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CO_2 emission abatement in the power sector:
on EU ETS and renewables

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Based on joint work with Kenneth Van den Bergh, Denny Ellerman, Hannes Weigt and William D'haeseleer

Outline

- Europe's climate policy on GHG emissions
- CO_2 abatement in the power sector
- Interaction between EU ETS and renewables
- Concluding remarks

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Outline

- Europe's climate policy on GHG emissions
  - EUA price evolution
  - Current problems and how to fix them
- CO_2 abatement in the power sector
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Europe's climate policy on GHG emissions

EUA price evolution

Second phase: 2008-2012

Europe's climate policy on GHG emissions

EUA price evolution

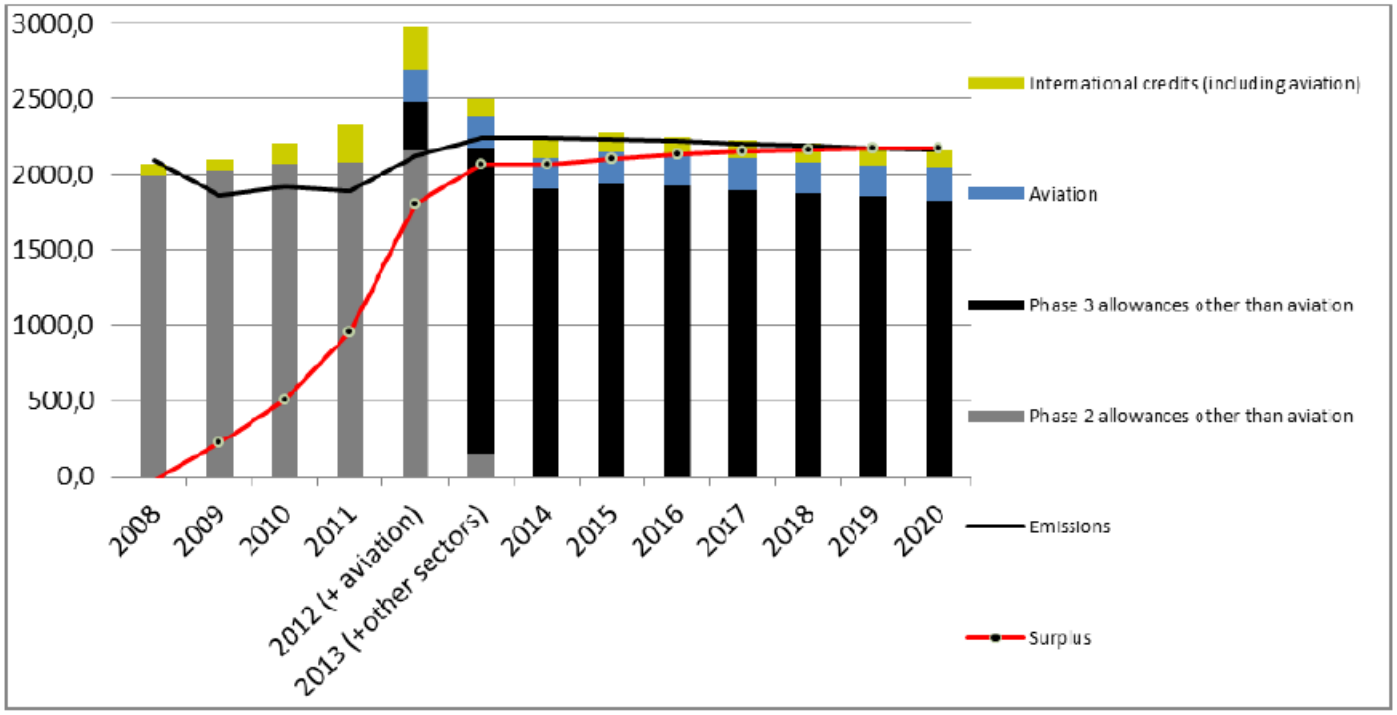
Second and third phase

Europe's climate policy on GHG emissions

Current problems and how to fix them

- Low prices
  - Economic recession
  - Inflow of international credits
  - Separate policies (e.g., renewables targets)
- Self-reinforcing effect
  - Banking
  - Surplus of allowances

Figure 2: Historic and likely future profile up to 2020 of supply and demand



Source: SDW (2012) 234 final

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Europe's climate policy on GHG emissions

Current problems and how to fix them

Reform options

- Increase demand for allowances
  - Extend scope of ETS to other sectors
- Decrease supply for allowances
  - Increase EU target to 30% in 2020
  - Retire number of allowances
  - Revise linear reduction factor
  - Limit access to international credits
- Discretionary price management
- Discretionary quantity management

Reform plans

1. **Backloading**: temporary withdrawal of number of allowances in the short term (phase 3)
2. **Market stability reserve**: quantity management to stabilize ETS price in the long term (phase 4)

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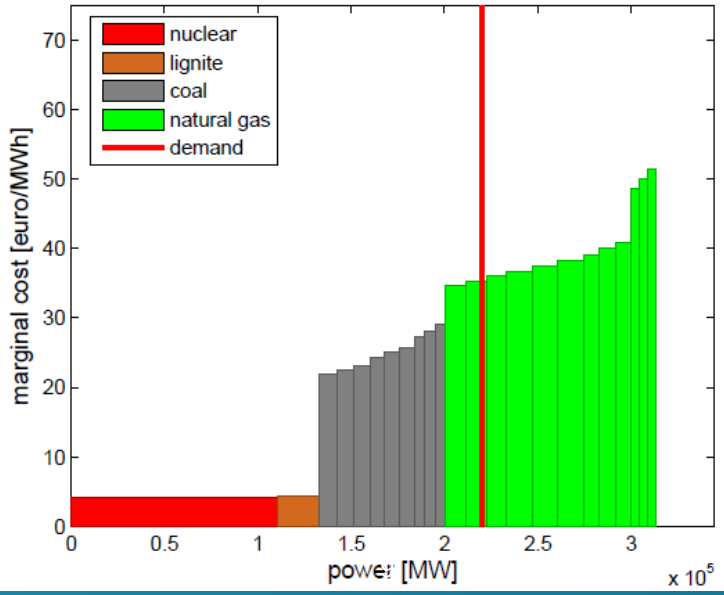
- Europe's climate policy on GHG emissions
- CO_2 abatement in the power sector
  - CO_2 emission drivers
  - Fuel switching as major abatement technology
- Interaction between EU ETS and renewables
- Concluding remarks

CO_2 abatement in the power sector

CO_2 emission drivers

Conventional portfolio	Residual load	Generation costs
• Fuel mix, age, technical parameters, etc. • Might change in the long term (years)	• Electricity demand minus renewables generation • Might change in the medium term (months)	• Marginal generation costs of conventional units • Might change in the short term (days)



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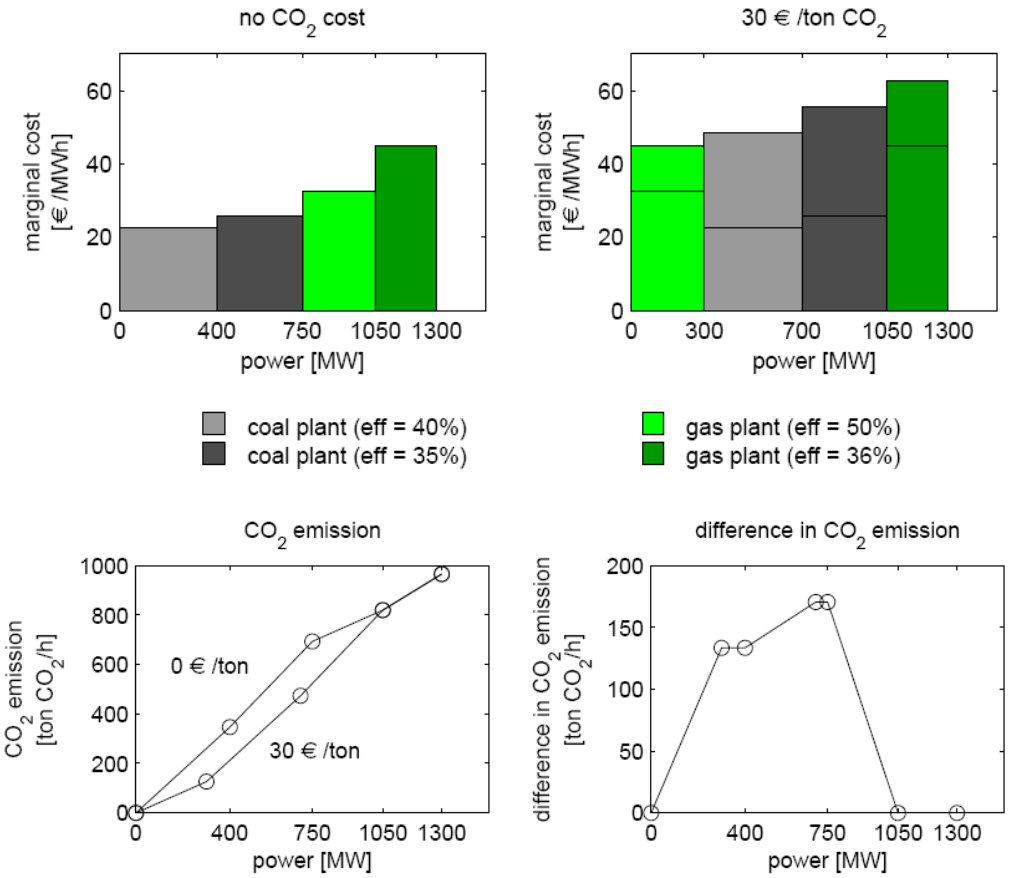
CO_2 abatement in the power sector

CO_2 emission drivers

	Conventional portfolio	Residual load	Generation costs
General influences/policies	Cost, legislation, etc.	Economic growth/ downturn, energy efficiency, electrification, RES obligation, etc.	Fuel prices.
CO_2 cost	Changes levelized cost of electricity, making low-carbon technology more interesting	Electricity price increase, reducing demand, renewables investments	Marginal costs and ranking in merit order

CO_2 abatement in the power sector

Fuel switching as major abatement technology



CO_2 price where

$MC_{coal} = MC_{gas}$

is ***switch price***

Pure operational,

short term

Outline

- Europe's climate policy on GHG emissions
- CO_2 abatement in the power sector
- Interaction between EU ETS and renewables
  - Framework
  - Quantification of interaction effect
- Concluding remarks

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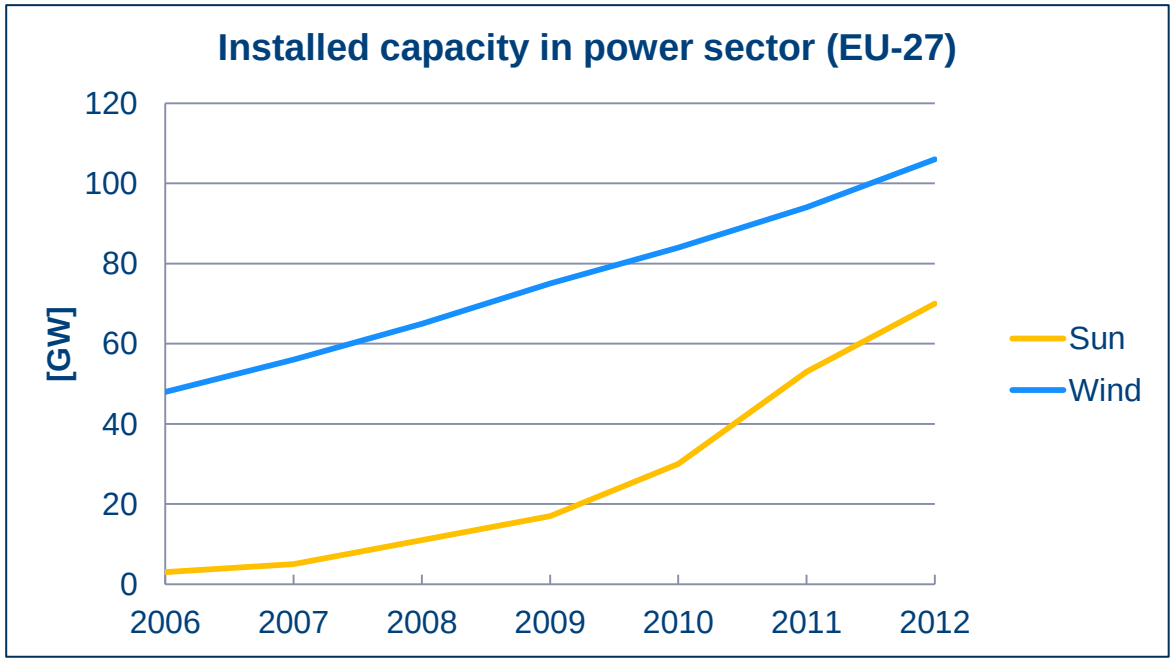
Interaction between EU ETS and renewables

Framework

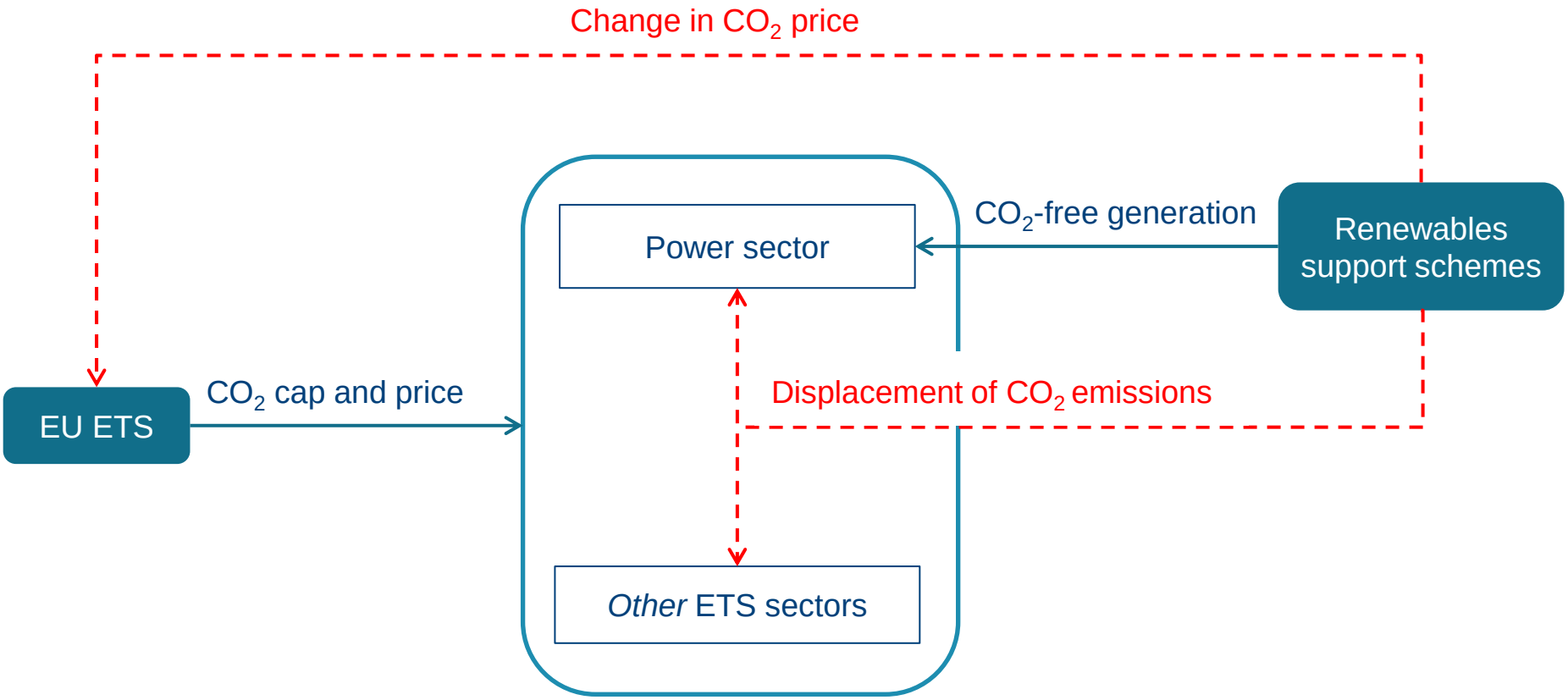
20% RES by 2020 → National targets



Source: EWEA, EPIA

Interaction between EU ETS and renewables

Framework



Given the historical amount of renewable injections, what is the effect on ...

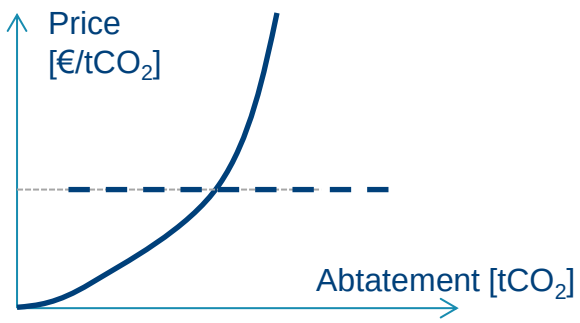
- the EUA price?
- CO_2 emission displacement within the EU ETS?

Interaction between EU ETS and renewables

Quantification of interaction effect

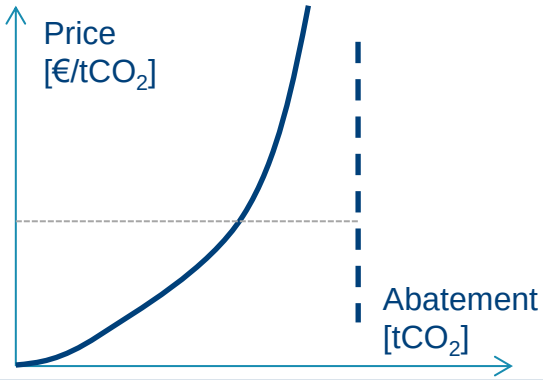
ETS-price assumption

- All equivalent abatement possible in other ETS sectors at current CO_2 price
- Power sector experiences EU ETS as CO_2 tax
- Renewables cause only CO_2 displacement away from power sector (outer limit)



ETS-cap assumption

- No change abatement possible in other ETS sectors at “any” CO_2 price
- Power sector experiences EU ETS as sectorial cap
- Renewables cause only CO_2 price decline (outer limit)



Interaction between EU ETS and renewables

Quantification of interaction effect

- Approach
  - Simulate the impact of renewables deployment according to the 2 extremes
  - Determine all possible situations between these 2 extremes
  - The ‘real’ solution lies somewhere on this curve

- Limitations of the analysis
  - Conventional generation system is assumed to be fixed
  - Historical emissions assumed as cap
    - Less banking in absence of RES?
  - No low-carbon investments triggered by a high CO_2 price
  - All wind, sun and bio assumed to be the result of support schemes

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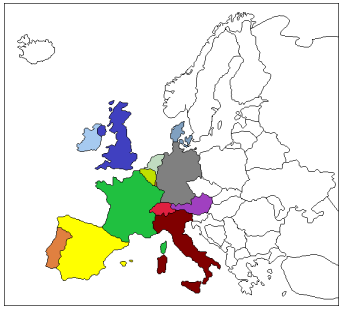
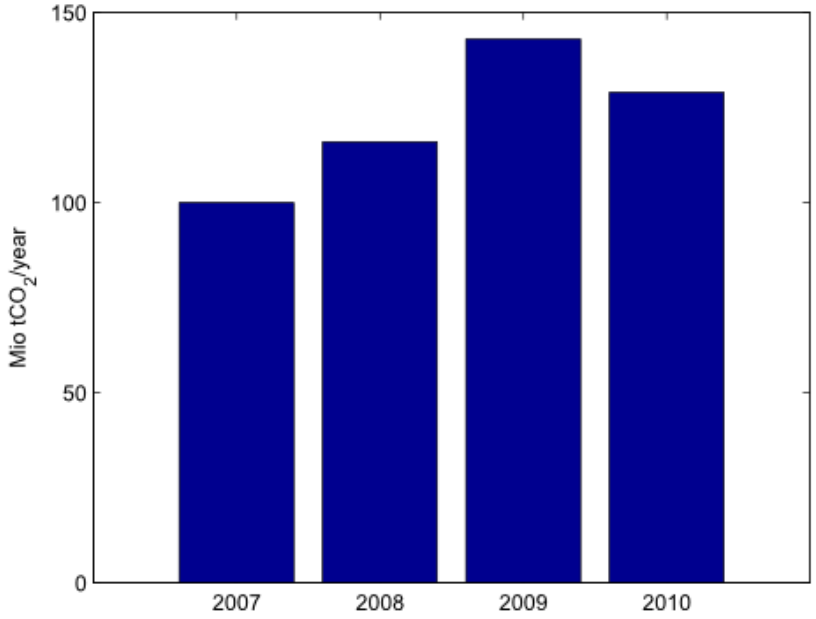
Interaction between EU ETS and renewables

Quantification of interaction effect

- CO_2 displacement according to ETS-price assumption
  - From the power sector to other ETS sectors
  - Respectively 10%, 13%, 16% and 15% of historical emissions





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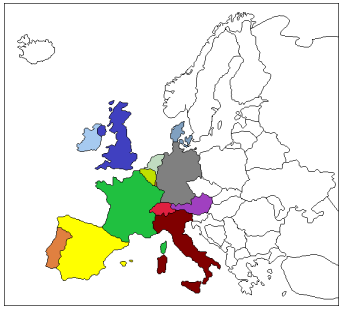
Interaction between EU ETS and renewables

Quantification of interaction effect

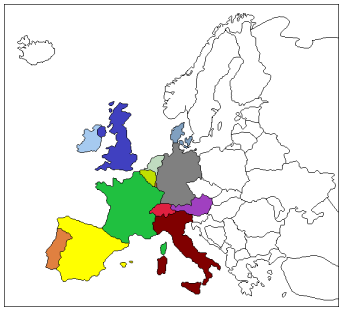
- CO_2 price increase according to ETS-cap assumption
  - CO_2 price needed to keep emissions constant without renewables
  - In 2009, impossible to reach historical emissions



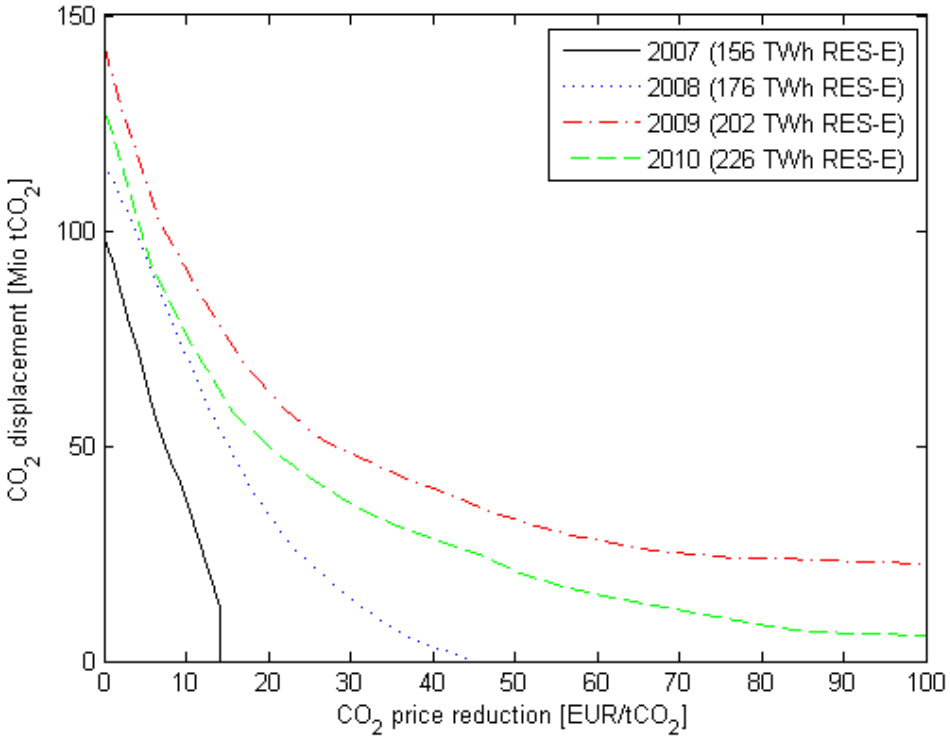
CO_2 price [EUR/tCO_2]	OBS	NORES
2007	1	15
2008	22	68
2009	13	∞
2010	14	474

Interaction between EU ETS and renewables

Quantification of interaction effect



Impact curve



Range of possible effects of historical renewable generation in terms of CO_2 price reduction and CO_2 displacement from the power sector towards other ETS sectors.

- All wind, sun and bio assumed to be the result of support schemes
- No investments in generation capacity
- Historical emissions assumed as cap

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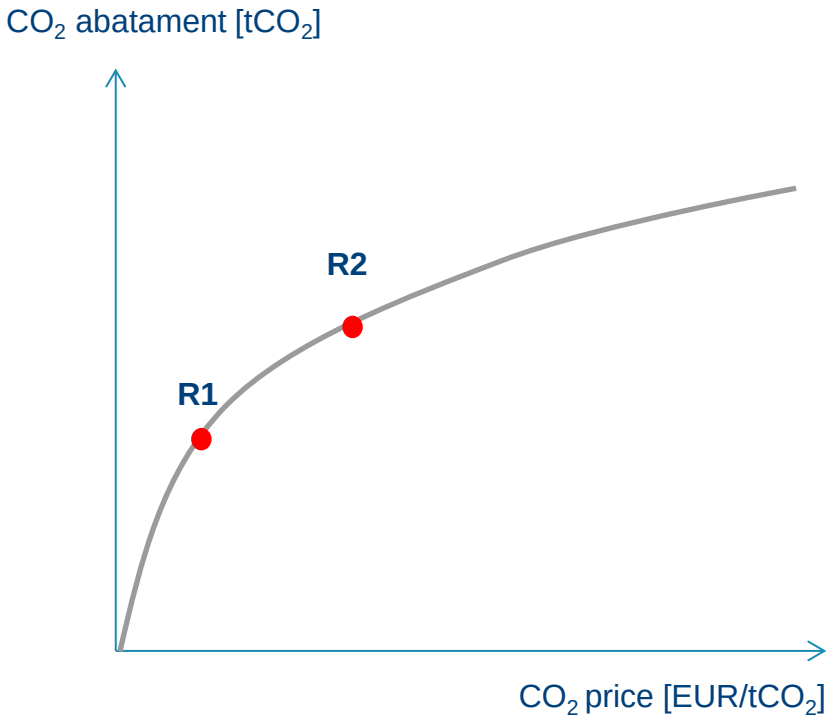
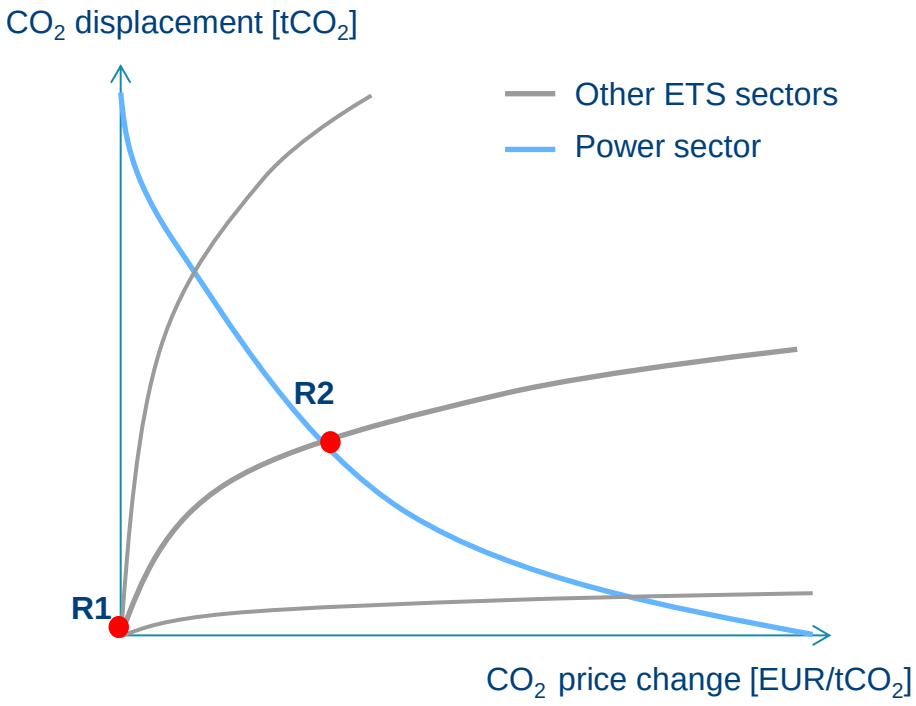
Interaction between EU ETS and renewables

Quantification of interaction effect

The intersection of the impact curve with the MACC of the other ETS sectors



MACC of other ETS sectors



Intersection MACC other ETS sectors and impact curve

Concluding remarks

- General conclusions
  - EU model
    - The CO_2 price decrease caused by renewables deployment turns out to be likely significant
    - CO_2 emission displacement from the power sector to other ETS sectors due to renewables deployment can be up to more than 10 % of historical emissions in the power sector

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Concluding remarks

- Reflections on 2030 framework
  - EU ETS
    - If prime instrument for climate action, make way for stable high enough price
    - Backloading
      - Good first step, but impact limited
      - Current ETS price far too low to trigger coal-to-gas fuel switching (order of 40 €/ton)
    - Market Stability Reserve
      - Impact remains to be seen & further studied

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Concluding remarks

- Reflections on 2030 framework
  - RES targets? → Be aware of interaction effects
    - To be further studied
    - RES do not decrease CO_2 emissions but decrease ETS price
    - If RES targets to be continued → market compatible support mechanisms
    - Higher costs

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More information?

See website research group in Leuven (Belgium):

http://www.mech.kuleuven.be/en/tme/research/energy_environment/Energy_and_environment

- Including publications

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