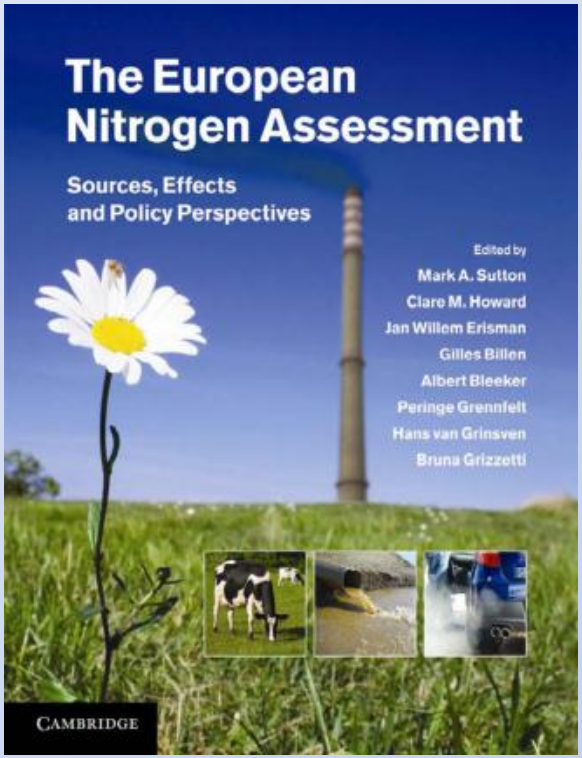


Integrating N processes at the European Scale

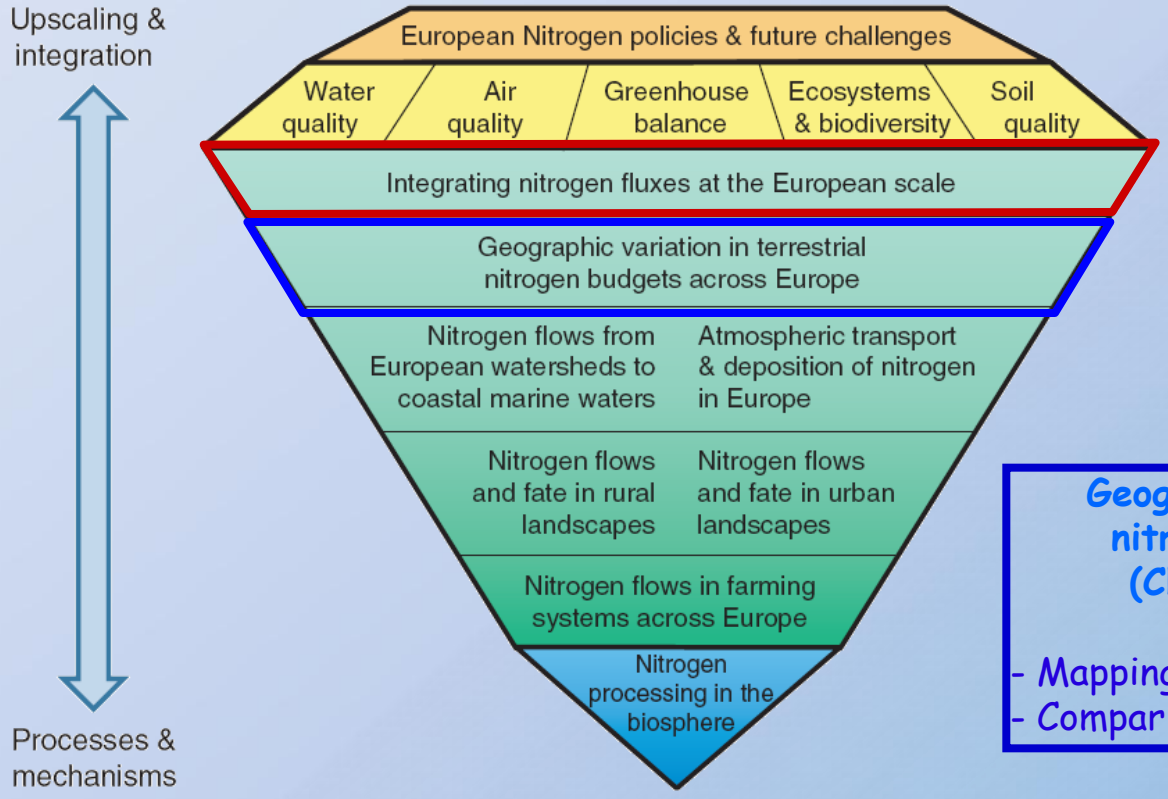
Adrian Leip[1] Wim de Vries[2]

1 European Commission - Joint Research Centre - Institute for Environment and Sustainability

2 ALTERRA

John van Aardenne, Peter Bergamaschi, Gilles Billen, Lex Bouwman, Klaus Butterbach Bahl, Hans Kros, Jan Peter Lesschen, Michel Prud'homme, Gert Jan Reinds, David Simpson, Mark Sutton, Maren Voss, Wim de Vries, Wilfried Winiwarter

The European Nitrogen Assessment



Integrating nitrogen fluxes at the European scale (Chapter 16, Leip et al.)

- Mapping key N-indicators
- Developing national and European integrated N-budgets

Geographic variation in terrestrial nitrogen budgets across Europe (Chapter 15, de Vries et al.)

- Mapping terrestrial N-budgets for EU27
- Comparing model-results

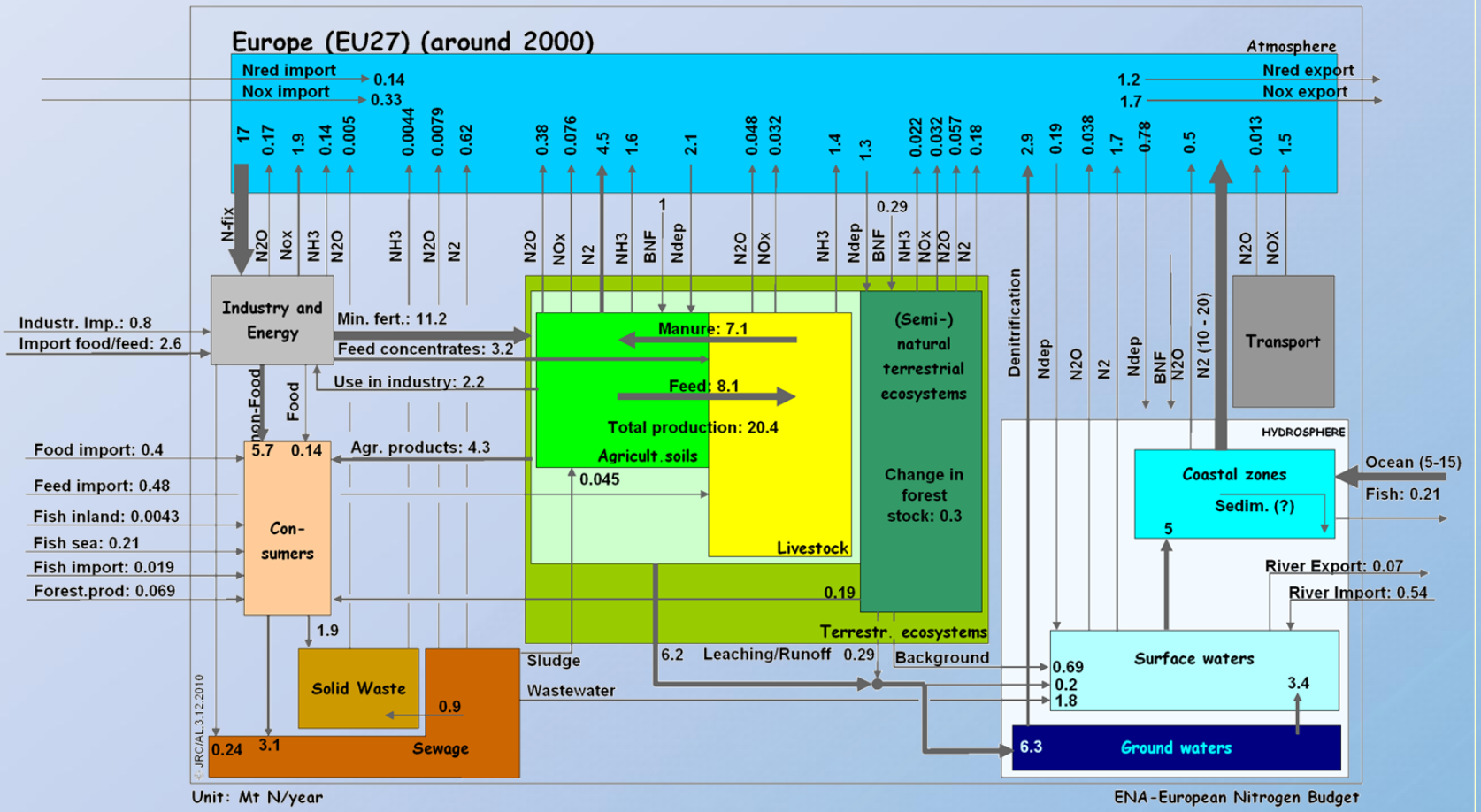
Integrated Nitrogen Budgets

"Quantification of all major nitrogen fluxes across all sectors and media within given boundaries, and fluxes across these boundaries, on an annual basis"

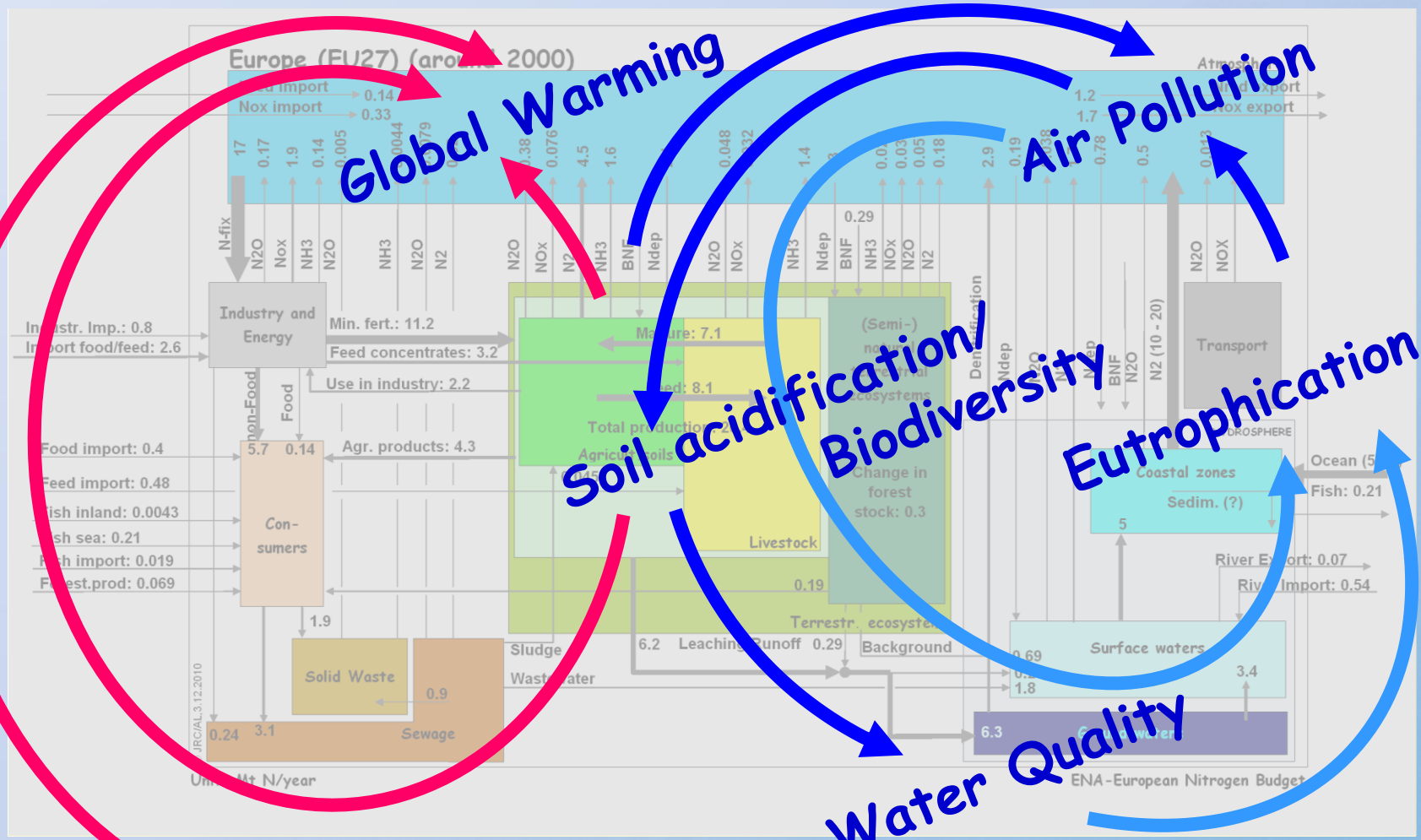
European Nitrogen Assessent, 2011

- Sectors: Industry/energy, transport, agriculture (crop- and livestock production), (semi)natural terrestrial ecosystems, consumers, waste management systems (waste water and solid)
- Media: atmosphere, hydrosphere (freshwater, coastal water)
- Boundaries: European Union (EU27) without Malta and Cyprus

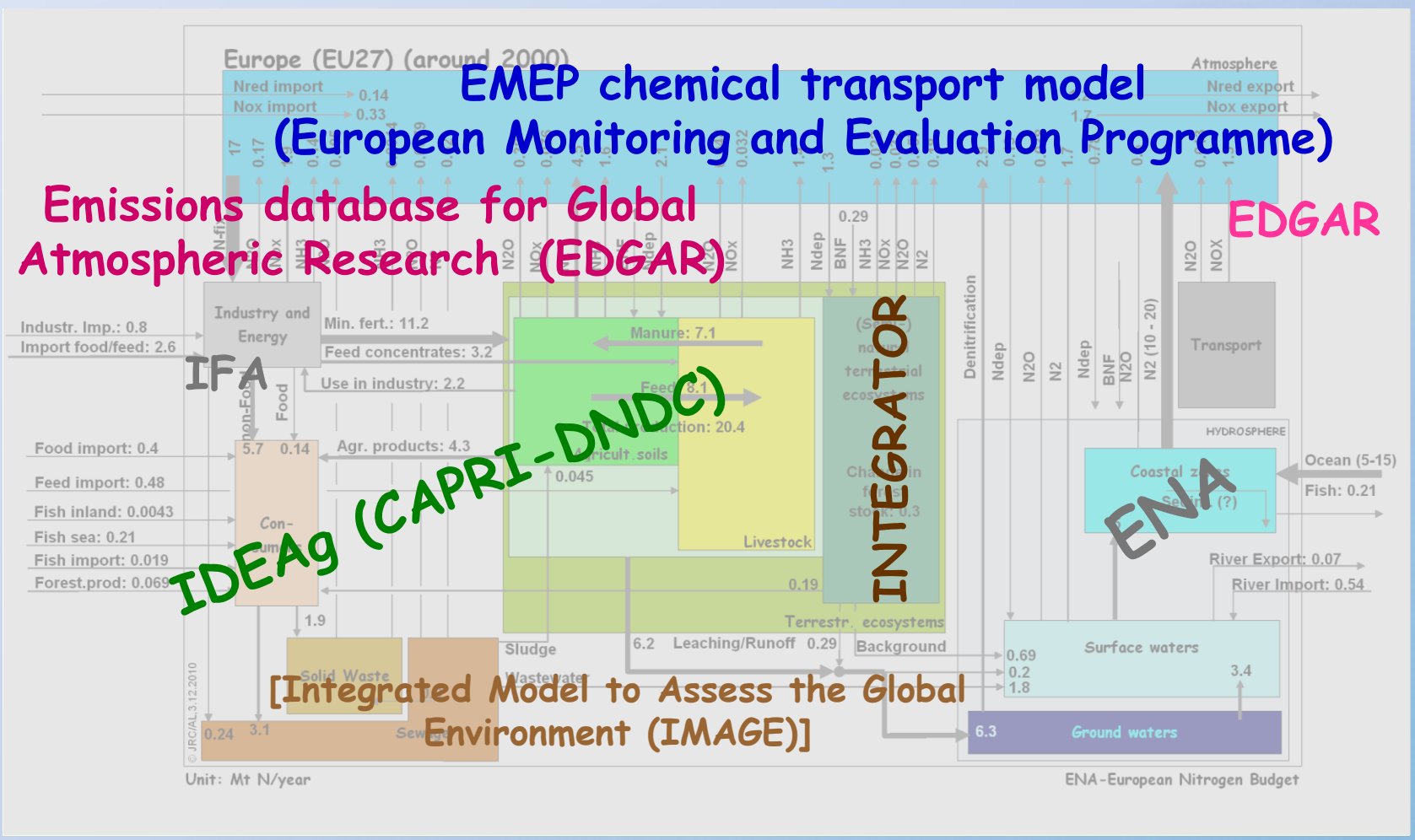
The European Nitrogen Budget (ENB)



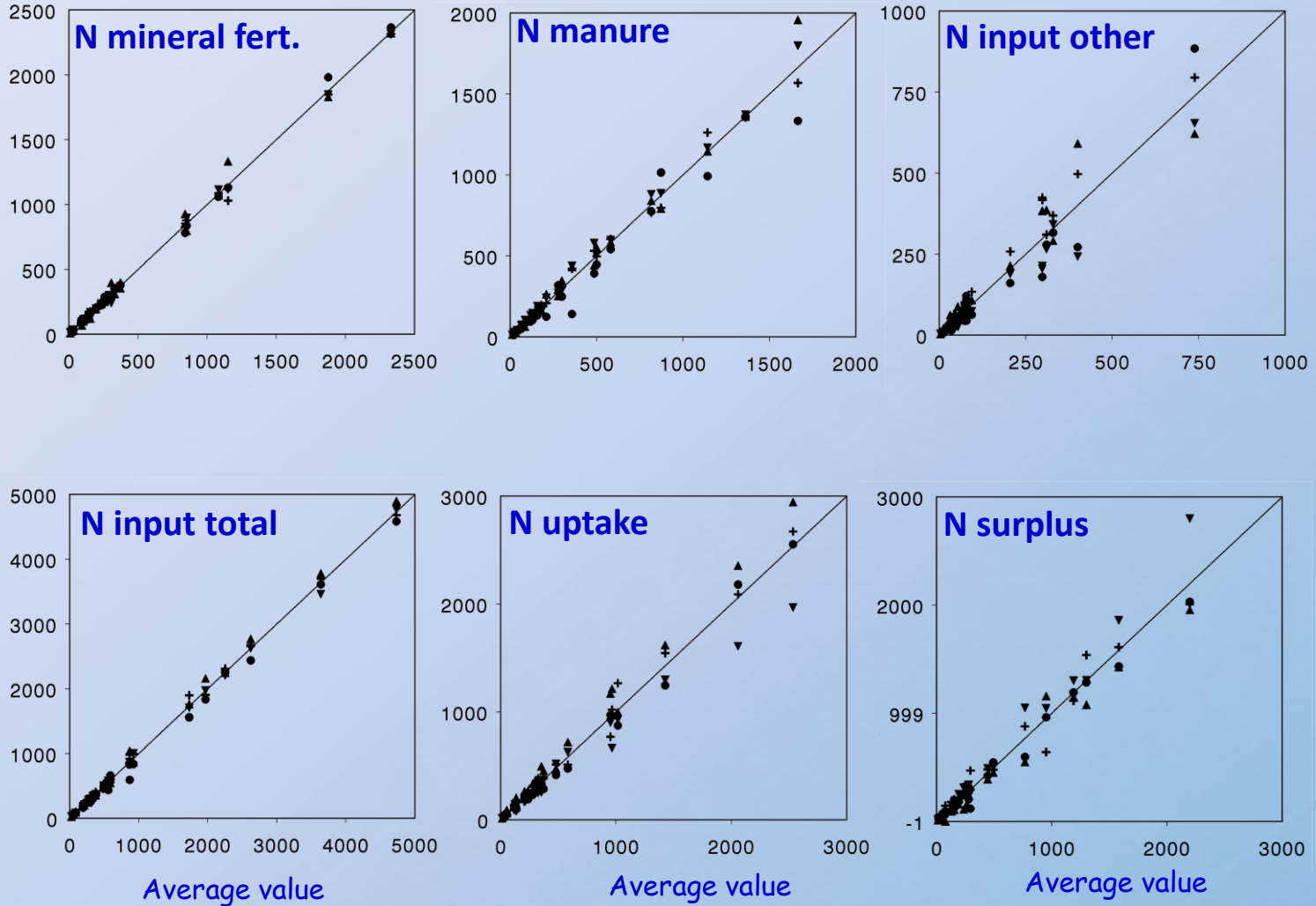
Visualization & Quantification of the Nitrogen Cascade



Methods: mainly model-based estimates



Model-comparison
Input data



MODELS

▲ INTEGRATOR

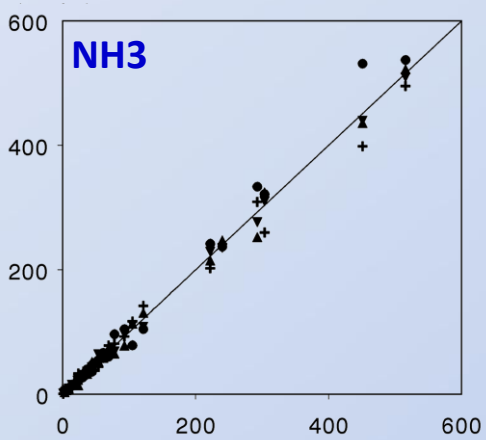
● IDEAg

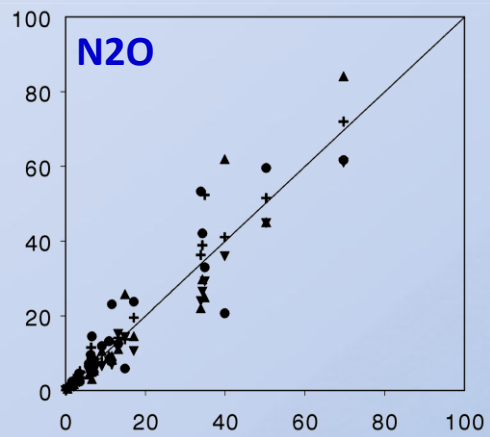
▼ MITERRA

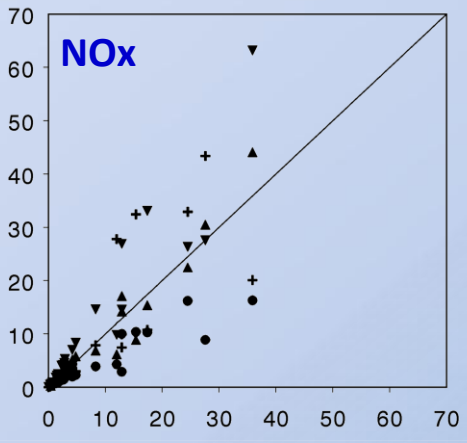
✚ IMAGE

All values in kt N yr^{-1}

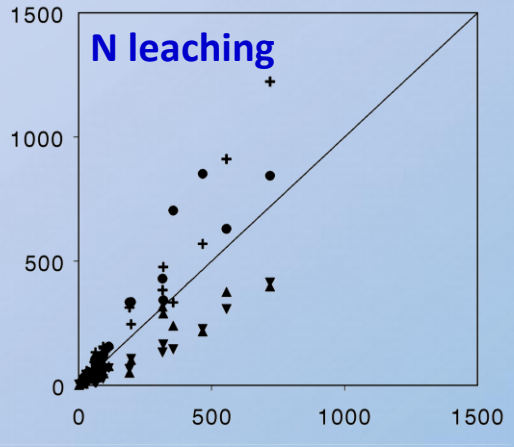
Model comparison
Emissions of reactive nitrogen







Average value



Average value

MODELS

▲ INTEGRATOR

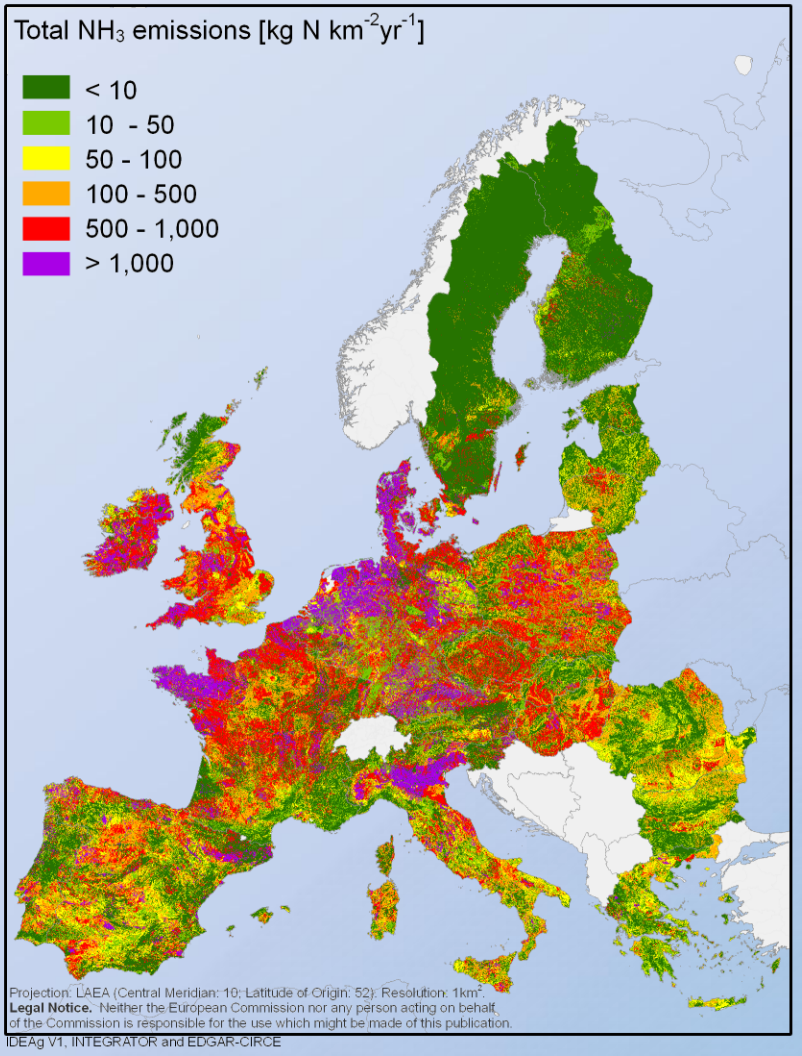
● IDEAg

▼ MITERRA

✚ IMAGE

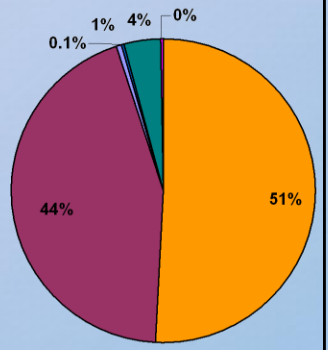
All values in kt N yr^{-1}

Total NH_3 emissions

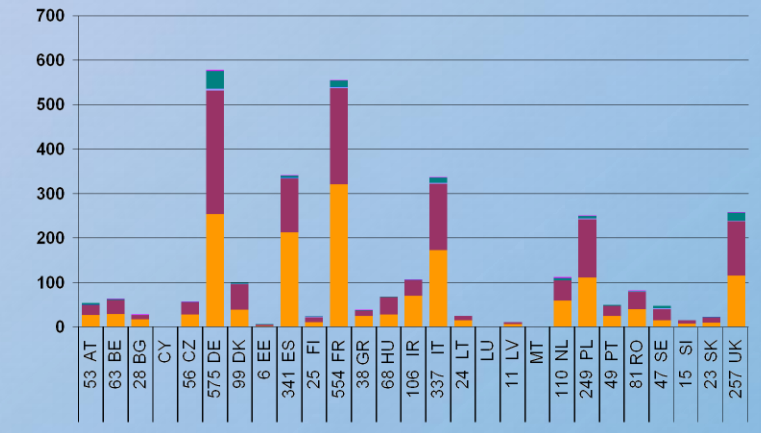


Split of total NH_3 emissions for EU27 [Gg N yr^{-1}]

Agriculture - soils	1640
Agriculture - manure	1430
Forest soils	22
Waste	4
Energy	123
Chemical industry	13
Total	3232

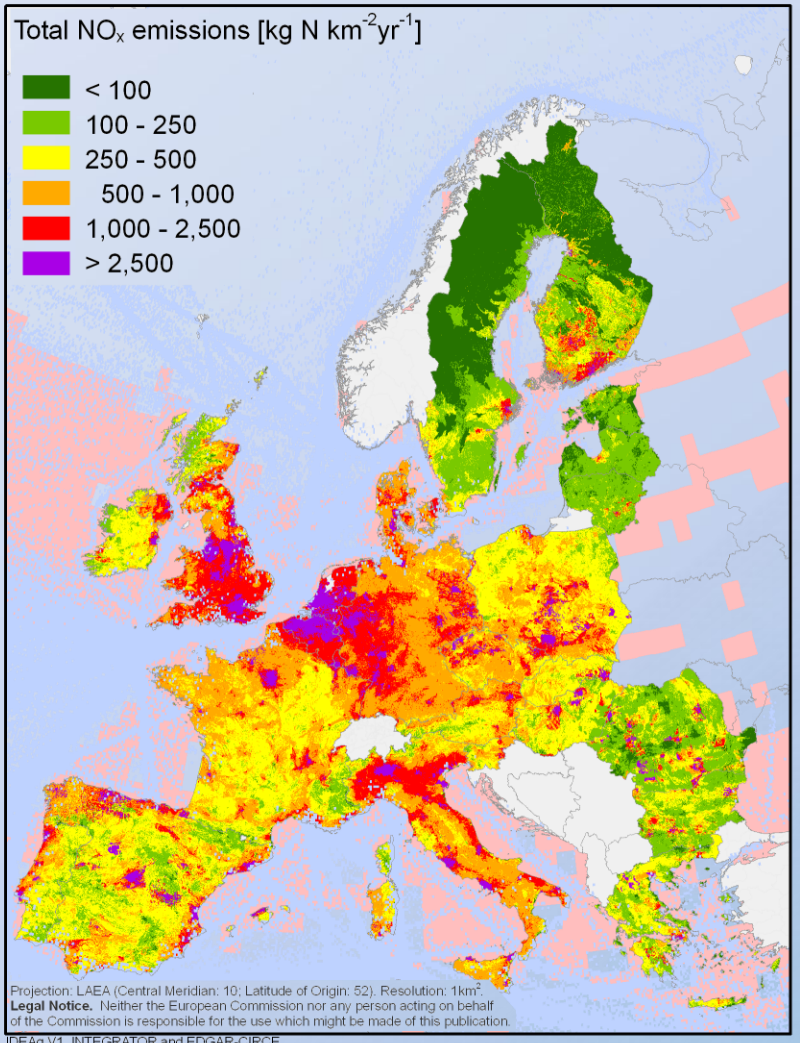


Split of total NH_3 emissions by country [Gg N yr^{-1}]



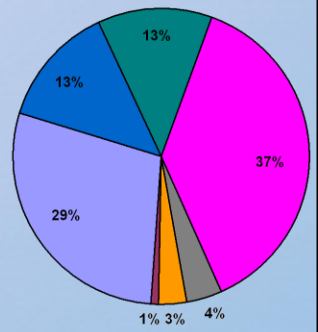
AL/HIR, 27.07.2010. ©European Communities, 2010

Total NO_x emissions

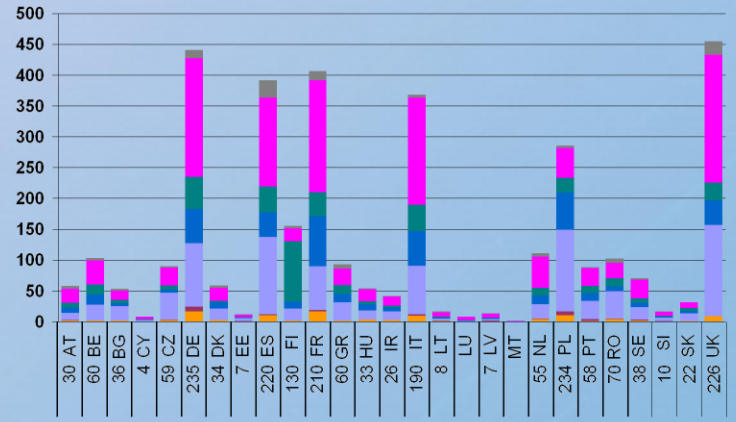


Split of total NO_x emissions for EU27 [Gg N year^{-1}]

Agriculture	110
Forests	30
Combustion industry	1010
Combustion resident.	470
Industry	440
Road transport	1340
Other transport	140
Total	3540



Split of total NO_x emissions by country [Gg N year^{-1}]



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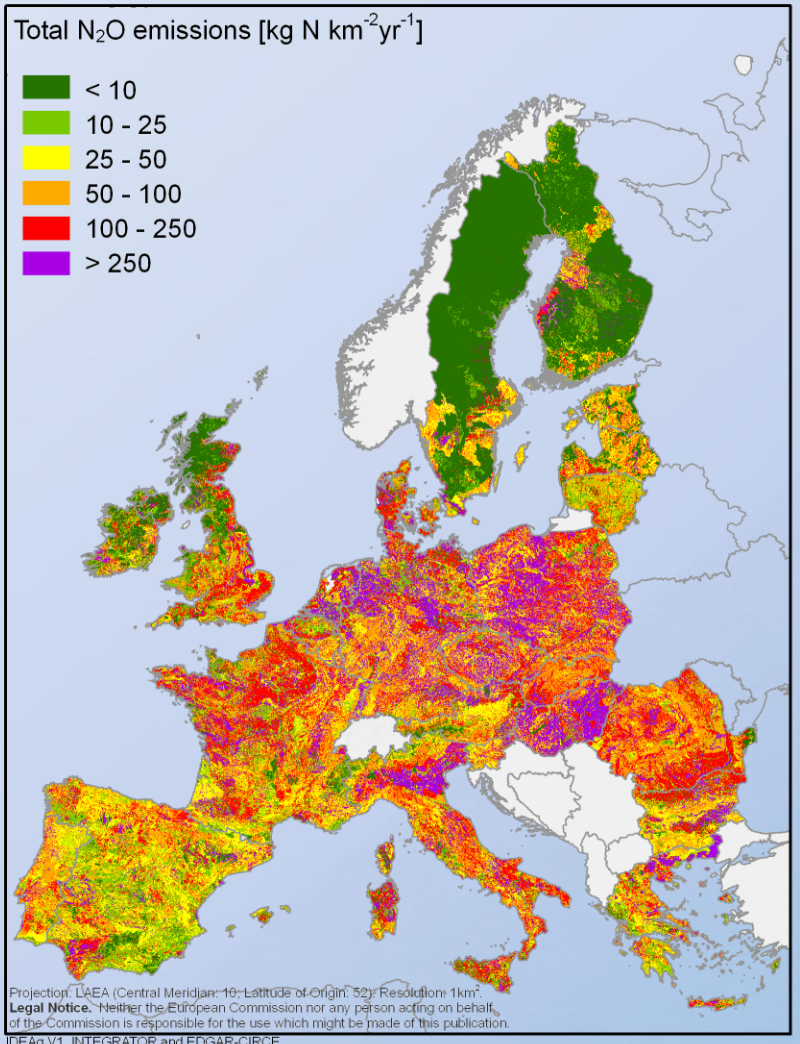
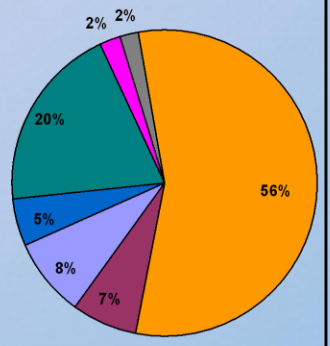
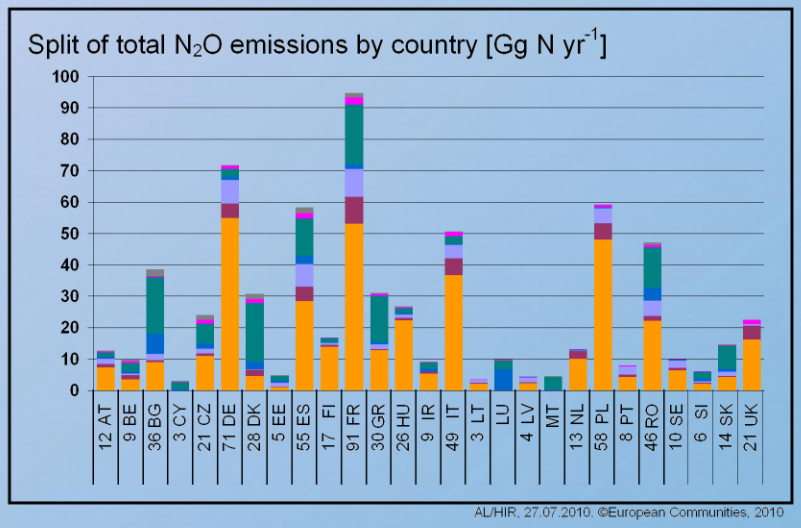
Total N_2O emissions



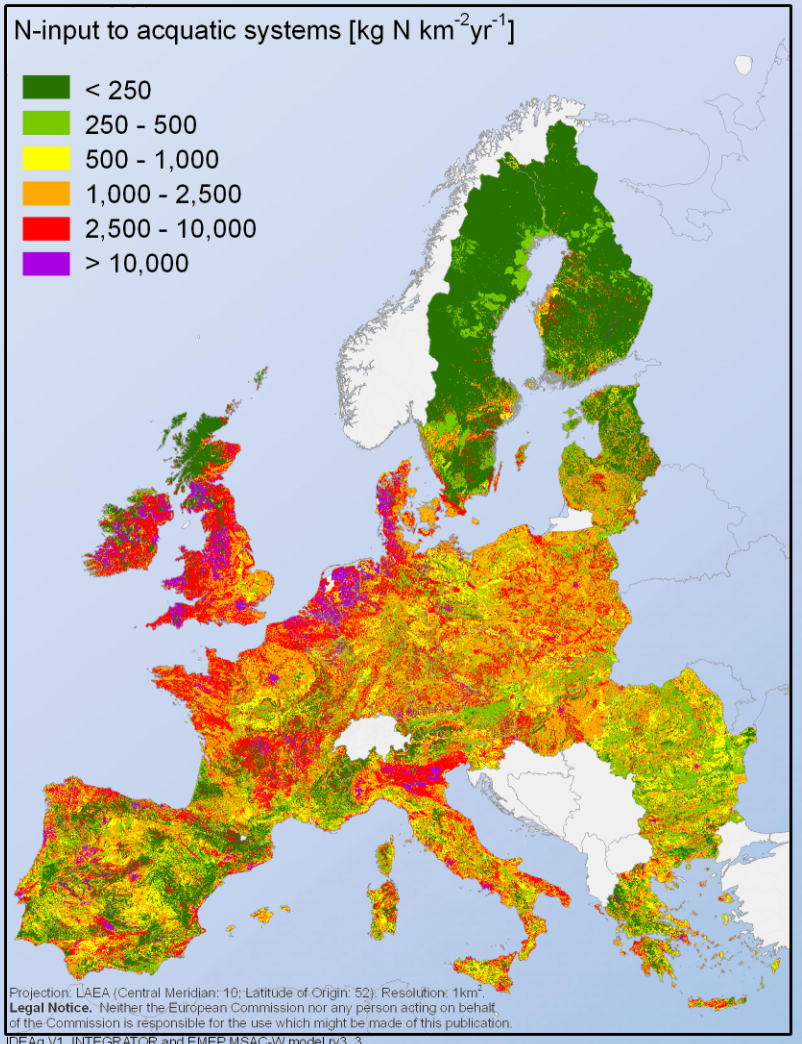
Split of total N_2O emissions for EU27 [Gg N yr^{-1}]

Agriculture - soils	380
Agriculture - manure	50
Forest soils	60
Energy	30
Industry	140
Waste	20
Transport	10
Total	690



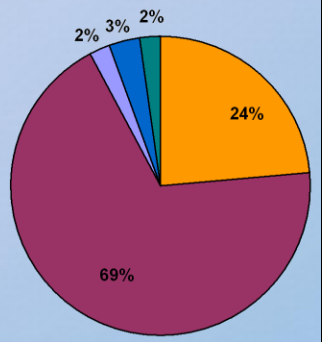


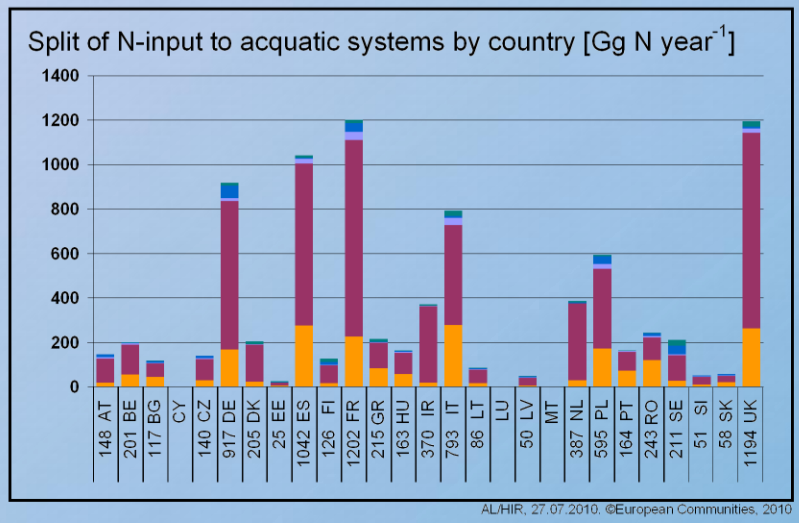
Total input to aquatic systems



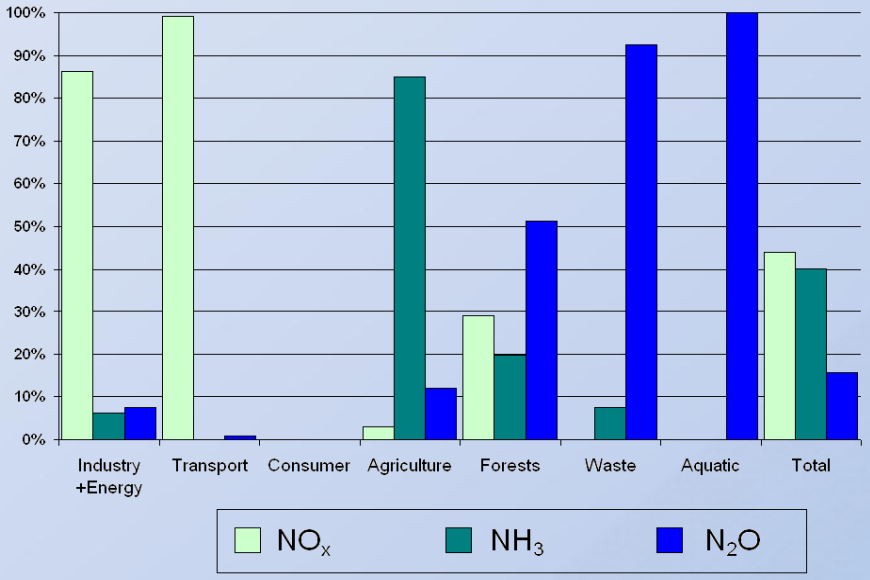
Split of N-input to acquatic systems for EU27 [Gg N year-1]

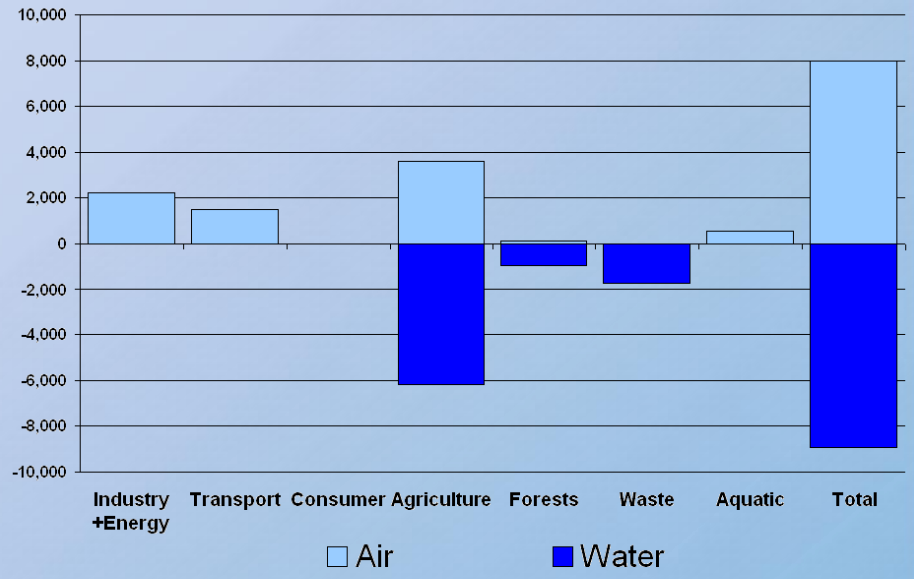
Direct sewage	2050
Diffuse agric. soils	5980
Diffuse agric. livestock	200
Diffuse - forests	290
N-deposition	190
Total	8710



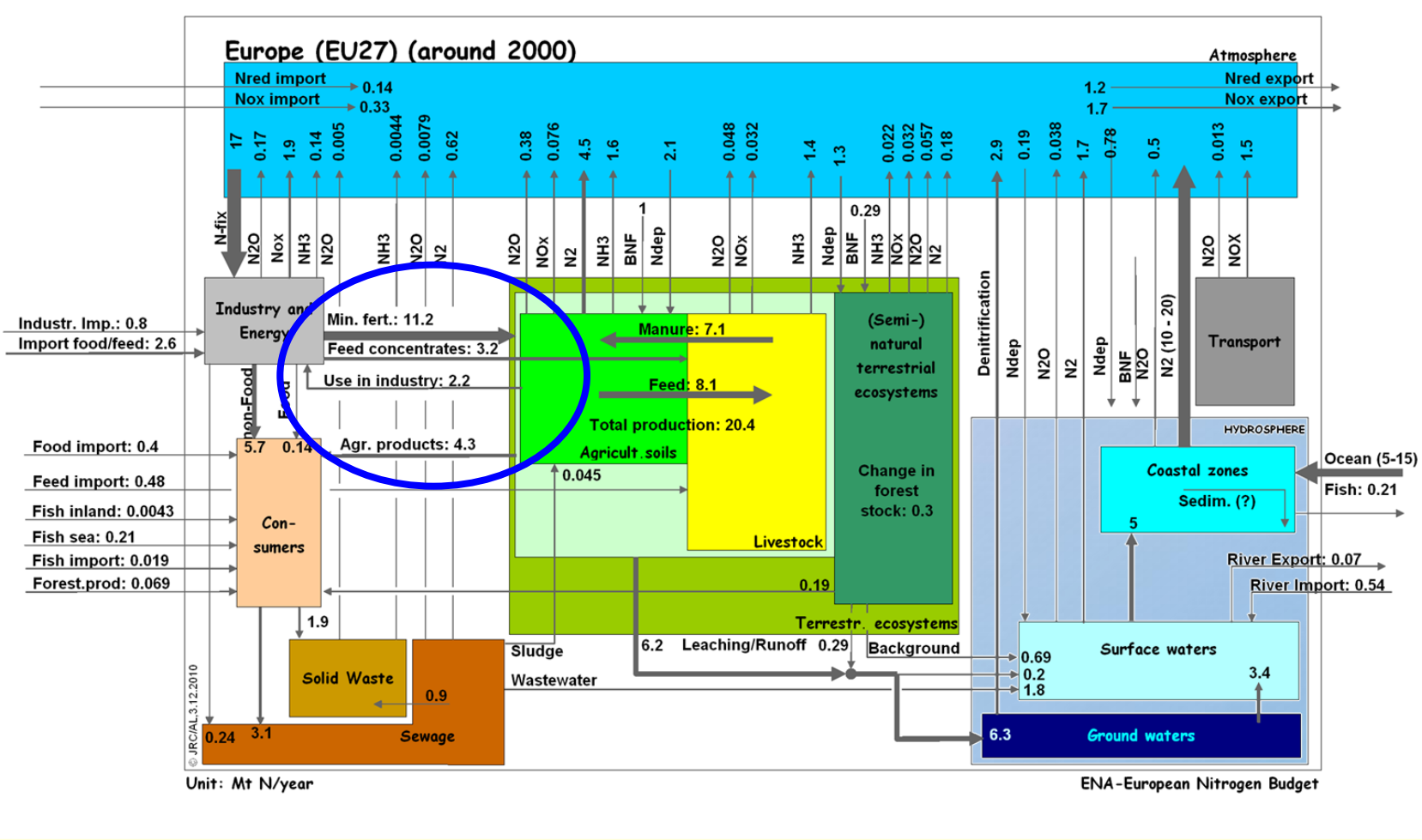


Emission inventories



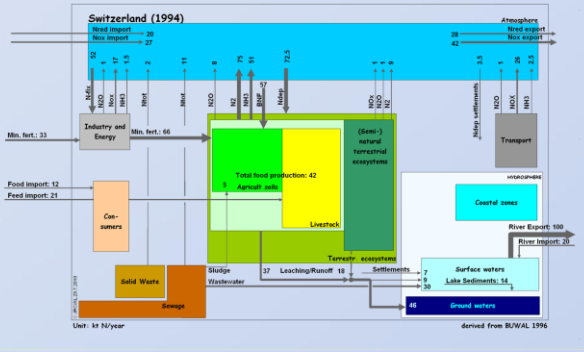


The ENB – highlighting important fluxes

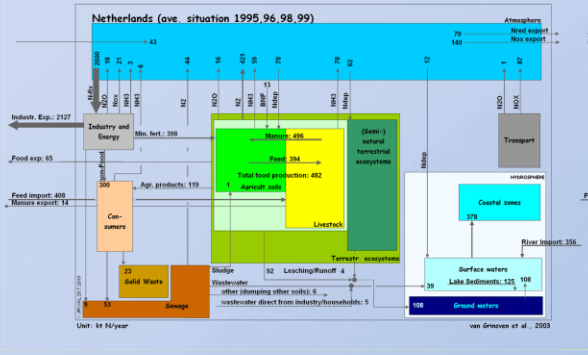


National integrated Nitrogen Budgets

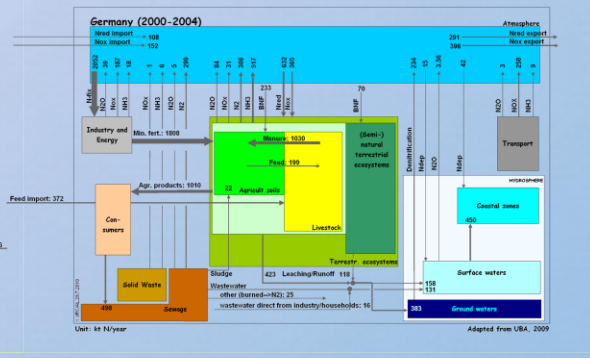
Switzerland 1994



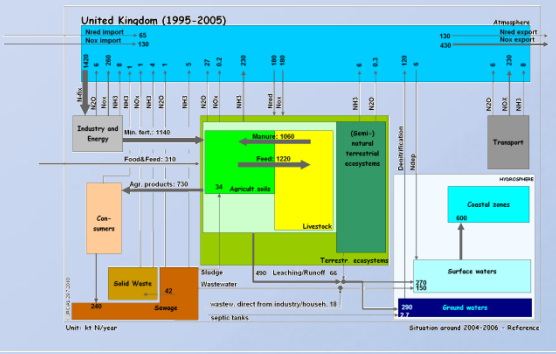
Netherlands 1995-1999



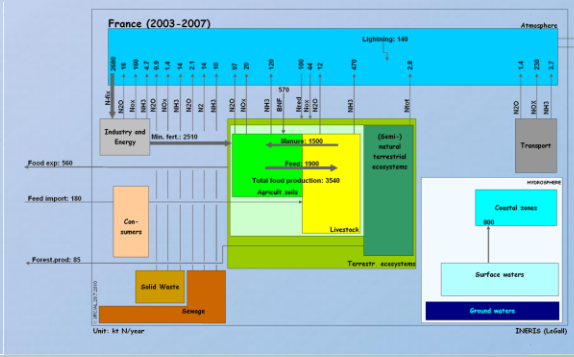
Germany 2000-2004



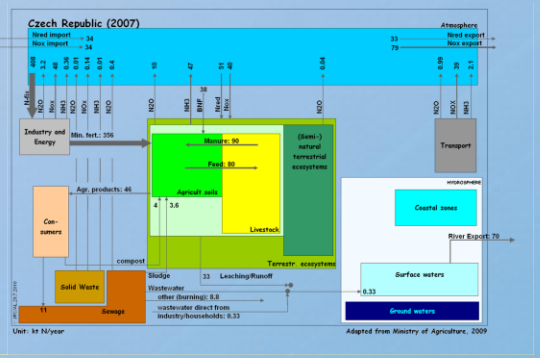
UK 1995-2005



France 2003-2007



Czech Republic 2007



Conclusions

- From ca. 18 Tg Nr yr^{-1} input to agriculture in the EU-27, only about 7 Tg Nr yr^{-1} are consumed or further processed by industry.
- About equal total losses estimated to the atmosphere and the hydrosphere. EU-27 is a net exporter of reactive nitrogen through atmospheric transport of c. 2.3 Nr yr^{-1}.
- Total N inputs at EU 27 level are comparable for all models (comparable basic data on fertilizer use and animal numbers)
- The various models for agro-ecosystems give in general very similar results for the emissions of NH3 and N2O but higher variation for NOx and N-leaching
- NH3 fluxes high in regions with high livestock density or agricultural crop production. NOx fluxes determined by fossil fuel use. N2O fluxes both effect important
- The largest single sink for Nr appears to be denitrification to N2 in European coastal shelf regions; however, this sink is also the most uncertain.
- Creation and closure of N budgets within European environments can help developing integrated nitrogen management approaches

THANK YOU!