

**Global Sectoral Approaches:
Sectoral Approaches as Part of a Post 2012 Framework
Final Project Workshop**

Brussels, 5 May 2010

**Trade Impacts of a Sectoral Approach
in the Cement Sector**

Results of the quantitative CGE analysis

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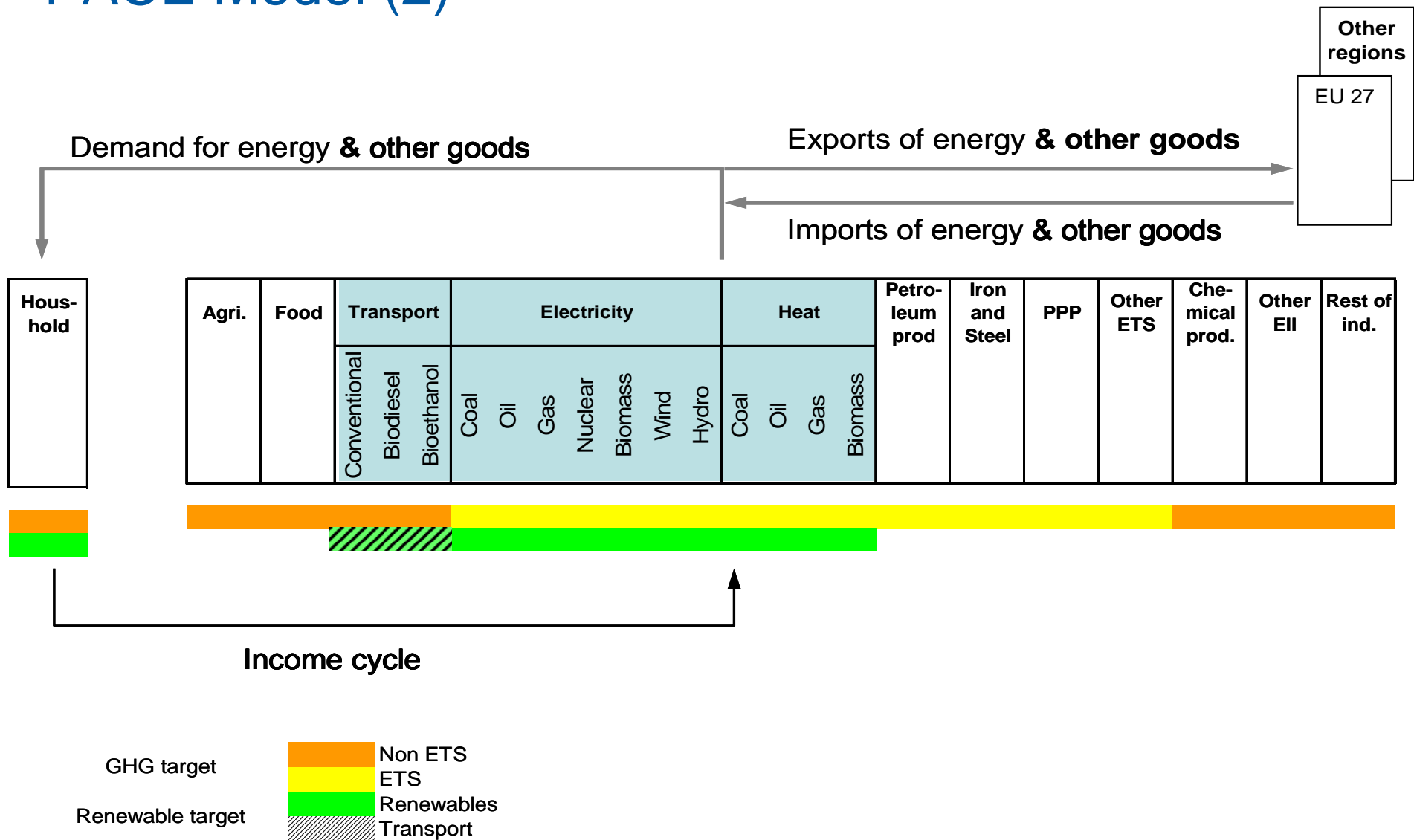
Modelling Work within the Project

- Further development of PACE model: Economy-wide global computable general equilibrium (CGE) model with bottom-up representation of the energy sector
- Level of sectoral disaggregation in core model is based on GTAP7 database (full bilateral trade flows)
- Explicit modelling of cement sector
 - Further sectoral disaggregation of the cement sector (production, trade)
 - Introduction of process emissions (approximately 50% of total emissions)
 - Sector specific carbon targets (marginal abatement costs in accordance with sectoral bottom-up study)
- 7 Scenarios encompassing different types of sectoral approaches

PACE Model (1)

- Use PACE (Policy Analysis based on Computable Equilibrium) model to assess impacts of different sectoral approaches on:
 - Welfare
 - Emission levels
 - Sectoral production
- Multi-sector, multi-region CGE model of global trade and energy use

PACE Model (2)



Sectoral Disaggregation of Cement Sector

	Agricultural products	Coal	Oil	Gas	Electricity	Petroleum products	Non-metallic minerals		Further sectors	Private consumption	Investment	Exports	Total value of use
							Cement	Rest of Sector					
Agricultural products													
Coal													
Oil													
Gas													
Electricity													
Petroleum products													
Non-metallic minerals													
Cement													
Rest of sector													
Further sectors													
Capital													
Labour													
Imports													
Total value of production													

Production data (e.g. Eurostat, UN Industry Commodity Statistics)

Trade data (e.g. Eurostat, UN Comtrade)

Production data (e.g. Eurostat, UN Industry Commodity Statistics)

Data on primary production factors (e.g. Eurostat)

Trade data (e.g. Eurostat, UN Comtrade)

- production, consumption, primary factors, international trade
- balancing of extended IO-tables required
- use SPLITCOM (Horridge, 2005) as far as possible

Sectoral Disaggregation of Cement Sector

- Data for EU countries provided by **Eurostat**
 - Structural Business Statistics (SBS)
 - Production value
 - Purchases of energy products as proxy for energy use
 - Trade data for EU countries: EU 27 Trade
- For non-EU countries
 - Production values provided by **UN Industrial Commodity Statistics**
 - ➔ also used to approximate energy use
 - Trade data by **UN Comtrade**

Scenarios (1)

3 types of scenarios:

1. EU and PLEDGES

- Only EU or Annex I countries commit to emission reduction targets

2. UNI

- Unilateral reductions by cement sector of selected countries in addition to reductions of developed countries

3. INT

- Reductions by cement sector of selected countries in an international context

Scenarios (2)

Scenario EU

- No international agreement until 2020 → unilateral EU policy
- By 2020:
 - 21% GHG reduction vs. 2005 in sectors covered by the EU Emissions Trading Scheme (EU ETS)
 - 11% in sectors not covered by EU ETS vs. 2005
- Full auctioning in power sector beyond 2012
- 100% of a benchmark free of charge in sectors exposed to risk of carbon leakage (Cement; Iron and Steel; Aluminium; Bricks, Tiles and Construction Products; Petroleum and Coal Products)
- Decreasing share of free allocation in other ETS sectors
80% of benchmark in 2013 ↔ 30% of benchmark in 2020

Scenarios (3)

Scenario PLEDGES

- Same reduction targets for EU27 as in Scenario EU
- Major developed countries commit to reduction targets vs. 1990

Canada	3%
Japan	9%
US	0%
Russia	10%
Australia & New Zealand	-13%

Scenarios (4)

Scenario UNI_L

- PLEDGES reduction targets for EU27 and major developed countries
- Chinese cement sector introduces unilateral reduction target
- Negative cost options as computed by a bottom-up (BU) analysis are realized (costly in CGE model!)
- Corresponds to 8.6% reduction by 2020 vs. BaU 2020 in the Chinese cement sector

Scenarios (5)

Scenario UNI_M

- Targets as in UNI_L
- BUT cement BU cumulative costs are zero in China (more costly in CGE!)
- Corresponds to 13.4% reduction by 2020 vs. BaU 2020 in the Chinese cement sector
- In addition: Analogous reduction targets in Mexican and Brazilian cement sector → 3.0% and 3.4% reduction targets by 2020, respectively

Scenario UNI_H

- All BU abatement options realized
- corresponds to 14.4%, 8.3% and 6.9% reduction by 2020 vs. BaU 2020 in the Chinese, Mexican and Brazilian cement sectors, respectively

Scenarios (6)

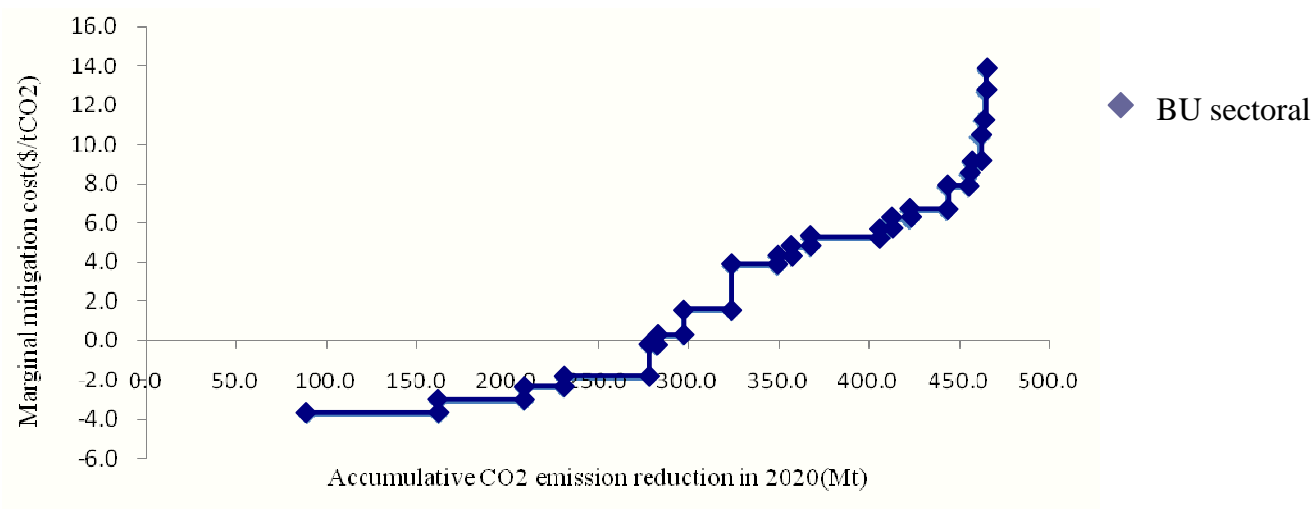
Scenario INT_0

- Targets as in UNI_H
- BUT integration in EU ETS
- Government is endowed with certificates

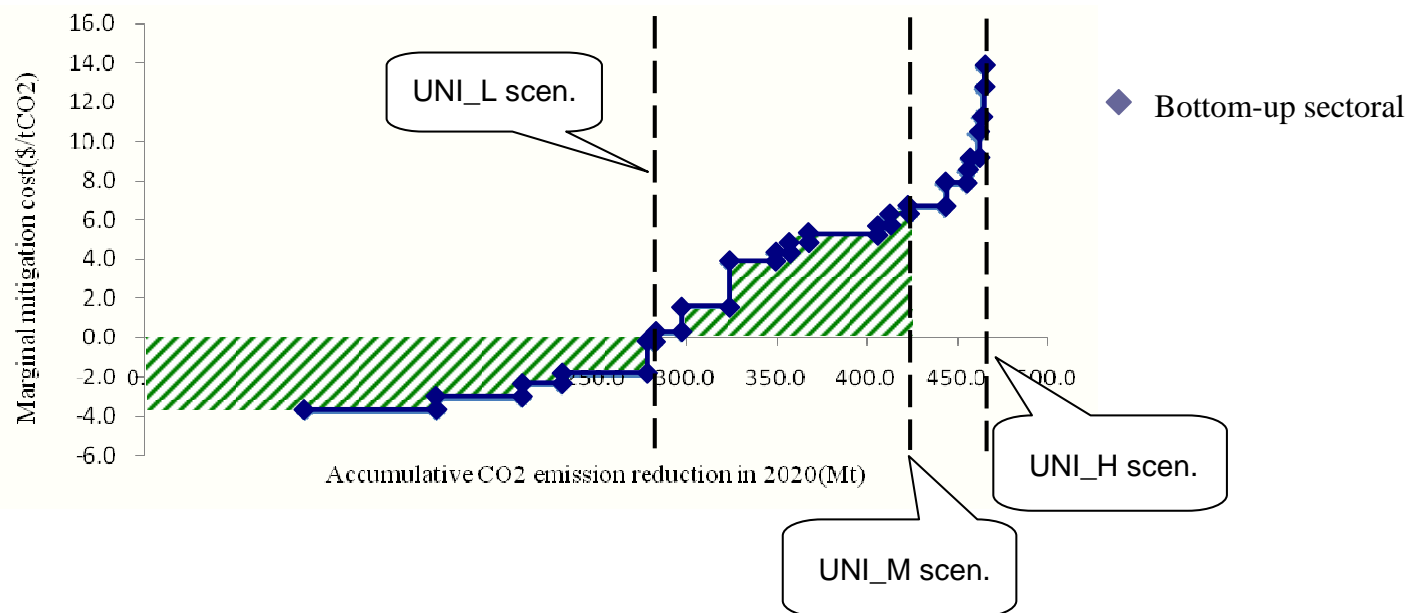
Scenario INT_50

- Targets as in UNI_H
- Government returns 50% of CO2 revenues back to sector

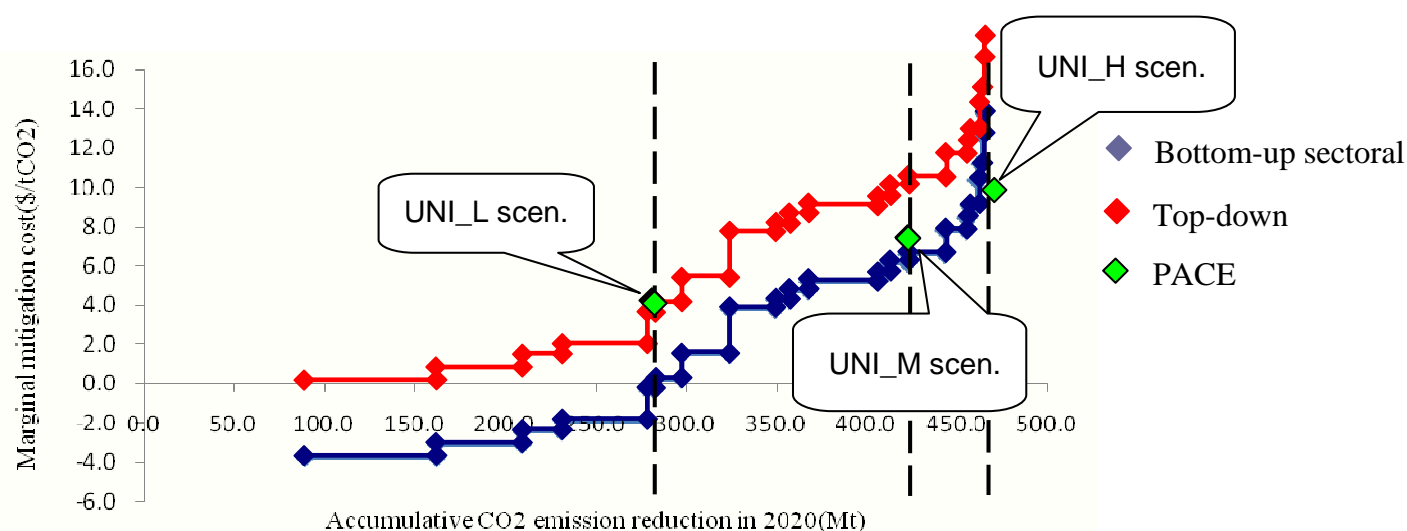
Marginal Abatement Costs



Marginal Abatement Costs



Marginal Abatement Costs



Significant share of negative cost options in sectoral analysis

neoclassical model w/o free lunch, i.e. no negative marginal abatement costs can be implemented (reduction efforts might e.g. imply transaction costs)

→ shift MAC curve of CCAP sector study upwards (to start with zero MAC for abatement option with lowest cost) and compare carbon prices

Simulation Results (EU27 - % change vs. BaU 2020)

	Scenario	EU	PLED GES	UNI_L	UNI_M	UNI_H	INT_0	INT_50
		Welfare	-0.68	-0.63	-0.63	-0.63	-0.63	-0.61
CO2 price (€/tCO2)	ETS	16.7	17.2	17.2	17.2	17.2	11.7	11.7
Sectoral output losses	Cement	-1.1	-1.1	-1.1	-1.0	-1.0	-0.8	-0.8

- Moderate welfare losses – smaller if other regions commit to emission reduction targets
- Output decrease in cement sector lower if cement industries of regions subject to sectoral approaches set higher reduction aims
- INT: reduced carbon prices moderate output effect, welfare hardly affected

Simulation Results (China - % change vs. BaU 2020)

	Scenario	EU	PLED GES	UNI_L	UNI_M	UNI_H	INT_0	INT_50
Welfare		-0.08	-0.11	-0.13	-0.15	-0.16	-0.02	-0.01
Marginal abatement costs in cement sector (€/tCO ₂)				3.7	6.6	7.3	7.3	7.5
Sectoral output losses	Cement	-0.1	0.0	-1.2	-2.0	-2.2	-2.2	-1.9

- Overall welfare loss moderate, even if cement sector reduces emissions
- Higher output decrease – but can be reduced if other sectors participate
- INT scenarios: EU finances part of emission reduction by buying certificates → government receives revenues in INT_0 → adverse welfare effects from reduction efforts neutralized by these financial transfers
- 50% free allowances (INT_50) reduce negative sectoral output effects since revenues are recycled to cement sector

Simulation Results (**Mexico** - % change vs. BaU 2020)

	Scenario	EU	PLED GES	UNI_L	UNI_M	UNI_H	INT_0	INT_50
Welfare		-0.12	-0.36	-0.36	-0.36	-0.37	-0.37	-0.36
Marginal abatement costs in cement sector (€/tCO ₂)					12.3	38.5	11.7	11.7
Sectoral output losses	Cement	0.1	0.1	0.1	-0.1	-0.6	-0.1	0.0

- Non-negligible welfare losses induced by emission reductions of Annex I countries
- Triggered by decreasing trade flows with developed countries
- In particular, declining demand from US

Simulation Results (**Brazil** - % change vs. BaU 2020)

	Scenario	EU	PLED GES	UNI_L	UNI_M	UNI_H	INT_0	INT_50
		Welfare	-0.06	0.02	0.01	0.01	0.01	0.02
Marginal abatement costs in cement sector (€/tCO ₂)					15.5	32.2	11.7	11.7
Sectoral output losses	Cement	0.0	0.2	0.2	-0.7	-1.7	-0.5	-0.3

- Mexico and Brazil face high marginal abatement costs in cement industry
- More advanced technologies used than in China
- In INT scenarios Mexico and Brazil reduce less emissions
 - Not worthwhile to reduce above EU ETS price of 11.7 € resulting in lower output losses in cement sector

Simulation Results (Emission Changes - % vs. 2005)

Scenario	EU	PLEDGES	UNI_L	UNI_M	UNI_H	INT_0	INT_50
EU	-16.10	-16.10	-16.10	-16.10	-16.10	-13.04	-13.04
China	89.23	90.97	89.60	88.88	88.73	88.67	88.67
Mexico	40.00	41.53	41.54	41.48	41.38	41.48	41.48
Brazil	57.39	61.47	61.49	61.35	61.22	61.32	61.33
World	34.97	26.69	26.46	26.34	26.31	26.82	26.82

- Impact on worldwide emissions level is moderate
- Carbon leaks into regions not covered by environmental regulation
- Presented analysis only considers reduction targets in cement sectors of selected countries
- Higher worldwide emission reduction expected if other developing countries and other sectors participate in Sectoral Approaches

Conclusions

- Sectoral Approaches can help reduce worldwide emissions BUT to small extent
- Result depends on countries under consideration
- Highest impact induced by reductions in Chinese cement sector
 - accounts for appr. 50% of worldwide cement production, moderate abatement costs
- Reductions in Mexico and Brazil less important from global perspective and more expensive
- Integration in EU ETS increases overall efficiency, in particular with respect to welfare
- Inclusion of further sectors and countries can increase moderate effects on global emissions level