Potential synergies between CH$_4$/N$_2$O and NH$_3$ abatement

EMEP Steering Body
Geneva, September 13-16, 2016

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Background

- Reductions of NH$_3$ emissions will be increasingly important for approaching WHO health guidelines and biodiversity targets.
- The 1.5 degree climate target will not be achievable without drastic mitigation of non-CO$_2$ emissions (CH$_4$, N$_2$O).
  - The ambition on non-CO$_2$ will determine the extent of negative CO$_2$ emissions.
- NH$_3$, CH$_4$ and N$_2$O emissions often originate from the same sources, thus there might by synergies.
- However, many emission control measures will result in trade-offs, at least if the interactions are poorly managed.
Multi-pollutant measures (1)

- **Stationary sources:**
  - SCR, SNCR: NO\textsubscript{x}, CO ↓, NH\textsubscript{3}, N\textsubscript{2}O ↑
  - Fluidized bed combustion: SO\textsubscript{2}, NO\textsubscript{x}↓, N\textsubscript{2}O ↑
  - New residential boilers: VOC, PM, CO, CH\textsubscript{4} ↓
  - IGCC: CO\textsubscript{2}, SO\textsubscript{2}, NO\textsubscript{x}, PM ↓
  - CHP: all pollutants ↓

- **Mobile sources:**
  - Euro-standards: NO\textsubscript{x}, VOC, PM, CO ↓ NH\textsubscript{3}, N\textsubscript{2}O ↑
  - Low sulfur fuels: SO\textsubscript{2}, PM ↓
  - Diesel: CO\textsubscript{2} ↓, PM ↑

- **Structural measures:**
  - Energy savings, efficiency improvements, bans: all pollutants ↓
  - Increased use of natural gas: CO\textsubscript{2}, SO\textsubscript{2}, VOC, NO\textsubscript{x}, PM ↓ CH\textsubscript{4} ↑
  - Biomass: CO\textsubscript{2} ↓ VOC, PM, CH\textsubscript{4} ↑
Multi-pollutant measures (2)

- **Agricultural sources:**
  - Low emission pig housing – NH$_3$, CH$_4$ ↓ N$_2$O ↑
  - Covered storage of slurry – NH$_3$ ↓ CH$_4$ ↑
  - Injection of manure – NH$_3$ ↓ N$_2$O ↑
  - Anaerobic digestion (biogas) – CH$_4$, CO$_2$, N$_2$O ↓ 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$_2$ ↓
Conclusions

- Potential synergies: Diet changes with reduced demand for meat and dairy products
- Potential trade-offs:
  - Introduction of some ammonia control options ($\text{NH}_3 \downarrow$) might lead to leaching ($\text{NO}_3 \uparrow$) and higher nitrous oxide emissions ($\text{N}_2\text{O} \uparrow$)
  - Intensified agricultural production driven by demand for biofuels might lead to increased fertilizer use ($\text{NH}_3 \uparrow$, $\text{NO}_x \uparrow$, $\text{N}_2\text{O} \uparrow$, $\text{NO}_3 \uparrow$)
- The topic is currently under-explored, but will gain increasing importance in the contemporary air and climate policies