Integrated measures in agriculture to reduce ammonia emissions

Contract No 070501/2005/422822/MAR/C1

http://ec.europa.eu/environment/air/cafe/activities/ammonia_en.htm

www.scammonia.wur.nl

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Outline

- Background
- Objectives Service Contract
- Results
  - Maps for year 2000
  - Effect of single measures
  - Scenario analyses
- Main results and conclusions
- Main uncertainties
- Main recommendations
- Questions

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Background

1. **Sixth Environmental Action Program of EU:**
   "No significant negative effects of air pollution on human health and the environment"

2. **Thematic Strategy on Air Pollution (TSAP)**
   Principle: Integrated approaches needed.
   Proposals to decrease the emissions of NH_3:
   - Review/revision of the NEC Directive
   - Make use of provisions of Rural Development Regulation
   - Implementation of Gothenborg protocol
   - Include effects of Nitrates Directive on NH_3 emissions and v.v.
   - In parallel: Review of the IPPC Directive

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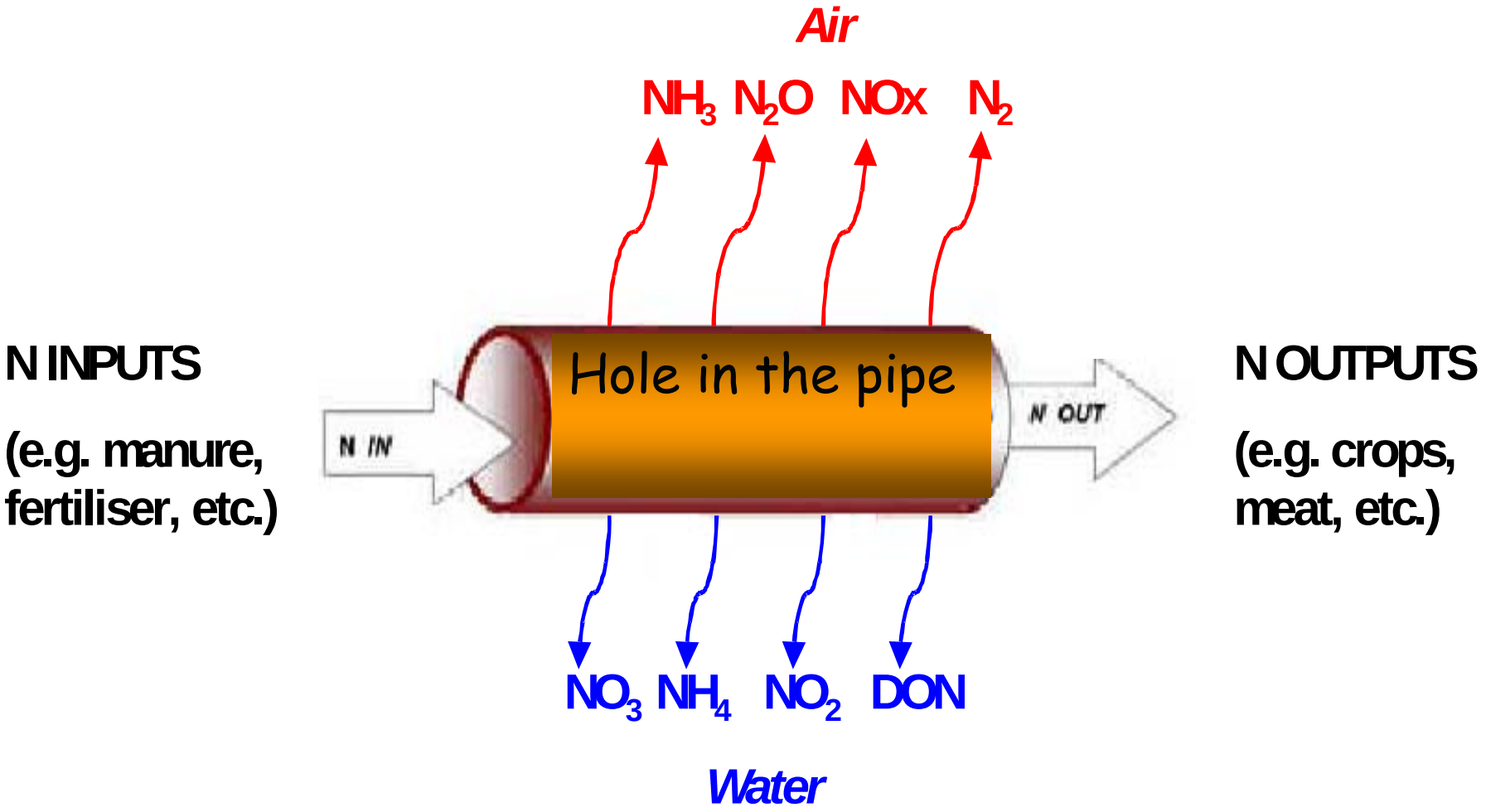
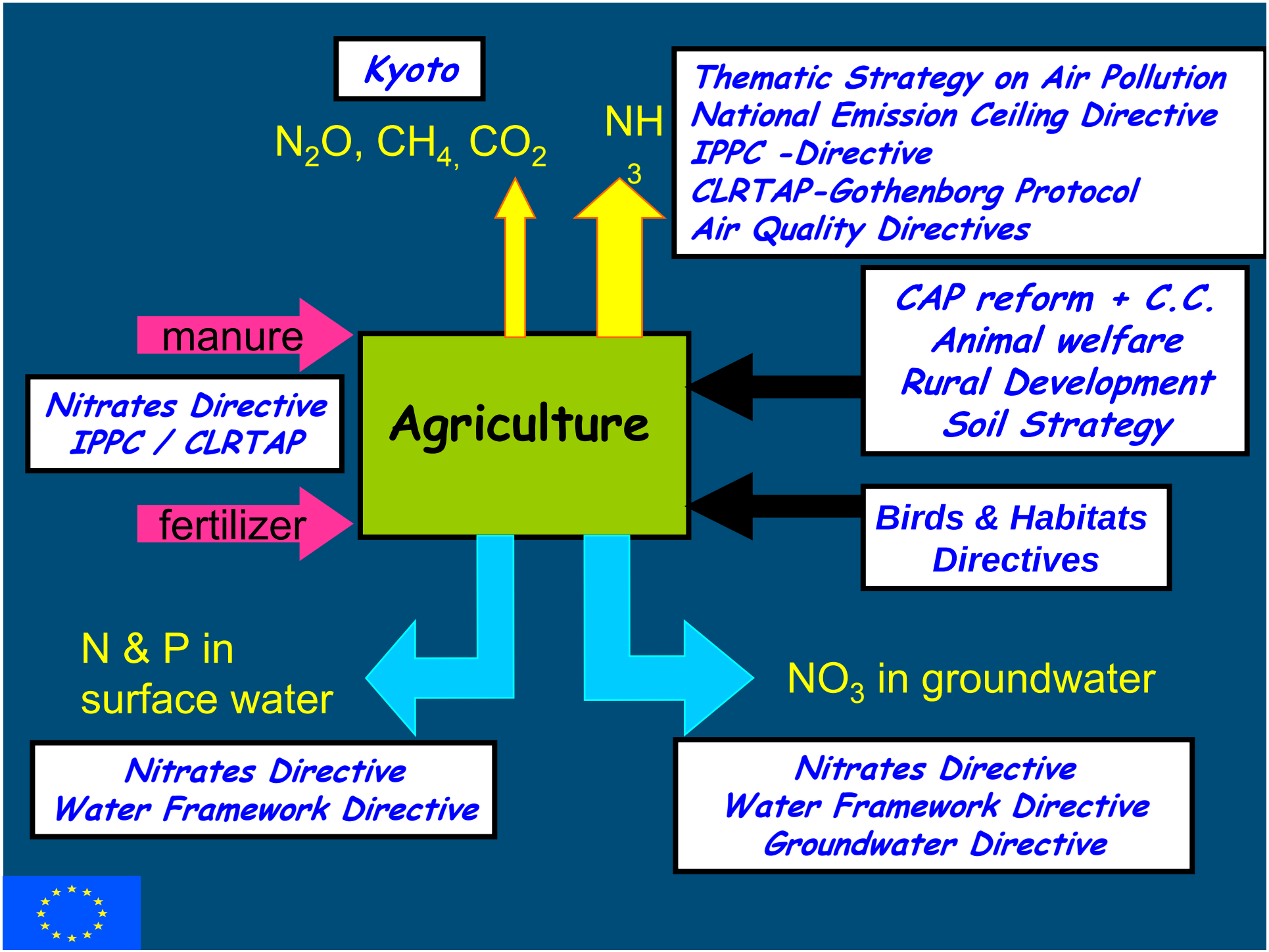
Agriculture and nitrogen: integrated approach needed

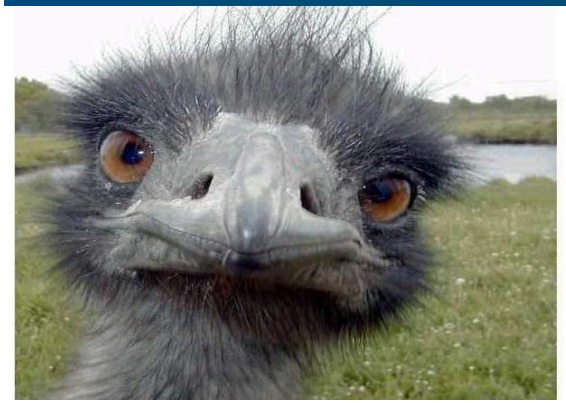



Kyoto
N_2O, CH_4, CO_2
NH3
Thematic Strategy on Air Pollution
National Emission Ceiling Directive
IPPC -Directive
CLRTAP-Gothenborg Protocol
Air Quality Directives
manure
Nitrates Directive
IPPC / CLRTAP
fertilizer
Agriculture
CAP reform + C.C.
Animal welfare
Rural Development
Soil Strategy
Birds & Habitats
Directives
N & P in
surface water
NO_3 in groundwater
Nitrates Directive
Water Framework Directive
Nitrates Directive
Water Framework Directive
Groundwater Directive

Objectives Service Contract

- ….to define the most appropriate integrated and consistent actions to reduce environmental impacts from agriculture…

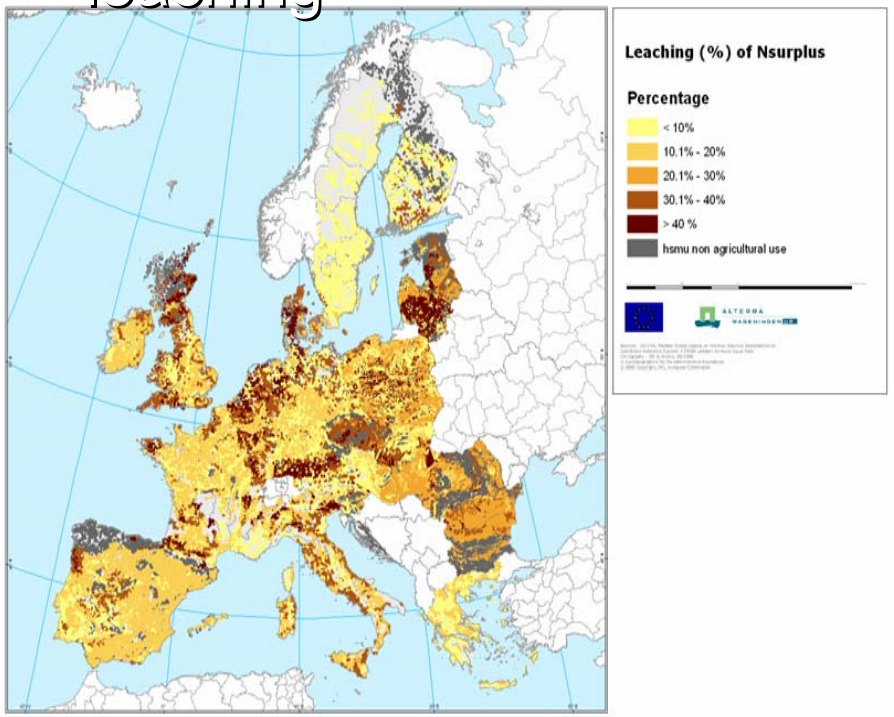
- Tasks
  1. Develop an integrated approach: MITERRA-EUROPE
  2. Analysis of International and European Instruments
  3. In depth assessment of the most promising measures
  4. Impact assessment of a possible modification of the IPPC
  5. Stakeholder consultation, presentations, workshop

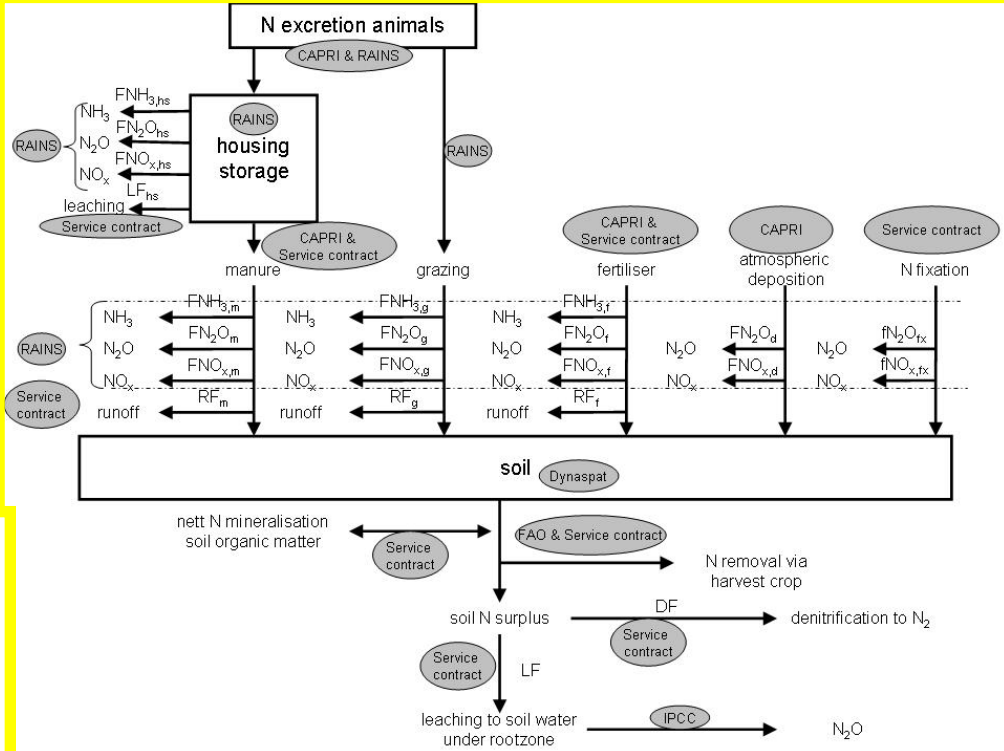


Integrated assessment tool MITERRA-EUROPE

Based on:

- RAINS: gaseous emissions:
- CAPRI: activity data
- Databases: activity data
- New developments: leaching





Three scales:

- EU-27
- Member State
- Regional (NUTS-2 / NVZ

Nitrate leaching

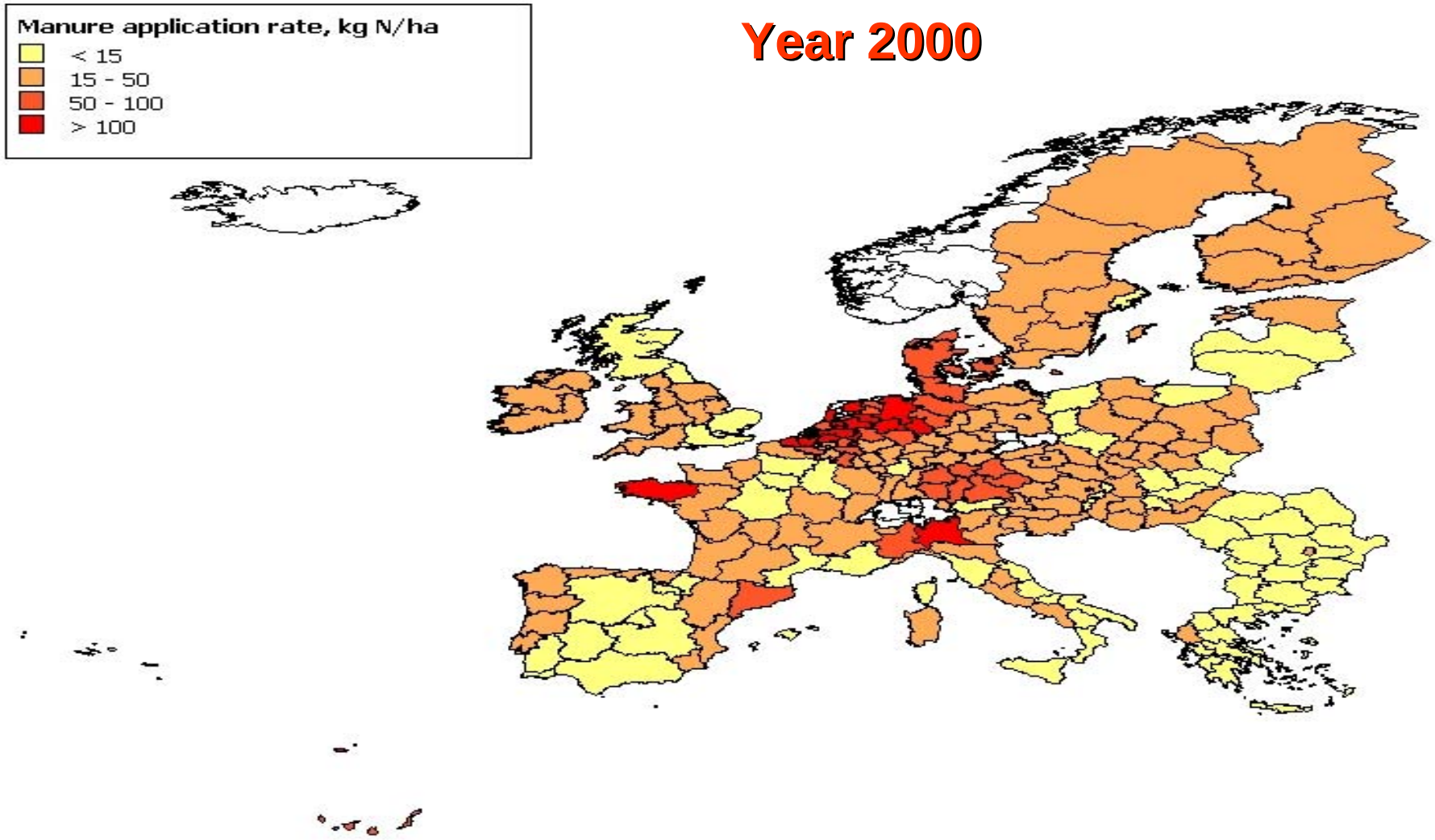
Calculation of leaching

- Stored manure, surface run-off, to groundwater
- Calculated using leaching fractions (dependent on soil properties), climate and crop

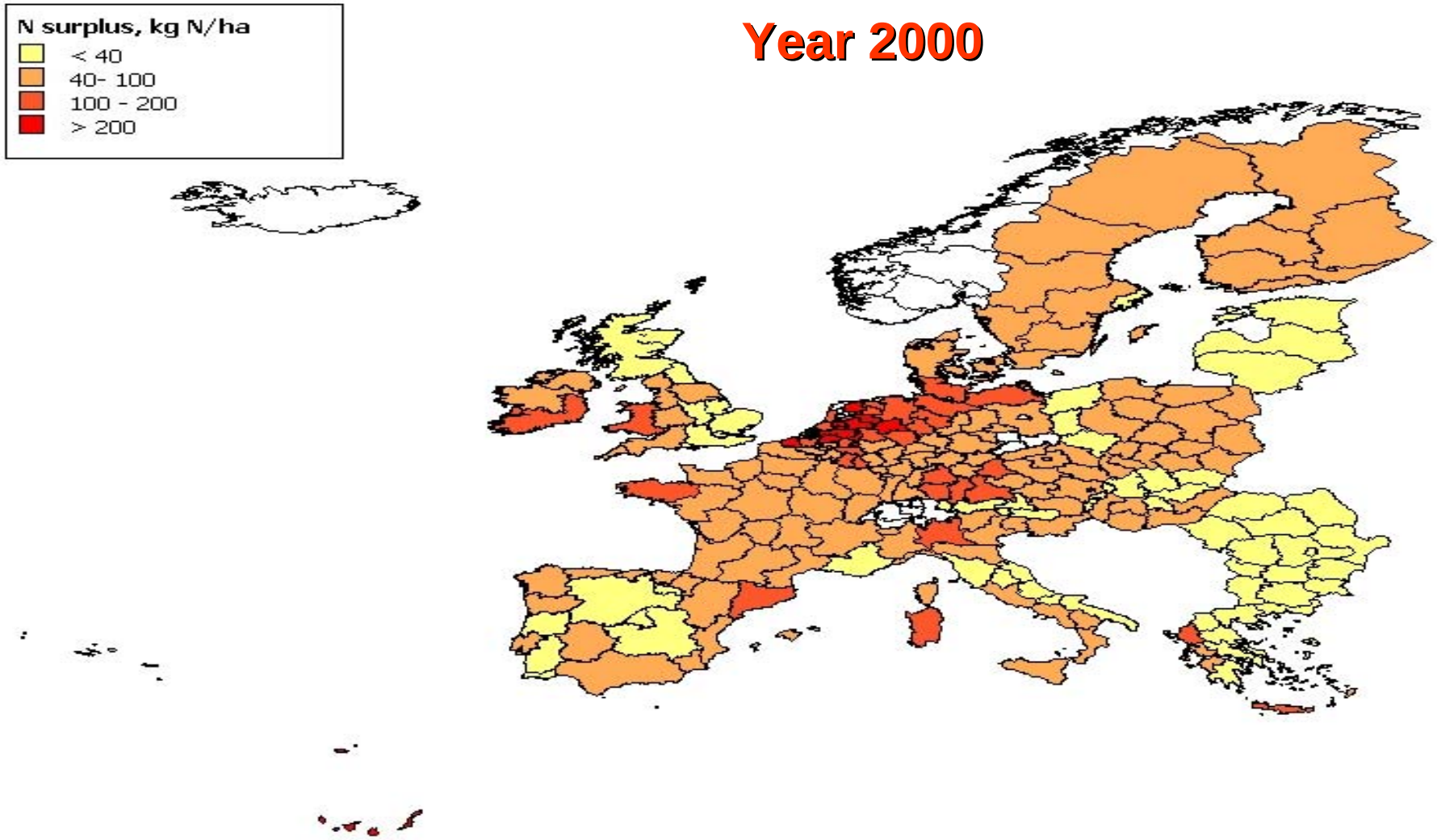
Implementation of Nitrates Directive

- Measures: uniform approach for all countries
- Implemented in NVZ (current en predicted for 2020)
- Implementation rate of measures in 2000, 2010, and 2020 estimated from action programmes and expert judgement

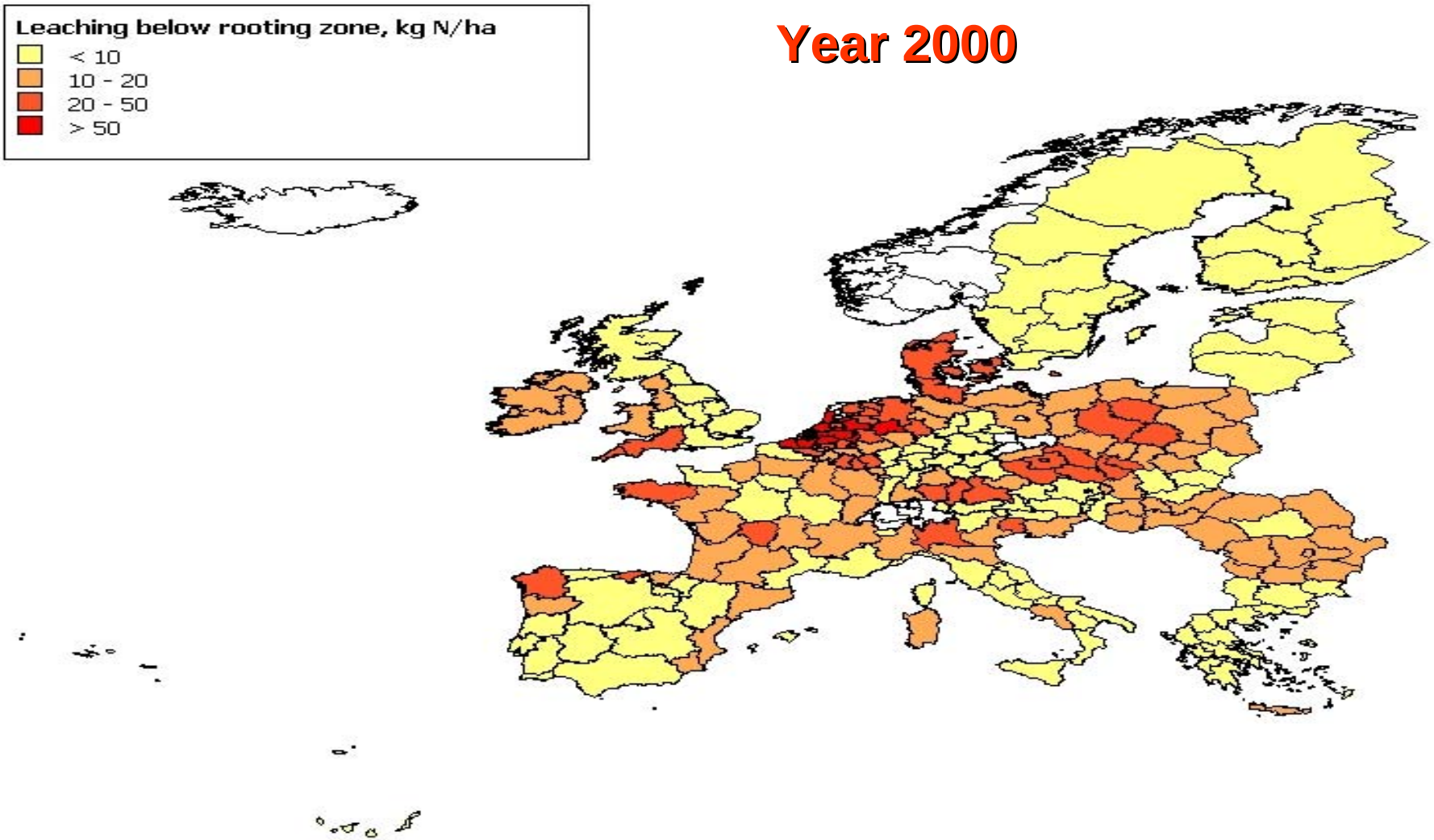
Regional distribution of manure N application rates



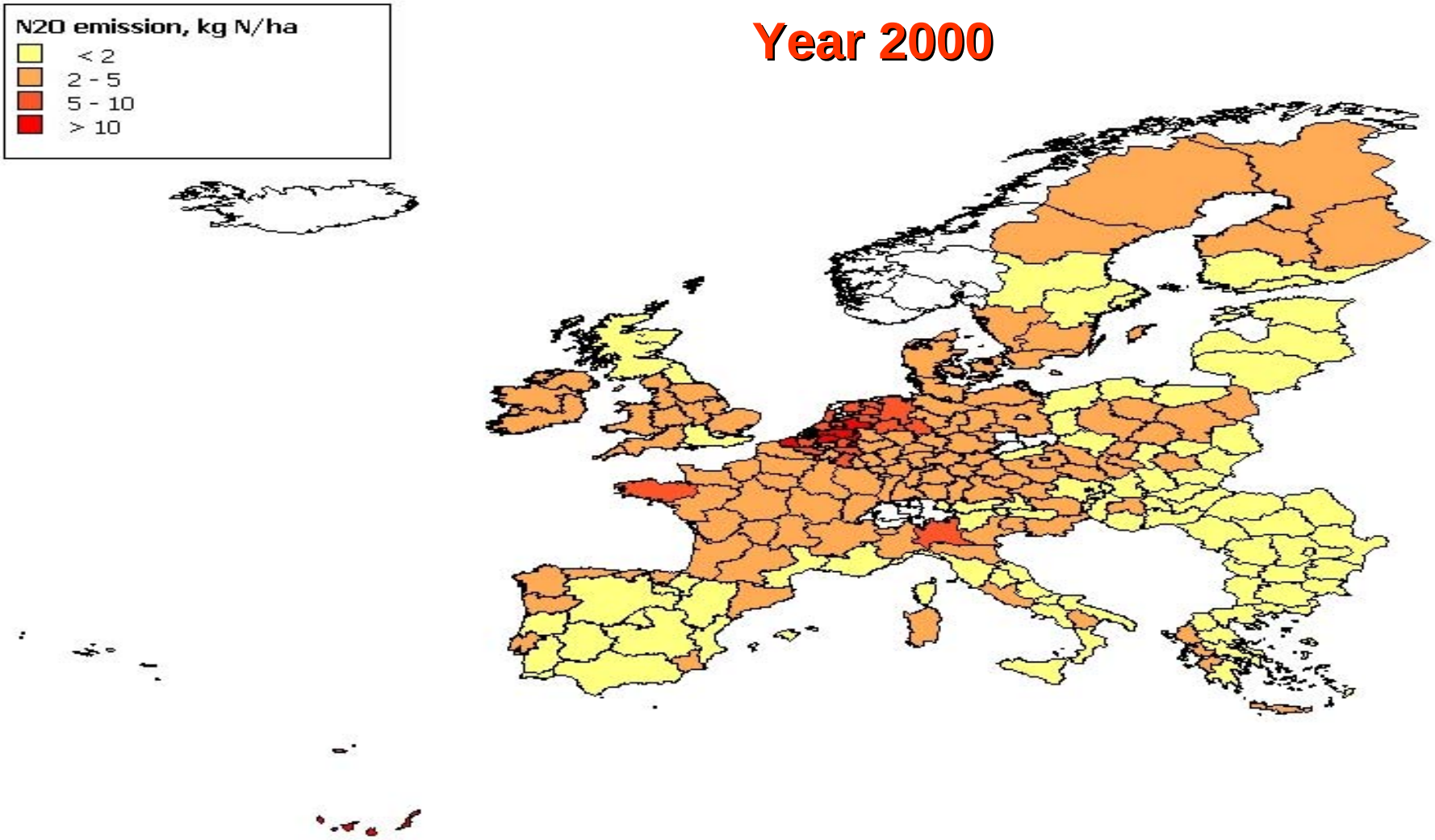
Regional distribution of N surpluses in 2000



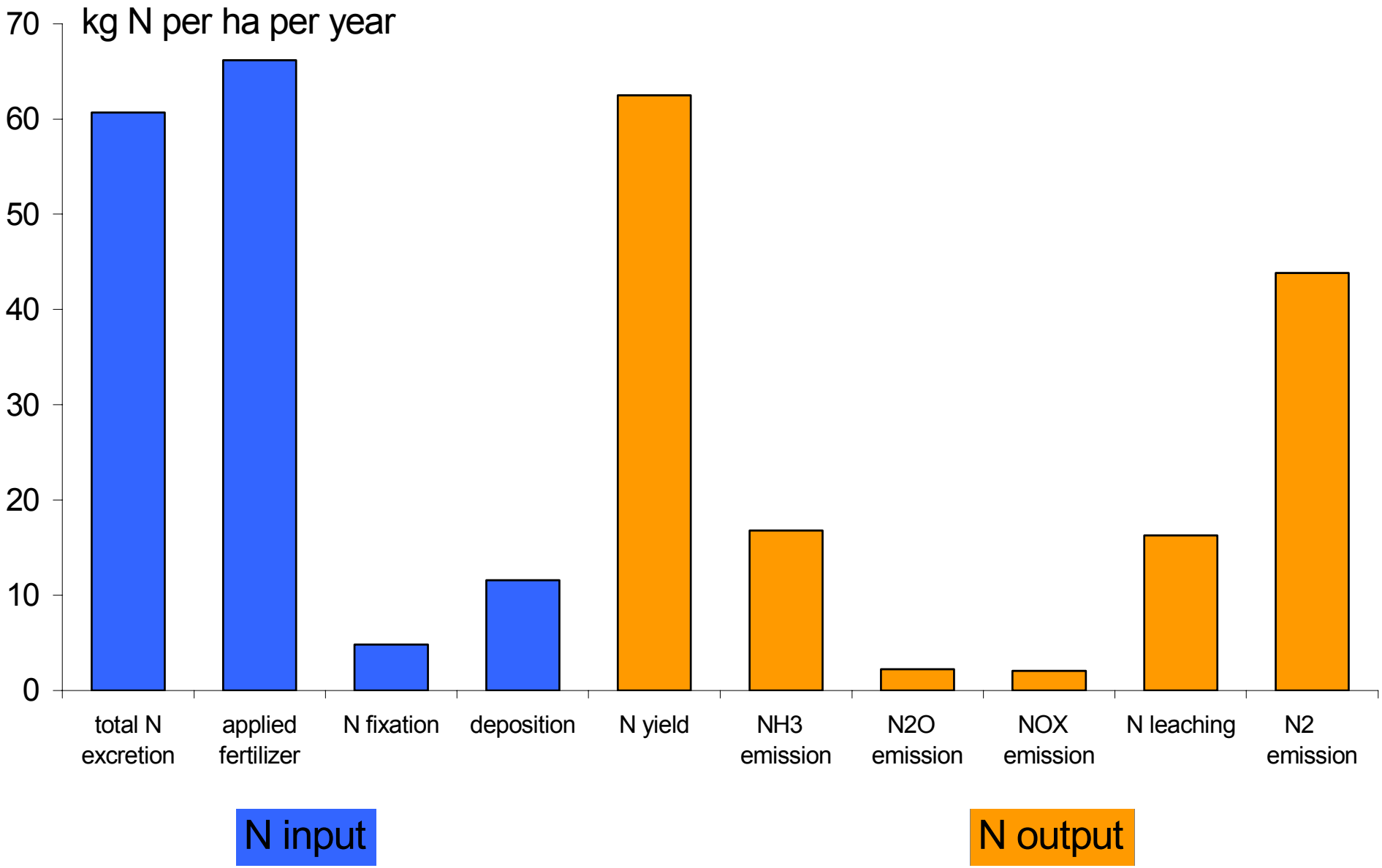
Regional distribution of N leaching in 2000



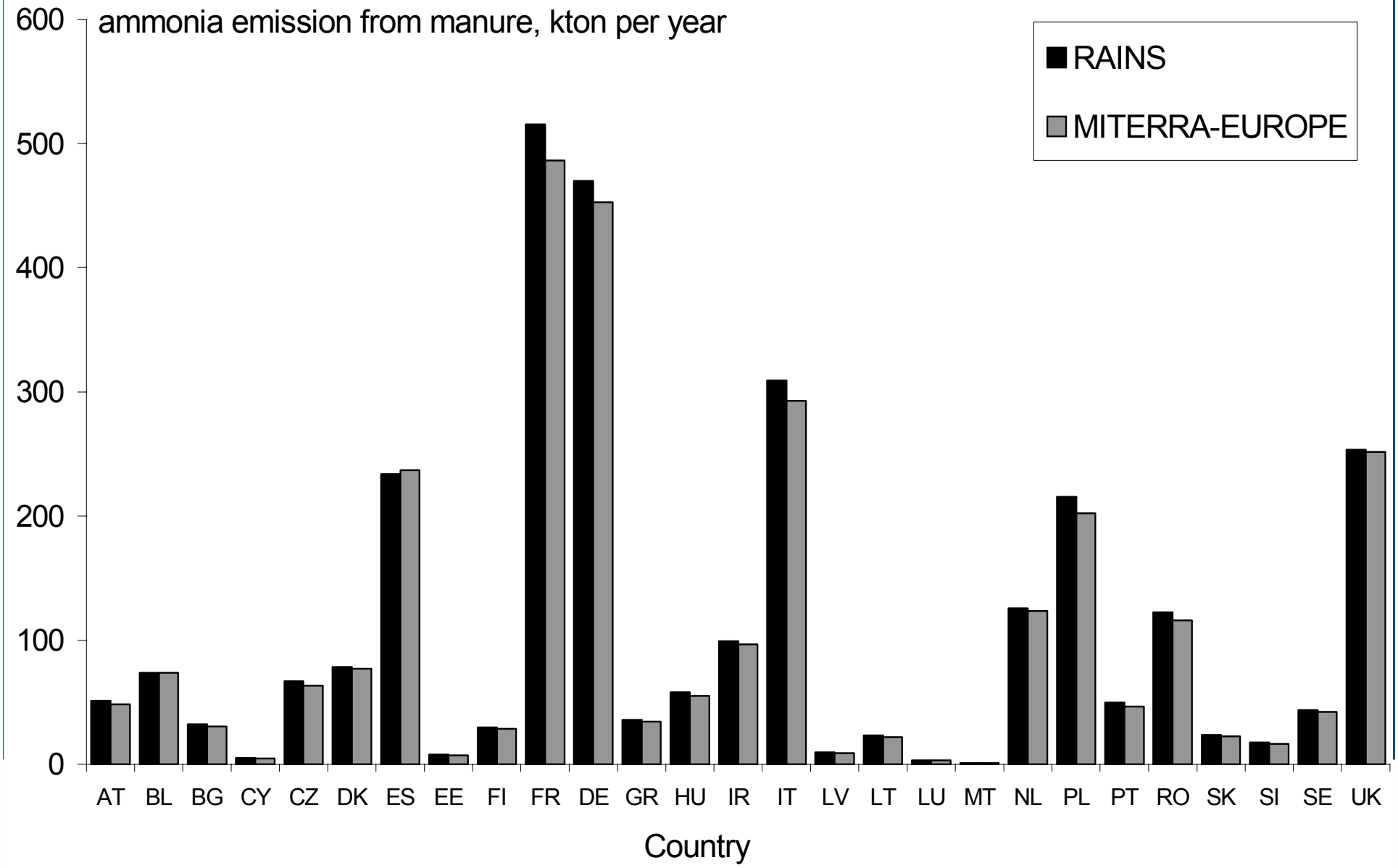
Regional distribution of N_2O emissions in 2000



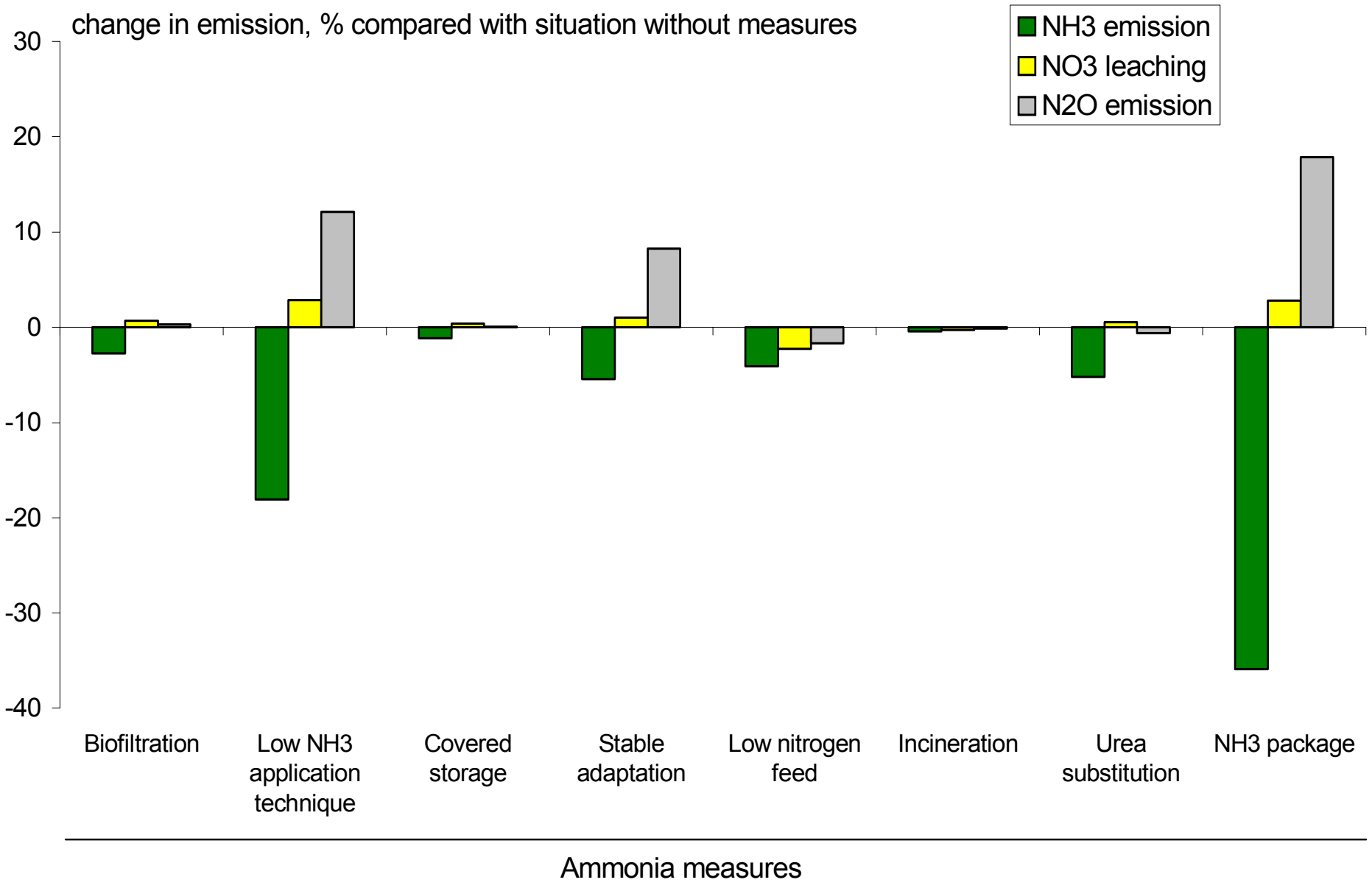
Mean N balance of agricultural land in EU-27 in 2000



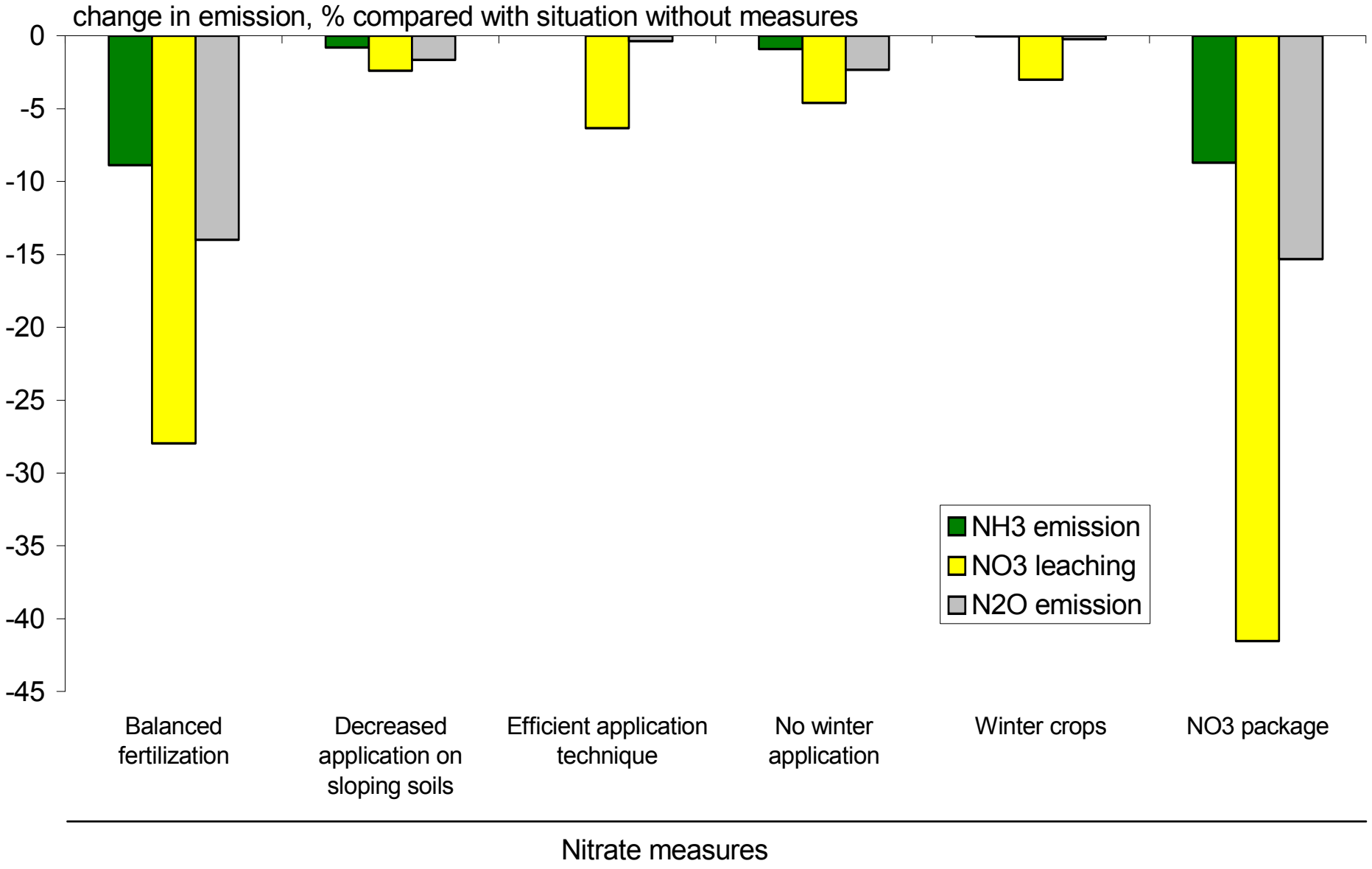
Total ammonia emissions in Member States



Effects of abatement measures for NH_3 emissions



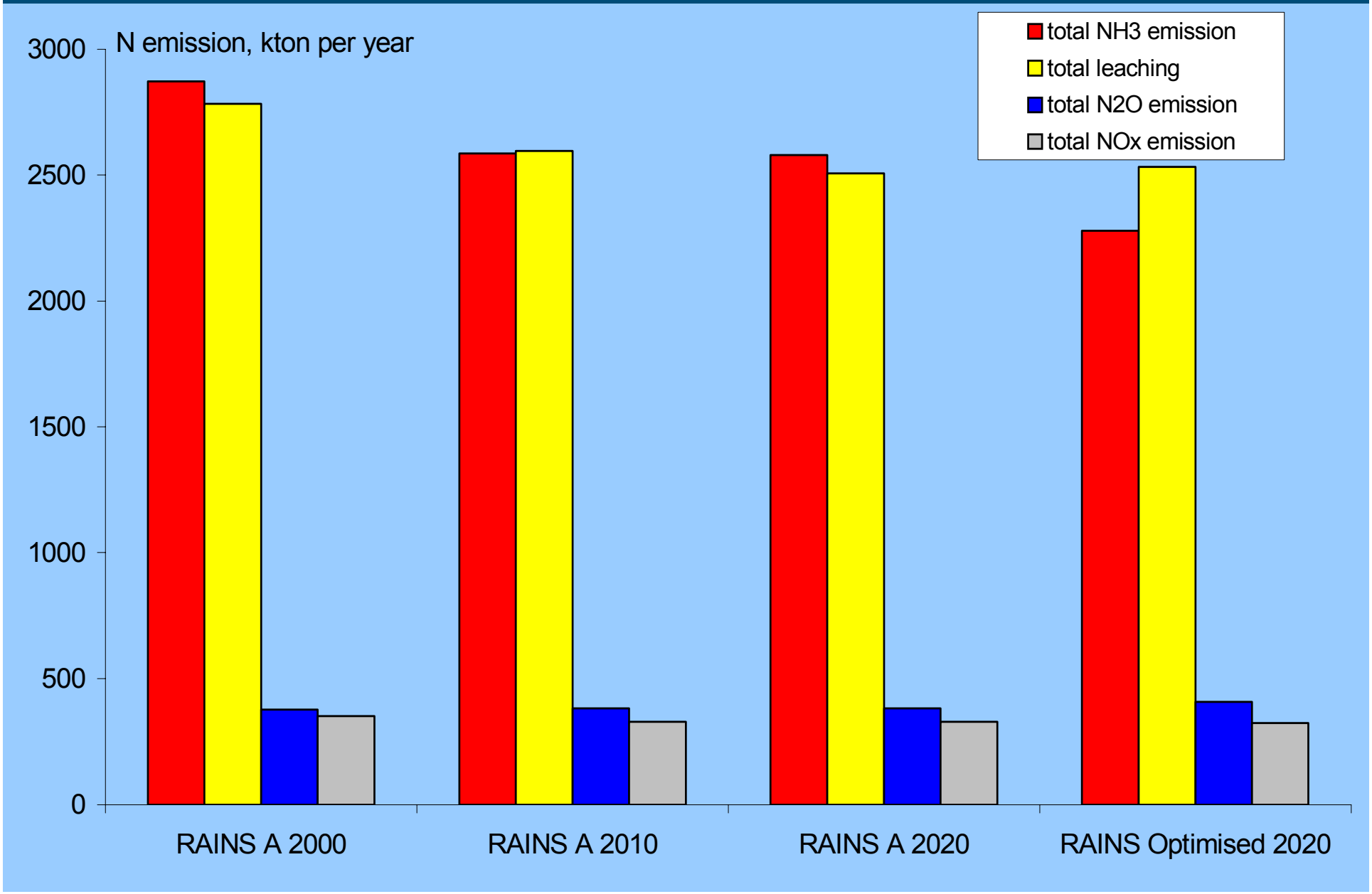
Effects of abatement measures for NO_3 leaching



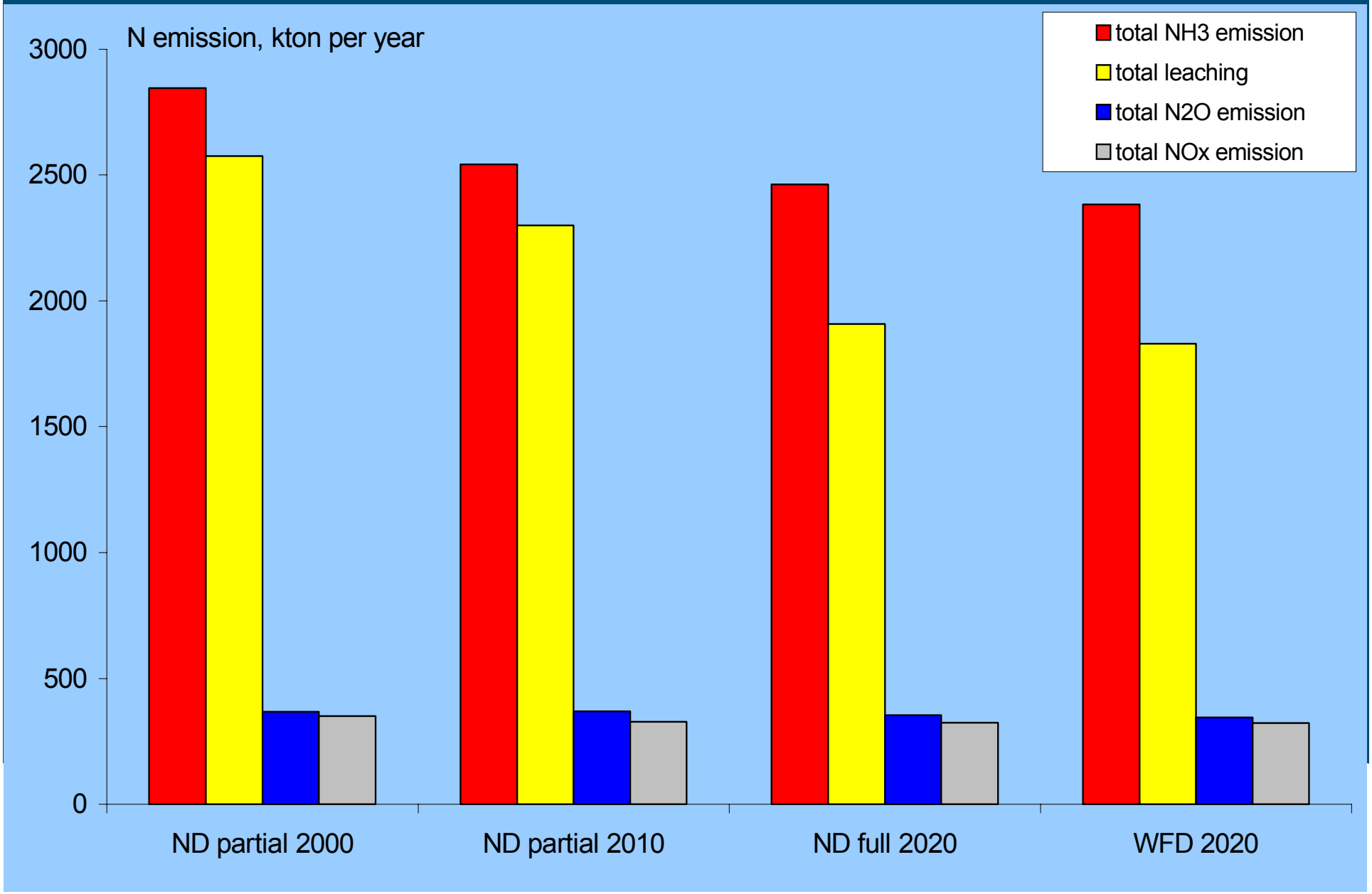
Scenario analyses

- National projections baseline (RAINS)
  - Optimized scenario to decrease NH3 emissions (TSAP-target)
- Nitrates Directive
  - Full implementation + optimized NVZ designations
  - Water Framework Directive (balanced P fertilization)
- Most promising measures scenarios:
  - Low-protein animal feeding
  - Balanced N fertilization
  - Optimal combination
- IPPC scenarios
  - Lower thresholds for pig and poultry farms
  - Including cattle farms
  - Including BAT on low-emission manure application

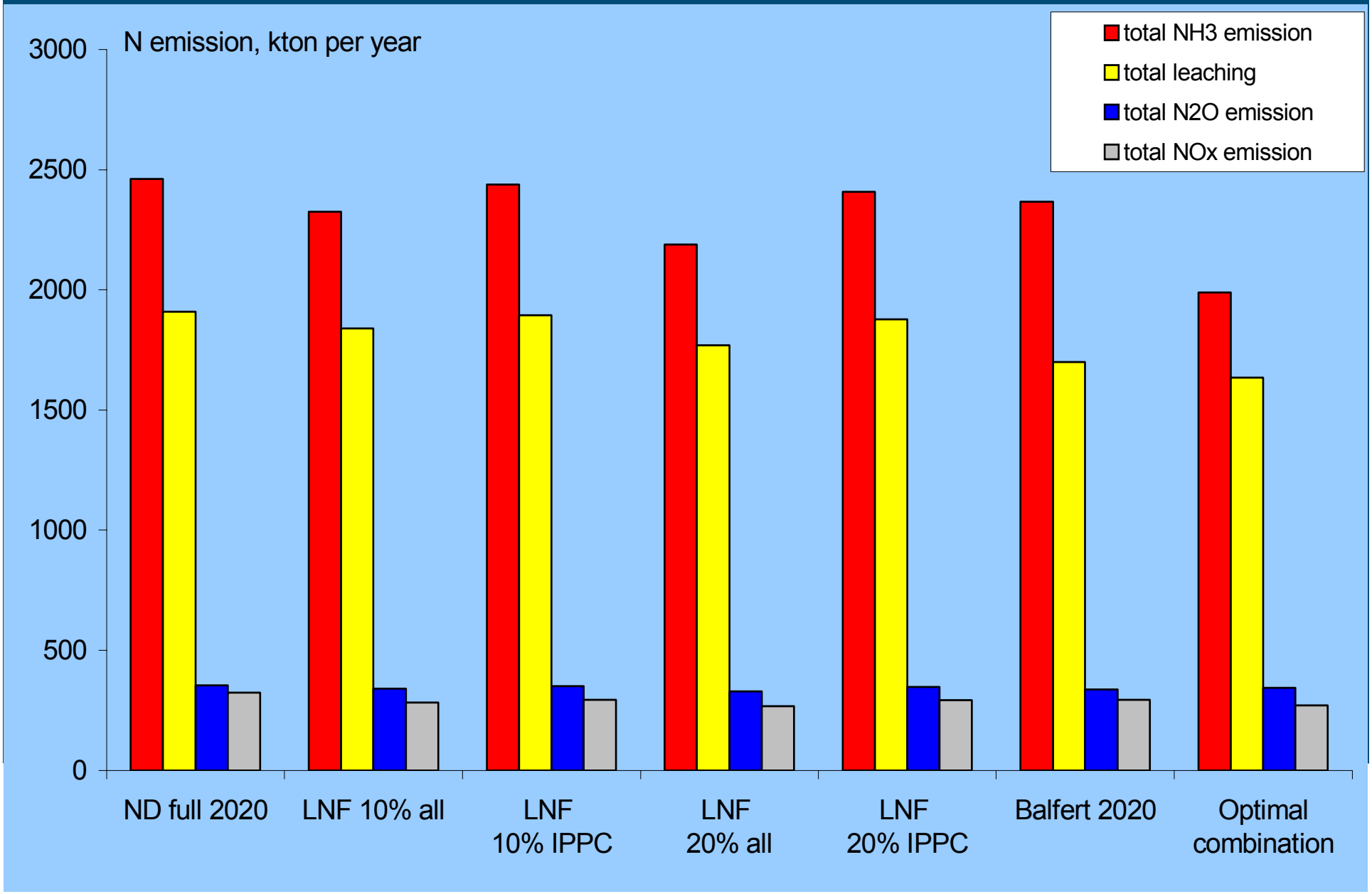
Total N losses in “National Projection Scenario”



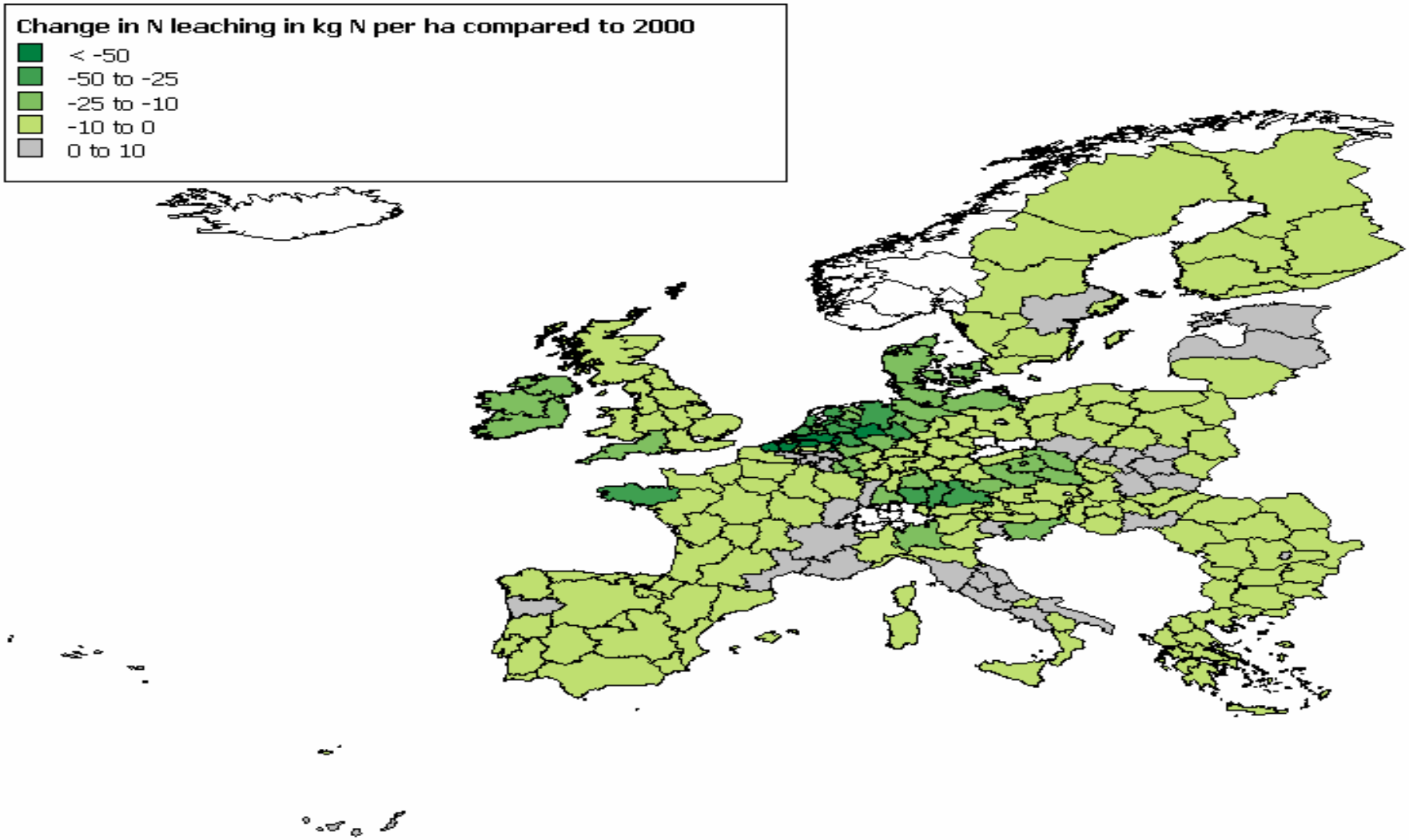
Total N losses in “Nitrate Directive scenarios”



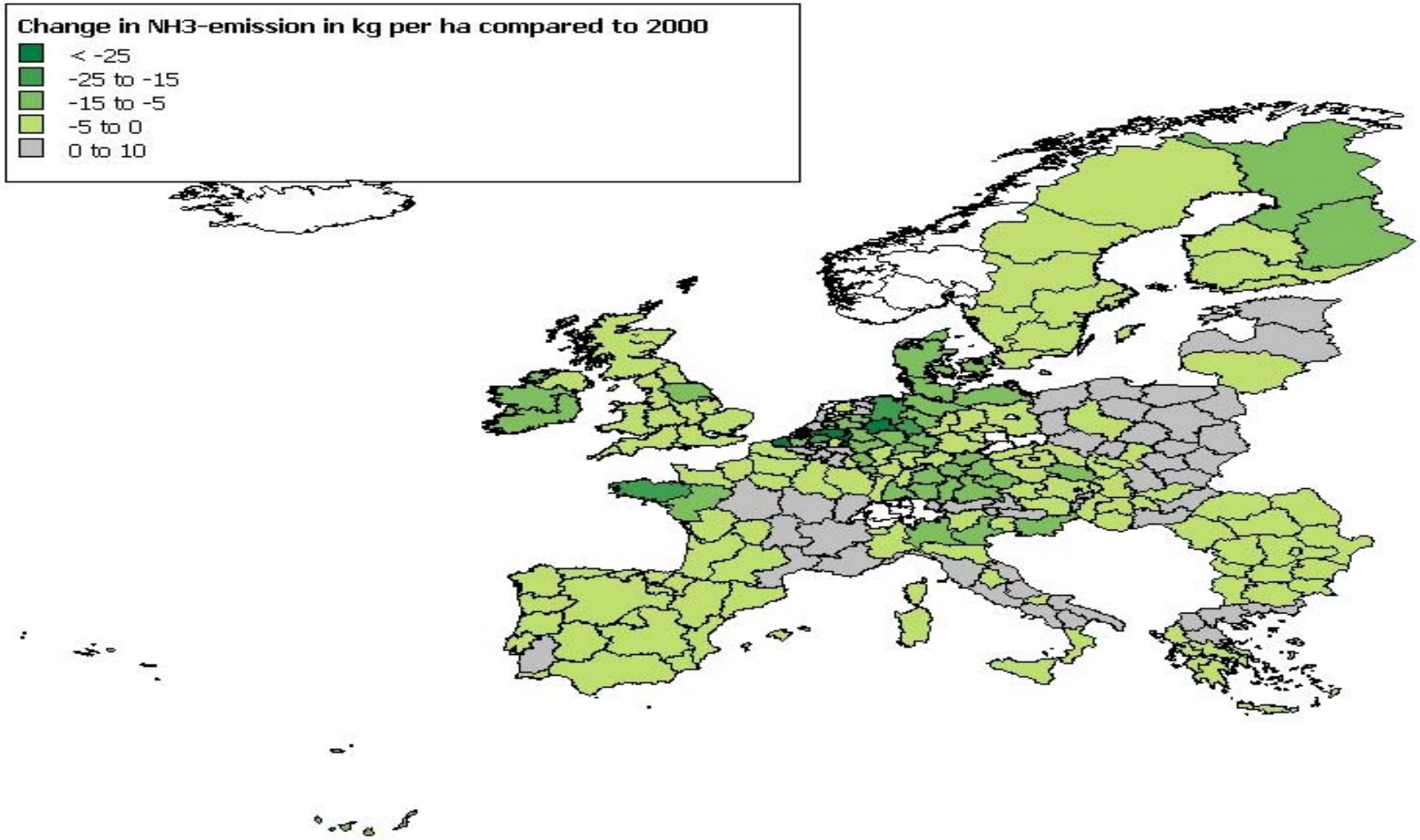
Total N losses in “Most promising measures scenarios”



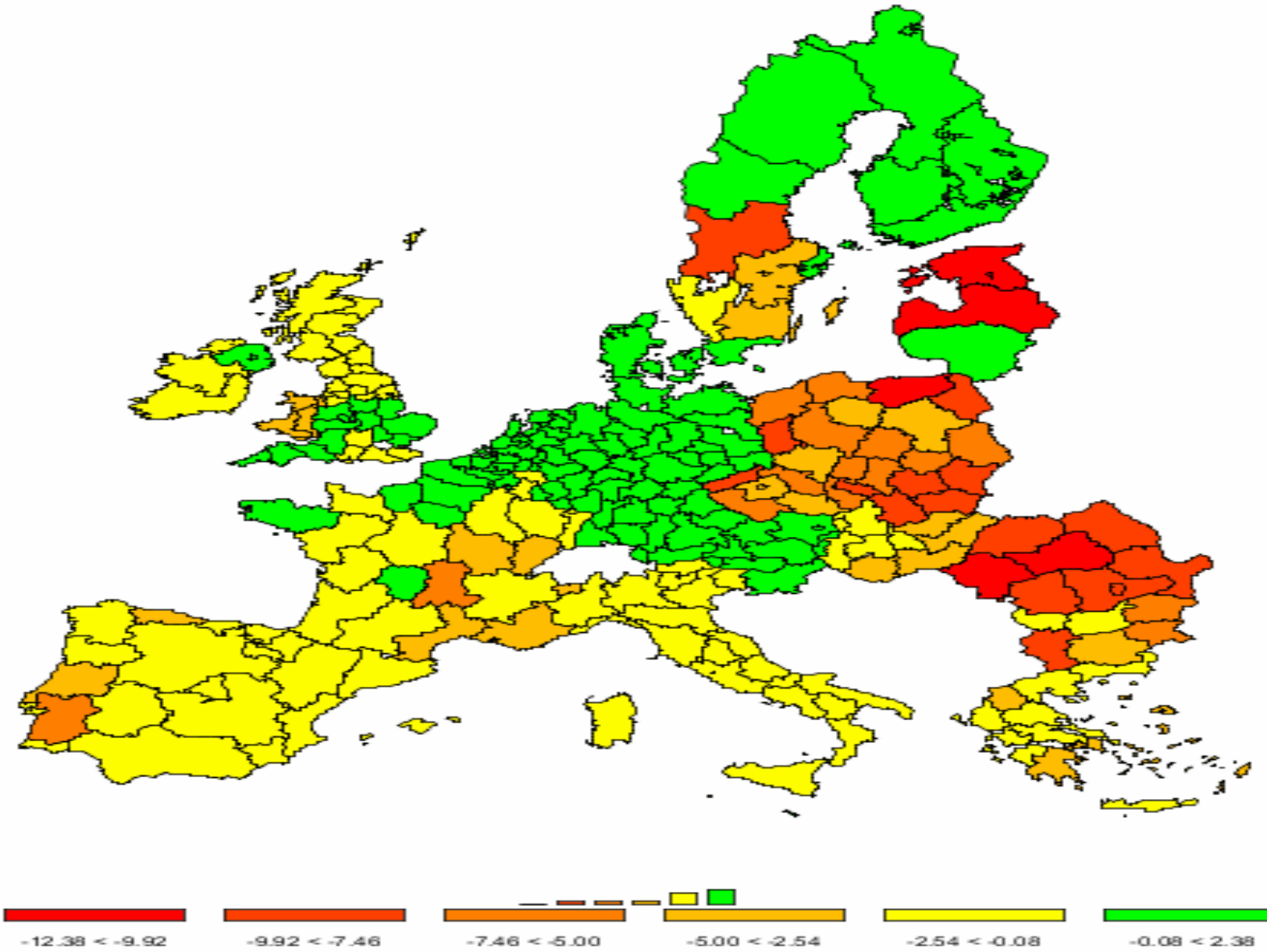
Effects of full implementation of ND on N leaching



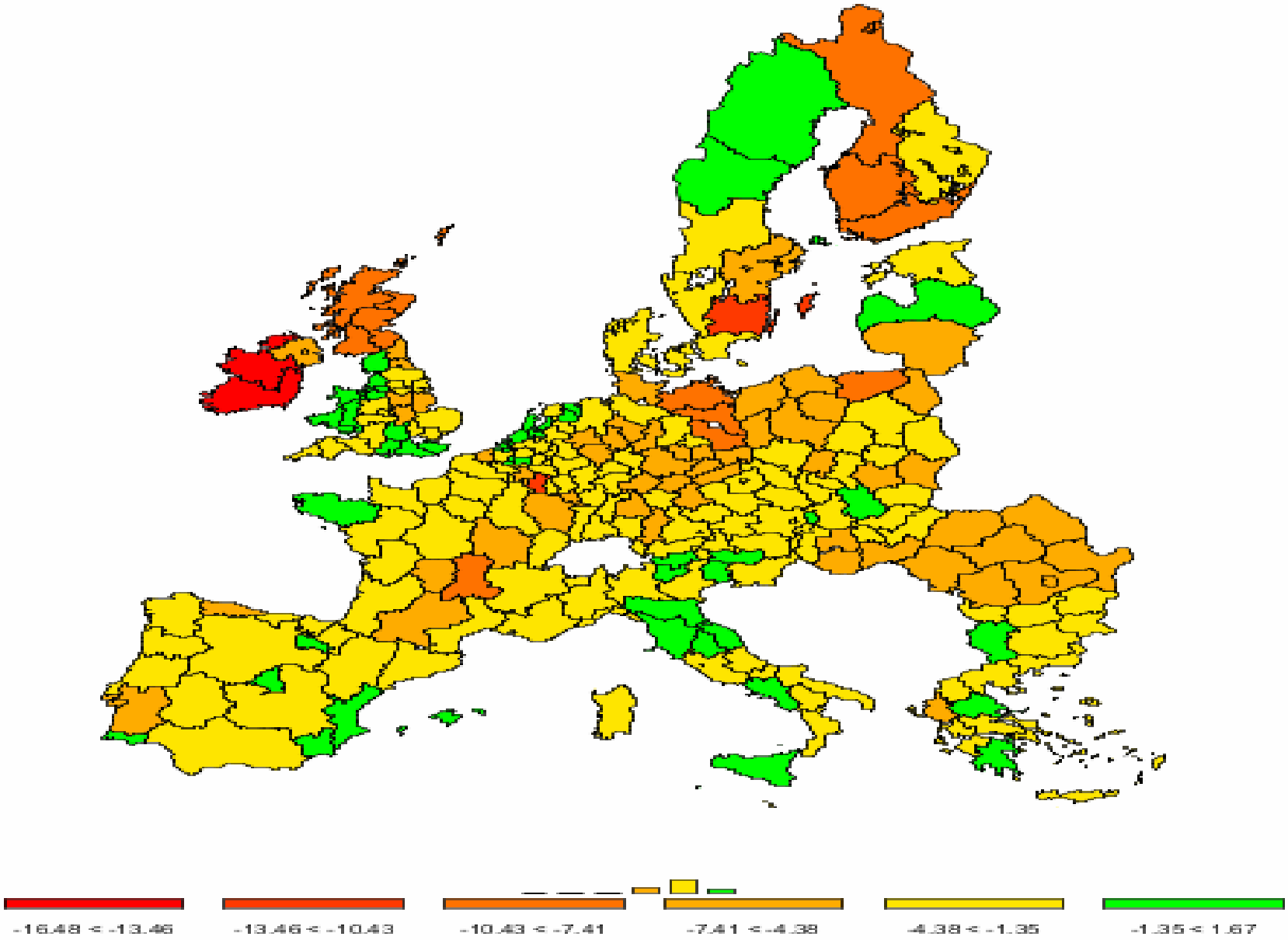
Effects of full implementation of ND on NH_3 emissions



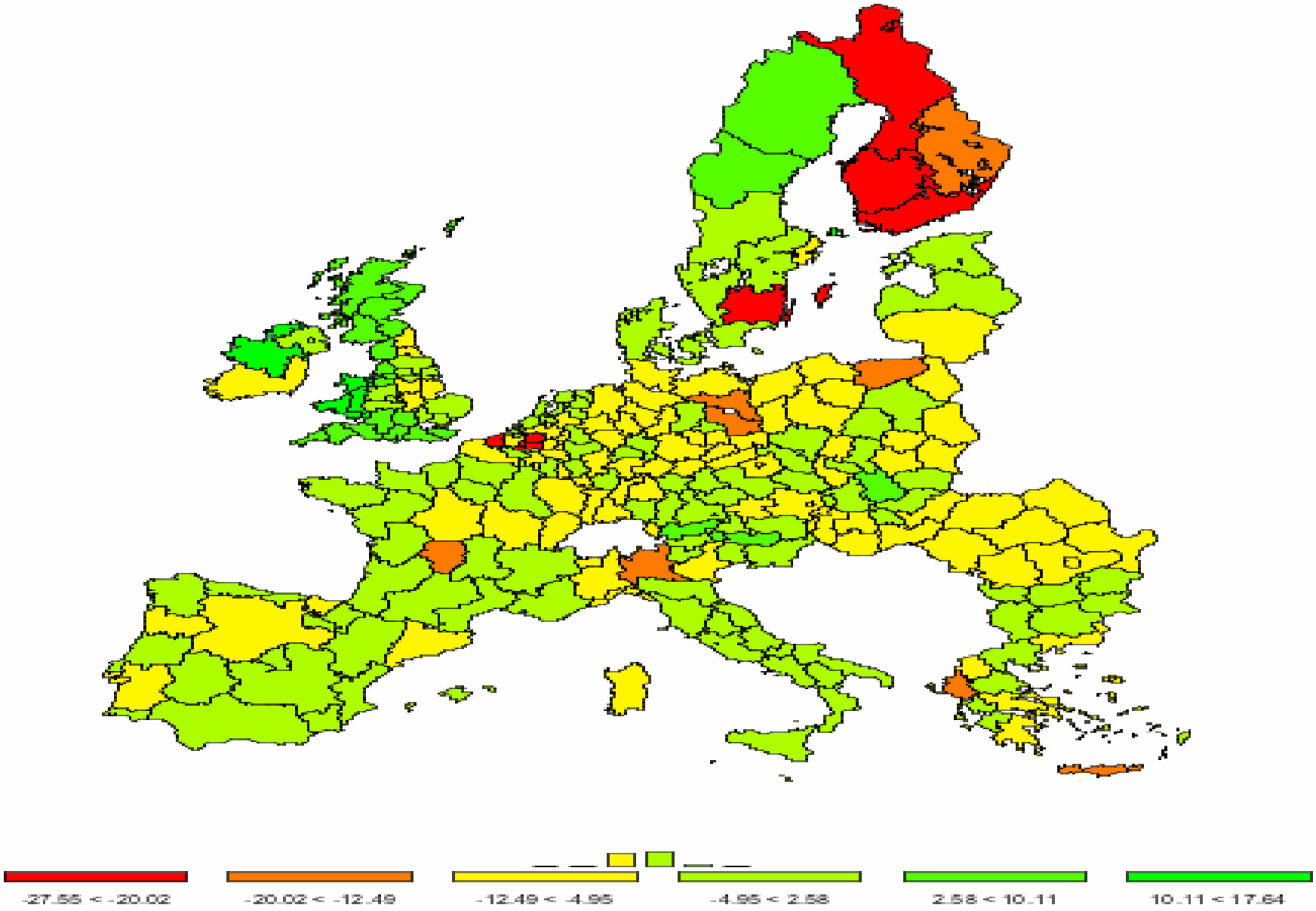
Income effects of ‘Balfert 2020’ relative to ‘ND full 2020’



Income effects of ‘LNF 10% 2020’ relative to ‘ND full 2020’



Income effects of ‘LNF 20% 2020’ relative to ‘ND full 2020’



Main Results / Conclusions (1)

- Final Summary Report + 4 underlying reports
- “Simple” integrated tool MITERRA – EUROPE, data viewer www.scammonia.wur.nl
- Similar results between RAINS/MITERRA/CAPRI

Main Results / Conclusions (2)

- Antagonistic effects of policies exist, but may be avoided;
- Synergistic effects of N input control measures are large;
- Costs of N input measures are significant, and/but are in part transferred to consumers

Main Results / Conclusions (3)

- IPPC, ND, WFD & CAP^{+} contribute to achieving objectives TSAP;
- Contribution of IPPC depends on: Interpretation > LNA > threshold
- Combining the measures of the Gothenborg protocol with ND measures may be attractive

Main Results / Conclusions (4)

- Balanced N fertilization, low-protein animal feeding and NH_3 emissions abatement measures are key to an integrated control of N emissions from European agriculture

- Large spatial variation in the effectiveness of measures in EU-27, both between and within Member States;

Main Uncertainties

- Future outlook (milk quota, farm structure, new MSs, etc.)
- Interpretation of measures of the Nitrates Directive and of the Gothenborg Protocol in practice in EU-27;
- Changing surface areas and cropping systems over time;
- Crops yields and N contents have been assumed homogeneous within Member States;
- Application of the concept of balanced fertilization and a uniform N uptake efficiency factor throughout EU-27;
- Costs of balfert and LNF based on assumptions

Main recommendations

- Further validation needed of MITERRA-EUROPE as regards (regional) variations in N losses;
- Uniform survey of animal feeding practices and methodologies for N excretion by animals throughout EU-27
- Mechanistic relationship between (low-protein) feeding and NH_3 emissions;
- Uniform survey of fertilization practices and N balance calculations throughout EU-27;
- Uniform survey of interpretation of IPPC throughout EU-27;

Questions?

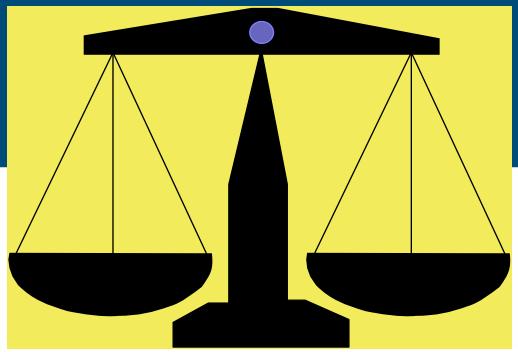
Balanced N fertilization

Uniform implementation of the balanced N fertilization concept at NUTS-2 level:

Balanced N fertilization:

Σ (input of available N from all sources) = Efficiency factor * Σ (N output via harvested crop + crop residues).

Efficiency factor = 1.25



N demand of a crop in MITERRA-EUROPE

- N yield
  - Yields of FAO and N contents estimated using literature
- N in crop residues
  - N index (yield/residue) from literature
- Efficiency factor (N uptake efficiency of roots)
  - 25% for grassland
  - 25% for cereals
  - 25% for other crops
- Overfertilization factor
  - For balanced fertilization: 0%

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Supply of plant-available N

- Plant-available N: NH_4 and NO_3 present in the soil in the N uptake period of crops (or released in this period)

- Sources
  - Fertilizers
  - Manures
  - N excreted during grazing
  - Biological N fixation
  - Atmospheric deposition
  - Soil N mineralization

Sources of plant-available N

- Fertilizers
  - RAINS and MITERRA-EUROPE
- Manures and N excreted during grazing
  - Number of animals, N excretion, losses from storage, grazing system
- Biological N fixation
  - Crop area and N fixation per ha
- Atmospheric deposition
  - CAPRI and RAINS
- Soil N mineralization
  - Equal to organic N input via crop residues and manure

Availability of N for crops: fertilizer equivalency

- Fertilizers and manures
  - correction for NH_3 losses and surface runoff
- N excreted during grazing
  - correction for NH_3 losses, surface runoff
  - 80%
- Biological N fixation
  - 100%
- Atmospheric deposition
  - 75%
- Soil N mineralization
  - 90% for grassland and 70% for arable land

Balanced N fertilization in MITERRA-EUROPE

- Calculation on regional scale (NUTS II regions)

- If supply of available N must be reduced, than:

  - i) fertilizer application is reduced:
    - Up to 0% on grassland
    - Up to 50% on arable land

  - ii) if N supply is still too high
    - Manure N is removed (“treated”)

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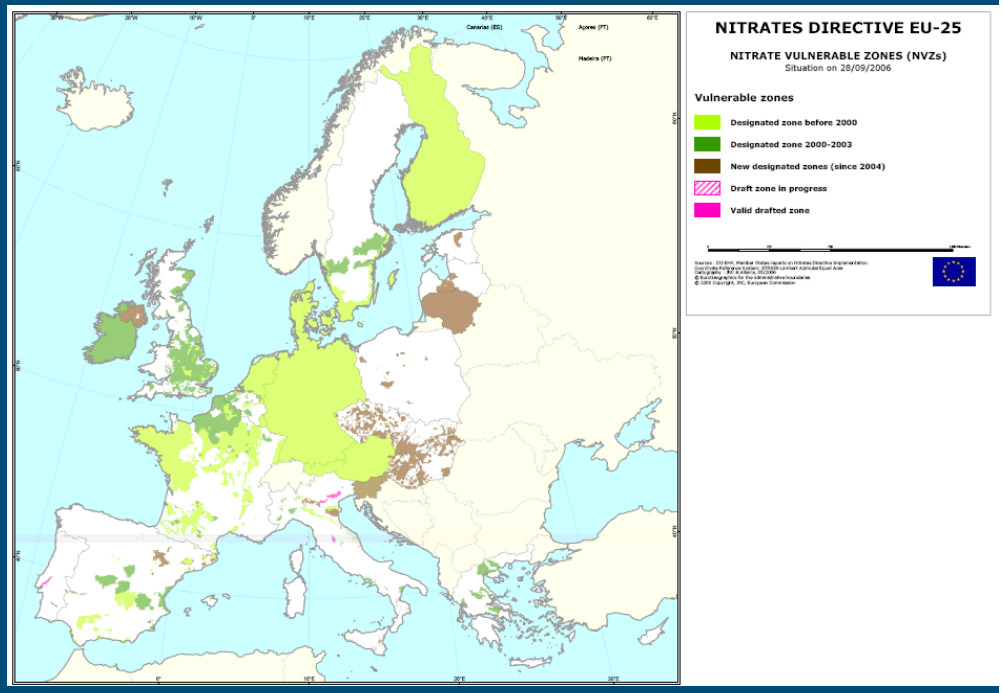
Calculations with MITERRA

- RAINS 2000: EFMA
- RAINS 2020: EFMA and CAPRI
- Full implementation Nitrates Directive in 2020 (in Nitrate Vulnerable Zones); based on RAINS 2020
- 100% implementation of balanced N fertilization in EU-27; based on RAINS 2020



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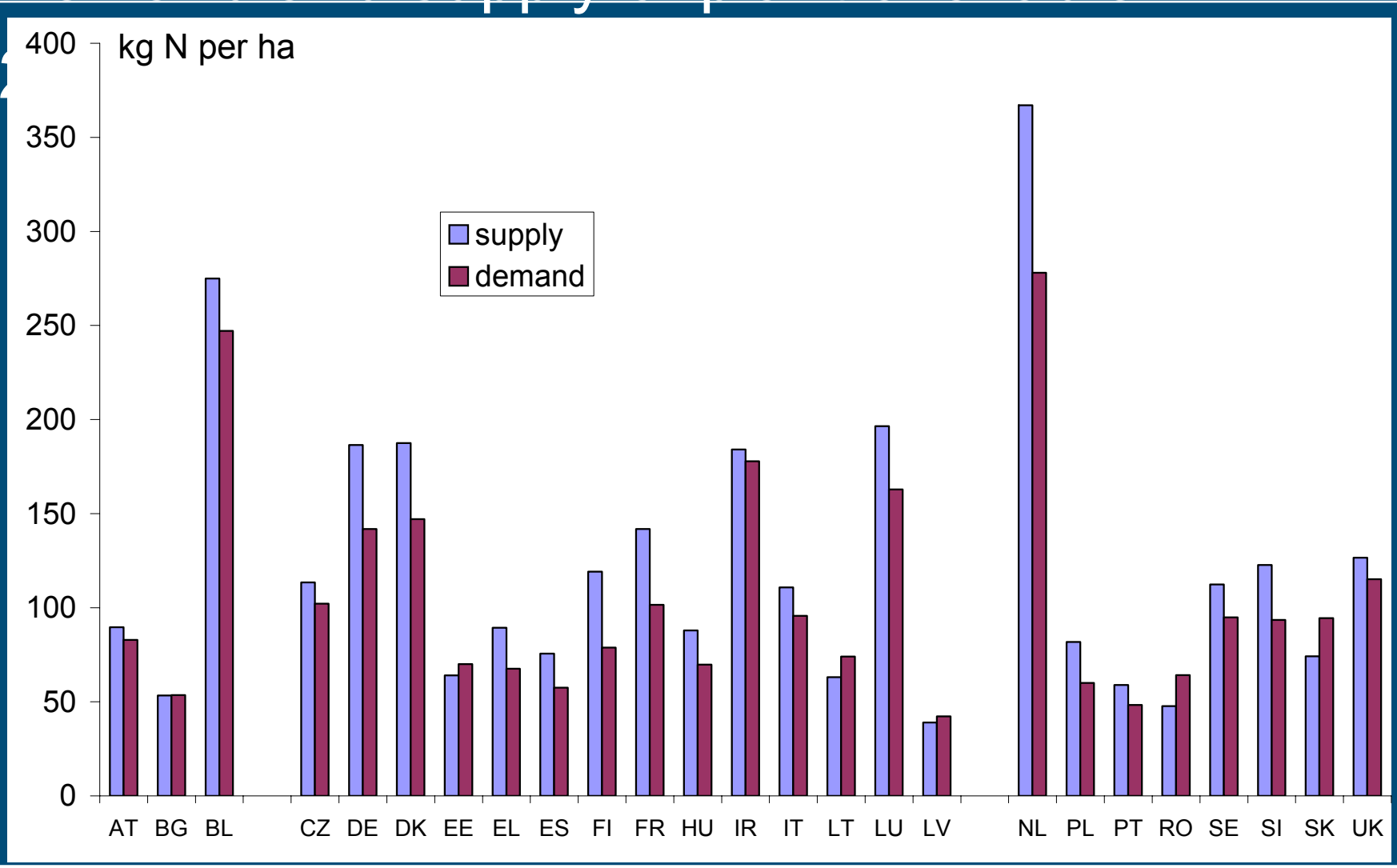
Demand and supply of plant-available in



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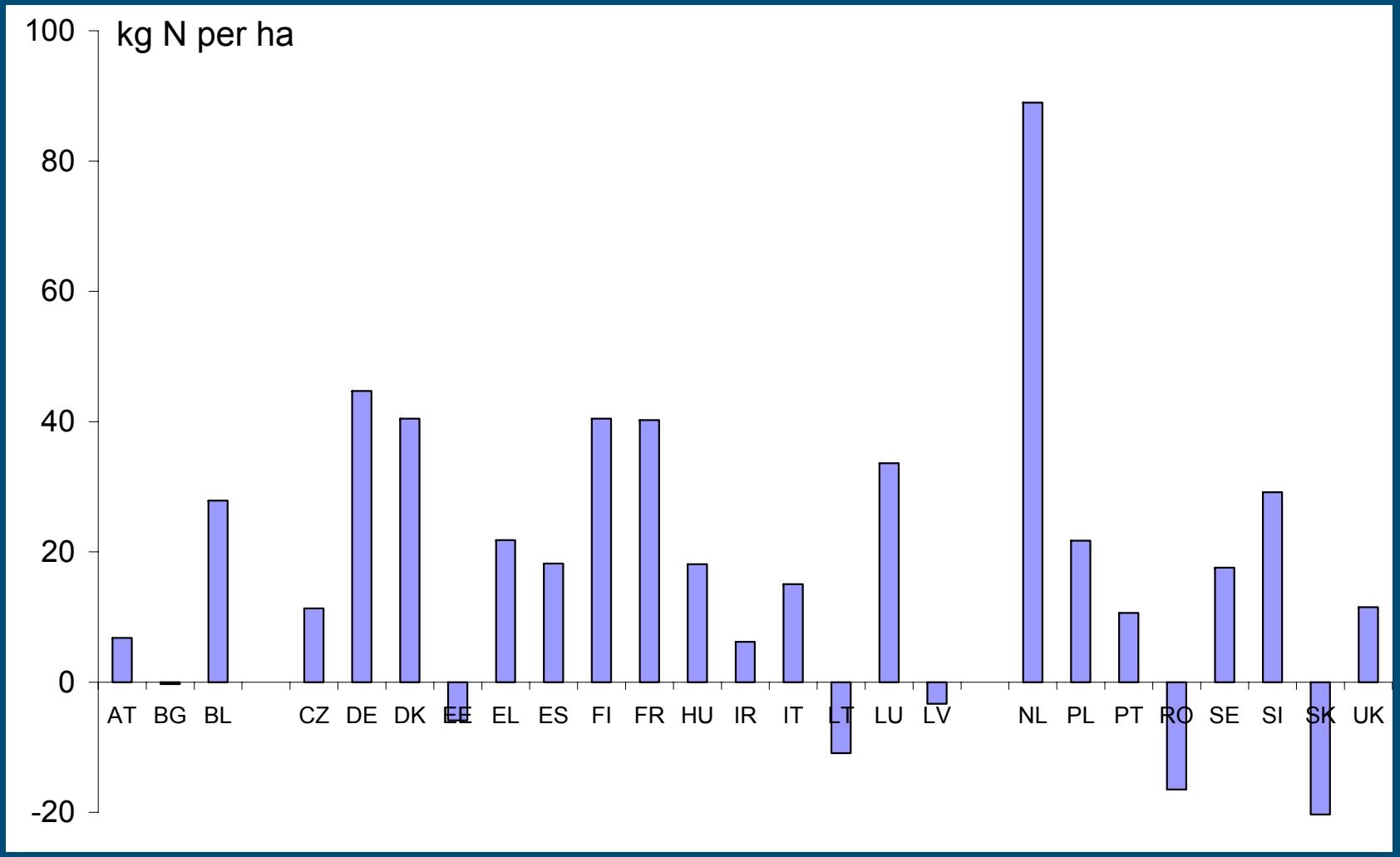
Year 2000: difference between supply and demand



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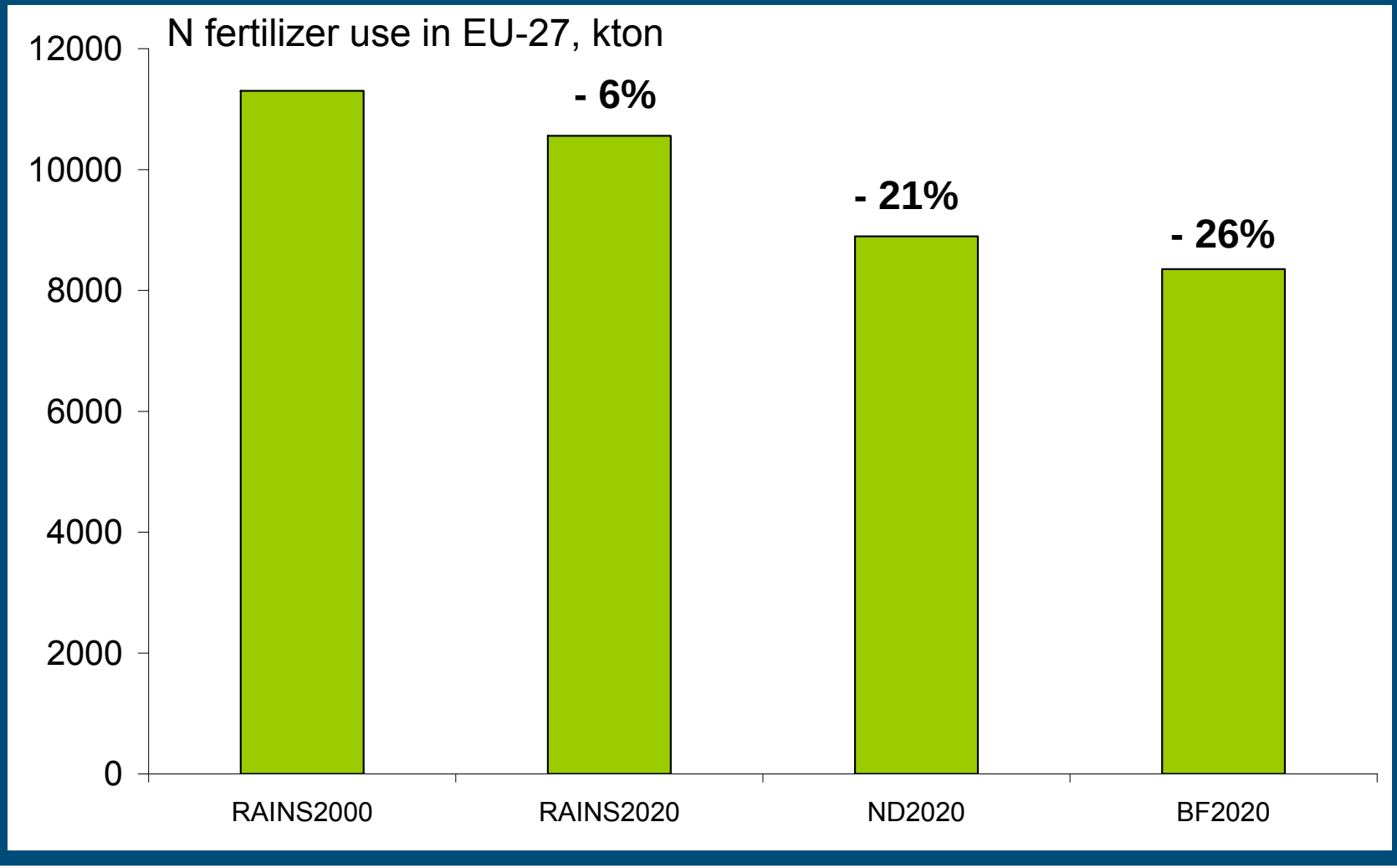
Prediction of fertilizer use in EU-27 at different scenarios



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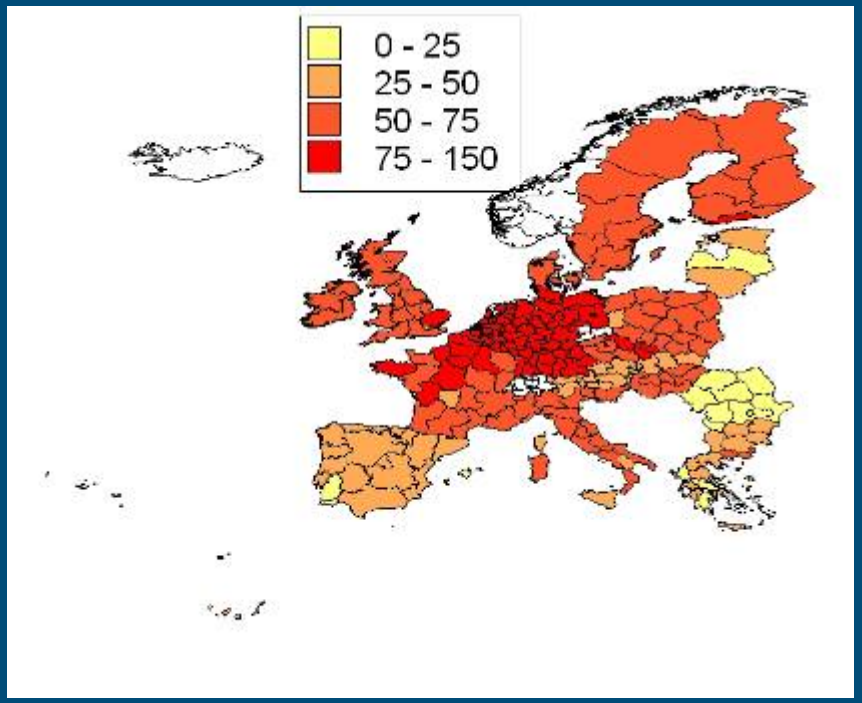
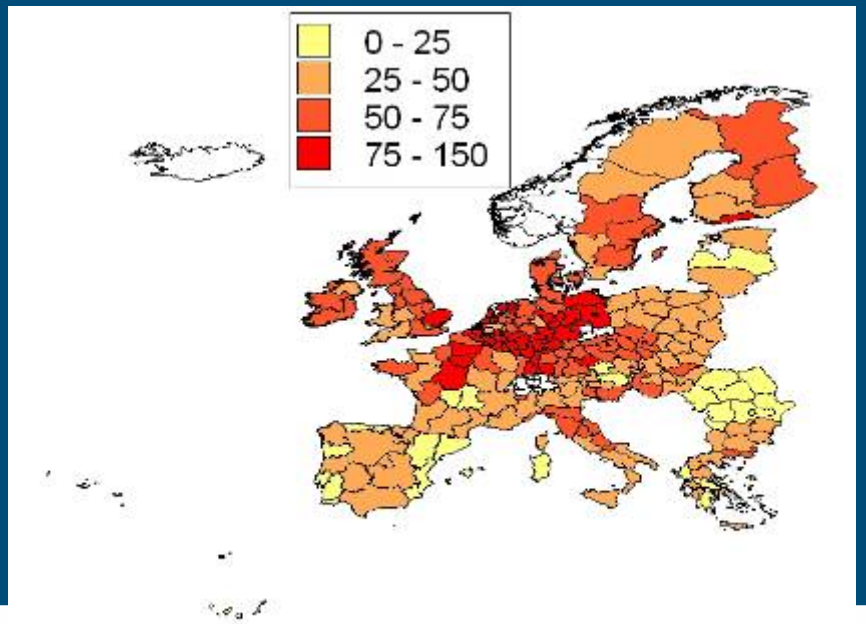
N fertilizer use in kg N per ha



2000

2020; balanced N fertilization



Conclusions

- MITERRA-EUROPE useful for predicting mineral N fertilizer use:
  - Crop, regional level, national level,and EU-27
  - Effects of different policies and measures
  - Effects of different estimates of yields, efficiency, and overfertilization, etc.
  - MITERRA-EUROPE also P
- Full implementation of Nitrates Directive result in significant decrease in fertilizer use.

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