FONDAZIONE ENI ENRICO MATTEI

Session 2

Revisiting the interactions of ETS and non-trading sectors

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The WITCH Model - www.witchmodel.org

WITCH: World Induced Technical Change Hybrid model

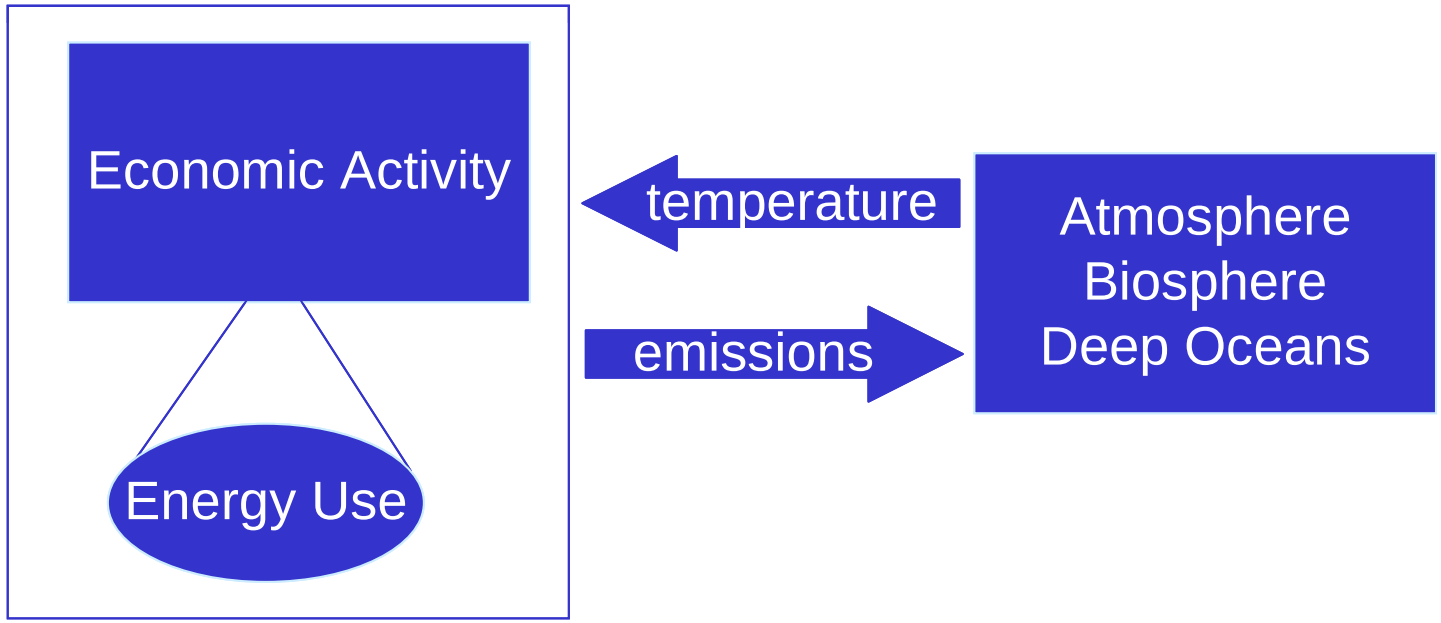
Hybrid I.A.M.:

- **Economy**: Ramsey-type optimal growth (inter-temporal)
- **Energy**: Energy sector detail (technology portfolio)
- **Climate**: Damage feedback (global variable)

- 13 Regions ("where" issues)
- Intertemporal ("when" issues)
- Game-theoretical set-up (free-riding incentives)

- Bosetti, V., E. Decian, A. Sgobbi and M. Tavoni (2009). "The 2008 WITCH Model: New Model Features and Baseline." FEEM Working Paper 85.09 .
- Bosetti V., E. Massetti, M. Tavoni (2007). "The WITCH Model, Structure, Baseline, Solutions", FEEM Working Paper 10.2007.
- Bosetti, V., C. Carraro, M. Galeotti, E. Massetti and M. Tavoni (2006). "WITCH: A World Induced Technical Change Hybrid Model", The Energy Journal, Special Issue. Hybrid Modeling of Energy-Environment Policies: Reconciling Bottom-up and Top-down, 13-38.

WITCH in Brief



Stabilization Scenario

WITCH is a forward looking model and needs a long-term price of carbon: stabilization target at 2100

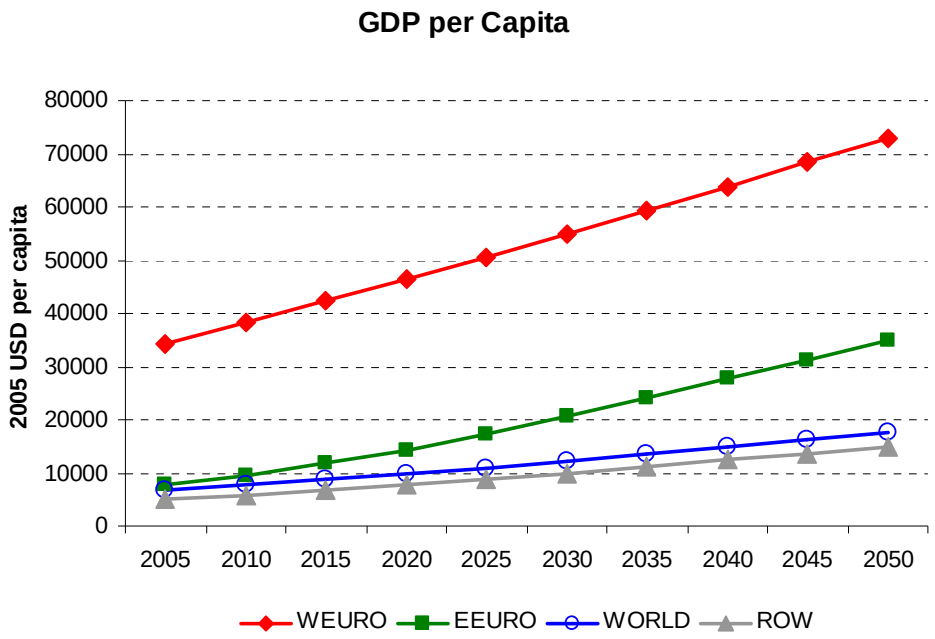
In order to simulate an international market for carbon offsets, we have assumed that all world countries sign in 2010 an international treaty to stabilize GHG concentrations at 535 ppm CO_2-eq at 2100

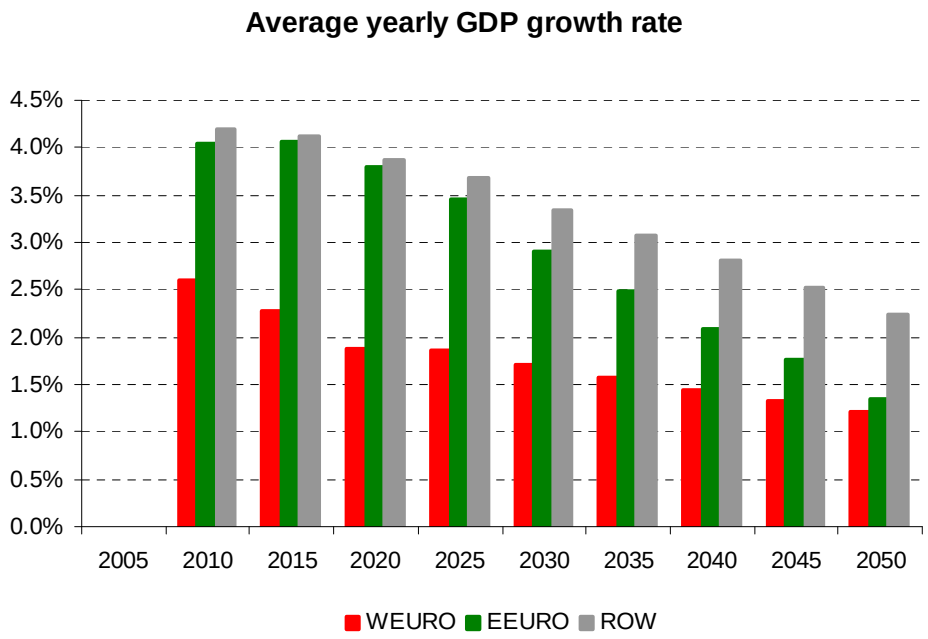
The abatement effort is distributed according to the "contraction-and-convergence" rule (equal-per-capita at 2050)

The international price of carbon is not affected by the distribution of permits (Coase Theorem)

This allocation requires a -20% reduction of emissions wrt 1990 in Europe

Economic Growth





Higher economic growth rates in Eastern Europe determine (mild) convergence

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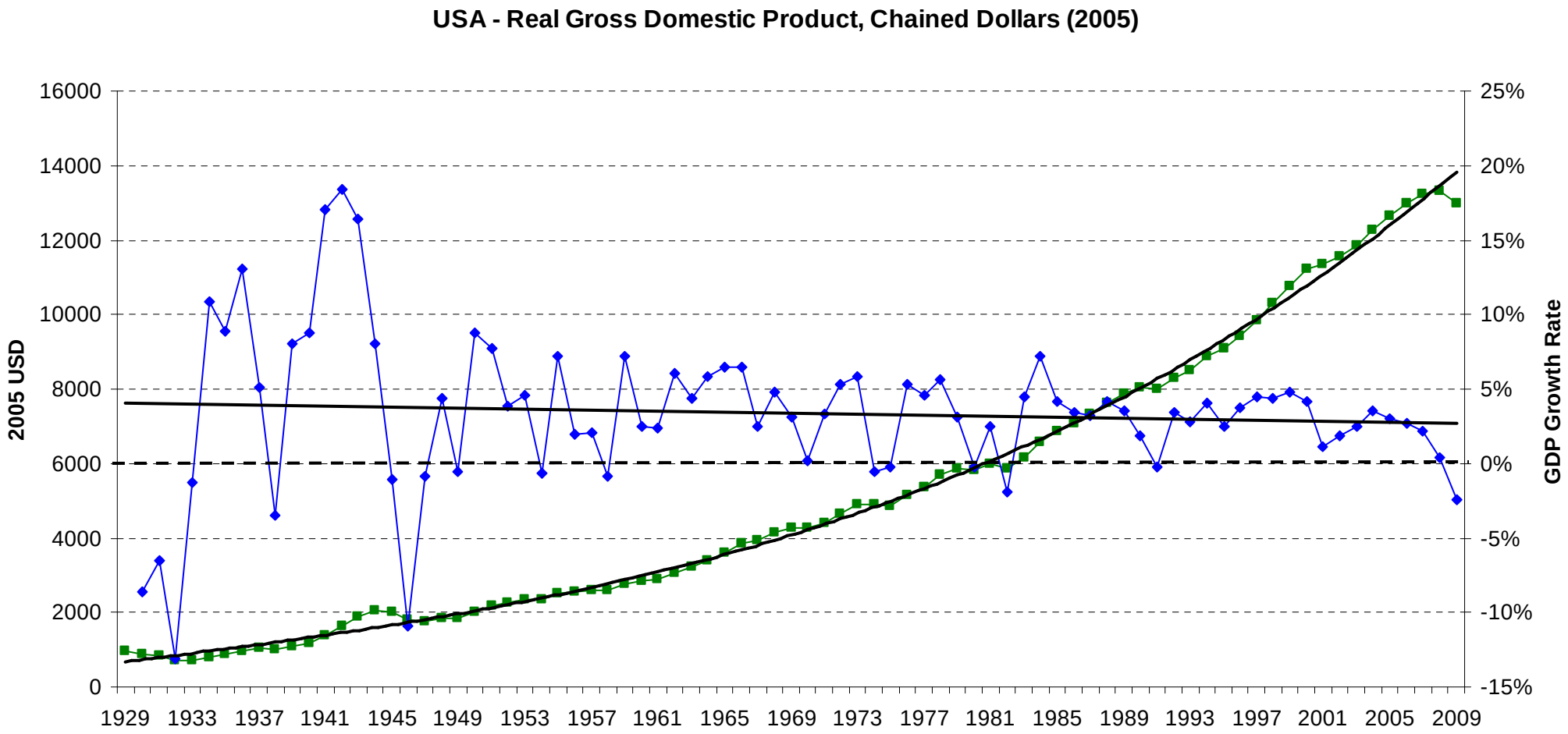
Scenarios of Economic Growth



USA WITCH: 2010 3.3%; 2015 2.9%; 2020 2.5%. Historic 2005-2007: 3.5%.

WEURO WITCH: 2010 2.6%; 2015 2.3%; 2020 1.9%. Historic 2005-2007: 2.7%.

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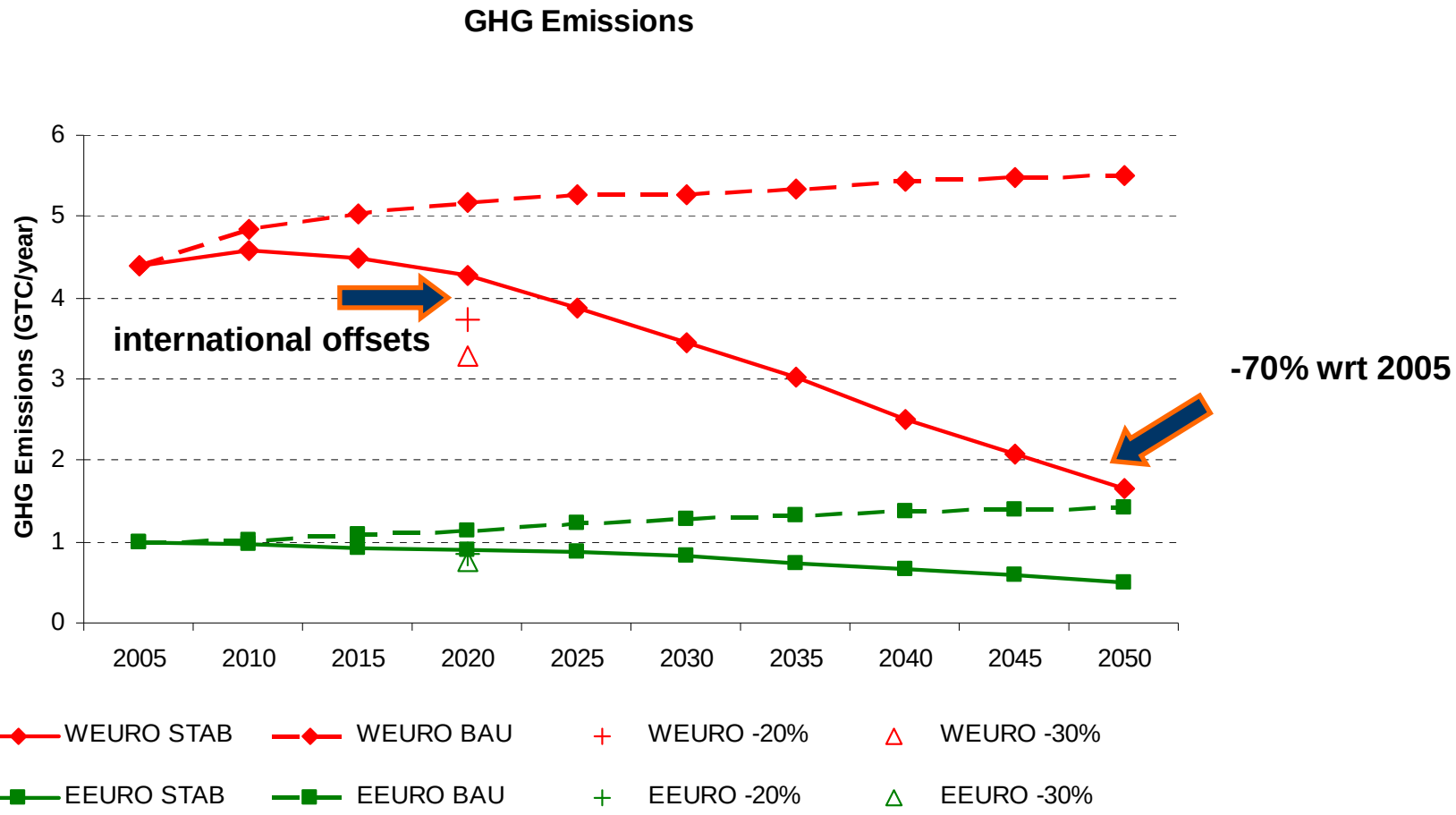
Emissions in the BaU and in the Policy Scenario



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The Economic Crisis: Implications for EU Climate Policy

With sufficient flexibility (i.e. banking) emissions reductions should be calibrated on long term growth rather than on short term economic fluctuations

It is not clear how the economic crisis has affected marginal abatement costs:

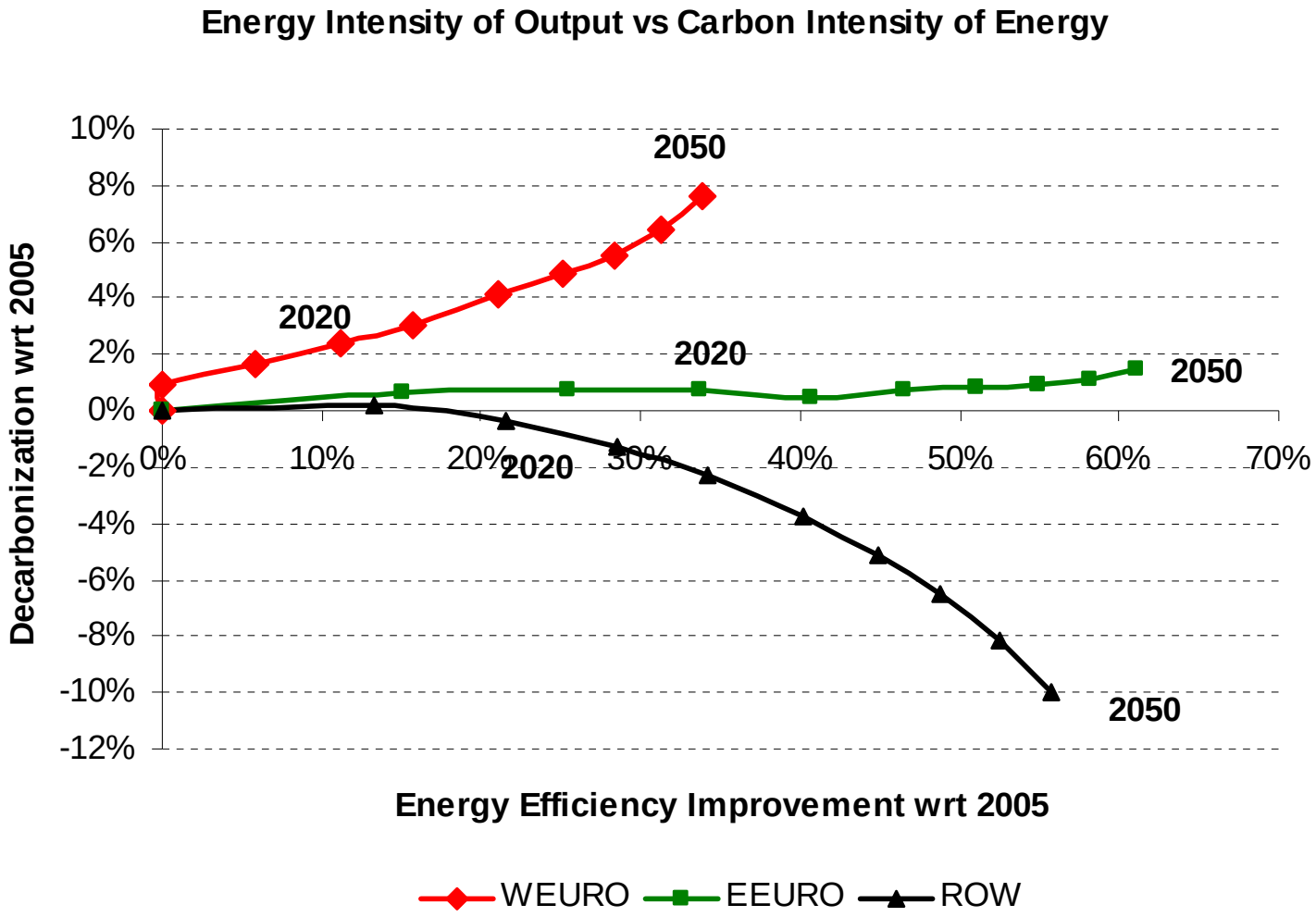
- only if marginal abatement costs are lower now than in the future it is rationale to adopt a stricter target

Very low abatement targets (-20% on wrong trajectory)?

Fear of "hot air"? A price floor can be imposed in the market

The rationale of cap&trade is to fix the pace of abatement not the price of carbon (Weitzman, 1974)

Energy Efficiency and Decarbonization: BaU



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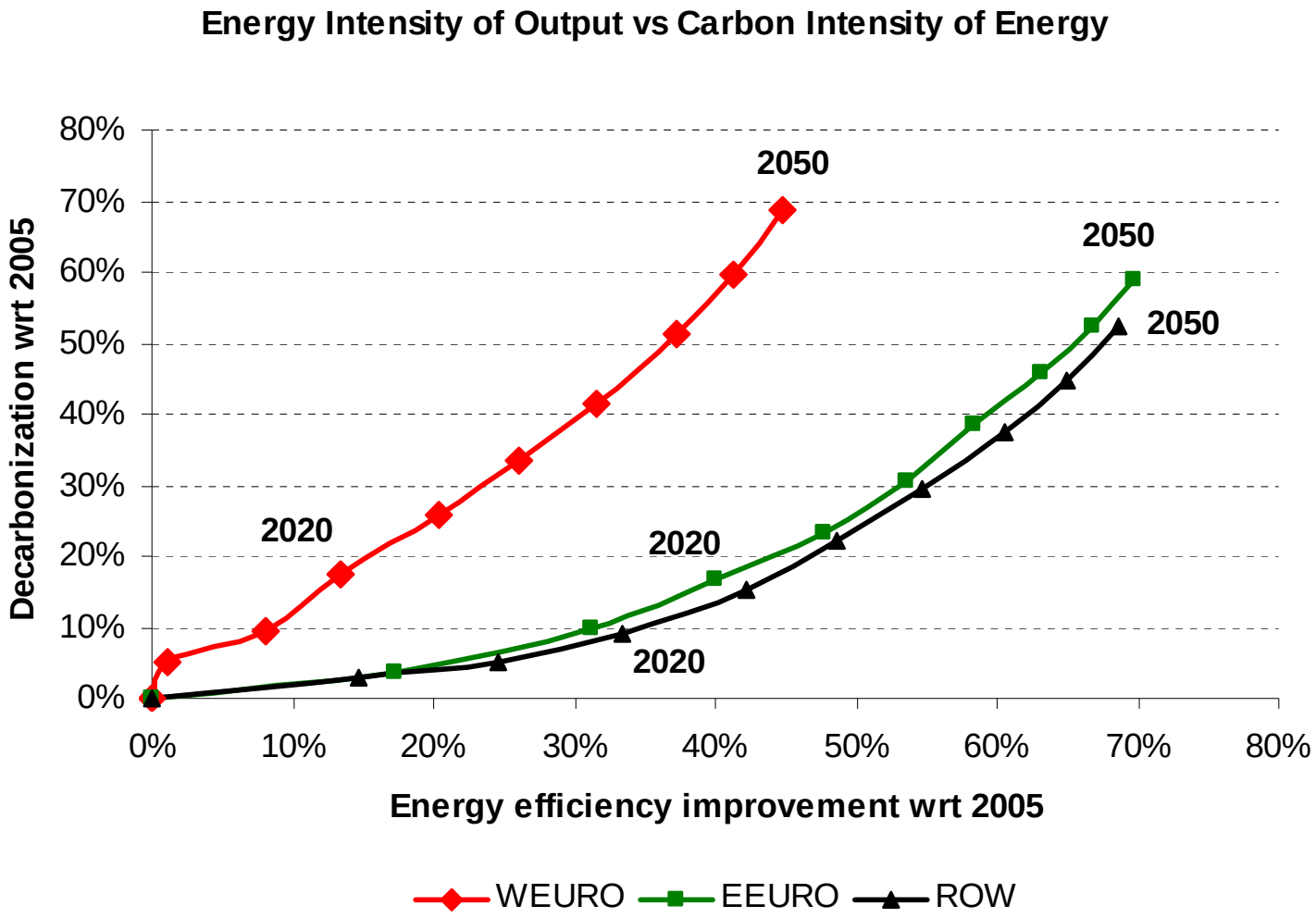
Energy Efficiency and Decarbonization: Climate Policy



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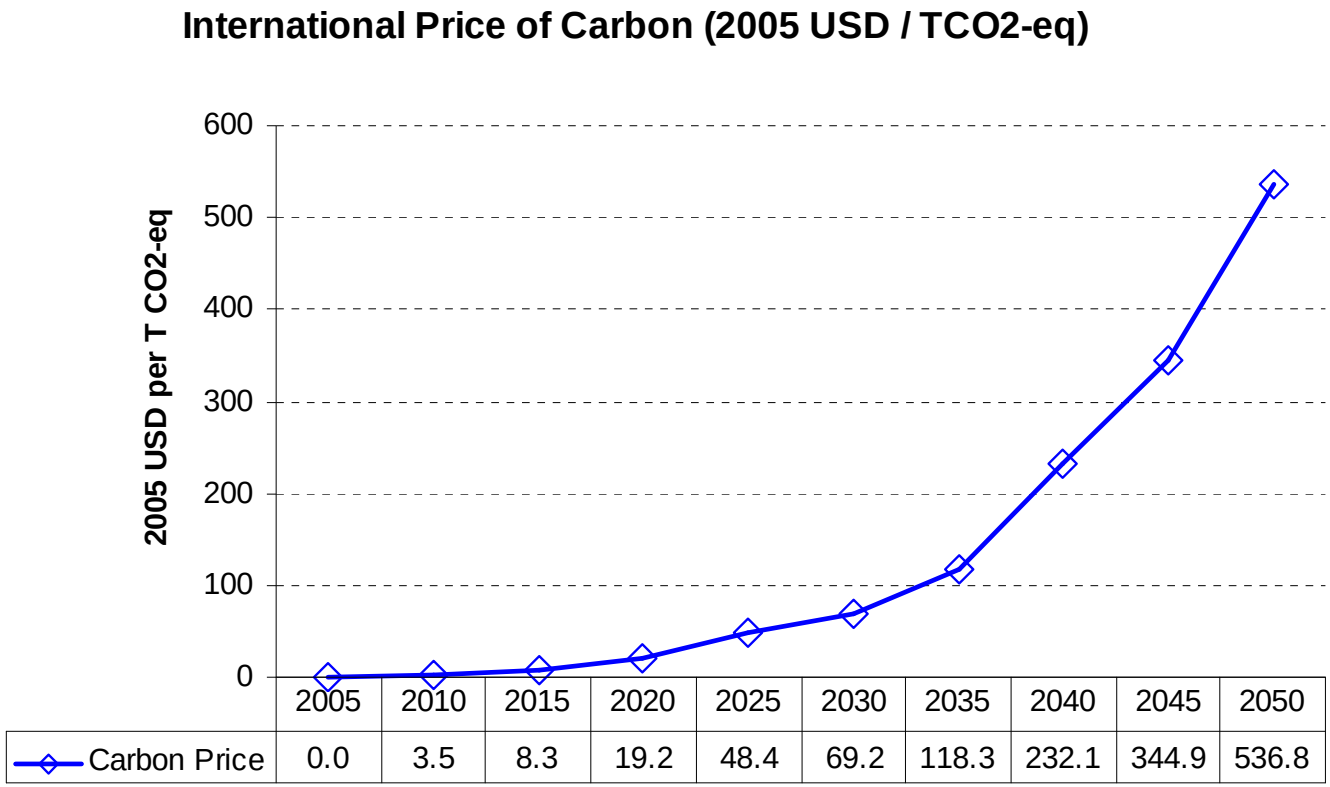
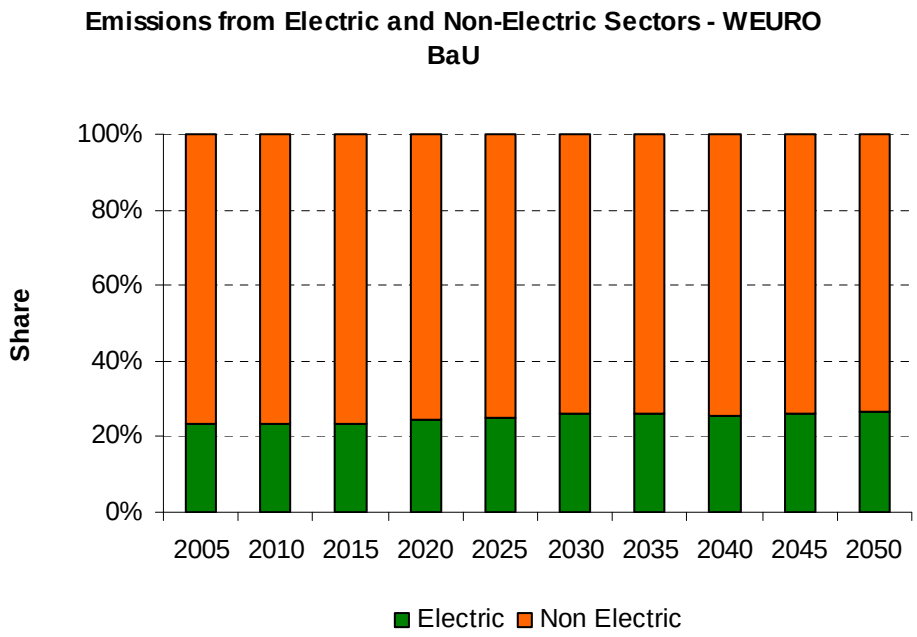
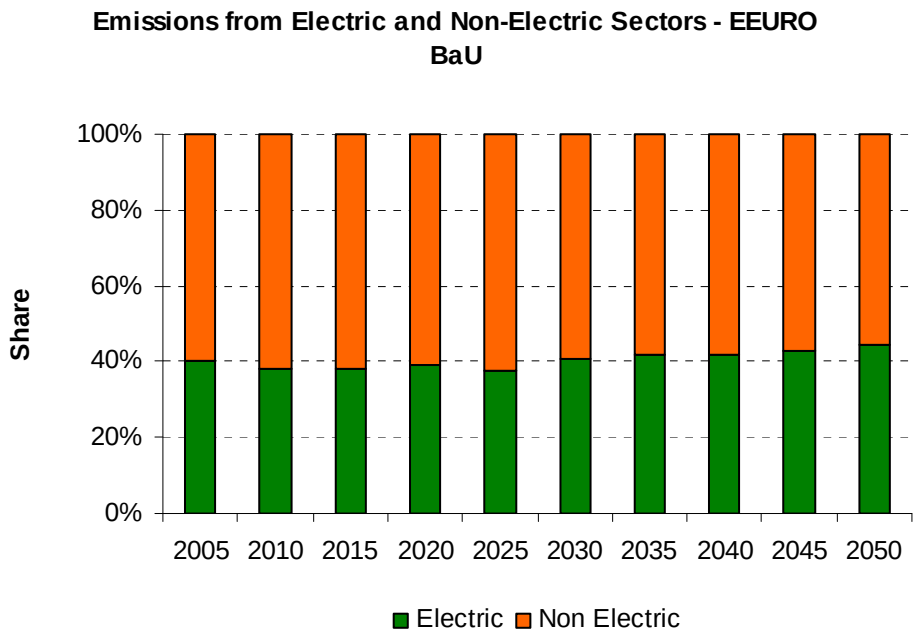
Carbon Price



	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Carbon Price	0.0	3.5	8.3	19.2	48.4	69.2	118.3	232.1	344.9	536.8

Electric vs non-Electric Sector (ETS vs NonETS) - BaU





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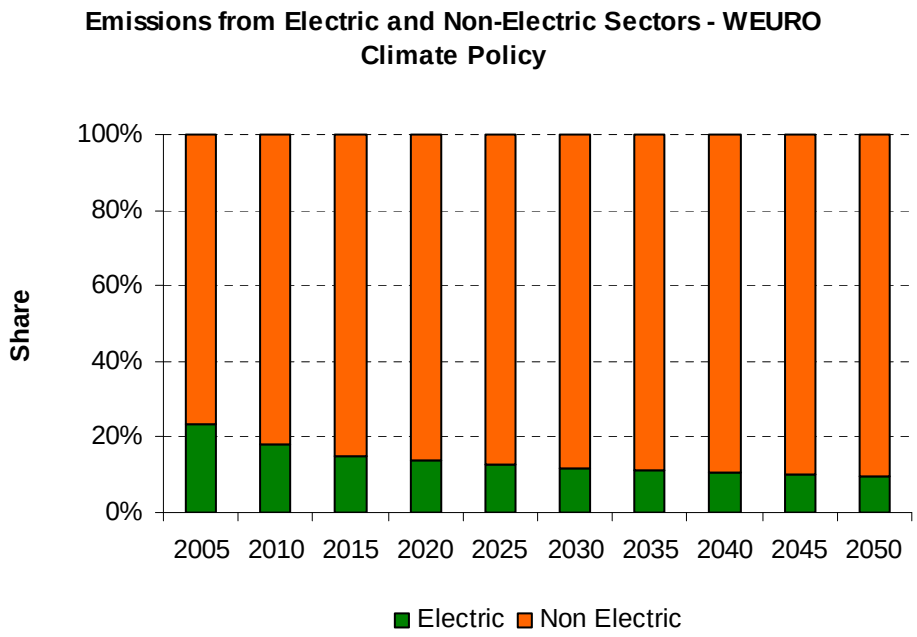
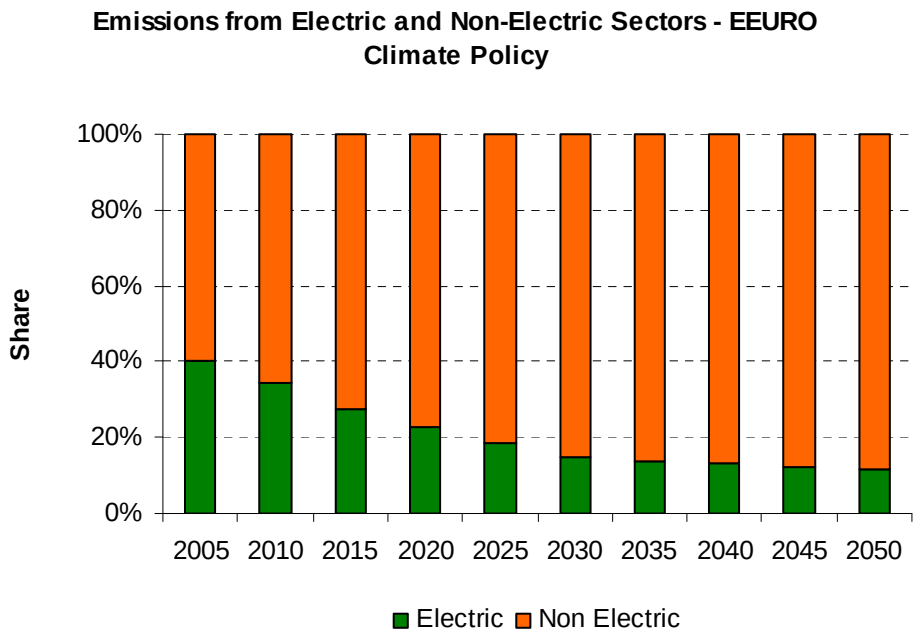
Electric vs non-Electric Sector (ETS vs NonETS) - Policy





- Priority to decarbonization in the Power Sector
- Decarbonization of transport is costly

The Optimal Abatement Mix

WITCH shows optimal distribution of abatement effort among sectors: highest efficiency

Transport: high marginal abatement costs

- Starting from the transport sector might be expensive

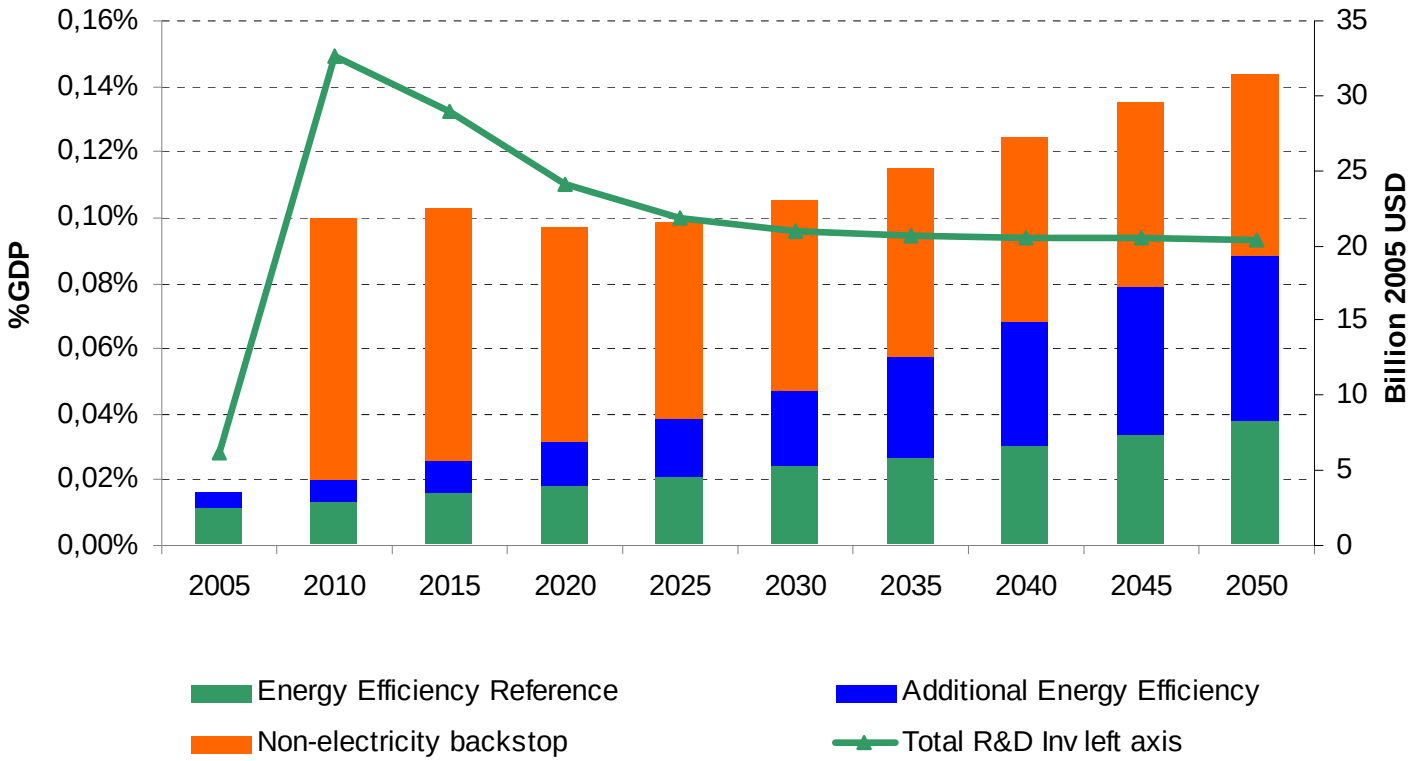
Residential uses: basically natural gas for heating purposes

- Beware of win-win options (McKinsey): households are credit-constrained, transaction costs are high

Agriculture:

- CO2 emissions from direct fuels use
- CO2 emissions from land management, non-CO2 emissions

Innovation: Crucial Role for Transport Sector



- R&D is induced by price signals alone in the model
- R&D remains at sub-optimal levels due to knowledge externalities

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Financing Innovation

- Suppose all permits are auctioned: we compute the share needed to cover investments in R&D
- Initially low carbon price and high R&D spending require about three quarters of permits to be auctioned
- In 2030 the share declines to a modest 5% mainly because the price will increase substantially after 2020

Stabilization of GHGs concentrations at 550ppm CO2-eq at 2100.

Source: Bastianin, Favero and Massetti (2010).

	OECD		**USA**		**Europe**	
Years	% of permits auctioned	R&D investments = auctioning revenue (Billion 2005 USD)	% of permits auctioned	R&D investments = auctioning revenue (Billion 2005 USD)	% of permits auctioned	R&D investments = auctioning revenue (Billion 2005 USD)
2010	76%	48.128	71%	21.906	75%	15.296
2015	28%	51.151	27%	22.453	27%	15.494
2020	14%	49.917	13%	21.278	13%	15.380
2025	9%	50.634	8%	21.541	8%	15.540
2030	5%	53.686	5%	23.005	5%	16.270

Support Policies to R&D?

Subsidies to compensate market failures in innovation markets?

In principle not: carbon price puts R&D activities on the same playground of other sectors (Nordhaus, 2009)

Society-wide optimal revenue recycling schemes should reduce distortions where they are greater, not necessarily in green technologies

Recently: Massetti and Nicita (2010) show that it might be economically sound to give priority to carbon free technologies

Not strong evidence on "green-jobs" hypothesis

Importance of a Long-Term, Stable, Credible Price Signal

Long-term decarbonization of our economies requires:

- structural investments
- renovation of long-lived capital goods
- innovation

A uniform carbon price must emerge on all GHGs emissions

The carbon price signal must be:

- universal
- long-term
- stable
- credible

Long-Term and Credible Price Signal

Clear definition of a long-term emissions trajectory

- Renegotiating emissions targets might be counterproductive

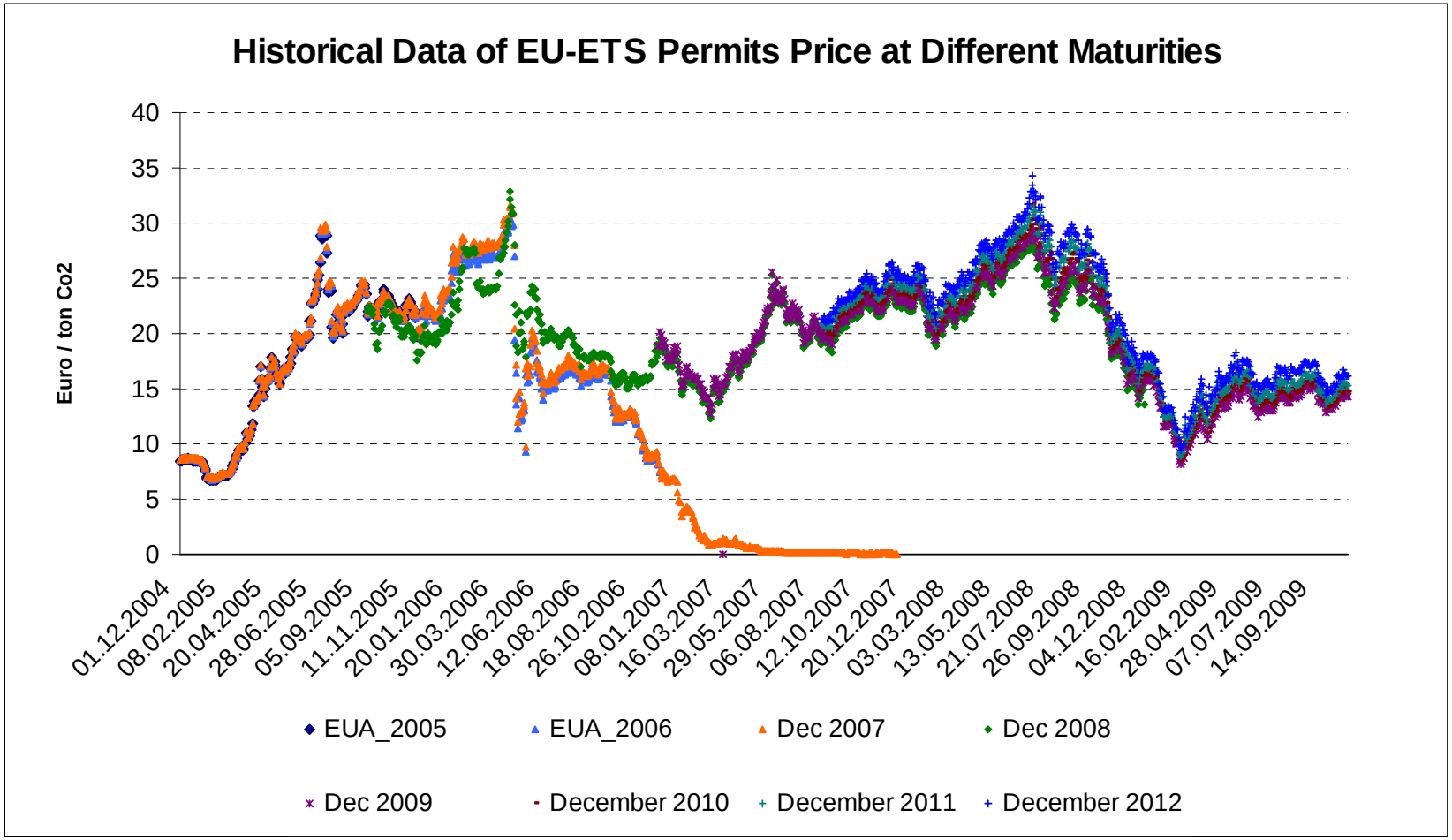
Credibility

- Credible emissions reductions targets
- Emissions reductions targets consistent with long-term temperature goals
- Credible long-term temperature goals (the +2ºC is not credible)

The same approach that Central Banks have when they announce inflation targets

- Climate policy should get inspiration from monetary policy

Stable Price Signal



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ETS with Price Collars?

A cap-and-trade system with price collars:

- Governments guarantee medium and long-term price collars to reduce volatility:
  - no spikes: safety valve;
    - no excessive costs for firms and consumers.
  - no sudden drops: price floor;
    - supports R&D and mitigation activity.

Combines benefits of carbon taxes and cap-and-trade

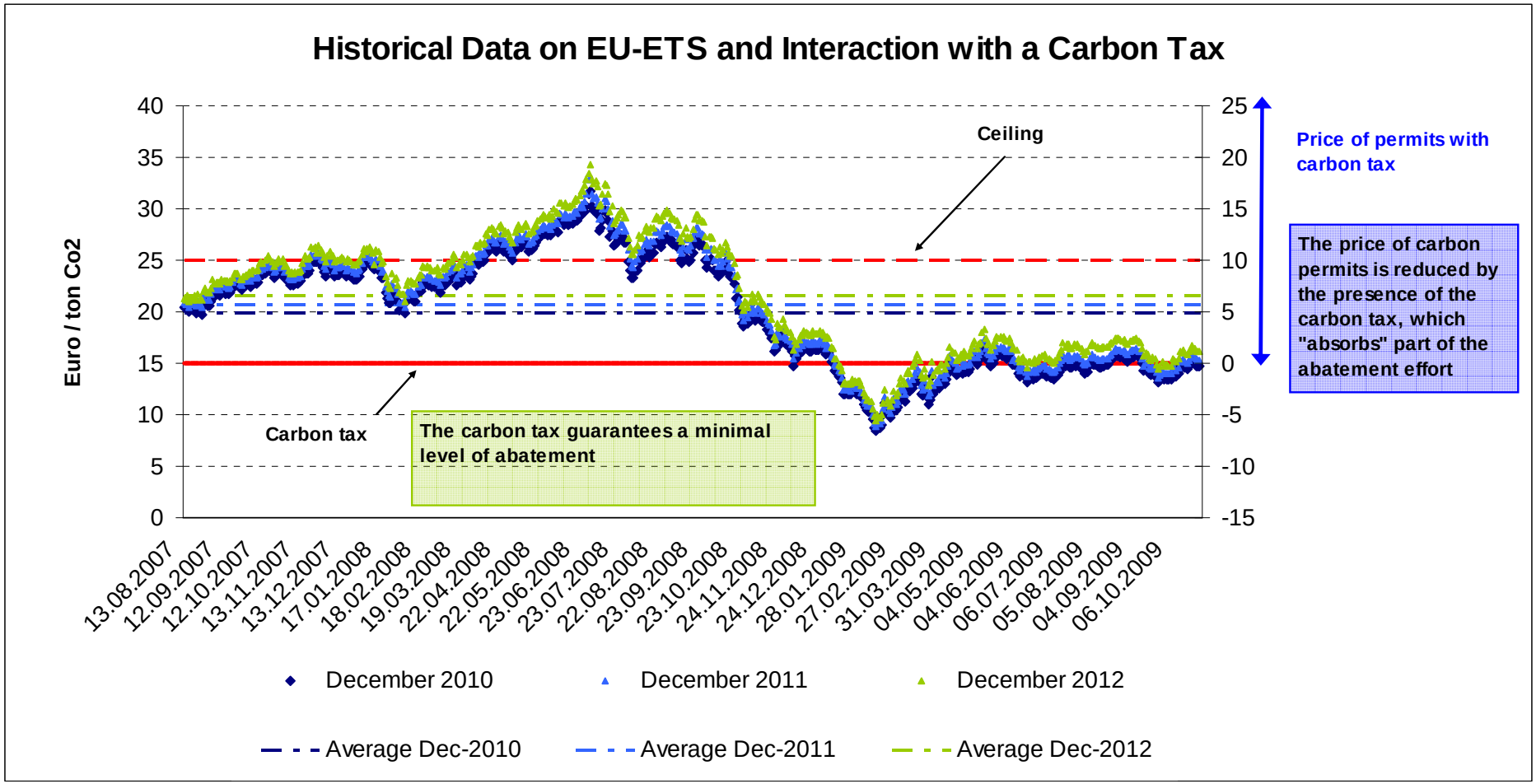
Universal, Minimal Carbon Price

- Need to extend the price signal to all sectors

- A practical approach (based on work done for Eni Copenhagen position paper; Oil, December 2009)
  - Minimal carbon tax on all sectors
  - Cap-and-trade for concentrated emissions (in addition to the carbon tax) and possibly with price ceiling

- Pros:
  - It gives a minimal, certain, carbon price signal in all sectors
  - It allows to control for the long term concentrations targets with the ETS on concentrated emissions

Cap-and-Trade with a Universal Carbon Tax



Source: Massetti et al (2009)

Conclusions

Economic crisis and the 20% target at 2020: need to move to a tighter target?

ETS and non-ETS: priority to power sector, but a carbon price signal is needed also for diffused emissions

Innovation: key role, especially for transport, energy efficiency

Building a long-term, universal, stable and credible carbon price signal

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