Cost-effective measures to reduce premature mortality from air pollution in Europe with multiple benefits

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There is widespread violation of the EU air quality limit values for particulate matter (PM)

Compliance with PM10 limit value in 2009

- PM pollution causes 10 times more fatalities than traffic accidents in Europe and shortens life expectancy by 8 months
- Current measures will not suffice to reach WHO guideline values
- Further measures are available, but their (cost-)effectiveness varies across economic sectors
Current air quality regulations will fail to protect human health and biodiversity

Current legislation’ projection for 2025

Loss of statistical life expectancy

Ecosystems area with excess nitrogen deposition
Small particles (PM2.5)

- Smaller than 2.5 micrometer – ~1/50 of a human hair
- Stay in air for several days
- Transported over several 100s (>500) kilometer across borders

- Some PM2.5 is emitted directly
  - mainly from fuel combustion (transport (diesel), heating (wood and coal burning) and industrial processes,
- or formed in the atmosphere from precursor gases
  - through chemical reaction of agricultural NH$_3$ with SO$_2$ and NO$_x$ from fuel combustion).
Half of the particles observed over Europe originate from unregulated sources
Origin of PM2.5 - 2009

- **Origin of PM2.5 - 2009**

- **Source:** IIASA GAINS

- **Netherlands**
  - Average of the urban AIRBASE stations

- **Lyon, Centre Ville**

- **Graphs**
  - Comparison of PM2.5 levels by origin (Natural, International, National, Urban, Street)
  - Categories: Households, Primary PM: Traffic, Sec. PM: Traffic + agri., Sec. PM: Industry + agri., Primary PM: Industry, Natural

- **Source:** IIASA GAINS
IIASA’s integrated assessment approach for identifying cost-effective emission control strategies

IIASA’s GAINS cost optimization

- Transport
- Industry
- Households
- Agriculture
- Waste
- Prim. PM
- SO₂
- NH₃
- NOₓ
- VOC
- CO₂, CH₄
- Health
- Biodiversity
- Acidification
- Agricultural crops
- Climate

Policy targets
The Commission proposal for National Emission Ceilings (NECs) in 2030

<table>
<thead>
<tr>
<th></th>
<th>EU-28 (relative to 2005)</th>
<th>EU-28 (in addition to Baseline)</th>
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<tbody>
<tr>
<td>SO₂</td>
<td>-81%</td>
<td>-8%</td>
</tr>
<tr>
<td>NOₓ</td>
<td>-69%</td>
<td>-4%</td>
</tr>
<tr>
<td>PM2.5</td>
<td>-51%</td>
<td>-24%</td>
</tr>
<tr>
<td>NH₃</td>
<td>-27%</td>
<td>-20%</td>
</tr>
<tr>
<td>VOC</td>
<td>-50%</td>
<td>-9%</td>
</tr>
<tr>
<td>CH₄</td>
<td>-33%</td>
<td>-9%</td>
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</tbody>
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![Graph showing emission reductions for different pollutants](chart.png)
Key measures for achieving the proposed NECs in 2030: Agriculture

- Improved storage of manure (e.g., closed tanks) + anaerobic digestion at large farms
- Improved application of manure on soil, e.g., trailing hose, slot injection (only at large farms)
- Improved application of urea fertilizer or substitution by ammonium nitrate
80% of NH$_3$ emissions emerge from <10% of the farms

The NEC proposal requires measures at the largest industrial farms, i.e., about 3% of all farms in the EU (assuming no changes in farm sizes)
Costs and benefits of the additional measures

**Costs:**

- Air pollution control measures: €2.2 bn/yr (0.008% of GDP)
- Methane measures: Cost savings €2.4 - 4.0 bn/yr
- Net costs: Likely to be negative

**Benefits:**

- Gains in statistical life expectancy from lower PM2.5: 4.4 months (-50% of 2005)
- Monetized health benefits: €35 - 135 bn/yr
- Additional Natura2000 areas protected against eutrophication: 150,000 km²
Conclusions

• While air pollution has improved in Europe, current levels still cause significant health and ecosystems impacts.

• About half of current PM2.5 in the atmosphere is caused by unregulated sources.

• The EU Clean Air Package suggests an internationally coordinated cost-effective approach to reduce health impacts.

• Measures to reduce agricultural NH₃ emissions form an integral part; they are technically simple, to be applied at the largest industrial farms, i.e., about 3% of all farms in the EU (assuming no further changes in farm sizes)

http://gains.iiasa.ac.at