N issues in Spain.

Emissions Trends, Critical Loads, Effects

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CIEMAT

Task Force on Reactive Nitrogen

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CONTENT

-Trends in the emissions of N compounds to the atmosphere. Influence of different sectors

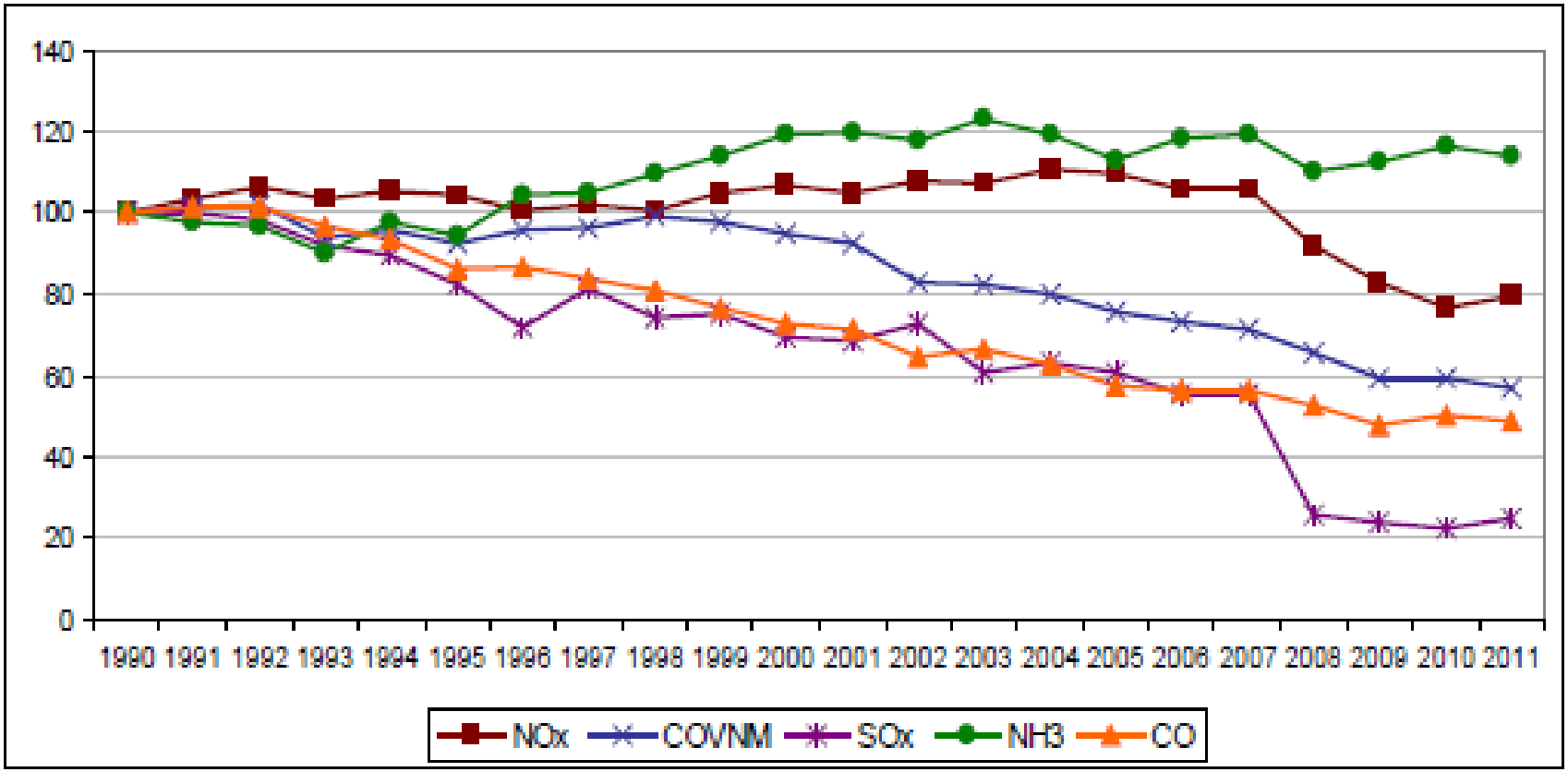
- Critical loads issues (CLNnut)

- Effects of N inputs on Spanish ecosystems

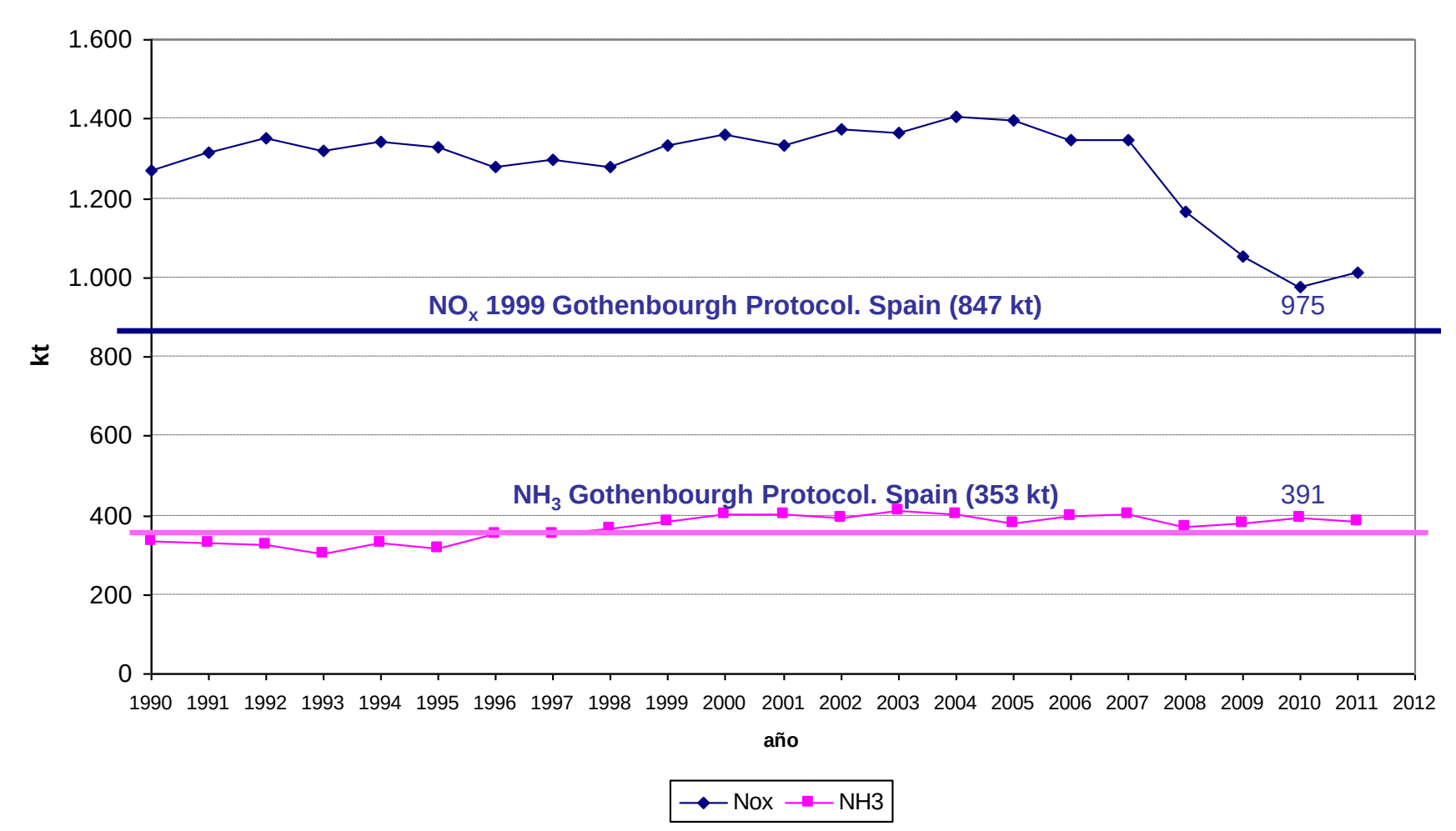
-Summary of current research relevant for N and CLRTAP

Trends in Spanish Emissions

Figura 3.1.1.a.- Índice de evolución de las emisiones (contaminantes principales)

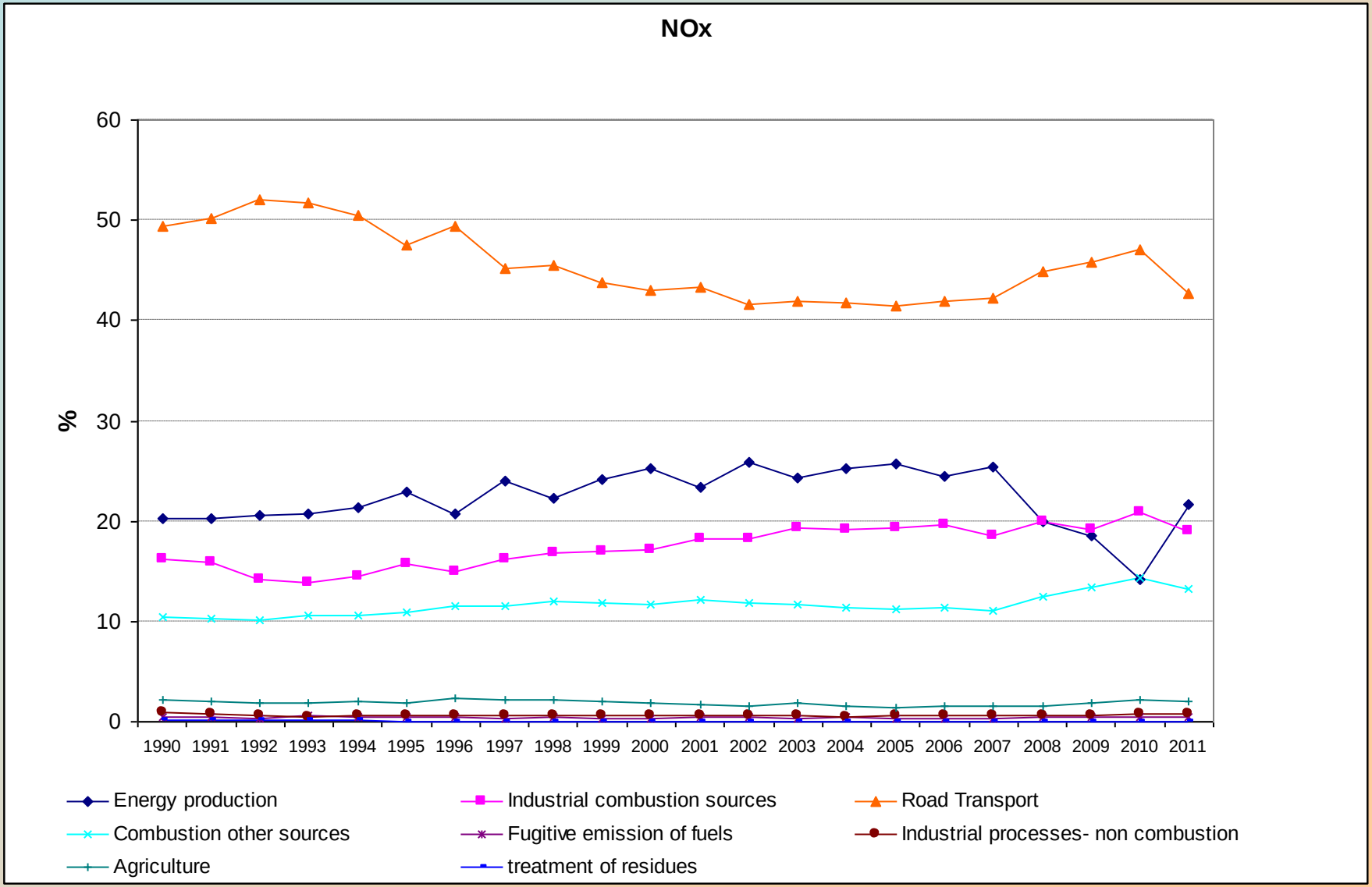


Trends in Spanish Emissions (No_x and NH_3)



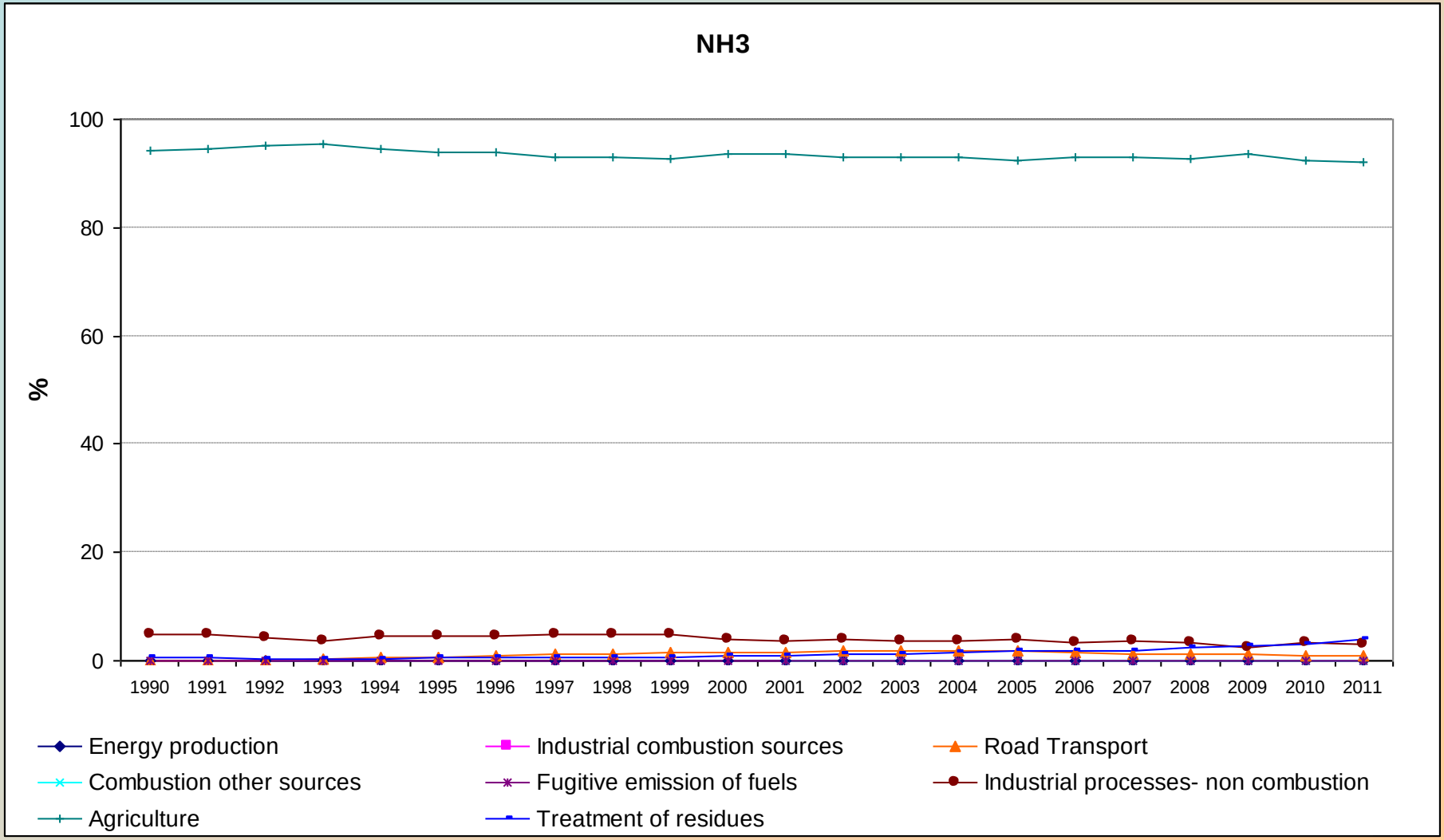
Emission Inventory. Spain. 1990-2011
Ministry of Agriculture, Food and Environment

Evolution of the share of the different sectors (%) on the total NO_x emissions



Emission Inventory. Spain. 1990-2011 .Ministry of Agriculture, Food and Environment

Evolution of the share of the different sectors (%) on the total NH_3 emissions



Emission Inventory. Spain. 1990-2011 .Ministry of Agriculture, Food and Environment

Policy: Air Quality and Emmisions Control (i)

AIR QUALITY

Spanish strategy on Air Quality and Atmospheric Protection (Ley 34/2007)

Air Quality Improvement (SOx NO2, NOx, PM, Pb, C6H6, CO O3, Ar, Cd, Hg, Ni) (RD 102/2011)

Ley 16/2002 –IPPC- Integrated Pollution Prevention and Control

EMISSIONS

Directive 2001/81/CE Emission Ceilings

Development of Directive IPPC – BAT for different sectors

Gothenburg protocol

Policy: Air Quality and Emmisions Control (ii)

Plan AIRE National Programme (2013-2016)

78 measures to reduce pollution and improve air quality in urban areas

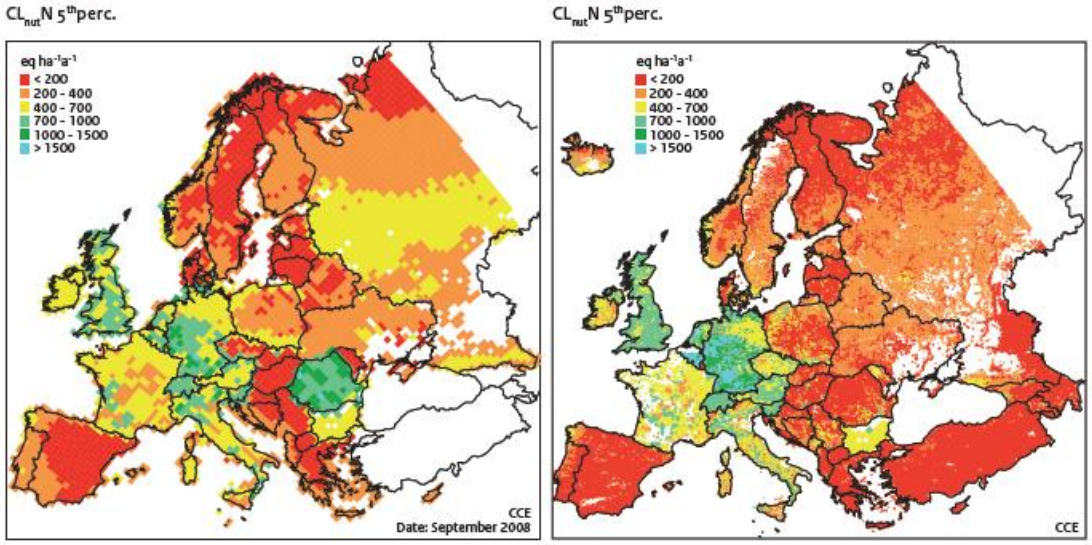
- 27 measures to improve aspects related with public information, Administration, public awareness, R+D+i.

- 51 measures to reduce emmisions from industry, construction, road transport, air transport, agriculture, residential, commercial and institutional

AGR1 Promote good agricultural practices
AGR2 Implementation of the Gothenburgh Protocol measures
AGR3 Reduce emissions from biomass burning

CLRTAP: Critical loads of nutrient N

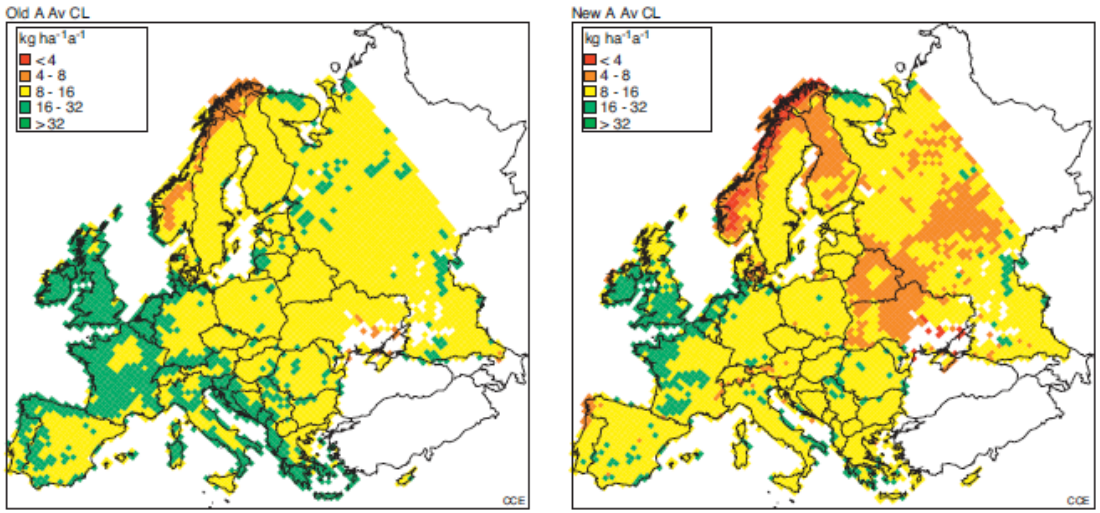
Figure 2.3 The 5th percentiles of the critical loads of modelled nutrient N for the 2008 dataset (left, 50×50 km² EMEP grid) and the 2011 dataset (right, 10×10 km² EMEP grid).



Critical Loads Modelling
CL Nnut
CCE Status Report 2011

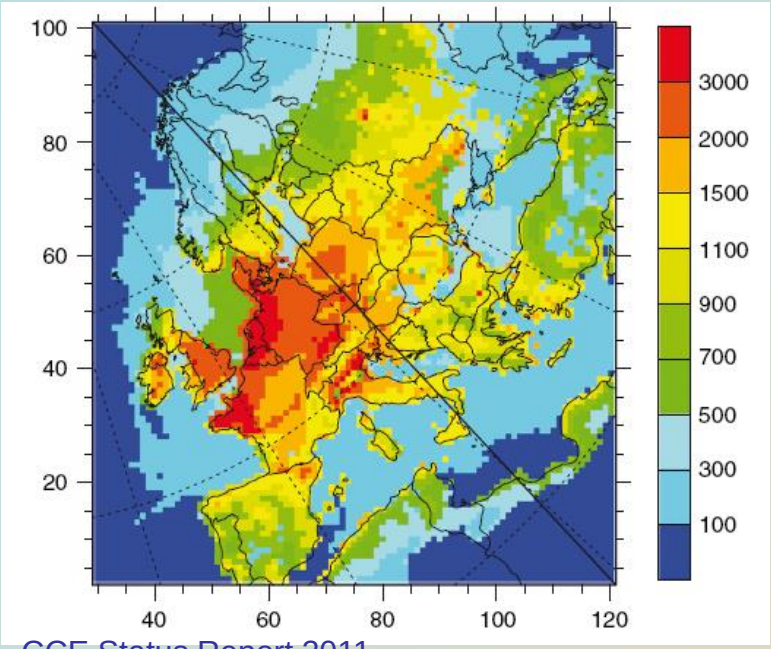
Empirical Critical Loads
CL Nnut
CCE Status Report 2010

Figure 3.1 The area-weighted grid averages of empirical critical loads from Achermann and Bobbink (2003; left) and from Table 3.1 (right)



CLRTAP: Critical loads of nutrient N

mg N $m^{-2} \cdot y^{-1}$



CCE Status Report 2011

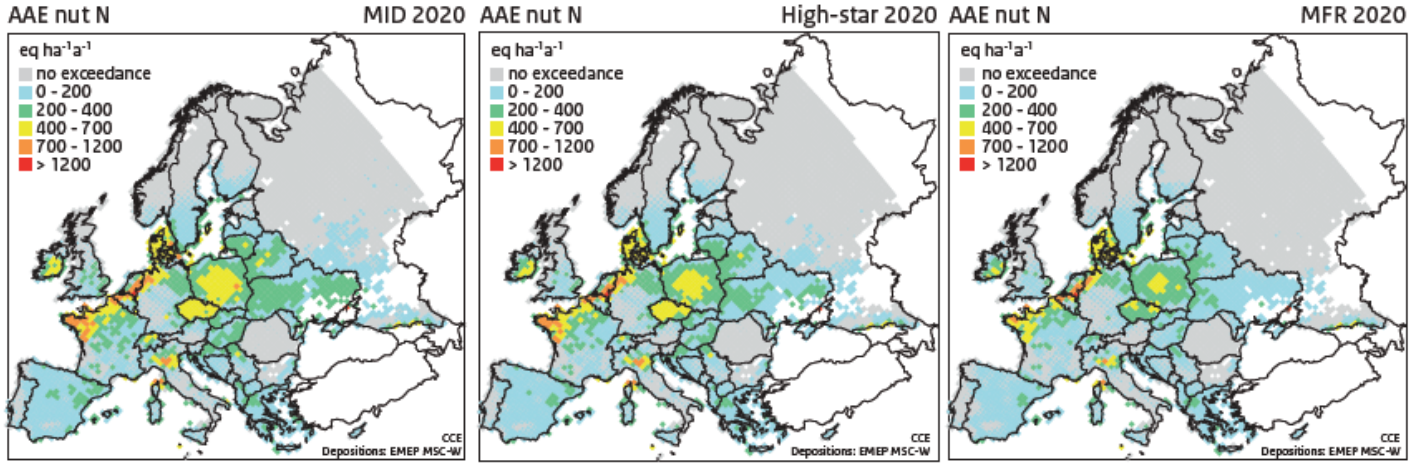
N Deposition (2009)
EMEP

N Exceedances

Exc = Ndep – CLNnut

CCE Status Report 2011

Figure 1.1 Average Accumulated Exceedance (AAE) of critical loads for *eutrophication* in 2000 (top-left), and in 2020 under the CLE (top-centre), Low* (top-right), MID (bottom-left), High* (bottom-centre) and MFR (bottom-right) scenarios. The areas with peaks of exceedances in 2000 (red shading) are markedly decreased in 2020. However, areas at risk of nutrient nitrogen (size of shades indicates area coverage) remain widely distributed over Europe in 2020, even under MFR.



CLRTAP: Critical loads of nutrient N

Challenges

a tool for assessment – a tool for communication

- Conceptual and algorithm adaptation of current methods to estimate CLs for Mediterranean ecosystems:
  - Seasonalities (inputs and dry deposition, biological activity, abiotic factors)
  - Target: N leaching, Biodiversity
  - Recurrent fire events; forest management; erosion processes

- Aggregation of present data to derive empirical CLs and to perform Dynamic Modelling exercises
  - Lack of data series (soil parameters, N dynamics in soils)

- Dry deposition

Effects of N inputs into Spanish ecosystems

Increase in N deposition in background monitoring stations in Catalonia (1995-2007) (CREAF-CIEMAT)

Study on the trends of N deposition in Spanish EMEP stations

Increase in N concentation in herbaria (Peñuelas & Filella, 2001, Global Change Biology, 7:427-433

Biodiversity – compilation of botanical inventories. Navarra: Increase of nitrophile moss species since 1880 (Ederra & Villarroya, 2008, Cryptogamie, bryologie)

Influence of N deposition on plant biodiversity at Natura 2000 sites in Spain (Ariño et al. 2011)

Detection of N impairment in ecosystem cycling in Catalonia (CIEMAT-UCM-CREAF) – influence of cities and large combustion sources

Increase of NO_3 levels in the Ebro River basin (1981-2005) (UCM-CIEMAT)

Relevant N-related research for LRTAP in Spain

- RUENA network: Optimization of N usage in Mediterranean Agriculture (ES)
- EDEN: Effects of nitrogen deposition in Mediterranean evergreen holm oak forests. 2010-2012 (ES)
- ECLAIRE: Effects of Climate Change on Air Pollution and Response Strategies for European Ecosystems (EU)
- NEREA4: Potential use of nitrogen fertilization for mitigating ozone effects on crops (2012, 2013-2015) (ES)
- MONTES interactions between the global change components and the ecosystem services provided by Mediterranean woodlands, in order to devise the necessary management strategies for mitigation and sustainability 2009-2013 (ES)

……..many others projects and research groups….

EDEN: Effects of nitrogen deposition in Mediterranean evergreen holm oak forests
(Plan Nacional, 2010-2012)

Objective: to determine N inputs to Holm oak (*Quercus ilex* L.) forests located at the North, Centre and North-eastern regions of the Iberian peninsula (Navarra, Madrid and Catalonia) and to assess the effects of those inputs on ecosystem N cycling. Critical loads.

Preliminary results

✓Meteorology and N deposition show important seasonal and inter-annual variations

✓ Total bulk inorganic N deposition 2.6 kg N ha^{-1} yr^{-1}

✓ Throughfall is not a good indicator of total N deposition in Holm oak forests

✓ Loss of NO_3^- in soil water when atmospheric N inputs occur while low biological activity

N dynamics in Mediterranean catchments

- Spatialized N budgets in a large agricultural Mediterranean watershed: high loading and low transfer (2012), *Biogeosciences* 9, 57–70
  Lassaletta, L., Romero, E., Billen, G., Garnier, J., García-Gómez, H., Rovira, J.V.

- The potential of organic fertilizers and water management to reduce N2O emissions in Mediterranean climate cropping systems. A review. (2013).
  Agriculture Ecosystems&Environment 164:32-52
  Aguilera,E., Lassaletta,L., Sanz-Cobena,A., Garnier,J., Vallejo,A.

- How changes in diet and trade patterns have shaped the N cycle in Spain(1961-2009)
  Lassaletta,L, Billen,G, Romero,E, Garnier,J, Aguilera,E. *To be published*

<u>Results</u>

✓High N retention in the Ebro catchment (N input 5118 kgN km^{-2} yr^{-1})

⇨ management measures to reduce agricultural N surpluses by better balancing N fertilization

✓ >90% of N agricola input is retained, creating risks in terms of water quality and atmospheric pollution

POLITÉCNICA

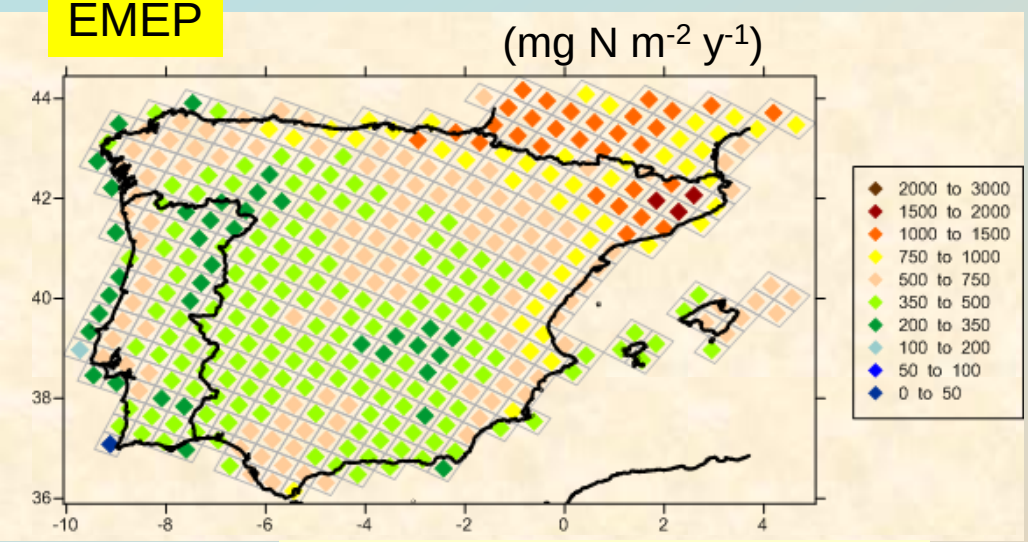
LRTAP Long-range Transboundary Air Pollution

GOBIERNO DE ESPAÑA MINISTERIO DE ECONOMÍA Y COMPETITIVIDAD Ciemat Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas

Modelling N deposition

EMEP

(mg N m^{-2} y^{-1})

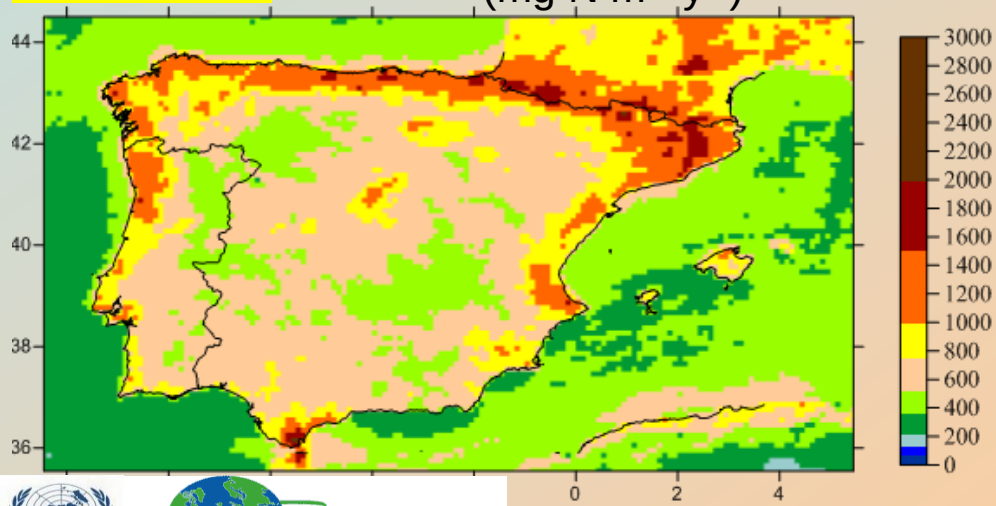


Total N dep in Spain:

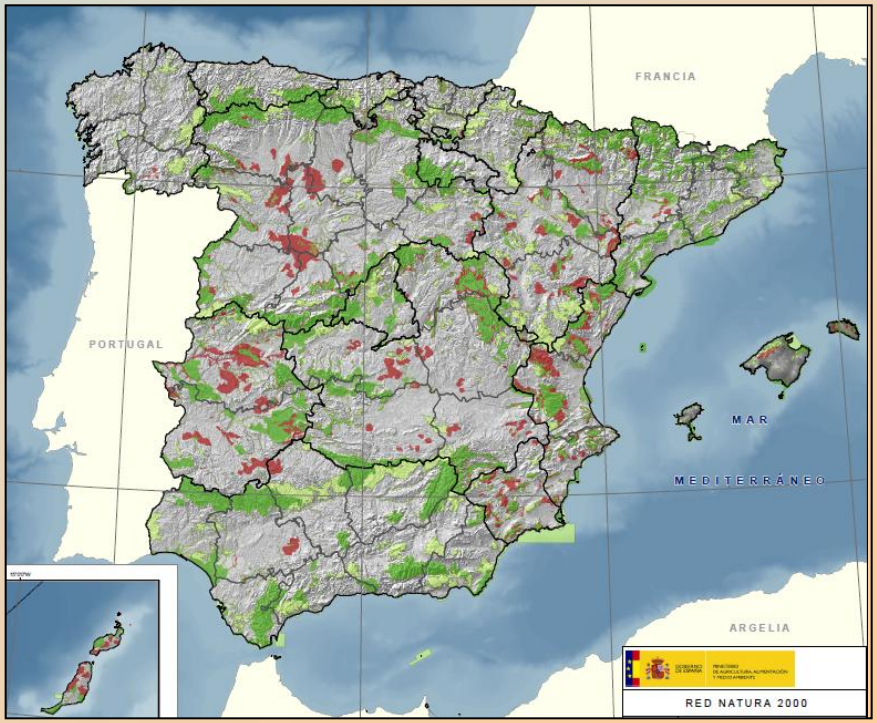
5-20 kg N ha^{-1} y^{-1}

CHIMERE

(mg N m^{-2} y^{-1})



Natura 2000



LIC - Habitats

ZEPA - Aves

LIC y ZEPA

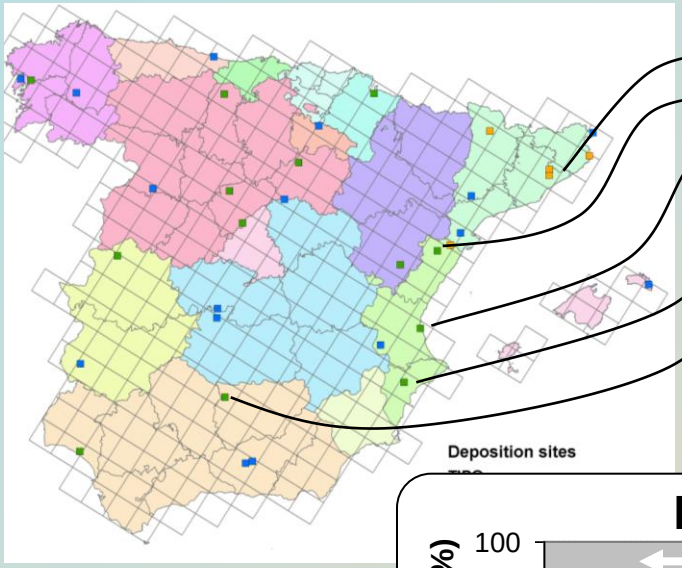
LRTAP Long-range Transboundary Air Pollution

GOBIERNO DE ESPAÑA MINISTERIO DE ECONOMÍA Y COMPETITIVIDAD

Ciemat Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas

Modelling N deposition

EMEP model vs. Measurements: Dry / Total N deposition



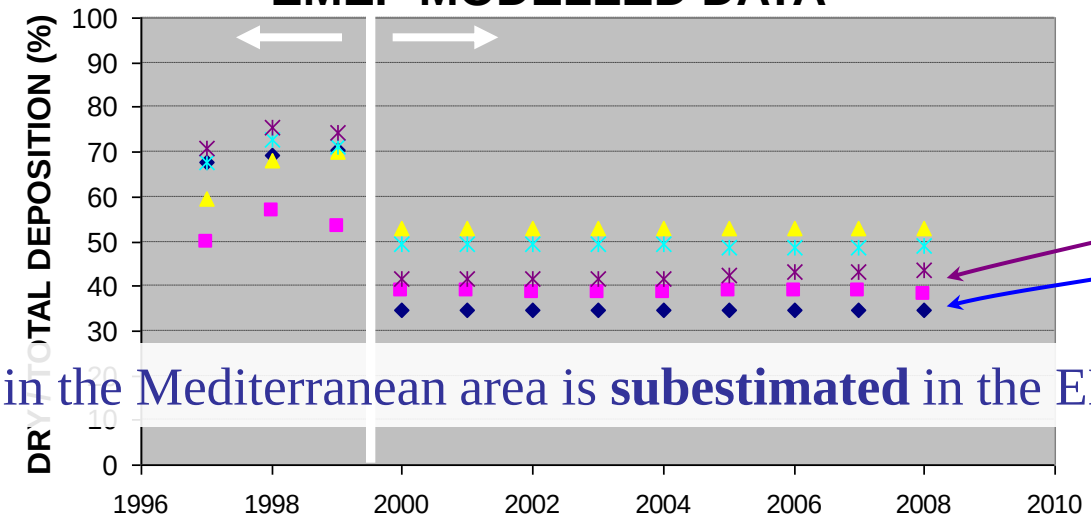
Q. ilex
Q. ilex
* *P. halepensis*
x *P. halepensis*
Q. ilex

MEASURED DATA

La Castanya - *Q. ilex*
Dry dep. / Total dep.= **62-67%**
(Avila et al., 2002; Rodà et al., 2002)

Valencia – *P. halepensis*
Dry dep. / Total dep.= **40-75%**
(Sanz et al., 2002)

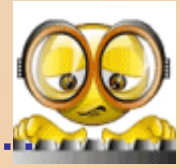
EMEP MODELLED DATA



Dry deposition in the Mediterranean area is **subestimated** in the EMEP model

Thank you for your attention !

……we keep working……



CLRTAP: Critical loads of nutrient N

Table I.2. *Health and environmental indicators values for the year 2020*

Party	Mortality PM (average months lost per person)	Mortality Ozone (cases.yr^{-1} per million people)	Morbidity PM and Ozone (cases.yr^{-1} per million people)	Acidification (% area at risk)	AAE Acidification (mol H^+.ha^{-1}.yr^{-1})	Eutrophication (% area at risk)	AAE Eutrophication (mol N.ha^{-1}.yr^{-1})	Biodiversity (%)	Wheat yield reduction Ozone (%)	Materials Corrosion (% area of country at significant risk)	Materials Soiling (% area of country at significant risk)
Austria	4	34	128	0	0	73	133	3	9	3	0
Belgium	7	32	210	15	108	85	410	39	14	80	80
Bulgaria	4	46	131	0	0	59	62	0	10	5	5
Cyprus	4	27	107	0	0	66	124	0	17	0	100
Czech Republic	5	36	144	18	75	100	652	12	11	43	1
Denmark	4	27	111	7	15	100	603	44	6	1	39
Estonia	3	13	80	0	0	31	25	0	7	0	0
Finland	2	9	58	1	1	26	18	0	5	0	0
France	4	30	130	3	9	87	277	1	10	7	20
Germany	5	35	157	19	62	62	278	38	11	43	16
Greece	4	45	151	0	0	98	187	0	13	3	12
Hungary	5	49	158	4	6	99	304	0	9	11	2
Slovenia	4	37	144	0	0	63	74	0	15	11	0
Spain	2	37	102	0	0	89	190	0	10	5	7
Sweden	2	17	68	4	2	36	60	0	5	0	0
United Kingdom	3	27	110	14	37	17	52	1	6	51	37
Luxembourg	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Malta	4	49	158						17	100	100
Netherlands	6	21	184	75	1046	86	891	56	9	100	100
Poland	5	26	147	37	159	98	490	4	9	79	4
Portugal	3	42	125	3	7	66	62	0	10	14	32
Romania	5	35	145	4	2	2	1	0	8	8	7
Slovakia	5	30	138	7	10	100	372	0	9	27	0

Guidance Document on health and environmental improvements. Gothenburg Protocol