Cobenefits of greenhouse gas mitigation for 2˚C

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Climate Action

Objective

European Commission

Overview

- Objective: to touch upon a number of issues termed "co-benefits" of GHG mitigation of 2 degree Celsius:
- 1. Cobenefits of reduced air pollution of 2 degree C: EU level
- 2. Cobenefits air pollution global level
- 3. Impacts on innovation: first mover advantage and technology dynamics

1. Cobenefits EU 27

Baseline projection

1. Current emission control legislation e.g. industrial Emissions Directive and Euro 6/VI legislation on mobile sources.

2. Penetration of control measures takes into account capacity/stock turnover.

3.Air pollution control costs: investments and operating costs per technology (e.g. flue gas desulfurization)

Source: Commission (2011) and Rafaj et al (2011)

Methodology: reduced Mortality

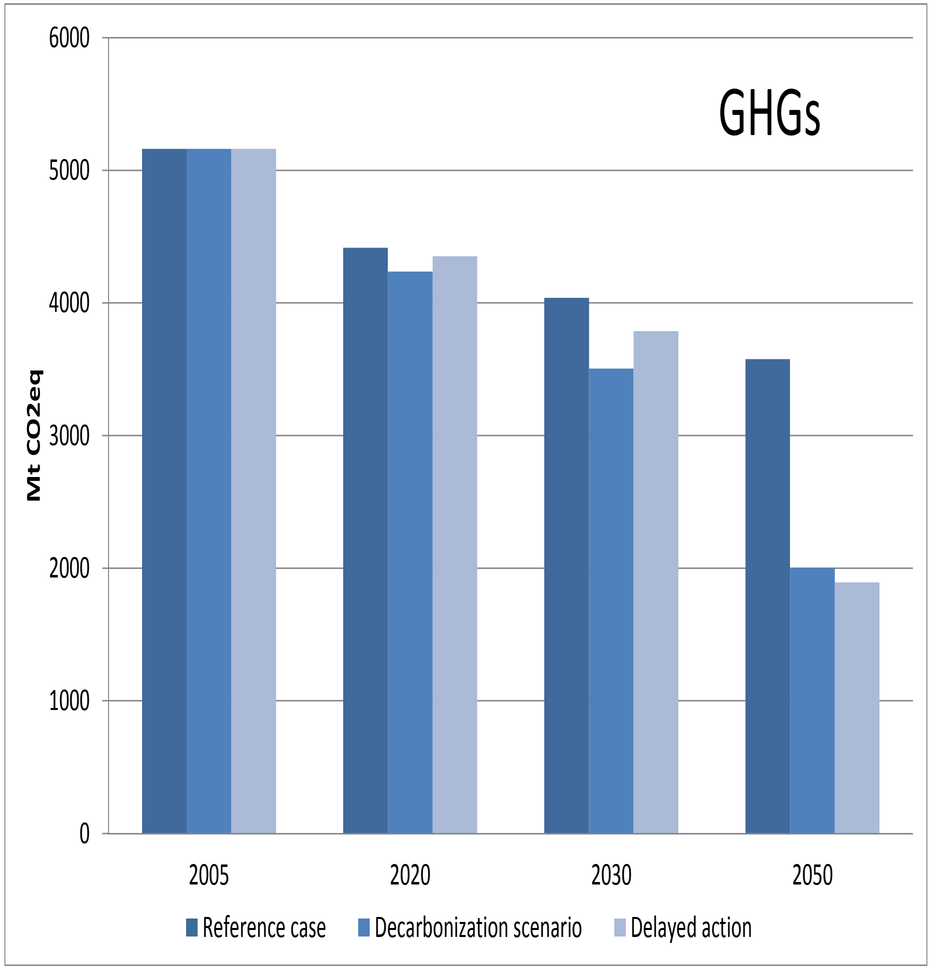
1. Energy scenario translated in air pollution emissions

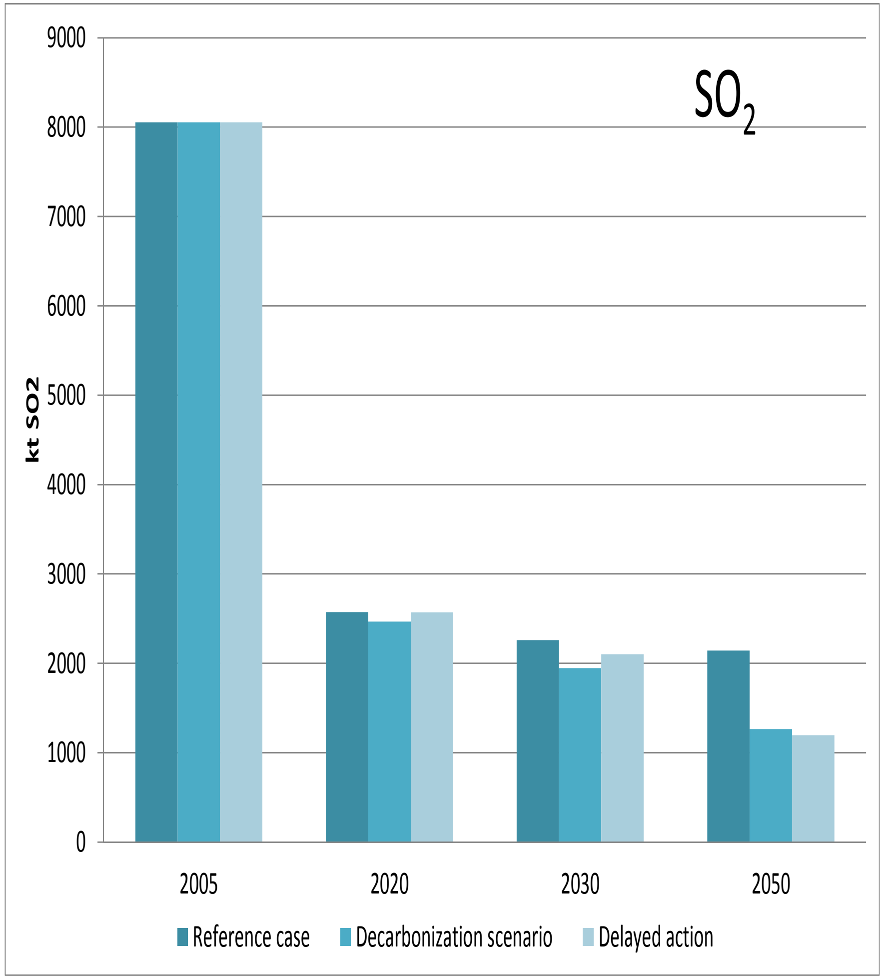
2. Emission by MS used to calculate concentrations using transfer matrices

3. Change concentrations to estimate physical impacts (i.e. mortality) using population data and dose response relations

4.Mortality valued using valuation statistical life/life year lost

GHG mitigation and co-benefits to 2050





Source: PRIMES and GAINS

Physical changes over baseline of 2˚C

	2030	2050
Emission reduction		
SO2 (Kton)	314	877
NOx (Kton)	369	1089
PM 2.5 (Kton)	36	43
Sum SO2, NOX and PM2.5)(%)	9.8	28.5
Health (avoided million life years lost) due to PM2.5	6	14
Premature deaths ozone avoided (cases/year)	415	846
Forests not acidified (1000 km2)	9	22
Ecosystems s.t. euthrophication (1000 Km2)	17	63

Monetary changes over baseline

Billion €2008/year	2030	2050
Air pollution control costs savings	12.6	46.3
Monetary damage health impact PM2.5	6.9-15.9	15.7-36.3
Monetary damage health ozone	0.4-0.9	0.9-1.8
SUM-monetized damage	7.3-16.8	16.6-38.1
SUM cost savings & monetized damage	20.0-29.4	62.9-84.4

PM2.5: value life year lost: €52000-120000, Ozone:
Value Of Statistical Life: 980000 – 2 million € (both in 2005 prices)

Cost savings "Climate Cost"

Billion €2005/year	2030	2050
Mortality & morbidity	19.9	42.8
Buildings	n.a.	0.264
Crops	n.a.	1.2
Damage avoided/benefits	20.0-29.4	44.2

Differs from Commission (2011) estimate: morbidity included + materials + buildings + different approach mortality
Closer to high estimate of Cion.
Source: Holland et al (2011)

Macroeconomic implications?

1. Saved pollution control costs: ~ 0.1 to 0.2% of GDP (2030/2050=

2. Cost saved + monetized benefits ~ 0.2 to 0.4% of GDP

3. Morbidity, crops, materials, buildings damage, forests, other ecosystems excluded

4. Macroeconomic feedbacks? Work days lost => productivity => GDP loss + crops + timber+ materials => future work.

2. Global Analysis: BAU versus 2˚C

1. ***POLES Reference Scenario*** *(2050 REF), globally +70% CO_2 in 2050 (rel. to 2005)*

2. Mitigation case: ***Recent POLES 2˚C Scenario*** *(2050 MIT), globally -43% CO_2 in 2050*

3. Estimate physical impacts of air pollution on human health, ecosystems and agricultural crops (IIASA, AEAT)

Source: Rafaj et al (2011)

Results for Climate Cost scenarios

1. POLES Reference Scenario *(2050 REF), globally +70% CO_2 in 2050 (rel. to 2005)*

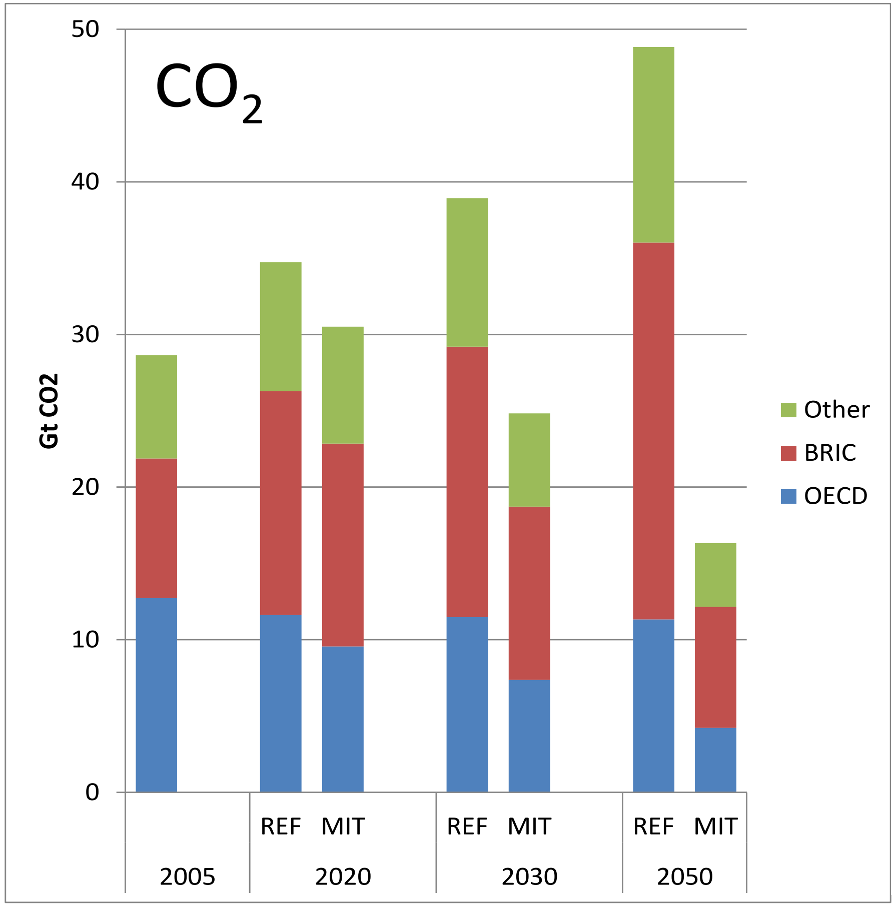
2. POLES 2˚C *(2050 MIT), globally -43% CO_2 in 2050*

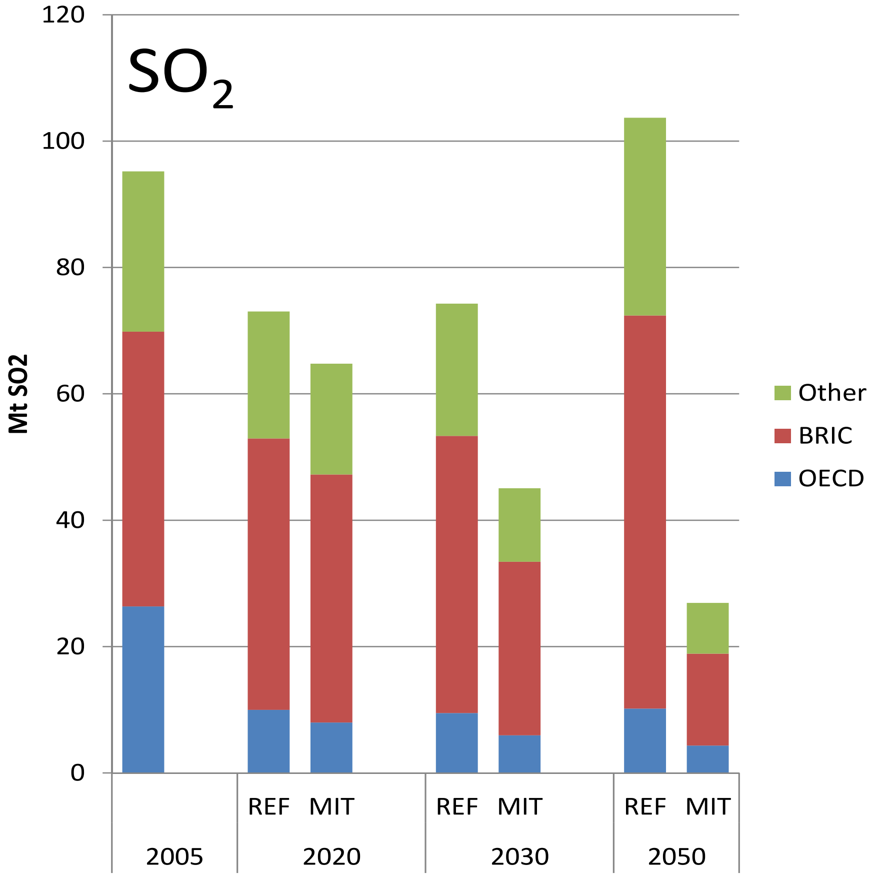
3. All countries implement current national legislation air pollution control.

4. Population in 2050 follows RCP assumption

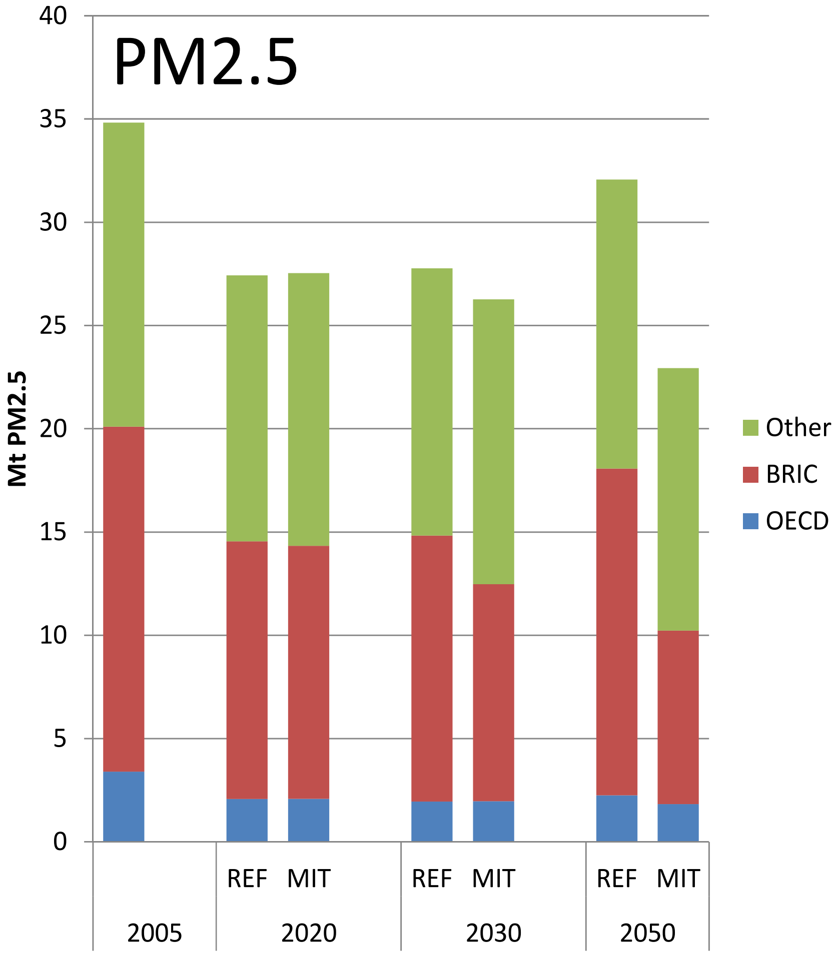
5. Linear exposure-response relation between PM2.5 and mortality, no impact from natural aerosols

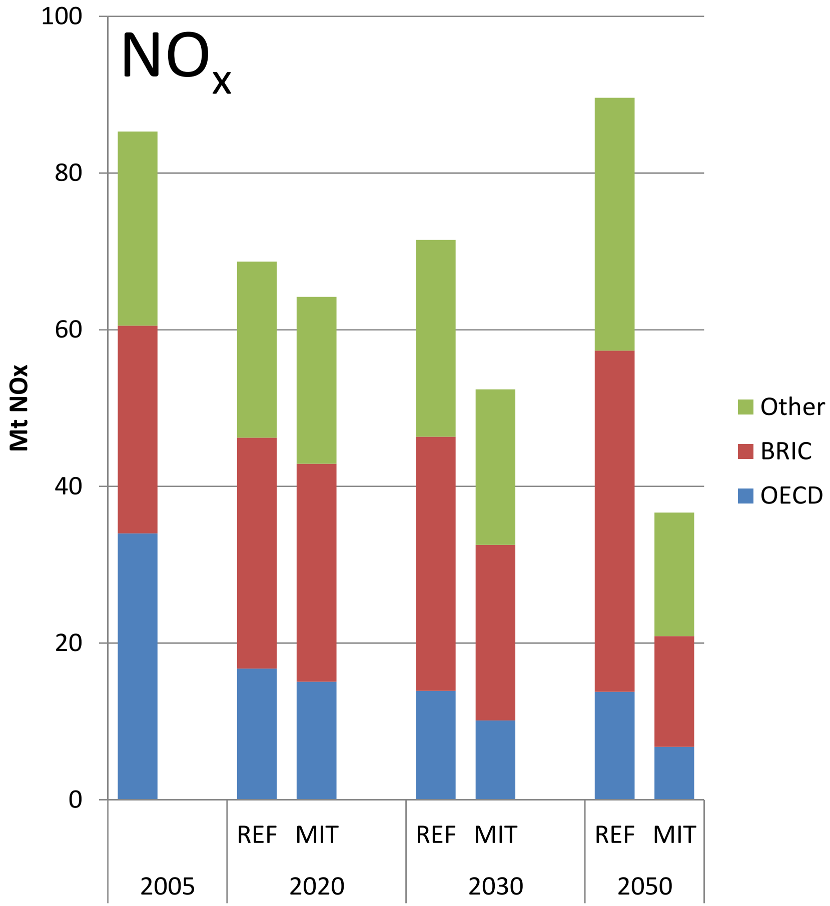
Global analysis 2˚C: CO2 +SO2



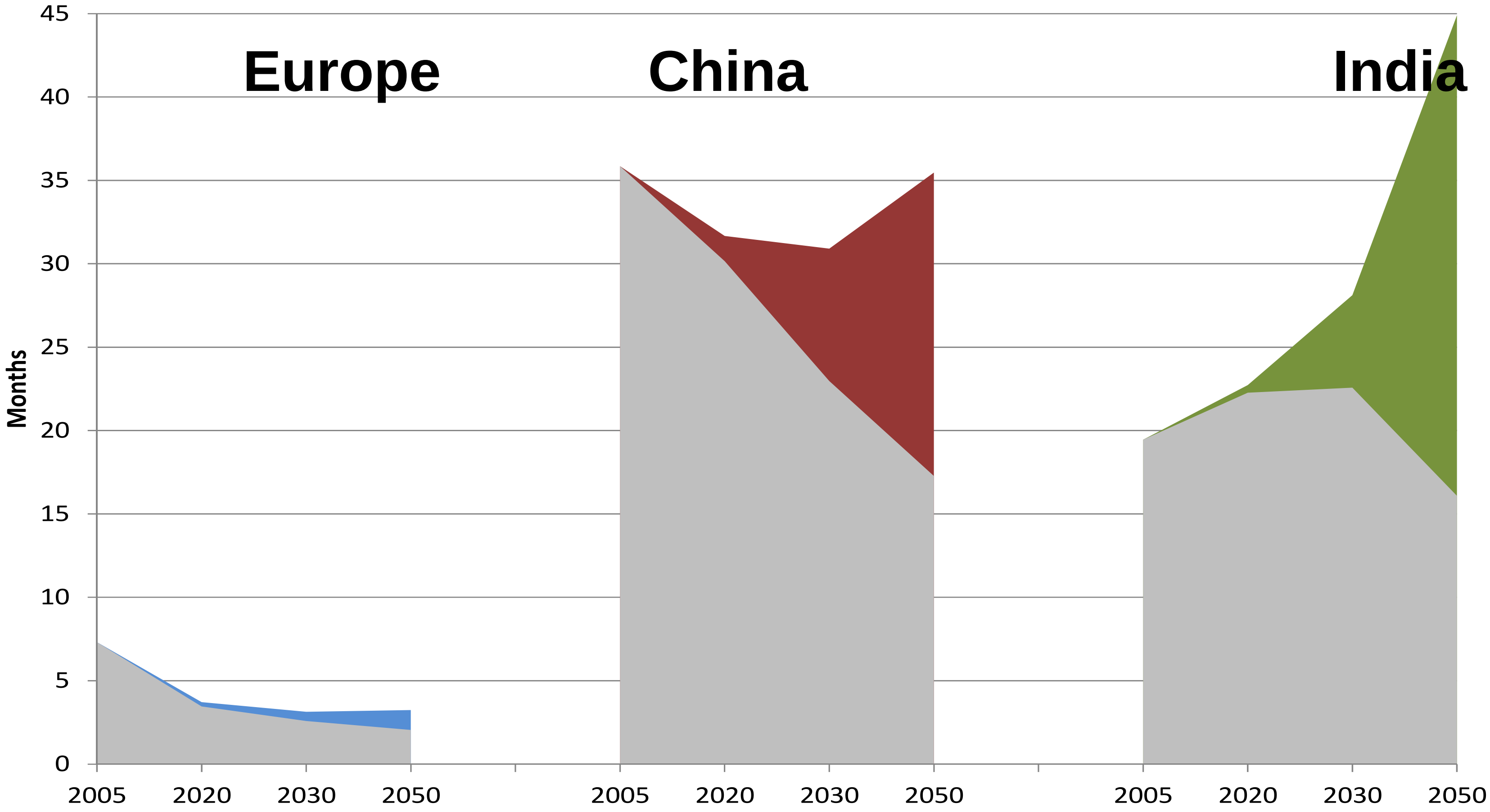


Global analysis 2˚C: PM2+NOX





Loss of statistical life-expectancy PM:
EU: 1 month, China: 18, India 29 months



Costs and benefits of 2˚C in 2050

	Pollution control costs (billion)		Average life expectancy lost (months) PM		Premature deaths ozone (x1000)		
	Baseline	2 C	Baseline	2 C	Baseline	2 C	
EU	82.0	46	3	2	16	13.6	
China	133.0	49.5	41	22	55.5	33.8	
India	16.1	8.1	48	18	89.6	34.9	

Macroeconomic "impacts" 2050 transfering EU valuation!

	cost saved	costs+ozone deaths	Costs+ozone+ PM deaths
Value	% of GDP	% of GDP	% of GDP
EU	0.21%	0.22%	0.3%
China	0.24%	0.30%	4.0%
India	0.06%	0.45%	16.7%

Note: GDP/capita India 5 times lower, China 2 times lower than EU in 2050 (in PPP) => valuation (Willingness to pay) lower ? (in part own estimates).

Crop damage ozone : method

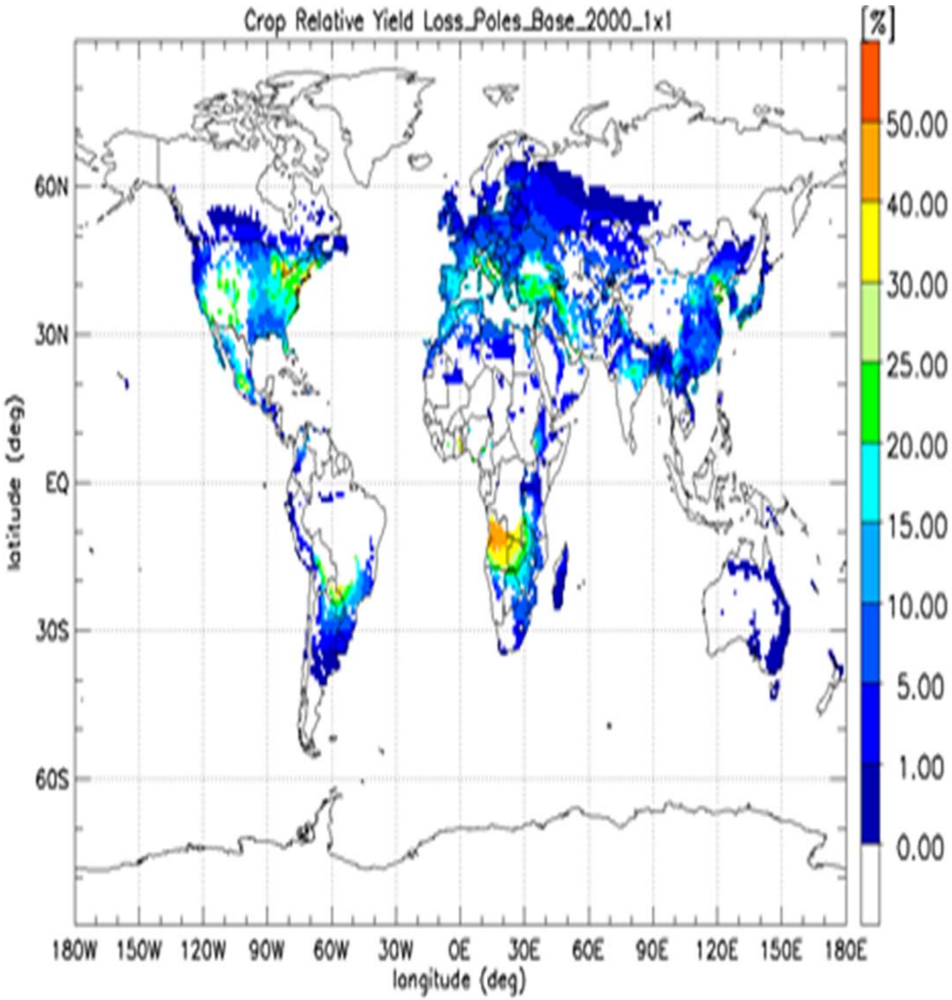
1. crop damage wheat calculated as relative yield loss.

2. dose-response: accumulated hourly concentration above threshold 40 ppbV in growing season

3. spatial crop distribution: crop-specific Global Agro-Ecological Zones.

4. wheat price constant (at 2000). Production follows population projection.

Source: van Aardenne et al, (2008)



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Crop (wheat) damage ozone globally

Unit	2000	2030	2030	2050	2050
		BAU	2˚C	BAU	2˚C
% loss	8	10	8	11	6
billion$/year	2	3.4	2.7	4.2	2.3
% of GDP		0.004	0.003	0.003	0.001

Source: Van Aardenne et al, 2000 + own calculations

3. Innovation: first-Mover Advantage (FMA)

Is it possible to quantify technological leadership as a result of climate policy?

Concept of FMA: there can be long-term benefits from capturing market share through advancing technology

It requires:

- **protection of intellectual property**
- **open trade between nations**

What might be the macroeconomic impacts if the EU could establish a FMA?

Source: Pollit and Klaassen (2013)

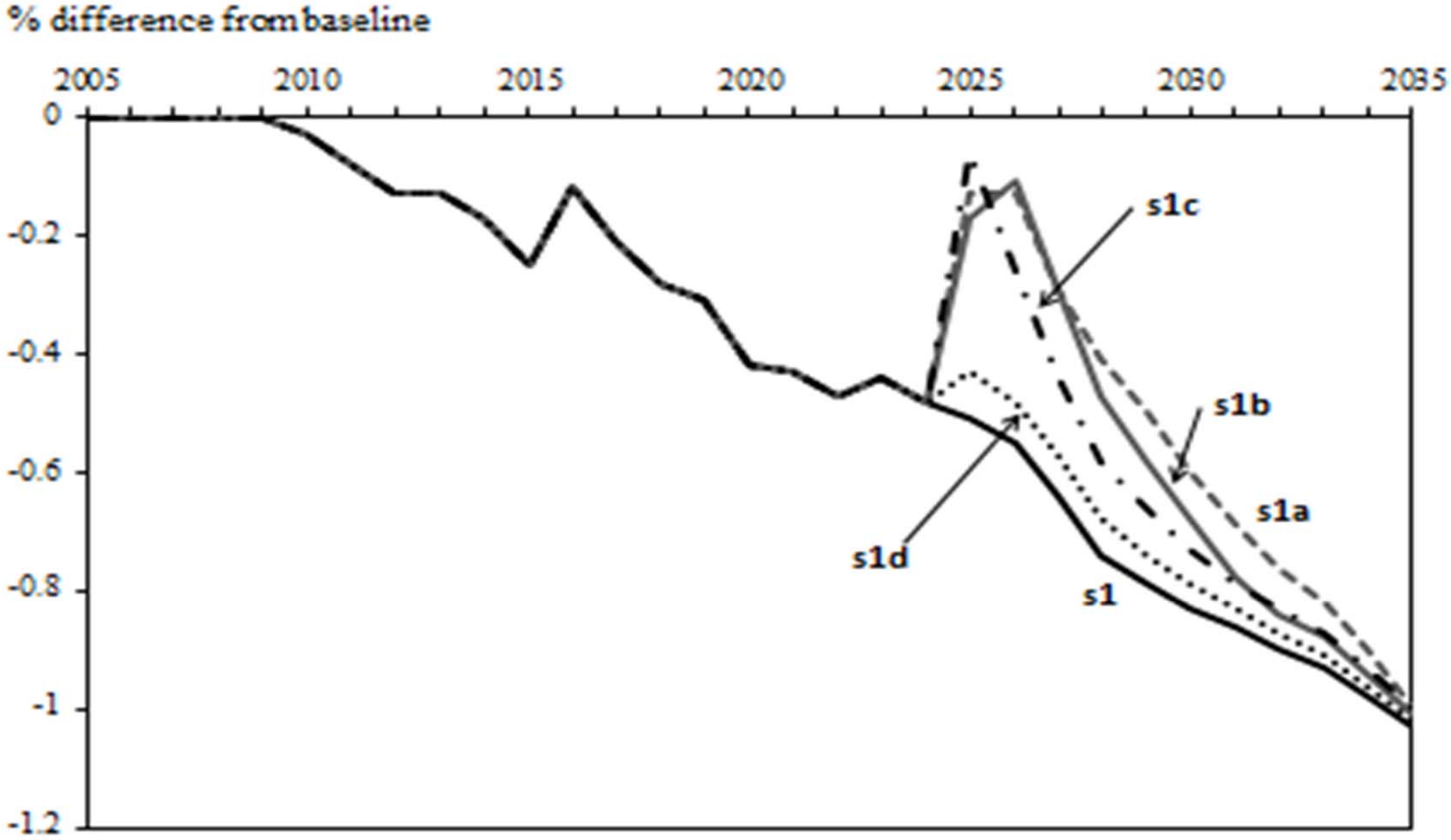
Method: the E3MG model

1. *global macroeconometric model*
2. *energy demands and CO_2 emissions*
3. *energy demand = F(activity, prices, technology)*
4. *20 global regions, 42 sectors (NACE 2), 19 users, 12 fuel types*
5. *Power sector: bottom-up technology specific*
6. *Technology progress: investment & R&D spending by sectort*

Scenarios

FMA scenarios	Descriptions
Baseline	EU : 80 % 2050 (2˚C) others also, later + low pledges (no carbon taxes recycled)
S1a	S1 + EU FMA all renewables (25% market share)
S1b	S1 + EU FMA wind & solar (100% market share)
S1c	S1 + EU FMA all renewables (50% market share)
S1d	S1 +EU FMA motor vehicles (1% market share)

FMA Scenarios – EU27 GDP



Source: Cambridge Econometrics

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Results

1. *GDP + 0.5%, employment impacts up to 0.1% (200000 jobs);*
2. *Temporarily if other catch-up (China PV!)*
3. *GDP rest of the world lower < 0.1%)*
4. *Sector impacts: mechanic engineering, basic metals, metal goods and mining (raw materials).*

Concluding

1. Cobenefits EU 2 degree C:

- Cost saved + health benefits: 0.2 to 0.4% GDP

2. Cobenefits "globally":

- China & India higher: 0.3/0.5% GDP or 5 to 10 higher

3. Morbidity, crops, materials, buildings forests, other ecosystems excluded

-gains crops (wheat!)> 0.002%, method there not applied

4. Macroeconomic feedbacks of air pollution damage?

5. First mover advantage EU27: GDP gain up to 0.5% depending on market share and catching up (no alternative for recycling!)

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3. Commission (2011) "IMPACT ASSESSMENT", COMMISSION STAFF WORKING DOCUMENT, Accompanying document to the COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS "A Roadmap for moving to a competitive low carbon economy in 2050" Brussels, 8.3.2011, SEC(2011) 288 final.

4. Pollit, H. and G. Klaassen (2013) A Model-Based Assessment of First-Mover Advantage and Climate Policy, Environmental Economics and Policy Studies (forthcoming).

5. Holland, M., M. Amann, C. Heyes, P. Rafaj, W, Schöpp, A. Hunt and P. Watkiss (2011), Technical Policy Briefing Note: Ancillary air quality benefits, Summary of the results of the DGRTD Climate Cost project. Stockholm Environment Institute, Sweden, ISBN 978-91-86125-35-6.