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In search of efficient air pollution strategy for Europe; *the role of nitrogen*

Workshop
The Causal Relations of Nitrogen in the Cascade
21 - 23 November 2005, Braunschweig - Germany

Content

- **Background**

- **Where do we want/expect to get?**

- **How do we construct the case?**
  Principal assumptions, approach

- **What does it take to get there?**
  Total costs, reduction, specific results for nitrogen compounds, and sensitivity runs

- **Important elements of the agricultural component**

Why CAFE programme?

- **Robust association of health impacts from fine particulate matter available – no threshold,**

- **Previously agreed legislation and UNECE Protocols extend to 2010 only,**

- **Harmonized strategy for reducing air pollution,**

- **Knowledge based approach,**

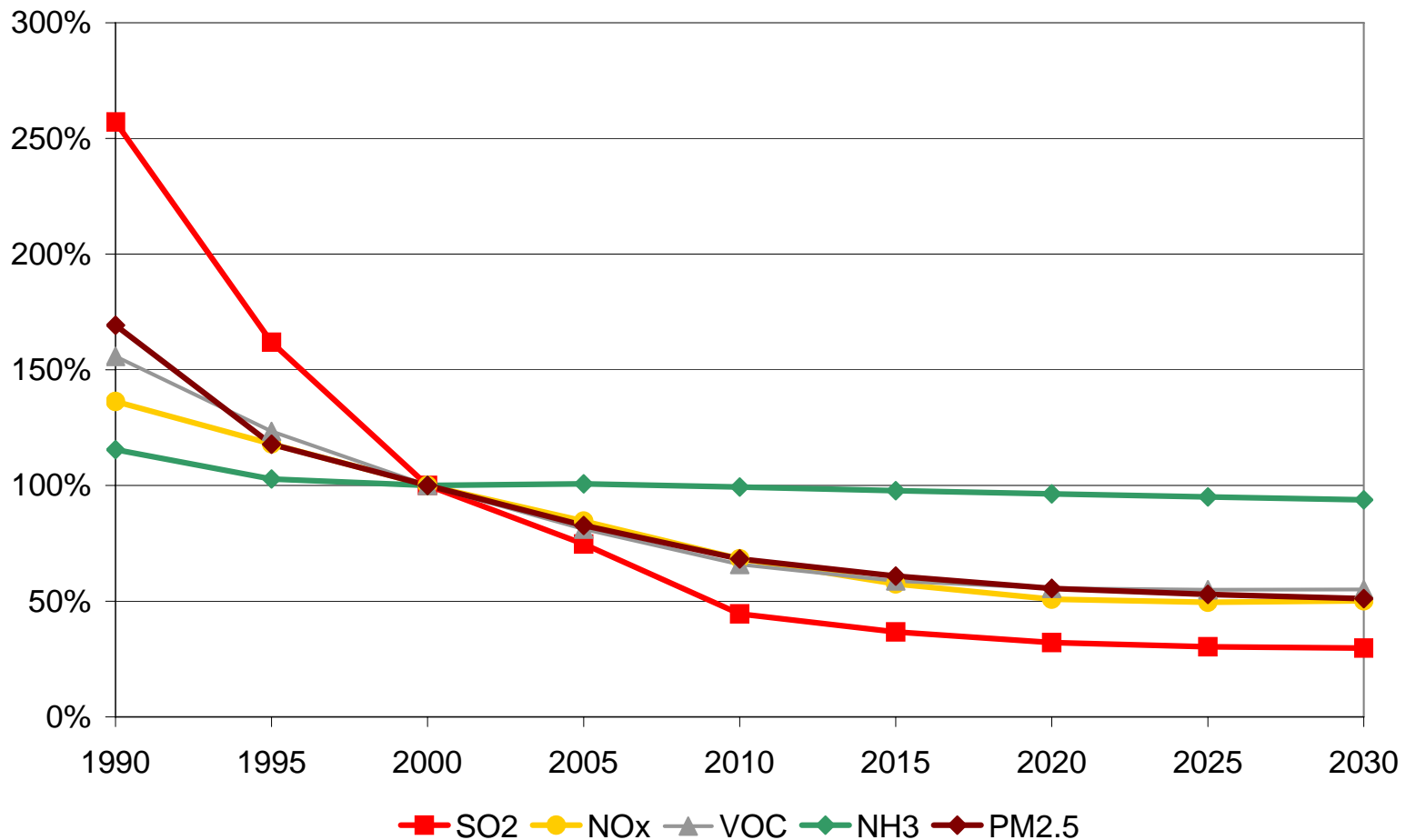- **European Union grew from 15 to 25 Member States.**

Land-based emissions
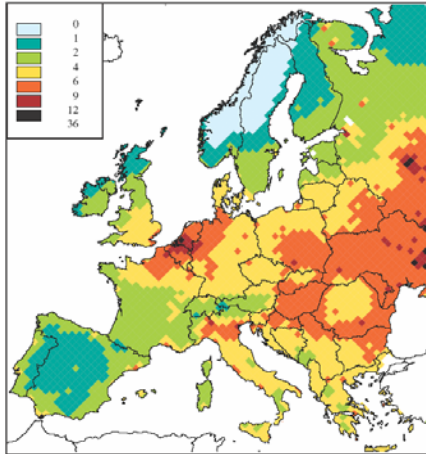## CAFE baseline "with climate measures", EU-25
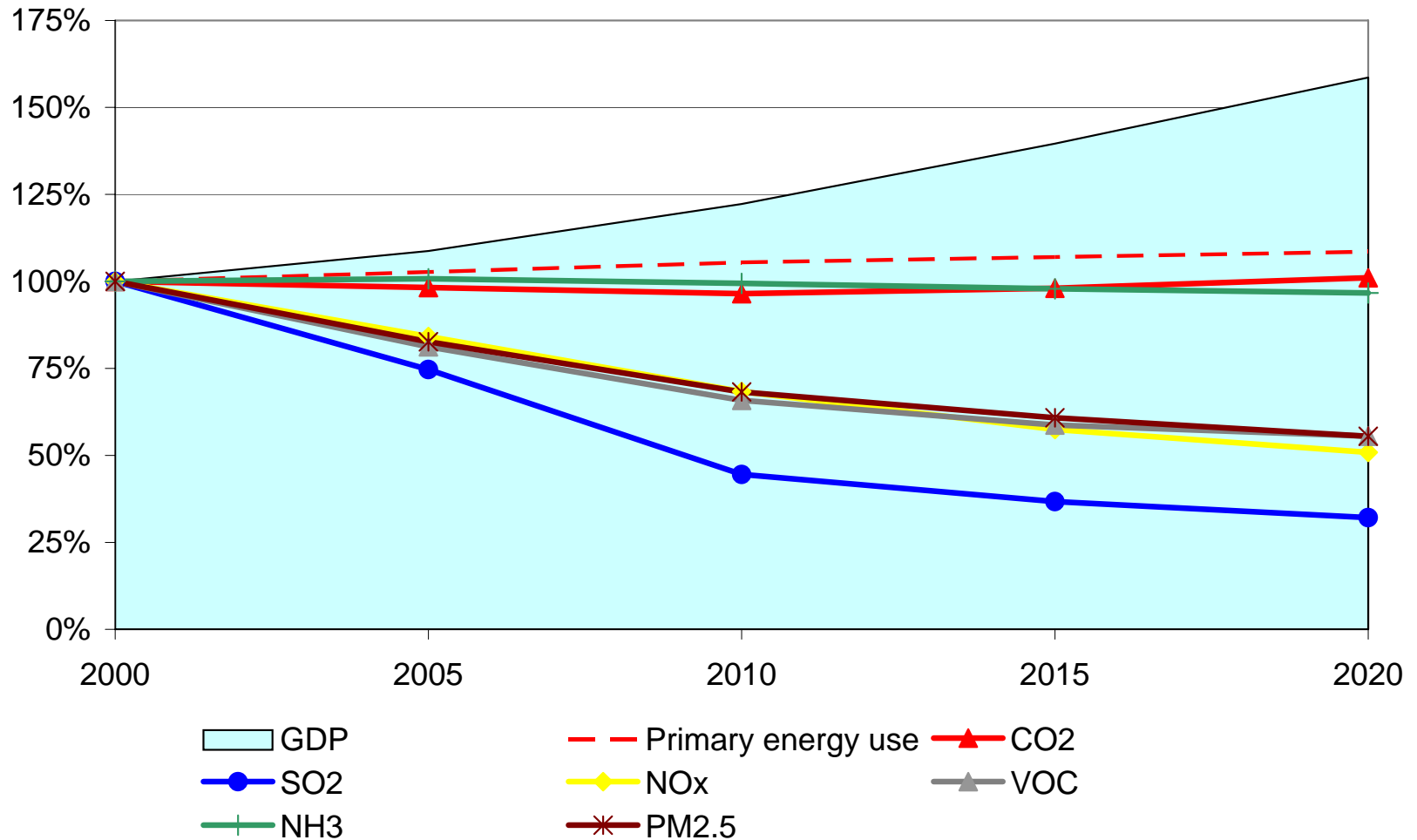
Long-term trends of EU-25 emissions
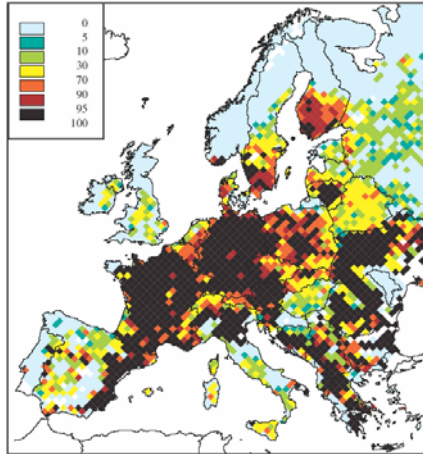## CAFE "Climate policy" projection, relative to year 2000 [= 100%]
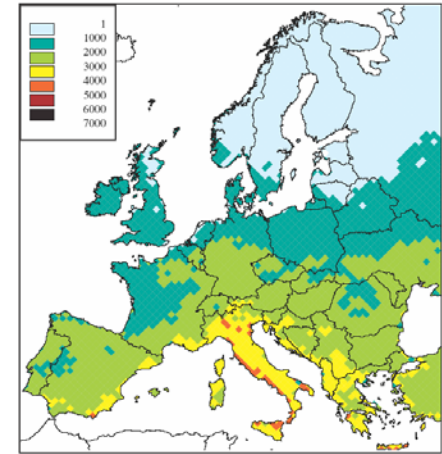
Remaining problem areas in 2020
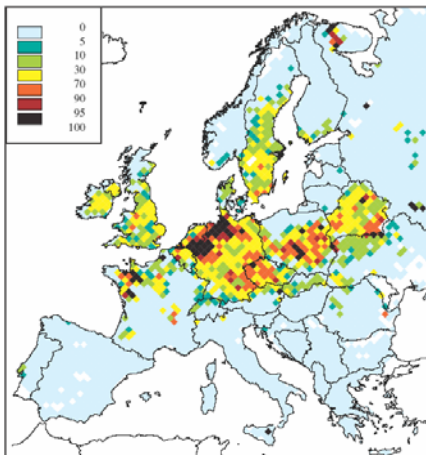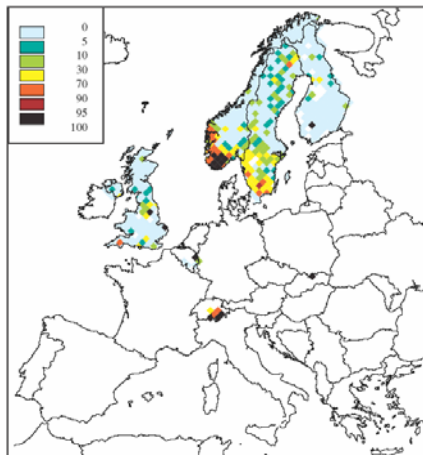
Light blue = no risk

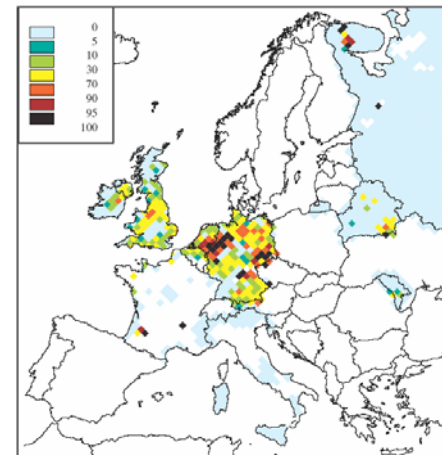**Health - PM**

Vegetation – N dep.

Health+vegetation - ozone

Forests – acid dep.

Freshwater – acid dep.

Semi-natural – acid dep.

Effects in 2000 and for CAFE medium ambition 2020

PM

Eutrophication

Ozone

Acid, forests

Acid, lakes

Acid, semi-nat.
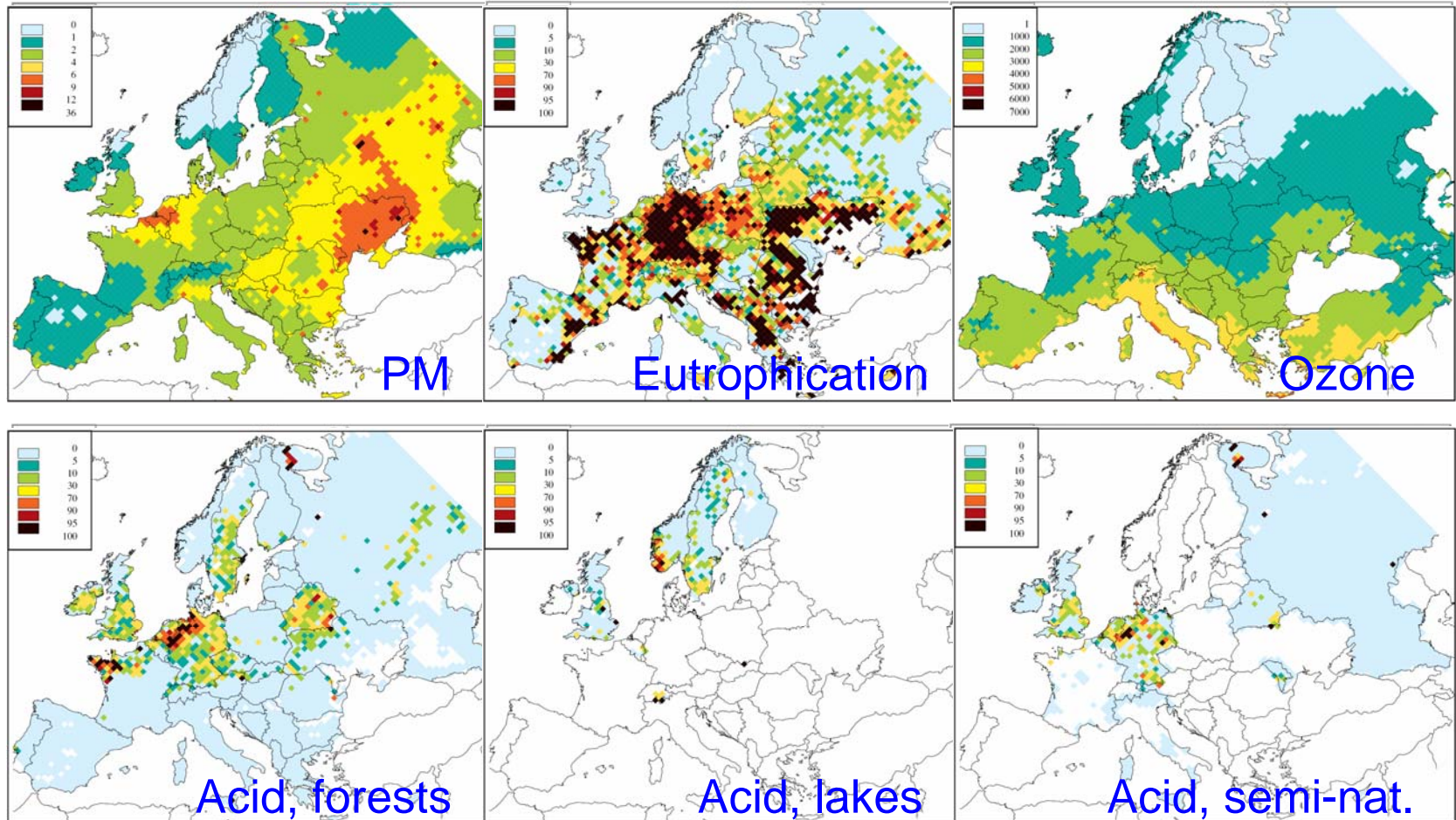
Clean Air for Europe (CAFE) - *Approach*

- **Baseline scenario - Current legislation (CLE) case for 2020 "with climate measures"**

- **Scope for further measures – Maximum technically feasible reduction" (MTFR) case assumes maximum reductions also in non-EU countries and sea regions**

- **Identify cost-effective policy measures**

Multi-pollutant/multi-effect analysis
for identifying cost-effective policy scenarios

IIASA's RAINS computer model

PM   SO$_2$ NH$_3$ NO$_x$ VOC

Health   Eutrophication   Acidification   Ozone

CAFE policy targets for 2020
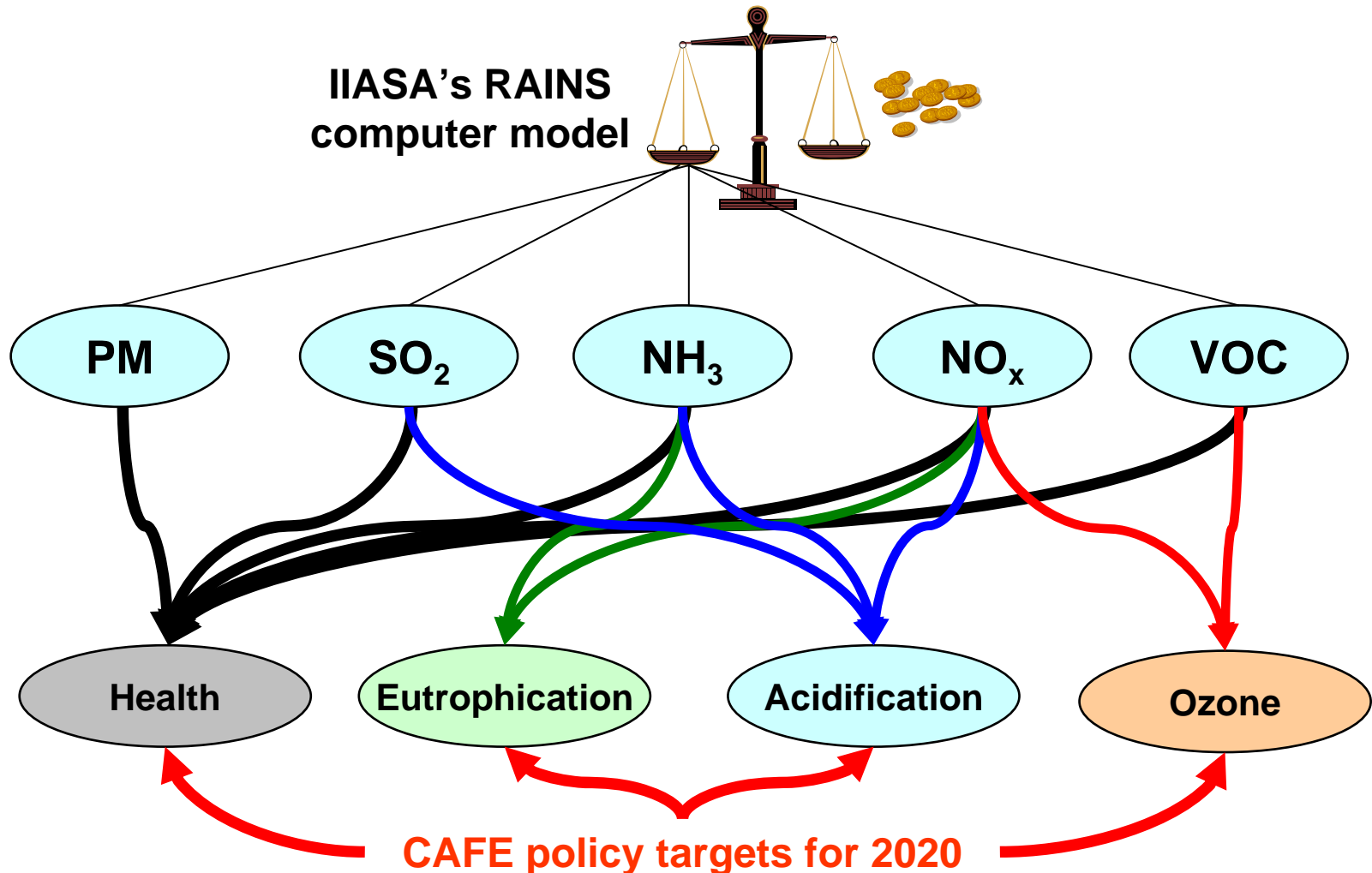
Environmental targets of the EU Thematic Strategy

Environmental effect	Targeted improvement compared to baseline	Costs
PM health impacts	30.8 million life years gained	5.9 bln €/yr
Eutrophication	Additional 165.000 km^2 ecosystems protected	3.9 bln €/yr
Acidification	Additional 52.000 km^2 ecosystems protected	3.8 bln €/yr
Ozone	1300 premature deaths per year avoided	2.9 bln €/yr
Joint optimization	All targets	7.1 bln €/yr

Costs of the joint scenarios
[billion €/year]
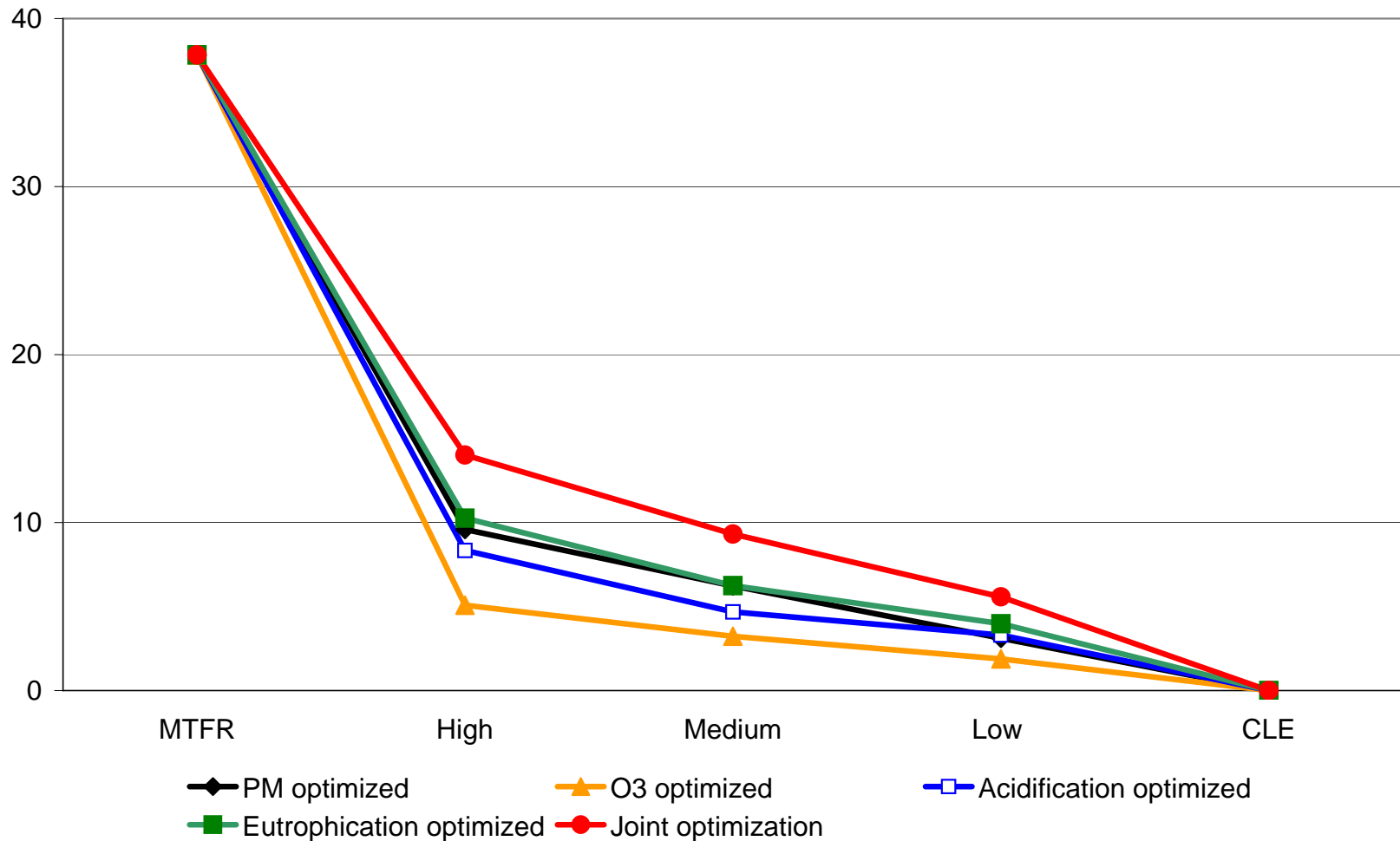
Emission reductions of EU-25
of the multi-effect optimization [2000=100%]

▲ Low ambition ■ Medium ambition ◆ High ambition
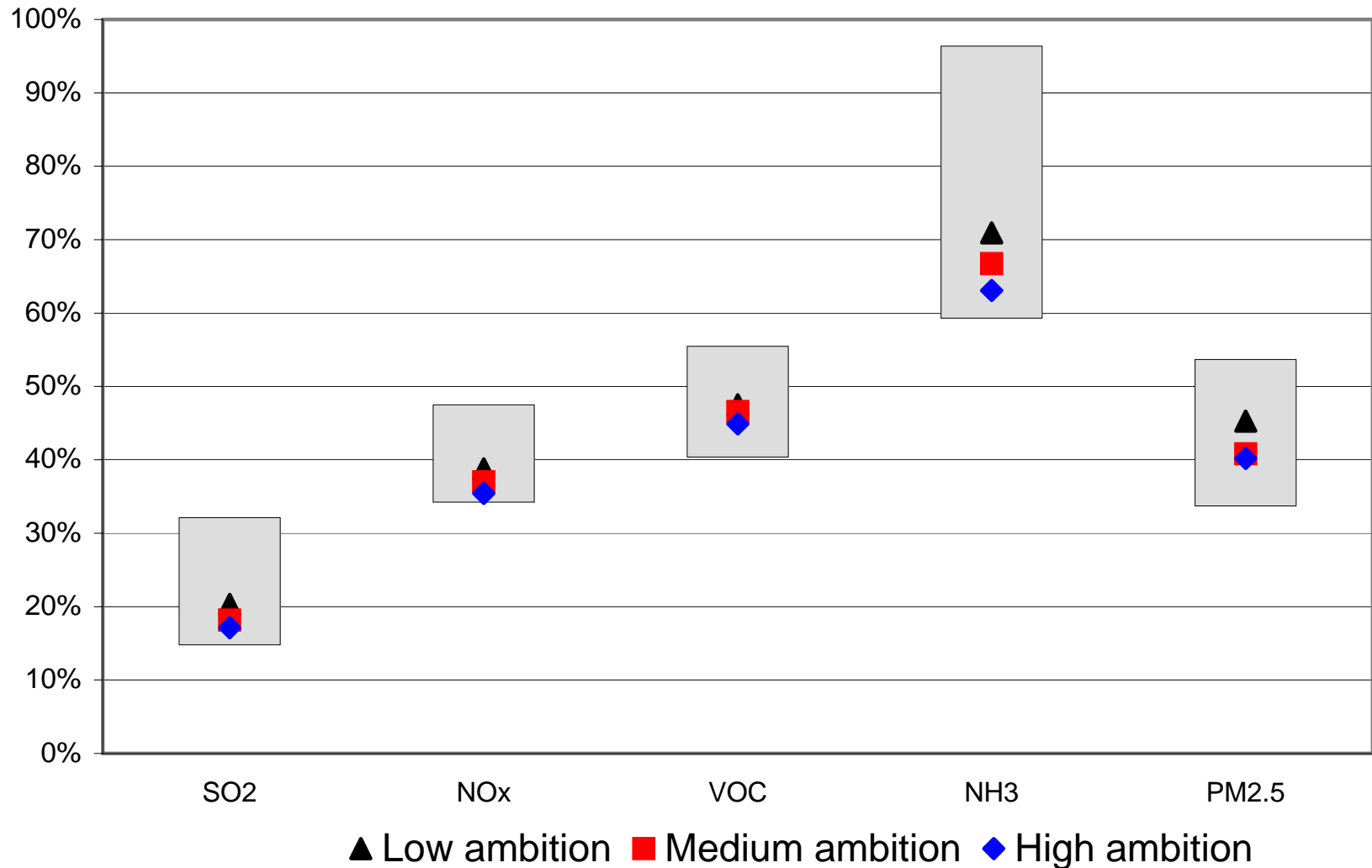
Costs per pollutant for EU-25
on top of CLE

Billion Euros/year

45
40
35
30
25
20
15
10
5
0

Low ambition Medium ambition High ambition MTFR

■ Road sources ■ SO2 ■ NOx ■ NH3 ■ VOC ■ PM
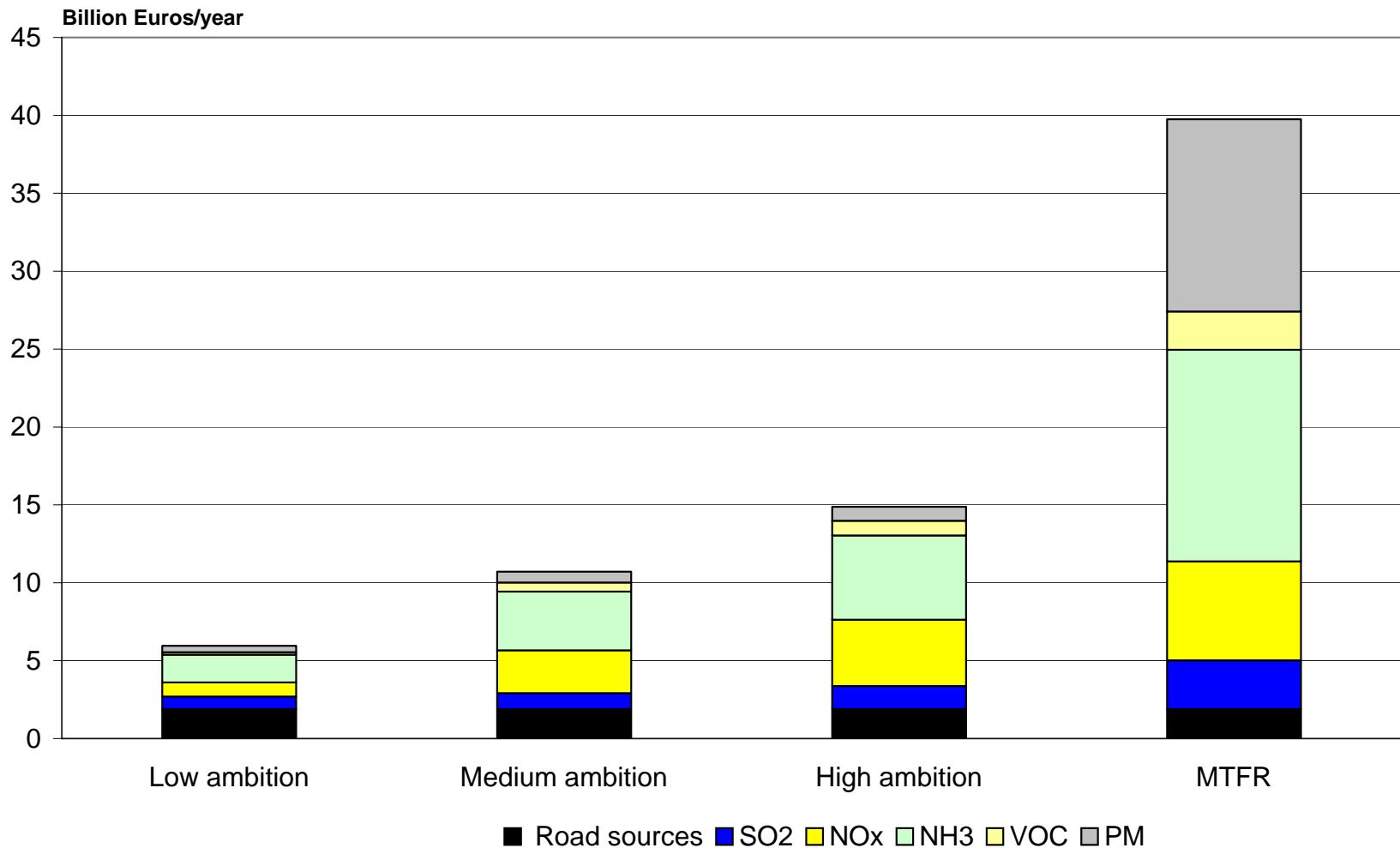
Sensitivity assessment for national projections

- **National energy and agricultural projections available for 10 countries**
- **Do not comply with Kyoto obligations**

- **Two questions:**
  - How would optimization results change based on the national projections?
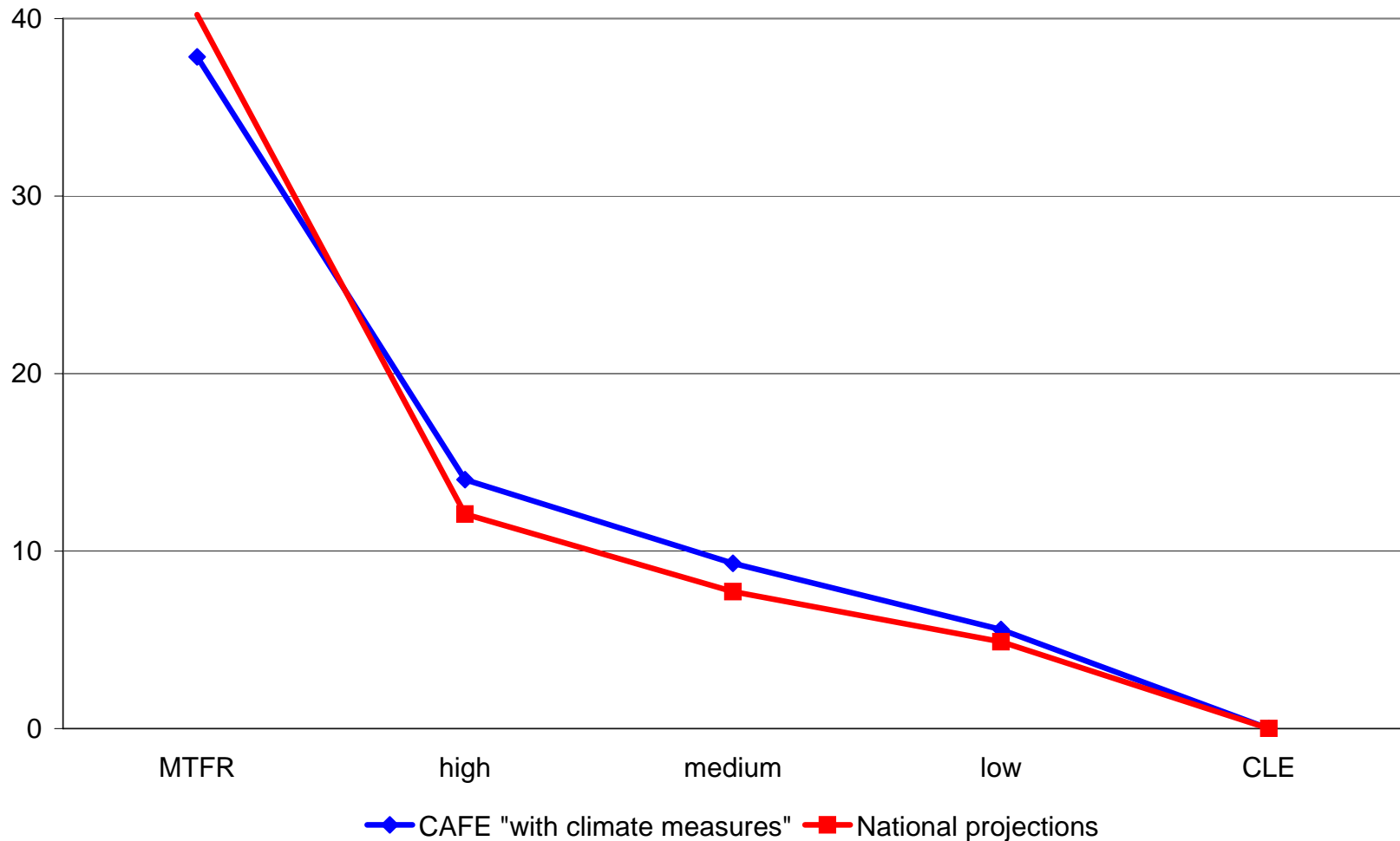 - What about the feasibility/costs of emission ceilings, if the underlying projection does not materialize?

- **Approach:**
  - Joint optimization with national projections for same target setting rules (gap closures and relative YOLL improvement recalculated for new CLE/MTFR)

Costs of the joint scenarios

[billion €/year]

# Sensitivity assessment for alternative health impact theory

- **Uncertainty about mechanism/causative factor of PM2.5 health impacts:**
  - Total PM2.5 mass?
  - Only primary particles? No impacts from secondary PM?
  - Ultra-fine particles?
  - Heavy metal content?

- **Sensitivity analysis:**
  - "Total PM2.5 mass" vs. "Primary PM only" theories
  - Target: same relative reduction in estimated health impacts
  - Together with targets for acidification, eutrophication and ozone (multi-effect context)

Sensitivity analysis
Reductions of
"Primary PM only" case vs. Standard approach, joint optimization
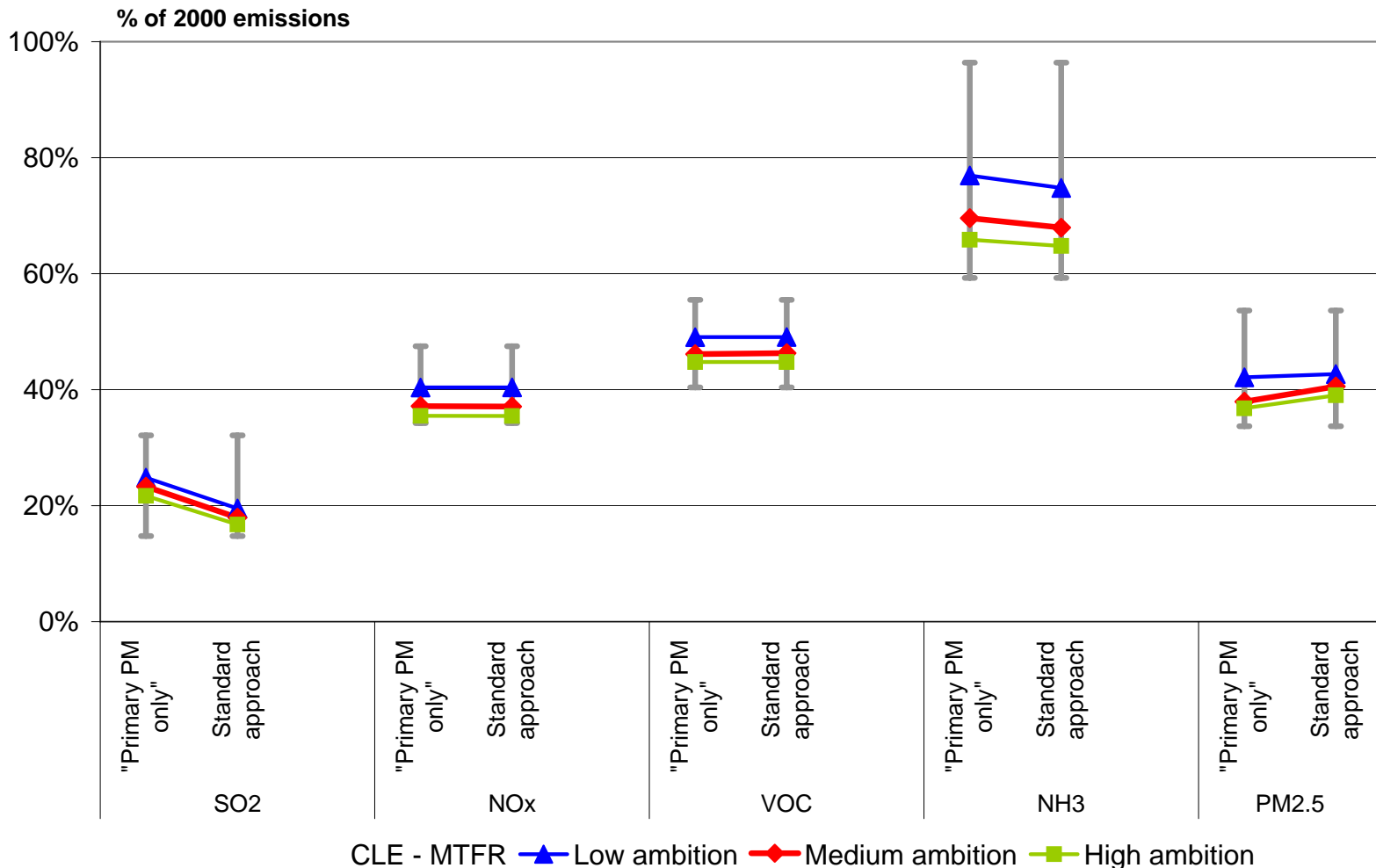
Specific issues for agriculture
Comparison of recent activity data scenarios

EU-15

NMS

Legend:
- Dairy cows - NEC
- Dairy cows - CAFE
- Dairy cows - CAP
- Other cattle - NEC
- Other cattle - CAFE
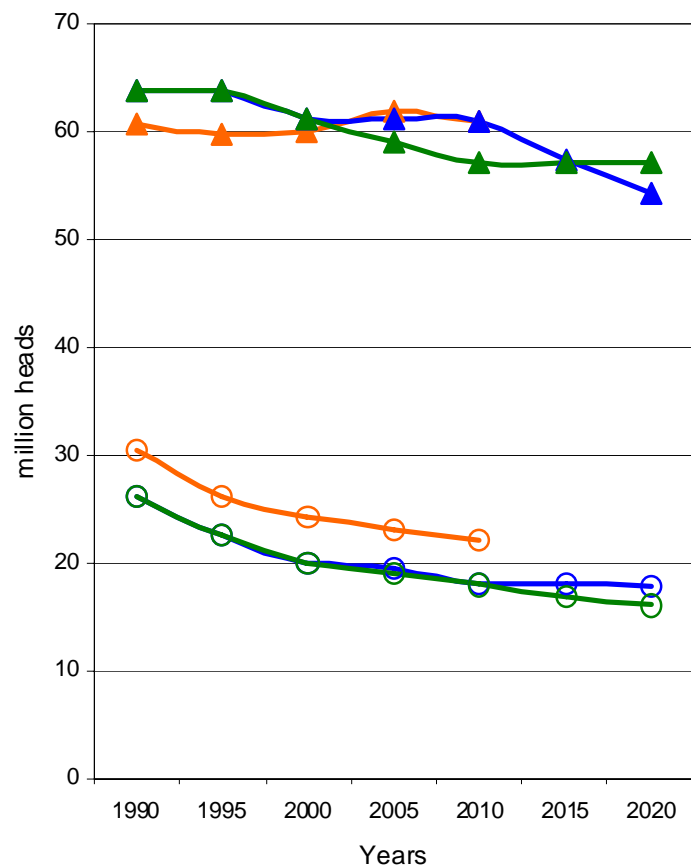- Other cattle - CAP
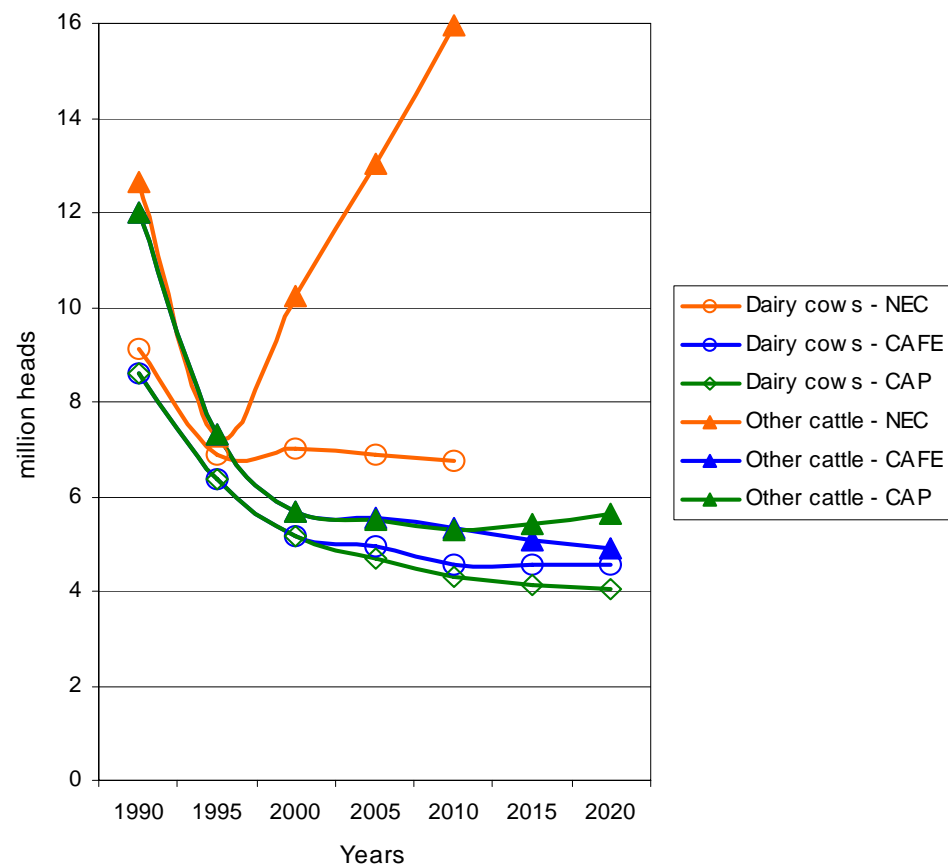
Specific issues for agriculture
Comparison of recent activity data scenarios

Poultry
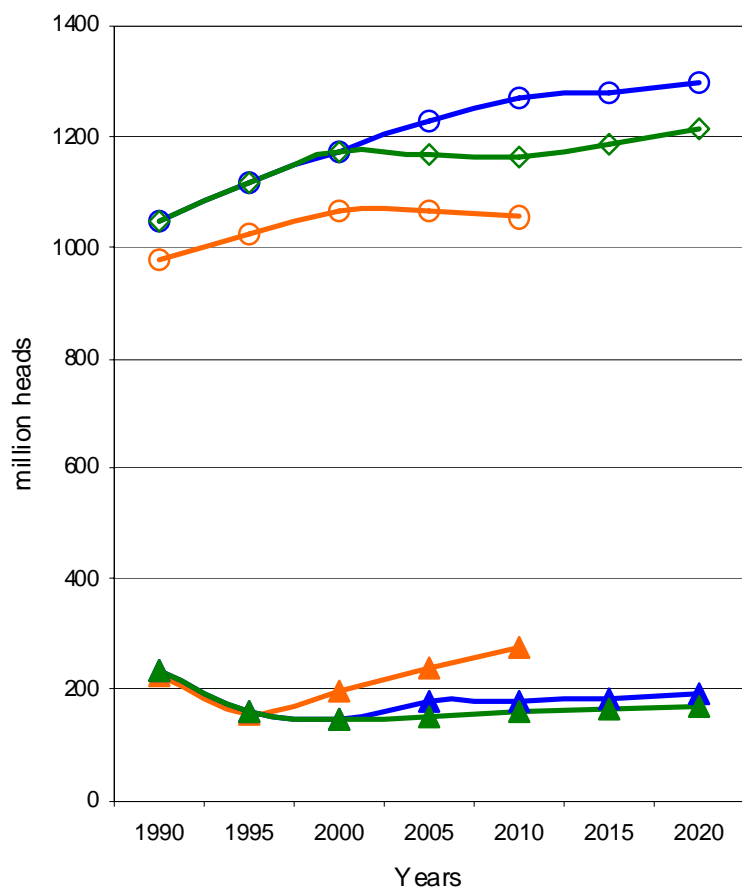
Pigs
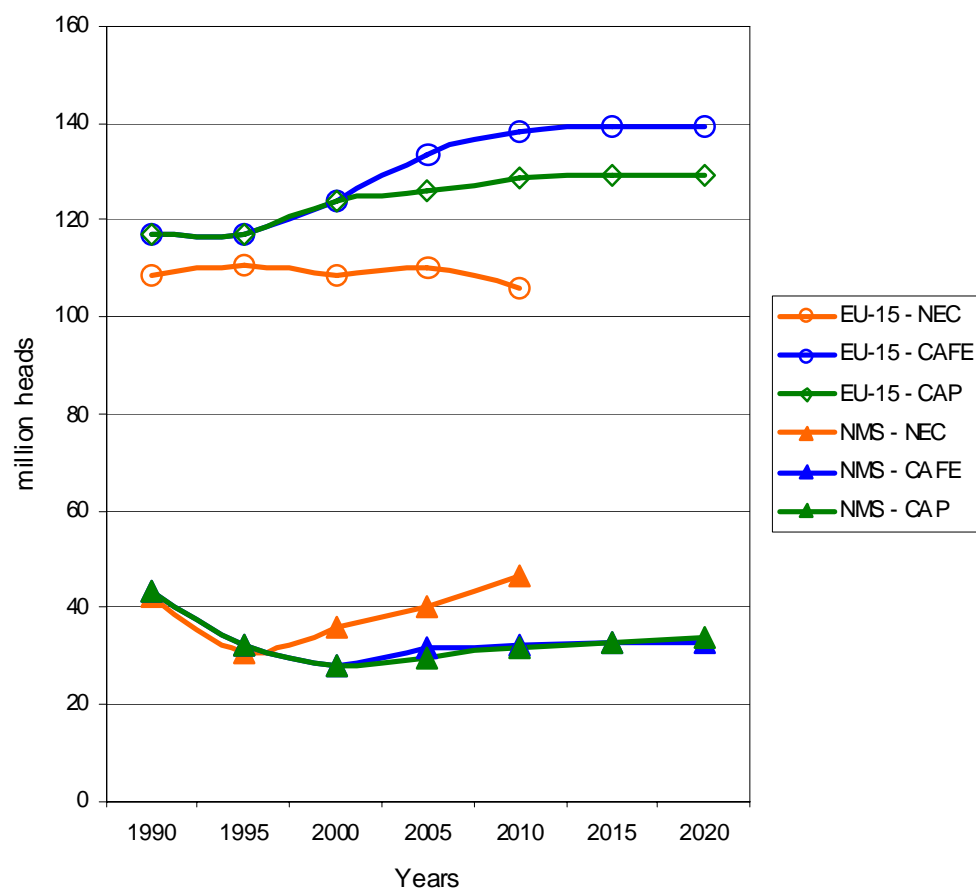
Specific issues for agriculture
Manure management systems
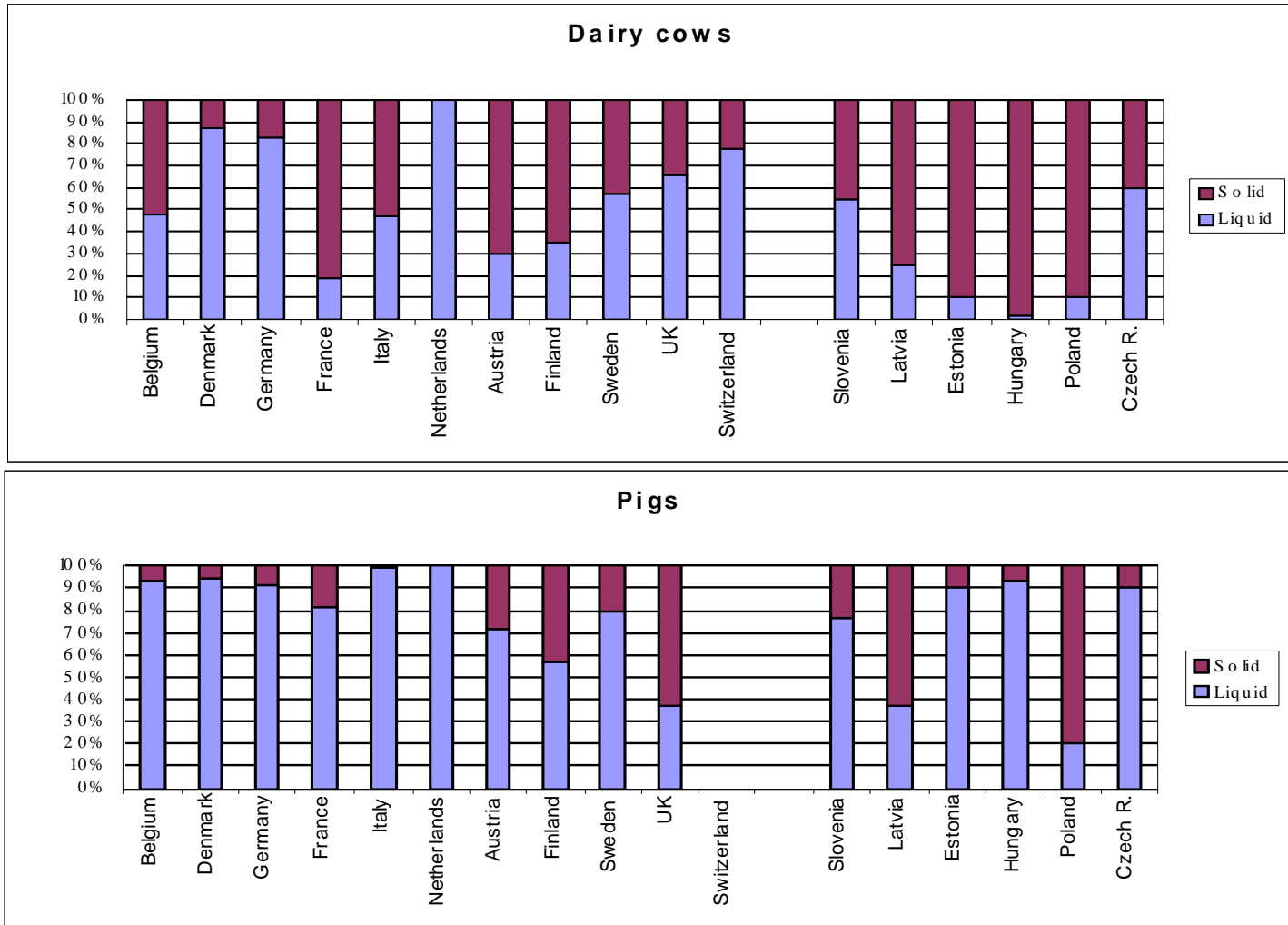
Specific issues for agriculture
Manure application methods - *Dairy cows*

Slurry

Legend:
- High efficiency
- Medium efficiency
- Low efficiency
- Broadcasting

Countries: Belgium, Denmark, Germany, France, Italy, Netherlands, Austria, Finland, Sweden, UK, Switzerland, Estonia, Slovenia, Hungary, Poland, Czech R.
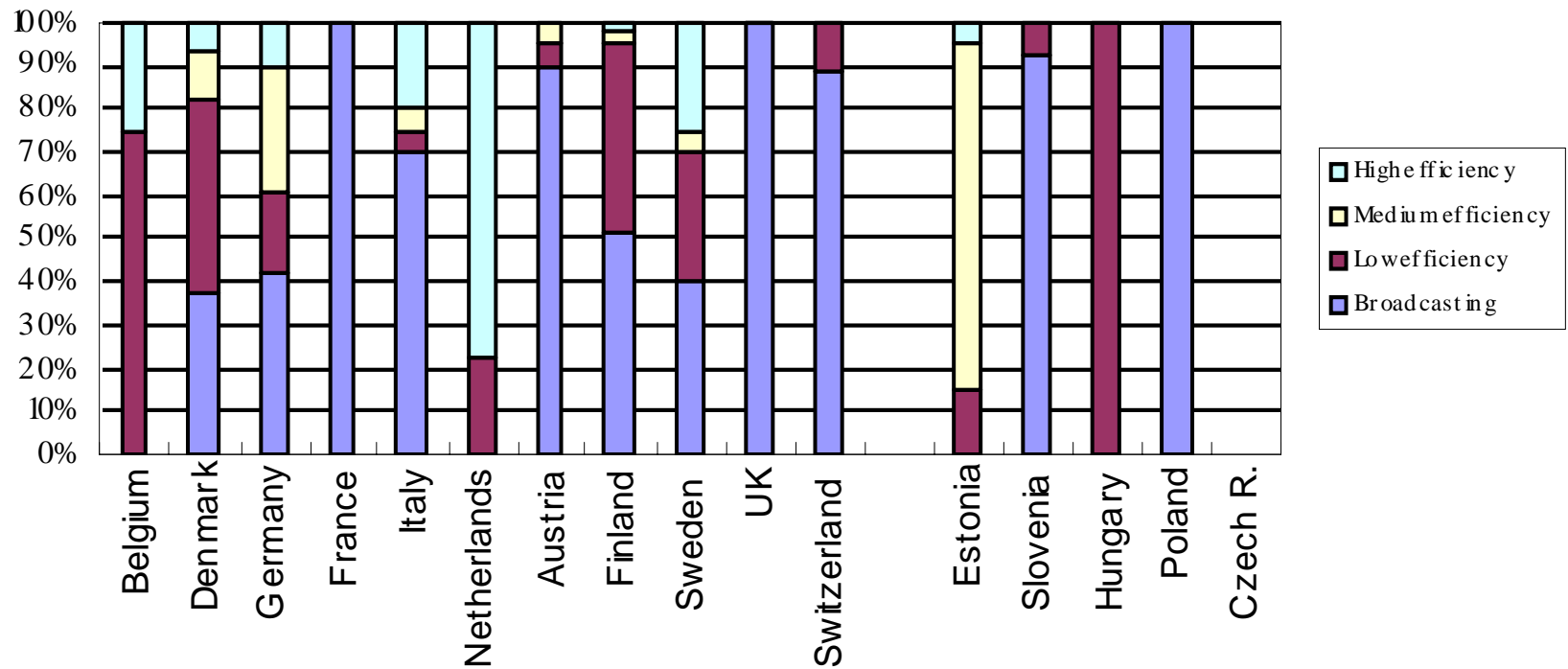
Specific issues for agriculture
Example of a cost curve

UK Ammonia cost curve for 2020 (agricultural sources only)

+Biofiltration

+Housing

+Storage and application

Urea subs.

mln Euro/year

Emissions (NH3, kt)

Conclusions

- **Proposed strategy asks for significant reduction of air pollutants' emissions but brings significant benefits for health and ecosystems protection.**

- **Important economic synergies between control measures for different air quality problems exist. Multi-effect strategies increase robustness vs. important uncertainties in the understanding of health impacts**
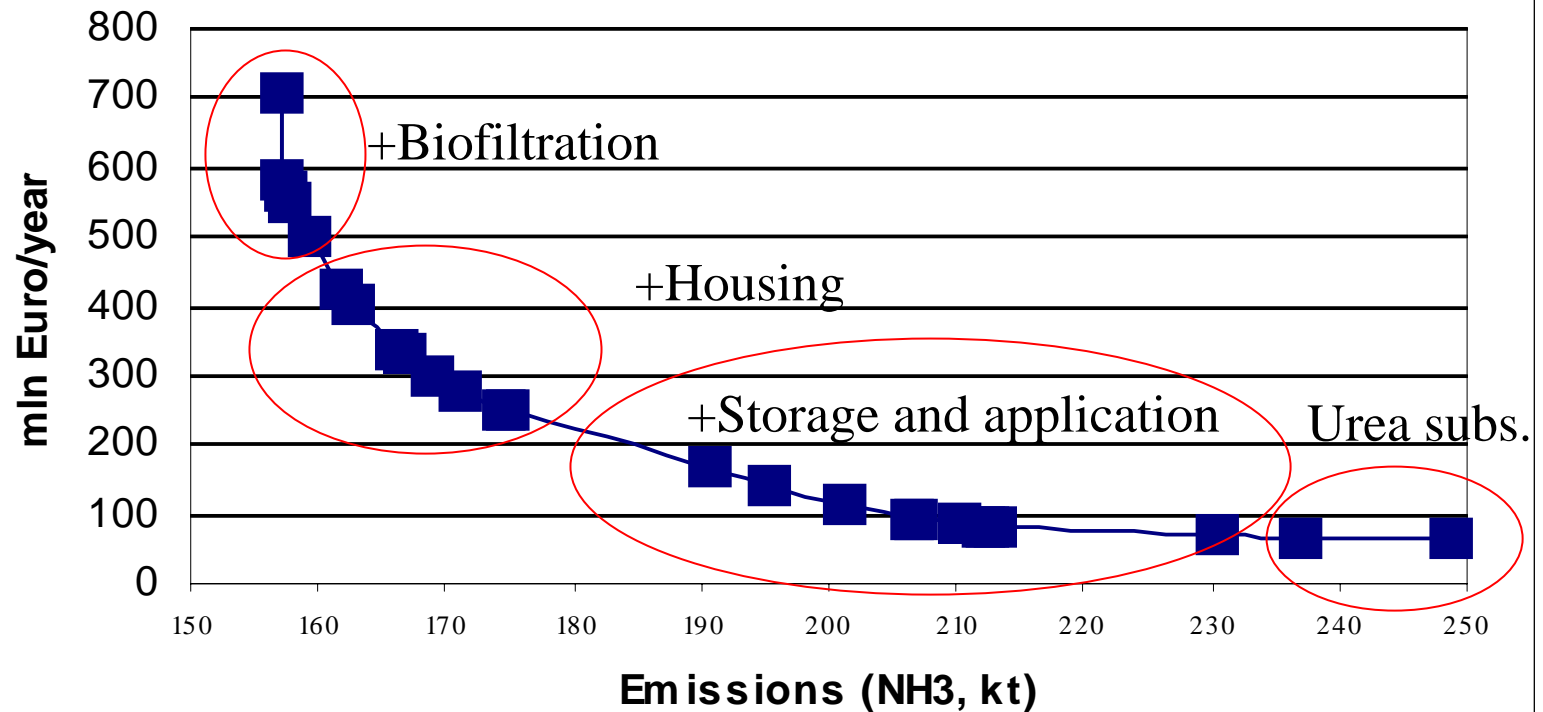
- **Nitrogen compounds are very important element of the strategy and their reduction is associated with significant costs.**

- **Sensitivity towards alternative energy/agricultural projections needs to be further explored, but more realistic (Kyoto-compliant) projections are required.**

- **Good understanding of agricultural structure across Europe and assessment of future abatement potential are more important than ever.**

Science for Global Insight

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RAINS review
Documentation
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The GAINS model

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CAFE - Clean Air for Europe
LRTAP Convention - EMEP
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Air Pollution (TAP)

The prioritization of action in different economic sectors and countries to control air pollution problems with different spatial and temporal

More information: www.iiasa.ac.at/rains

for 'clean air management' in the coming decade.

News:

new All reports and detailed scenario data for the **Clean Air For Europe (CAFE) analysis** can be downloaded from this web site.

new **Bilateral consultations** for the forthcoming revision of the National Emission Ceilings Directive begin in April 2005. National coordinators are inviated to settle a date for consultation with IIASA - see timetable.

new **Scenarios of global emissions** of air pollutants and methane were prepared with the RAINS model and are available for download.

IIASA's new **GAINS (Greenhouse Gas and Air Pollution Interactions and Synergies) model** was presented at a side event of the UNFCCC Conference of Parties (COP10) in Buenos Aires (December 8, 2004). See the new GAINS web site ...

7th Workshop on the **Model Intercomparison Study for Asia** (MICS-Asia Phase II) - IIASA, February 14-15, 2005. More information ...