The Nitrogen Cascade:
Updates on sources- environment impacts - solutions
Vienna, 24/11/2015

Nitrogen – Strategies for resolving an urgent environmental problem

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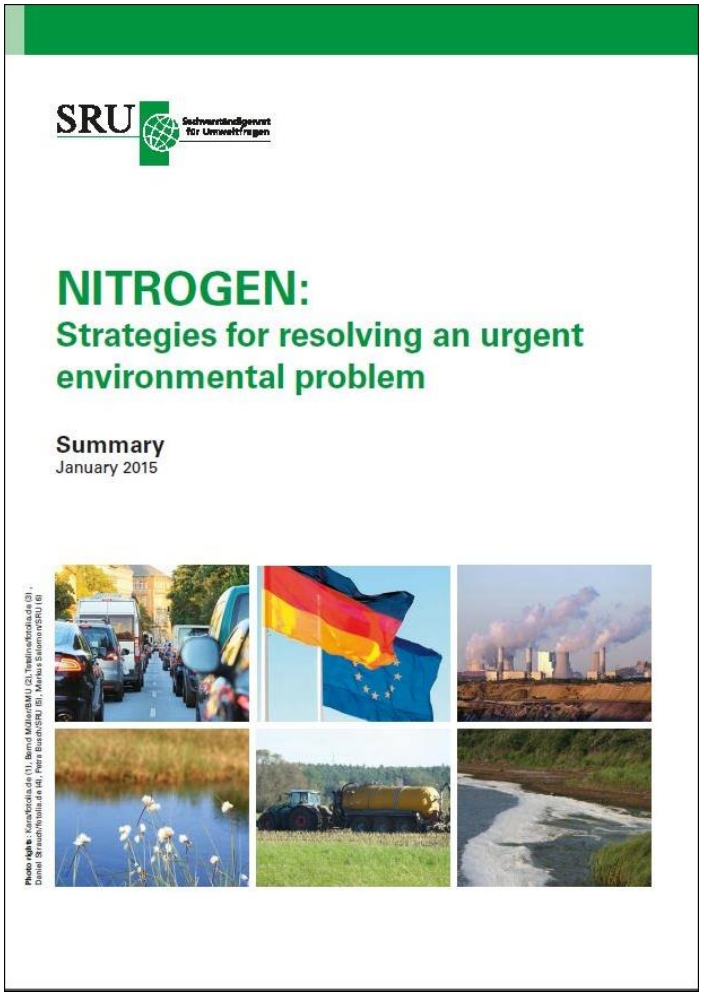
Advisory Council on the Environment

- Interdisciplinary, scientific and independent
- Seven professors from different disciplines nominated by Cabinet
- Judgements on environmental issues
- Early warning function
- Ideas for sustainable transitions
- Inform stakeholders and the broader public

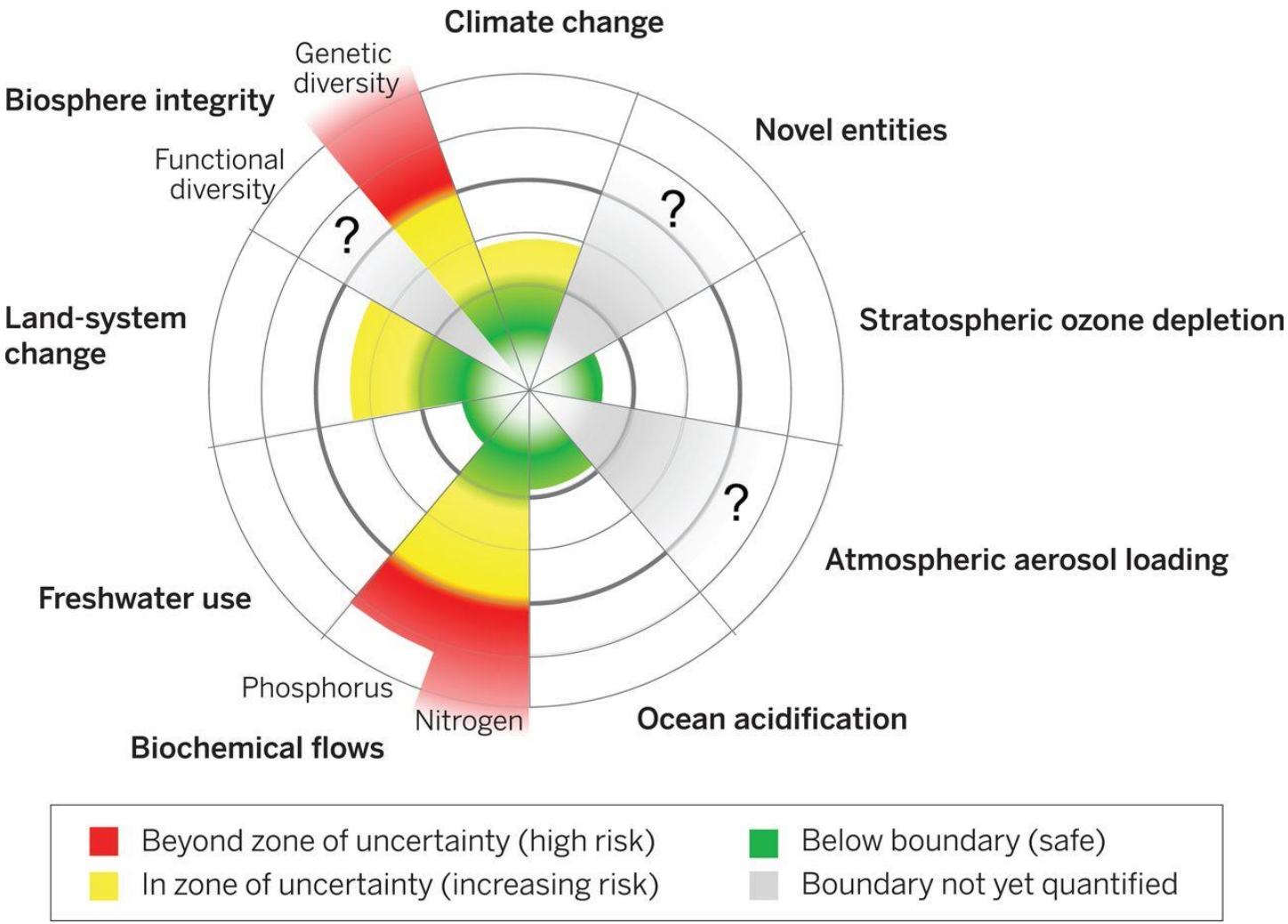
Special report

NITROGEN



Planetary Boundaries

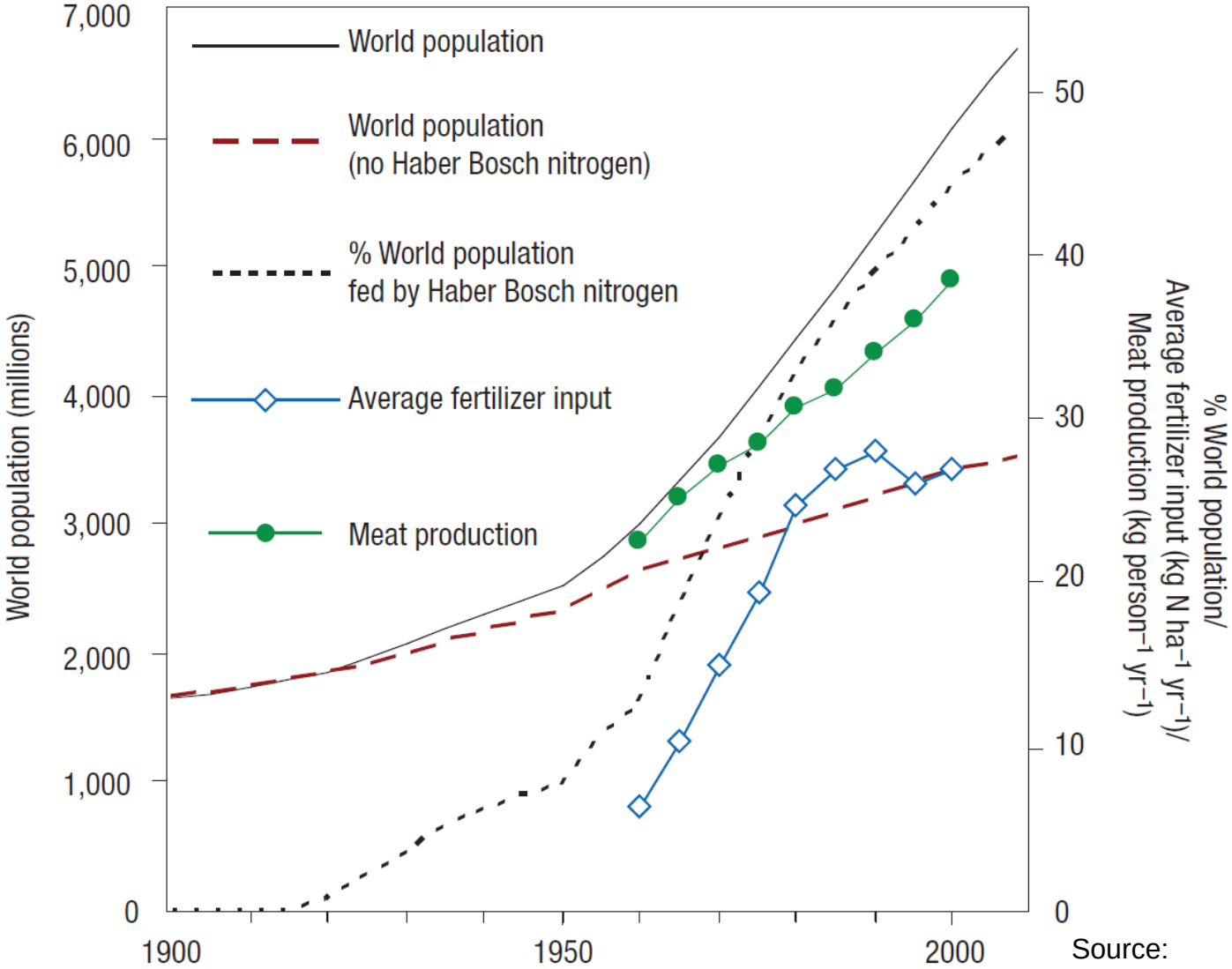
A safe operating space for humanity



Steffen et al., 2015: Planetary boundaries: Guiding human development on a changing planet.

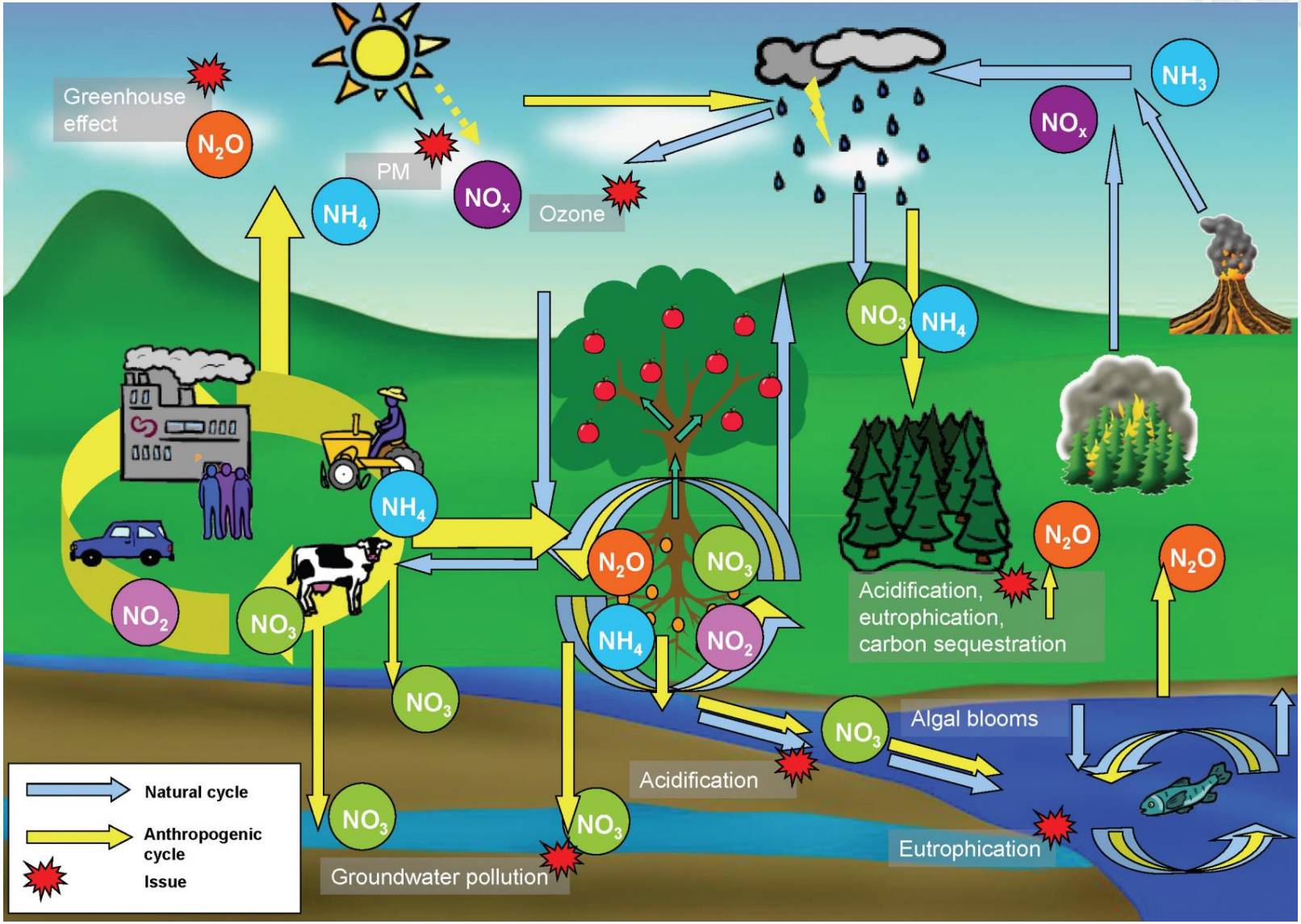
The Nitrogen Cycle

World population and fertilizer input



Source:
Erisman et al. (2008, p. 637)

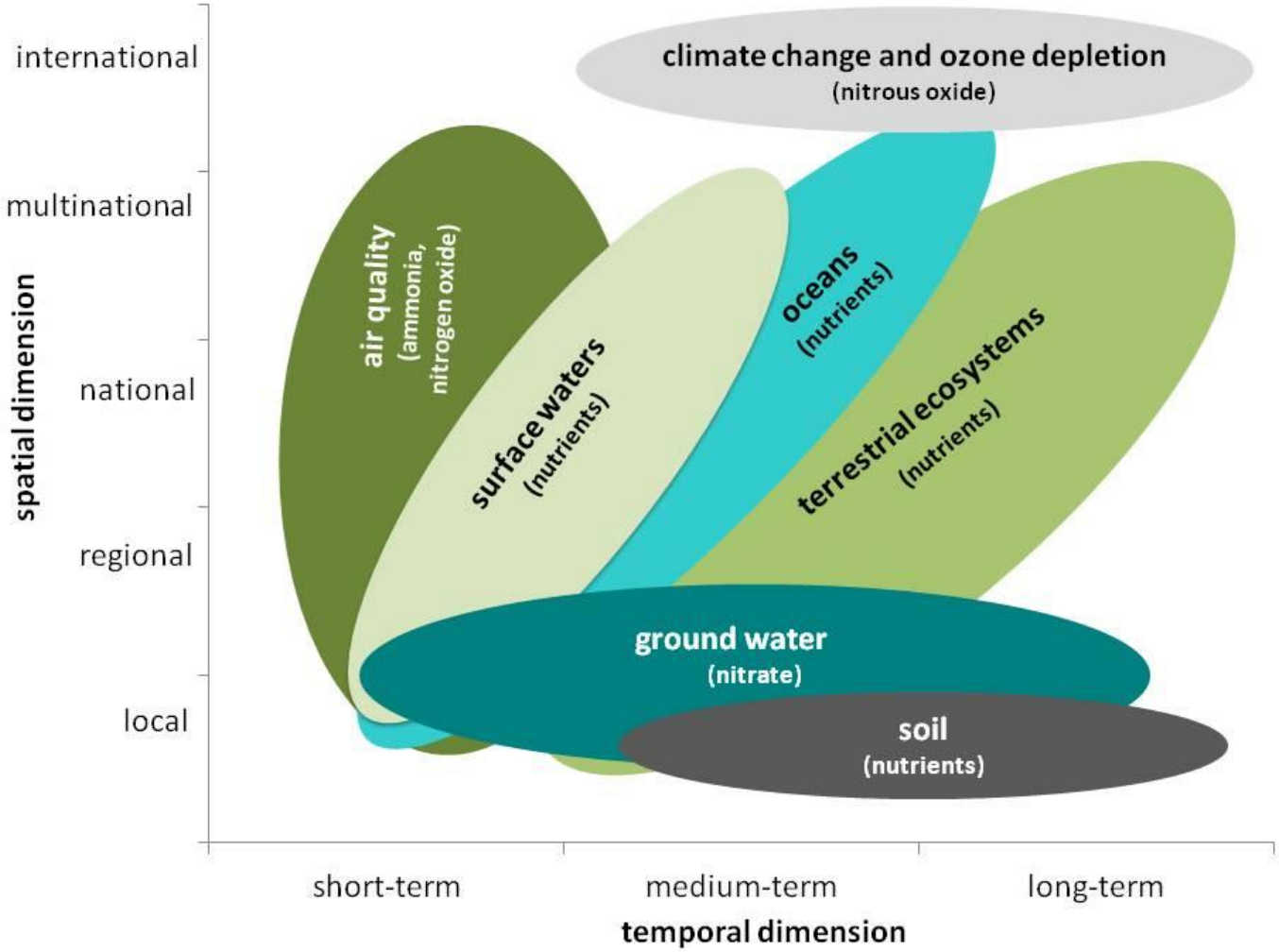
The Nitrogen Cycle



Source: Anne Christine Le Gall, INERIS

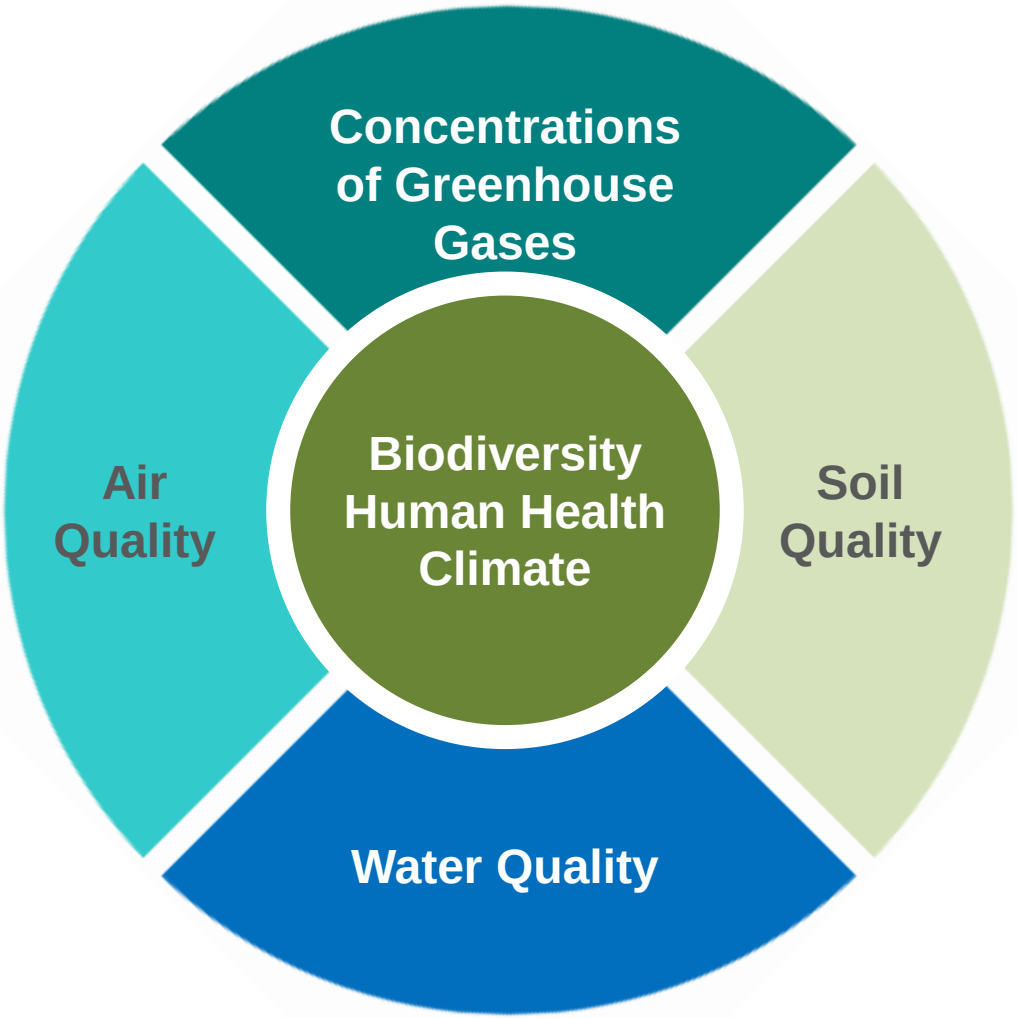
Nitrogen compounds

An important issue with multiplex dimensions



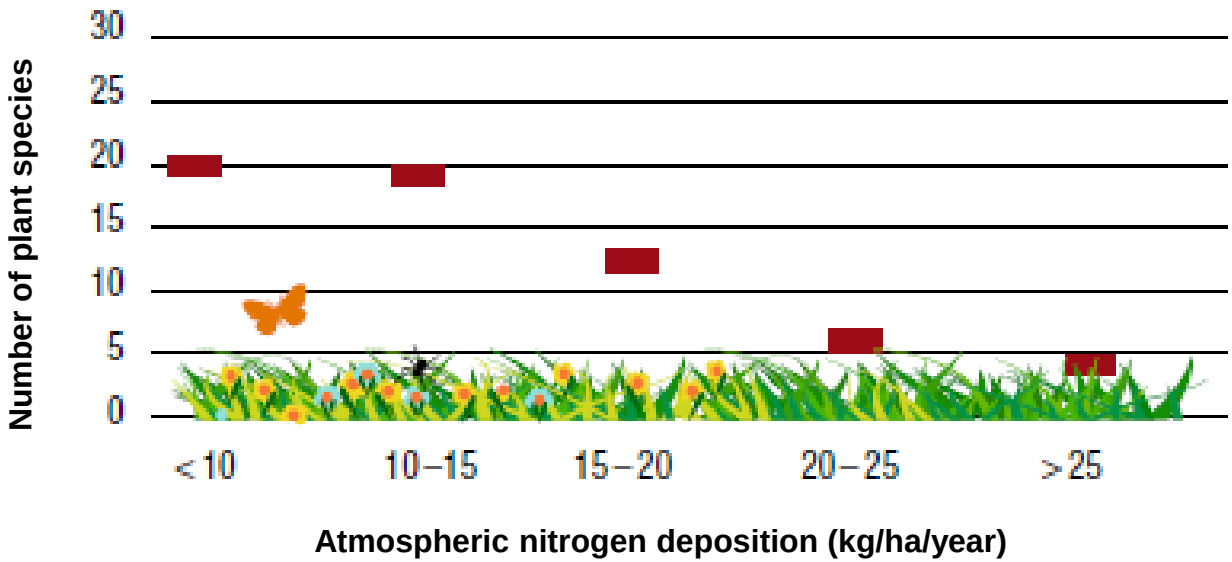
Diverse effects of nitrogen pollution

The underestimated threat to biodiversity



Emissions of reactive nitrogen

One of the main causes of biodiversity loss (I)



Biodiversity of sensitive plants in mountain meadows, which are adapted to a low nutrient supply, decreases with increasing nitrogen deposition from the air.
Source: Biodiversitäts-Monitoring Schweiz BDM

- **Visible effects:**
  - **Loss of species-rich meadows and field margins rich in wild herbs**
  - **Excessive sea foam induced by algae blooms**
  - **Substantially greater abundance of plants (blackberries, nettle)**

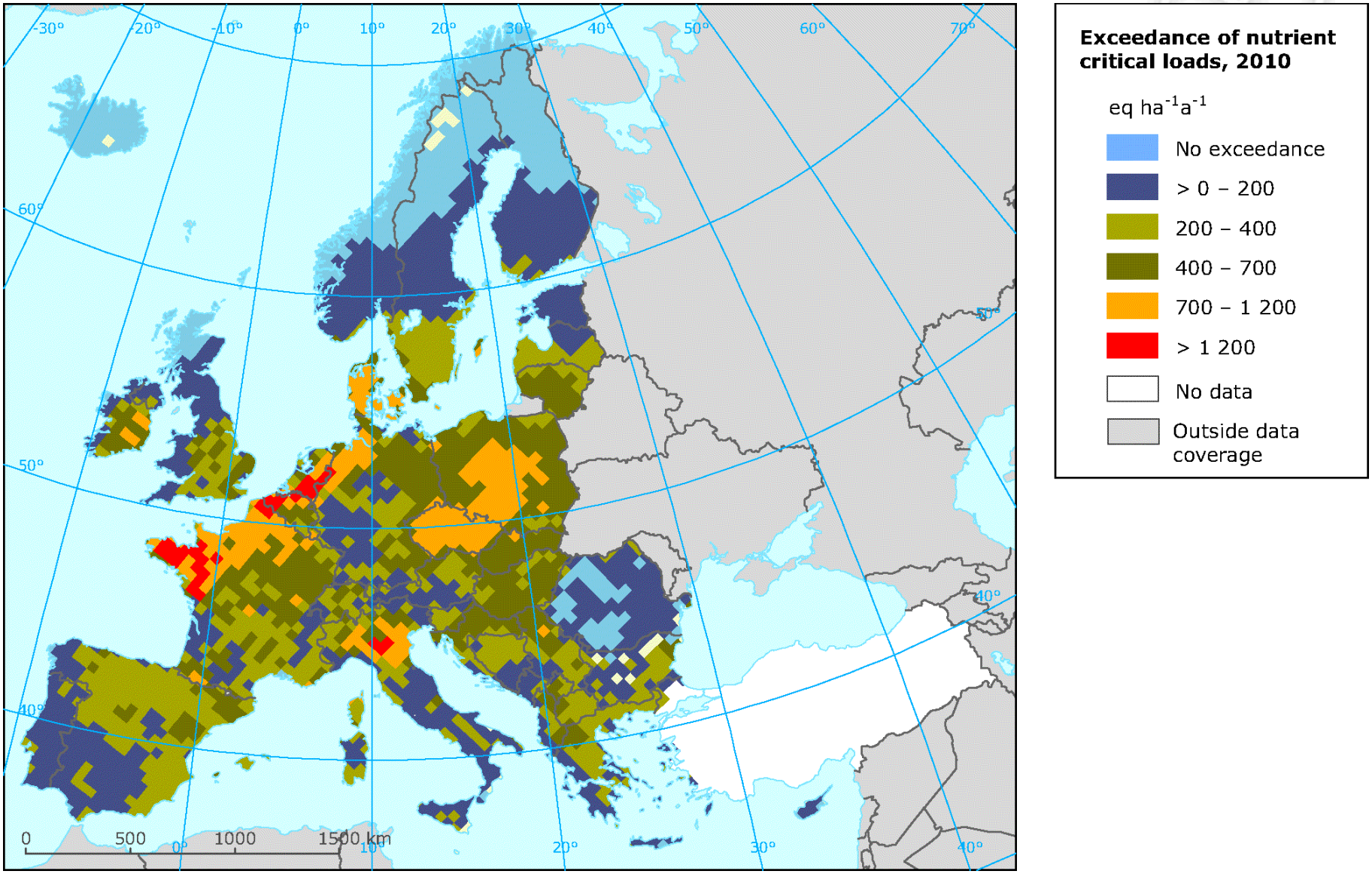
Emissions of reactive nitrogen

One of the main causes of biodiversity loss (II)

- **Even very low input levels can have a deleterious effect on certain species and ecosystems.**
- **Processes, such as acidification, nitrogen loading and species loss are irreversible or only reversible over long periods of time.**
- **Limit values for the protection of human health are woefully inadequate for protecting more sensitive species and ecosystems.**

Emissions of reactive nitrogen

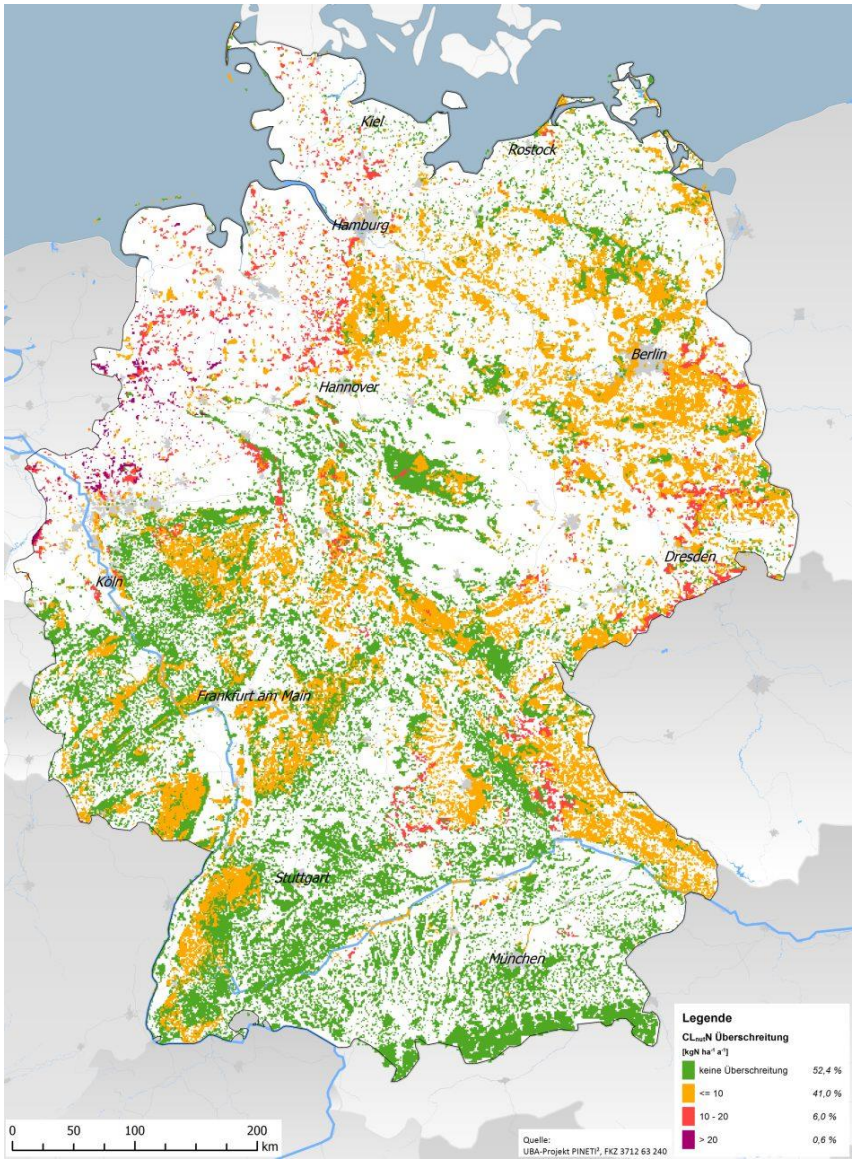
Exceedance of critical loads for eutrophication (I)



Source: EEA 2010b

Emissions of reactive nitrogen

Exceedance of critical loads for eutrophication (II)



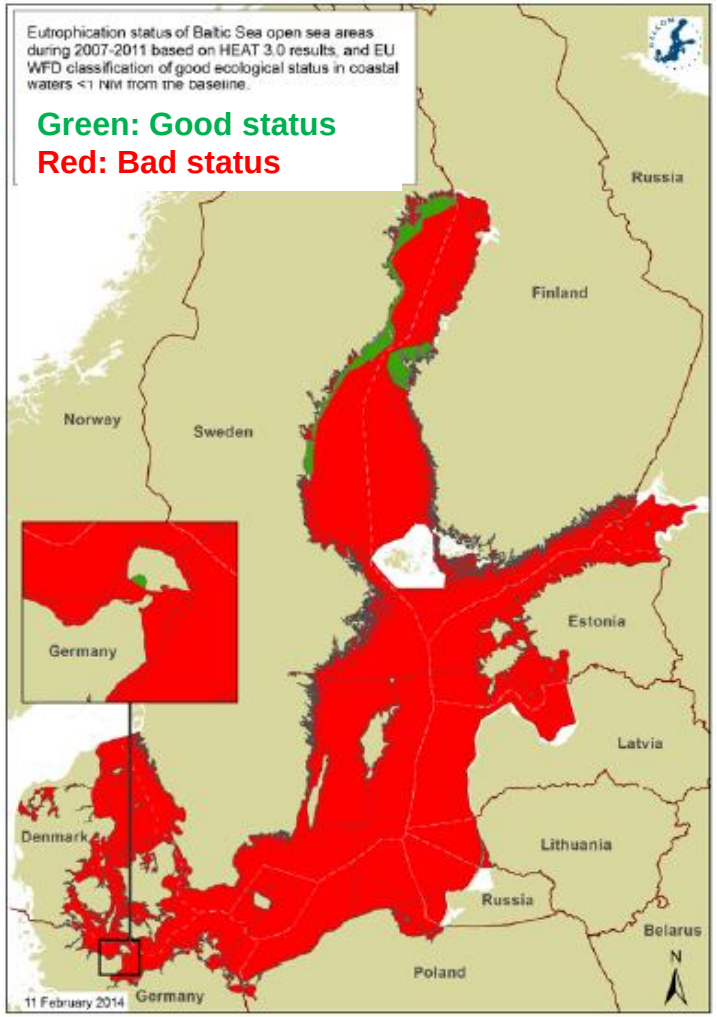
- **In 2009, 48 per cent of Germany's natural and semi-natural terrestrial ecosystems were exceeding eutrophication limits**

Source:
Schaap et al. (2014): Ermittlung und Bewertung der Einträge von versauernden und eutrophierenden Luftschadstoffen in terrestrische Ökosysteme. Zwischenbericht zum F&E-Vorhaben, FKZ 3712 63 240 1. Dessau-Roßlau: Umweltbundesamt. Im Erscheinen.

Nitrogen pollution

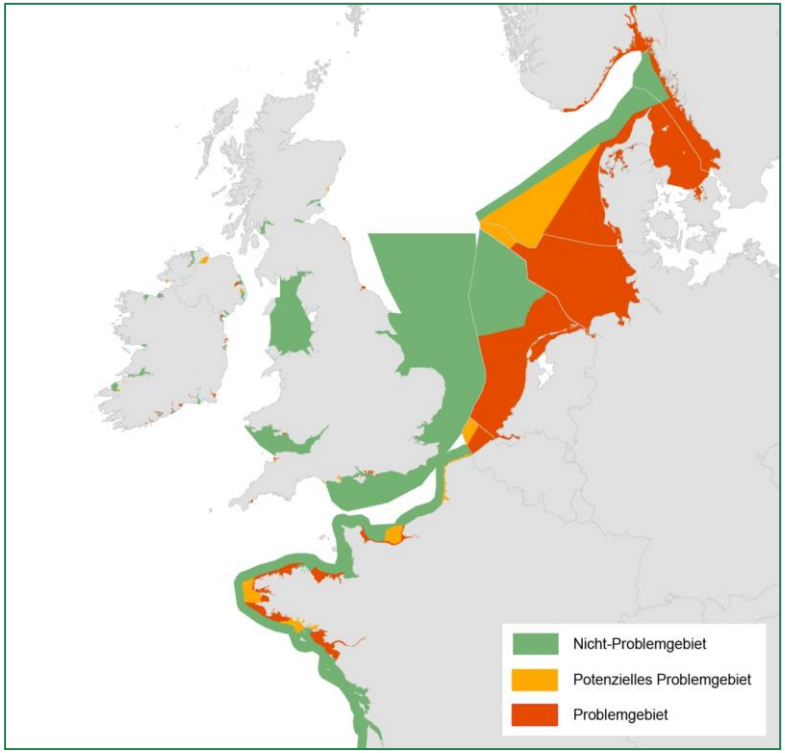
Eutrophication status for North Sea and Baltic Sea

Eutrophication status of the Baltic Sea (2007-2011)



Source: HELCOM 2014

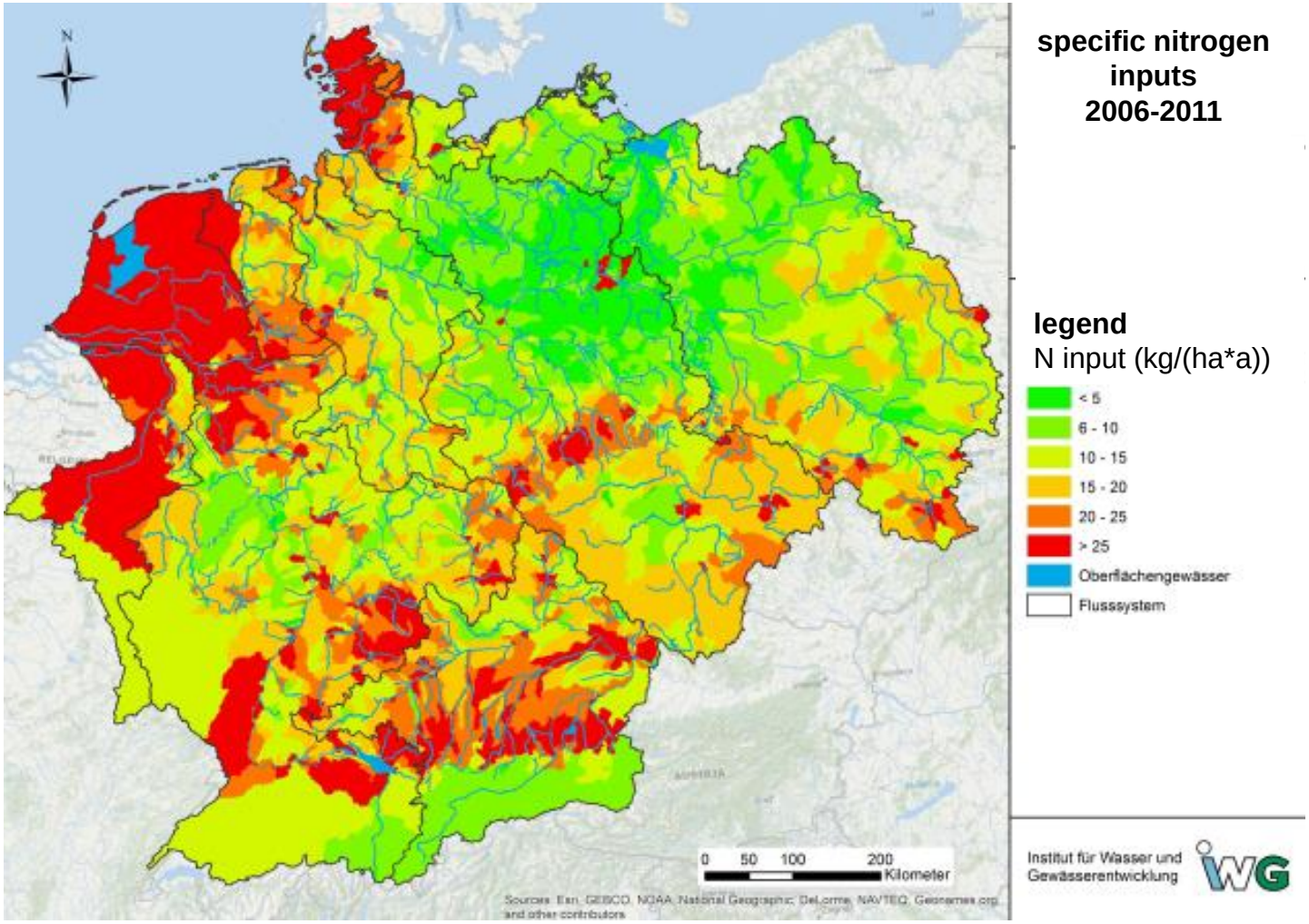
Eutrophication status of the North Sea (2007)



Source: OSPAR Commission 2009

Nitrogen pollution

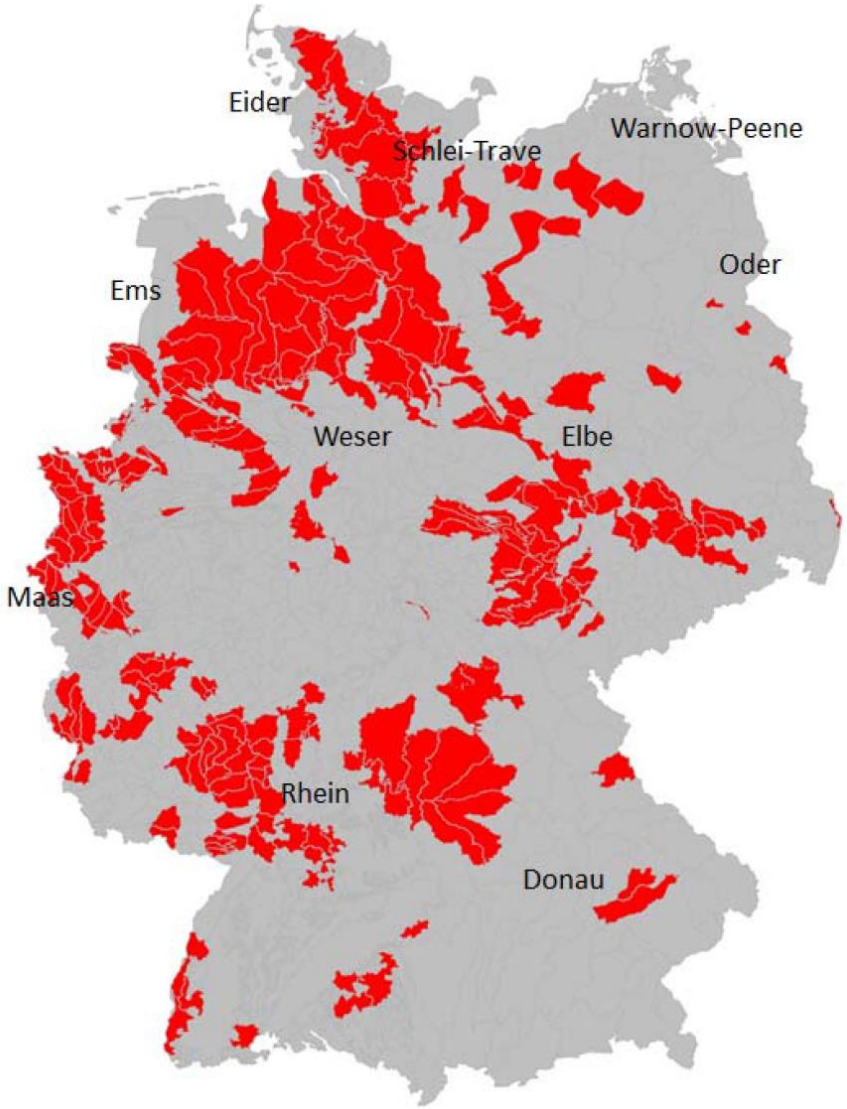
Total nitrogen inputs into German surface waters



Source: UBA 2014

Nitrogen pollution

Good chemical status of groundwater

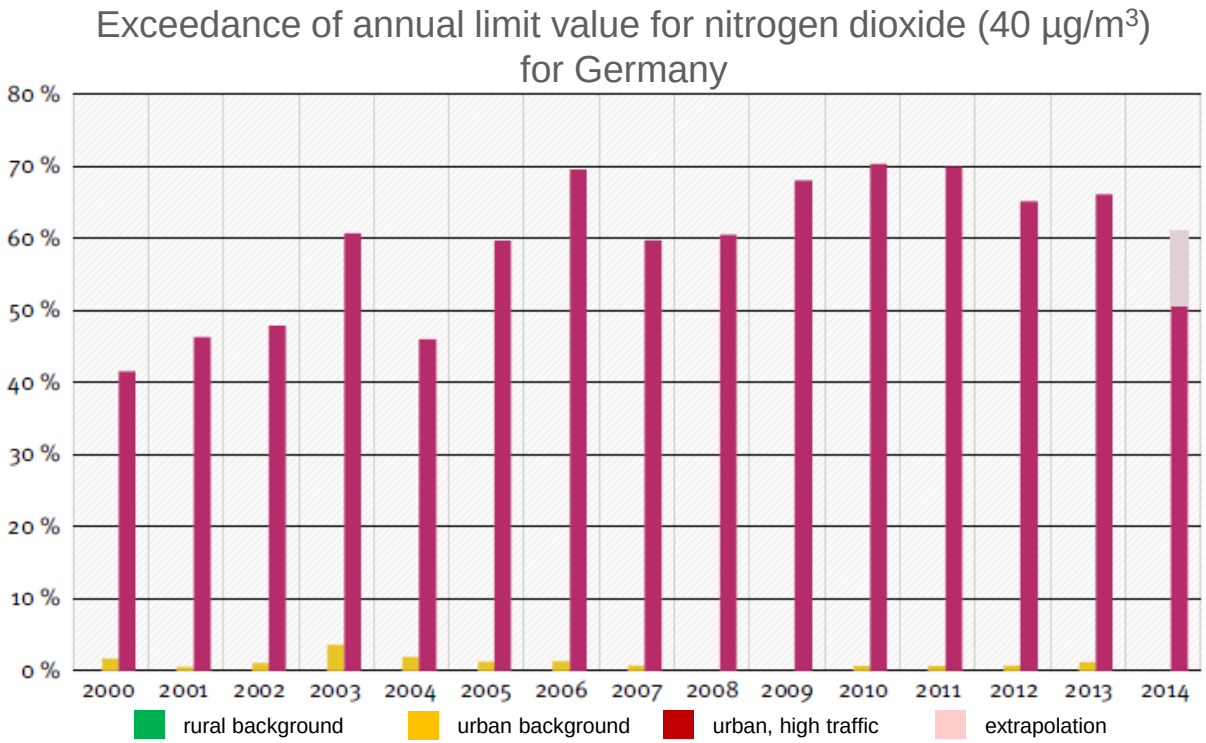


- **Due to nitrate concentration (>50mg/l): 27 % of German groundwater bodies do not reach a good chemical status**

Source: SRU 2015, S. 97, based on Völker 2014
Data from March 2010

Nitrogen pollution

Air Quality

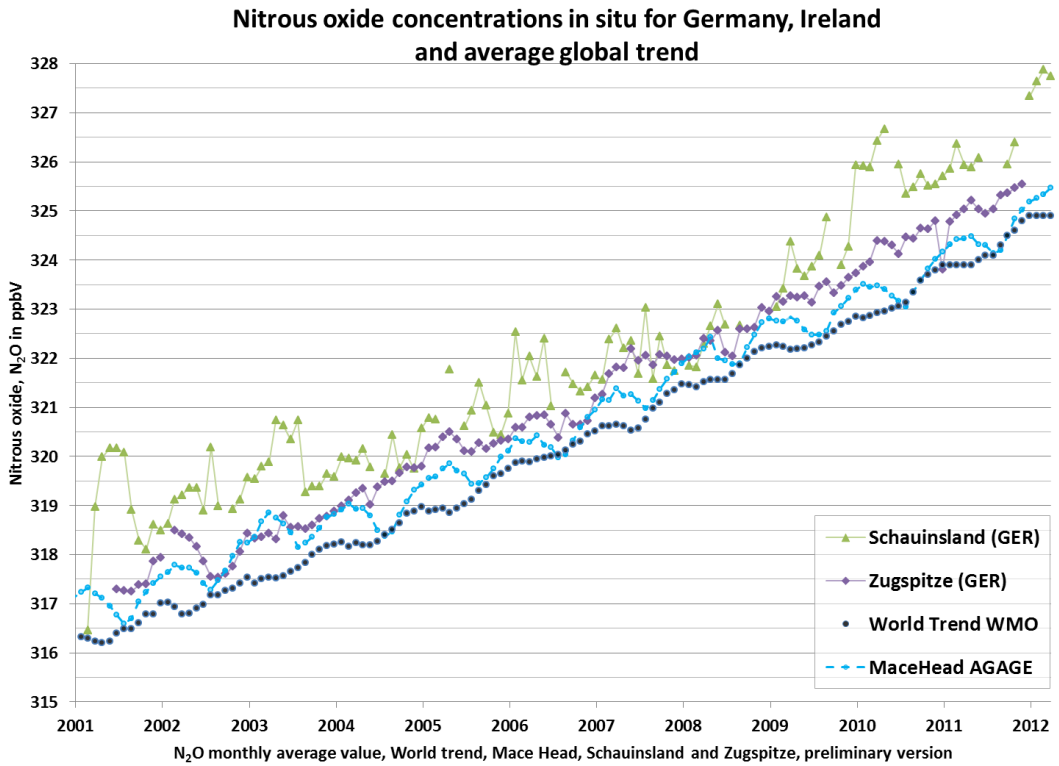


Source: UBA 2015

- **Air quality standards are still being exceeded regularly**
  - **Particularly for busy roads**
  - **lower standard for NO_2 of 20 µg/m³ should be established**
  - **World Health Organization has stricter standards for ozone and particulate matter**

Nitrogen pollution

Nitrous oxide: Climate change and ozone layer

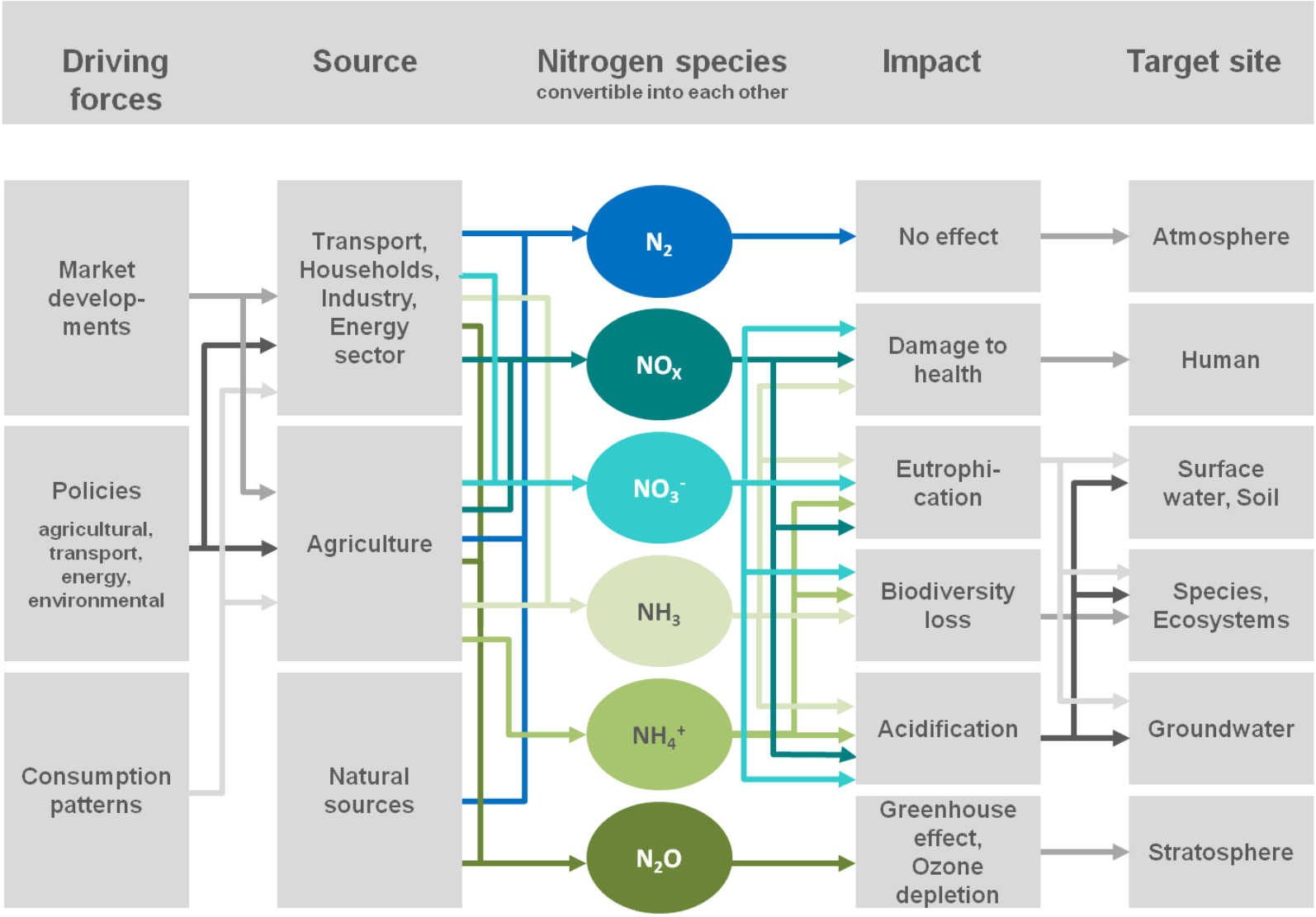


Source: UBA 2014

- Although emissions of nitrous oxide decreased (by 34 % since 1990), there is no trend reversal of atmospheric N_2O concentration (shown in figure)
- About 6 % of worldwide anthropogenic Greenhouse effect
- Major driver of ozone layer depletion

Nitrogen pollution

Driving forces



Source: BLW 2004, p. 83, modified

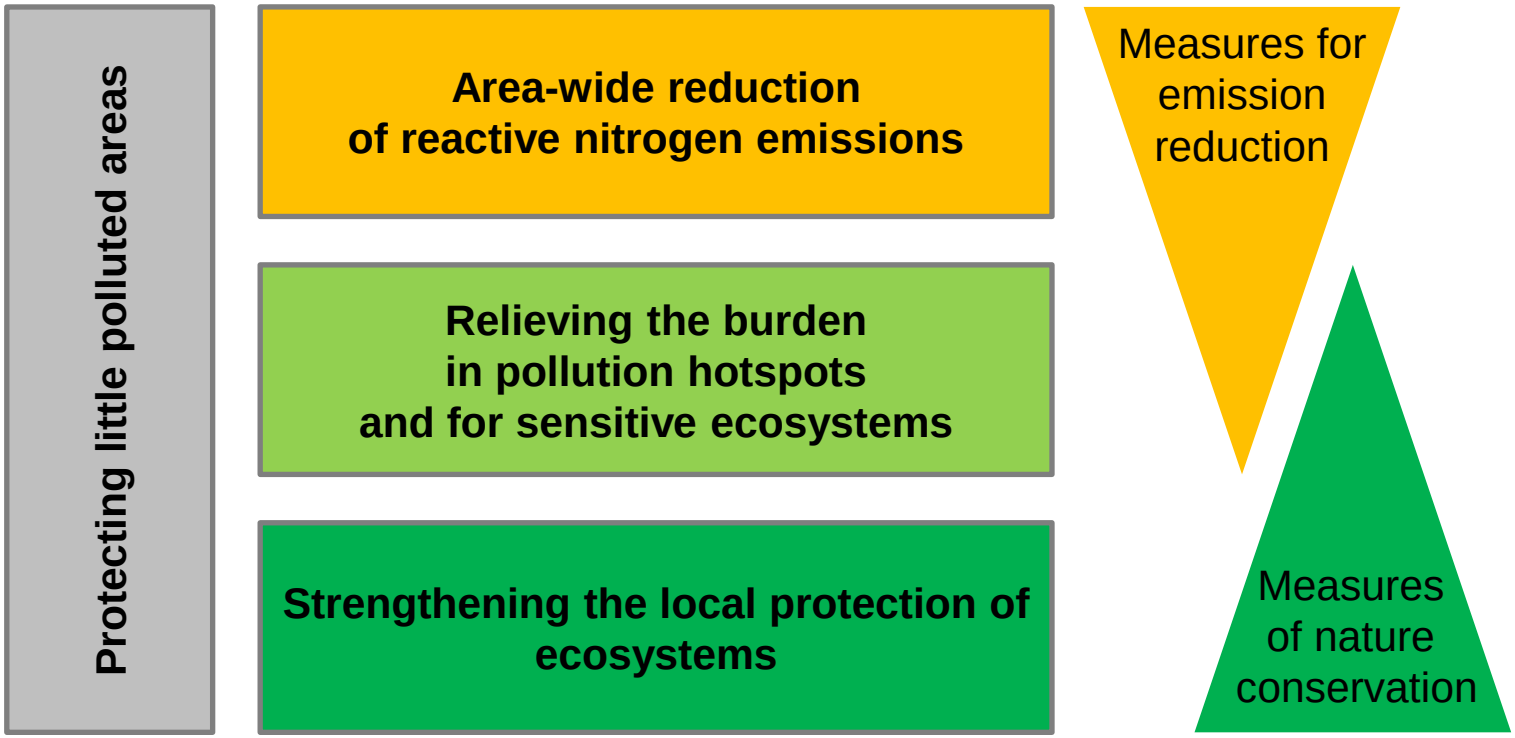
Recommendations

Areas of activity

- **Clean air policies: draft of a NERC directive**
- **Implementation of the WFD**
- **Reform of the CAP**
- **Reform of the Fertilizer Regulation**
- **Raise a tax on nitrogen surplus**
- **Nature protection measures**
- **Make biogas production environmentally sustainable**
- **Change food consumption pattern**
- **Reshape the transportation sector**
- **Reduce power plant emissions**
- **…**

Recommendations

Four complementing approaches



Recommendations

Clean air policies: draft of a NERC directive

- **National emission ceilings for nitrogen oxide and ammonia urgently need to be reduced**
  - **Review NERC draft:**
    - **Reduction of nitrogen oxides (69%) and ammonia (39 %) until 2030 insufficient in terms of environmental impact**
    - **Proposed ceiling not sufficient to protect biodiversity**
    - **Critical loads for eutrophication will still be exceeded in 40 % of natural and semi-natural ecosystems (Amman et al. 2014)**
    - **Additional legally binding Intermediate goals for 2025 needed**

Recommendations

Water protection and agriculture

- **Existing environmental quality objectives are ambitous; it is questionable if these objectives can be met**
- **Fertilizer regulation has to be improved**
- **Agri-environmental measures and advisory services are insufficient**
- **More compulsary measures are necessary (designation of water protection areas and risparian strips)**

Recommendations

Reduce inputs from agriculture (I)

- **Fertilizer regulation**
  - **A central instrument in nitrogen policy**
  - **Draft of a new regulation: improvement but not sufficient**
    - **Demanding a fertilizer plan from farmers**
    - **Applying the upper limit of manure application to all organic fertilizer**
    - **Requiring a farm gate balancing to calculate the nutrient surplus**
  - **Improvement of the enforcement of the Fertilizer Regulation**

Recommendations

Reduce inputs from agriculture (II)

- **Raise a tax on nitrogen surplus**
  - **Serve as an incentive to reduce overall nitrogen emissions in a cost efficient manner, beyond the levels required by other regulations**
- **Differentiate requirements geographically**
  - **need to be countered by enacting tougher regulations in the receiving regions (unfavourable local conditions and proximity to sensitive ecosystems)**
- **Reform Common Agricultural Policy still further**
  - **public funds be expended solely on public goods**
  - **Greening more ambitiously!**
- **Make „good practice" really mean something**

Recommendations

For a more sustainable energy production from biogas

- **Stop the expansion of biogas production**
  - **New biogas plant should mainly use agricultural residues and waste**
- **Negative impacts of existing plants need to be reduced**
  - **Incentives to make energy production more flexible**
  - **Digestates used in agriculture should be fully incorporated in fertilizer regulation**

Recommendations

Gradually change food consumption patterns

- **A mix of measures and instruments is necessary**
  - **Reduce food waste**
  - **Reducing the consumption of animal products**
  - **Reduce avoidable losses caused by exaggerated quality requirements (e.g. total absence of blemishes)**
  - **Lower value added tax for meat, eggs and dairy products should be abolished**
  - **Government as a more effective role model**

Recommendations

Reshape the transportation sector

- **Optimization of emission standards**
- **Improving environmental zones for NO_x**
- **Tax advantage for Diesel fuel is not justified**
- **Expanding the scope of truck tolls to include all utility vehicles above 3.5 tons and all federal highways**

- **Reduce maritime shipping emissions (classify the North and Baltic Seas as nitrogen emission control areas)**

Recommendations

Reduce power plant emissions still further

- **Exploit synergies to the energy system transition (Energiewende)**
- **Elaboration of a coal phaseout strategy**
- **Enact stricter limit values (NO_x) for power plants using fossil fuel and biomass**

Beyond single policy instruments

The need of an integrated view

- **Synergies**
  - **e.g. reduction of nitrous oxide emissions due to the Nitrate Directive**
- **Pollution swapping**
  - **e.g. increased transport of manure to sensitive areas due to Nitrate Directive**
- **Policy coherence**
  - **e.g. boost of German biogas production and water quality**

➔ Institutional tool needed to promote integrated view

A Nitrogen Strategy

- **SRU recommends a “Nitrogen Strategy” to the German government**
- **Different dimensions of integration**
  - **Coordination of existing nitrogen policies**
  - **Horizontal (environment, agriculture, transport, industry)**
  - **Vertical (EU, national, regional)**
- **Follow-up and implementation of 7th EAP-target towards sustainable nutrient cycles**

A Nitrogen Strategy

Benefits from a Nitrogen Strategy

- **Strengthening role of environmental policy and promoting policy coherence**
- **Integrating environmental, energy and agriculture policy**
- **Public attention**
- **Raising awareness**
- **Systematic approach**

Thank you for your attention!

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