For our Environment

Joint OECD / TFRN Nitrogen Workshop

National Nitrogen Budget Germany
A tool for policy making

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Section II 4.3
Air Quality and Terrestrial Ecosystems
Objective: Quantification of the nitrogen cycle

National Nitrogen Budget for Germany

after Galloway et al., 2003
Background

➢ Policy support
  o Where are the main flows?
  o Who are the main polluters?
  o Where are the most promising intervention points?

➢ Part of our agency’s recommendations to go for an integrated approach.

➢ Application of a national method

➢ First approach in 2009 (data from 2000-2004)
➢ Second approach in 2015 (data from 2005-2010)

➢ Exchange of experiences with EPNB

➢ No application of EPNB Guidelines yet
Methods and system boundaries

- Pools, entity that stores, releases or receives nitrogen
  1. Industry and Energy
  2. Transport
  3. Agriculture
  4. Natural and semi-natural ecosystems
  5. Waste and wastewater
  6. Atmosphere
  7. Hydrosphere
  8. Urban system

- Review work – basically no own calculations
- Focus on fluxes between pools
- International exchange with products incomplete
- Values $> 1 \text{ Gg N yr}^{-1}$
- Where data are available, average values are given for 2008-2010.
- Otherwise the single value between 2005 and 2010 is taken
### Data collection

#### Industry and Energy
- Industrial statistics
- Emission inventories (CLRTAP, IPCC)

#### Transport
- Emission inventories (CLRTAP, IPCC)

#### Agriculture
- Agricultural statistics
- Emission inventories (CLRTAP, IPCC)

#### Natural and semi-natural ecosystems
- Research data

#### Wastewater
- Research data
- Wastewater statistics

#### Atmosphere
- EMEP-data
- National deposition data

#### Hydrosphere
- Research data
## Inputs and Outputs

### Rate of input of reactive nitrogen into the environment (in 1000 Gg N yr⁻¹)

<table>
<thead>
<tr>
<th>Source</th>
<th>Global</th>
<th>Europe</th>
<th>Germany</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological N-fixing</td>
<td>58.0 (14.0 %)</td>
<td>0.3 (1.5 %)</td>
<td>0.1 (2.0 %)</td>
</tr>
<tr>
<td>Lightning</td>
<td>5.0 (1.0 %)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N-fixing in oceans</td>
<td>140.0 (34.0 %)</td>
<td>0.5 (2.5 %)</td>
<td>0.1 (2.0 %)</td>
</tr>
<tr>
<td>Sub-total</td>
<td>203.0 (49.0 %)</td>
<td>0.8 (4.0 %)</td>
<td>0.1 (2.0 %)</td>
</tr>
<tr>
<td>Haber-Bosch</td>
<td>120.0 (29 %)</td>
<td>16.6 (74 %)</td>
<td>2.7 (74 %)</td>
</tr>
<tr>
<td>Biological N-fixing in farming</td>
<td>60.0 (15 %)</td>
<td>1.0 (4 %)</td>
<td>0.2 (6 %)</td>
</tr>
<tr>
<td>Fodder imports</td>
<td>0.5 (2 %)</td>
<td>0.4 (10 %)</td>
<td></td>
</tr>
<tr>
<td>Combustion processes</td>
<td>30.0 (7 %)</td>
<td>3.7 (16 %)</td>
<td>0.4 (10 %)</td>
</tr>
<tr>
<td>Sub-total</td>
<td>210.0 (51 %)</td>
<td>21.8 (96 %)</td>
<td>3.6 (98 %)</td>
</tr>
<tr>
<td>Total</td>
<td>413.0 (100 %)</td>
<td>22.6 (100 %)</td>
<td>3.7 (100 %)</td>
</tr>
<tr>
<td>Area-related [kg ha⁻¹]</td>
<td>8</td>
<td>53</td>
<td>103</td>
</tr>
</tbody>
</table>

Global: Fowler et al. (2013), Europe: Sutton et al. (2011), Germany: this study
### Proportions of the main N-compounds and emitting groups in the mean annual emissions affecting air and surface waters in the current budget period

<table>
<thead>
<tr>
<th></th>
<th>Air</th>
<th>Water</th>
<th>Total [Gg N yr(^{-1})]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(\text{NO}_x)</td>
<td>(\text{NH}_3)</td>
<td>(\text{N}_2\text{O})</td>
</tr>
<tr>
<td>Agriculture</td>
<td>33</td>
<td>435</td>
<td>88</td>
</tr>
<tr>
<td>Traffic</td>
<td>192</td>
<td>13</td>
<td>2</td>
</tr>
<tr>
<td>Industry/ Energy sector</td>
<td>166</td>
<td>15</td>
<td>27</td>
</tr>
<tr>
<td>Households/ Wastewater treatment plants/ Surface run-off*</td>
<td>21</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>412</strong></td>
<td><strong>464</strong></td>
<td><strong>123</strong></td>
</tr>
</tbody>
</table>

*Includes urban systems and the entire surface run-off, because currently no distinction can be made between agricultural and other areas. The atmospheric emissions include small domestic combustion units.*
Trends of key flows

Share of sectors to the total nitrogen emissions

- Agriculture
- Traffic
- Industry / Energy sector
- Households/ Wastewater
Use in policy support

Report to the public and to the Federal Ministry for the Environment

Published in January 2015

Policy support with the aim to convince policy makers of the need to go for an integrated approach

Main messages
➢ Negative impacts of the intensified nitrogen cycle
➢ Needs for action and policy strategies
➢ Germany’s nitrogen cycle
➢ Measures and recommendations for action

Successful!
Since last year the Federal Ministry for the Environment has started the elaboration of a national nitrogen strategy.

→ Third update of the national nitrogen budget with application of the EPNB Guidelines planned.

umweltbundesamt.de/en/publikationen/reactive-nitrogen-in-germany
Thank you for your attention!

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umweltbundesamt.de/en/topics/air
# National Nitrogen Budget for Germany

## Inputs and Outputs

<table>
<thead>
<tr>
<th>Quantified Input 4200 Gg N yr(^{-1})</th>
<th>Quantified Output 3550 Gg N yr(^{-1})</th>
</tr>
</thead>
<tbody>
<tr>
<td>2700 industrial fixation</td>
<td>900 coastal ecosystems</td>
</tr>
<tr>
<td>370 feed import</td>
<td>560 transboundary atmosphere</td>
</tr>
<tr>
<td>440 emission fossil fuel burning</td>
<td>340 wastewater treatment</td>
</tr>
<tr>
<td>275 biological fixation</td>
<td>750 denitrification agri. surpluses</td>
</tr>
<tr>
<td>570 transboundary import</td>
<td>1000 industrial products</td>
</tr>
</tbody>
</table>
The key flows of reactive nitrogen in Germany