



PBL Netherlands Environmental
Assessment Agency

Putting an economic value on nitrogen pollution in Europe

can we improve the unit N cost
method using results of the
Eurobarometer

Hans van Grinsven



Application of N cost – benefit assessments

- CBA is a “trick” to weigh and add up various Nr emissions causing a variety of impacts
- For policy support

Supporting information to

1. Communicate relevance of N pollution – price tag
2. Find optimum level of mitigation (deal with pollution swapping)
3. Find optimum level of N-fertilization
4. Find optimum spatial configuration of N polluting activities
5. Put a price tag on diets



CBA is one of various approaches to value emissions of Nr

- Tier 1: Metrics for impacts of nitrogen pollution on health and environment
 - Incidence of respiratory illness, cancers; frequency and extent of harmful algal blooms, loss of species; forest health etc.
 - Tier 1A: Metrics for exceedance of critical loads or critical losses
 - › Based on critical levels / standards for air and water quality (MPR, NOEC)
 - Tier 1B: Metrics expressing achievement of internationally or nationally agreed policy objectives (Distance to target)
 - › To show effect of policies or interventions; less ambitious than critical loads
- Tier 2: Aggregated metrics in units meaningful for society, general public
 - Loss of (healthy) Life expectancy, loss of biodiversity of ecosystems, reduced ecosystem functioning, services.
- Tier 3: Aggregated impacts expressed as loss or gain of prosperity or welfare;
 - in economic term units, based on various monetarization methods



Tier 3: The economic value of N damage in EU by ENA

Monetarization mainly based on willingness to pay (WTP)

- Health impacts
 - WTP (stated) to reduce risk of premature death (additional life year)
 - WTP (stated) to reduce pain and suffering (additional healthy life year)
 - Costs for real economy: medical treatment, loss of labor productivity
- Ecosystems impacts
 - WTP (stated) to restore ecosystems
- Climate impacts
 - WTP (revealed in CO₂ price) to reduce greenhouse gas emissions



Marginal damage costs between 1995 and 2005 of different N_r - emissions in EU based on WTP

Effect	Emitted nitrogen form	Emission/ loss to	Estimated cost € per kg N_r emitted,
Human health (PM, NO_2 and O_3)	NO_x	Air	10 – 30
Ecosystems (eutrophication, biodiversity)	N_r runoff, deposition	Surface Water	5 – 20
Human health (particulate matter)	NH_3	Air	2 – 20
Climate (greenhouse gas balance)	N_2O	Air	4 – 17
Climate**	NO_x	Air	-9 - 2
Climate**	NH_3 ,	Air	-3 – 0
Ecosystems (eutrophication, biodiversity)	NH_3 and NO_x	Air	2 – 10
Human health (drinking water)	N_r (nitrate)	Groundwater	0 – 4
Human health (increased ultraviolet radiation from ozone depletion)	N_2O	Air	1 – 3
Crop damage (ozone)	NO_x	Air	1 – 2

* Cooling effects

Source Grinsven et al, ES&T 2013



Costs of N pollution EU27 in 2008

Total sources

N pollution cost:

75-485 billion euro/yr

150-1150 euro/capita

1-4% GDP loss

Large uncertainties

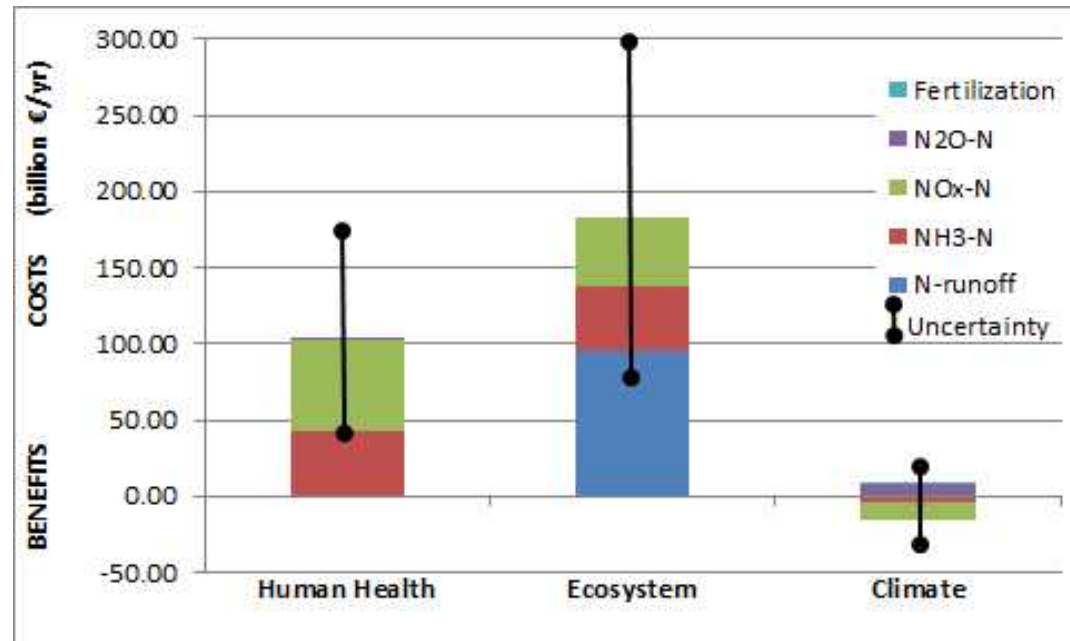
50 - 70% air pollution

35 - 55% human health

60 - 100% ecosystems

-50 - 20% climate change

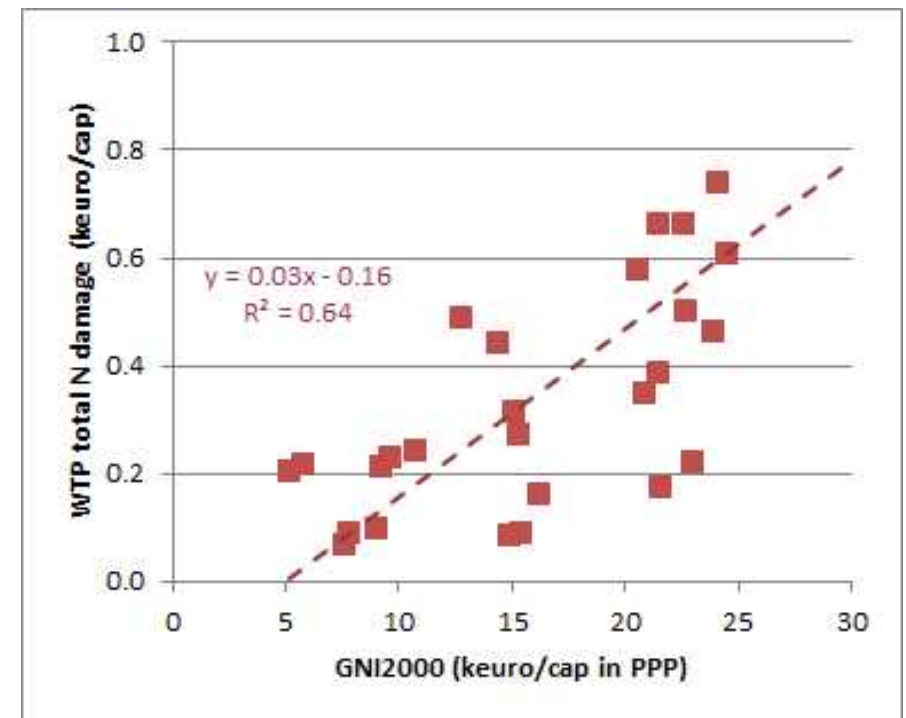
Climate benefits



(ENA 2011, Our Nutrient World, 2013)

Willingness to Pay is a controversial concept

- WTP depends on a.o.
 - Citizen awareness
 - Problem framing
 - Gross National Income (GNI)
- in Our Nutrient World (2013) GNI scaling was used for a first estimate of global cost of N damage
 - 150 to 1500 billion euro/year (200 to 2000 billion USD)



WTP results per EU27 member state



Question marks WTP approach for N costing as used ENA

- Uncertainties in unit costs:
 - Thresholds below which there are no impacts / cost
 - Shape of dose-response relationships
 - Relative contribution of N to impacts (e.g. eutrophication)
 - Regional variability, scale dependency (see eg. Keeler et al., 2016)
- Compatibility and representativeness of underlying impact – WTP studies
 - Health impacts air pollution based on DALY, VOLY (EU Commission)
 - Aquatic UC heavily rely on Baltic study (Soderqvist 2010; Ahtiainen et al 2014)
 - Climate cost based on CO₂ price
- Interdependence – interactions between WTPs for single impacts
 - In EU and US maximum WTP to prevent all environmental problems ≈1%?
- EU WTP data are sometimes outdated (1995-2005)

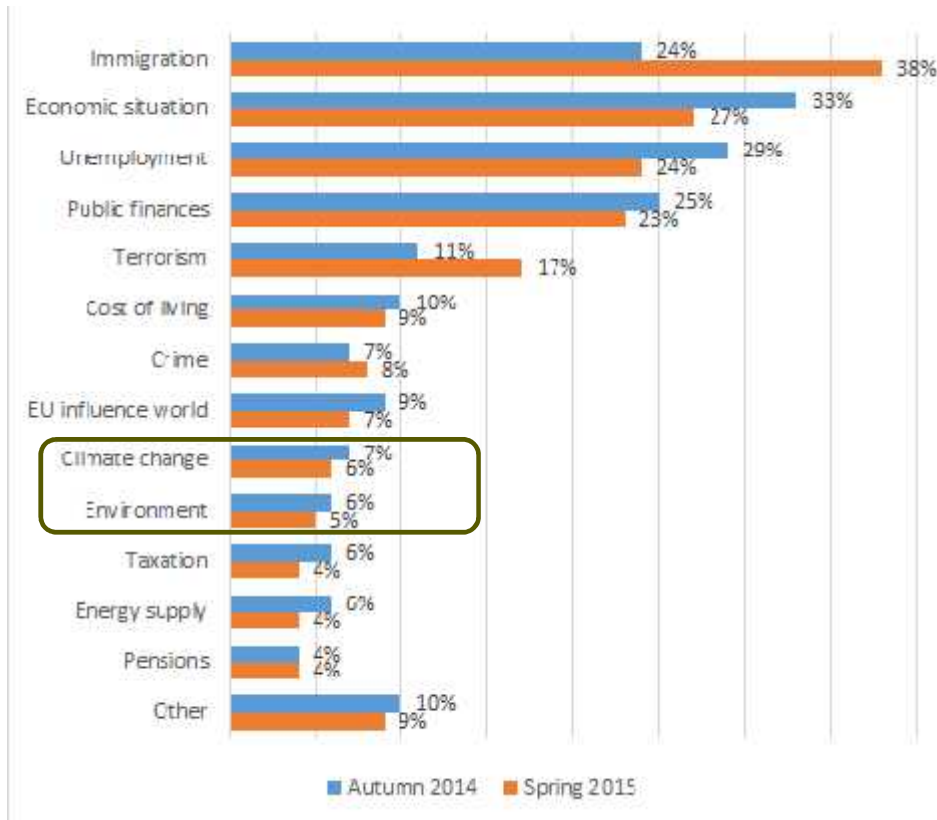


A first step to validate and improve the unit N cost method

- Using of the Eurobarometer surveys
 - On behalf of the EU Directorate-General for Environment
 - Annual survey, 28,000 respondents
 - interviewed face-to-face at home in their mother tongue
 - What are 5 major concerns;
 - > in general
 - > environment



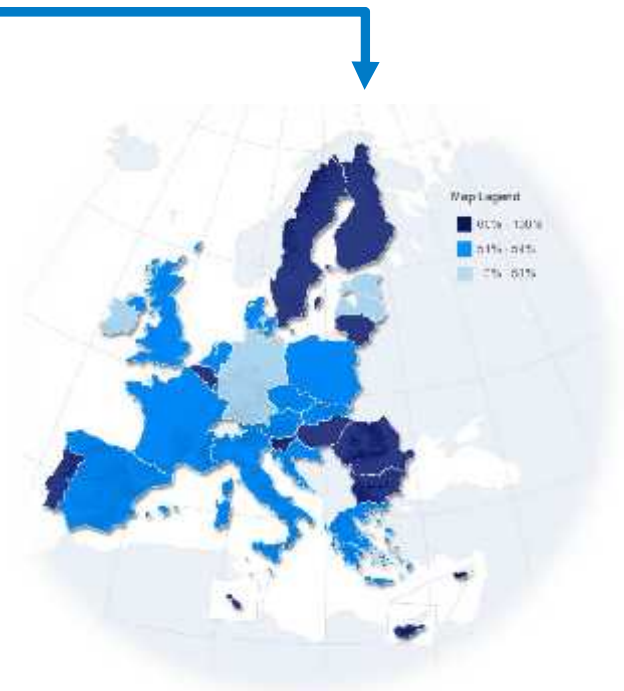
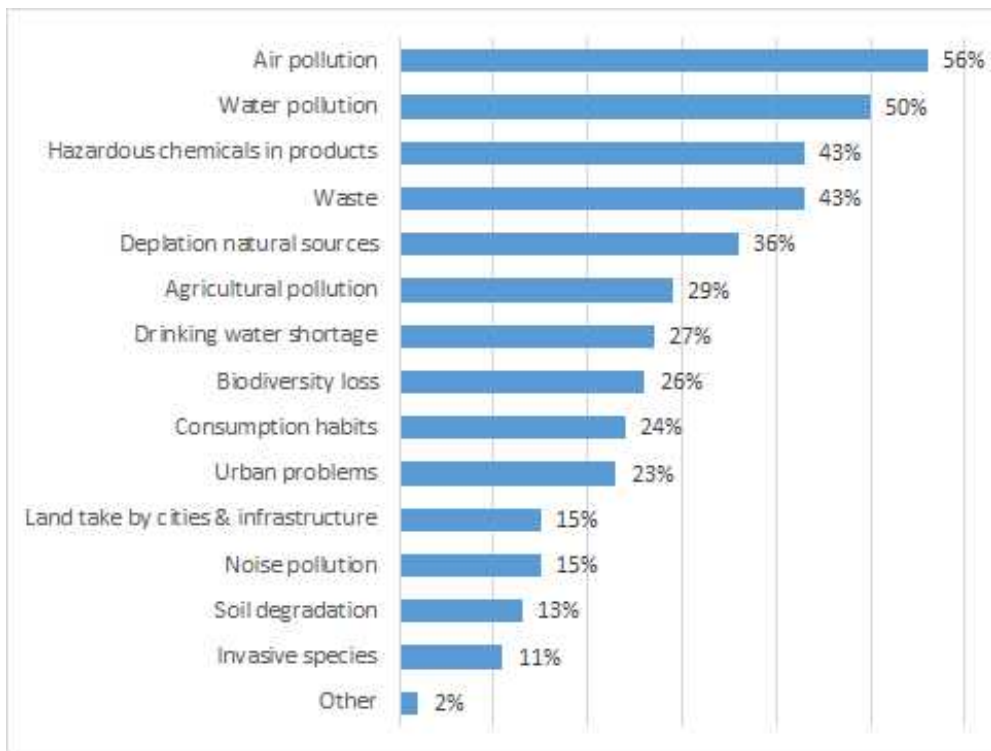
Relative concern of Europeans for social issues



Environment and climate change are not the major public concerns



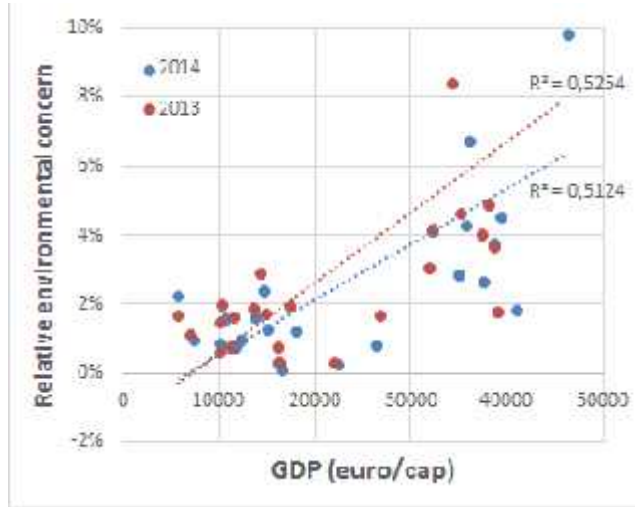
Relative concern EU for environmental issues 2014



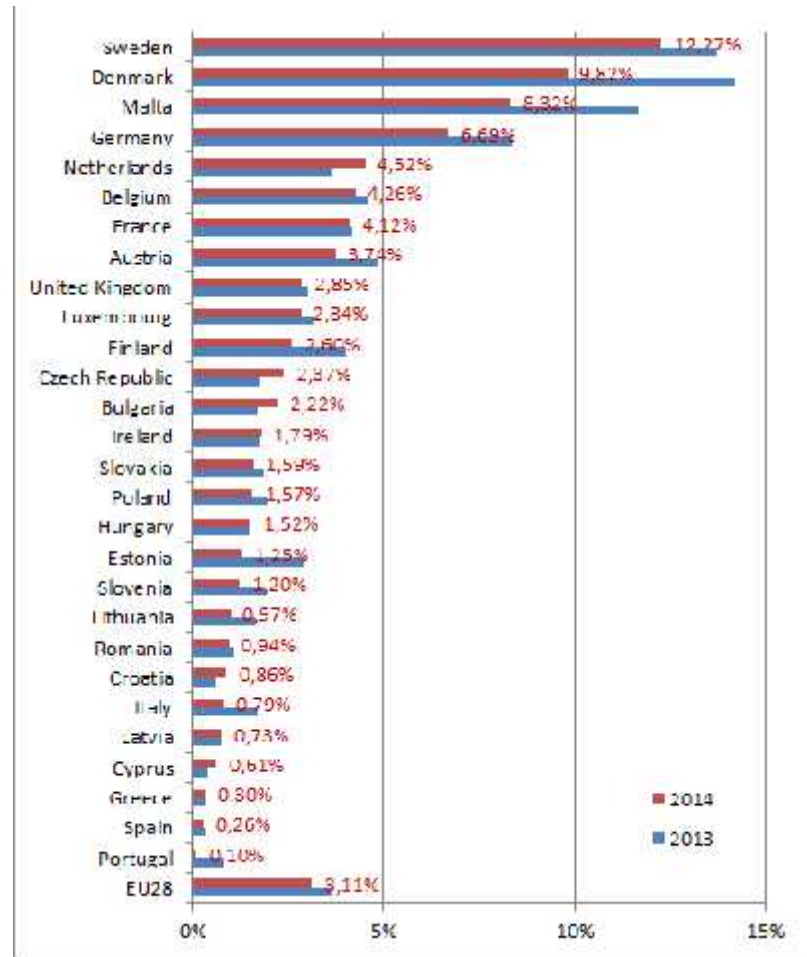
Regional distribution concerns about air pollution; other factors than GNI are relevant



Relative concern of European countries for environment, climate and energy issues



Fair correlation with GDP (excl. Cyprus, Malta, Luxembourg)





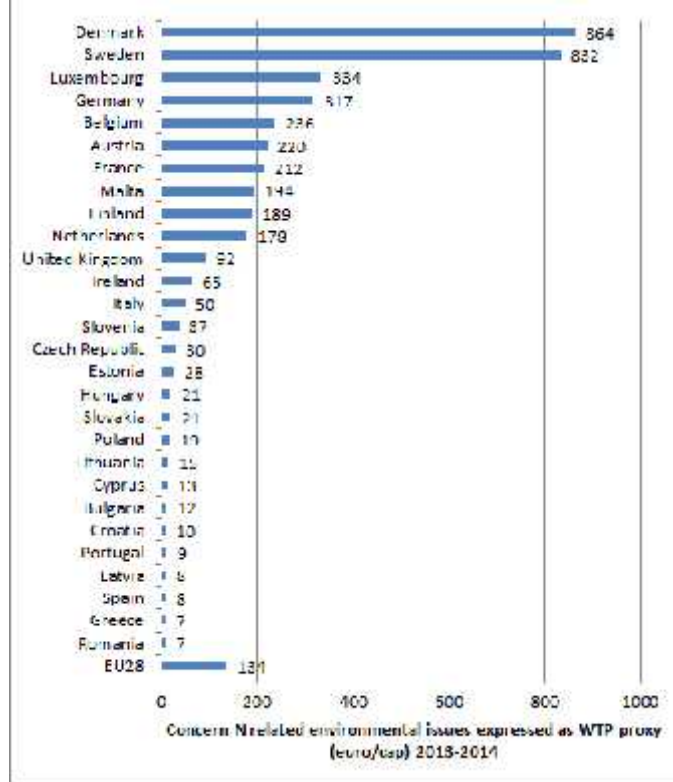
Assumptions to convert general concern about the environment in Eurobarometer to WTP to prevent N impacts

- Public concern is equivalent WTP to spend tax money to prevent or repair N damage
 - Tax receipt in EU in 2012 was 5300 billion €
- Uniform efficiency of every euro of tax to reduce public concerns
- Only three issues with a strong link to N pollution are considered; these represent 33% of the concern for all surveyed environmental issues

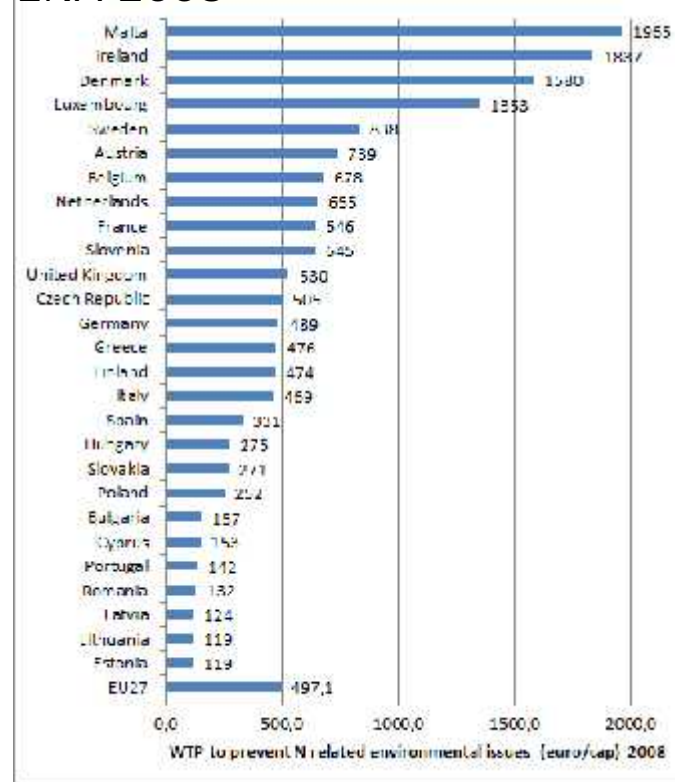


WTP to prevent or reduce N pollution in EU (euro/person)

Eurobarometer 2013-2014



ENA 2008



0.3x
More contrast
(R² = 0,33)



Results and conclusions

- Eurobarometer based estimate for N pollution cost in 2013-2014 (73 billion €/yr) more than three times lower than the 2008 ENA estimate (245 billion €/yr)
 - Just outside uncertainty range ENA (75-495 €/yr; Current prices)
 - Represents 1.5% of total tax receipt (5300 billion € in 2012)
- Eurobarometer based estimate puts abatement of Nr pollution in a broader context of public concerns
 - Bounds the potential WTP to a proportion of the total budget for public expenditure
 - Eurobarometer is not pollutant (N) specific
- Assuming [relative public concern] [WTP to spend tax revenues] questionable
 - Financial cost for solution of widely divergent issues, from immigration tot water and air quality, is very different



THANK YOU

Future part INMS activity 1.4: Development of
approaches for N threat-benefit valuation

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