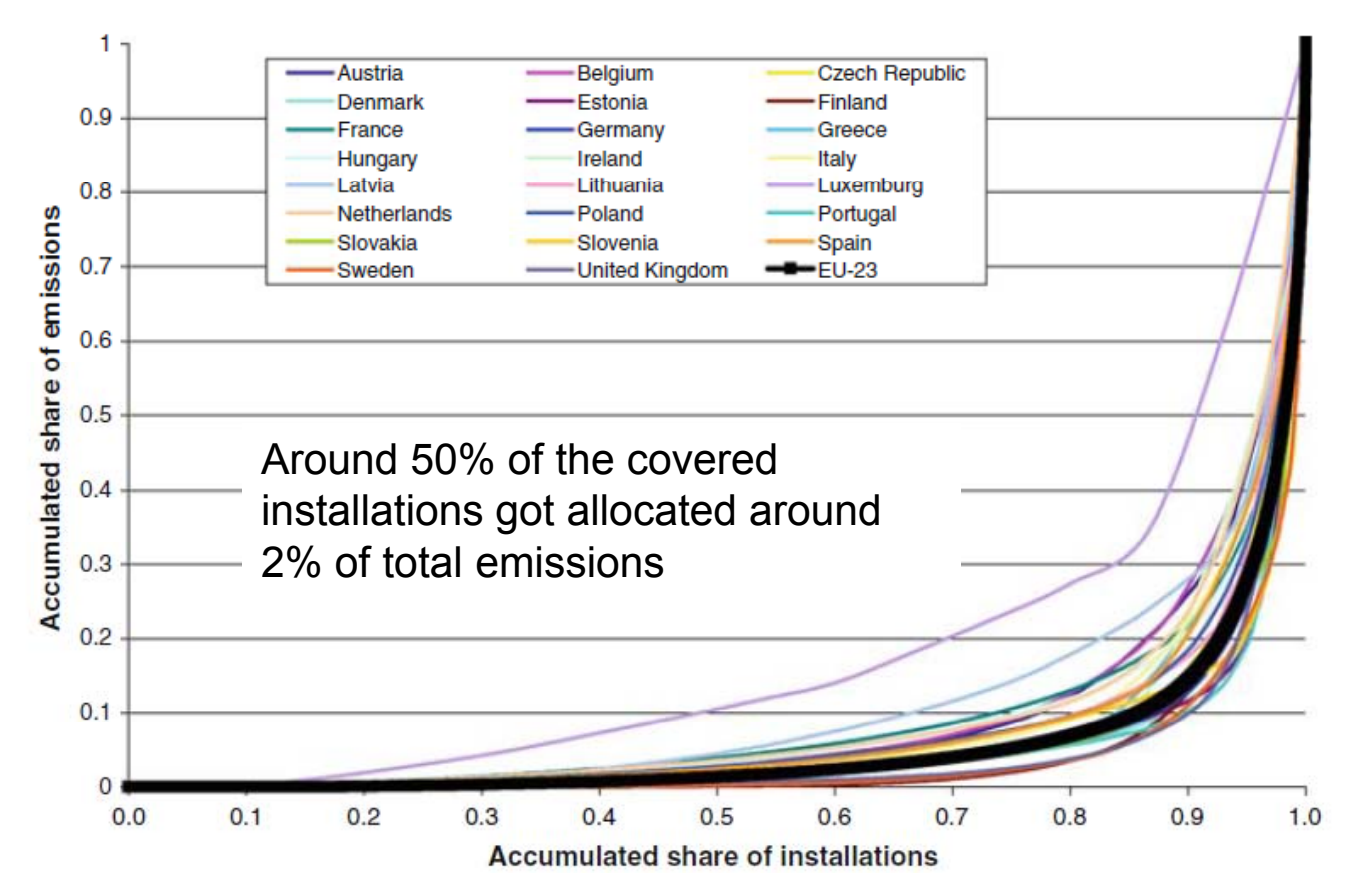
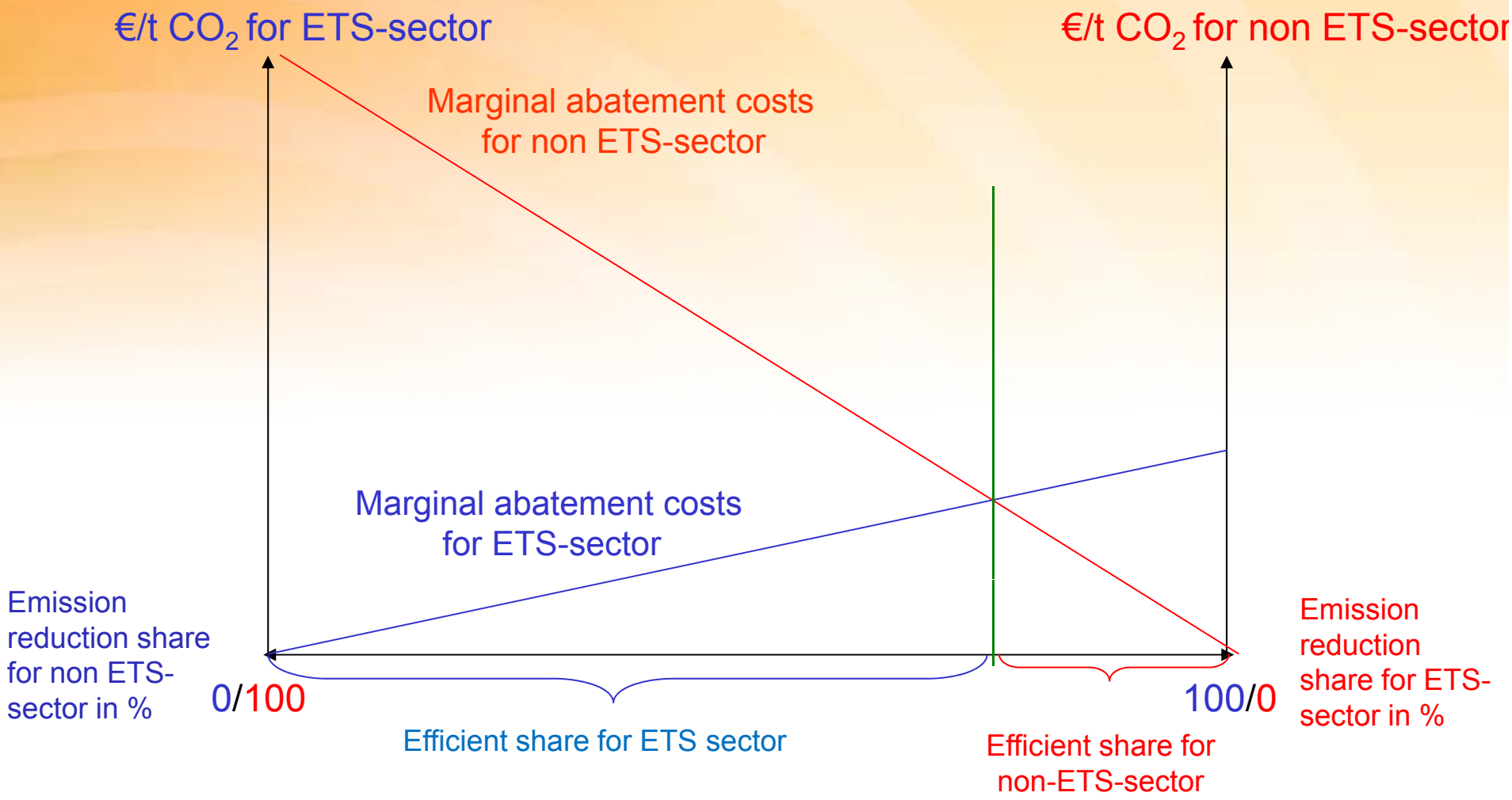


Fig. 1 Share of verified emissions 2005 compared to share of number of installations (Lorenz Curve).
Source: Community Independent Transaction Log (CITL) data

Target setting of ET and Non-ET sector

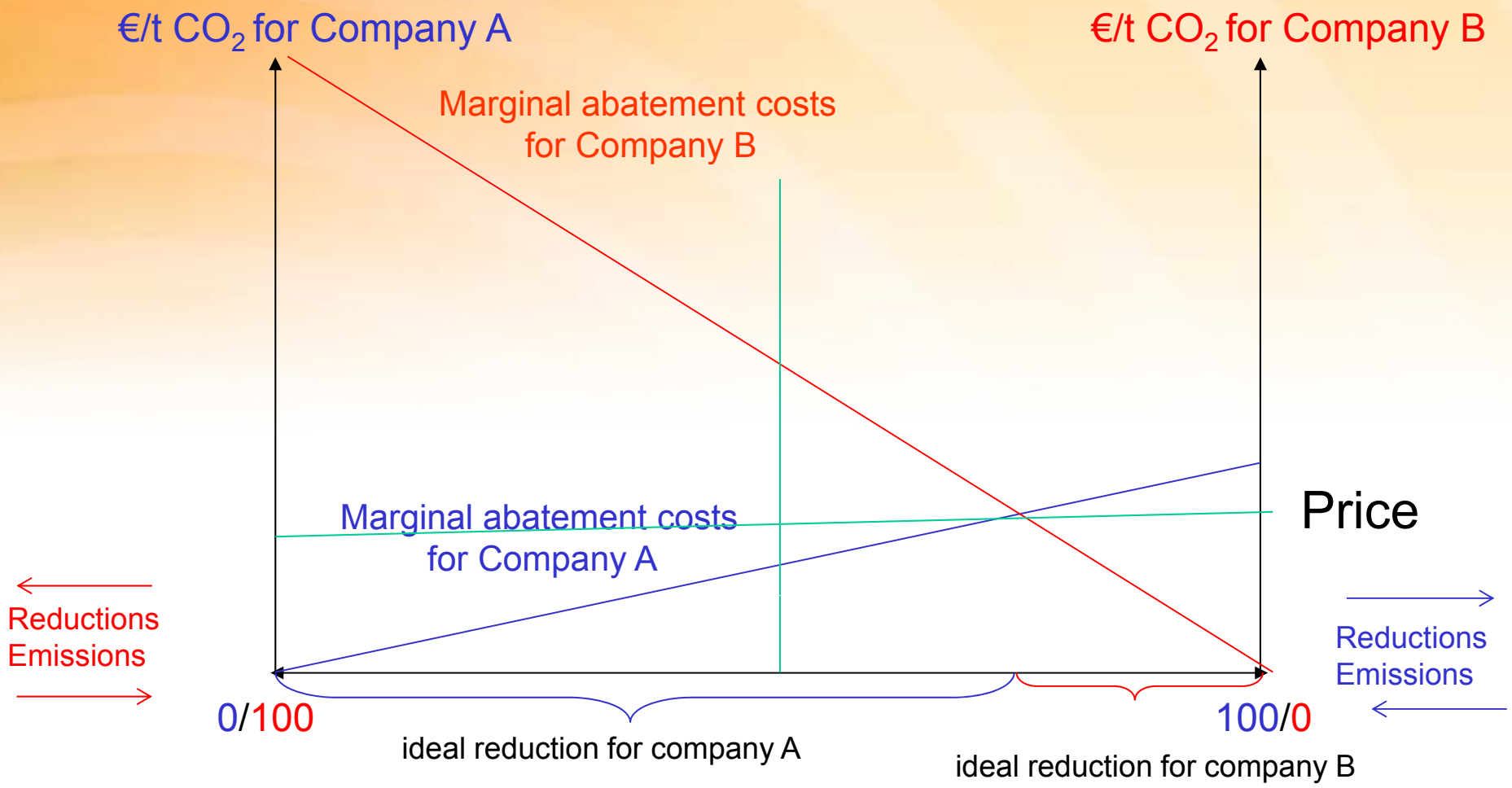


Market efficiency

- Market input related factors
  - Information on abatement options and costs (incl. offsets)
  - Transparency e.g. emissions, reserves
  - Market structure e.g. competitiveness
  - Transaction costs
  - Uncertainty
  - Rational participants (profit maximising, risk neutral)
  - Market oversight
- Output
  - EUA price and volume development
  - Market transactions
  - Production volume
  - Import/Export volume
  - Technology and fuel use
  - Investment and investment plans

- Theory: Under ideal conditions of market input related factors, allocation method only has financial effects, no operational effects (Coase)
- EU ETS (Betz, R.; Rogge, K.; Schleich, J. 2006) :
  - Phase 1: 99.7 % free allocation based on 27 different methods
  - Phase 2: Only around 3% of auctioning, rest free allocation

Theory: Efficiency of ETS based on trading



EU ETS market efficiency

Necessary market conditions	EU ETS
▪ Information on abatement options and costs (incl. offsets)	▪ 60% of companies do not know their abatement costs[1]
▪ Transparency e.g. emissions	▪ Emissions are revealed annualy
▪ Market structure	▪ 46% of emitters did not trade, mainly due to excess allocation. Under-allocated installations avoid trading on the market by internally transfering allowances without payment (61% of companies). Market power?
▪ Transaction costs	▪ Transaction costs are high, especially for small emitters, as they tend to be fixed costs
▪ Uncertainty	▪ UNFCCC process uncertainty affects trust in long-term future of EU ETS
▪ Rational participants	▪ Theory and Experiments: free allocation and uncertainty aversion reduces market efficiency[2]
▪ Market oversight	▪ Oversight is missing, as scandals of VAT carrousel and phishing show

1) KfW/ZEW 2011 2) Theory: Baldurson and von der Fehr 2004; Experiments: Goree et al. 2010; Betz and Gunnthorsdottir 2009

Allocation affects efficiency

- In EU ETS: Free allocation to existing installations leads to strategic behaviour and provides rents to incumbents which will reduce efficiency (see next slide)
  - historic vs. benchmarking affects efficiency
    - Updating of baseperiod: incentive of more emissions as strategic motivation for additional allocation in the future -> less abatement
    - Updating with benchmark: Strategic incentive only for higher production output
  - Fuel-specific vs. fuel-neutral benchmarking distorts reduction decisions
- Free allocation to new entrants coupled with withdrawal of allocation from ceasing installations gives an incentive to keep inefficient plants in operation.
- Allocation to new entrants based on benchmarks on capacity installed gives perverse incentive to build oversized boilers (Denmark has reduced allocation BAT/benchmark)
- Experiment have shown that auctioning will imprive efficiency:

  Auctioning will achieve higher pass-through of opportunity costs (Goree et al 2010)

  Auctioning yields better price discovery at the beginning and better investment-cost efficiency and higher static efficiency (Restiani and Betz 2011)

Auction design matters (Betz, Seifert, Cramton, Kerr 2010)

Distortions of Allocation Methods

Allowance allocation method	*Impacts*	More expenditure on extending plant life relative to new build		Increase plant operation		Less energy efficiency investment
	Distortions	Discourage plant closure	Distortion biased towards higher emitting plants	Shields output (and consumption) from average carbon cost	Distortion biased towards higher emitting plants	Reduce incentives for energy efficiency investments
Auction						
Bench-marking	**capacity only**	X				
	capacity by fuel/ plant type*	X	X			
Updating from previous periods'	**output only**	Y		X		
	output by fuel/ plant type*	X	X	X	X	
	emissions	X	X	X	X	X

Note: X indicates a direct distortion arising from the allocation rule. Y indicates indirect distortions if allocation is not purely proportional to output/emissions.
* Differentiating by plant type adds additional distortions compared to purely fuel-based.

Source: Neuhoff et al. Climate Policy 2006

Dynamic efficiency/Innovation incentives

- Theory: Expected carbon price will give companies (emitters and technology companies) an incentive to invest in low emitting technologies (R&D as well as adaptation of technologies)
- EU ETS evaluation based on case studies (Rogge, Schneider, Hoffmann 2011), interviews (Rogge, Hoffmann 2010) shows:
  - EU ETS does not yet lead to significantly higher rate of investment and adaptation of low emitting technologies
    - Some influence on CCS investment
    - Technology specific policies and fuel price expectations more important
  - EU ETS has had an impact on organisational processes
    - Management is aware of carbon costs
    - Carbon costs are included in investment models
- Analysis on patent data (Dechezleprêtre and Calel 2011) indicates that there may have been positive effects in innovation, especially in France and Germany in 2005

Major barriers to innovation:

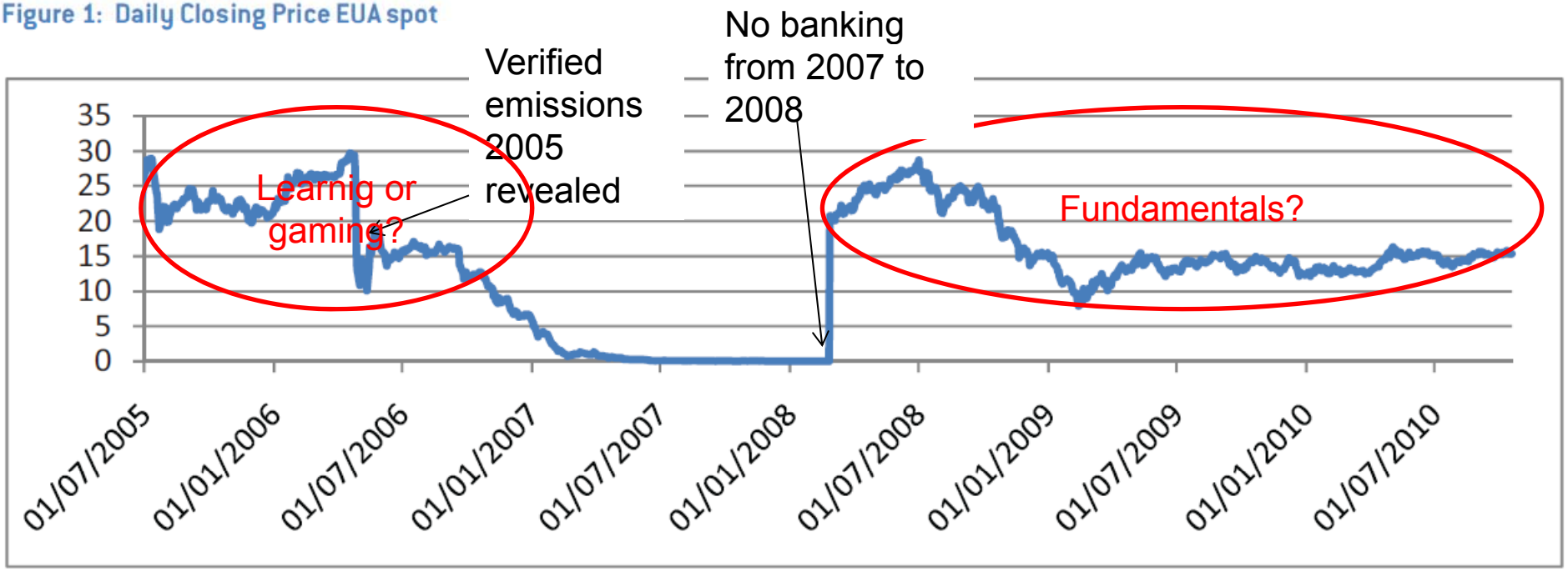
Allocation: excess permits and distortions due to free allocation methods

Long term expectations: uncertainty of future of ETS and cap, price volatility

Therefore investments are postponed due to option value for waiting for more information

Price and Volume Development

Figure 1: Daily Closing Price EUA spot

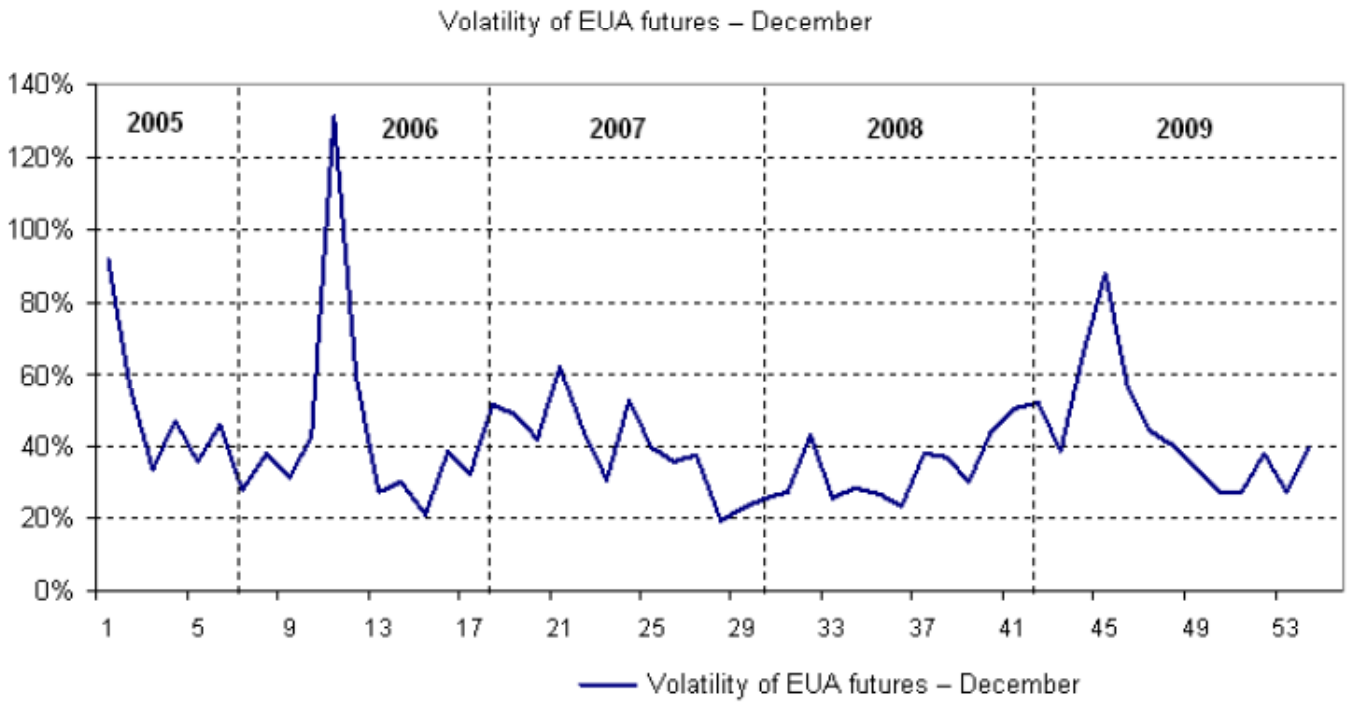


- In theory: Prices should reflect scarcity of permits
- Efficiency should lead for a given target to a low permit price c.p.
- Price volatility may reflect uncertainty
- Phase II: Influence of fundamentals (fuel prices, temperature, availability of hydro power, stock market) but also influence of policy decisions

Source for price graph: Abrell et al. 2011

EUA futures price volatility

Graph no. 1 – Price volatility observed for CO_2 allowances between 2005 and 2009



Source: *CDC Climat Recherche*

Source: Prada Report 2010

General conclusions

- A flexible process to improve the design over time seems crucial to achieve an effective, efficient and fair ETS... Lobbying is compromising early design
- Design matters... the instrument may not work in practice as claimed in the textbook
- Effectiveness: Commission played a crucial role in target setting
- Efficiency:
  - Static: Risk if rules get too complicated and complex some companies will not participate in trading
  - Dynamic incentives: Too early to judge but we may need complementary policies to enhance R&D and diffusion e.g. Sweden introduced a carbon tax that can be avoided when undertaking an energy efficiency audit.
- Equity matters: if allocation unfair, may give emission trading bad name → harms future use of market mechanisms (instrument hopping)
- What did we want in the outset: a price or a quanitity instrument? ETS was setting a price but not reflecting the quantity restrictions of Phase 1

Specific design recommendations

- Target
  - Data and M/R/V rules have to be inplace in order to dermine target
  - Brave politicians or specific institutional set-ups are necessary to set ambigous targets, as no other policy can go beyond the target. Some positive feed-back mechanism of the price.
- Coverage
  - Upstream coverage for small emitters may be more efficient. Opt-out in Phase III
- Allocation
  - There has not been any free allocation formula that did not lead to distortions
  - Auctioning is becoming the dominant form, and auction revenue will have important role to play in terms of fairness
- Market
  - More transparency and disclosure of information necessary: e.g. Moving from calculation to measurement
  - Oversight is necessary to have long term trust in the market

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Thank you for your attention

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