Task Force on Reactive Nitrogen

European Nitrogen Assessment
Annex IX & the Guidance Document
& the Economic Costs

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(co-chairs TFRN)

WGSR-49, Geneva
13 -15 September 2011
The European Nitrogen Assessment
Sources, Effects and Policy Perspectives

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ENA Launch
11-15 April 2011
Edinburgh
International Conference
“Nitrogen & Global Change”

ENA Authorship
200 experts,
21 countries &
89 organizations

Scientifically independent process

www.nine-esf.org/ENA
Nitrogen in the News

- International TV & Press Coverage
- ENA summary in Nature
- ENA 4-minute video on “Youtube”

Too much of a good thing

Curbing nitrogen emissions is a central environmental challenge for the twenty-first century, argue Mark Sutton and his colleagues.

The Sun, Scotsman, Guardian, La Monde, VOK, Nature

14 April 2011
Nitrogen Damage Costs & Sources

DAMAGE COSTS OF NITROGEN POLLUTION
Agriculture and fossil-fuel burning load the environment with reactive nitrogen, affecting water, soils and air.

MAIN NITROGEN SOURCES

EU Damage cost: 70 - 320 billion € / year
Nitrogen and climate effects roughly balance, but we cannot count on the cooling effects of particulate matter and nitrogen deposition, which have even larger societal costs for human health and ecosystems.

Total economic cost of N emissions:
€70 billion – €320 billion per year for EU27

Climate balance for EU27: -16 [-47 to +16] mW m⁻²

- N₂O
  - Warming 17 mW m⁻²
  - Climate cost: €7 billion

- Tropos O₃
  - Warming 7 mW m⁻²
  - Health cost: €30 billion

- N deposition
  - Cooling: 19 mW m⁻²
  - Health & Biodiversity cost: €12 billion

- Particulate matter
  - Cooling: 17 mW m⁻²
  - Health cost: €70 billion

ENA, 2011
Summary of N flows in Europe

Atmospheric N\(_2\) pool

- Net atmosph. export: 2.4 TgN/yr
- Net import of food & feed: 3.5 TgN/yr
- Export by rivers to the sea: 6.8 TgN/yr

N\(_2\) fix

- Indust & traffic: 3.4 TgN/yr
- Semi-nat. soils: 0.2 TgN/yr
- Wood exp.: 0.2 TgN/yr

Atmospheric NH\(_3\), NO\(_x\), N\(_2\)O

- Fertilizers: 11.2 TgN/yr
- Crop production: 17.6 TgN/yr
- Livestock farming: 11.8 TgN/yr

Crop N\(_2\)fix

- Wood deposits: 3.8 TgN/yr

N\(_2\)fix

- Indust & traffic: 0.2 TgN/yr

Leaching & runoff

- NH\(_3\), NO\(_x\), N\(_2\)O emission: 4.5 TgN/yr
- Nat N\(_2\)fix: 0.2 TgN/yr

Denitrification

- Wood exports: 0.2 TgN/yr
- Leaching & runoff: 3.2 TgN/yr
- Human nutrit.: 0.4 TgN/yr

Export

- Net atmosph. export: 2.4 TgN/yr
- Net import of food & feed: 3.5 TgN/yr
- Export by rivers to the sea: 6.8 TgN/yr

ENA, 2011
Seven key actions for better nitrogen management

Agriculture
1. Improving nitrogen use efficiency in crop production
2. Improving nitrogen use efficiency in animal production
3. Increasing the fertilizer N equivalence value of animal manure

Transport and Industry
4. Low-emission combustion and energy-efficient systems

Waste water treatment
5. Recycling nitrogen (and phosphorus) from waste water systems

Societal consumption patterns
6. Energy and transport saving
7. Lowering the human consumption of animal protein

ENA, 2011 and Nature 14 April 2011
Seven key actions for better nitrogen management

Agriculture

1. Improving nitrogen use efficiency in crop production
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The Way Forward:

More efficient N use saves farmers money reducing nitrogen air pollution, while being needed to meet Parties’ commitments for climate and water pollution
TFRN inputs for Gothenburg Revision
1. Report of TFRN-6 in Rome, including a further amended, draft revised technical Annex IX (ECE/EB.AIR/WG.5/2011/16)

2. Revised Draft Guidance Document for preventing and abating NH$_3$ emissions (Informal Document No. 21)


4. European Nitrogen Assessment; Summary for Policy Makers (Informal Document No. 11)
Report TFRN-6
11-12 May 2011, Rome

TFRN-6 discussed:

- Feedback from WGSR-48
- Economic costs of ammonia abatement measures, further on to TFRN-5 in Paris, 2010.
- Proposals for slight modifications to draft Annex IX, also in response to comments of WGSR-48 - consistency
- Draft Guidance Document
- Work of Expert Panels on Nitrogen & Food (EPNF) and on Nitrogen Budgets (EPNB)
- TFRN-7 in St Petersburg, spring 2012 - budget
Guidance Document

- Revised draft version available, which include now information on economic costs;

- The Guidance Document lists 3 categories of techniques/approaches:
  - Category 1: well proven
  - Category 2: sound, but some uncertainties
  - Category 3: with problems and not recommended
Costs of ammonia abatement

Main results:

- Cost of abatement measures are much less than previously reported (often 1/2 or 1/10!);

- Co-benefits of abatement provide benefits to farmers:
  - e.g., fertilizer savings, less smothering of herbage, increase animal health

- Climate co-benefits can be significant:
  - e.g. CO$_2$ and N$_2$O emissions associated with fertilizer production
Costs of ammonia abatement

Main results:

- Cost of abatement measures depend on farm size and structure (farm-specific);
- Most measures cost roughly €0.5 to 2 per kg NH$_3$-N saved, but some more expensive;
- Measures have to be considered from a ‘whole-farm’ perspective, as a strategic package of measures (which then may lead to innovation and technical change);
- Farmers need time to adjust and learn (also from each other).
## Overview of costs of ammonia abatement measures

<table>
<thead>
<tr>
<th>Measures</th>
<th>Cost, €/kg NH$_3$-N saved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen management</td>
<td>-1.0 to 1.0</td>
</tr>
<tr>
<td>Feeding strategies</td>
<td>-0.5 to 1.0</td>
</tr>
<tr>
<td>Animal housing</td>
<td>0.0 to 10.0</td>
</tr>
<tr>
<td>Covering slurry storages</td>
<td>0.1 to 4.0</td>
</tr>
<tr>
<td>Slurry application</td>
<td>-0.5 to 3.0</td>
</tr>
<tr>
<td>Urea application</td>
<td>-0.1 to 4.0</td>
</tr>
</tbody>
</table>
Costs of ammonia abatement

- Relatively cheap measures are
  - Slurry application (esp. via contractors)
  - Nitrogen management
  - Feeding strategies
  - Covers on slurry storages

- Expensive measures are:
  - Rebuilding existing housing systems
  - New housing systems when reduction targets are high
  - Go beyond ‘minimum thresholds for animal feeding’
Costs of ammonia abatement

Experiences from practice:

- DK and NL have reduced ammonia emissions by ~50%, yet have competitive animal agriculture.

- Overall mean costs of housing and slurry storage measures in pig houses (decreasing NH₃ emissions by >60%) in NL are estimated at 3 euro per kg N saved.
Total emissions in options A, B and C per sector
Results of CIAM-GAINS
Total Costs of options A, B and C per country
Results of CIAM-GAINS

[Graph showing total costs per country for options A, B, and C, with specific data for each country and varying years such as 2010, Baseline 2020, Amb_lev_C, Amb_lev_B, Amb_lev_A, and MID_CIAM.]
Costs per kg NH3-N of options A, B and C per sector

Results of CIAM-GAINS

Note that cost in cattle sector need further study!
Proposals for Updated and **New** measures in Annex IX

- Nitrogen management, considering the whole N cycle
- Livestock feeding strategies
- Animal housing, **including cattle housing**
- Manure storage, **including those for cattle manure**
- Manure spreading
- Mineral fertilizer use, including urea, **ammonium phosphate and ammonium sulphate**
Three ambition levels; all technical feasible

A. High level of ambition in reducing NH$_3$ emissions,

B. Moderate level of ambition, as well as being cost effective;

C. Modest level of ambition, as well as being cost effective;
Ambition levels (A, B, C) vary in targets, thresholds and implementation dates

- **Targets**
  - Emissions reduction targets (% decrease from reference)

- **Thresholds**
  - Farm size, size of tankers for manure spreading

- **Implementation dates**
  - Delayed implementation for countries in transition
Identifying Priorities to Support WGSR negotiation

Criteria for Priority Setting:

a) availability and applicability of the measures across the UNECE region;
b) being cost neutral or have a low cost to farmers, especially when considering their co-benefits;
c) measures which give a big contribution to NH$_3$ emissions reduction & N cycle efficiency;
d) long-term capacity-building.

If you committed to only 5 things what would they be?
5 top priorities for commitments in Annex IX

1. Low-emission land application of manure & fertilizer:
   a) Application of cattle, pig & poultry slurry & solid manure
   b) Low emission use of urea fertilizer (ban is not proposed)
2. Animal feeding strategies to reduce N excretion, from cattle, pig & poultry.
3. Low-emission techniques for all new stores for cattle and pig slurries and poultry manure.
4. Strategies to improve N use efficiencies and reduce N surpluses, with N balances on demonstration farms,
5. Low-emission techniques in new and largely rebuilt pig & poultry housing.
Concluding remarks

- Many options are available for decreasing ammonia emissions, at relatively low cost.
- The options have been described in detail in the draft Annex IX and the draft Guidance Document.
- Ammonia abatement is part of improving N use efficiency in farming, helping meet climate & water pollution targets.
- 5 key priorities have been identified on a technical basis to support WGSR negotiation of the commitments.
- Final polishing of Guidance Document after decisions have been made about final version on Annex IX.
4-minute video of the ENA for public stakeholders

http://www.youtube.com/watch?v=uuwN6qxM7BU