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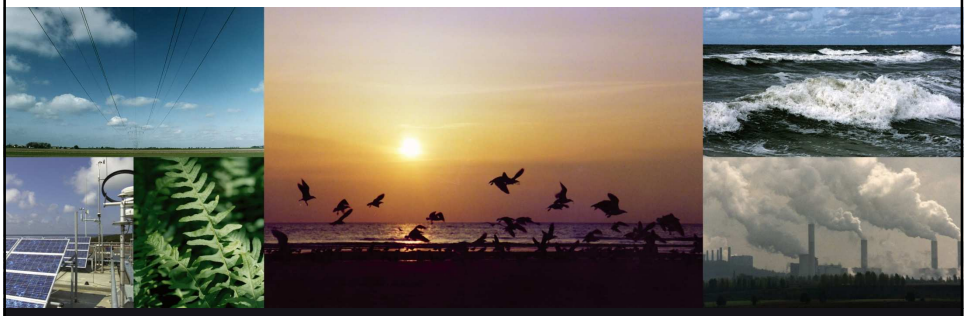
ECN research activities on EU emissions trading

Jos Sijm

Visit of ICAP Summer School to ECN, Amsterdam, 29 July 2010



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- Introduction
- Impact EU ETS on power prices
- [Break]
- Interaction EU ETS and other energy/climate policies
- EU ETS carbon price model
- Questions & discussion

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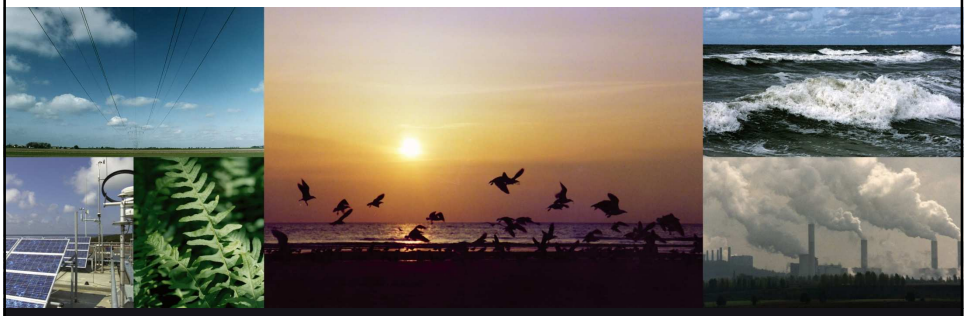
Part I: Impact EU ETS on power sector



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Main research activities by ECN

- **Clients:**
  - Dutch government (2005-2006)
  - Climate Strategies (2006-2007)
  - European Commission (2007-2008)
- **Partners:**
  - Johns Hopkins University (Baltimore, USA)
  - CS Network (Cambridge UK; Oeko-Institute, Berlin)
- **Output (**see ECN website on emissions trading)
  - Publications: reports, papers, book chapters, etc
  - presentations

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Leading questions & major results

- **Questions:**
  - What is the impact of the EU ETS /free allocations on:
    - Electricity prices?
    - Generators' profits?
    - Fuel technology mix?
    - Power sector emissions?

- **Major results:**
  - CO2 costs of free allowances are passed through
  - Power prices and profits increase
  - Fuel switch from coal/lignite to gas/biomass
  - Emissions reductions due to both supply and demand response
  - Policy implications: auctioning rather than free allocations

Analytical tools

1. Review of the literature
2. Theorectical analyses
3. Interview with stakeholders
4. Empirical & statistical analyses
5. COMPETES model analyses
6. Policy analyses

Today focus on 4 and 5

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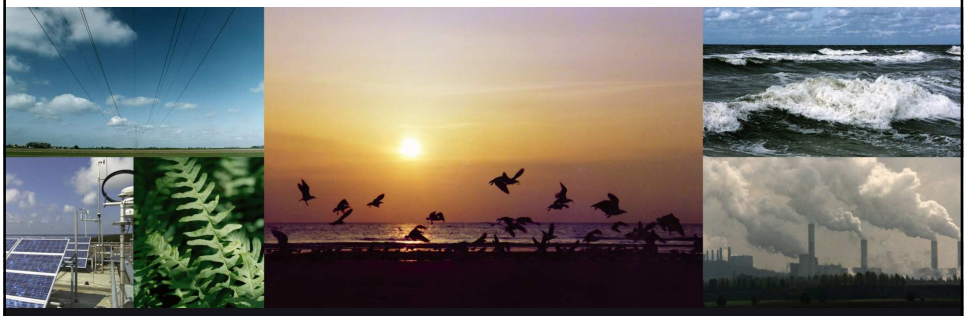
Empirical & statistical analyses



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Coverage & type of analyses

- **Countries**:
  - Germany, France, Italy, Poland, Spain, Sweden, the Czech Republic, the Netherlands and the United Kingdom
- **Markets**:
  - Wholesale: forward and spot
  - Retail: households and industry
- **Period**:
  - peak & off-peak
  - 2005 and 2006
- **Type of analyses**:
  - Trends in power prices and fuel/carbon costs
  - Trends in (clean) power spreads (i.e. price minus costs)
  - Estimates of carbon cost pass-through rates

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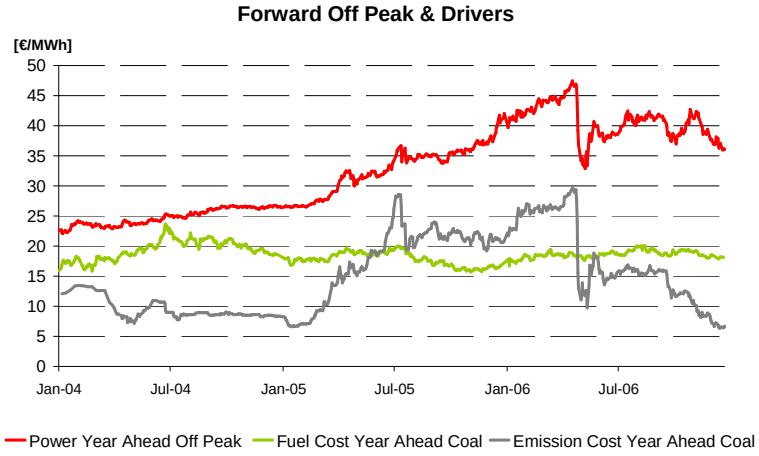
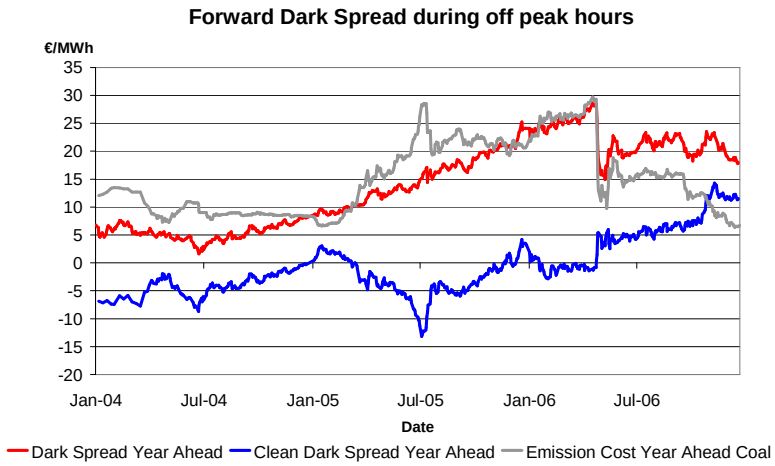
Germany: trends on fuel, carbon and power markets (Year-ahead, off-peak, 2004-2006)



Germany: trends in power spreads & emission costs (Year-ahead, off-peak, 2004-2006)



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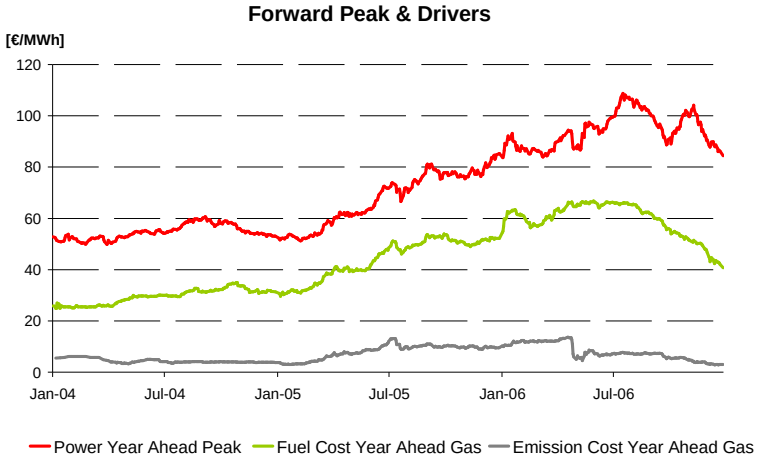
The Netherlands: trends on fuel, carbon and power markets (Year-ahead, peak, 2004-2006)



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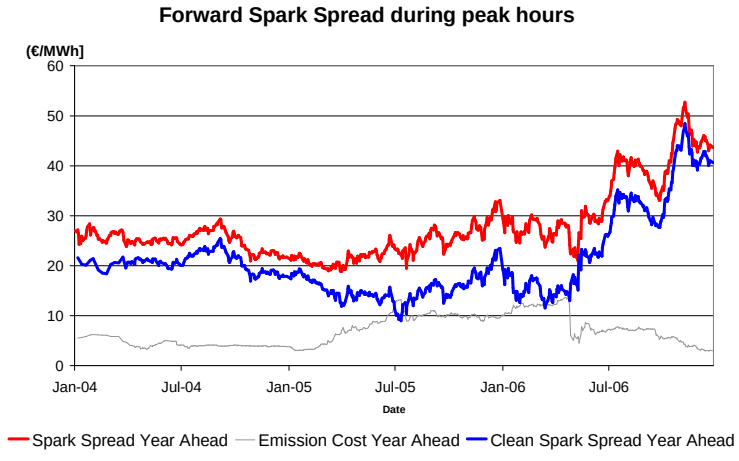
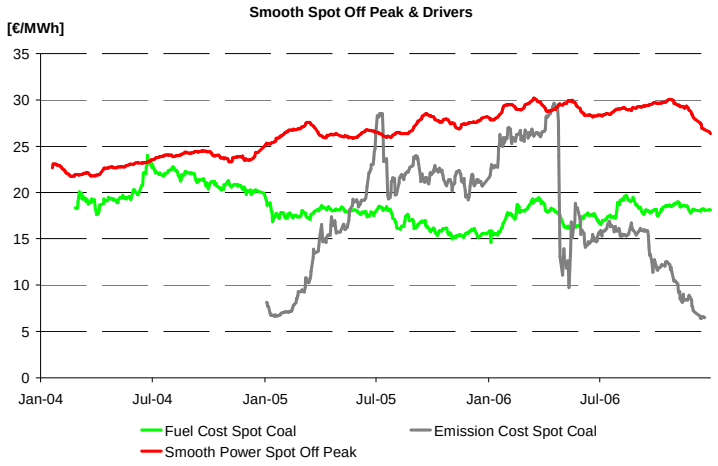
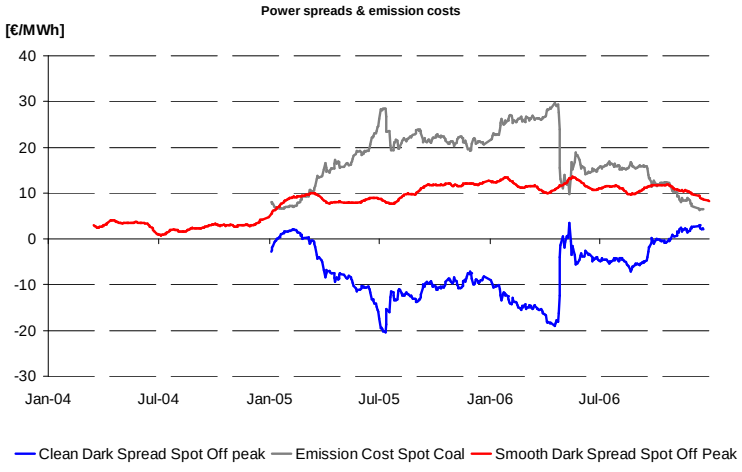
The Netherlands: trends in power spreads & emission costs (Year-ahead, peak, 2004-2006)



Poland: trends on fuel, carbon and power markets (spot, off-peak, 2004-2006)



Poland: trends in power spreads & emission costs (Year-ahead, off-peak, 2004-2006)



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Major empirical and statistical results

- Significant increases in power prices, notably between early 2005 and mid-2006.
- Increases in power prices are due to increases in fuel costs (gas/oil) and carbon costs (notably in case of coal).
- Link between spot prices and fuel/carbon costs is less clear due to other factors affecting spot prices.
- CO2 costs of (free) EU allowances are passed through (40-100%).
- Statistical evidence is lacking or inconclusive for some cases (Poland, Italy).

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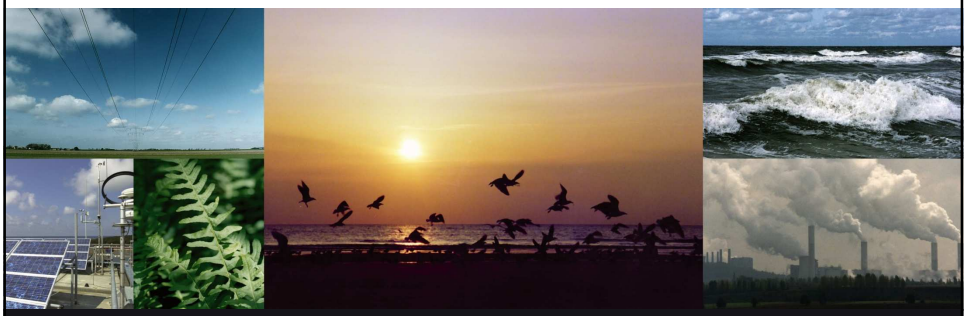
COMPETES model analyses



Model characteristics/advantages model

- Simulation model of wholesale power market, including:
  - all major EU ETS countries,
  - all major generation technologies, and
  - 12 different load periods.
- Model analyses impact of different factors on pass-through of carbon costs to power prices, including differences in:
  - market structure,
  - fuel mix/switch, and
  - demand responsiveness.
- Other advantages of COMPETES model:
  - Analyse impact of EU ETS on carbon emissions, differentiated by changes in supply (dispatch) and demand
  - Analyse impact of EU ETS and allocation (auctioning versus grandfathering) on generators profits.

Major results of COMPETES analyses (1)

- **Scenario**: perfect competition, 2006 data (including CO2 price of 20 €/t)
- **Change in power prices**:
  - EU-20: +13 €/MWh (Hungary-Poland: 9-19 €/MWh)
  - EU-20: +29% (Portugal-Poland: 17-82%)
- **Pass-through rate**:
  - Marginal: EU-20: 93% (UK-Italy: 56-122%)
- **Changes in generators' profits**:
  - Due to free allocation ("Windfall B"): +20 bn € (+27%)
  - Total ("Windfall profits A + B): +35 bn € (+49%)
- **Reductions in CO_2 emissions (all 20€/t scenarios)**:
  - Due to fuel switch (dispatch): 81-133 MtCO2
  - Due to demand response: 0-82 Mt CO2
  - Total: 112-215 MtCO2 (i.e. 10-20% of reference emissions)

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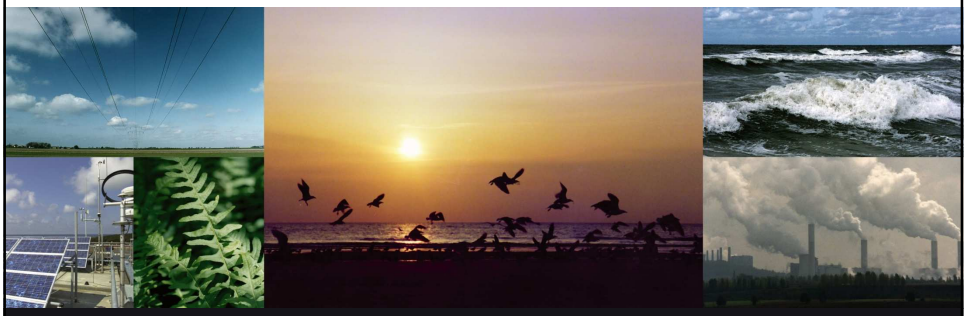
PART II: Interaction and other climate/energy policies



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Main research activities by ECN

1. **Project:** 'Interaction in EU climate policy' (INTERACT)
   - **Client:** European Commission (2001-2003)
   - **Objectives:**
     - Analyse interactions ETS and national energy & climate policies
     - develop recommendations to improve policy mix
   - **Partners:**
     - research institutes from UK, France, Germany and Greece

2. **Project: '**Roadmap 2050'
   - **Client:** European Climate Foundation (ECF)
   - **Objectives:**
     - General: Design/analyse roadmap for decarbonisation of EU power sector by 2050.
     - Specific: what are the implications for the EU ETS and other, interacting policies
   - **Partners**:
     - McKinsey, Oxford Economics, E3G, KEMA

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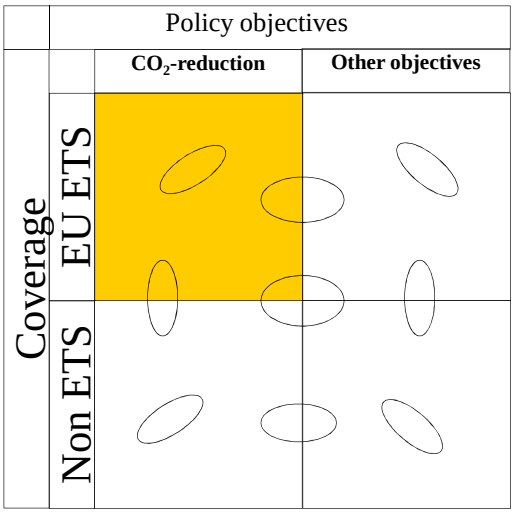
Interaction EU ETS and other policy instruments



INTERACT: countries and policy instruments analysed besides emissions trading

Category	UK	Nether-lands	Germany	France	Greece
Carbon/ energy taxes	✓	✓	✓		
Negotiated agreements	✓	✓	✓	✓	
Support mechanisms for renewable electricity	✓	✓	✓	✓	✓
Industrial pollution control	✓			✓	✓
GHG emissions trading	✓			✓	
Promotion of energy efficiency	✓				

EU ETS: main features & implications

- Two features of Cap & Trade system:
  - Environmental effectiveness: target will be reached
  - Cost effectiveness: target will be reached efficiently
- Implications for other policies:
  - Other policies are no longer CO_2 effective
  - Increase social abatement costs
  - Decrease price of emission allowance
  - Hence: abolish all other policies??

Justifications for interacting instruments

- Improving the static efficiency of the ETS by overcoming market failures other than CO_2 externalities that inhibit the adoption of energy efficiency and carbon saving technologies;
- Improving the dynamic efficiency of the ETS by overcoming market failures in the area of technology innovation and diffusion;
- Delivering objectives other than carbon efficiency, such as the promotion of energy security or social equity, or the mitigation of local pollution; and
- Addressing deficiencies of the ETS design such as mitigating the risks of allowance price uncertainty for long-term investments in carbon reducing innovations.

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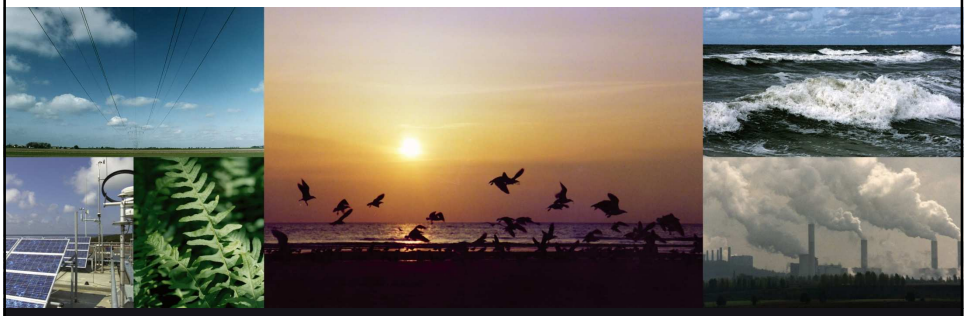
EU ETS carbon price model



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Purpose & basic model features

- **Purpose**:
  - Explain/predict the (average) EU ETS carbon price over the period 2008-2020
  - Analyse impact of changes in market fundamentals and certain policy variables on carbon price
  - Use & adjust model for specific projects/assignments

- **Features**: simulation market model (in Excel):
  - Demand/supply of EU ETS allowances (EUAs)
  - Demand/supply of EU ETS emission reductions
  - See Figures 1 and 2

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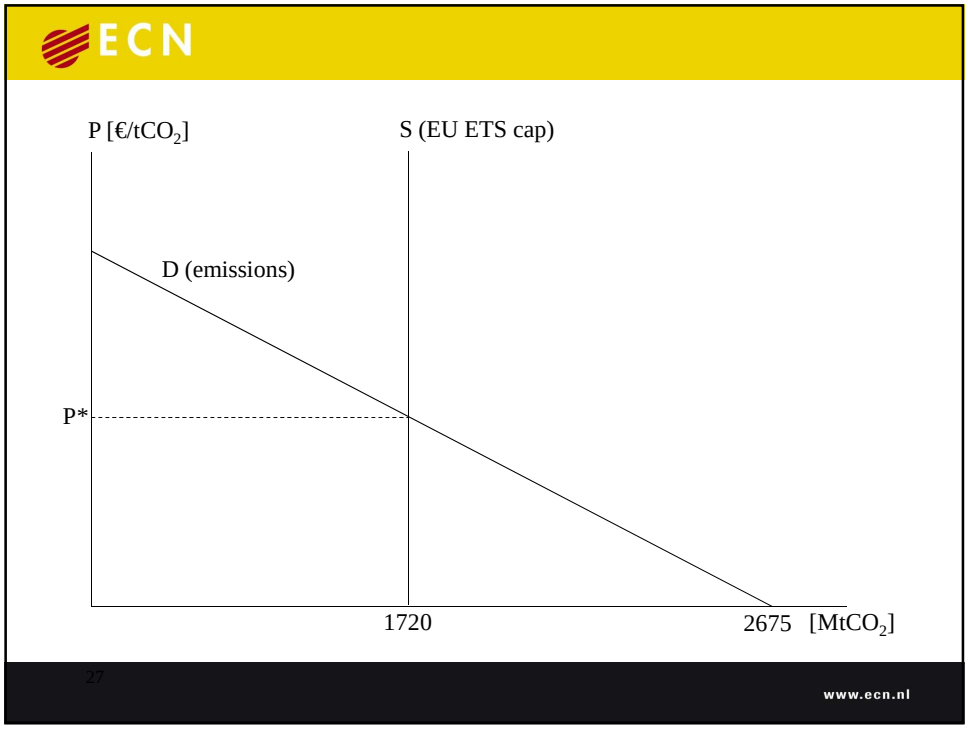
P [€/tCO2]
S (EU ETS cap)
D (emissions)
P*
1720
2675
[MtCO2]
27
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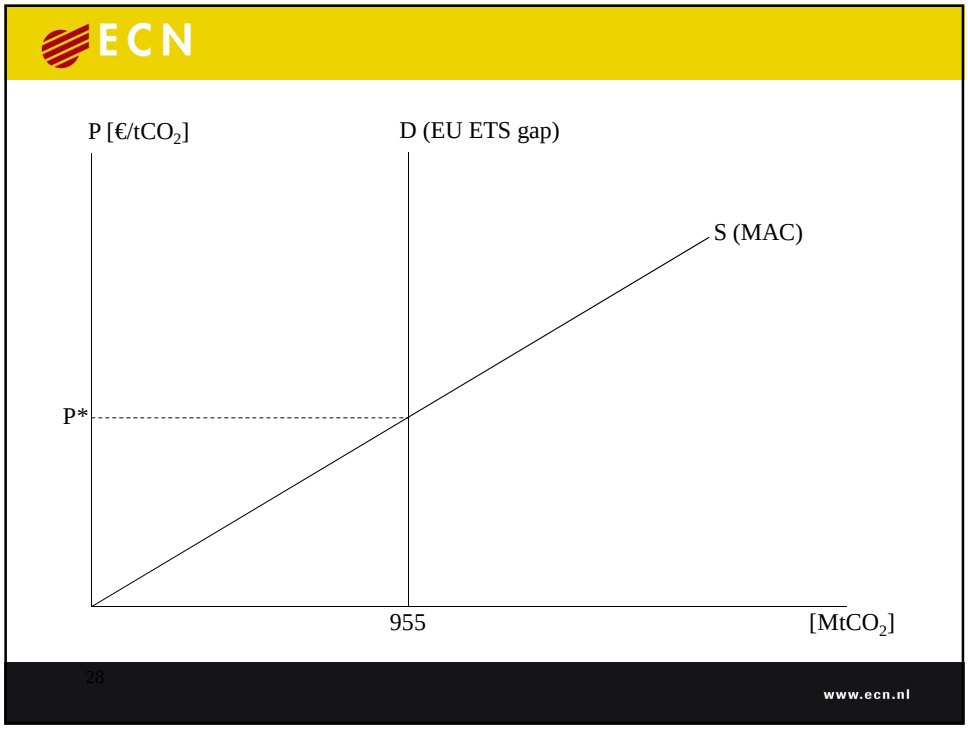
P [€/tCO2]
D (EU ETS gap)
S (MAC)
P*
955
[MtCO2]
28
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Major input variables/data

- EU ETS emissions scenario (2008-2020), depending on:
  - Market fundamentals:
    - Economic growth (2010-20: 2.4% p.a.)
      - Economic growth/emission elasticity: 0.6
      - Emissions growth (2010-20: 1.44%)
    - Fuel prices
  - Policy variables, i.e. CO_2 reductions in ETS sectors due to:
    - Renewable energy (RE) policies
    - Energy efficiency (EE) policies
- EU ETS cap
- Use of off-set credits (JI/CDM)
- EU ETS abatement potentials and costs (MAC curve)

Major output variables/results

- 'EUA demand' (ex-ante), i.e. demand for EU allowances (EUAs) when CO2 price is 0

- 'EUA gap' (ex ante), i.e. shortage of EUAs (=E EUA demand -/- supply/cap)

- EUA (equilibrium) price, i.e. when EUA demand = supply

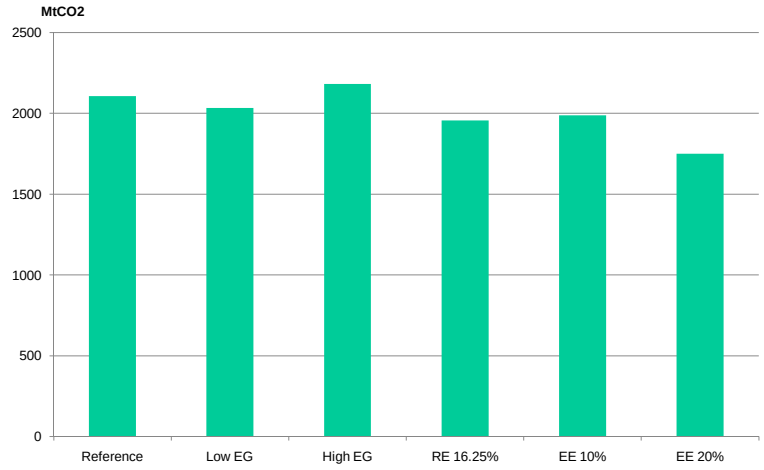
- Emission reductions in ETS sectors due to:
  - EU ETS
    - Domestic reductions
    - Foreign reductions (JI/CDM)
  - Other (i.e. additional RE/EE) policies

- Total abatement costs due to:
  - EU ETS
  - Other (i.e. additional RE/EE) policies

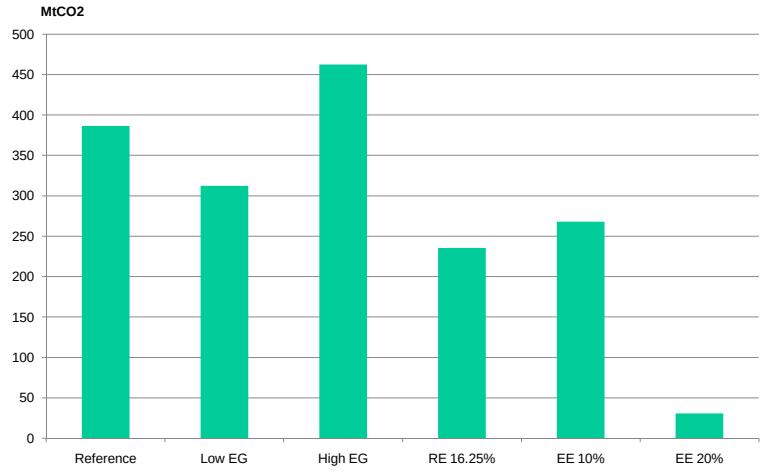
Model scenarios

	EG 2010-20	EE	RE
Scenario	%	%	%
Reference	2,40%	5,00%	12,57%
Low EG	1,90%	5,00%	12,57%
High EG	2,90%	5,00%	12,57%
RE 16.25%	2,40%	5,00%	16,25%
EE 10%	2,40%	10,00%	12,57%
EE 20%	2,40%	20,00%	12,57%

Results (1): ex-ante demand for EU allowances (EUAs)



Results (2): EUA gap – required EU ETS emission reduction



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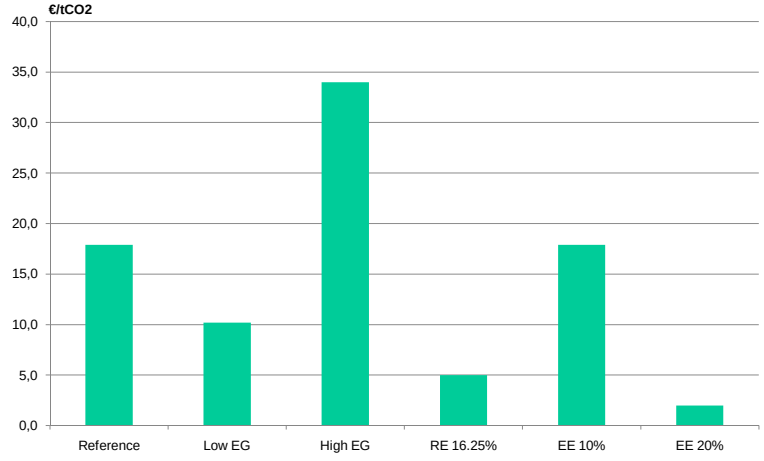
Results (3) EUA price



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Model results: summary table

	EUA demand	EUA gap	EAU price
Scenario	MtCO2	MtCO2	€/tCO2
Reference	2106	386	17,9
Low EG	2033	313	10,2
High EG	2183	463	34,0
RE 16.25%	1955	235	0,0
EE 10%	1988	268	17,9
EE 20%	1751	31	0,0