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Scenarios for the Negotiations on the Revision of the Gothenburg Protocol

with contributions from Imrich Bertok, Jens Borken-Kleefeld, Janusz Cofala, Chris Heyes, Lena Höglund-Isaksson, Zbigniew Klimont, Peter Rafaj, Wolfgang Schöpp

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Stockholm, February 23-25, 2011

emep
Co-operative programme for monitoring and evaluation of the long-range transmissions of air pollutants in Europe

Contents

- Target setting
- Emission control costs
- Emission ceilings and implied reduction measures
- Sensitivity cases:
  - National activity projections
  - Radiative forcing
  - No urban increments
- Conclusions

Mandate from the Working Group on Strategies

The Working Group on Strategies and Review (WGSR 47) … :

- supported the effects-based approach for target setting ..
- concluded that in particular the national and Europe-wide gap closure and optimization options [...] should be further explored, as well as the option for achieving equal ecosystem improvements across countries;
- invited the Task Force on Integrated Assessment Modelling and CIAM to further explore the "hybrid" scenarios of options 3 and 4, combined with some aspects of the option 2; and to provide further information on other gap closure percentages (in the range of 25 to 75 per cent), for presentation at the 48th session of the Working Group in April 2011;
- invited the Task Force on Integrated Assessment Modelling and CIAM to analyse the sensitivity of scenario results for different assumptions on baseline developments …
- and to publish on the Internet all relevant input data and scenario results for each country;

Activity projections - sources

	Europe-wide PRIMES 2009 scenario	*National scenario*
Energy projections		
PRIMES 2009 baseline	EU-27, MK, NO	
National projections	CH	AT, CR, CZ, DK, FI, GR, IE, IT, NL, NO, PT, ES, SE, CH, UK
PRIMES 2008 C&E		BE, BG, CY, EE, FR, DE, HU, MK, LV, LT, LU, MT, PL, RO, SK, SI
IEA WEO 2009	AL, BY, BA, CR, MD, RU, RS, UA	AL, BY, BA, MD, RU, RS, UA
Agriculture		
CAPRI 2009	EU-27, AL, BA, CR, MK, NO, RS	AL, BA, BG, CY, CZ, DK, EE, FR, DE, GR, HU, LV, LT, LU, MK, MT, NO, PL, PT, RS, SL
National projections	CH	AT, BE, CR, FI, IE, IT, NL, RO, SK, ES, SE, CH, UK
FAO 2003	BY, MD, RU, UA	BY, MD, RU, UA

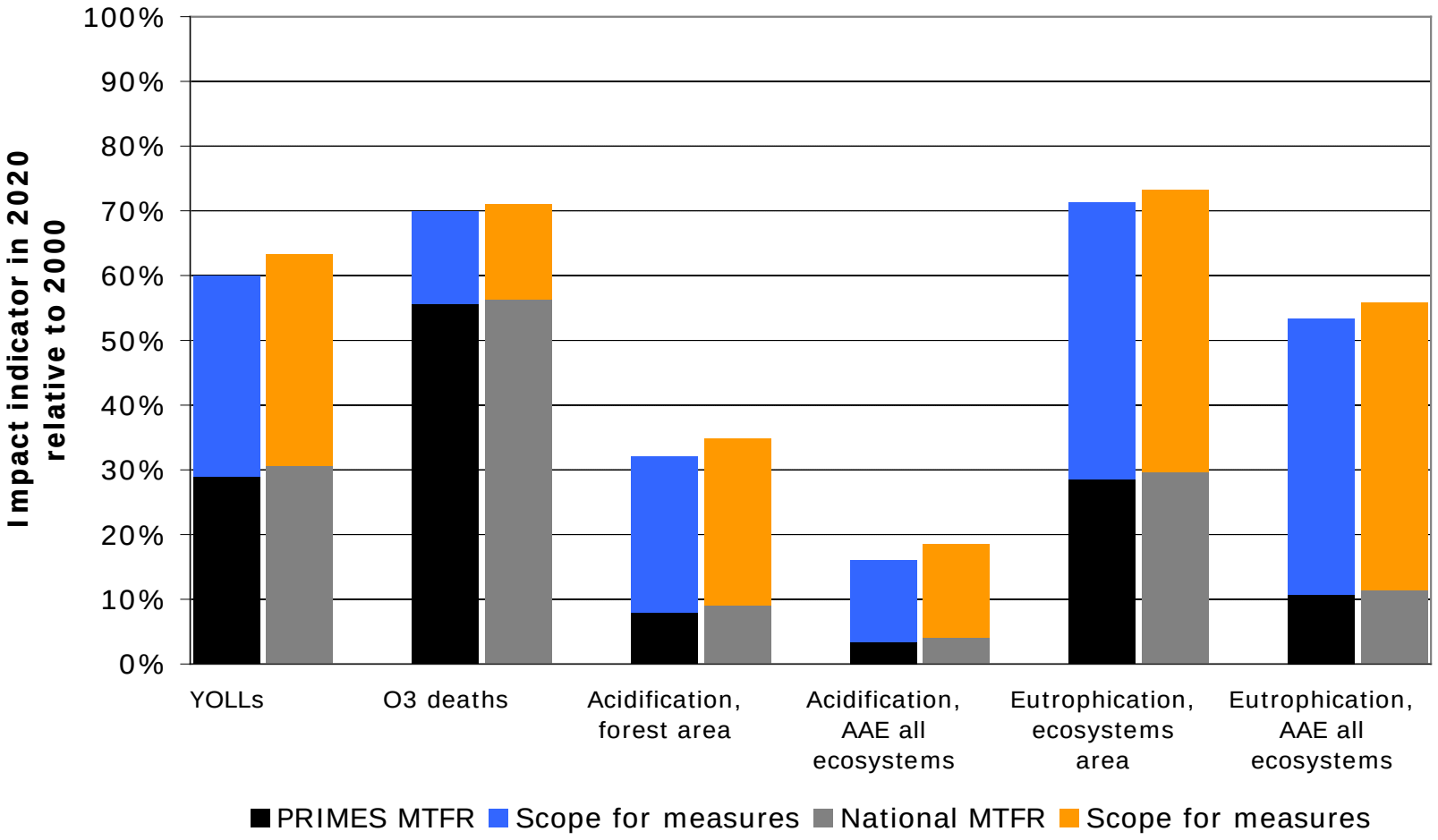
The Europe-wide PRIMES 2009 scenario is adopted as the central case, and sensitivity analyses are carried out for the National scenario

Update of NH_3 cost information

Update of cost information based on material provided by TFRN (Experts' workshop, Paris, Oct. 2010):

- Small farms (<15 LSU) are now excluded
- Generally, costs are lower:
  - Low protein feed: ~0.5 €/kg NH_3-N abated
  - Exhaust air purification (acid scrubbers): ~10 €/kg NH_3-N
  - Manure spreading costs decrease to ~1 €/kg NH_3-N due to
    - work done by contractors,
    - reduced need for mineral fertilizer.
  - But manure storage costs not changed

Scope for further environmental improvements



Four options for target setting

(re-cap of CIAM 1/2010 report)

Environmental targets for a cost-effectiveness optimization

- must be achievable in all countries,
- should result in internationally balanced costs and benefits.

Four options have been analysed with GAINS:

1. Uniform absolute targets (‘caps’) on environmental quality (in terms of impact indicators)
2. Equal relative change (‘gap closure’) in impact indicators compared to a base year
3. Equal portions of the possible improvements in each country (equal ‘gap closure’ between Baseline and MTFR)
4. Europe-wide improvements at least cost

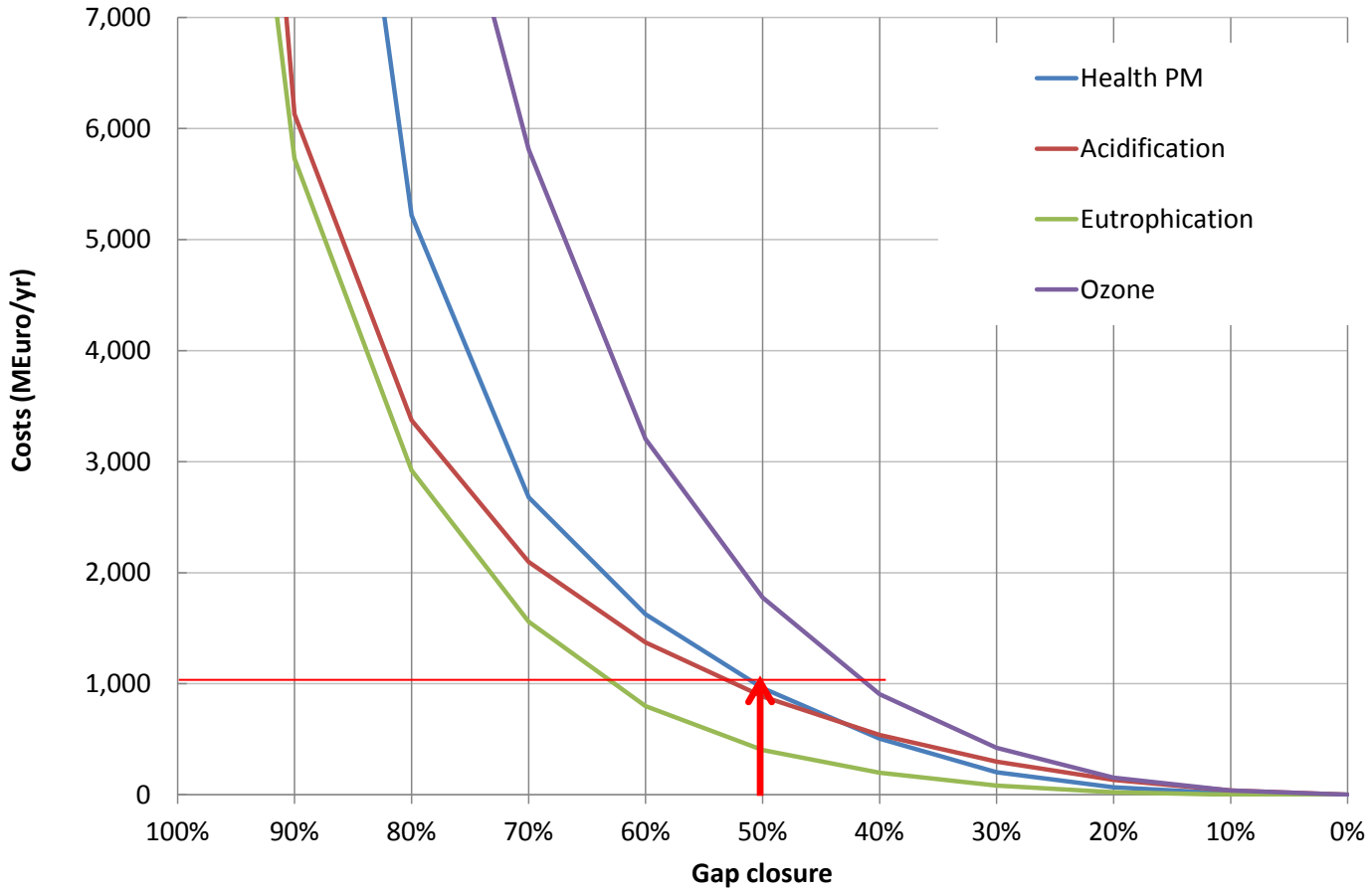
Impact indicators and targets

used for this report

- Health impacts of PM2.5:
  - YOLL (with actual population)
  - Europe-wide gap closure between CLE and MTFR
- Eutrophication:
  - Excess deposition accumulated over all ecosystems in a country
  - Country-wise gap closure between CLE and MTFR
  - Area of protected ecosystems calculated ex-post
- Acidification
  - Excess deposition accumulated over all ecosystems in a country
  - Country-wise gap closure between CLE and MTFR
  - Area of protected ecosystems calculated ex-post
- Ozone:
  - For health effects: SOMO35
  - Country-specific gap closure between CLE and MTFR
  - Vegetation and crop impacts calculated in ex-post analysis

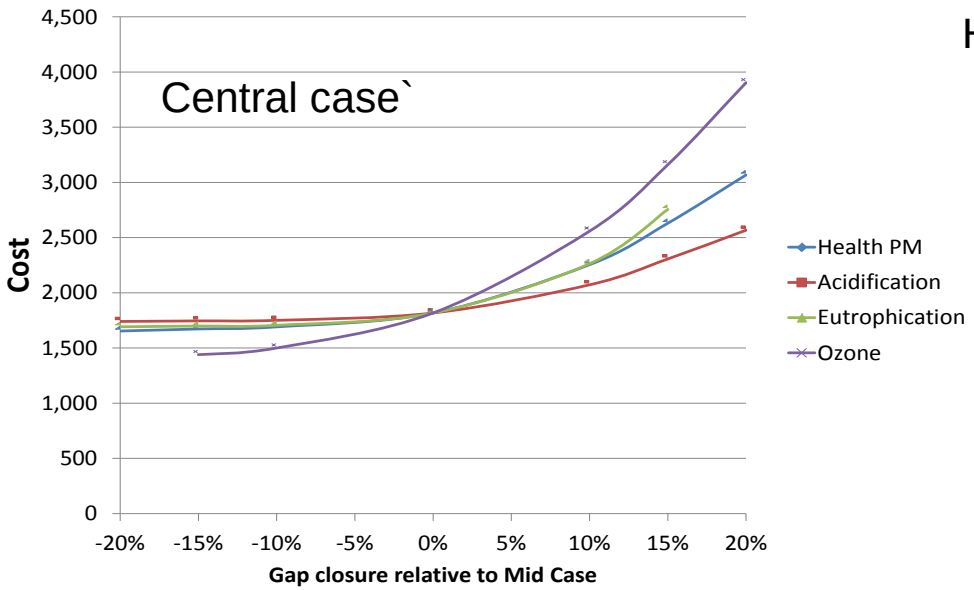
Choosing an ambition level

Costs for improving individual effects

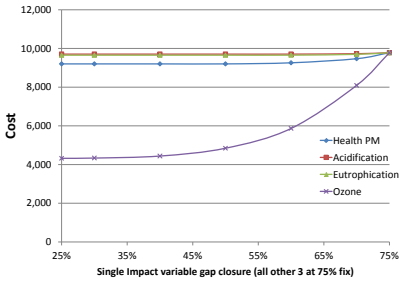


Five sets of targets

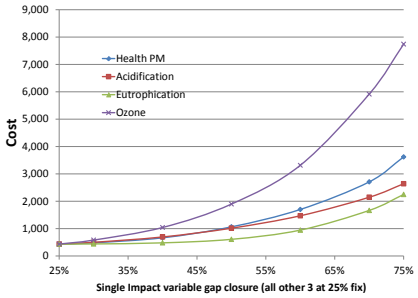
How costs change if ambition level of a single effect is modified



High case

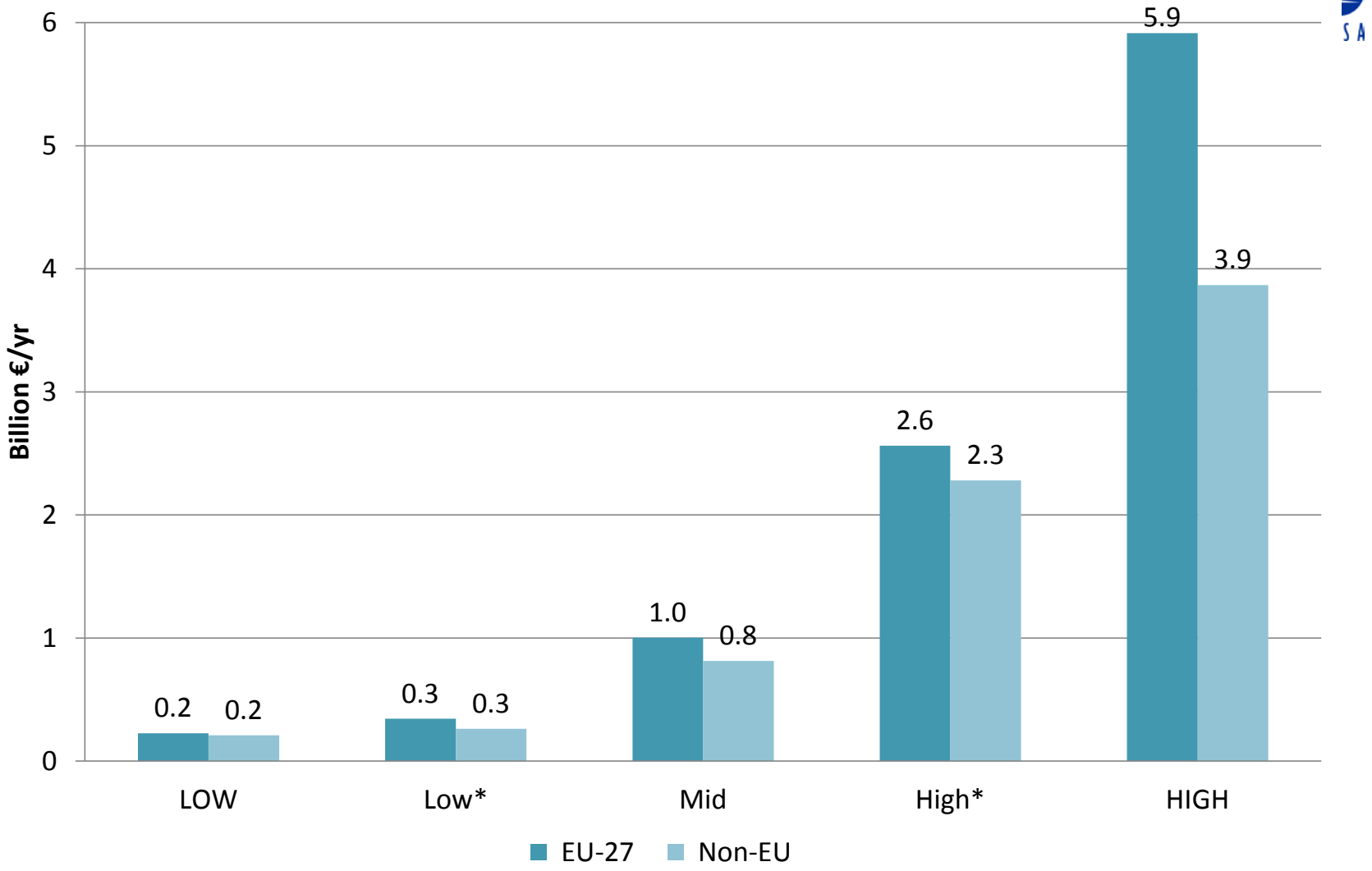


Low case



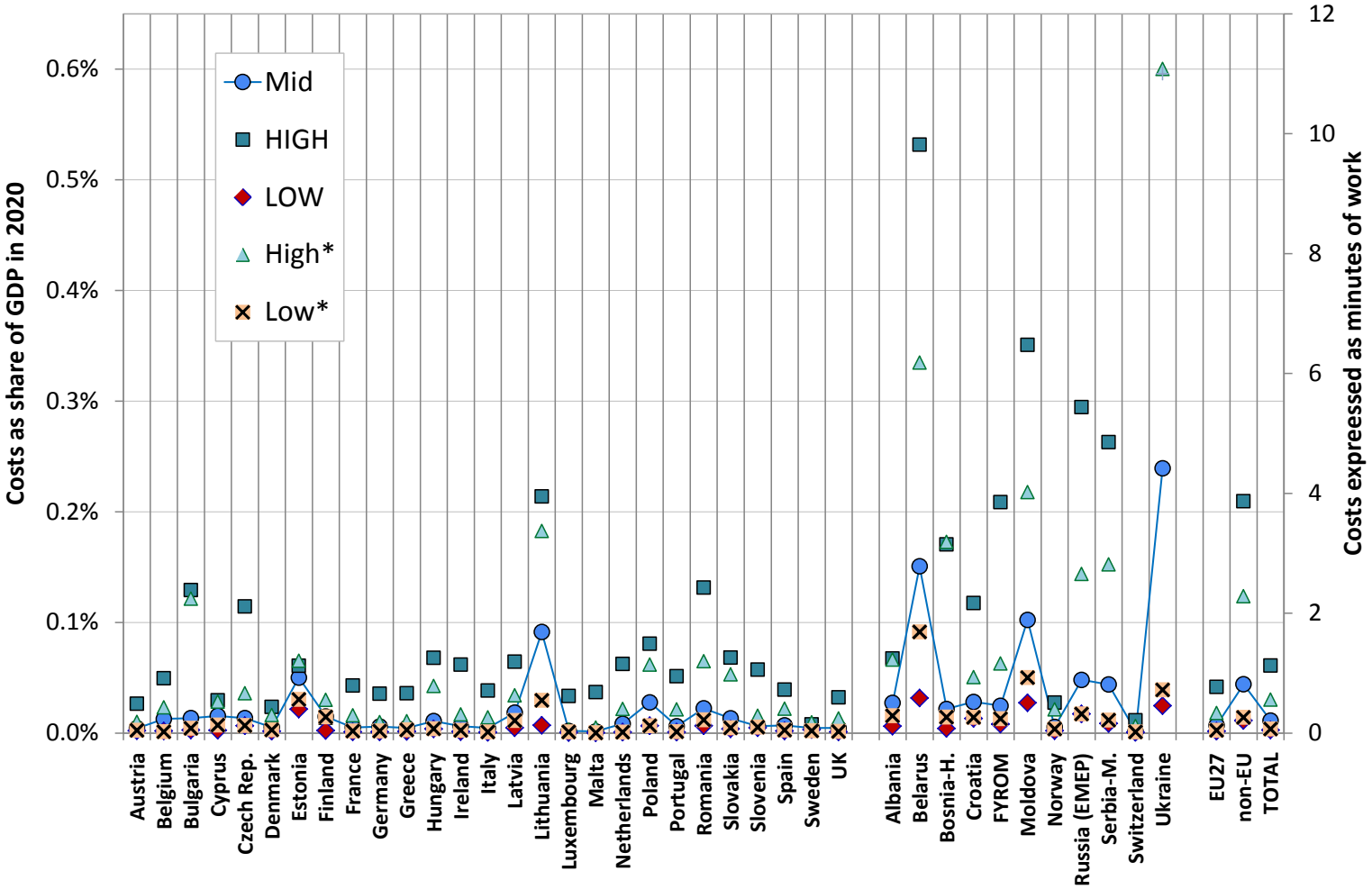
	Health-PM	Acidification	Eutrophication	Ozone
HIGH	75%	75%	75%	75%
High*	75%	75%	75%	50%
Mid	50%	50%	60%	40%
Low*	25%	25%	50%	25%
LOW	25%	25%	25%	25%

Additional air pollution control costs (on top of baseline)



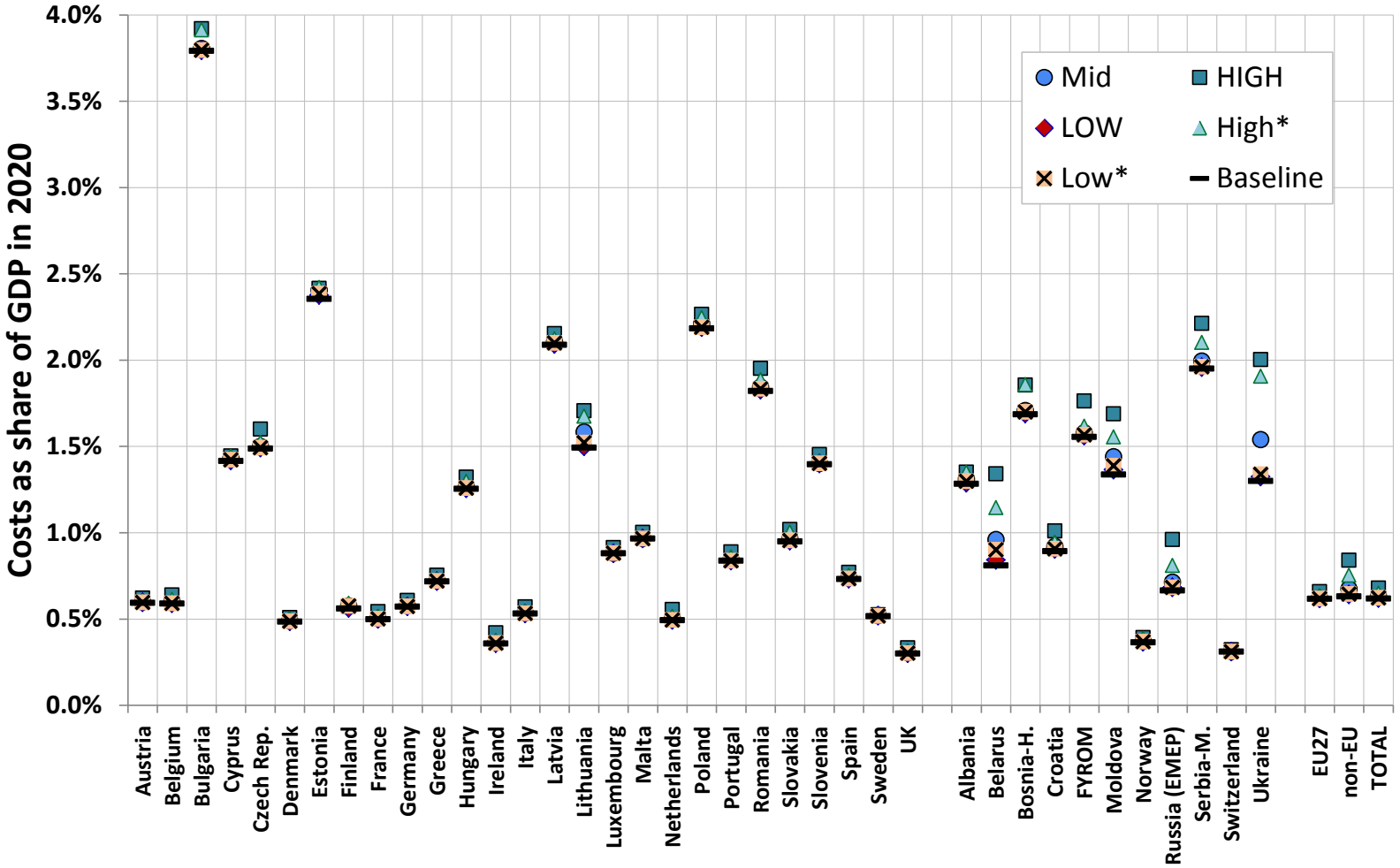
Additional air pollution control costs (on top of baseline)

as a percentage of GDP in 2020, and in work time required



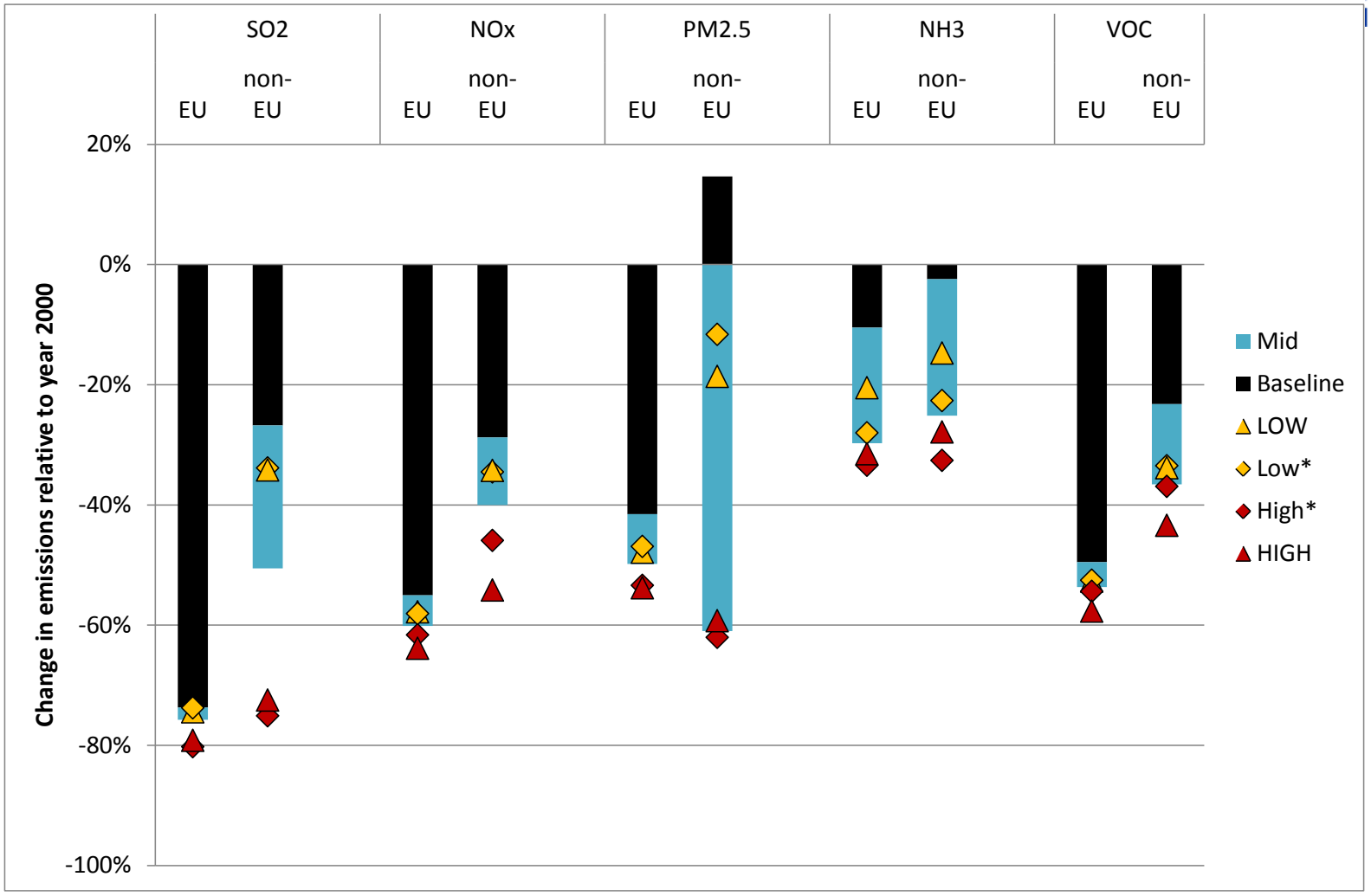
Total air pollution control costs (incl. costs of baseline)

as a percentage of GDP in 2020



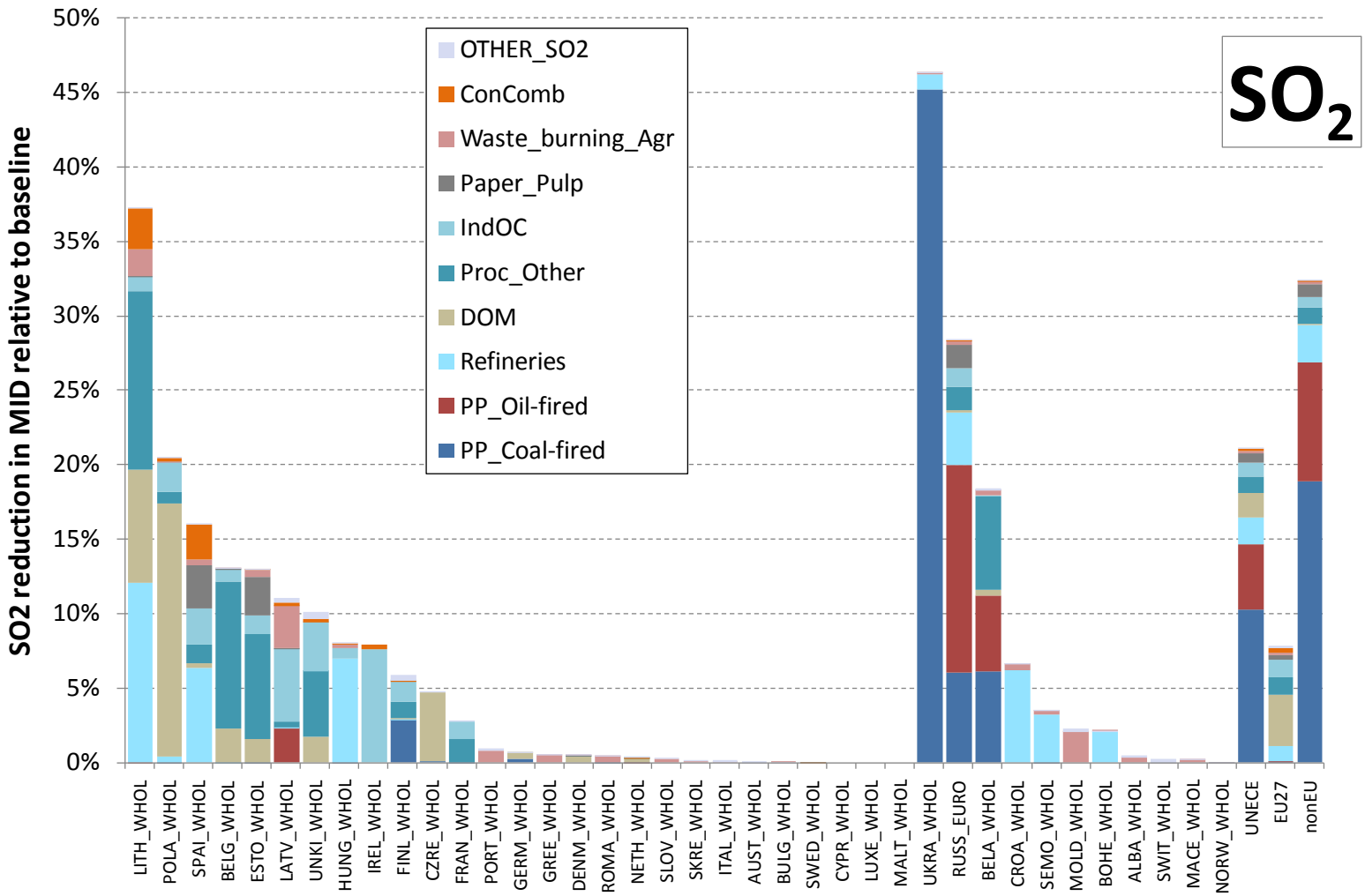
Change in emissions relative to the year 2000

for the different scenarios



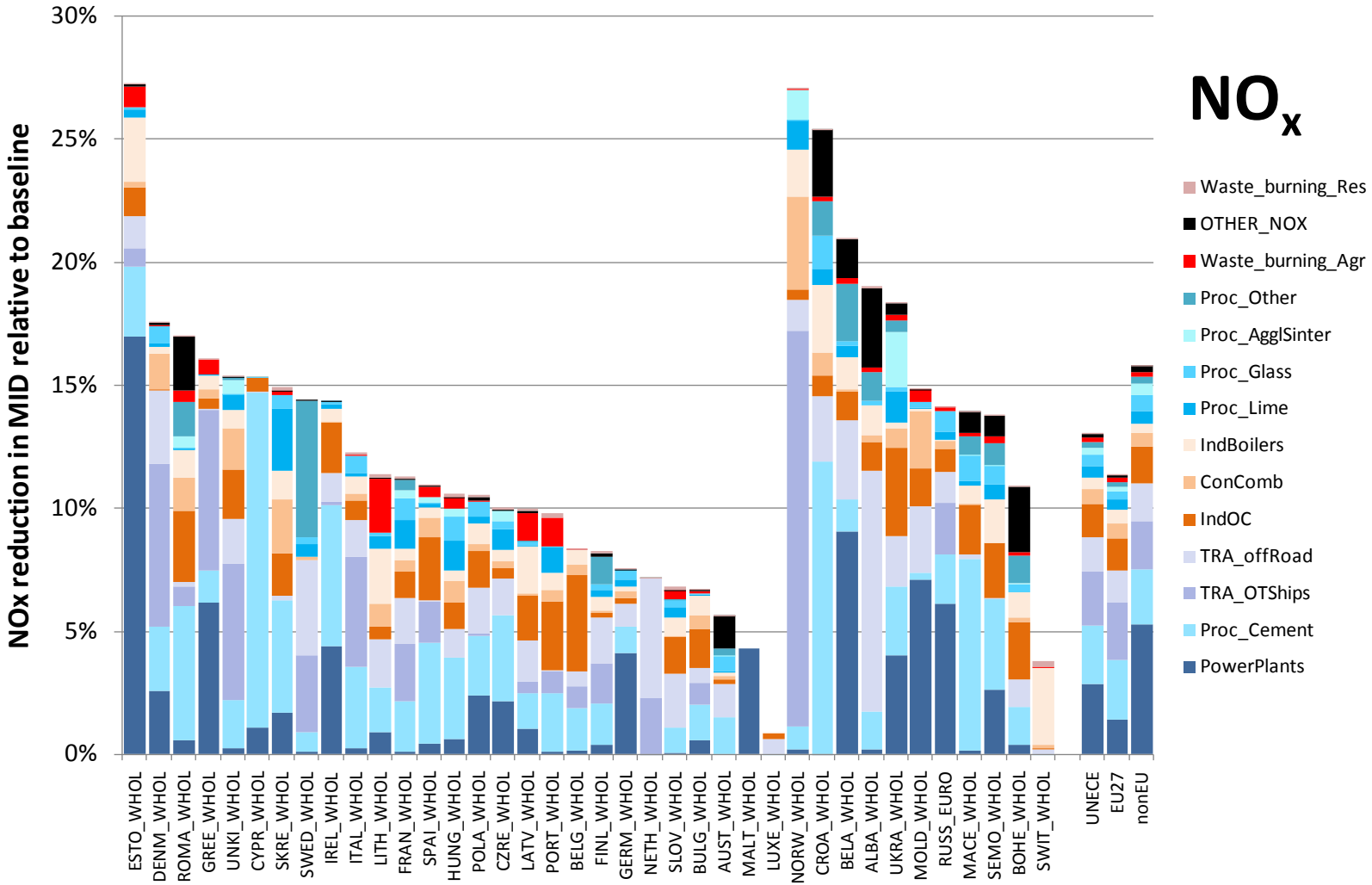
Additional measures for SO_2

to achieve the mid case



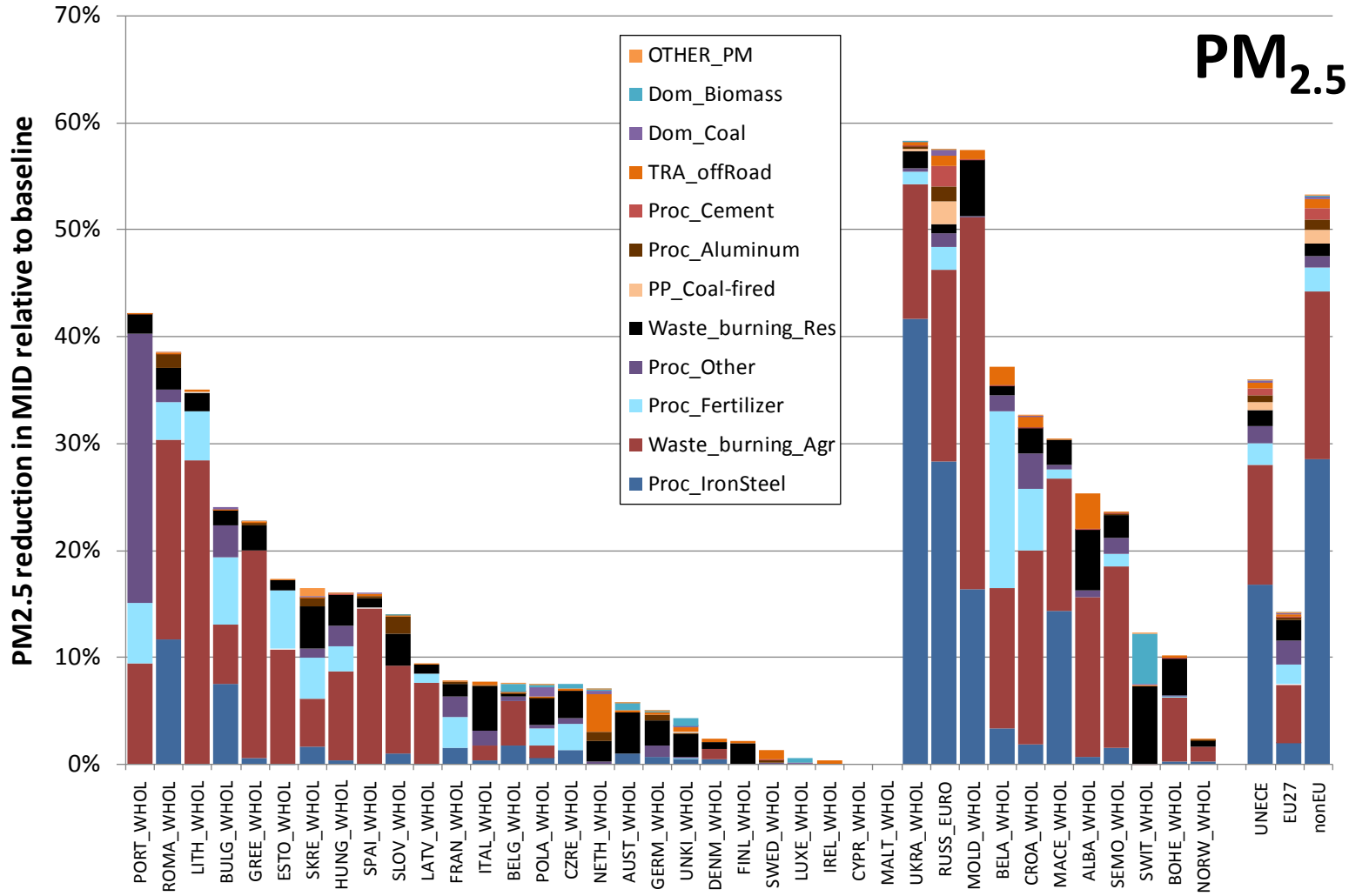
Additional measures for NO_x

to achieve the mid case



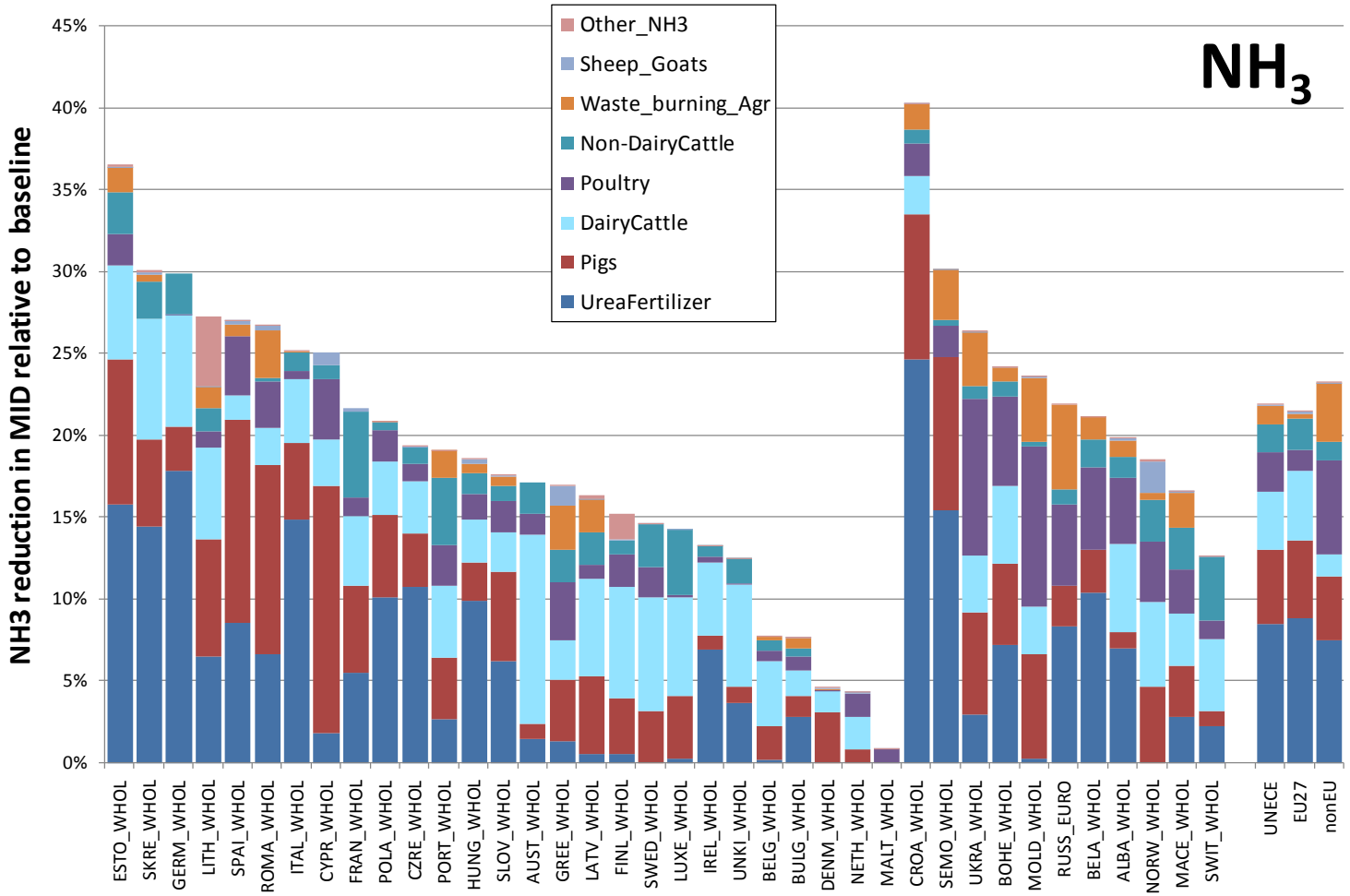
Additional measures for PM2.5

to achieve the mid case



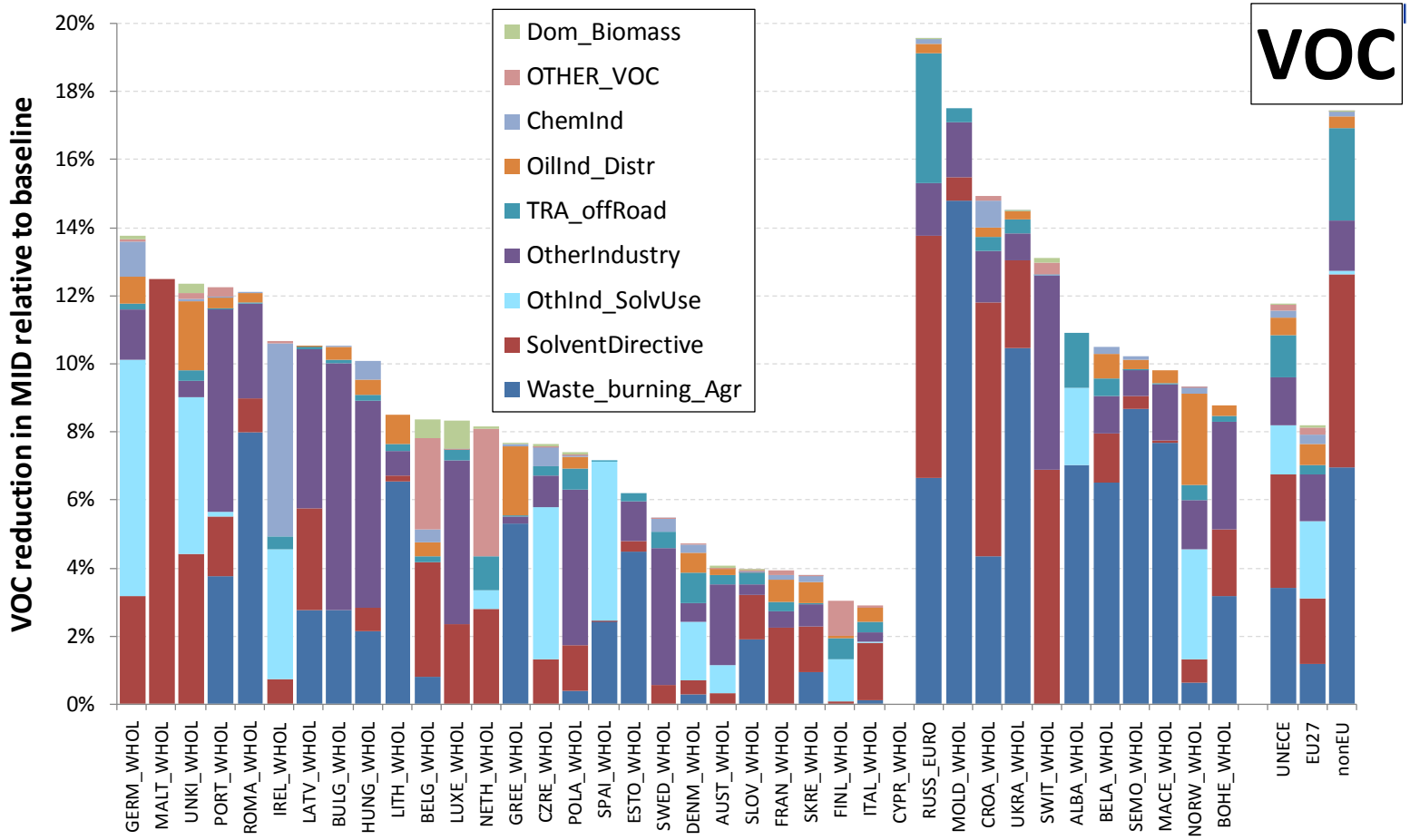
Additional measures for NH_3

to achieve the mid case



Additional measures for VOC

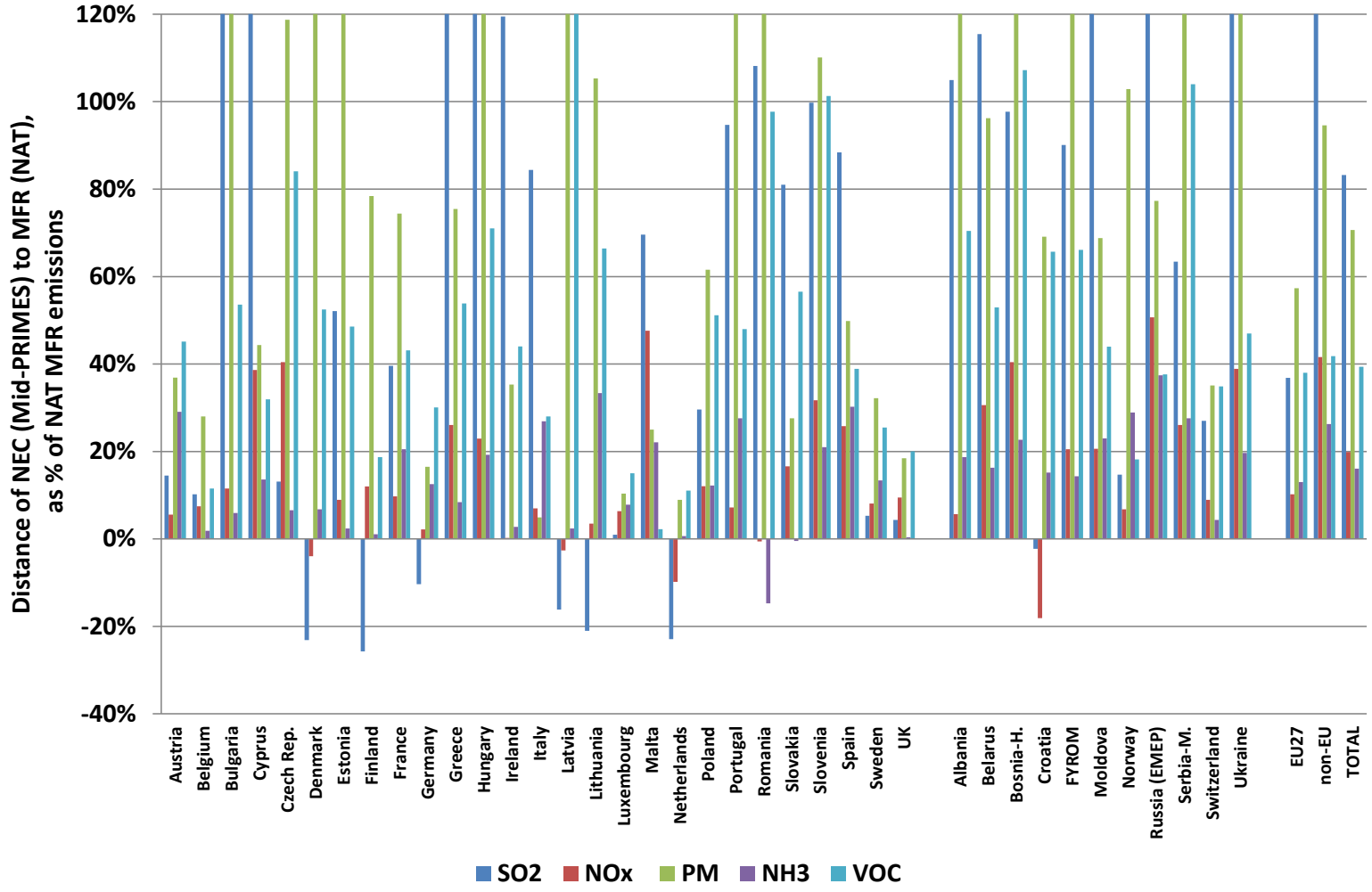
to achieve the mid case



Sensitivity analyses

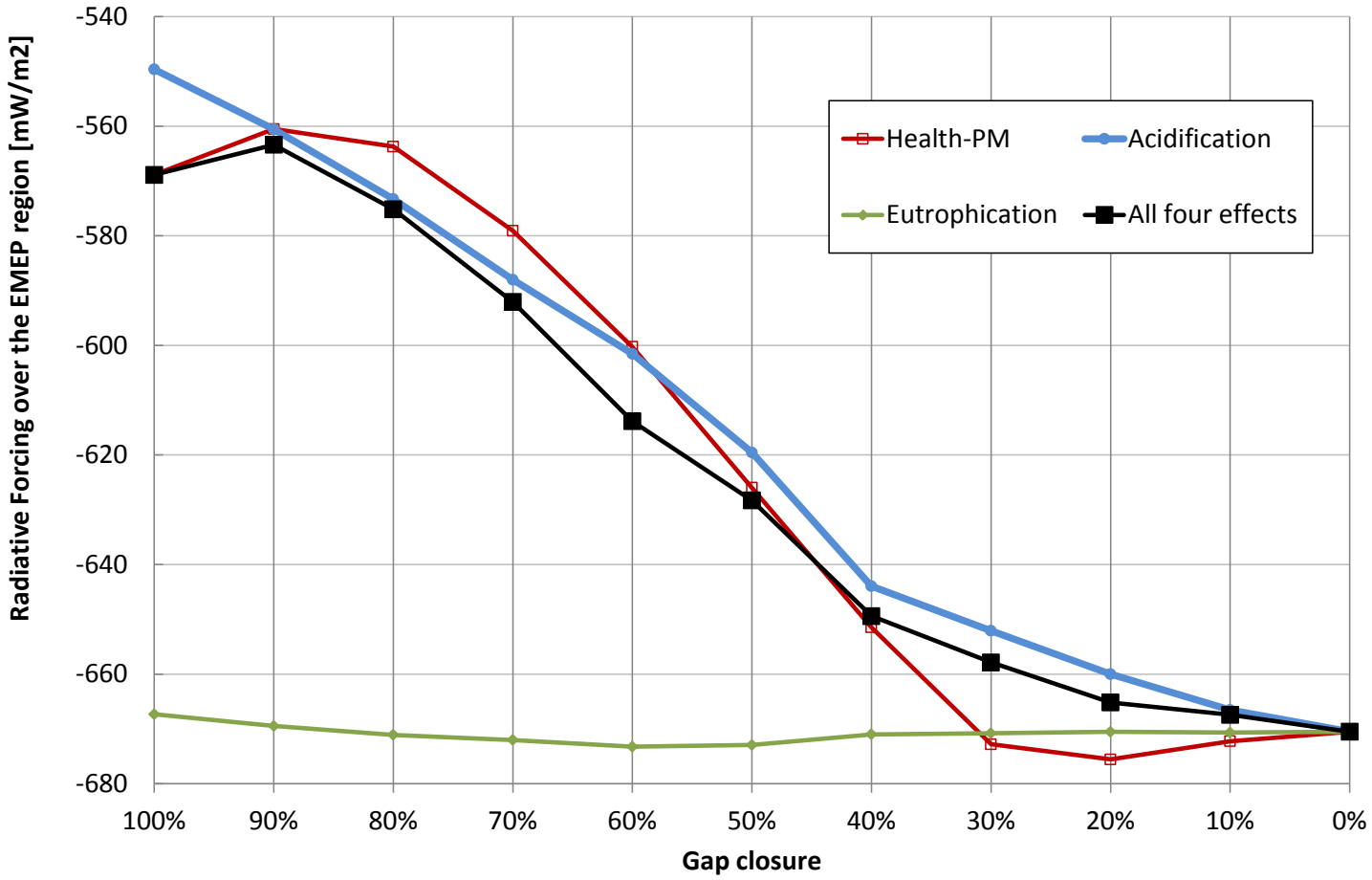
- For national activity projections
- Additional targets on radiative forcing
- Excluding the urban increment for PM

Feasibility of mid-PRIMES ceilings under the National scenario



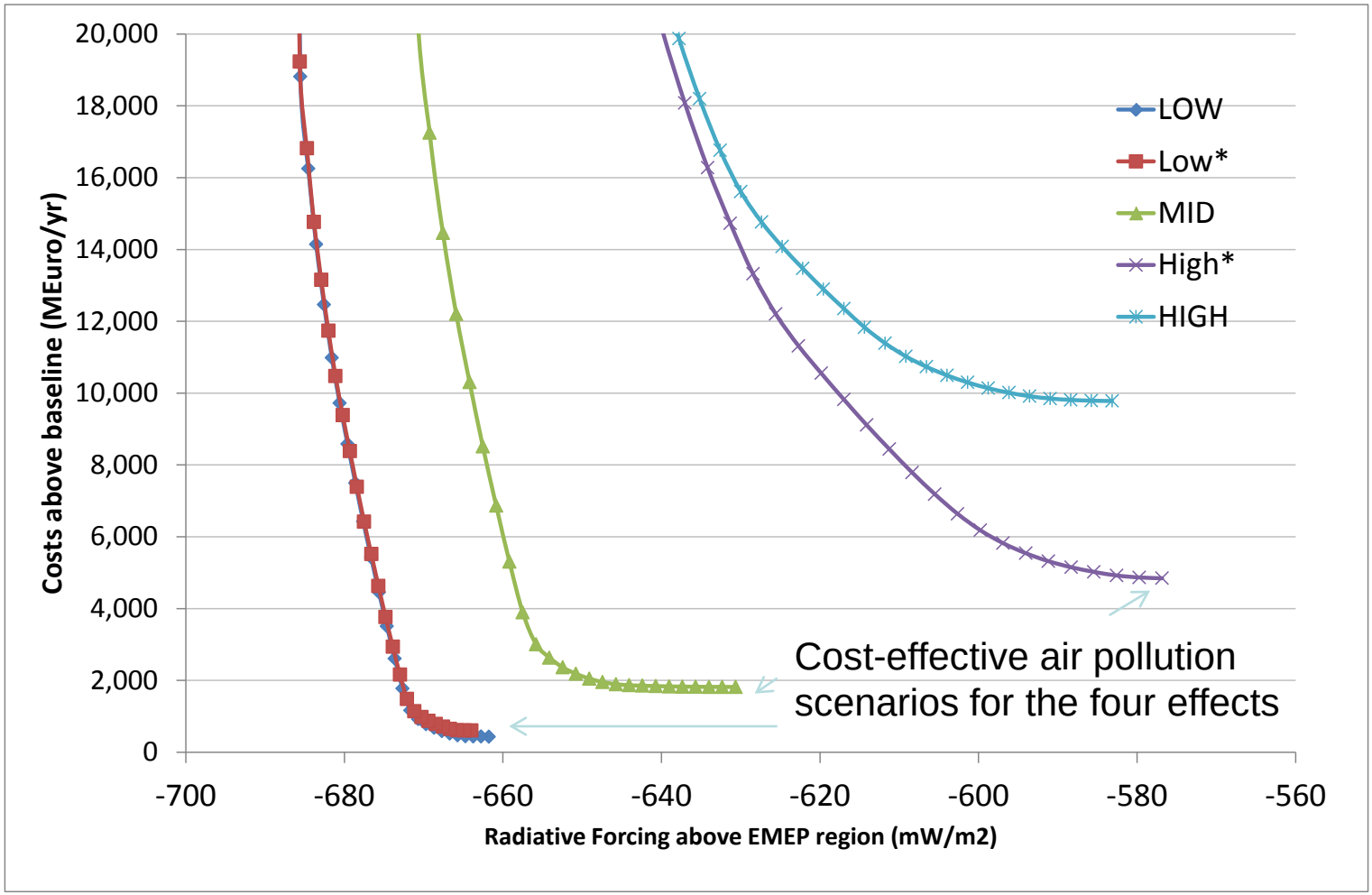
Instantaneous radiative forcing over the EMEP region

for cost-effective air pollution scenarios (from aerosol emissions)

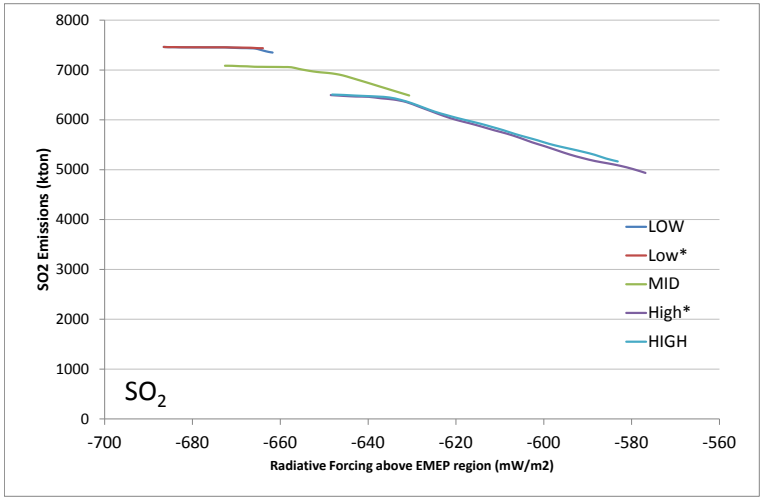


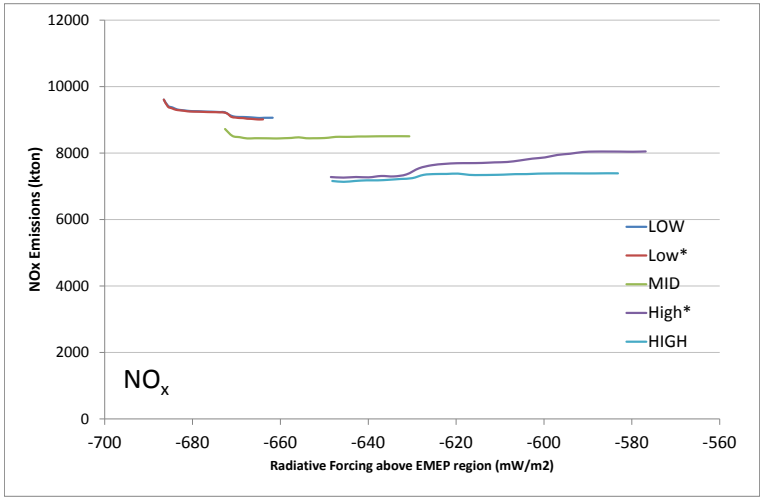
Costs for reducing radiative forcing

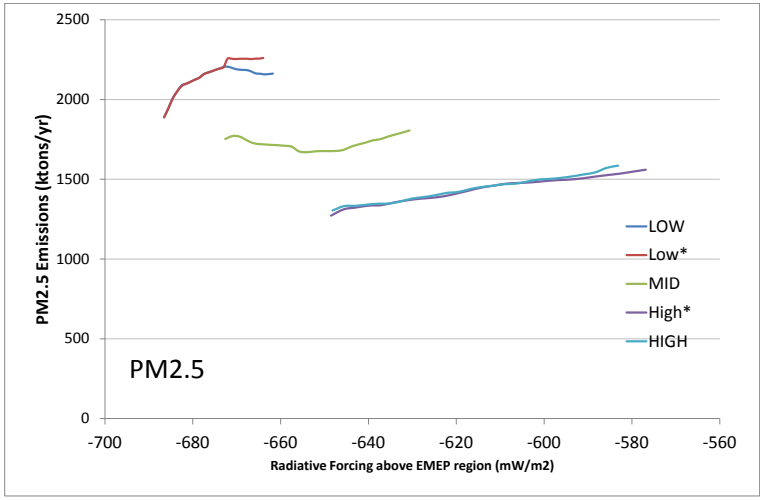
in addition to the air quality targets

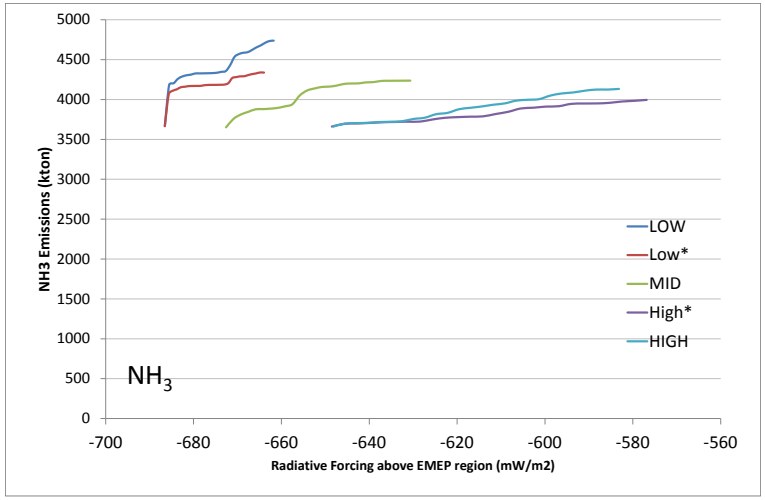


Cost-effective changes in emissions for reducing radiative forcing, in addition to the targets for air quality impacts









Conclusions

- Despite significant reductions in emissions in the baseline, there remains scope for cost-effective further air quality improvements in 2020.
- The report presents five scenarios aiming at 25% to 75% of the feasible improvements for each air quality effect, with additional emission control costs ranging from 0.4 to 9.8 billion €/yr.
- Between 50 and 60% of these costs emerge in the EU-countries. However, relative efforts in most non-EU countries are higher than in the EU.
- Modified targets for ozone would have largest impact on control costs.
- The scenarios reduce the negative forcing (and thus increase radiative forcing) in the EMEP domain by up to 0.1 W/m^2 (compared to a current total forcing from long-lived greenhouse gases of about 2.7 W/m^2).
  Low cost options are available that could reduce these negative impacts on near-term climate change to some extent.

Access to all data via GAINS-Online

URL:	http://gains.iiasa.ac.at
Version:	GAINS-Europe
Scenario group:	GOTH_RevFeb2011
Scenarios:	
Data for the year 2000:	GOTH_Nat10_Feb2011
Optimized scenarios:	
	GOTH_PRIMESBL2009_baseline
	GOTH_PRIMESBL2009_LOW
	GOTH_PRIMESBL2009_Low*
	GOTH_PRIMESBL2009_MID
	GOTH_PRIMESBL2009_High*
	GOTH_PRIMESBL2009_HIGH
	GOTH_PRIMESBL2009_MFR