NEC Scenario Analysis Report Nr. 4

Updated baseline projections for the revision of the National Emission Ceilings Directive

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Glossary of terms used in this report

CAFE	Clean Air For Europe Programme
CAP	Common Agricultural Policy
CAPRI	Agricultural model developed by the University of Bonn
CH_4	Methane
CLE	Current legislation
CO_2	Carbon dioxide
EEA	European Environment Agency
EFMA	European Fertilizer Manufacturer Association
EMEP	European Monitoring and Evaluation Programme
EU	European Union
GAINS	Greenhouse gas - Air pollution Interactions and Synergies model
GW	Gigawatt
IIASA	International Institute for Applied Systems Analysis
IPPC	Integrated Pollution Prevention and Control
kt	kilotons = 10^3 tons
LREM	Long Range Energy Modelling Scenarios developed by the National Technical University of Athens for DG Transport and Energy
Mt	megatons = 10^6 tons
N_2O	Nitrous oxide
NEC	National Emission Ceilings
NH_3	Ammonia
NO_x	Nitrogen oxides
O_3	Ozone
PJ	petajoule = 10^{15} joule
PM10	Fine particles with an aerodynamic diameter of less than 10 µm
PM2.5	Fine particles with an aerodynamic diameter of less than 2.5 µm
PRIMES	Energy Systems Model of the National Technical University of Athens
RAINS	Regional Air Pollution Information and Simulation model
SNAP	Sector aggregation system of the CORINAIR emission inventory
SO_2	Sulphur dioxide
SOMO35	Sum of excess of daily maximum 8-h means over the cut-off of 35 ppb calculated for all days in a year
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
VOC	Volatile organic compounds

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Executive Summary

This report describes the baseline projections for the revision of the National Emission Ceilings Directive. The report presents two views on the future development of economic activities, energy use and agricultural projections.

The national projections that have been submitted by the Member States to IIASA imply by 2020 CO_2 emissions levels as in the Kyoto base year. Alternatively, a "Coherent scenario" that has been developed within the LREM project of DG Transport and Energy resembles the recent decisions of the EU Heads of States in March 2007 on future greenhouse gas emissions, energy efficiency and the shares of renewable energy and biofuels.

For these two projections, the analysis estimates future emissions of SO_2, NO_x, PM2.5, NH_3 and VOC as they are likely to result under the assumption that current national legislation on air pollution control will be fully implemented. Emissions from the EU-27 are expected to decline between 2000 and 2020 for SO_2 between 61 and 77 percent, for NO_x between 43 and 52 percent, for PM2.5 between 34 and 42 percent, for NH_3 by about 10 percent, and for VOC by approximately 43 percent. For the year 2000, emission control costs are estimated at 31.1 billion €/yr. For 2020, costs for implementing the current legislation on air pollution depend on the development of energy use and agricultural activities. For the national projections, costs would increase up to almost 80 billion €/yr. In contrast, structural changes in the more climate-friendly Coherent scenario lead, as a side effect, also to lower implementation costs of the current air pollution legislation. In this case, costs would amount to 69 billion €/yr.

The anticipated decline in emissions will also reduce the harmful health and ecosystems impacts of air pollution. For 2020, it is estimated that the number of years of life lost attributable to PM2.5 should decline by 25 to 43 percent, depending on the underlying activity projections. The forest area with acid deposition above critical loads should shrink from 16 percent in 2000 to five to six percent in 2020. In contrast, only little progress is anticipated for eutrophication, for which the ecosystems area with excess nitrogen deposition is calculated to decline from 71 to approximately 60 percent in 2020.

This report provides the starting point for the analysis of policy scenarios that address the environmental interim objectives of the Thematic Strategy on Air Pollution (the NEC Report #5).

1 Introduction

1.1 Context

In its Thematic Strategy on Air Pollution, the European Commission outlined the strategic approach towards cleaner air in Europe (CEC, 2005) and established environmental interim targets for the year 2020. As one of the main policy instruments, the Thematic Strategy announced the revision of the Directive on National Emission Ceilings (2001/81/EC) with new emission ceilings that should lead to the achievement of the agreed interim objectives.

In the meantime, the European Commission started the process to develop national ceilings for the emissions of the relevant air pollutants. The analysis started from an updated baseline projection of emissions and air quality impacts to be expected from the envisaged evolution of anthropogenic activities taking into account the impacts of the presently decided legislation on emission controls. These draft baseline projections have been presented to stakeholders in September 2006 (Amann *et al.*, 2006b). In a further step, analysis explored sets of cost-effective measures that achieve the environmental ambition levels of the Thematic Strategy. This assessment has been presented to the meeting of the NECPI working group on December 18, 2006, and is documented in Amann *et al.*, 2006a. As follow-up, the NEC Report #2 analyzed potential emission ceilings that emerge from the environmental objectives established in the second round, and studies the robustness of the identified emission reduction requirements against a range of uncertainties. NEC Report #3 (Amann *et al.*, 2007a) presented in March 2007 a third round of analysis on emission ceilings, taking into account a series of methodological improvements and a more comprehensive representation of the inter-annual meteorological variability.

The remainder of the report is organized as follows: Section 1.2 summarizes the changes in input data that have been introduced to the analysis since the NEC Report #3. Section 2 presents input data on energy related and agricultural activities for the national projections and a "Coherent scenario" that resembles elements of the policy targets on greenhouse gas reductions, energy efficiency and renewable energy that have been established by the Heads of States in March 2007. Section 3 introduces the resulting emission projections, and associated emission control costs are listed in Section 4. Section 5 summarizes the development of the impact indicators for health impacts from PM, eutrophication, acidification and ground-level ozone.

1.2 Methodology

The scenario analysis employs as the central analytical tool an extended version of the RAINS model called GAINS that allows, inter alia, studying of interactions between air pollution control and greenhouse gas mitigation. The methodology of the GAINS model and the differences to the RAINS methodology has been summarized in Amann *et al.*, 2006a. The different optimization approaches are documented in Wagner *et al.*, 2006 and Wagner *et al.*, 2007. In January 2007, the GAINS model has been reviewed by a team of experts from Member States and stakeholders; the findings of the review are available on http://www.iiasa.ac.at/rains/reports/gains-review.pdf.

1.3 Changes since the NEC report #3

Since the NEC report #3 a number of changes have been introduced to the GAINS model. Improvements relate to input data used for the calculations of emissions from energy use, agricultural activities. The following paragraphs provide a brief summary of the changes. Details can be extracted from a comparison of the 'NEC Report Nr. 3' and 'NEC Report Nr. 4' versions of the GAINS model that is accessible over the Internet (http://www.iiasa.ac.at/web-apps/apd/RainsWeb/).

1.3.1 Input data for energy-related activities

For energy related input data, the following changes have been introduced since March 2007:

- Energy scenarios for Hungary, Greece and Norway have been implemented or corrected.
- The national energy projection scenario of the Netherlands and the associated "Current legislation" control strategy for the Netherlands were adjusted to allow the achievement of the SO_2 emission ceiling for 2010. This correction was based on the national programme provided by the Netherlands to the Commission. Results were communicated to the Dutch experts by the Commission.
- The SO_2 and NO_x control strategies for Greece were corrected taking into account new information provided by Greek experts.
- The sulphur contents of gas oil used by non-road mobile machinery and inland waterway vessels were changed (from 1000 ppm to 10 ppm) following the Proposal Com(2007) 18 of the Directive of the European Parliament and of the Council to amend Directives 98/70/EC and 1999/32/EC.
- Based on discussions with national experts from Belgium, constraints on the maximum penetration (applicabilities) of advanced combustion and control technologies in the domestic sector were modified.

1.3.2 Input data for agricultural activities

- Following the last NECPI meeting in March 2007, Belgium provided new national projections of agricultural activities. Specifically, the development of pig and poultry production was revised taking into account the envisaged impacts of the manure policy for the Flemish region that has been introduced on December 22, 2006. Further communication with Belgian experts resulted in slight adjustments of the poultry data for the base year 2000.
- In May 2007, Spain provided new national projections (data for 2005-2020) for livestock and mineral fertilizer use as well as information on emission-factor related parameters. The new projection, including the split between solid and liquid manure systems, has been implemented in GAINS. While the emission factor parameters have been discussed with Spanish experts, due to the very late submission it was not possible to introduce the modifications to GAINS databases at this stage. Taking into account the new information on manure systems in Spain, the penetration levels of abatement measures for pigs kept on IPPC farms (assuming that they are with liquid systems) were adjusted.

- Minor modifications of applicability rates for several technologies, inter alia for covered storage of manures, were introduced for the UK.

1.3.3 Input data for VOC relevant activities

- In April 2007, Belgium provided new projections of the development of VOC emissions from extraction and loading of liquid fuels and several industrial sectors, e.g., pulp and paper industry, iron and steel production and asphalt production and use. After consultation with Belgium national experts in April 2007, the VOC control strategy for the production of paints, glues and inks was modified.

2 Input data

2.1 General economic development

The GAINS analysis on the cost-effectiveness of measures to achieve the targets established by the Thematic Strategy on Air Pollution is based on exogenously supplied assumptions on the future development of the driving forces of air pollution. Since the future is inherently uncertain and the GAINS model does not attempt to identify the most likely development, GAINS explores the possible range of future economic development and the resulting implications on the cost-effectiveness of air pollution control strategies. In particular, the assumptions on future climate policies have been identified in earlier work as key factors influencing the need for further air pollution control measures. In view of this finding, GAINS employs for the revision of the NEC directive two different sets of projections of emissions.

2.1.1 National projections

The national projections scenario reflects current national expectations on future energy use and agricultural activities. In the course of the bilateral consultations between IIASA and Member States in 2005-2006, 23 Member States have supplied national energy projections and 19 Member States national agricultural projections to IIASA. DG Environment of the European Commission had requested in 2005 that these projections must reflect national policies as laid down, e.g., in governmental energy plans, and that they must include all necessary measures to comply with the Kyoto targets on greenhouse gas emissions and the burden sharing agreement for 2012. For 2020, it should be assumed as a minimum that the Kyoto emission caps remain unchanged. With these requirements, the national energy projections for the revision of the NEC Directive should, in principle, be consistent with the energy projections presented by the Member States to UNFCCC in their Fourth National Communications in 2006. However, it turned out that collectively for the EU-27 these projections imply for 2020 a slight increase in CO_2 emissions compared to the UNFCCC base year levels. While these national projections are supposed to reflect the latest governmental views in the individual Member States on the future energy development, there is no guarantee for Europe-wide consistency in terms of assumptions on economic development trends, the prices of oil, gas, coal, etc., on electricity imports and exports, and on the availability of natural gas. Unfortunately, Member States did not supply sufficient detail to judge the EU-wide consistency of the underlying assumptions.

2.1.2 The Coherent scenario

Alternatively, the NEC analysis explores potential implications of the agreement reached by the European Council – i.e., the European Union's Heads of State – in March 2007 on the 20 percent reduction of greenhouse gas emissions by 2020 as compared with 1990, and increasing the share of renewables to 20 percent by 2020. While the in-depth analysis on possible implementations of these decisions is currently underway, this report presents an explorative assessment based on an earlier developed energy scenario that comes relatively close to the agreement of having 20 percent greenhouse gas reduction and 20 percent renewable share by 2020 . This "Coherent scenario" was developed with the PRIMES model in conjunction with the decisions of the

European Council. However, the starting point for the Coherent scenario was the energy baseline constructed in 2003 in the context of the "Long Range Energy Modelling" (LREM) framework contract financed by the Directorate-General for Transport and Energy. Thereby, the starting point is the same as for the other LREM scenarios that have been employed in the analysis of possible ceilings under the NEC Directive in the earlier NEC reports.

This "Coherent scenario" combines policies towards energy efficiency, promotion of renewable energy forms and reducing CO_2 emissions. In 2020, this scenario results for the EU-27 in a 22 percent reduction in domestic CO_2 emissions compared to the 1990 (implying an implicit carbon price of 45 €/t CO_2), with renewable energy constituting approximately 17 percent of total primary energy use. More information on the Coherent scenario can be found in the report *'Service contract to exploit synergies between air quality and climate change policies and reviewing the methodology of cost-benefit analysis*' by the National Technical University of Athens.

In 2006, DG Transport and Energy of the European Commission started consultations with the Member States for a revised baseline. At the time of writing, Member States have given their comments to this baseline and NTUA is making the necessary adjustments to ensure that the PRIMES energy model will use the most relevant assumptions. However, as the new baseline is not ready at the time of writing, the "Coherent Scenario" is used, with the understanding that it is likely to give an indication of the importance of changed energy and climate policies in the EU up to 2020.

In terms of GDP, the LREM scenarios used a exogenous projection of 2.2 percent annual growth rate of total GDP in the EU-27 between 2000 and 2020. Faster growth up to 6.2 percent annually is expected for the new Member States, while growth rates of the EU-15 range between 1.5 and 2.2 percent, with rates up to 4.3 percent for Ireland, Greece and Spain. To the extent Member States have supplied their own projections, these match generally rather closely the assumptions taken for the EU-wide projections, although for some Member States differences occur (Table 2.1). Equally, assumed population changes are similar, anticipating for the EU-27 a 0.1 percent increase per year (Table 2.2).

As a consequence, income of the EU-27 citizens (measured as GDP per capita) is expected to increase (in real terms) between 2000 and 2020 by 50 percent (Table 2.3), although substantial disparities across Member States will prevail (Figure 2.1).

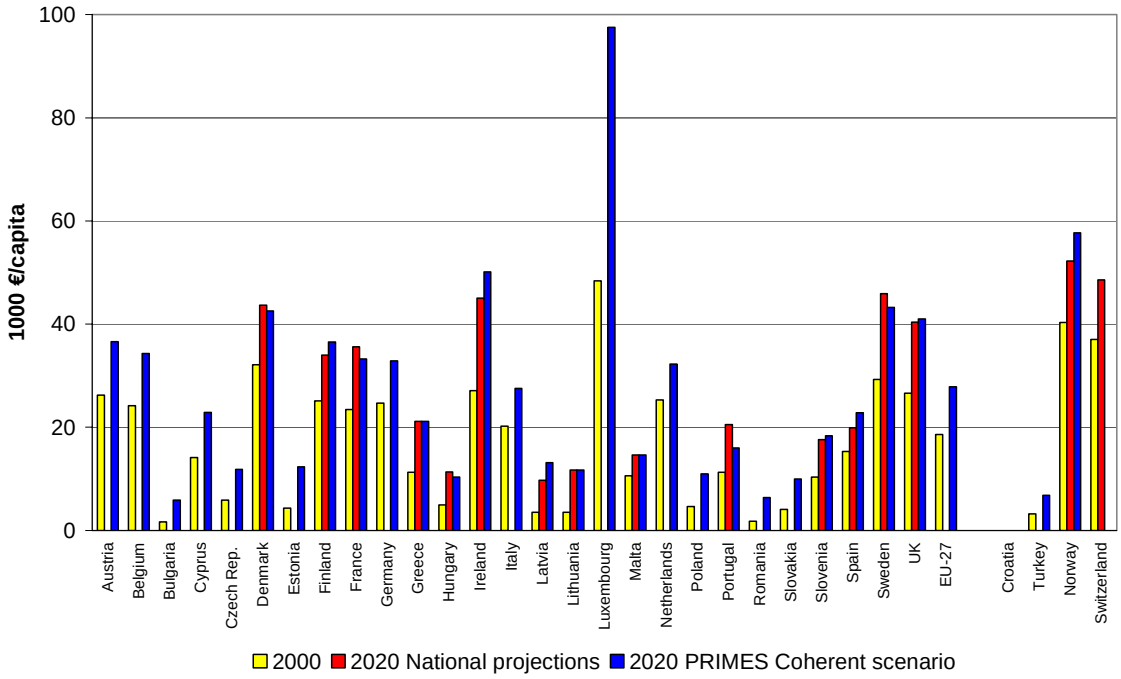

Figure 2.1: Income levels (GDP/capita) for the year 2000 and 2020, for the national projections and the LREM scenario (labelled as “PRIMES Coherent scenario”), in 1000 €/person/year

Table 2.1: Development of GDP assumed in the national projections and the LREM scenarios [billion €/yr]

	National projections			LREM scenario		
	2000	2020	Annual growth rate	2000	2020	Annual growth rate
Austria				210.4	309.0	*1.9%*
Belgium				247.9	370.2	*2.0%*
Bulgaria				13.7	39.8	*5.5%*
Cyprus				9.9	19.9	*3.5%*
Czech Rep.				60.4	117.1	*3.4%*
Denmark	171.7	236.3	*1.6%*	171.6	235.2	*1.6%*
Estonia				5.9	15.4	*4.9%*
Finland	115.3	180.9	*2.3%*	130.2	197.5	*2.1%*
France	1416.9	2232.8	*2.3%*	1420.1	2113.3	*2.0%*
Germany				2030.0	2714.9	*1.5%*
Greece	123.2	241.4	*3.4%*	123.2	241.4	*3.4%*
Hungary	52.0	111.3	*3.9%*	50.7	100.0	*3.5%*
Ireland	103.5	216.2	*3.8%*	103.1	238.6	*4.3%*
Italy				1166.6	1604.2	*1.6%*
Latvia	6.7	21.2	*5.9%*	8.4	27.9	*6.2%*
Lithuania	12.4	37.2	*5.7%*	12.3	37.2	*5.7%*
Luxembourg				21.3	50.7	*4.4%*
Malta	4.1	6.6	*2.4%*	4.1	6.6	*2.4%*
Netherlands				402.3	555.6	*1.6%*
Poland				180.6	406.9	*4.1%*
Portugal	115.0	221.8	*3.3%*	115.6	172.2	*2.0%*
Romania				40.4	129.3	*6.0%*
Slovakia				21.9	52.5	*4.5%*
Slovenia	19.7	34.5	*2.8%*	20.6	37.1	*3.0%*
Spain	582.7	970.1	*2.6%*	610.5	1040.2	*2.7%*
Sweden	224.6	445.0	*3.5%*	259.9	414.0	*2.4%*
UK	1559.6	2541.6	*2.5%*	1559.6	2578.9	*2.5%*
EU-27				9001.0	13825.4	*2.2%*
Croatia						
Turkey				216.7	583.3	*5.1%*
Norway	182.9	265.5	*1.9%*	181.1	285.0	*2.3%*
Switzerland	266.7	364.2	*1.6%*			

Table 2.2: Development of population assumed in the national projections and the LREM scenarios [million people]

	National projections			LREM scenario		
	2000	2020	Annual growth	2000	2020	Annual growth
Austria				8.0	8.4	*0.3%*
Belgium				10.3	10.8	*0.3%*
Bulgaria				8.2	6.8	*-0.9%*
Cyprus				0.7	0.9	*1.1%*
Czech Rep.				10.3	9.9	*-0.2%*
Denmark	5.3	5.4	*0.1%*	5.3	5.5	*0.2%*
Estonia				1.4	1.3	*-0.5%*
Finland	5.2	5.3	*0.1%*	5.2	5.4	*0.2%*
France	58.9	62.7	*0.3%*	60.6	63.6	*0.2%*
Germany				82.2	82.7	*0.0%*
Greece	10.9	11.4	*0.2%*	10.9	11.4	*0.2%*
Hungary	10.2	9.8	*-0.2%*	10.2	9.7	*-0.3%*
Ireland	3.8	4.8	*1.2%*	3.8	4.8	*1.1%*
Italy				57.8	58.3	*0.0%*
Latvia	2.4	2.2	*-0.4%*	2.4	2.1	*-0.6%*
Lithuania	3.5	3.2	*-0.5%*	3.5	3.2	*-0.5%*
Luxembourg				0.4	0.5	*0.8%*
Malta	0.4	0.5	*0.7%*	0.4	0.5	*0.7%*
Netherlands				15.9	17.2	*0.4%*
Poland				38.7	37.1	*-0.2%*
Portugal	10.2	10.8	*0.3%*	10.2	10.8	*0.3%*
Romania				22.4	20.3	*-0.5%*
Slovakia				5.4	5.3	*-0.1%*
Slovenia	2.0	2.0	*-0.1%*	2.0	2.0	*0.1%*
Spain	40.3	48.8	*1.0%*	39.9	45.6	*0.7%*
Sweden	8.9	9.7	*0.4%*	8.9	9.6	*0.4%*
UK	58.6	62.9	*0.4%*	58.6	62.9	*0.4%*
EU-27				483.5	496.4	*0.1%*
Croatia						
Turkey				67.5	85.7	*1.2%*
Norway	4.5	5.1	*0.6%*	4.5	4.9	*0.5%*
Switzerland	7.2	7.5	*0.2%*			

Table 2.3: Development of per-capita income levels [1000 €/person/yr]

	Per-capita income		
	2000	2020 National projections	2020 LREM scenario
Austria	26.3		36.6
Belgium	24.2		34.3
Bulgaria	1.7		5.9
Cyprus	14.1		22.9
Czech Rep.	5.9		11.8
Denmark	32.1	43.7	42.5
Estonia	4.3		12.3
Finland	25.1	34.0	36.6
France	23.4	35.6	33.2
Germany	24.7		32.8
Greece	11.3	21.1	21.1
Hungary	5.0	11.3	10.3
Ireland	27.1	45.0	50.1
Italy	20.2		27.5
Latvia	3.5	9.7	13.2
Lithuania	3.5	11.7	11.7
Luxembourg	48.4		97.5
Malta	10.6	14.6	14.6
Netherlands	25.3		32.3
Poland	4.7		11.0
Portugal	11.3	20.5	16.0
Romania	1.8		6.4
Slovakia	4.1		10.0
Slovenia	10.3	17.6	18.4
Spain	15.3	19.9	22.8
Sweden	29.3	45.9	43.2
UK	26.6	40.4	41.0
EU-27	18.6		27.8
Croatia			
Turkey	3.2		6.8
Norway	40.3	52.3	57.7
Switzerland	37.0	48.6	

2.2 Energy and transport projections

As a starting point for the further analysis, Table 2.4 summarizes the statistics on energy consumption by fuel for the year 2000 as implemented in the GAINS database. As these are historic data, both the national and LREM projections will be compared against the same basis. It should be noted that there are discrepancies between energy balances provided by national statistics and by EUROSTAT. For the EU-27 as a whole, differences are below 0.5 percent, but larger discrepancies exist for a few countries.

Table 2.4: Primary energy consumption in 2000 [PJ]. Source: GAINS (based on national and EUROSTAT energy balances)

	Coal	*Biomass, waste*	*Heavy fuel oil*	*Diesel*	*Gasoline, LPG*	*Natural gas*	*Nuclear*	*Other renew.*	*Electr. import*[1)]	*Total*
Austria	119	128	114	253	114	324	0	153	-5	1200
Belgium	257	49	78	497	447	655	496	2	15	2496
Bulgaria	268	23	52	60	63	136	196	10	-17	792
Cyprus	1	0	47	22	25	1	0	1	0	99
Czech Rep.	823	28	58	147	112	385	147	6	-38	1668
Denmark	165	70	72	152	125	205	0	19	2	811
Estonia	120	21	10	16	14	31	0	0	-3	208
Finland	207	237	80	171	117	189	236	47	39	1324
France	494	448	452	1811	1351	1727	4538	259	-250	10830
Germany	3327	221	741	2469	2252	3334	1851	117	11	14322
Greece	382	40	170	279	223	96	0	19	0	1208
Hungary	156	16	94	87	107	423	153	1	12	1049
Ireland	117	8	70	160	97	144	0	5	0	600
Italy	426	139	1262	1213	1335	2445	0	339	150	7309
Latvia	3	49	9	19	16	41	0	10	16	164
Lithuania	3	23	43	26	24	86	93	1	-14	286
Luxembourg	5	2	1	55	40	28	0	1	21	152
Malta	0	0	19	6	9	0	0	0	-1	34
Netherlands	269	60	112	504	569	1542	39	4	68	3167
Poland	2279	166	210	320	296	557	0	8	-23	3812
Portugal	155	133	247	220	175	97	0	46	3	1076
Romania	271	119	171	138	98	636	59	54	-3	1542
Slovakia	136	47	22	33	28	315	178	17	-10	766
Slovenia	57	17	6	51	39	35	52	15	-11	263
Spain	830	155	610	1027	853	800	672	125	16	5087
Sweden	95	294	131	237	263	57	619	286	14	1997
UK	1771	58	176	1119	1735	3983	822	88	51	9802
EU-27	12734	2552	5057	11093	10528	18272	10151	1632	45	72064
Croatia	30	22	99	56	42	121	24	16	11	421
Turkey	881	274	404	375	485	601	0	173	12	3206
Norway	56	49	9	151	147	245	0	512	-69	1101
Switzerland	8	72	25	270	237	101	289	133	-25	1108

[1)] Exports are indicated by negative numbers.

Table 2.5: Energy consumption of the EU-27 by fuel and sector in 2000 [PJ] Source: GAINS (based on national and EUROSTAT energy balances)

	Coal	*Biomass, waste*	*Heavy fuel oil*	*Diesel*	*Gasoline LPG*	*Natural gas*	*Nuclear*	*Other renew.*	*Electr.*[1)]	*Total*
Power sector	9695	437	1533	172	18	4675	10151	1595	-10549	17728
Industry	1588	802	1180	414	354	5149	0	4	3741	13232
Conversion	319	15	957	134	77	1260	0	0	1607	4369
Domestic	594	1298	117	2757	590	6497	0	33	5011	16896
Transport	0	0	72	7443	7635	19	0	0	234	15403
Non-energy	539	0	1197	173	1854	673	0	0	0	4435
Total	12734	2552	5057	11093	10528	18272	10151	1632	45	72064

[1)] Power sector - gross power generation (reported with negative sign); the conversion sector includes own use of energy industries as well as transmission and distribution losses; Total - net electricity import. Exports are indicated by negative numbers.

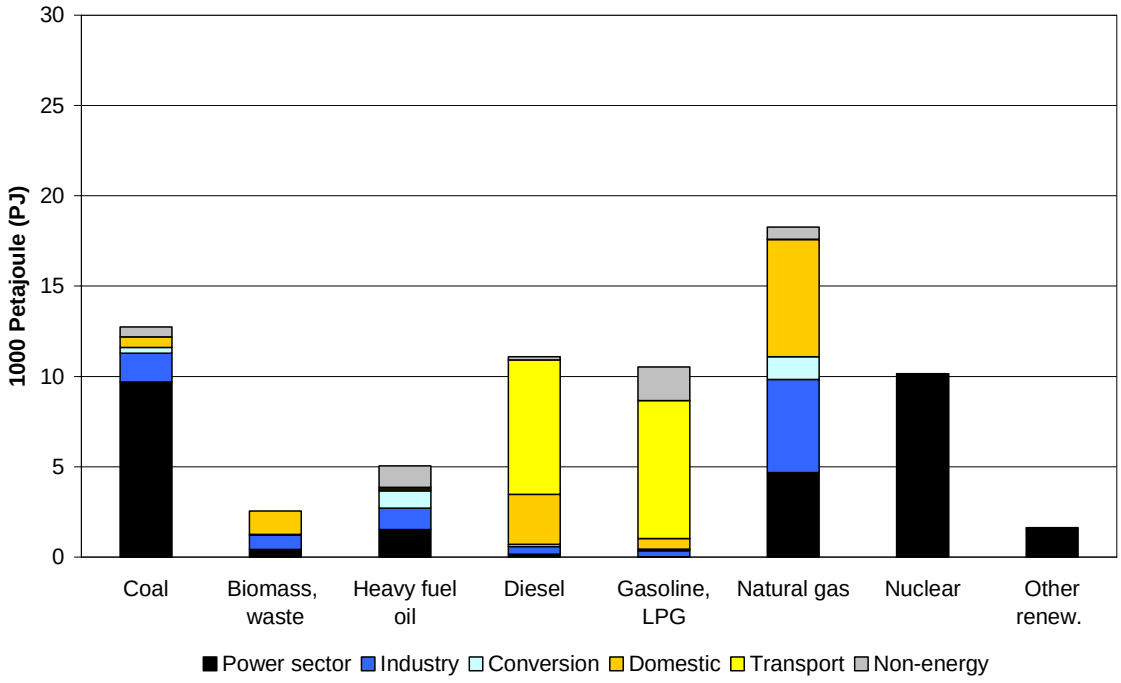

Figure 2.2: Energy consumption by fuel and sector in 2000

2.2.1 National energy projections for 2020

For the revision of the NEC directive, DG Environment of the European Commission requested in 2005 all Member States to provide official national energy projections up to 2020. These projections must reflect national policies as laid down, e.g., in governmental energy plans. Furthermore, these projections must include all necessary measures to comply with the Kyoto targets on greenhouse gas emissions and the burden sharing agreement for 2012. For 2020, it should be assumed as a minimum that the Kyoto emission caps remain unchanged. With these requirements, the national energy projections for the revision of the NEC Directive should, in

principle, be consistent with the energy projections presented by the Member States to UNFCCC in their Fourth National Communications in 2006.

In the course of the bilateral consultations in 2005-2006, 23 Member States supplied national energy projections to IIASA for implementation into the GAINS model (Table 2.6). Collectively, these national projections constitute the "National projections" baseline scenario for the revision of the NEC directive. For those Member States that have not provided their own energy projection, the "National projections" baseline case assumes by default the energy development as outlined by the "PRIMES €20" energy projection presented in Amann *et al.*, 2007a.

Table 2.6: Data sources for the "National projections" NEC baseline scenario

	Data source	*Date of last information exchange*
Austria	National projection (2006)	04 July 2006
Belgium	National projection (2006)	31 August 2006
Bulgaria	PRIMES €20 (2006)	No national inputs
Cyprus	PRIMES €20 (2006)	No national inputs
Czech Rep.	National projection (2006)	01 August 2006
Denmark	National projection (2006)	11 November 2006
Estonia	National projection (2006)	30 October 2006
Finland	National projection (2006)	23 February 2007
France	National projection (2006)	30 June 2006
Germany	National projection (2006)	05 May 2006
Greece	National projection (2006)	18 April 2007
Hungary	National projection (2006)	13 April 2007
Ireland	National projection (2006)	05 December 2006
Italy	National projection (2006)	07 July 2006
Latvia	National projection (2006)	09 December 2005
Lithuania	National projection (2006)	20 January 2007
Luxembourg	PRIMES €20 (2006)	No national inputs
Malta	National projection (2006)	24 January 2007
Netherlands	National projection (2006)	17 April 2007
Poland	National projection (2006)	25 August 2006
Portugal	National projection (2006)	31 August 2006
Romania	PRIMES €20 (2006)	No national inputs
Slovakia	National projection (2006)	16 November 2006
Slovenia	National projection (2006)	06 October 2006
Spain	National projection (2006)	31 January 2007
Sweden	National projection (2006)	22 January 2007
UK	National projection (2006)	20 September 2006
Croatia	RAINS projection from 1996	No national inputs
Turkey	PRIMES €20 (2006)	No national inputs
Norway	National projection (2006)	23 January 2007
Switzerland	National projection (2006)	23 January 2007

The perceived evolution of fuel consumption in the various Member States is summarized for the year 2020 in Table 2.7. Overall, EU-27 Member States expect an increase in total primary energy use by 16 percent between 2000 and 2020. Coal consumption is projected to decrease by six percent, while for natural gas a 46 percent increase is envisaged. Member States anticipate a five percent drop in gasoline consumption and a 33 percent increase in diesel and light fuel oil.

According to these projections, the EU-27 net electricity imports would increase by about 80 percent until 2020.

Table 2.7: Primary energy consumption of the national energy projections in 2020 [PJ] Source: GAINS, based on national submissions to IIASA.

	Coal	*Biomass, waste*	*Heavy fuel oil*	*Diesel*	*Gasoline LPG*	*Natural gas*	*Nuclear*	*Other renew.*	*Electr. Import*[2)]	*Total*
Austria	129	179	53	389	86	463	0	201	0	1500
Belgium	160	82	53	567	449	933	338	15	17	2614
Bulgaria	139	48	47	112	134	214	215	19	-20	909
Cyprus	1	3	68	26	33	1	0	4	0	135
Czech Rep.	718	84	87	184	180	467	318	17	-25	2031
Denmark	114	122	54	174	146	315	0	45	-8	962
Estonia	173	27	13	30	16	45	0	3	-9	298
Finland	180	336	74	173	118	288	345	56	21	1591
France	484	711	540	2464	1113	2185	5093	360	-139	12811
Germany	3550	306	510	2616	1492	4041	693	363	8	13579
Greece	393	46	140	274	343	423	0	65	6	1690
Hungary	124	103	0	182	128	615	161	1	21	1334
Ireland	63	26	35	277	172	326	0	34	6	940
Italy	657	406	507	1501	1314	3410	0	483	304	8580
Latvia	47	60	24	50	40	72	0	16	17	324
Lithuania	4	51	62	54	38	258	45	4	-14	503
Luxembourg	1	5	2	71	47	59	0	1	23	209
Malta	0	1	21	14	13	0	0	0	0	50
Netherlands	402	154	130	665	762	1736	39	96	12	3997
Poland	2046	305	297	566	387	1121	0	50	-19	4753
Portugal	96	149	224	349	172	358	0	100	-108	1339
Romania	392	182	125	319	214	988	125	94	-3	2435
Slovakia	259	55	28	65	49	399	89	28	-8	966
Slovenia	47	29	4	86	24	70	59	21	-23	317
Spain	516	335	417	1562	825	3381	626	394	0	8056
Sweden	84	430	122	242	247	196	448	275	-11	2033
UK	1170	160	100	1605	1465	4495	268	406	35	9704
EU-27	11948	4395	3739	14617	10005	26858	8862	3153	82	83658
Croatia	31	17	80	68	55	187	25	21	4	487
Turkey	935	325	483	662	1128	1790	0	417	-10	5731
Norway	49	59	13	213	178	276	0	467	27	1282
Switzerland	9	91	23	291	197	115	308	151	-23	1161

[1)] No national projections have been supplied. The PRIMES €20 projection have been used instead for the national scenario.

[2)] Exports are indicated by negative numbers.

While these national projections are supposed to reflect the latest governmental views in the individual Member States on the future energy development, there is no guarantee for Europe-wide consistency in terms of assumptions on economic development trends, the prices of oil, gas, coal, etc., on electricity imports and exports, and on the availability of natural gas. Unfortunately, Member States did not supply sufficient detail to judge the EU-wide consistency of the underlying assumptions.

Table 2.8: Energy consumption of the EU-27 by fuel and sector for the national energy projections for 2020 [PJ]

	Coal	*Biomass, waste*	*Heavy fuel oil*	*Diesel*	*Gasoline LPG*	*Natural gas*	*Nuclear*	*Other renew.*	*Electr.*[1)]	*Total*
Power sector	9387	1577	599	136	12	9236	8862	2987	-14033	18763
Industry	1419	1321	963	522	306	6663	0	3	4884	16081
Conversion	248	134	931	183	118	1422	0	0	1705	4742
Domestic	388	1358	84	2538	472	8138	0	151	7226	20354
Transport	0	0	71	11073	7418	119	0	12	301	18993
Non-energy	507	4	1091	166	1678	1279	0	0	0	4726
Total	11948	4395	3739	14617	10005	26858	8862	3153	82	83658

Note: Gross power generation in the power sector is reported with negative sign. The conversion sector includes own use of energy industries as well as transmission and distribution losses. Totals exclude net electricity imports.

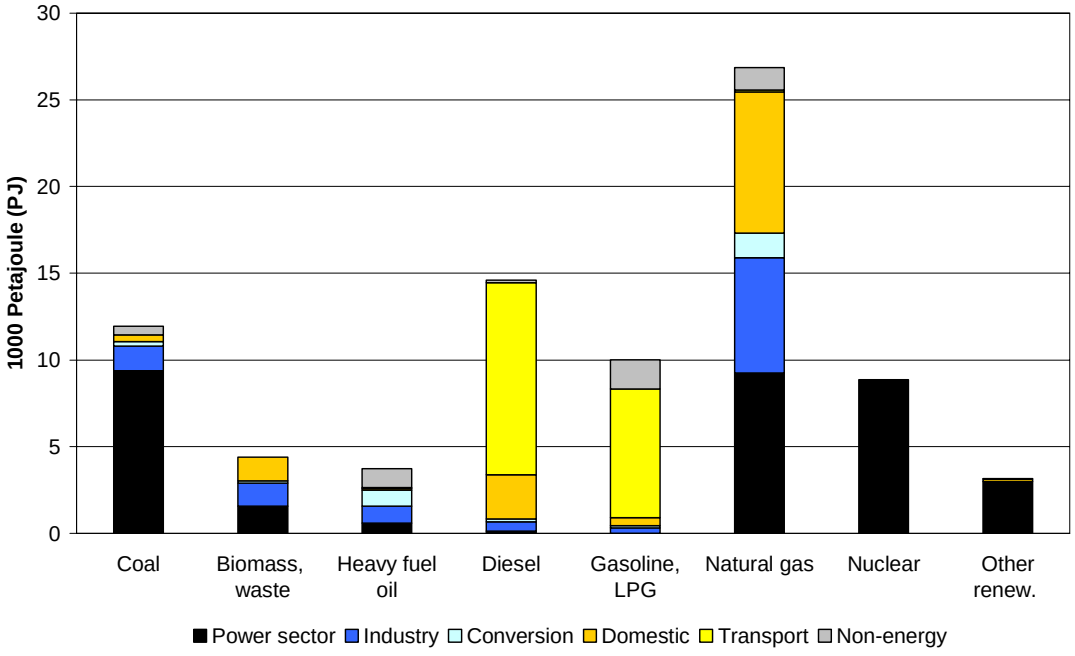

Figure 2.3: National projections of the energy consumption of the EU-27 for 2020

In terms of CO_2 emissions, the national projections imply for the EU-27 for 2010 a decrease of five percent and for 2015 by 2.3 percent compared to the UNFCCC base year level. For 2020, the projections suggest CO_2 emissions to increase again to reach the base year (~1990) levels. While these projections seem to include certain climate policies, they appear inconsistent with the recent climate policy target of a 20 percent cut in greenhouse gas emissions that has been established by the Heads of States for the year 2020.

2.2.2 The "Coherent Scenario" developed under the Long Range Energy Modelling energy project

As discussed above, the national energy projections, which have been provided by the Member States to IIASA in 2006, imply for the EU-27 in 2020 an increase of CO_2 emissions up to the base year levels of the Kyoto Protocol. Thus, they deviate from the March 2007 European Council conclusions on a 20 percent reduction of the EU-27 greenhouse gas emissions by 2020 compared to 1990. In addition, these projections also do not meet the agreed binding obligation on a share of 20 percent renewables in energy use by 2020 including a share of 10 percent for biofuels.

Obviously, achieving these obligations imply substantial modifications to the business-as-usual energy projections that have been submitted by the Member States for the revision of the NEC directive in 2006. Earlier analyses have clearly demonstrated an important connection between the ambition level of greenhouse gas mitigation strategies and the requirements for additional air pollution control measures (e.g., Amann *et al.*, 2007a).

However, at the time of writing this report the detailed implementation of these decisions is still under development. Thus a conclusive quantitative analysis of cost-effective emission ceilings cannot be conducted in this report. Instead, to explore the potential implications of the envisaged changes in the energy systems for the setting of national emission ceilings, an illustrative analysis is carried out for a "Coherent scenario" that has been developed with the PRIMES model before the decisions of the European Council. While not matching the exact objectives that have been agreed by the Council, this Coherent scenario analyzes the response to objectives on climate policy and energy security in a combined manner. Building upon the 2003 energy baseline scenario constructed in the context of the "Long Range Energy Modelling" (LREM) framework contract financed by the Directorate-General for Energy and Transport, the Coherent scenario combines policies towards energy efficiency, promotion of renewable energy forms and reducing CO_2 emissions. Details on this energy scenario are available in the report *'Service contract to exploit synergies between air quality and climate change policies and reviewing the methodology of cost-benefit analysis*' by the National Technical University of Athens, which is available at the CIRCA website.

For the year 2030, the Coherent scenario aims at a reduction of energy- and process-related CO_2 emissions within the EU-25 by 35 percent compared to 1990 without the instruments of Joint Implementation and CDM, and assuming the availability of carbon capture and storage to reduce CO_2 to the atmosphere. In addition, renewable energy forms should reach in 2030 a share of 20 percent in total primary energy consumption, and energy efficiency should improve by 20 to 30 percent compared to the baseline projection. The implied carbon price would increase from 20 €/t CO_2 in 2010 to 75 €/t CO_2 in 2030. With the perspective of the emission ceilings analysis, the Coherent scenario results in 2020 in a CO_2 reduction of 22 percent compared with 1990 (24 percent compared with the Kyoto base year emissions) and implies a carbon price of 45 €/t CO_2, while the share of renewable energy reaches only 17 percent of total primary energy consumption.

To reach the 20 percent share for renewable energy in 2030, the PRIMES analysis assumed additional financial support mechanisms equivalent to those for the carbon constraint. The Coherent scenario also differs from the associated baseline projection in the assumption of different consumers' behaviours. Reflecting the fundamental change in energy policies, consumers are assumed to perceive lower risks associated with the adoption of advanced technologies, and to show more discipline in their behaviour in terms of rational use of energy.

Main factors leading to the achievement of the carbon and renewable energy objectives are changes in the fuel mix, the adoption of more efficient technologies and a more rational behaviour of energy consumers.

Table 2.9: Primary energy consumption of the Coherent scenario in 2020 [PJ]. Source: GAINS, based on projected energy balances of the PRIMES model

	Coal	Biomass, waste	Heavy fuel oil	Diesel	Gasoline LPG	Natural gas	Nuclear	Other renew.	Electr. import[1)]	Total
Austria	68	205	76	294	136	428	0	231	6	1443
Belgium	70	79	85	464	316	849	377	25	19	2283
Bulgaria	63	52	48	109	129	248	215	23	-20	868
Cyprus	1	3	68	26	34	1	0	4	0	136
Czech Rep.	268	255	74	181	187	536	342	34	-46	1831
Denmark	89	113	43	168	117	221	0	52	-12	790
Estonia	22	63	11	27	21	50	0	4	-1	197
Finland	85	373	86	205	135	212	430	66	14	1605
France	164	958	359	1984	1285	1584	5132	407	-178	11695
Germany	1095	996	391	2318	2193	4587	339	641	39	12600
Greece	20	111	163	401	286	293	0	126	9	1411
Hungary	21	230	44	122	140	512	150	41	10	1270
Ireland	10	42	38	198	155	195	0	51	4	694
Italy	109	599	781	1214	1147	3237	0	623	135	7845
Latvia	3	119	14	28	25	60	0	14	8	272
Lithuania	1	112	19	44	36	126	17	9	-14	349
Luxembourg	1	5	2	67	42	54	0	1	23	195
Malta	0	1	22	8	14	0	0	0	0	45
Netherlands	93	162	136	325	571	1883	45	58	46	3320
Poland	1155	805	161	546	528	1107	188	110	-20	4579
Portugal	1	129	92	247	270	298	0	110	4	1151
Romania	162	209	125	315	204	1053	126	95	-3	2288
Slovakia	85	91	53	46	71	387	205	28	-11	955
Slovenia	25	32	11	52	52	70	58	41	6	348
Spain	46	730	471	1348	1102	1501	876	495	11	6579
Sweden	46	572	77	289	295	165	423	280	9	2156
UK	293	404	347	1036	1769	4017	1110	334	29	9337
EU-27	3996	7450	3796	12059	11262	23675	10032	3904	66	76240
Croatia	31	17	80	68	55	187	25	21	4	487
Turkey	313	383	470	649	1124	1876	0	483	-10	5288
Norway	6	77	30	173	141	227	0	568	-28	1193
Switzerland	6	142	27	218	236	194	299	170	-27	1264

[1)] Exports are indicated by negative numbers.

Table 2.10: Energy consumption in the EU-27 by fuel and sector for the Coherent scenario in 2020 [PJ]. Source: GAINS, based on energy balances of the PRIMES model

	Coal	Biomass waste	Heavy fuel oil	Diesel	Gasoline LPG	Natural gas	Nuclear	Other renew.	Electr.[1)]	Total
Power sector	2578	4910	486	80	0	8865	10032	3740	-14250	16441
Industry	1114	559	979	501	337	5858	0	0	4928	14276
Conversion	91	334	363	6	7	545	0	0	1717	3063
Domestic	132	1648	75	2590	444	7671	0	143	7401	20104
Transport	0	0	71	8693	8498	20	0	22	269	17571
Non-energy	80	0	1822	190	1976	717	0	0	0	4785
Total	3996	7450	3796	12059	11262	23675	10032	3904	66	76240

[1)] Gross power generation in the power sector is reported with negative sign. The conversion sector includes own use of energy industries as well as transmission and distribution losses. Totals exclude net electricity imports.

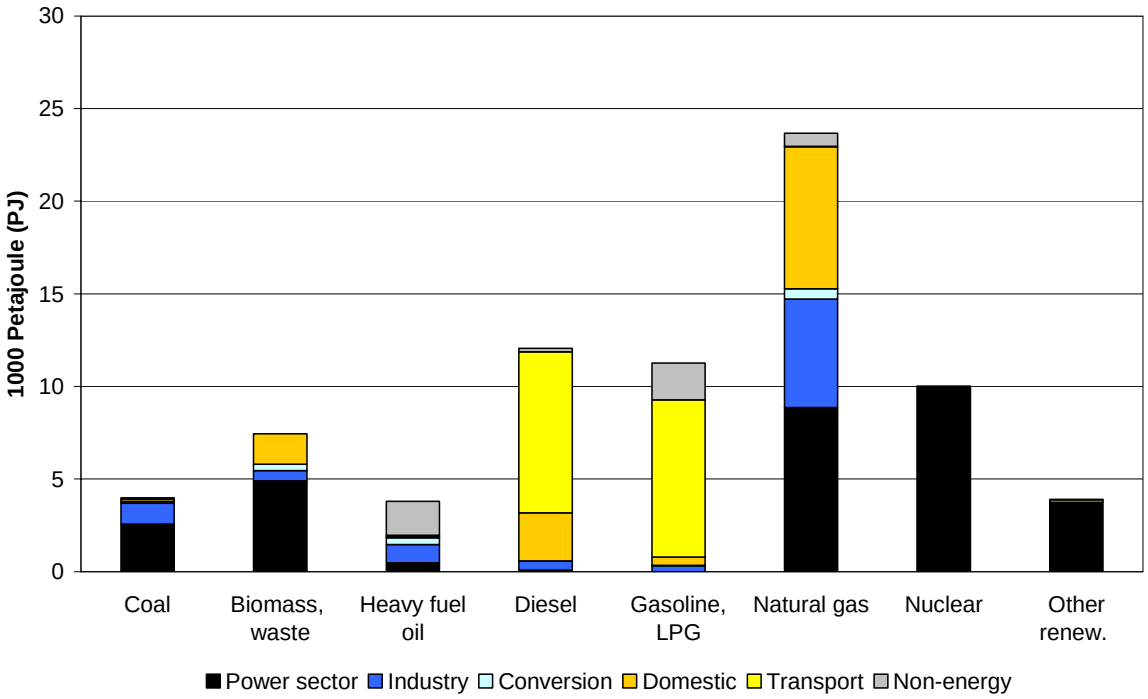

Figure 2.4: EU-27 energy consumption by fuel and sector in 2020 of the Coherent scenario

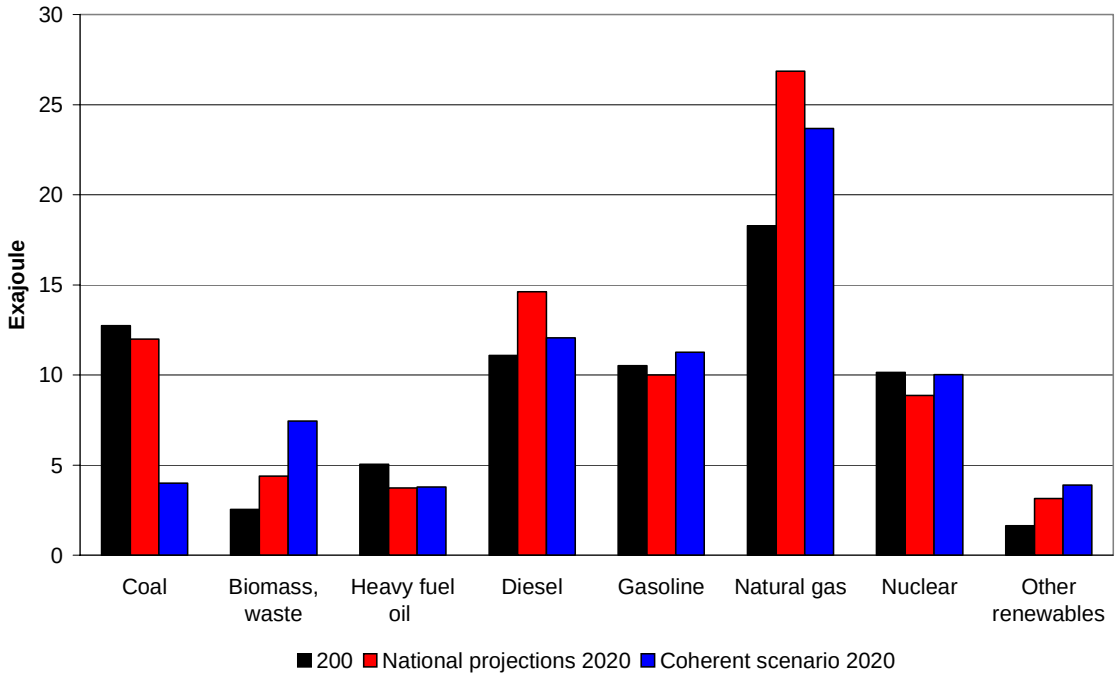

Figure 2.5: Comparison of energy projections by fuel for the two scenarios

2.2.3 CO_2 emissions of the two energy scenarios

As discussed above, there are distinct differences in the CO_2 emissions of the two baseline energy projections analyzed for the revision of the NEC directive. For 2010, the national projections imply CO_2 emissions of the EU-27 to be five percent below the base level of the Kyoto protocol, while the coherent scenario with its climate, renewable energy and energy efficiency objectives leads to a 13 percent decline associated with a carbon price of €20/t CO_2 (Table 2.11).

For 2015, the national projections suggest CO_2 emissions at 2.3 percent below the base year level, while the Coherent scenario leads to a 19 percent decline. In 2020, the national projections see CO_2 emissions reaching the base year levels again, while the Coherent scenario, with a carbon price of €45/t CO_2, calculates 24 percent less CO_2 emissions than in the UNFCCC base year. This is equivalent to having a 22 percent reduction of CO_2 emissions compared with 1990.

Table 2.11: CO_2 emissions by country [million tons CO_2]

	2000		2010				2020			
	UNFCCC base year		National activity projections		"Coherent" energy scenario and CAPRI MTR agricultural projection		National activity projections		"Coherent" energy scenario and CAPRI MTR agricultural projection	
Austria	*61*	65	71	*16%*	69	*12%*	77	*27%*	66	*8%*
Belgium	119	126	127	*6%*	120	*0%*	131	*10%*	107	*-10%*
Bulgaria	98	46	50	*-49%*	38	*-62%*	48	*-51%*	33	*-66%*
Cyprus	5	7	8	*61%*	8	*60%*	9	*73%*	9	*71%*
Czech Rep.	164	126	133	*-19%*	106	*-35%*	123	*-25%*	78	*-53%*
Denmark	53	53	56	*6%*	47	*-11%*	54	*2%*	42	*-21%*
Estonia	38	19	25	*-34%*	14	*-63%*	27	*-29%*	10	*-73%*
Finland	56	58	59	*6%*	62	*10%*	59	*5%*	50	*-11%*
France	397	414	448	*13%*	387	*-2%*	462	*16%*	343	*-14%*
Germany	1015	860	837	*-18%*	748	*-26%*	854	*-16%*	669	*-34%*
Greece	84	104	100	*20%*	109	*30%*	93	*11%*	89	*6%*
Hungary	85	59	62	*-27%*	53	*-38%*	69	*-19%*	52	*-39%*
Ireland	32	45	52	*63%*	43	*33%*	59	*84%*	40	*23%*
Italy	431	472	485	*13%*	461	*7%*	503	*17%*	402	*-7%*
Latvia	19	7	14	*-28%*	8	*-58%*	17	*-8%*	8	*-57%*
Lithuania	39	14	24	*-39%*	18	*-55%*	28	*-27%*	16	*-59%*
Luxembourg	12	9	10	*-16%*	10	*-17%*	11	*-5%*	11	*-11%*
Malta	2	2	3	*40%*	3	*37%*	3	*48%*	3	*32%*
Netherlands	158	169	183	*16%*	170	*8%*	203	*29%*	159	*1%*
Poland	477	315	327	*-31%*	307	*-36%*	350	*-27%*	266	*-44%*
Portugal	44	66	72	*63%*	65	*48%*	80	*83%*	57	*31%*
Romania	184	92	117	*-36%*	96	*-48%*	143	*-22%*	95	*-48%*
Slovakia	59	39	50	*-15%*	47	*-20%*	60	*2%*	47	*-20%*
Slovenia	16	15	17	*5%*	15	*-4%*	17	*7%*	15	*-7%*
Spain	228	306	383	*68%*	332	*46%*	451	*98%*	283	*24%*
Sweden	56	53	53	*-6%*	52	*-7%*	58	*3%*	55	*-3%*
UK	589	559	533	*-10%*	530	*-10%*	536	*-9%*	433	*-26%*
EU-27	4521	4100	4296	*-5%*	3916	*-13%*	4527	*0%*	3436	*-24%*
Croatia	23	23	25	*10%*	21	*-11%*	27	*19%*	21	*-10%*
Turkey	126	223	272	*116%*	213	*69%*	389	*208%*	273	*116%*
Norway	34	38	45	*32%*	39	*15%*	44	*29%*	37	*10%*
Switzerland	45	43	43	*-4%*	42	*-7%*	42	*-7%*	39	*-13%*

Emission trends differ greatly across economic sectors. As shown in Table 2.12, increases in transport emissions are foreseen both by the national projections and the Coherent scenario. CO_2 emissions from the power sector are generally assumed to decline. The national projections anticipate slight reductions, while the Coherent scenario implies for 2020 a cut of emissions by more than 50 percent for this sector (Figure 2.6).

Table 2.12: CO_2 emissions by SNAP sector [million tons CO_2]. Note that this table lists sectoral emissions for 1990, but not for the Kyoto base year.

	1990[1)]	2000	2010				2020			
			National activity projections		"Coherent" energy scenario and CAPRI MTR agricultural projection		National activity projections		"Coherent" energy scenario and CAPRI MTR agricultural projection	
1: Power generation	1718	1524	1563	-9%	1227	-29%	1652	-4%	792	-54%
2: Domestic	767	673	707	-8%	679	-12%	718	-6%	668	-13%
3: Industrial combustion	892	731	756	-15%	773	-13%	817	-8%	749	-16%
4: Industrial processes	187	195	205	10%	178	-5%	212	14%	183	-2%
5: Extraction and distrib.	0	0	0	0	0	0	0	0	0	0
6: Solvents	0	0	0	0	0	0	0	0	0	0
7: Road transport	682	832	917	34%	906	33%	971	42%	897	32%
8: Other mobile sources	154	138	144	-7%	148	-4%	153	-1%	142	-8%
9: Waste	9	7	5	-42%	6	-36%	5	-47%	4	-52%
10: Agriculture	0	0	0	0	0	0	0	0	0	0
EU-27	4408	4100	4296	-3%	3916	-11%	4527	3%	3436	-22%

[1)] These emissions relate to 1990, but do not represent the Kyoto base year levels.

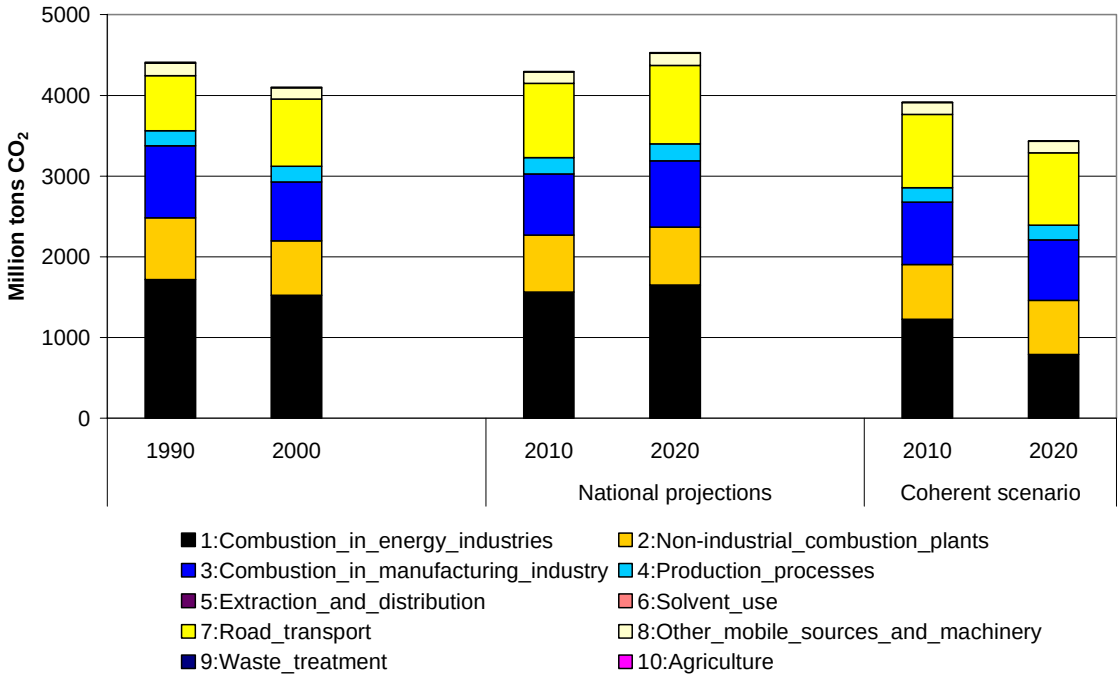

Figure 2.6: CO_2 emissions by SNAP sector for 1990, 2000 and for 2010 and 2020 for the national projections and the coherent scenario. Note that 1990 reflect the emissions in 1990, but not the Kyoto base year levels.

2.3 Agricultural projections

As a starting point for the further analysis, Table 2.13 summarizes the statistics on agricultural activities for the year 2000 as implemented in the GAINS database.

Table 2.13: Agricultural activity data for the year 2000

	Cattle	Pigs	Chicken and poultry	Sheep and goats	Horses	Fertilizer consumption	Fertilizer production
	1000 animal heads					kt N	
Austria	2155	3348	11787	395	82	121	185
Belgium	3001	7266	39728	176	73	145	1440
Bulgaria	652	1512	14963	3595	374	145	404
Cyprus	54	408	3310	625	7	8	0
Czech Rep.	1609	3315	32043	118	26	213	306
Denmark	1868	11922	21831	91	150	252	133
Estonia	253	300	2366	32	4	22	38
Finland	1057	1298	12570	107	57	167	245
France	20310	14930	270989	10788	444	2571	1494
Germany	14568	25767	118447	2305	520	1848	1308
Greece	566	936	28193	14449	140	285	216
Hungary	805	4834	31244	1219	79	320	290
Ireland	6558	1732	15338	7957	80	408	248
Italy	7245	8307	176722	12464	337	786	428
Latvia	367	394	3105	39	20	29	0
Lithuania	898	936	6373	39	75	98	530
Luxembourg	200	83	70	8	2	17	0
Malta	19	80	830	17	1	0	0
Netherlands	4070	13118	104972	1487	118	339	1300
Poland	5723	15447	111900	337	550	896	1497
Portugal	1172	2359	41195	4145	80	170	125
Romania	2532	4797	70076	8195	865	239	872
Slovakia	647	1488	12446	399	10	82	286
Slovenia	493	604	5107	118	14	34	0
Spain	6074	24367	169133	26892	499	1255	899
Sweden	1684	1918	16900	437	300	189	94
UK	11134	6482	168973	42340	291	1036	490
EU-27	95714	157948	1490610	138774	5198	11674	12827
Croatia	427	1233	11251	608	15	116	328
Turkey	11219	3	246477	38030	989	1276	479
Norway	987	609	12080	1841	48	103	618
Switzerland	1543	1498	6983	483	62	55	15

Data source: GAINS, based on EUROSTAT statistics, FAO, IFA, national statistical yearbooks, and bilateral consultations with national experts

2.3.1 National agricultural projections for 2020

In addition to the request for energy projections, DG Environment of the European Commission invited all Member States to provide official national projections of their agricultural activities up to 2020 as a basis for the revision of the NEC Directive. These projections should reflect national agricultural policies (as laid down, e.g., in governmental plans). Furthermore, these projections must include all necessary measures to comply with the Kyoto targets on greenhouse gas

emissions and the burden sharing agreement for 2012. For 2020, it should be assumed as a minimum that the Kyoto emission caps remain unchanged. With these requirements, the national agricultural projections for the revision of the NEC Directive should be consistent with the agricultural projections presented by the Member States to UNFCCC in their Fourth National Communications in 2006, however not taking into consideration areas outside of the modelling domain.

In the course of the bilateral consultations in 2006, 19 Member States as well as Norway and Switzerland have supplied national agricultural projections to IIASA for implementation into the GAINS model (Table 2.14). Collectively, these national projections constitute the "National Projections" baseline scenario for the revision of the NEC directive. For those Member States that have not provided their own agricultural projection, the "National Projections" baseline case assumes by default the agricultural development as outlined by the CAPRI (EEA, 2004) and EFMA (EFMA, 2005) agricultural and fertilizer projections (see Section 2.3.2). For Member States for which CAPRI and/or EFMA projections are unavailable, projections developed by the Food and Agricultural Organization (FAO) have been used (Bruinsma, 2003).

For the EU-27 as a whole (Table 2.15), these national projections anticipate between 2000 and 2020 for cattle a 12 percent decline in livestock numbers (dairy cows drop by about 16 percent and beef cattle by about 10 percent), for sheep a reduction by 11 percent and increases of four and eight percent in the numbers of pigs and poultry, respectively. Use of nitrogen fertilizers is estimated to decline in the EU-27 by about six percent.

While these national projections reflect the latest governmental views of the individual Member States on the future agricultural development, there is no guarantee for Europe-wide consistency in terms of assumptions on economic development trends, and national as well EU-wide agricultural policies.

Table 2.14: Data sources for the “National projections” NEC baseline scenario

	Data source	Date of last information exchange	Comments
Austria	National (2006)	9 January 2006	
Belgium	National (2007)	30 April 2007	
Bulgaria	FAO (2003)		Update using CRONOS database
Cyprus	FAO (2003), EFMA (2005)		
Czech Rep.	National (2005)	26 June 2006	
Denmark	National (2006)	10 November 2006	
Estonia	National (2006)	4 May 2006	
Finland	National (2006)	1 March 2007	
France	National (2004)	18 May 2004	
Germany	CAPRI (2004), EFMA (2005)		
Greece	CAPRI (2004), EFMA (2005)		
Hungary	National (2006)		Projection submitted to UNECE
Ireland	National (2006)	20 November 2006	
Italy	National (2006)	31 August 2006	
Latvia	National (2006)	7 February 2006	
Lithuania	CAPRI (2004), EFMA (2005)		
Luxembourg	CAPRI (2004), EFMA (2005)		
Malta	National (2006)	27 January 2007	For some categories discrepancies for historical years, supplementary data from FAO, IFA , and CRONOS database used
Netherlands	National (2006)	14 September 2006	
Poland	National (2005)	19 October 2005	
Portugal	National (2006)	16 October 2006	
Romania	FAO (2003), National (2007)	26 January 2007	For some categories discrepancies for historical years, supplementary data from FAO and IFA used
Slovakia	CAPRI (2004), EFMA (2005)		
Slovenia	National (2006)	6 September 2006	
Spain	National (2007)	24 May 2007	
Sweden	National (2006)	2 July 2006	
UK	National (2006)	27 July 2006	
Croatia	FAO (2003)		
Turkey	FAO (2003)		Update using CRONOS database
Norway	National (2005)	10 February 2005	
Switzerland	National (2006)	10 January 2007	

Table 2.15: National projections of agricultural activities for the year 2020. Source: GAINS, based on national submissions to IIASA.

	Cattle	Pigs	Chicken and poultry	Sheep and goats	Horses	Fertilizer consumption	Fertilizer production
	1000 animal heads					kt N	
Austria	1896	3228	13007	389	87	102	225
Belgium	2586	7266	39728	129	73	142	1440
Bulgaria	677	1100	22958	2411	373	151	350
Cyprus	48	457	4830	655	7	7	0
Czech Rep.	1400	3800	36234	260	28	230	310
Denmark	1310	14728	18146	95	168	176	0
Estonia	222	448	2640	87	4	21	38
Finland	791	1270	13113	97	65	145	210
France	19145	16327	226966	9971	458	2313	1374
Germany	12216	22490	89767	1592	770	1688	1000
Greece	520	994	23923	14819	140	202	200
Hungary	907	7000	43000	1600	82	398	250
Ireland	4937	1503	13200	4941	85	320	0
Italy	6418	9181	197983	11320	337	799	428
Latvia	350	508	5091	55	16	35	0
Lithuania	766	1208	12782	38	65	119	500
Luxembourg	189	94	86	7	2	16	0
Malta	19	82	1010	26	3	1	0
Netherlands	3506	11181	108629	1951	165	272	1000
Poland	4850	15598	171500	340	355	963	1450
Portugal	1256	2064	38699	3992	40	170	152
Romania	2630	7300	90000	8297	800	391	800
Slovakia	693	1901	11602	359	10	101	270
Slovenia	527	665	5552	142	17	33	0
Spain	6173	26447	227461	26119	733	995	650
Sweden	1455	2490	20000	395	300	170	65
UK	8317	4835	175620	33813	291	976	500
EU-27	83804	164165	1613525	123900	5474	10936	11212
Croatia	566	1273	12589	916	14	116	300
Turkey	14561	4	344710	32000	664	1200	600
Norway	907	633	14290	1416	55	90	630
Switzerland	1403	1357	7490	485	72	50	15

Data sources: GAINS, based on national submissions to IIASA

2.3.2 CAPRI agricultural projection including the CAP mid-term review

As an alternative to the national agricultural projections, EU-wide livestock projections developed with the CAPRI model for the European Environment Agency (EEA, 2004) as well as projections of mineral fertilizer use provided by the European fertilizer association EFMA have been implemented into GAINS (Table 2.16). The methodology used for CAPRI projections combines the standard structure of the agricultural sector model CAPSIM with amendments to systematically integrate external forecasts. CAPSIM is a partial equilibrium modelling tool with behavioural functions for activity levels, input demand, consumer demand and processing. It covers the whole of agriculture of the EU Member States.

Table 2.16: CAPRI model projections of agricultural activities of fertilizer production and consumption for the year 2020. Source: GAINS, based on CAPRI results and EFMA projections.

	Cattle	Pigs	Chicken and poultry	Sheep and goats	Horses	Fertilizer consumption	Fertilizer production
	1000 animal heads					kt N	
Austria	1950	3532	11225	337	87	92	225
Belgium	2806	8241	67363	146	73	142	1440
Bulgaria	677	1100	22958	2411	373	151	350
Cyprus	48	457	4830	655	7	7	0
Czech Rep.	1435	3913	41035	171	28	333	310
Denmark	1343	13821	18441	91	165	190	0
Estonia	214	300	3052	36	4	30	38
Finland	886	1271	12152	79	65	156	210
France	18723	17408	317895	10986	458	2355	1374
Germany	12216	22490	89767	1592	770	1688	1000
Greece	520	994	23923	14819	140	202	200
Hungary	801	4695	31470	1446	82	392	250
Ireland	5306	1994	15621	7906	80	307	0
Italy	5794	9506	187656	9033	337	558	428
Latvia	270	409	3811	76	16	32	0
Lithuania	766	1208	12782	38	65	119	500
Luxembourg	189	94	86	7	2	16	0
Malta	14	74	1010	26	3	1	0
Netherlands	3631	10892	124043	1570	165	231	1000
Poland	4887	19712	125282	476	355	1103	1450
Portugal	794	2692	32894	4148	40	87	152
Romania	2740	7300	90000	8295	800	391	800
Slovakia	693	1901	11602	359	10	101	270
Slovenia	528	773	5032	171	17	31	0
Spain	6614	29547	186444	27037	497	1007	865
Sweden	1747	1549	20160	422	300	159	65
UK	10732	5047	173346	33258	291	995	500
EU-27	86322	170920	1633880	125590	5230	10873	11427
Croatia	566	1273	12589	916	14	116	300
Turkey	14561	4	344710	32000	664	1200	600
Norway	897	725	16325	1784	55	97	630
Switzerland	1422	1419	8477	501	72	47	15

The reference projection (EEA, 2004), referred to further as the CAPRI projection, explores the long term impact of the Common Agricultural Policy (CAP) on the European Union agriculture. This scenario is based on existing exogenous projections (e.g., FAPRI, FAO, DG AGRI) for cropping areas, production, consumption, feed use, supplemented by own trend projections.

For the EU-27 as a whole, these CAPRI model projections anticipate between 2000 and 2020 largely similar changes as the national projections. They foresee about 21 percent drop in dairy cow numbers followed by a seven percent decline in beef. The development of the beef sector depends on the assumption of a continued milk quota regime with expected milk yield increases (approximately 30 percent on average) and on the long term demand shift from beef to pig and poultry meat. The latter (in terms of livestock numbers) are projected to increase by about eight percent during the period. More details on the modelling approach and results of CAPRI reference run can be found in EEA, 2004.

The mineral nitrogen fertilizer projection for the EU-25 as well as for Norway and Switzerland was developed by EFMA, 2005. EFMA prepares such forecast annually using quantitative information from various sources (e.g., from USDA, FAPRI, DG AGRI) and combines this with qualitative analyses made by EFMA experts. The results are consulted with national experts. Overall for EU-25, EFMA projects a nine percent decline in N-fertilizer use between 2000 and 2015. Projections for Bulgaria and Romania originate from the FAO study (Bruinsma, 2003).

2.4 Emission control legislation

The NEC baseline projections estimate future emissions on the basis of the development of emission generating activities, country- and sector-specific emission factors and the progressing implementation rates of already decided emission control legislation. The analysis is based on a detailed inventory of national emission control legislation (including the transposition of EU-wide legislation) as of mid 2006. The baseline emission projections consider legislation listed in Table 2.17 to Table 2.21, and assume that they are fully implemented in all Member States according to the foreseen time schedule. They ignore, however, further measures that might be necessary to meet the national emission ceilings in 2010 if they are not already put into national legislation. Furthermore, the baseline projections neglect emission reduction measures that could be required for compliance with the EU air quality limit values, especially for NO_2 and PM10.

Table 2.17: Legislation considered in the baseline projections for SO_2 emissions

Large combustion plant directive
Directive on the sulphur content in liquid fuels
Directives on quality of petrol and diesel fuels
IPPC legislation on process sources
Sulphur content of gasoil used by non-road mobile machinery and inland waterway vessels (reduction from 1000 ppm to 10 ppm) according to the Proposal Com(2007) 18 of the Directive of the European Parliament and of the Council to amend Directives 98/70/EC and 1999/32/EC.
National legislation and national practices (if stricter)

Table 2.18: Legislation considered in the baseline projections for NO_x emissions

Large combustion plant directive
Euro-standards, including adopted Euro-5 and Euro-6 for light duty vehicles
EU emission standards for motorcycles and mopeds
Legislation on non-road mobile machinery
Higher real life emissions of Euro-II and Euro-III for diesel heavy duty and light duty vehicles compared with the test cycle
IPPC legislation for industrial processes
National legislation and national practices (if stricter)

Table 2.19: Legislation considered in the baseline projections for VOC emissions

Stage I directive (liquid fuel storage and distribution)
Directive 91/441 (carbon canisters)
Euro-standards, including adopted Euro-5 and Euro-6 for light duty vehicles
Fuel directive (RVP of fuels)
Solvents directive
Product directive (paints)
National legislation, e.g., Stage II (gasoline stations)

Table 2.20: Legislation considered in the baseline projections for NH_3 emissions

IPPC directive for pigs and poultry production
National legislation including elements of EU law, i.e., Nitrate and Water Framework directives
Current practice that includes implementation of *Code of Good Agricultural Practice* which is mandatory under the UNECE Gothenburg Protocol

Table 2.21: Legislation considered in the baseline projections for PM2.5 emissions

Large combustion plant directive
Euro-standards, including the adopted Euro-5 and Euro-6 standards for light duty vehicles
Emission standards for motorcycles and mopeds
Legislation on non-road mobile machinery
IPPC legislation on process sources
National legislation and national practices (if stricter)

2.5 The impacts of including Euro 5 and 6 emission limit values to the NEC Baseline

In contrast to the baseline projections developed for the CAFE analyses leading to the Thematic Strategy on Air Pollution, the NEC baseline incorporates the recent agreement of the Council and the Parliament on the Euro5/6 emission standards for light duty vehicles. The following paragraphs provide a quantitative assessment of the changes in baseline emissions and costs.

The emission limit values corresponding to the adopted standards are given in Table 2.22.

Table 2.22: Selected emission limit values for passenger cars of Euro 5 and 6 [milligrams per kilometre][(a), (b)]

Emission limit values	*Total hydrocarbons (THC)*		*Oxides of nitrogen (NO_x)*		*Combined THC+NO_x*		*Particulate matter (PM)*	
	Petrol	Diesel	Petrol	Diesel	Petrol	Diesel	Petrol[(c)]	Diesel
Euro 5 (from 2009)	100	-	60	180	-	230	5	5
Euro 6 (from 2014)	100	-	60	80	-	170	5	5

Key: Petrol = Positive Ignition, diesel =Compression Ignition

(a) The final Regulation awaits finalisation in Council and Parliament. The compromise text that was agreed in December 2006 can be obtained at the following web site: http://www.europarl.europa.eu/sides/getDoc.do?pubRef=-//EP//TEXT+TA+20061213+ITEMS+DOC+XML+V0//EN&language=EN#title10

(b) The limit values for the lowest weight class of light commercial vehicles (N1 class I) are identical to those for passenger cars. The limit values for the heavier weight classes (N1 class II and class III) are higher.

(c) Positive ignition particulate mass standards apply only to vehicles with direct injection engines

During the negotiations on the Euro5/6 standards the Commission has prepared impact assessments for the Euro 5 and Euro 6 proposals[1]. The finally adopted emission limit values were closest to those analysed as Scenario A25 by the TREMOVE model. Increases in ex-tax retail prices compared to Euro 4 vehicles for the years 2010 and 2015 have been estimated by TREMOVE for each vehicle category and are given in Table 2.23, emission reductions in Table 2.24.

[1] See http://ec.europa.eu/enterprise/automotive/pagesbackground/pollutant_emission/sec_2005_1745.pdf; and http://ec.europa.eu/enterprise/automotive/pagesbackground/pollutant_emission/impact_assessment_euro6.pdf

Table 2.23: Costs of Euro 5 and Euro 6 emission limit values in € per vehicle (2000 price level). Source: TREMOVE, GAINS

	TREMOVE		*GAINS*	
	2010	2015	Euro 5	Euro 6
PCGS small gasoline car -1,4 l	31	31		
PCGM medium gasoline car 1,4-2,0 l	42	42		
PCGB big gasoline car +2,0 l	63	63		
PCDS small diesel car -1,4 l	220	415		
PCDM medium diesel car 1,4-2,0 l	283	504		
PCDB big diesel car +2,0 l	693	761		
LTD light duty vehicle diesel	799	913		
LTG light duty vehicle gasoline	67	67		
Gasoline vehicles[1)]			46	46
Diesel vehicles[1)]			340	532

[1)] Cost data used by GAINS are weighted averages of the costs of the detailed vehicle categories in the TREMOVE database, derived with weights provided by DG ENV.

Table 2.24: Emission reductions of Euro 5 and 6 computed by TREMOVE v 2.32b for 2020

	kt	*% of reduction effort of the Thematic Strategy on Air Pollution*
PM	27	11%
NO_x	314	26%
Hydrocarbons (VOC)	33	5%

Source: Impact Assessment for Euro 6 emission limits for light duty vehicles. European Commission Staff Working Paper, Brussels, 20 September 2006

The cost assessment with TREMOVE includes a 1.5 percent increase in fuel consumption for diesel passenger cars. Net welfare cost of the measure – without including environmental externalities – was estimated by TREMOVE at €1.9 billion. These costs represent the net present value of the annual welfare cost for the period 2010-2020, calculated with a 4% discount rate. This calculation used version 2.32b of the TREMOVE model, available in 2005 when the impact assessments for Euro 5 and 6 were performed. A newer version of the model (2.44) is now available, where the share of diesel cars in vehicle sales has been re-estimated on the basis of latest observed data. For example, in Version 2.44 the share of diesel light duty vehicles amounts now to 49 percent of the sales in 2015, while the earlier Version 2.32b had a share of only 34 percent. This difference has an obvious influence on the average costs per vehicle and on resulting emission reductions. While assessments of the impacts of the adopted Euro5/6 limit values are not yet available, simplified calculations comparing vehicle sales in both TREMOVE versions would suggest an increase in costs by 39 percent, implying total costs of the new emission standards for light duty vehicles of €2.6 billion. At the same time, the larger share of diesel vehicles would also imply higher emission reductions.

While the NEC baseline projection described in this report includes the recent agreement on the Euro5/6 emission standards, they were not considered in the CAFE baseline projections (Amann

et al., 2004) that have been used for the analyses for the Thematic Strategy on Air Pollution. Thus, a proper comparison of emission control costs between CAFE and NEC of the further measures to address the objectives of the Thematic Strategy must include the costs of the adopted Euro5/6 standards on top of costs computed in relation to the NEC baseline projections.

To estimate these differences, GAINS applied input data on costs per vehicle, the dates of introduction of the limit values and the emissions limit values as provided in Table 2.23 and Table 2.24 for the national energy projections and for the Coherent scenario. These are compared in Table 2.25 with the LREM scenario computed with the PRIMES model assuming a carbon price of 20 €/t CO_2 as presented in the NEC Report #3 (Amann *et al.*, 2007a), which is similar to the CAFE baseline scenario that assumed a carbon price of 20 €/t CO_2. Resulting health benefits have been quantified with the CAFE Cost-Benefit model. The differences in emission control costs between projections is caused by different growth projections for the numbers of diesel and gasoline vehicles.

Table 2.25: Emission reductions, costs and benefits of Euro 5 and 6 for the year 2020, as they are included in the NEC baseline presented in this report

	LREM energy projections with some climate policies baseline (€20/tCO_2)[1)]	National baseline projections	"Coherent scenario" presented in this report
Emission reductions			
Reduction in PM2.5 emissions	15 kt	28 kt	14 kt
Reduction in hydrocarbon emissions	29 kt	21 kt	28 kt
Reduction in NO_x emissions	336 kt	615 kt	334 kt
Costs	**€3.0 bn**	**€5.1 bn**	**€2.9 bn**
Monetised health benefits			
Benefits (VOLY – median)	€3.9 bn	€7.4 bn	€3.9 bn
Benefits (VOLY – mean)	€7.2 bn	€13.8 bn	€7.2 bn
Benefits (VSL – median)	€6.5 bn	€12.4 bn	€6.5 bn
Benefits (VSL – mean)	€12.1 bn	€23.2 bn	€12.1 bn
Benefit/Cost ratios			
Benefit (VOLY – median)/Cost ratio	1.3	1.4	1.3
Benefit (VOLY – mean)/Cost ratio	2.4	2.7	2.4
Benefit (VSL – median)/Cost ratio	2.2	2.4	2.2
Benefit (VSL – mean)/Cost ratio	4.0	4.6	4.0

Source: GAINS and CAFE CBA model estimates.

1) PRIMES €20 scenario as presented in Amann et al., 2007a

With the final numbers on emission standards and implementation dates, the GAINS cost estimates presented in Table 2.25 are – for a scenario with comparable ambition level on greenhouse gas emissions - somewhat higher (i.e., €3.0 billion per annum in 2020) than the earlier RAINS estimate for the Thematic Strategy on Air Pollution. Note that the updated estimates also

include the implementation costs in Bulgaria and Romania. Health benefits (mortality and morbidity) of the Euro 5/6 standards are estimated at 3.9-12.1 billion in 2020, depending on the value and methodology used for estimating the value of human life. Thereby, health benefits of Euro 5 and 6 alone would be between 1.3 and 4 times higher than the costs.

As a sensitivity analysis the costs of introducing Euro 5 and 6 were calculated for the national energy and transport projections that have been collected for the NEC analysis. Compared to the CAFE baseline, these projections assume for 2020 higher fuel consumption (as only few climate change policies are included in the baselines), as well as a higher share of diesel fuel for passenger cars. With these assumptions, the annual implementation costs of Euro 5 and 6 are estimated by GAINS at €5.1 billion in 2020, while annual health benefits would range between €7.4 and €23.2. billion. Health benefits are higher because of larger emission reductions resulting from the higher level of fuel consumption and the larger share of diesel vehicles. The benefit-cost ratio would range between 1.4 and 4.6, i.e., somewhat higher than in the baseline with climate policies.

It should be noted that the impacts and costs of Euro 5 and 6 will be higher after 2020 when new vehicles will have fully replaced the older ones. In the same vein costs and benefits will be lower in 2015 than in 2020.

3 Resulting baseline emission projections

3.1 Projections of SO_2 emissions

Table 3.1: SO_2 emissions for 2000, 2010 and 2020 [kt SO_2]

	2000	2010			2020	
		National activity projections	"Coherent" energy scenario and CAPRI MTR agricultural projection	National emission ceiling	National activity projections	"Coherent" energy scenario and CAPRI MTR agricultural projection
Austria	34	21	27	39	20	22
Belgium	175	98	94	99	86	65
Bulgaria[1)]	847	441	437	836	115	90
Cyprus[1)]	48	18	18	39	8	8
Czech Rep.	252	236	141	265	178	60
Denmark	28	19	18	55	21	19
Estonia	90	76	26	100	48	8
Finland	76	66	72	110	59	44
France	658	494	359	375	493	269
Germany	630	470	330	520	438	231
Greece	483	175	147	523	96	54
Hungary	484	144	79	500	67	50
Ireland	132	35	26	42	36	20
Italy	755	340	291	475	345	260
Latvia	14	22	9	101	19	9
Lithuania	48	39	12	145	39	12
Luxembourg[1)]	4	2	2	4	2	2
Malta	34	9	12	9	8	8
Netherlands	75	50	46	50	50	35
Poland	1509	1165	1066	1397	857	474
Portugal	289	132	95	160	86	55
Romania[1)]	773	331	332	918	139	109
Slovakia	128	68	48	110	81	38
Slovenia	99	27	23	27	23	16
Spain	1457	501	438	746	446	282
Sweden	46	43	38	67	41	37
UK	1155	458	409	585	274	146
EU-27	10322	5481	4594	8297	4074	2424
Croatia[1)]	108	67	67		62	62
Turkey[1)]	1646	1145	1146		911	436
Norway	27	25	28		26	23
Switzerland	20	19	16		18	15

1) No national projections have been supplied. The PRIMES €20 projection and/or the CAPRI agricultural projections have been used instead for the national scenario.

Table 3.2: SO_2 emissions of the EU-27 by SNAP sector for 2000, 2010 and 2020 [kt SO_2]

	2000	2010			2020	
		National activity projections	"Coherent" energy scenario and CAPRI MTR agricultural projection	National emission ceiling	National activity projections	"Coherent" energy scenario and CAPRI MTR agricultural projection
1: Power generation	7009	3193	2447		1774	585
2: Domestic	741	528	401		495	301
3: Industrial combustion	1516	1075	1048		1109	862
4: Industrial processes	650	561	573		568	548
5: Extraction and distrib.	0	0	0		0	0
6: Solvents	0	0	0		0	0
7: Road transport	156	16	19		14	19
8: Other mobile sources	236	97	98		102	100
9: Waste	8	6	4		6	3
10: Agriculture	5	5	6		5	6
EU-27	10322	5481	4594		4074	2424

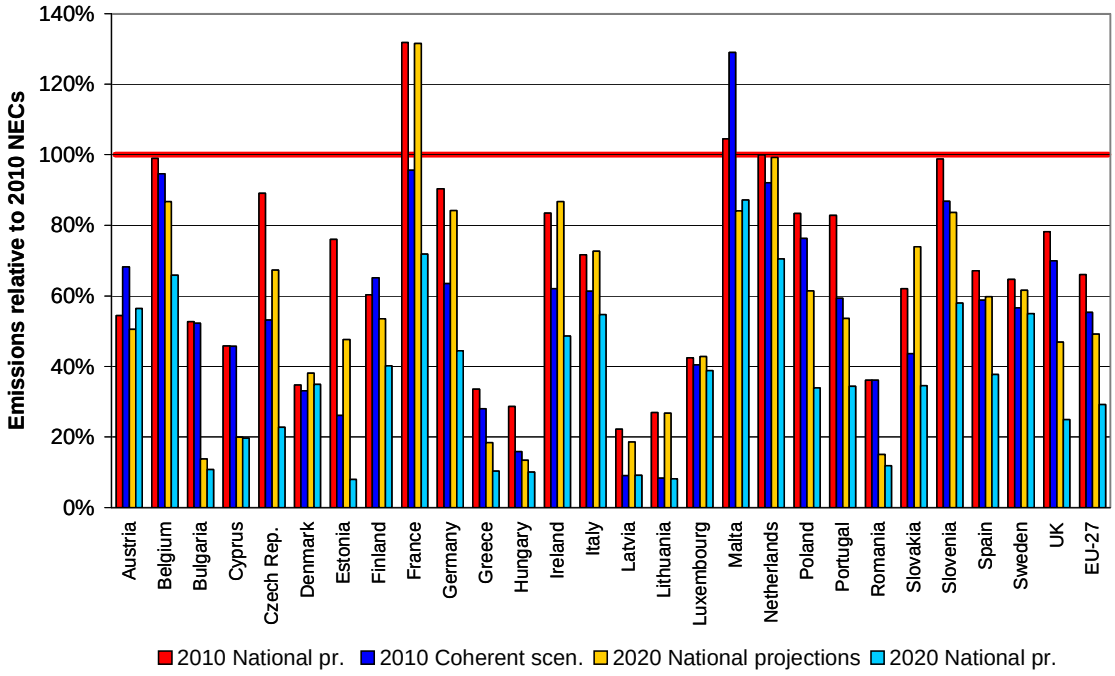

Figure 3.1: Comparison of SO_2 baseline projections for 2010 and 2020 with the 2010 National Emission Ceilings

3.2 Projections of NO_x emissions

Table 3.3: NO_x emissions for 2000, 2010 and 2020 [kt NO_x]

	2000	2010			2020	
		National activity projections	"Coherent" energy scenario and CAPRI MTR agricultural projection	National emission ceiling	National activity projections	"Coherent" energy scenario and CAPRI MTR agricultural projection
Austria	202	172	147	103	130	103
Belgium	351	259	255	176	201	167
Bulgaria[1)]	163	156	156	247	110	100
Cyprus[1)]	26	18	18	23	15	15
Czech Rep.	315	297	233	286	188	135
Denmark	213	168	155	127	126	104
Estonia	39	37	28	60	24	18
Finland	212	169	178	170	129	120
France	1475	1187	1073	810	867	698
Germany	1750	1212	1194	1051	933	826
Greece	326	233	234	344	192	170
Hungary	186	140	119	198	106	88
Ireland	132	100	95	65	74	59
Italy	1353	1074	1037	990	769	652
Latvia	34	42	28	61	31	20
Lithuania	50	51	42	110	42	31
Luxembourg[1)]	33	25	25	11	17	16
Malta	8	8	7	8	6	6
Netherlands	410	287	275	260	230	209
Poland	840	683	687	879	431	403
Portugal	279	211	189	250	157	119
Romania[1)]	329	334	334	437	261	248
Slovakia	109	95	74	130	79	60
Slovenia	60	52	41	45	35	22
Spain	1343	1161	1169	847	855	686
Sweden	229	182	201	148	157	160
UK	1855	1204	1084	1167	845	658
EU-27	12322	9556	9078	9003	7011	5891
Croatia[1)]	87	73	73		53	53
Turkey[1)]	822	795	794		731	671
Norway	226	204	186		182	162
Switzerland	91	66	65		49	48

1) No national projections have been supplied. The PRIMES €20 projection and/or the CAPRI agricultural projections have been used instead for the national scenario.

Table 3.4: NO_x emissions of the EU-27 by SNAP sector for 2000, 2010 and 2020 [kt NO_x]

	2000	2010			2020	
		National activity projections	"Coherent" energy scenario and CAPRI MTR agricultural projection	National emission ceiling	National activity projections	"Coherent" energy scenario and CAPRI MTR agricultural projection
1: Power generation	2495	2021	1891		1482	949
2: Domestic	702	701	699		703	680
3: Industrial combustion	1416	1394	1291		1488	1237
4: Industrial processes	237	249	224		259	218
5: Extraction and distrib.	0	0	0		0	0
6: Solvents	0	0	0		0	0
7: Road transport	5599	3601	3480		1806	1660
8: Other mobile sources	1851	1571	1473		1254	1129
9: Waste	10	8	8		8	7
10: Agriculture	11	11	12		11	12
EU-27	12322	9556	9078		7011	5891

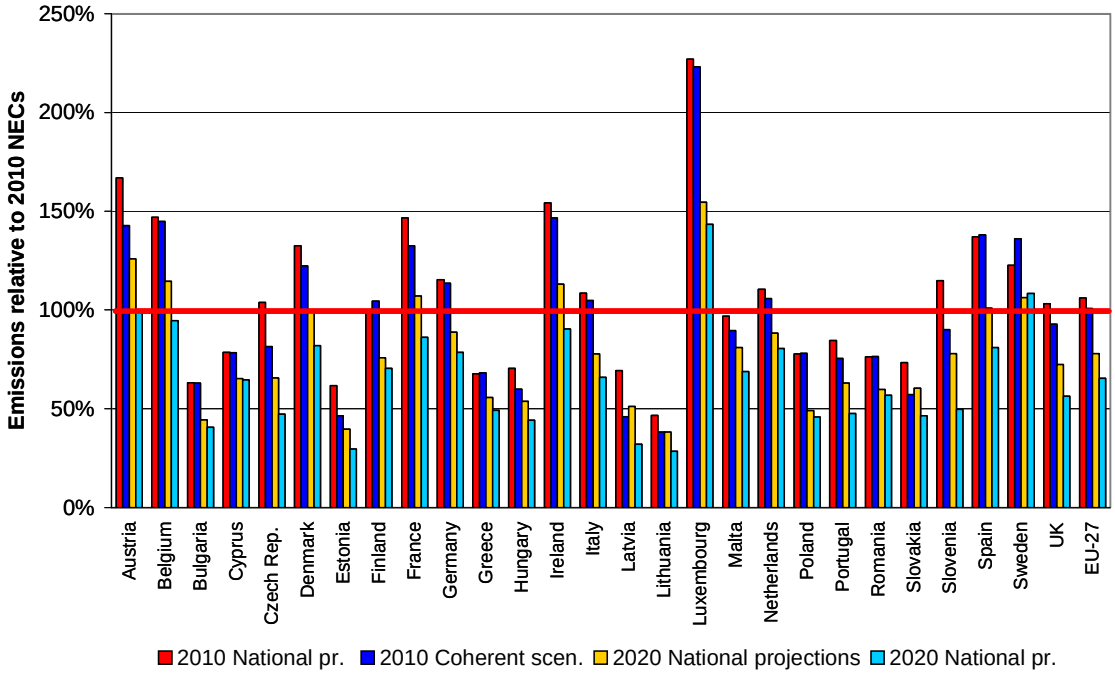

Figure 3.2: Comparison of NO_x baseline projections for 2010 and 2020 with the 2010 National Emission Ceilings

3.3 Projections of PM2.5 emissions

Table 3.5: PM2.5 emissions for 2000, 2010 and 2020 [kt PM2.5]

	2000	2010			2020	
		National activity projections	"Coherent" energy scenario and CAPRI MTR agricultural projection	National emission ceiling	National activity projections	"Coherent" energy scenario and CAPRI MTR agricultural projection
Austria	31	25	25		21	21
Belgium	35	29	26		26	21
Bulgaria[1)]	61	63	62		42	35
Cyprus[1)]	2	2	2		2	2
Czech Rep.	57	49	35		32	21
Denmark	25	20	20		15	14
Estonia	23	16	11		16	8
Finland	31	26	23		24	24
France	293	168	213		129	157
Germany	158	115	119		100	99
Greece	48	41	36		36	22
Hungary	52	33	26		40	23
Ireland	16	10	9		7	7
Italy	158	135	115		113	91
Latvia	18	17	14		16	12
Lithuania	13	12	11		11	10
Luxembourg[1)]	3	2	2		2	2
Malta	1	0	0		0	0
Netherlands	27	21	21		18	18
Poland	197	173	154		144	130
Portugal	81	52	28		43	18
Romania[1)]	127	142	142		142	122
Slovakia	25	20	15		21	14
Slovenia	12	10	8		9	6
Spain	143	106	107		85	79
Sweden	23	19	20		17	16
UK	121	80	77		61	55
EU-27	1782	1385	1321		1171	1027
Croatia[1)]	21	15	15		13	13
Turkey[1)]	313	249	250		290	249
Norway	56	54	58		44	43
Switzerland	12	8	8		7	6

1) No national projections have been supplied. The PRIMES €20 projection and/or the CAPRI agricultural projections have been used instead for the national scenario.

Table 3.6: PM2.5 emissions of the EU-27 by SNAP sector for 2000, 2010 and 2020 [kt PM2.5]

	2000	2010			2020	
		National activity projections	"Coherent" energy scenario and CAPRI MTR agricultural projection	National emission ceiling	National activity projections	"Coherent" energy scenario and CAPRI MTR agricultural projection
1: Power generation	199	165	133		140	43
2: Domestic	567	437	449		360	353
3: Industrial combustion	143	120	115		132	128
4: Industrial processes	236	194	175		204	177
5: Extraction and distrib.	7	6	5		5	4
6: Solvents	0	0	0		0	0
7: Road transport	310	184	163		99	93
8: Other mobile sources	157	118	114		69	64
9: Waste	85	85	86		85	85
10: Agriculture	77	77	80		78	81
EU-27	1782	1385	1321		1171	1027

3.4 Projections of NH_3 emissions

Table 3.7: NH_3 emissions for 2000, 2010 and 2020 [kt NH_3]

	2000	2010			2020	
		National activity projections	"Coherent" energy scenario and CAPRI MTR agricultural projection	National emission ceiling	National activity projections	"Coherent" energy scenario and CAPRI MTR agricultural projection
Austria	60	58	59	66	59	59
Belgium	84	80	83	74	77	82
Bulgaria[1)]	69	67	67	108	68	68
Cyprus[1)]	7	7	7	9	7	7
Czech Rep.	84	79	80	80	77	79
Denmark	91	58	59	69	53	53
Estonia	9	10	10	29	11	10
Finland	35	31	33	31	30	32
France	702	655	673	780	651	678
Germany[1)]	601	471	475	550	448	449
Greece[1)]	54	49	48	73	47	46
Hungary	77	82	72	90	90	74
Ireland	125	105	114	116	98	110
Italy	425	395	366	419	385	354
Latvia	13	14	12	44	15	12
Lithuania[1)]	37	37	37	84	40	40
Luxembourg[1)]	6	6	6	7	6	6
Malta	2	3	2	3	3	3
Netherlands	149	123	133	128	138	130
Poland	317	314	324	468	312	342
Portugal	76	71	61	90	70	57
Romania[1)]	133	165	166	210	173	174
Slovakia[1)]	31	31	31	39	32	32
Slovenia	20	21	19	20	21	19
Spain	390	360	369	353	368	378
Sweden	55	51	50	57	51	48
UK	323	270	299	297	267	280
EU-27	3975	3612	3657	4294	3594	3624
Croatia[1)]	28	30	30		32	32
Turkey[1)]	422	449	449		491	491
Norway	24	21	21		21	21
Switzerland	52	45	49		41	45

1) No national projections have been supplied. The CAPRI agricultural projections and/or the GAO (2003) projections have been used instead for the national scenario.

Table 3.8: NH_3 emissions of the EU-27 by SNAP sector for 2000, 2010 and 2020 [kt NH_3]

	2000	2010			2020	
		National activity projections	"Coherent" energy scenario and CAPRI MTR agricultural projection	National emission ceiling	National activity projections	"Coherent" energy scenario and CAPRI MTR agricultural projection
1: Power generation	6	8	10		13	11
2: Domestic	18	18	19		18	18
3: Industrial combustion	4	6	4		6	4
4: Industrial processes	75	66	69		64	68
5: Extraction and distrib.	0	0	0		0	0
6: Solvents	0	0	0		0	0
7: Road transport	78	43	53		20	21
8: Other mobile sources	1	1	1		1	1
9: Waste	180	176	174		175	173
10: Agriculture	3614	3296	3328		3297	3327
EU-27	3975	3612	3657		3594	3624

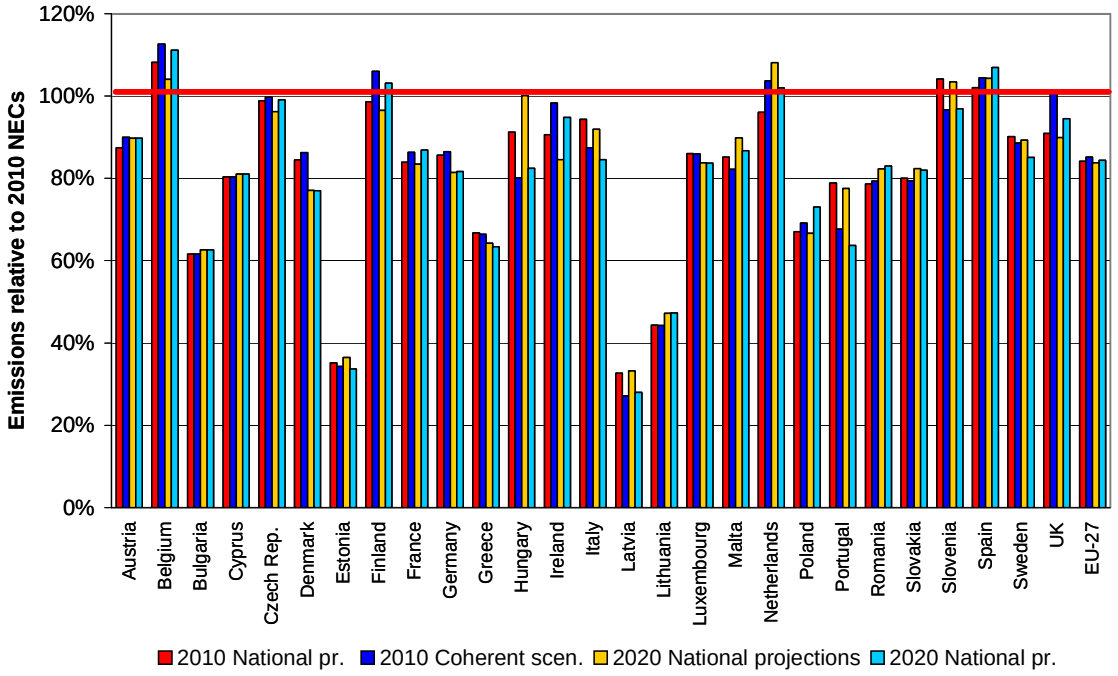

Figure 3.3: Comparison of NH_3 baseline projections for 2010 and 2020 with the 2010 National Emission Ceilings

3.5 Projections of VOC emissions

Table 3.9: VOC emissions for 2000, 2010 and 2020 [kt VOC]

	2000	2010			2020	
		National activity projections	"Coherent" energy scenario and CAPRI MTR agricultural projection	National emission ceiling	National activity projections	"Coherent" energy scenario and CAPRI MTR agricultural projection
Austria	184	136	141	159	114	114
Belgium	225	141	137	139	128	121
Bulgaria[1)]	134	133	133	175	86	85
Cyprus[1)]	14	6	6	14	5	5
Czech Rep.	234	194	180	220	148	133
Denmark	141	92	81	85	71	62
Estonia	39	28	29	49	22	22
Finland	160	111	101	130	91	82
France	1803	949	1094	1050	862	939
Germany	1461	1039	1104	995	858	908
Greece	291	171	163	261	139	121
Hungary	161	122	119	137	117	101
Ireland	86	57	57	55	51	51
Italy	1509	870	889	1159	702	642
Latvia	69	58	55	136	43	40
Lithuania	69	53	55	92	42	45
Luxembourg[1)]	13	8	8	9	7	7
Malta	7	4	3	12	3	3
Netherlands	259	158	157	185	168	158
Poland	578	400	460	800	319	382
Portugal	270	175	173	180	157	147
Romania[1)]	414	417	417	523	298	304
Slovakia	88	62	58	140	61	56
Slovenia	53	35	36	40	30	26
Spain	1125	815	779	662	838	767
Sweden	240	156	166	241	123	130
UK	1380	920	899	1200	837	809
EU-27	11007	7310	7500	8848	6321	6261
Croatia[1)]	102	74	74		42	42
Turkey[1)]	784	664	664		474	477
Norway	380	139	140		91	88
Switzerland	160	103	105		88	88

1) No national projections have been supplied. The PRIMES €20 projection and/or the CAPRI agricultural projections have been used instead for the national scenario.

Table 3.10: VOC emissions of the EU-27 by SNAP sector for 2000, 2010 and 2020 [kt VOC]

	2000	2010			2020	
		National activity projections	"Coherent" energy scenario and CAPRI MTR agricultural projection	National emission ceiling	National activity projections	"Coherent" energy scenario and CAPRI MTR agricultural projection
1: Power generation	108	113	121		101	86
2: Domestic	1094	733	862		565	643
3: Industrial combustion	56	74	57		79	51
4: Industrial processes	1157	1064	1082		1109	1109
5: Extraction and distrib.	704	584	624		586	628
6: Solvents	3865	2940	2906		2708	2650
7: Road transport	2978	913	980		483	484
8: Other mobile sources	858	690	663		489	403
9: Waste	111	122	122		124	124
10: Agriculture	77	77	83		77	83
EU-27	11007	7310	7500		6321	6261

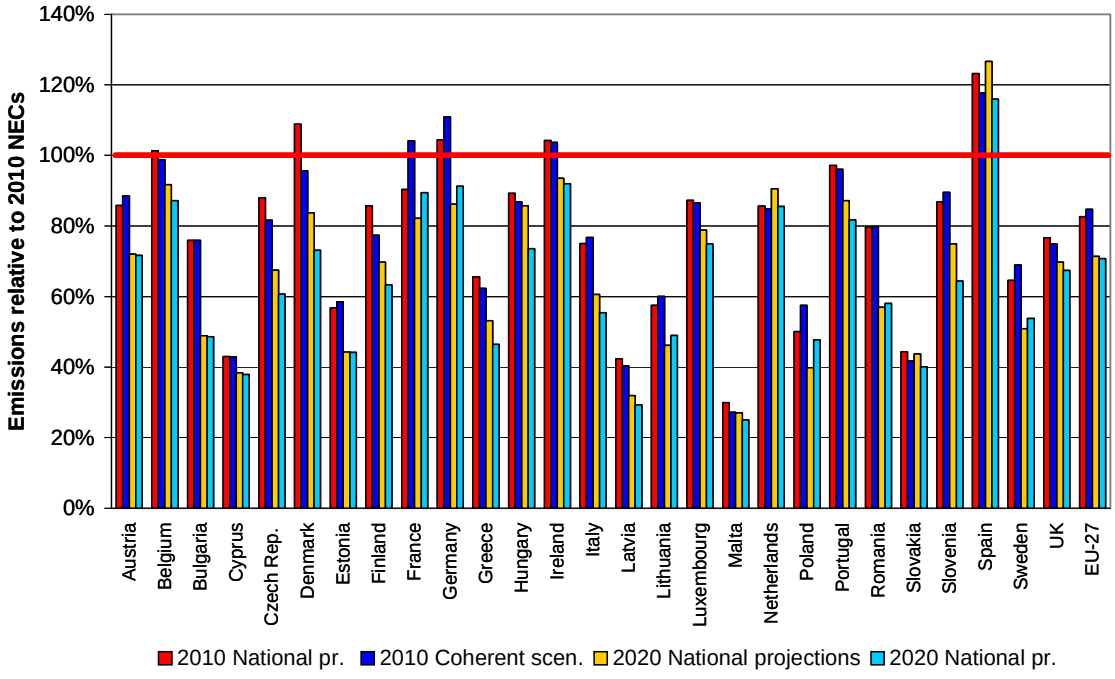

Figure 3.4: Comparison of VOC baseline projections for 2010 and 2020 with the 2010 National Emission Ceilings

4 Emission control costs

Table 4.1: Emission control costs for SO_2 and NO_x [million €/yr]

	SO_2			NO_x		
	2000	2020 National activity projections	2020 "Coherent" energy scenario and CAPRI MTR agricultural projection	2000	2020 National activity projections	2020 "Coherent" energy scenario and CAPRI MTR agricultural projection
Austria	295	447	272	221	953	730
Belgium	393	600	440	272	992	894
Bulgaria	66	167	122	4	598	571
Cyprus	2	53	53	12	82	82
Czech Rep.	500	510	208	105	707	655
Denmark	307	242	188	98	420	458
Estonia	5	89	30	7	121	117
Finland	268	341	209	91	467	414
France	948	1916	1324	939	5936	5400
Germany	2837	3215	1835	3552	7166	1204
Greece	151	433	378	179	1305	1409
Hungary	92	195	112	62	667	536
Ireland	99	253	156	64	428	433
Italy	2052	2238	1610	1310	6236	5102
Latvia	10	72	28	3	221	144
Lithuania	17	64	44	36	276	277
Luxembourg	28	53	49	44	183	173
Malta	1	25	23	8	71	64
Netherlands	363	665	337	358	1491	1528
Poland	652	1236	910	387	4008	4619
Portugal	82	357	176	134	1000	949
Romania	89	469	371	1	1247	1187
Slovakia	84	160	66	37	319	250
Slovenia	46	113	60	27	145	125
Spain	704	1778	1233	520	5330	4727
Sweden	421	464	285	220	834	766
UK	436	732	250	1053	4634	3497
EU-27	10947	16888	10768	9744	45838	42308
Croatia	51	82	82	0	19	19
Turkey	256	894	609	1	3293	3152
Norway	64	120	95	94	613	614
Switzerland	113	157	117	230	664	688

Table 4.2: Emission control costs for PM2.5 and NH_3 [million €/yr]

	PM2.5			NH_3		
	2000	2020 National activity projections	2020 "Coherent" energy scenario and CAPRI MTR agricultural projection	2000	2020 National activity projections	2020 "Coherent" energy scenario and CAPRI MTR agricultural projection
Austria	218	233	250	15	18	18
Belgium	202	194	134	110	128	142
Bulgaria	220	177	134	0	15	15
Cyprus[1)]	4	6	6	0	6	6
Czech Rep.	417	389	177	12	88	88
Denmark	64	120	113	139	452	433
Estonia	85	148	60	0	3	2
Finland	194	227	204	35	53	57
France	546	1730	2428	38	102	116
Germany	1943	1936	1560	511	994	994
Greece	342	336	91	2	7	7
Hungary	91	176	110	36	85	58
Ireland	50	66	51	24	36	41
Italy	460	945	516	110	208	205
Latvia	41	100	127	0	3	2
Lithuania	34	78	95	0	11	11
Luxembourg	6	8	7	0	0	0
Malta	1	3	3	0	0	0
Netherlands	214	315	293	501	544	509
Poland	886	1050	1030	81	140	141
Portugal	76	157	97	0	17	19
Romania	319	665	548	0	36	36
Slovakia	139	143	111	0	18	18
Slovenia	41	38	28	10	12	12
Spain	449	534	396	51	325	249
Sweden	214	247	206	26	47	42
UK	639	584	482	50	114	119
EU-27	7893	10605	9259	1749	3460	3341
Croatia	24	40	40	0	0	0
Turkey	727	1312	1037	0	0	0
Norway	85	232	232	3	5	6
Switzerland	68	61	58	38	120	130

Table 4.3: Emission control costs for VOC and total emission control costs [million €/yr]

	VOC			Total costs		
	2000	2020 National activity projections	2020 "Coherent" energy scenario and CAPRI MTR agricultural projection	2000	2020 National activity projections	2020 "Coherent" energy scenario and CAPRI MTR agricultural projection
Austria	-12	68	83	737	1720	1353
Belgium	52	187	196	1028	2102	1807
Bulgaria	2	-8	-9	292	948	832
Cyprus	-1	0	0	18	147	147
Czech Rep.	25	32	34	1060	1726	1162
Denmark	-1	17	12	607	1251	1203
Estonia	-4	-5	-4	93	356	206
Finland	-51	-52	-51	536	1036	487
France	261	1255	1275	2733	10939	10543
Germany	519	1130	1242	9361	14441	13783
Greece	-51	-61	-64	623	2021	1822
Hungary	-6	-6	-5	275	1117	810
Ireland	22	59	57	259	841	738
Italy	-390	-318	-433	3542	9308	7001
Latvia	-6	-24	-25	47	371	276
Lithuania	-7	-41	-41	81	388	387
Luxembourg	2	3	3	80	247	232
Malta	-2	-2	-2	9	97	88
Netherlands	257	392	383	1693	3407	3051
Poland	-18	-125	-117	1988	6309	6582
Portugal	-32	-20	-21	261	1511	1220
Romania	-26	-34	-34	384	2383	2108
Slovakia	-32	-46	-45	228	595	399
Slovenia	0	7	8	123	316	233
Spain	-19	31	111	1705	7998	6716
Sweden	-6	33	38	874	1624	720
UK	316	559	595	2492	6622	4943
EU-27	795	3031	3188	31129	79822	68851
Croatia	-4	-14	-14	71	127	127
Turkey	-88	-305	-305	896	5195	4493
Norway	-10	5	5	236	975	952
Switzerland	65	149	160	514	1151	1152

Table 4.4: Emission control costs by SNAP sector for SO_2 and NOx for the EU-27 [million €/yr]

	SO_2			NO_x		
	2000	2020 National activity projections	2020 "Coherent" energy scenario and CAPRI MTR agricultural projection	2000	2020 National activity projections	2020 "Coherent" energy scenario and CAPRI MTR agricultural projection
1: Power generation	5301	5921	1681	1162	1852	608
2: Domestic	817	1032	1092	656	1099	1063
3: Industrial combustion	929	1366	989	181	293	287
4: Industrial processes	233	346	315	276	318	269
5: Extraction and distrib.	0	0	0	0	0	0
6: Solvents	0	0	0	0	0	0
7: Road transport	3197	6963	5497	7459	36601	34730
8: Other mobile sources	470	1260	1194	9	5673	5350
9: Waste	0	0	0	0	0	0
10: Agriculture	0	0	0	1	1	1
EU-27	10947	16888	10768	9744	45838	42308

Table 4.5: Emission control costs by SNAP sector for PM2.5 and NH_3 for the EU-27 [million €/yr]

	PM2.5			NH_3		
	2000	2020 National activity projections	2020 "Coherent" energy scenario and CAPRI MTR agricultural projection	2000	2020 National activity projections	2020 "Coherent" energy scenario and CAPRI MTR agricultural projection
1: Power generation	2893	2729	862	0	0	0
2: Domestic	1755	3690	4661	0	0	0
3: Industrial combustion	972	1172	970	0	0	0
4: Industrial processes	1831	2607	2430	101	96	96
5: Extraction and distrib.	339	281	213	0	0	0
6: Solvents	0	0	0	0	0	0
7: Road transport	0	0	0	0	0	0
8: Other mobile sources	0	0	0	0	0	0
9: Waste	0	0	0	0	0	0
10: Agriculture	103	125	123	1648	3364	3246
EU-27	7893	10605	9259	1749	3460	3341

Table 4.6: Emission control costs by SNAP sector for VOC, and total emission control costs for the EU-27 [million €/yr]

	VOC			Total		
	2000	2020 National activity projections	2020 "Coherent" energy scenario and CAPRI MTR agricultural projection	2000	2020 National activity projections	2020 "Coherent" energy scenario and CAPRI MTR agricultural projection
1: Power generation	0	0	0	9355	10502	3150
2: Domestic	0	0	0	3228	5821	6816
3: Industrial combustion	0	0	0	2083	2831	2246
4: Industrial processes	218	310	306	2660	3677	3416
5: Extraction and distrib.	533	595	838	872	876	1050
6: Solvents	43	2127	2044	43	2127	2044
7: Road transport	0	0	0	10656	43564	40213
8: Other mobile sources	0	0	0	479	6933	6545
9: Waste	0	0	0	0	0	0
10: Agriculture	0	0	0	1752	3491	3370
EU-27	795	3031	3188	31129	79822	68851

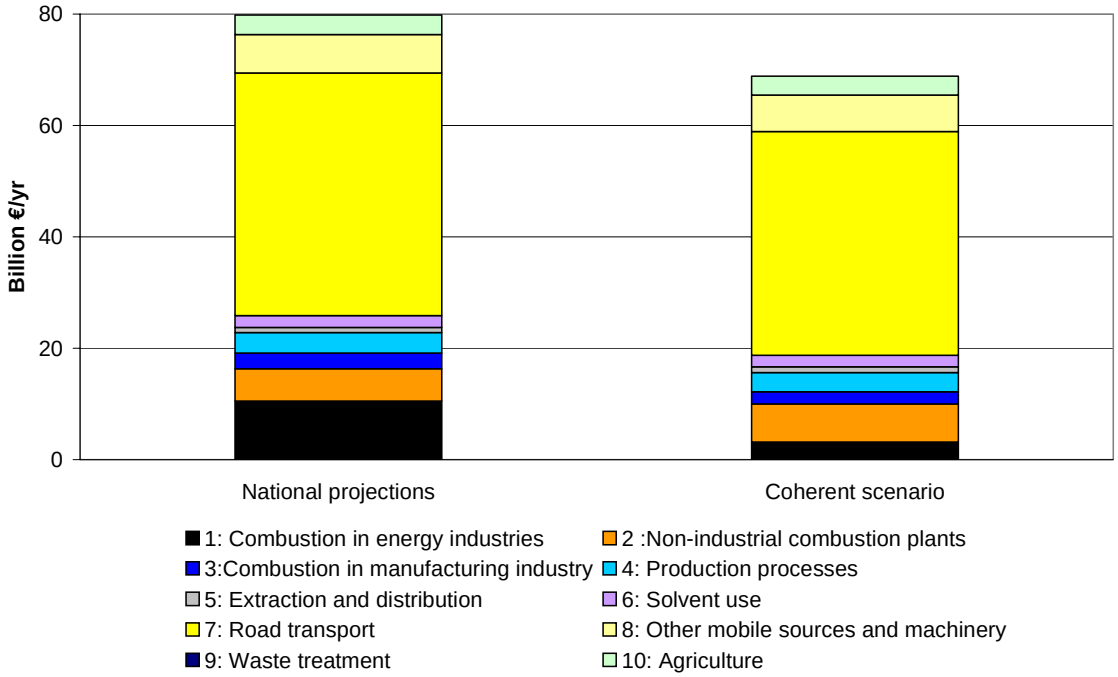

Figure 4.1: Emission control costs for the two current legislation baseline activity projections in 2020 by SNAP sector

5 Air quality and ecosystems impacts

5.1 Health impacts from PM

Table 5.1: Health impacts attributable to the human exposure to PM2.5

	Loss in statistical life expectancy [months]			Years of life loss (YOLL) [million years]		
	2000	2020 National activity projections	2020 "Coherent" energy scenario and CAPRI MTR agricultural projection	2000	2020 National activity projections	2020 "Coherent" energy scenario and CAPRI MTR agricultural projection
Austria	7.8	5.0	4.2	3.4	2.4	2.0
Belgium	12.2	8.5	7.2	6.7	5.1	4.3
Bulgaria	8.2	5.6	5.1	3.4	2.3	2.1
Cyprus	4.4	3.1	2.6	0.1	0.2	0.1
Czech Rep.	9.6	6.3	4.9	4.9	3.7	2.9
Denmark	6.6	4.8	4.3	1.9	1.4	1.3
Estonia	4.8	4.6	4.1	0.3	0.3	0.3
Finland	2.9	2.8	2.5	0.8	0.8	0.8
France	7.6	4.5	4.0	23.0	15.6	13.6
Germany	9.3	6.3	5.2	43.1	30.7	25.5
Greece	7.7	4.7	4.0	4.4	3.2	2.7
Hungary	11.0	7.8	6.1	5.6	4.3	3.4
Ireland	3.8	2.3	2.0	0.6	0.6	0.5
Italy	8.1	5.2	4.3	26.1	18.0	15.0
Latvia	5.9	5.2	4.6	0.7	0.6	0.6
Lithuania	5.7	5.2	4.6	1.0	0.9	0.8
Luxembourg	9.1	5.9	4.9	0.2	0.2	0.1
Malta	6.2	5.0	4.6	0.1	0.1	0.1
Netherlands	11.5	8.2	7.1	9.7	7.7	6.6
Poland	10.0	7.3	6.1	17.8	15.5	12.9
Portugal	5.8	3.4	2.4	3.1	2.1	1.5
Romania	8.9	7.1	6.4	9.3	8.2	7.4
Slovakia	9.4	6.7	5.2	2.3	2.0	1.6
Slovenia	8.4	5.6	4.5	0.9	0.7	0.5
Spain	4.8	2.8	2.4	10.1	7.5	6.4
Sweden	3.4	2.7	2.4	1.6	1.4	1.3
UK	6.7	4.2	3.6	20.6	14.5	12.4
EU-27	8.0	5.3	4.5	201.5	150.3	126.7
Croatia	8.5	5.7	5.0	2.1	1.4	1.2
Turkey						
Norway	2.5	1.8	1.7	0.6	0.5	0.4
Switzerland	6.2	3.7	3.0	2.5	1.5	1.2

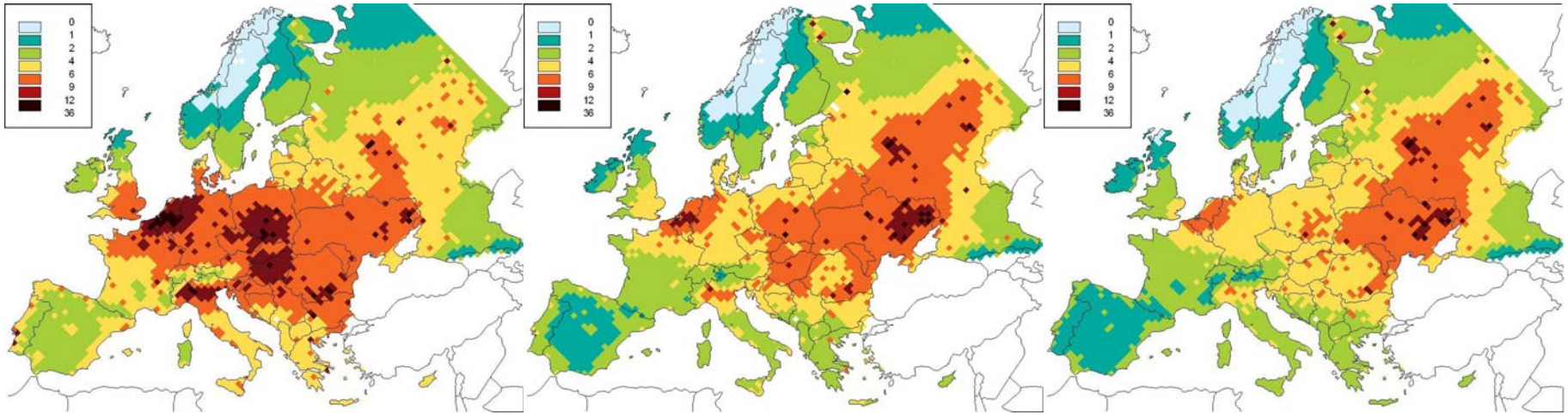

Figure 5.1: Loss in statistical life expectancy attributable to the exposure to PM2.5 (in months). Estimate for 2000 (left graph), for the 2020 national current legislation baseline projections (middle graph) and for the 2020 baseline projection of the Coherent scenario (right graph)

5.2 Eutrophication of terrestrial ecosystems

Table 5.2: Ecosystems with nitrogen deposition above critical loads for eutrophication

	Total ecosystems area [1000 km^2]	Ecosystems area with nitrogen deposition above critical loads [1000 km^2]			Percent of ecosystems area		
		2000	2020 National activity projections	2020 "Coherent" energy scenario and CAPRI MTR agricultural projection	2000	2020 National activity projections	2020 "Coherent" energy scenario and CAPRI MTR agricultural projection
Austria	35.7	35.6	29.9	26.3	100%	84%	74%
Belgium	7.1	6.7	6.4	6.4	95%	90%	90%
Bulgaria	48.3	45.6	43.5	40.5	94%	90%	84%
Cyprus	4.1	3.0	3.1	3.0	74%	76%	73%
Czech Rep.	11.2	11.2	10.9	10.8	100%	97%	96%
Denmark	3.1	3.0	2.5	2.5	98%	81%	81%
Estonia	22.4	12.3	8.6	7.2	55%	38%	32%
Finland	240.4	112.2	91.1	88.0	47%	38%	37%
France	180.1	176.7	168.6	164.1	98%	94%	91%
Germany	104.2	101.8	96.8	95.1	98%	93%	91%
Greece	9.3	9.3	9.3	9.3	100%	100%	100%
Hungary	10.4	10.3	8.3	6.8	99%	80%	65%
Ireland	8.9	7.4	6.2	6.3	83%	70%	71%
Italy	125.9	87.7	70.9	61.4	70%	56%	49%
Latvia	27.0	26.8	25.7	25.7	99%	95%	95%
Lithuania	17.7	17.7	17.7	17.7	100%	100%	100%
Luxembourg	0.8	0.8	0.8	0.8	100%	100%	100%
Malta		0.0					
Netherlands	4.4	4.1	3.8	3.8	94%	86%	86%
Poland	88.4	86.4	84.2	84.1	98%	95%	95%
Portugal	21.2	20.1	19.7	18.5	95%	93%	87%
Romania	62.8	60.6	60.0	60.0	96%	96%	96%
Slovakia	19.3	19.2	18.4	17.4	100%	95%	90%
Slovenia	5.3	5.3	5.2	5.2	99%	98%	98%
Spain	85.2	75.1	66.8	61.8	88%	78%	73%
Sweden	225.3	60.0	22.9	21.0	27%	10%	9%
UK	74.2	21.0	14.5	13.8	28%	20%	19%
EU-27	1442.7	1020.0	895.8	857.5	71%	62%	59%
Croatia	7.0	3.1	2.8	2.4	44%	40%	34%
Turkey							
Norway	318.8	13.1	4.4	2.9	4%	1%	1%
Switzerland	22.8	18.9	12.3	12.2	83%	54%	54%

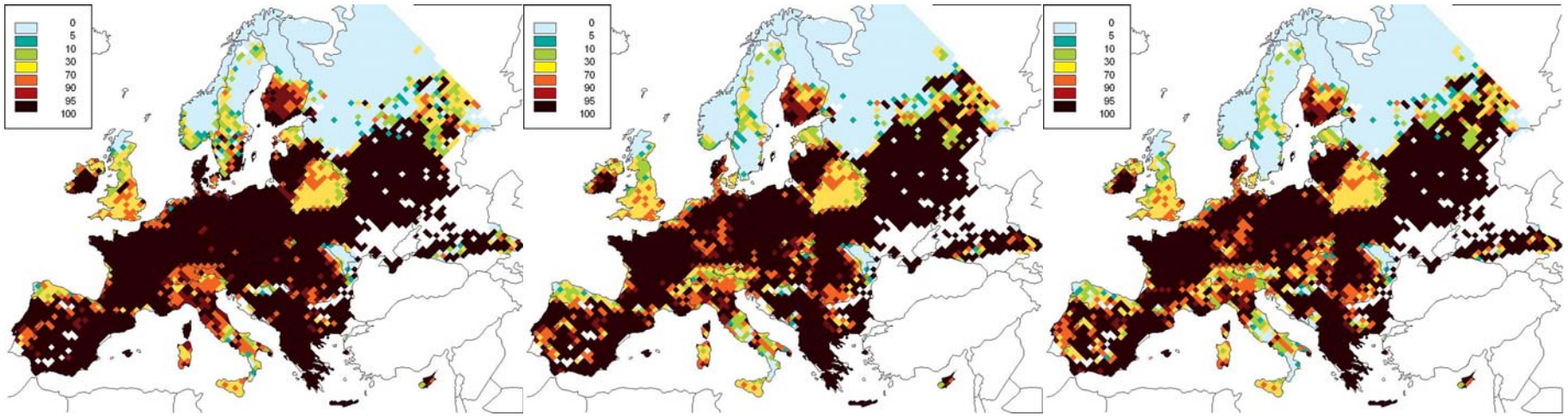

Figure 5.2:Percent of ecosystems area with nitrogen deposition exceeding the critical loads for eutrophication.

Estimate for 2000 (left graph), for the 2020 national current legislation baseline projections (middle graph) and for the 2020 baseline projection of the Coherent scenario (right graph)

5.3 Acidification

Table 5.3: Forests with acid deposition exceeding the critical loads for acidification

	Total ecosystems area [1000 km^2]	Ecosystems area with acid deposition above critical loads [1000 km^2]			Percent of ecosystem's area		
		2000	2020 National activity projections	2020 "Coherent" energy scenario and CAPRI MTR agricultural projection	2000	2020 National activity projections	2020 "Coherent" energy scenario and CAPRI MTR agricultural projection
Austria	35.7	0.4	0.1	0.0	1%	0%	0%
Belgium	6.3	4.6	1.4	0.9	73%	22%	14%
Bulgaria	48.3	0.0	0.0	0.0	0%	0%	0%
Cyprus	2.3	0.0	0.0	0.0	0%	0%	0%
Czech Rep.	11.2	9.2	4.9	2.4	82%	44%	21%
Denmark	3.1	1.2	0.1	0.0	39%	3%	0%
Estonia	21.5	0.0	0.0	0.0	0%	0%	0%
Finland	240.4	6.1	3.5	3.0	3%	1%	1%
France	170.7	19.6	11.0	5.8	12%	6%	3%
Germany	101.0	62.5	32.1	17.6	62%	32%	17%
Greece	9.3	0.9	0.3	0.2	10%	3%	2%
Hungary	10.4	0.1	0.0	0.0	0%	0%	0%
Ireland	4.3	1.7	0.6	0.5	39%	14%	12%
Italy	89.6	0.0	0.0	0.0	0%	0%	0%
Latvia	27.0	0.5	0.0	0.0	2%	0%	0%
Lithuania	17.7	13.2	10.5	8.9	75%	59%	50%
Luxembourg	0.8	0.3	0.2	0.2	34%	25%	25%
Malta		0.0					
Netherlands	5.6	5.1	5.0	4.8	91%	89%	86%
Poland	88.4	53.0	27.4	9.6	60%	31%	11%
Portugal	21.2	3.3	1.0	1.0	16%	5%	5%
Romania	62.8	3.5	0.4	0.2	6%	1%	0%
Slovakia	19.3	4.7	2.1	1.4	24%	11%	7%
Slovenia	5.3	0.6	0.0	0.0	12%	0%	0%
Spain	85.2	0.9	0.1	0.1	1%	0%	0%
Sweden	225.3	58.4	24.0	15.3	26%	11%	7%
UK	19.7	9.4	3.6	2.6	48%	18%	13%
EU-27	1332.4	259.4	128.3	74.5	19%	10%	6%
Croatia	6.9	0.4	0.0	0.0	5%	0%	0%
Turkey							
Norway	67.0	2.8	0.7	0.2	4%	1%	0%
Switzerland	11.6	1.9	0.7	0.6	16%	6%	5%

Table 5.4: Semi-natural ecosystems with acid deposition above critical loads for acidification

	Total ecosystems area [1000 km^2]	Ecosystems area with acid deposition above critical loads [1000 km^2]			Percent of ecosystems area		
		2000	2020 National activity projections	2020 "Coherent" energy scenario and CAPRI MTR agricultural projection	2000	2020 National activity projections	2020 "Coherent" energy scenario and CAPRI MTR agricultural projection
Belgium	0.7	0.4	0.2	0.1	57%	29%	14%
France	9.4	4.0	2.5	2.0	43%	27%	21%
Germany	3.2	0.8	0.3	0.1	24%	9%	3%
Ireland	4.7	0.3	0.0	0.0	6%	0%	0%
Italy	36.3	0.0	0.0	0.0	0%	0%	0%
Netherlands	1.7	1.1	1.0	0.8	65%	59%	47%
UK	50.1	15.3	3.9	2.7	30%	8%	5%
EU-27	107.8	21.8	7.9	5.7	20%	7%	5%

Table 5.5: Catchment area with acid deposition above critical loads for acidification

	Total ecosystems area [1000 km^2]	Ecosystems area with acid deposition above critical loads [1000 km^2]			Percent of ecosystem's area		
		2000	2020 National activity projections	2020 "Coherent" energy scenario and CAPRI MTR agricultural projection	2000	2020 National activity projections	2020 "Coherent" energy scenario and CAPRI MTR agricultural projection
Finland	26.4	0.1	0.0	0.0	0%	0%	0%
Sweden	294.1	36.8	21.3	19.4	13%	7%	7%
UK	7.8	0.7	0.3	0.2	8%	4%	3%
EU-27	328.3	37.6	21.6	19.6	11%	7%	6%
Norway	322.1	67.6	42.3	37.0	21%	13%	11%
Switzerland	0.2	0.1	0.1	0.1	79%	56%	47%

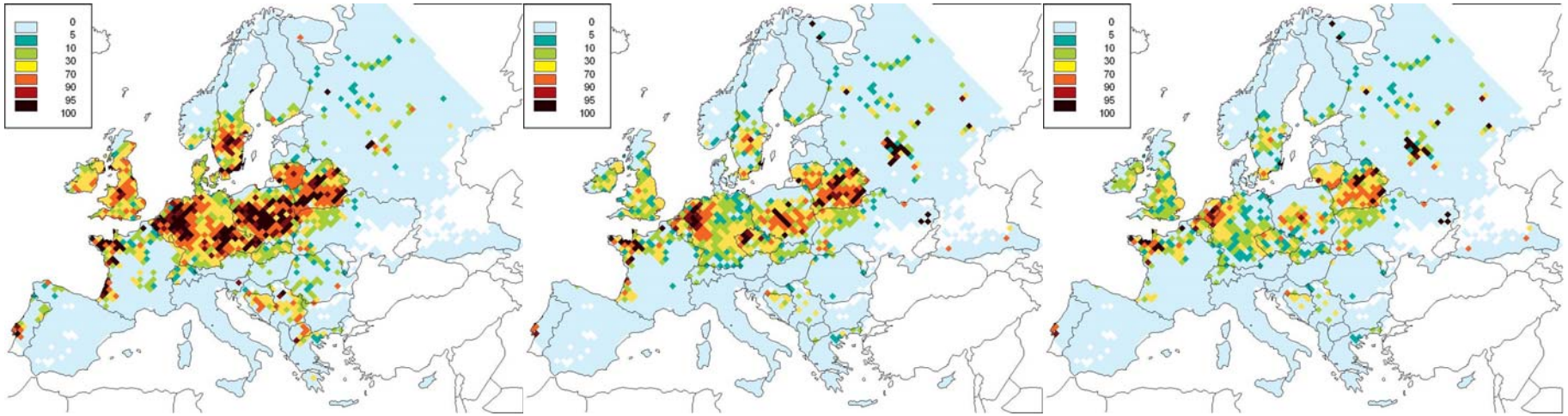

Figure 5.3: Percent of forest area with acid deposition exceeding the critical loads for acidification.

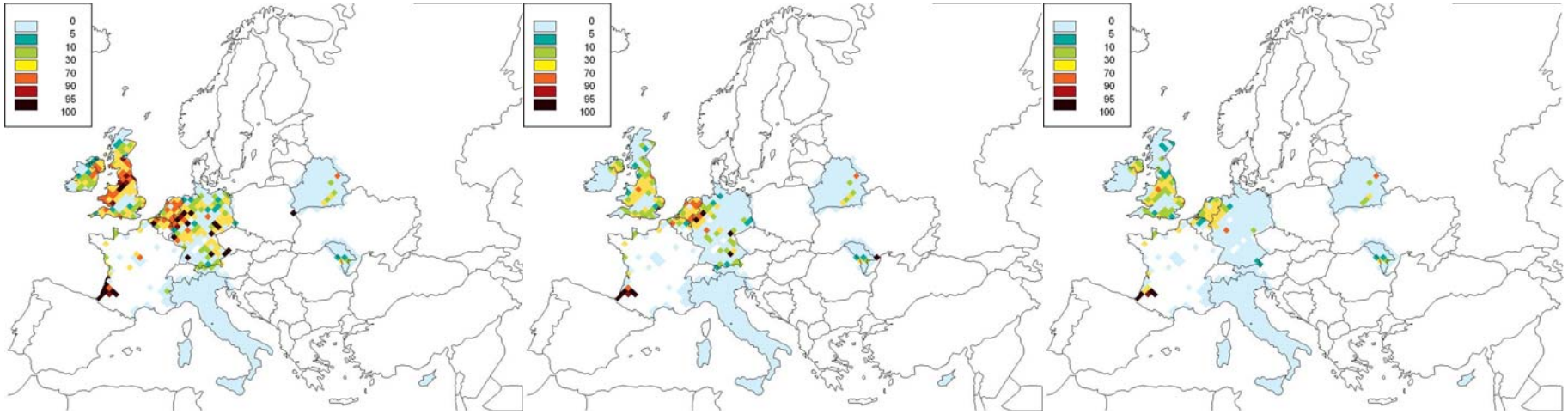

Figure 5.4: Percent of area with semi-natural ecosystems with acid deposition exceeding the critical loads for acidification.

Estimate for 2000 (left graph), for the 2020 national current legislation baseline projections (middle graph) and for the 2020 baseline projection of the Coherent scenario (right graph)

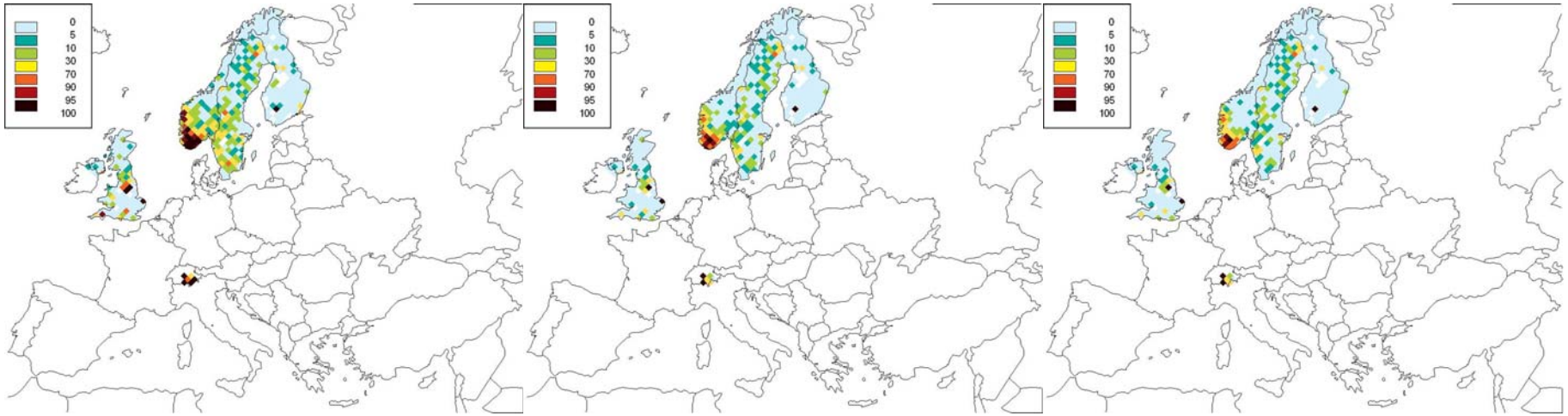

Figure 5.5: Percent of the catchment area for freshwater ecosystems with acid deposition exceeding the critical loads for acidification.

5.4 Ground-level ozone

Table 5.6: Cases of premature deaths attributable to ground-level ozone for the policy scenarios for the year 2020

	2000 (indicative levels only; exact calculation is required	2020 National activity projections	2020 "Coherent" energy scenario and CAPRI MTR agricultural projection
Austria	478	327	298
Belgium	533	376	359
Bulgaria	575	472	452
Cyprus	30	27	27
Czech Rep.	683	445	396
Denmark	225	169	161
Estonia	26	22	21
Finland	62	53	51
France	2978	2129	1987
Germany	4741	3318	3159
Greece	673	553	532
Hungary	882	626	573
Ireland	101	84	82
Italy	5089	3670	3432
Latvia	61	51	48
Lithuania	92	77	72
Luxembourg	42	27	25
Malta	29	22	20
Netherlands	529	370	355
Poland	1708	1194	1119
Portugal	607	480	450
Romania	1277	1059	1012
Slovakia	306	206	183
Slovenia	135	87	77
Spain	2122	1689	1576
Sweden	226	179	173
UK	2223	1787	1751
EU-27	26428	19495	18391
Croatia	371	260	240
Turkey	2125	1882	1799
Norway	101	86	84
Switzerland	398	277	260

6 Conclusions

The updated NEC baseline projections that take into account recent national information confirm the earlier finding that the progressing implementation of the current EU legislation on air pollution control combined with ongoing structural changes in the energy and agricultural systems will lead to substantially lower emissions of air pollutants in the future (Figure 6.1). The analysis demonstrates, however, that the exact level of future emissions will be crucially influenced by the assumptions on future climate policies. A comparison of the national activity projections with an illustrative "Coherent scenario" that comes closest to the decisions of the March 2007 Council on climate policy and renewable energy highlights significant implications of these policies on air pollution. The national projections, which imply by 2020 31 percent higher emissions of CO_2 than the Coherent scenario, result with current air pollution control legislation

- in 68 percent higher SO_2 emissions,
- 19 percent higher NO_x emissions, and
- 14 percent higher PM2.5 emissions.

At the same time, costs for the emission control measures that are required by current legislation are for the national projections 16 percent (or €11 billion/yr) higher than in the Coherent scenario.

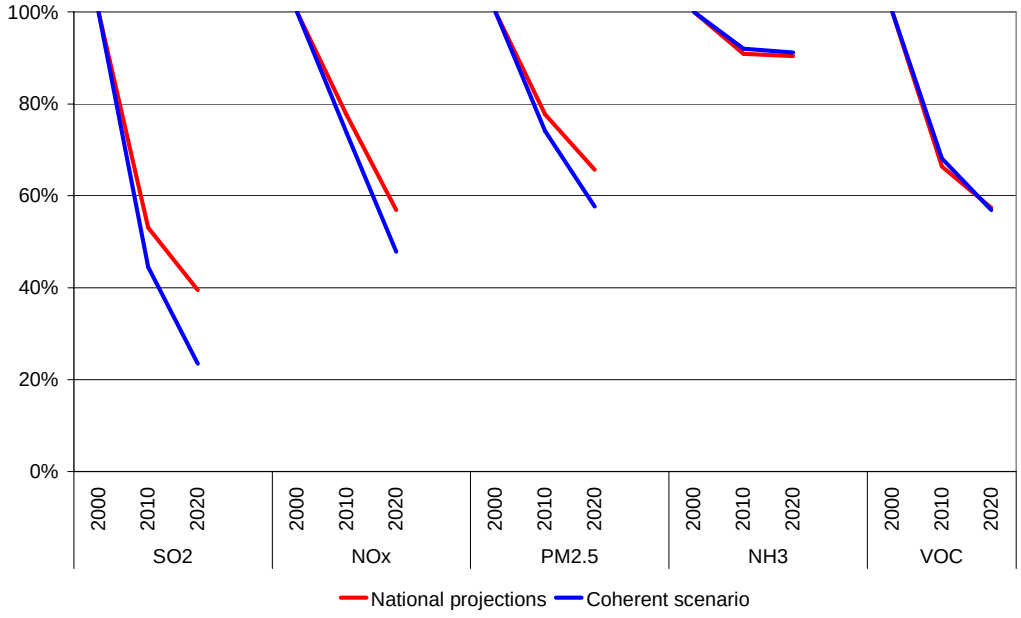

Figure 6.1: Comparison of baseline emission estimates for the two baseline projections, emissions scaled to the year 2000 levels

The anticipated decline in emissions will substantially reduce the adverse health and ecosystems impact of air pollution in Europe. However, especially threats to human health from fine particles and to biodiversity from excess nitrogen deposition will remain serious in large parts of Europe. Again, without additional air pollution control measures, future climate policies will make an

important difference to these impacts in the future: For the national activity projections, 20 percent more life years lost due to the exposure of fine particulate matter are computed than for the Coherent scenario. The forest area receiving acid deposition above their critical loads is 72 percent larger in the national projections than in the Coherent scenario, and five percent more ecosystems receive nitrogen deposition in excess of their critical loads for eutrophication (Figure 6.2).

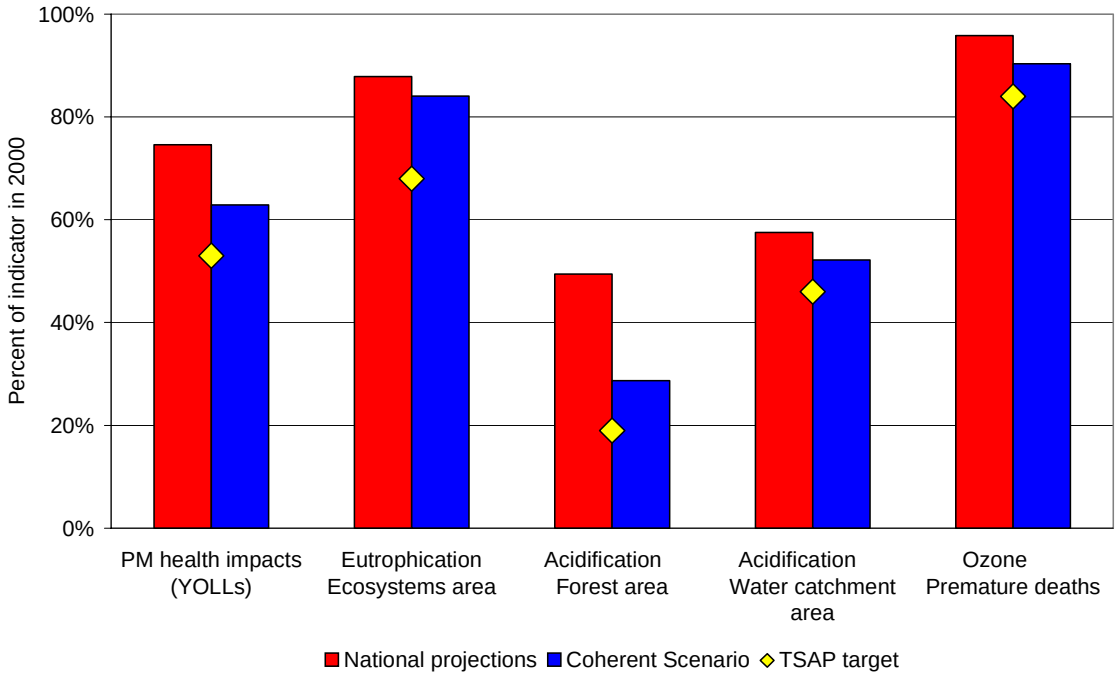

Figure 6.2: Impact indicators for the two baseline projections in 2020 compared to the year 2000.

Thus, these differences in environmental impacts emerge as direct co-benefits of greenhouse gas reduction strategies in the EU compared to the business-as-usual national projections. Together with the cost savings of €11 billion/yr for the implementation of the currently required air pollution control measures, these benefits will make up a substantial fraction of the direct greenhouse gas mitigation costs.

In view of the environmental objectives established by the Thematic Strategy on Air Pollution, the environmental improvements that come along with the greenhouse gas reduction provide a significant part of the additional measures that are necessary to achieve the targets (indicated by the yellow marks in Figure 6.2). The economic implications for setting cost-effective emission ceilings are analyzed in the NEC Report #5 (Amann *et al.*, 2007b).

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