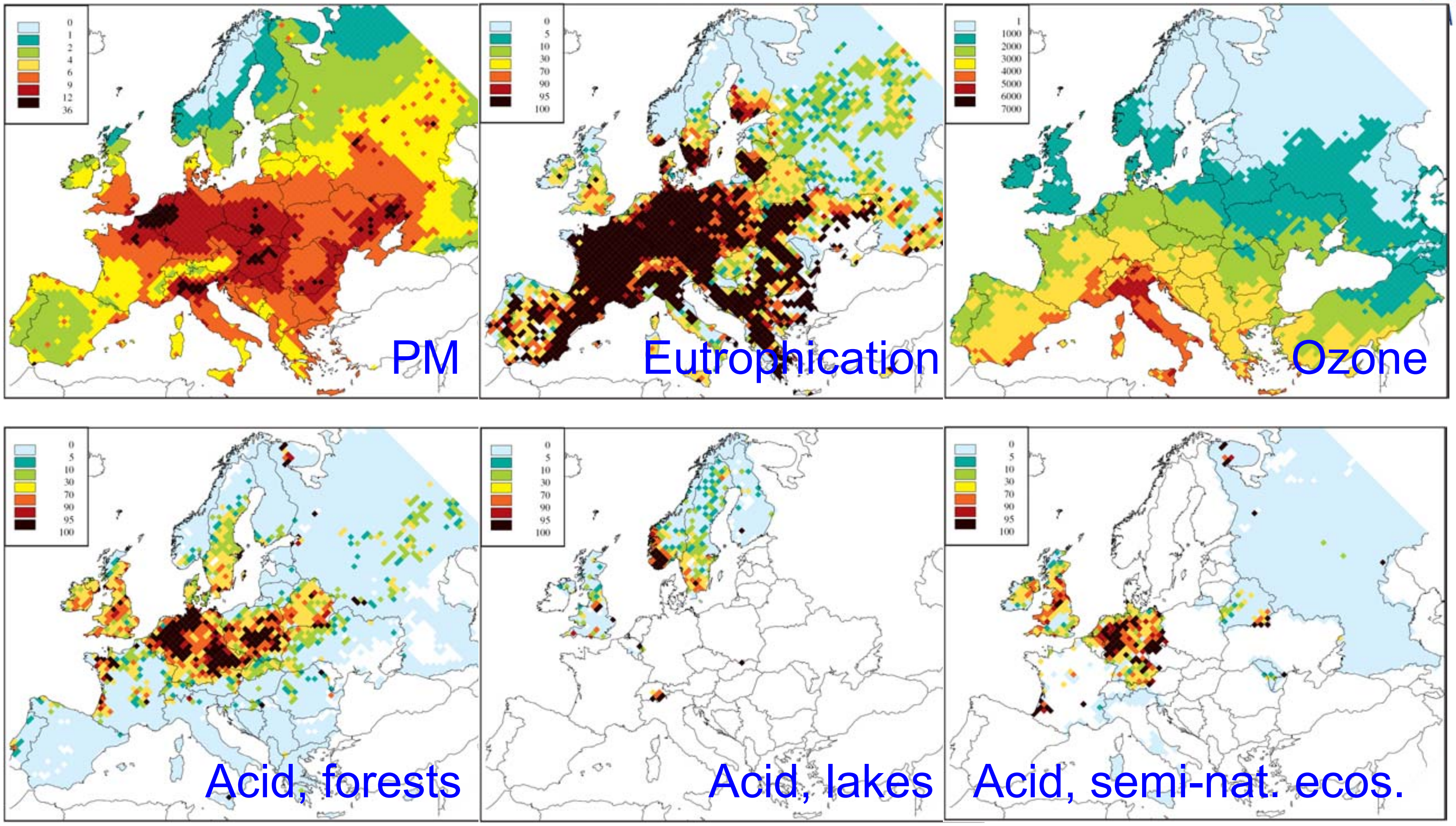
Markus Amann
International Institute for Applied Systems Analysis (IIASA)

Synergies between greenhouse gas mitigation and air pollution control in the European Union

The Greenhouse Gas-Air Pollution Interactions and Synergies model

Environmental impacts of air pollution

RAINS estimates for 2000



The Greenhouse Gas-Air Pollution Interactions and Synergies model

Multi-pollutant measures considered in GAINS (1)

Trade-offs shown in red, GHGs are underlined

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- **Structural measures**:
  - Energy savings, efficiency improvements, bans: all pollutants ↓
  - Increased use of natural gas: $\underline{CO_2}$, SO_2, VOC, NO_x, PM ↓ $\underline{CH_4}$ ↑
  - Biomass: $\underline{CO_2}$ ↓ VOC, PM, $\underline{CH_4}$ ↑
- **Stationary sources:**
  - SCR, SNCR: NO_x, CO ↓, NH_3, $\underline{N_2O}$, $\underline{CO_2}$ ↑
  - Fluidized bed combustion: SO_2, NO_x↓, $\underline{N_2O}$ ↑
  - Advanced residential combustion: VOC, PM, CO, $\underline{CH_4}$ ↓
  - FGD: SO_2, PM ↓ $\underline{CO_2}$ ↑
  - IGCC: $\underline{CO_2}$, SO_2, NO_x, PM ↓
  - CHP: all pollutants ↓
- **Mobile sources:**
  - Euro-standards: NO_x, VOC, PM, CO ↓ NH_3, $\underline{N_2O}$ ↑
  - Low sulfur fuels: SO_2, PM ↓
  - Diesel: $\underline{CO_2}$, VOC↓, PM, NO_x, SO_2 ↑

The Greenhouse Gas-Air Pollution Interactions and Synergies model

Multi-pollutant measures considered in GAINS (2)

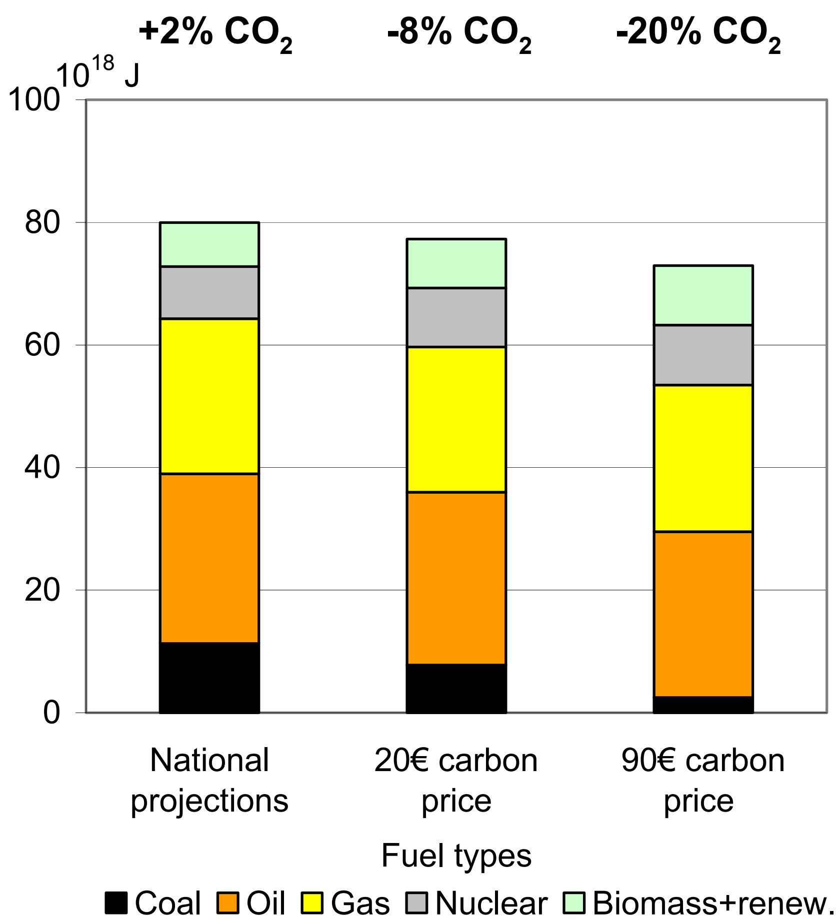
Trade-offs shown in red, GHGs are underlined

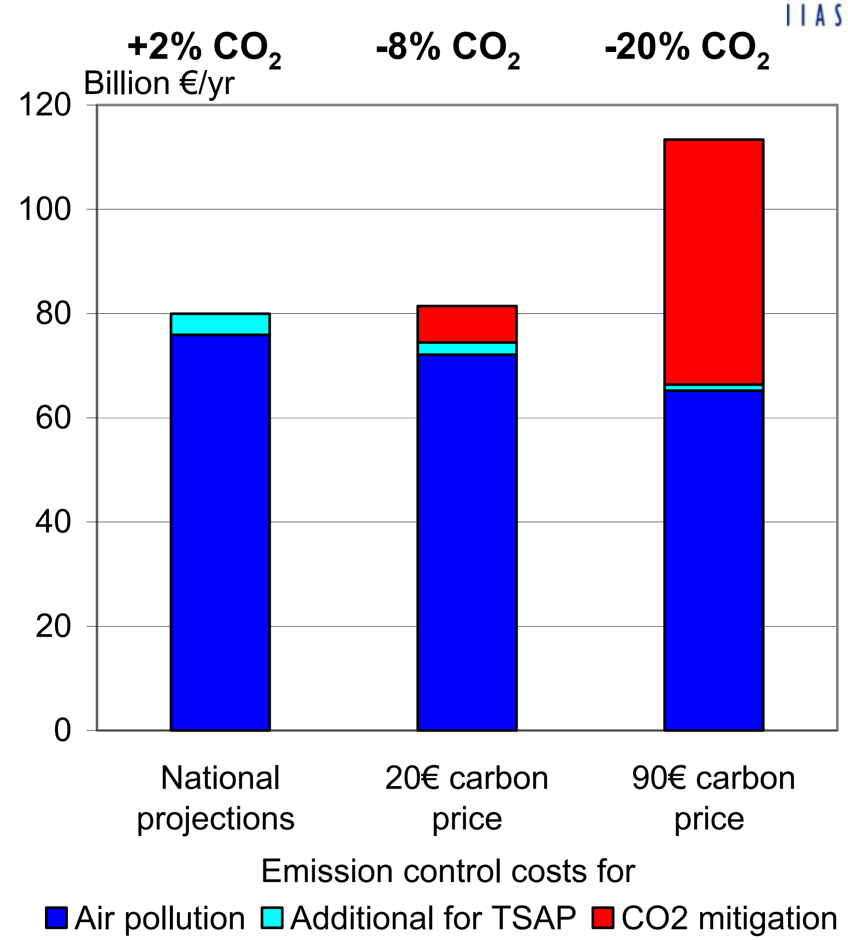
- **Agricultural sources:**
  - Low emission pig housing – NH_3, CH_4 ↓ N_2O ↑
  - Covered storage of slurry – NH_3 ↓ CH_4 ↑
  - Injection of manure – NH_3 ↓ N_2O ↑
  - Anaerobic digestion (biogas) – CH_4, N_2O ↓ CO_2 ↑ NH_3 ↓↑

- **Other sources**
  - Gas recovery and flaring: CH_4 ↓ CO_2, PM, VOC, SO_2, NO_x, CO ↑
  - Gas recovery and re-use: CH_4 ↓ CO_2 ↑
  - Improving flaring efficiency: PM, VOC, NO_x, SO_2, CO ↓
  - Waste incineration: CH_4 ↓ CO_2 ↑
  - Gas recovery from wastewater treatment: CH_4 ↓ CO_2 ↑

In total approx. 500 measures with multi-pollutant impacts considered in GAINS

Energy consumption and emission control costs
EU-25, 2020, GAINS estimates





Conclusions

Greenhouse gas mitigation leads to substantial cost savings for achieving air quality targets.

An accurate appraisal of GHG mitigation potentials and costs requires an integrated perspective:

- to avoid double-counting of costs,
- to reveal win-win measures,
- to identify trade-offs, *inter alia* for
  - enhanced use of biofuels,
  - diesel vehicles,
  - reduction of SO_2 emissions