

Für Mensch & Umwelt

Umwelt 
Bundesamt

Stickstoff in der Umwelt

Integrated nitrogen indicator and national nitrogen target

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DESTINO: Research project to support strategy development

1 DESTINO

DEutsche STickstoffflüsse, INdikatoren und Objectives

2 FRAME

Contractor: INFRAS with subcontractor Uni Gießen, KIT Karlsruhe

Focus 1: Basic data nitrogen strategy => National Nitrogen Budget (Markus!)

Focus 2: Development of Integrated Nitrogen Indicator and National Nitrogen Target (Jürg, Bettina)

3 MOTIVATION

Proposal for the introduction of a national nitrogen target

"618. the SRU recommends the development of a target value for a total entry of reactive nitrogen in Germany, which is compatible with the load carrying capacity limits of terrestrial and aquatic ecosystems, the objectives of climate protection and health protection."

=> Information on the scope of necessary changes

=> Political communication

=> Success control of measures

Objectives

Impact-based, integrated goal

Connection to various nitrogen-related environmental areas
Link to existing objectives (concentration limits, target values)

Backward calculations

Forward: start with Emission and calculate Concentration $c = f(E)$

Backward: start with max. concentration and calculate max Emission $E_{\max} = f^{-1}(c_{\max})$

What is the maximum amount of nitrate surplus in order to comply with the nitrate limit values?

Restriction: Determine national N target by means of nationally aggregated parameters (independent of space)

otherwise we enter into questions regionalized N indicators (ambiguous solutions)

Construction of an integrated nitrogen indicator with current status and target

Comparable to the 2-degree target of climate change

Target is only achieved, when every sectoral target is achieved

„Target achieved“ does not guarantee, that target is everywhere achieved, only on spatial average!
(necessary but not sufficient condition)

Environmental sectors, targets and DESTINO-indicators

Environmental sectors	Target values	Basis	DESTINO-indicators
Terrestrial ecosystems/biodiversity	NH ₃ ambient pollution level: Critical level for vascular plants: 3·µg·m ⁻³ ·NH ₃	Gothenburg Protocol	NH ₃ emissions
Terrestrial ecosystems/ Eutrophication	Nitrogen deposition: Critical Load <u>N_{tot}</u> (values are ecosystem-specific)	Gothenburg Protocol NEC Directive ^{b1}	Total NH ₃ and NO _x emissions
Surface waters	Nitrate concentration North Sea: 2.8·mg· <u>N_{tot}</u> ·l ⁻¹ and Baltic Sea: 2.6·mg· <u>N_{tot}</u> ·l ⁻¹	Surface water Ordinance	N-load
Groundwater	Nitrate concentration in groundwater: 50·mg·l ⁻¹	Groundwater Ordinance ^d	Nitrate input (N-exceedance)
Climate	N ₂ O emission: Long-term goal Climate action plan	Climate Action Plan ^e	N ₂ O emissions
Human health	NO ₂ ambient pollution level in air: WHO-Background response threshold 20·µg·m ⁻³	HRAPIE Study of WHO ^f	NO _x emissions

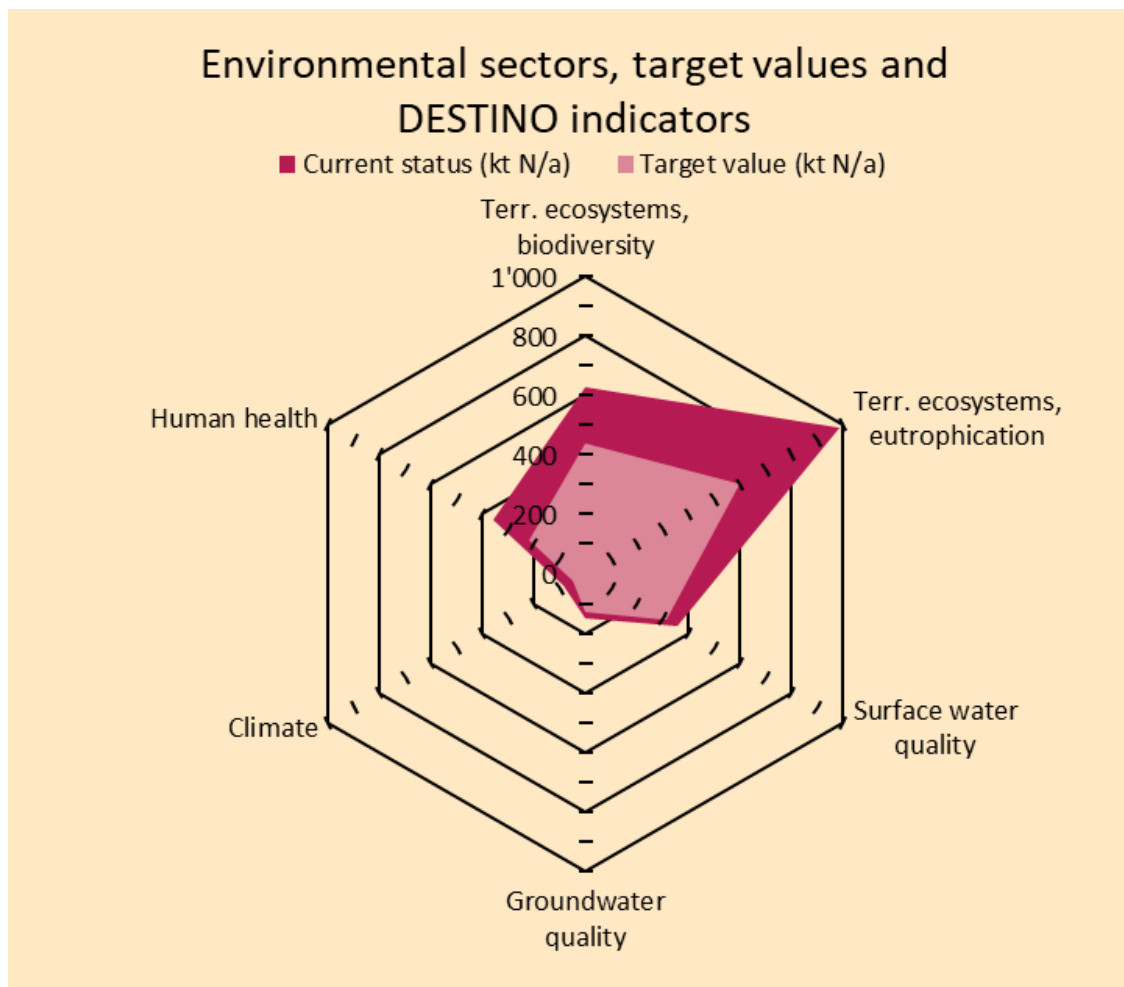
Current status and national N target

Environmental sector	DESTINO-indicators			
	Nitrogen species	Current status - absolute	- relative	Target value (100%)
Terr. ecosystems/ Biodiversity	NH ₃ emissions	625.2 kt·NH ₃ -N·a ⁻¹	142%	441.1 kt·NH ₃ -N·a ⁻¹
Terr. ecosystems/ Eutrophication	Total NH ₃ and NO _x emissions	625.2 kt·NH ₃ -N·a ⁻¹ 361.0 kt·NO _x -N·a ⁻¹	173%	402 kt·NH ₃ -N·a ⁻¹ 168 kt·NO _x -N·a ⁻¹
Surface waters	Total nitrogen load	356.2 kt·TN·a ⁻¹	113%	314.0 kt·TN·a ⁻¹
Groundwater	N-exceedance/ Nitrate	147.6 kt·NO ₃ -N·a ⁻¹	117%	126.6 kt·NO ₃ -N·a ⁻¹
Climate	N ₂ O emissions	83.4 kt·N ₂ O-N·a ⁻¹	174%	47.8 kt·N ₂ O-N·a ⁻¹
Human health	NO _x emissions	361.0 kt·NO _x -N·a ⁻¹	163%	221.1 kt·NO _x -N·a ⁻¹
Sum (green rows)		1573 kt·N·a ⁻¹ current indic. value	149%	1058 kt·N·a ⁻¹ national N target

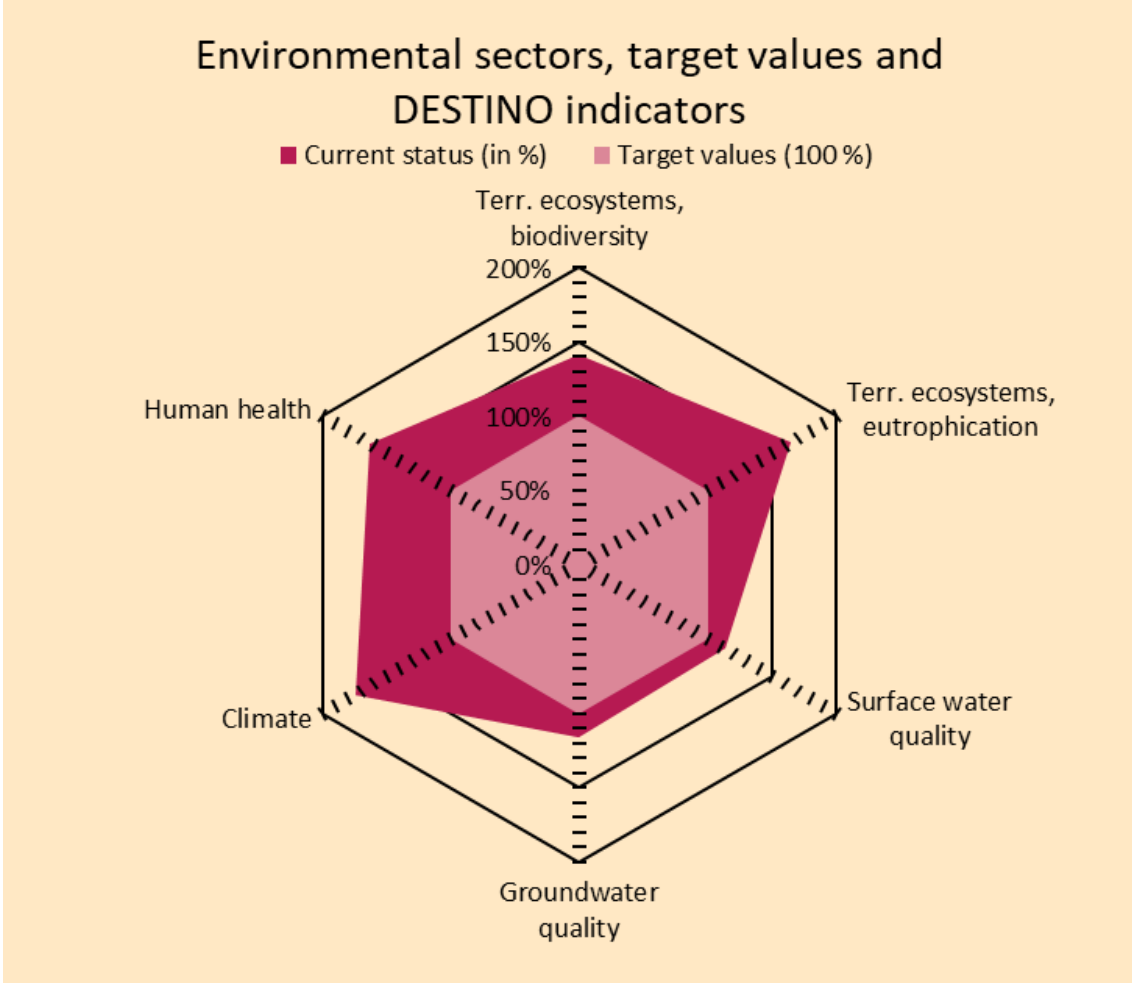
Green sectors have strictest target values for 5 N-species => Their target values are summed up to form the national nitrogen target.

Their current values are summed up to form the current status of the integrated N-indicator

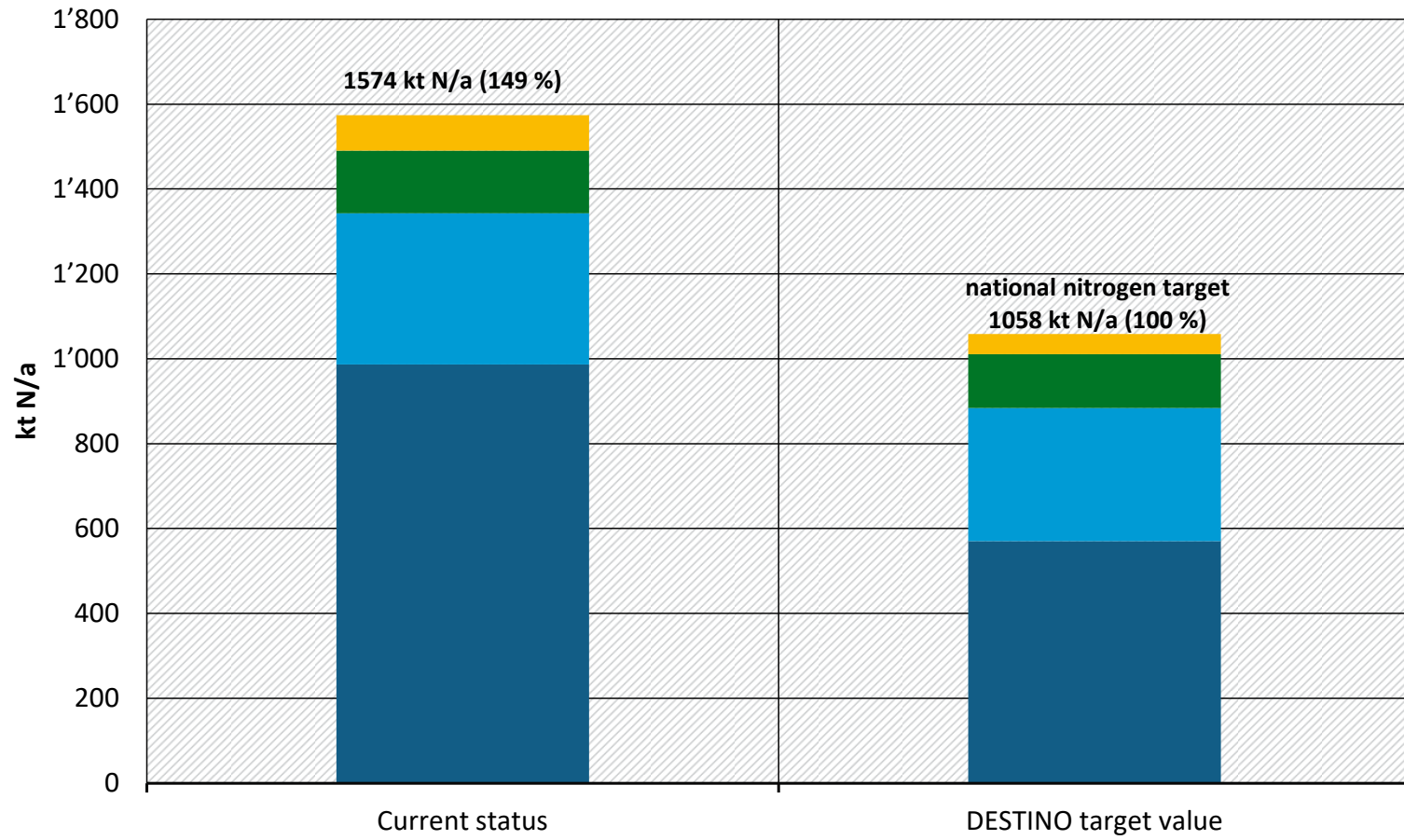
Current status and absolute target values of DESTINO Indicators



Current status and relative target values of DESTINO Indicators



Current status of integrated N indicator (left) and national N target (right)



■ Eutrophication NH3 + NOx emissions

■ Surface waters TN-load

■ Groundwater N-exceedance/Nitrate

■ Climate N2O emissions

**Germany's national nitrogen target
1000 kt N per year**

**Current value (2015)
1600 kt N per year**

inhab. 2015 (82 mio): 12 kg N / inhab. 19 kg N / inhab.

Indicators and methods to calculate target values

- 1. TERRESTRIAL ECOSYSTEMS/BIODIVERSITY (NH₃ CONCENTRATION)**
Correlation between concentration and emissions for every cell of EMEP-Grid
Determination of maximal national NH₃ emission such that Critical Level (3 µg/m³) is not exceeded
- 2. TERRESTRIAL ECOSYSTEMS / EUTROPHICATION (N-DEPOSITION)**
NH₃ and NO_x emission reduction targets given by NEC Directive for Germany (no robust result for purely aggregated parameters)
- 3. SURFACE WATERS (N-LOAD)**
Nitrogen reduction requirement in German watercourses flowing into North and Baltic Sea
Ratio of target N-load to current N-load is adopted to determine maximum N input
- 4. GROUNDWATER (NITRATE CONCENTRATION)**
Ratio current N-surplus to reduced N-surplus is adopted to determine max. nitrate input
- 5. CLIMATE (N₂O CONCENTRATION)**
Reduction target of the national „Klimaschutzplan 2050“ is broken down on N₂O reduction target 2030
- 6. HUMAN HEALTH (NO₂ CONCENTRATION)**
Correlation of 98%-value of background measurements to national NO_x emissions is used to determine maximum NO_x emissions such that 20 µg/m³ background target is fulfilled

Conclusion and further steps

1 CONCLUSION

- DESTINO is the **first attempt** towards an integrated N indicator.
- Since NEC targets and the groundwater targets are declared as interim (staged) targets, the national N target of 1000 kt N must also be considered as **interim target**. Later updates are to be expected
- Simplified analyses of available indicators. Also **improvements** are to be expected

2 FURTHER STEPS

- UBA will recommend the introduction of a national nitrogen target to influence political and public debate
- Existing N indicators and target systems shall not be replaced but extended
- Publication of final report and background paper for INI2020 in Berlin
- Open Access Publication

Thank you for your attention

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