

For our Environment

Umwelt   
Bundesamt

International Nitrogen Initiative 2016 conference (INI2016).

# Quantification of the German nitrogen cycle

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Section II 4.3

Air Quality and Terrestrial Ecosystems

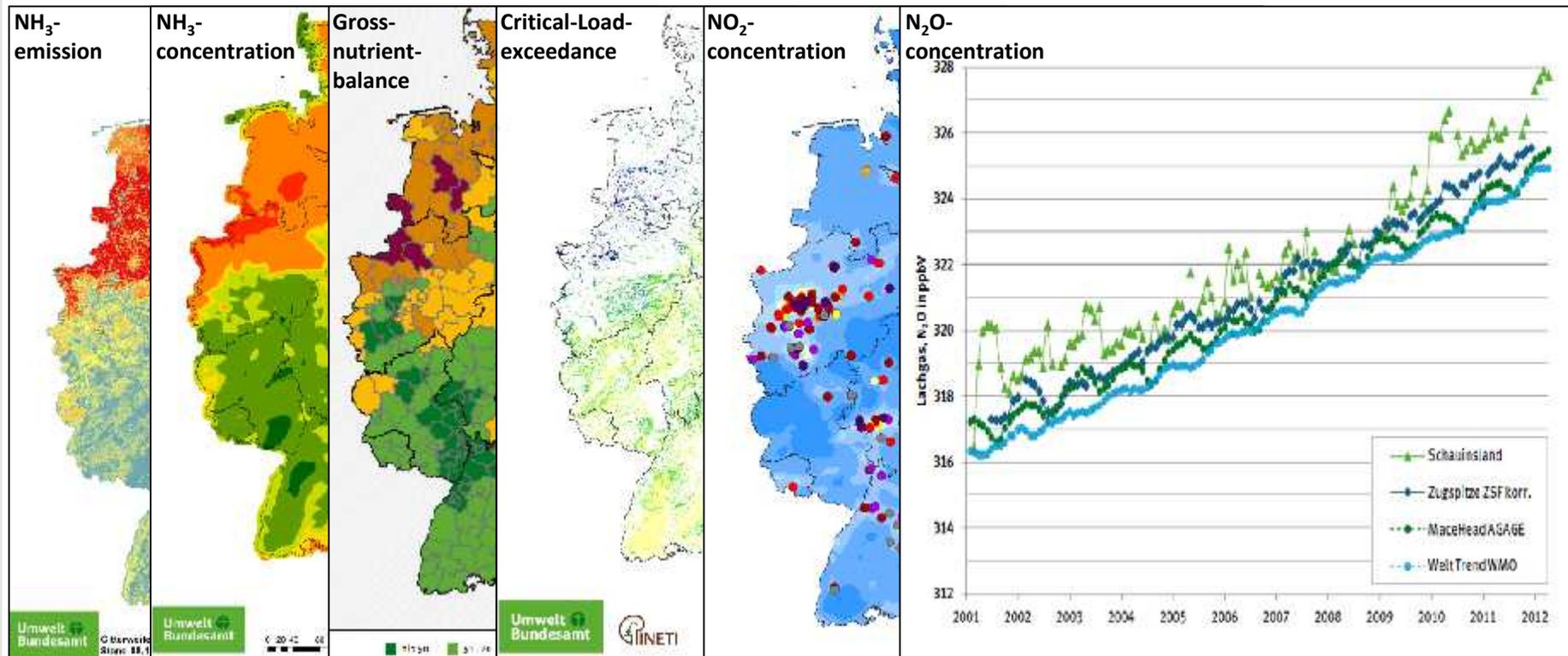
Quantification of the German nitrogen cycle

## **Background - environmental targets to be reached:**

- National emission ceilings (ammonia, nitrogen oxide)
- Critical loads for eutrophication
- Gross nutrient balance in agriculture as a national goal/indicator
- Nitrogen input to Baltic Sea and into the North Sea
- Quality standards for nitrate in groundwater bodies
- Nitrogen dioxide (NO<sub>2</sub>) concentration limits

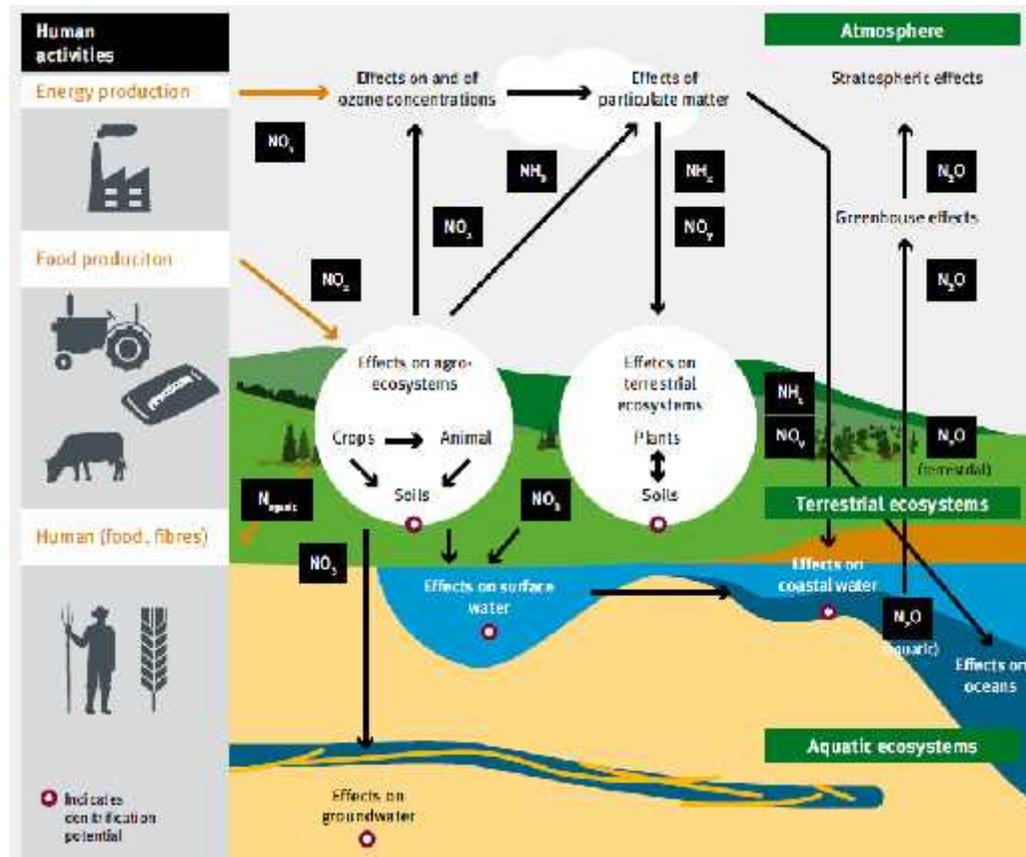
Quantification of the German nitrogen cycle

## Background - environmental targets to be reached:



Quantification of the German nitrogen cycle

**Objective: Quantification of the nitrogen cycle**



after Galloway et al., 2003

## Objective: Quantification of the nitrogen cycle

- Policy support
  - Where are the main flows?
  - Who are the main polluters?
  - Where are the most promising intervention points?
- Part of our agency's recommendations to go for an integrated approach.
- First quantification in 2009 (data from 2000-2004)
- Second quantification in 2015 (data from 2005-2010)
- Application of a national method
- No application of Guidelines of the Expert Panel Nitrogen Budgets (EPNB)
- Exchange of experiences with EPNB

## Methods and system boundaries

- Review work – basically no own calculations

- **Pools, entities that store, release or receive nitrogen**

Industry and Energy	Transport	Agriculture	Natural and semi-natural ecosystems
Waste and wastewater	Atmosphere	Hydrosphere	Urban system

- Focus on **fluxes** between pools
- Pooled nitrogen has not been quantified
- Values  $> 1 \text{ Gg N yr}^{-1}$  rounded to values of  $5 \text{ Gg N yr}^{-1}$
- Relevant period 2005 – 2010, if available average values for 2008 - 2010

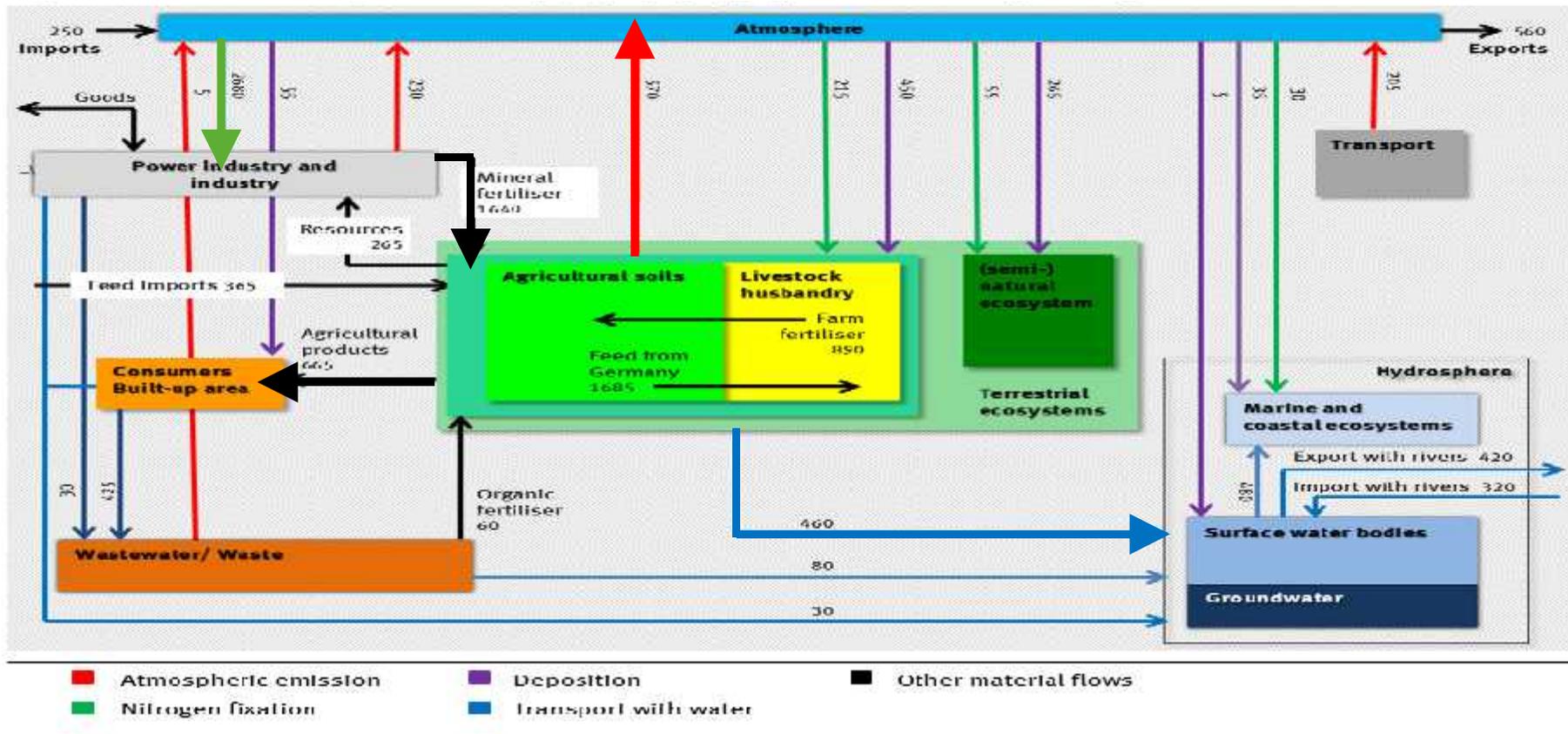
## Quantification of the German nitrogen cycle

### Data collection

Type of flow in N-cycle	N-amount (Gg yr <sup>-1</sup> )	Ref. period	Source of data	Type of flow in N-cycle	N-amount (Gg yr <sup>-1</sup> )	Ref. period	Source of data
<b>Industry and Energy</b> <ul style="list-style-type: none"> <li>➤ Industrial statistics</li> <li>➤ Emission inventories (CLRTAP, IPCC)</li> </ul>				<b>Natural and semi-natural ecosystems</b> <ul style="list-style-type: none"> <li>➤ Research data</li> </ul>			
<b>Transport</b> <ul style="list-style-type: none"> <li>➤ Emission inventories (CLRTAP, IPCC)</li> </ul>				<b>Wastewater</b> <ul style="list-style-type: none"> <li>➤ Research data, Wastewater statistics</li> </ul>			
<b>Agriculture</b> <ul style="list-style-type: none"> <li>➤ Agricultural statistics</li> <li>➤ Emission inventories (CLRTAP, IPCC)</li> </ul>				<b>Atmosphere</b> <ul style="list-style-type: none"> <li>➤ EMEP-data</li> <li>➤ National deposition data</li> </ul>			
				<b>Hydrosphere</b> <ul style="list-style-type: none"> <li>➤ Research data</li> </ul>			

Quantification of the German nitrogen cycle

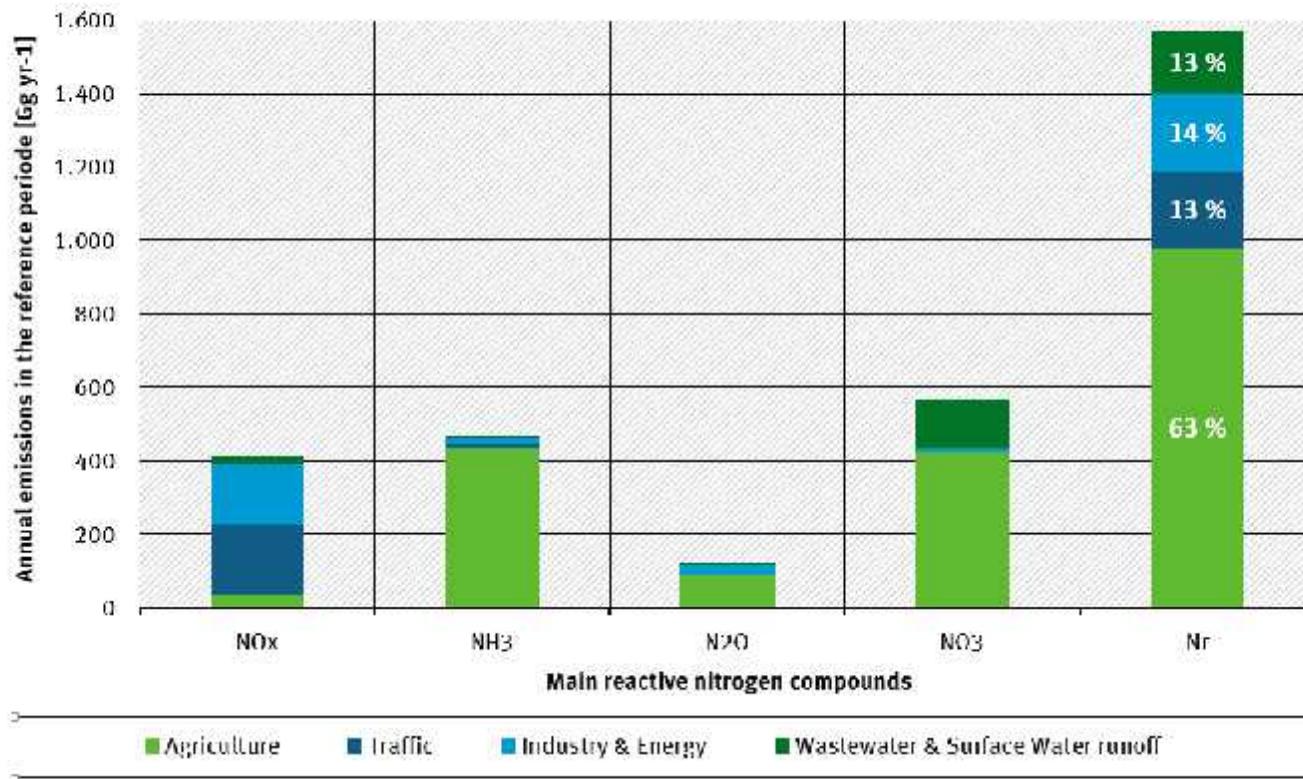
## Nitrogen cycle - Key flows of reactive nitrogen



## Quantification of the German nitrogen cycle

# Reactive Nitrogen Emissions

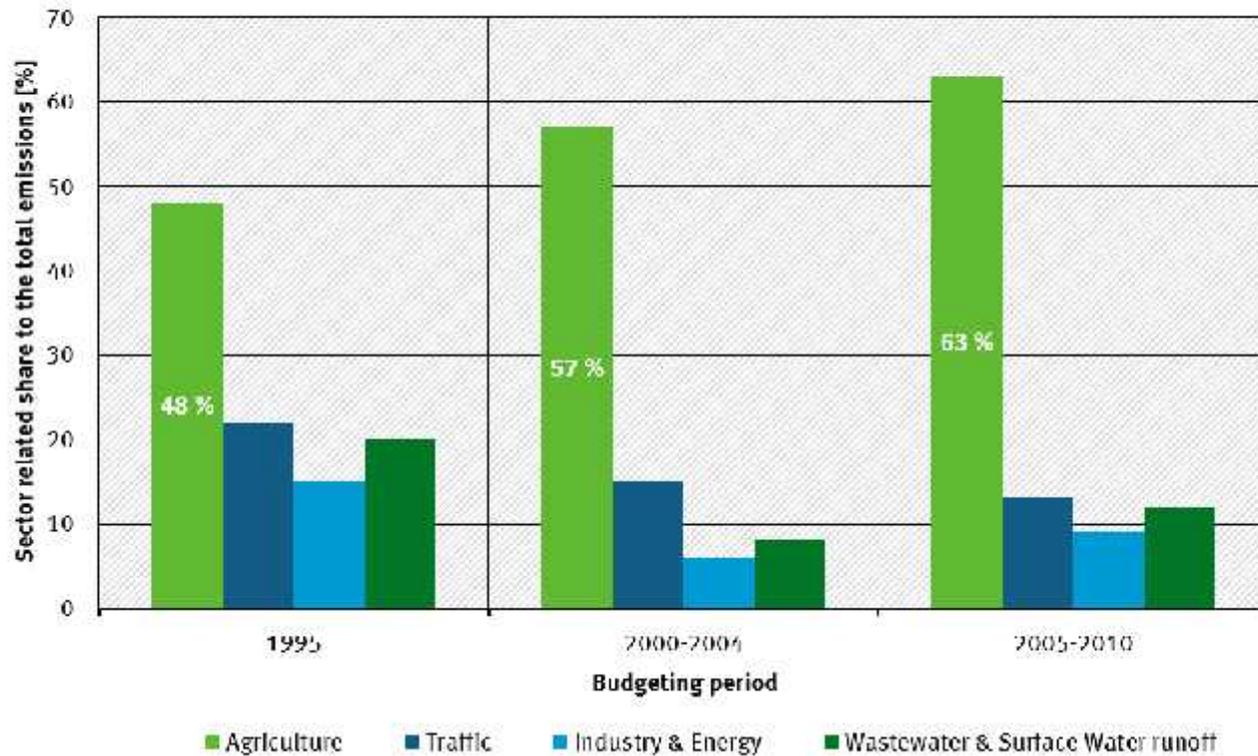
Average annual emissions of the main N-compounds by different sectors



## Quantification of the German nitrogen cycle

# Contribution to the nitrogen problem in Germany

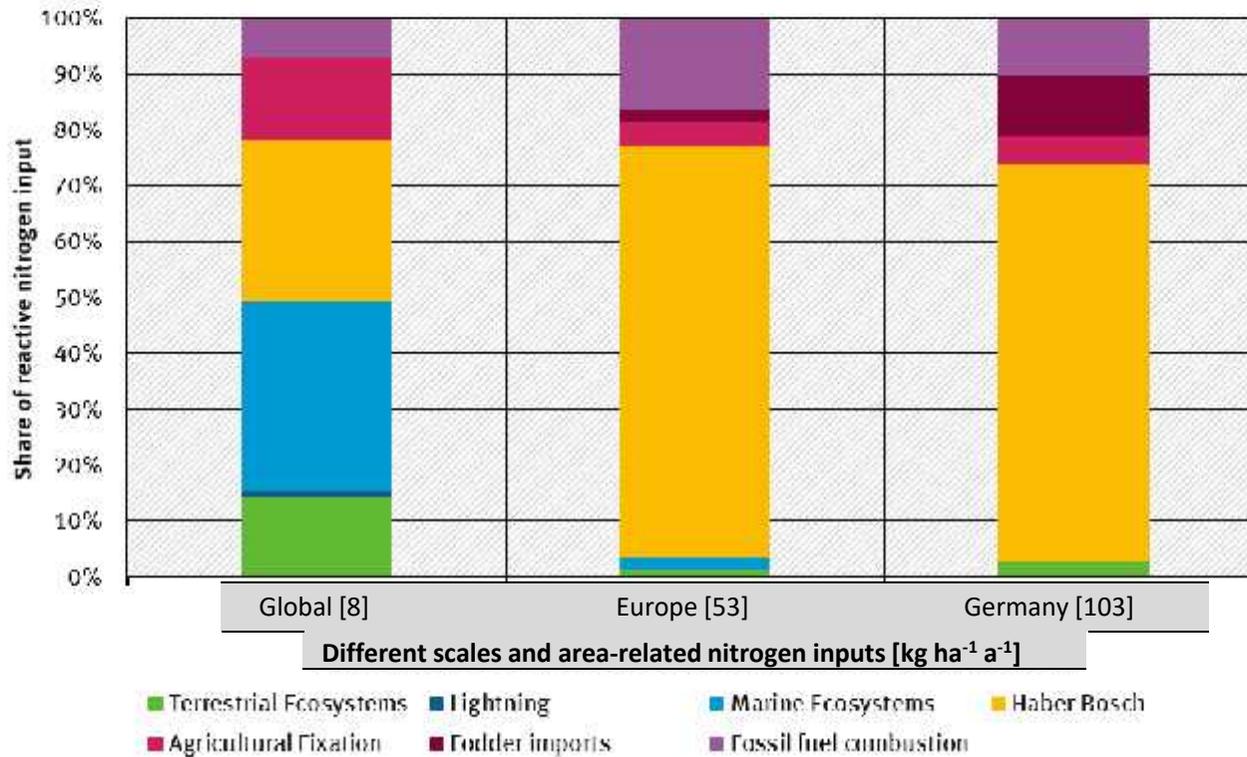
Sector related share to the total emissions over three budgeting periods



## Quantification of the German nitrogen cycle

### Reactive nitrogen inputs

Share of reactive nitrogen input at different scales by different natural and human activities



Total input including riverine and atmospheric imports:

**4200 Gg a<sup>-1</sup>**

≈

**50 kg person<sup>-1</sup> a<sup>-1</sup>**

## Discussion

- Budget / balance is not closed yet
- Denitrification or retention in the aquatic and soil ecosystems had not been taken into account, yet
- This assumption is backed by the fact, that the nitrogen surplus per area amounts to a larger number than what is recorded as emission to atmosphere or the aquatic environment
- Nitrogen in industrial products had not been taken into account yet
- International exchange with products incomplete
- However very valuable information to further develop nitrogen related policies

## Conclusions

- $N_r$  induced environmental effects go along with an intensified nitrogen cycle.
- $N_r$  is emitted to the environment in similar shares as  $NH_3$ ,  $NO_x$  and  $NO_3$ .
- 1/3 is released to the hydrosphere, 2/3 are released to the atmosphere.
- Agriculture is the dominant polluter with nearly 2/3 of the emissions.
- All the other sectors contribute equally to the problem.
- The results underpin significantly that an integrated approach is necessary.
- However: Picking the low hanging fruits and using existing reduction potential in agriculture has the largest potential.

[umweltbundesamt.de/en/publikationen/reactive-nitrogen-in-germany](http://umweltbundesamt.de/en/publikationen/reactive-nitrogen-in-germany)

Thank you for your attention!

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