CAFE Scenario Analysis Report Nr. 7

A further emission control scenario for the Clean Air For Europe (CAFE) programme

2 October 2005

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Executive Summary

The Clean Air For Europe (CAFE) programme of the European Commission aims at a comprehensive assessment of the available measures for further improving European air quality beyond the achievements expected from the full implementation of all present air quality legislation.

For this purpose, CAFE has compiled a set of baseline projections outlining the consequences of present legislation on the future development of emissions, of air quality and of health and environmental impacts up to the year 2020. In further steps, the CAFE integrated assessment has explored the costs and environmental benefits associated with gradually tightened environmental quality objectives, starting from the baseline (current legislation - CLE) case up to the maximum that can be achieved through full application of all presently available technical emission control measures (the maximum technically feasible reduction case - MTFR).

This paper (*A further emission control scenario for the Clean Air For Europe (CAFE) programme*) introduces the policy scenario that has been adopted by the European Commission in September 2005 as a basis for outlining its strategy towards cleaner air in Europe.

The Commission has decided to aim by 2020

- for an improvement in mortality effects attributable to particulate matter by 75 percent of what is feasible by the available technical measures,
- for a reduction of accumulated excess nitrogen deposition to terrestrial ecosystems by 55 percent of what is feasible,
- for a reduction of accumulated excess acid deposition by 55 percent of what is feasible, and for a reduction of health-relevant ozone exposure by 60 percent of what can be achieved by the available technical measures.

Based on the optimization analysis of the RAINS model, measures have been identified that achieve these targets at least costs. For the EU-25, the additional costs of these measures (on top of the costs of current legislation) amount to 7.1 billion €/year, or approximately 15 € per person per year. This report provides country-specific details on emission reductions, emission control costs and environmental impacts of the policy scenario.

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1 Introduction

The Clean Air For Europe (CAFE) programme of the European Commission aims at a comprehensive assessment of the available measures for further improving European air quality beyond the achievements expected from the full implementation of all present air quality legislation.

For this purpose, CAFE has compiled a set of baseline projections outlining the consequences of present legislation on the future development of emissions, of air quality and of health and environmental impacts up to the year 2020. In further steps, the CAFE integrated assessment has explored the costs and environmental benefits associated with gradually tightened environmental quality objectives, starting from the baseline (current legislation - CLE) case up to the maximum that can be achieved through full application of all presently available technical emission control measures (the maximum technically feasible reduction case - MTFR).

The CAFE assessment is based on recent scientific knowledge, taking into account

- advice received from the World Health Organization on the health impacts of air pollution (http://www.euro.who.int/document/e79097.pdf),
- information on vegetation impacts of air pollution compiled by the UNECE Working Group on Effects (http://www.unece.org/env/wge/welcome.html),
- syntheses of the understanding and modelling of the dispersion of air pollutants in the atmosphere at the regional scale developed by the European Monitoring and Evaluation Programme (EMEP) (http://www.unece.org/env/emep/welcome.html) under the Convention on Long-range Transboundary Air Pollution including the review of the EMEP Eulerian model (http://www.unece.org/env/documents/2004/eb/ge1/eb.air.ge.1.2004.6.e.pdf), and the modelling of urban pollution developed within the City-Delta project (http://rea.ei.jrc.it/netshare/thunis/citydelta/),
- projections of future economic activities and their implications on the evolution of energy systems (www.europa.eu.int/comm/dgs/energy_transport/figures/trends_2030/index_en.htm) and agricultural activities.

For integrating this variety of information to allow policy-relevant conclusions, CAFE has employed the Regional Air Pollution Information and Simulation (RAINS) model (www.iiasa.ac.at/rains). The model is freely available on the Internet (http://www.iiasa.ac.at/web-apps/tap/RainsWeb/) and has been subject to extensive peer review (http://europa.eu.int/comm/environment/air/cafe/pdf/rains_report_review.pdf). Its databases have been reviewed in detail during more than 20 bilateral consultations involving more than 100 experts from Member States and industry.

All databases used for the analysis (http://www.iiasa.ac.at/web-apps/tap/RainsWeb) and all interim reports (http://www.iiasa.ac.at/rains/cafe.html) developed for the iterative discussions conducted in the CAFE Working Group on Target Setting and Policy Advice as well as in the CAFE Steering Group are available on the Internet. A series of six CAFE scenario reports has been produced for these discussions:

- CAFE Report #1: *Baseline Scenarios for the Clean Air for Europe (CAFE) Programme* (http://www.iiasa.ac.at/rains/CAFE_files/Cafe-Lot1_FINAL(Oct).pdf).

- CAFE Report #2: *The "Current Legislation" and the "Maximum Technically Feasible Reduction" cases for the CAFE baseline emission projections*. (http://www.iiasa.ac.at/rains/CAFE_files/baseline3v2.pdf).
- CAFE Report #3: *First Results from the RAINS Multi-Pollutant/Multi-Effect Optimization including Fine Particulate Matter* (http://www.iiasa.ac.at/rains/CAFE_files/CAFE-A-full-jan12.pdf).
- CAFE Report #4: *Target Setting Approaches for Cost-effective Reductions of Population Exposure to Fine Particulate Matter in Europe*. (http://www.iiasa.ac.at/rains/CAFE_files/CAFE-B-full-feb3.pdf).
- CAFE Report #5: *Exploratory CAFE Scenarios for Further Improvements of European Air Quality*. (http://www.iiasa.ac.at/rains/CAFE_files/CAFE-C-full-march16.pdf).
- CAFE Report #6: *A final set of scenarios for the Clean Air For Europe (CAFE) programme.* (http://www.iiasa.ac.at/rains/CAFE_files/CAFE-D3.pdf).

This paper (*A further emission control scenario for the Clean Air For Europe (CAFE) programme*) constitutes the seventh CAFE report and introduces the policy scenario that has been adopted by the European Commission in September 2005 as a basis for outlining its strategy towards cleaner air in Europe.

This report provides country-specific details on emission reductions, emission control costs and environmental impacts of the policy scenario. Because the scenario rests on the general assumptions for all CAFE scenarios as described in detail in the CAFE report #6, these assumptions are not repeated in this report.

2 Environmental targets

For the deliberations of the European Commission on the CAFE Thematic Strategy on Air Pollution a scenario has been developed that addresses the four environmental endpoints considered in the CAFE programme (health impacts from PM2.5, ozone, acidification and eutrophication). It has been shown in the earlier CAFE reports that even the maximum application of all presently available control measures (with the assumptions taken by RAINS) will not entirely eliminate all risk from air pollution to human health and ecosystems everywhere in Europe. This scenario employs the following sets of effect indicators and target setting principles:

For PM2.5:

The target is to reduce the (population-weighted) loss in statistical life expectancy (i.e., of life years lost – "YOLL") attributable to exposure to PM2.5 in Europe at least costs to 106.5 million life years in 2020. This corresponds to a 75 percent "gap closure" between the "current legislation" baseline projection and what is considered feasible through full implementation of present emission control measures as assumed in the CAFE "Maximum Technically Feasible Reduction" scenario.

Note that this definition of gap closure is fundamentally different from the gap closure concepts applied for the emission ceilings directive. For CAFE, the gap relates strictly to the range between "Current legislation" and "Maximum technically feasible reductions", i.e., it is defined solely on source-related criteria. In contrast, for the emission ceilings directive and for the Gothenburg protocol, the gap referred to the exposure in the base year in excess of the sustainable environmental long-term targets (no-effect levels, such as critical loads). In no case can numerical gap closure targets of these analyses be compared.

The optimization identifies those measures that would achieve in the EU-25 a given improvement of YOLL at least costs. The location where the health benefit occurs is thus not taken into account, and the optimization will allocate measures to those regions where benefits are largest over all of Europe, maximizing the cost-effectiveness of resources spent. While in theory such an approach might compromise on (perceived) equity aspects, because not all Member States receive equitable environmental improvements, earlier analysis has revealed that in practice with the current data set most equity indicators are comparable to other target setting principles.

For eutrophication:

For eutrophication, the scenarios aim at reducing excess nitrogen deposition accumulated over all ecosystems in a country by 55 percent in all Member States. The relative improvement ("gap closure") is scaled between the baseline current legislation case (CLE) and the maximum technically feasible reductions (MTFR) that have been computed for 2020. Again, it needs to be emphasized that this definition of a gap closure is entirely different from the "effect-based" gap closure concept that was used in the preparations for the NEC directive, since it does not establish any relationship with the environmental long-term target of the European Union. At the same time, both quantifications of the "baseline" emission levels for 2020 and the "maximum technically feasible reduction" (MTFR) case are loaded with serious uncertainties and potentially strategically motivated disagreements, which could make this definition prone to political dispute.

For acidification:

For acidification a country-wide “gap closure” of 55 percent has been applied. This scales the envisioned improvement between the baseline current legislation (CLE) and the maximum technical MTFR in terms of total deposition of acidifying compounds in excess of the critical loads for acidification, accumulated over all ecosystem types (forests, semi-natural, water) in a country. The optimization has been carried out for this ‘accumulated excess deposition’, while results are displayed separately for different types of ecosystems.

For ozone:

For health impacts attributable to ozone, RAINS calculates the number of premature deaths attributable to ozone (based on the SOMO35 concept) on a grid basis and sums them up to a country balance. Formally, this is equivalent to a gap closure calculated on the basis of population-weighted SOMO35 grid data. As an interim target for 2020, these country-wide gaps are reduced by 60 percent (scaled between CLE and MTFR) for all countries.

No separate targets have been considered in this first optimization study for vegetation effects from ozone. However, the critical level for forest trees (AOT40) parallels the SOMO35 to a large extent, so that an optimization targeted at AOT40 is likely to yield similar results as the SOMO35 optimization.

Table 2.1: Comparison of the environmental achievements and costs of Thematic Strategy scenario with the CAFE scenarios analysed in Amann et al. (2005)

	Current legislation CLE	**The Thematic Strategy scenario**	**Case A**	**Case B**	**Case C**	**Maximum technically feasible reductions MTFR**
PM indicator in years of life lost (YOLL) due to PM2.5	137 (0%)	106.5 (75%)	110 (66%)	104 (81%)	101 (88%)	96 (100%)
Ozone indicator in SOMO35	52427 (0%)	45469 (60%)	45469 (60%)	43254 (80%)	42150 (90%)	41051 (100%)
Acidification indicator as accumulated excess deposition	1464 (0%)	543 (55%)	543 (55%)	414 (75%)	353 (85%)	300 (100%)
Eutrophication indicator as accumulated excess deposition	7200 (0%)	4167 (55%)	4167 (55%)	3288 (75%)	2837 (85%)	2320 (100%)
Costs (€ million per annum)	0	7149	5923	10679	14852	39720

Note: Percentage figures in brackets refer to the percentage of the range between the baseline (CLE) and the maximum improvement achievable with the application of all technical measures (MTFR).

3 Emission reductions and costs

Table 3.1: SO_2 emissions for the year 2000, the emission ceiling for 2010, the current legislation baseline in 2020 and for the Thematic Strategy scenario (kt SO_2)

	2000	2010 National emission ceiling	2020 Baseline Current legislation	2020 The Thematic Strategy scenario
Austria	38	39	26	23
Belgium	187	99	83	57
Cyprus	46	39	8	8
Czech Rep.	250	265	53	33
Denmark	28	55	13	12
Estonia	91	100	10	6
Finland	77	110	62	59
France	654	375	345	188
Germany	643	520	332	267
Greece	481	523	110	74
Hungary	487	500	88	20
Ireland	132	42	19	13
Italy	747	475	281	135
Latvia	16	101	8	3
Lithuania	43	145	22	9
Luxembourg	4	4	2	1
Malta	26	9	2	2
Netherlands	84	50	64	45
Poland	1515	1397	554	201
Portugal	230	160	81	48
Slovakia	124	110	33	18
Slovenia	97	27	16	6
Spain	1489	746	335	186
Sweden	58	67	50	50
UK	1186	585	209	135
EU-25	**8735**	**6543**	**2805**	**1602**

Table 3.2: NO_x emissions for the year 2000, the emission ceiling for 2010, the current legislation baseline in 2020 and for the Thematic Strategy scenario (kt NO_x)

	2000	**2010 National emission ceiling**	**2020 Baseline Current legislation**	**2020 The Thematic Strategy scenario**
Austria	192	103	127	108
Belgium	333	176	190	137
Cyprus	26	23	18	14
Czech Rep.	318	286	113	79
Denmark	207	127	105	84
Estonia	37	60	15	10
Finland	212	170	117	89
France	1447	810	819	626
Germany	1645	1051	808	694
Greece	322	344	209	169
Hungary	188	198	83	61
Ireland	129	65	63	50
Italy	1389	990	663	534
Latvia	35	61	15	11
Lithuania	49	110	27	21
Luxembourg	33	11	18	13
Malta	9	8	4	2
Netherlands	399	260	240	201
Poland	843	879	364	276
Portugal	263	250	156	127
Slovakia	106	130	60	45
Slovenia	58	45	24	20
Spain	1335	847	681	519
Sweden	251	148	150	121
UK	1753	1167	817	646
EU-25	**11581**	**8319**	**5888**	**4657**

Table 3.3: VOC emissions for the year 2000, the emission ceiling for 2010, the current legislation baseline in 2020 and for the Thematic Strategy scenario (kt VOC)

	2000	2010 National emission ceiling	2020 Baseline Current legislation	2020 The Thematic Strategy scenario
Austria	190	159	138	130
Belgium	242	139	144	118
Cyprus	13	14	6	6
Czech Rep.	242	220	119	97
Denmark	128	85	58	54
Estonia	34	49	17	15
Finland	171	130	97	90
France	1542	1050	923	846
Germany	1528	995	809	741
Greece	280	261	144	110
Hungary	169	137	90	73
Ireland	88	55	46	37
Italy	1738	1159	731	691
Latvia	52	136	28	23
Lithuania	75	92	43	39
Luxembourg	13	9	8	7
Malta	5	12	2	2
Netherlands	265	185	203	161
Poland	582	800	320	296
Portugal	260	180	162	147
Slovakia	88	140	64	59
Slovenia	54	40	20	19
Spain	1121	662	692	571
Sweden	305	241	174	153
UK	1474	1200	878	766
EU-25	**10661**	**8150**	**5916**	**5252**

Table 3.4: NH_3 emissions for the year 2000, the emission ceiling for 2010, the current legislation baseline in 2020 and for the Thematic Strategy scenario (kt NH_3)

	2000	**2010 National emission ceiling**	**2020 Baseline Current legislation**	**2020 The Thematic Strategy scenario**
Austria	54	66	54	50
Belgium	81	74	76	59
Cyprus	6	9	6	5
Czech Rep.	74	80	65	43
Denmark	91	69	78	62
Estonia	10	29	12	8
Finland	35	31	32	29
France	728	780	702	521
Germany	638	550	603	453
Greece	55	73	52	44
Hungary	78	90	85	48
Ireland	127	116	121	108
Italy	432	419	399	300
Latvia	12	44	16	12
Lithuania	50	84	57	50
Luxembourg	7	7	6	5
Malta	1	3	1	1
Netherlands	157	128	140	105
Poland	309	468	333	221
Portugal	68	90	67	62
Slovakia	32	39	33	23
Slovenia	18	20	20	14
Spain	394	353	370	285
Sweden	53	57	49	44
UK	315	297	310	220
EU-25	**3824**	**3976**	**3686**	**2774**

Table 3.5: Primary emissions of PM2.5 for the year 2000, the emission ceiling for 2010, the current legislation baseline in 2020 and for the Thematic Strategy scenario (kt PM2.5)

	2000	**2010 National emission ceiling**	**2020 Baseline Current legislation**	**2020 The Thematic Strategy scenario**
Austria	37		27	22
Belgium	43		24	17
Cyprus	2		2	2
Czech Rep.	66		18	13
Denmark	22		13	12
Estonia	22		6	5
Finland	36		27	26
France	290		165	114
Germany	171		111	90
Greece	49		41	31
Hungary	60		22	9
Ireland	14		9	8
Italy	209		99	75
Latvia	7		4	3
Lithuania	17		12	9
Luxembourg	3		2	2
Malta	1		0	0
Netherlands	36		26	22
Poland	215		102	62
Portugal	46		37	24
Slovakia	18		14	7
Slovenia	15		6	3
Spain	169		90	64
Sweden	67		39	38
UK	129		67	54
EU-25	**1749**		**964**	**714**

Table 3.6: Emission control costs for the current legislation and for the Thematic Strategy scenario in 2020 (million €/year)

	Additional costs for the Thematic Strategy scenario		
	Road emissions	**Stationary sources**	**Total costs**
Austria	50	45	95
Belgium	82	216	298
Cyprus	3	6	9
Czech Rep.	20	152	172
Denmark	20	66	86
Estonia	4	11	15
Finland	21	42	63
France	259	918	1177
Germany	360	1041	1401
Greece	26	48	74
Hungary	26	118	144
Ireland	33	61	94
Italy	185	507	692
Latvia	7	7	14
Lithuania	11	37	48
Luxembourg	11	8	19
Malta	1	2	3
Netherlands	82	246	328
Poland	60	573	633
Portugal	68	85	153
Slovakia	22	46	68
Slovenia	6	23	29
Spain	267	421	688
Sweden	24	47	71
UK	221	555	776
EU-25	**1868**	**5281**	**7149**

Table 3.7: Additional emission control costs for stationary sources by pollutant for the Thematic Strategy scenario, on top of the costs of the current legislation (million €/year)

	SO_2	NO_x	NH_3	VOC	PM2.5	Total
Austria	*5*	*15*	*6*	*1*	*18*	**45**
Belgium	28	47	110	11	20	**216**
Cyprus	0	3	3	0	0	**6**
Czech Rep.	24	31	89	1	7	**152**
Denmark	1	18	45	1	1	**66**
Estonia	2	5	3	0	1	**11**
Finland	2	26	13	1	0	**42**
France	148	165	384	11	210	**918**
Germany	75	74	849	11	32	**1041**
Greece	14	21	9	1	3	**48**
Hungary	30	13	64	1	10	**118**
Ireland	4	10	42	4	1	**61**
Italy	123	137	190	4	53	**507**
Latvia	2	2	3	0	0	**7**
Lithuania	6	4	26	0	1	**37**
Luxembourg	1	2	5	0	0	**8**
Malta	0	2	0	0	0	**2**
Netherlands	20	82	126	10	8	**246**
Poland	263	77	104	2	127	**573**
Portugal	16	6	9	0	54	**85**
Slovakia	11	13	18	0	4	**46**
Slovenia	5	4	8	0	6	**23**
Spain	97	74	195	3	52	**421**
Sweden	0	31	12	2	2	**47**
UK	56	136	287	50	26	**555**
EU-25	**933**	**998**	**2600**	**114**	**636**	**5281**

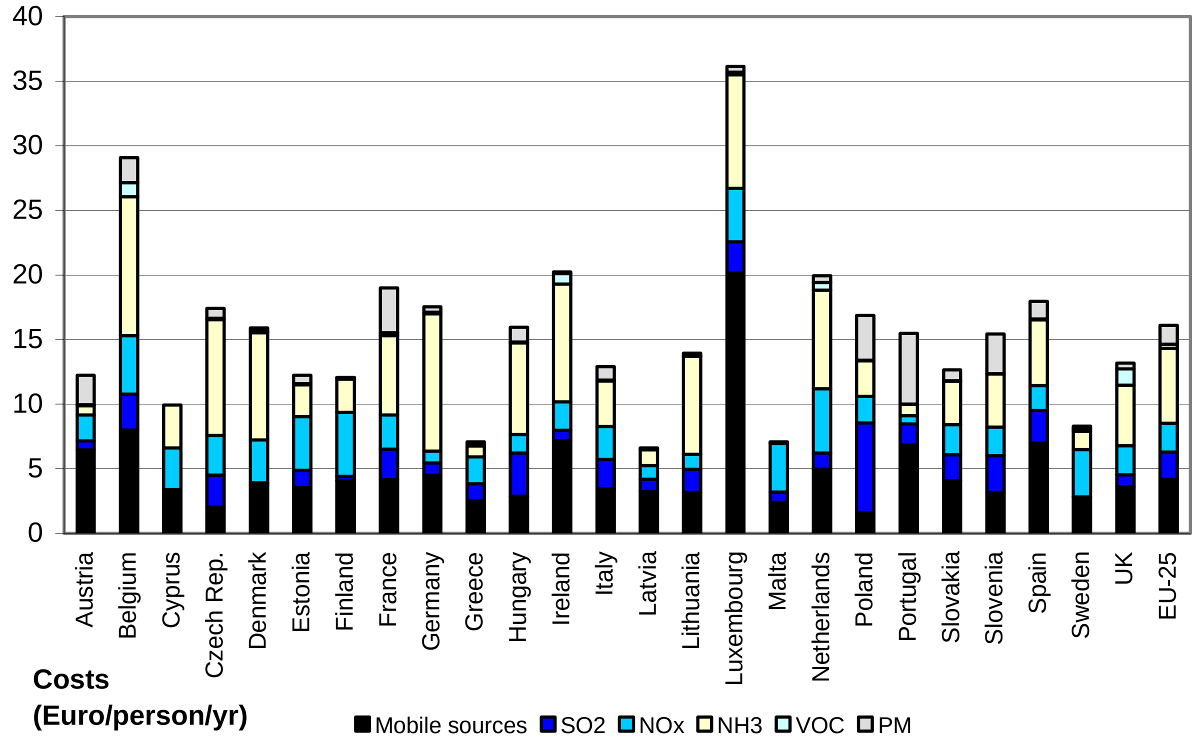

Figure 3.1: Per-capita emission control costs for the Thematic Strategy scenario (€/person/year)

4 Environmental impacts

4.1 Loss in life expectancy attributable to exposure to fine particulate matter

Table 4.1: Losses in statistical life expectancy attributable to the exposure to anthropogenic PM2.5 for the year 2000, the emission ceilings for 2010, the current legislation baseline in 2020 and the Thematic Strategy scenario (in months). These calculations are based on the meteorological conditions of 1997 and thus differ slightly from the computations of the CAFE baseline scenario, which were based on the meteorological conditions of four different years.

	2000	**2010 National emission ceilings**	**2020 Baseline, Current legislation**	**2020 The Thematic Strategy scenario**
Austria	7.2	5.7	5.4	4.3
Belgium	13.2	9.5	8.9	7.1
Cyprus	4.8	4.3	4.2	4.1
Czech Rep.	8.8	6.5	5.8	4.2
Denmark	5.9	4.7	4.5	3.7
Estonia	3.8	3.2	3.0	2.6
Finland	2.6	2.3	2.2	2.1
France	8.0	6.0	5.5	4.3
Germany	9.2	6.8	6.5	4.8
Greece	6.7	5.5	5.2	4.8
Hungary	10.6	8.3	7.6	5.4
Ireland	4.0	2.9	2.6	2.1
Italy	9.0	6.1	5.3	4.3
Latvia	4.5	4.0	3.8	3.3
Lithuania	6.1	5.4	5.0	4.4
Luxembourg	9.6	7.0	6.8	4.8
Malta	5.6	4.3	4.1	3.8
Netherlands	11.8	8.6	8.3	6.3
Poland	9.6	7.5	6.5	5.1
Portugal	5.1	3.2	3.2	2.5
Slovakia	9.1	7.2	6.4	4.7
Slovenia	8.2	6.5	6.0	4.7
Spain	5.2	3.5	3.2	2.7
Sweden	3.5	2.9	2.7	2.4
UK	6.9	5.0	4.6	3.4
EU-25	8.1	5.9	5.5	4.2

Table 4.2: Life years lost due to the exposure to anthropogenic PM2.5 for the year 2000, the emission ceilings for 2010, the current legislation baseline in 2020 and the Thematic Strategy scenario (million years). These calculations are based on the meteorological conditions of 1997 and thus differ slightly from the computations of the CAFE baseline scenario, which were based on the meteorological conditions of four different years.

	2000	**2010 National emission ceilings**	**2020 Baseline, Current legislation**	**2020 The Thematic Strategy scenario**
Austria	3.28	2.62	2.45	1.95
Belgium	7.61	5.46	5.13	4.10
Cyprus	0.21	0.19	0.18	0.18
Czech Rep.	5.05	3.74	3.32	2.41
Denmark	1.74	1.37	1.32	1.09
Estonia	0.26	0.22	0.20	0.18
Finland	0.74	0.66	0.63	0.60
France	26.09	19.39	17.95	13.96
Germany	43.30	32.05	30.70	22.86
Greece	3.96	3.26	3.07	2.85
Hungary	5.61	4.39	3.99	2.85
Ireland	0.80	0.57	0.53	0.41
Italy	30.16	20.54	17.70	14.27
Latvia	0.56	0.50	0.47	0.42
Lithuania	1.18	1.04	0.97	0.84
Luxembourg	0.24	0.18	0.17	0.12
Malta	0.12	0.09	0.09	0.08
Netherlands	10.55	7.69	7.48	5.65
Poland	19.17	15.02	13.00	10.15
Portugal	2.74	1.76	1.72	1.38
Slovakia	2.57	2.02	1.80	1.31
Slovenia	0.92	0.72	0.67	0.52
Spain	12.04	8.02	7.49	6.25
Sweden	1.70	1.39	1.31	1.16
UK	22.29	16.13	15.03	10.93
EU-25	**202.88**	**149.00**	**137.35**	**106.5**

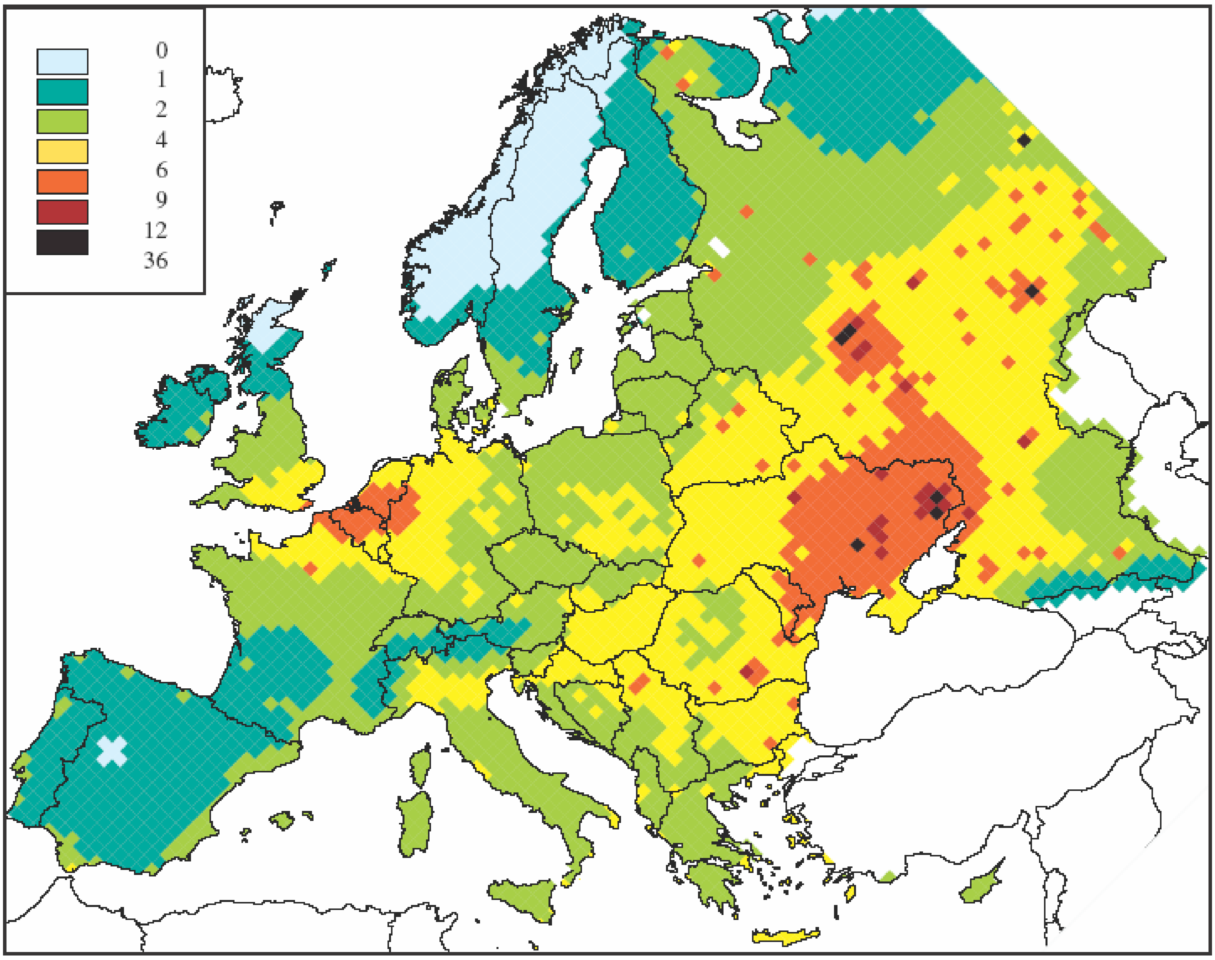

Figure 4.1: Loss in statistical life expectancy that can be attributed to the identified anthropogenic contribution to PM2.5 (months), for the emissions of the Thematic Strategy scenario in 2020. Calculation results for the meteorological conditions of 1997.

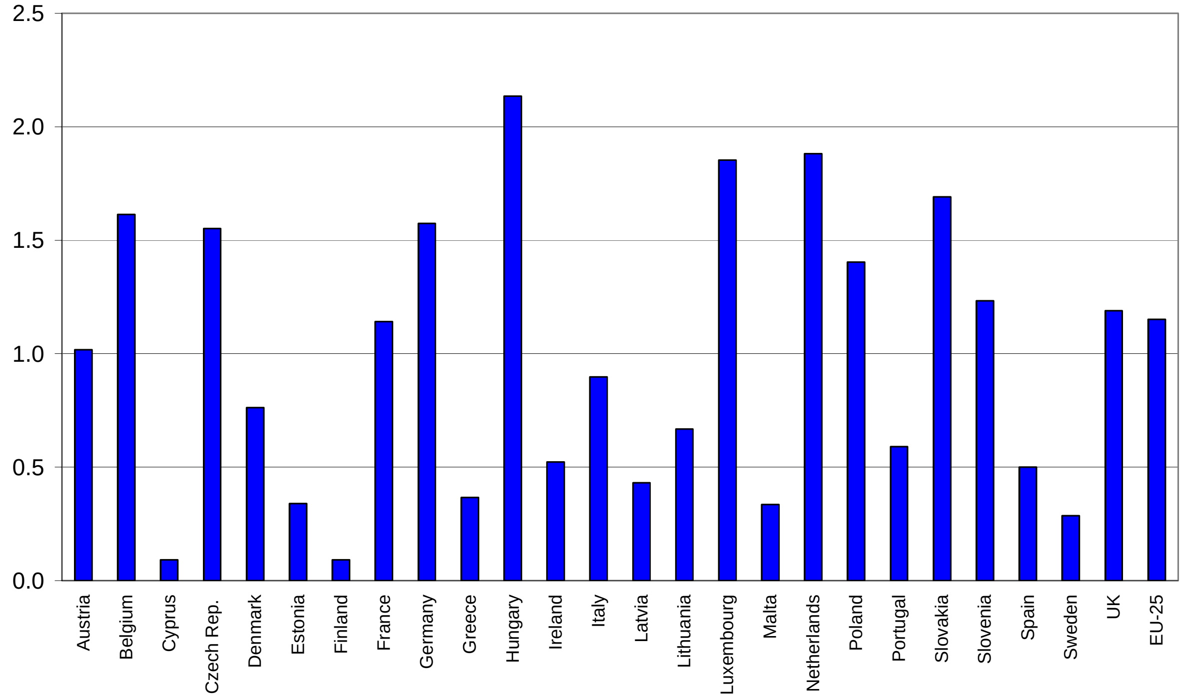

Figure 4.2: Gains in statistical life expectancy (in months) for the Thematic Strategy scenario compared to the CAFE current legislation baseline for 2020.

4.2 Excess nitrogen deposition

Table 4.3: Ecosystems area (km^2) with nitrogen deposition above the critical loads for eutrophication. Results calculated for 1997 meteorology, using grid-average deposition. Critical loads data base of 2004.

	Ecosystems area [1]	**2000**	**2020 Baseline Current legislation**	**2020 The Thematic Strategy scenario**
Austria	35563	34137	30730	27244
Belgium	6615	6134	4023	2246
Cyprus	4806	2296	3056	2363
Czech Rep.	18364	17481	14072	6550
Denmark	3031	1597	1126	321
Estonia	24326	2853	1409	1045
Finland	238698	59985	34468	14991
France	179227	171610	141840	98268
Germany	106908	102867	100868	97912
Greece	13714	10392	9993	7166
Hungary	10763	3302	2630	1590
Ireland	8791	1015	294	29
Italy	119679	74548	57135	31727
Latvia	29982	16277	11399	4364
Lithuania	13182	11209	10647	8182
Luxembourg	935	901	767	480
Malta [2]				
Netherlands	3244	2158	1970	1640
Poland	91265	78442	71871	58824
Portugal	11053	3280	1323	159
Slovakia	18213	16179	10962	5139
Slovenia	4249	4006	3739	3205
Spain	84278	54410	42207	26605
Sweden	184369	48176	29702	15620
UK	73791	9792	4029	356
EU25	**1285046**	**733048**	**590261**	**416029**

1) Ecosystems area for which critical loads data have been supplied

2) Data for Malta are not available

Table 4.4: Percent of ecosystems area with nitrogen deposition above the critical loads for eutrophication. Results calculated for 1997 meteorology, using grid-average deposition. Critical loads data base of 2004. These calculations are based on the meteorological conditions of 1997 and thus differ slightly from the computations of the CAFE baseline scenario, which were based on the meteorological conditions of four different years.

		2000	**2020**	
	Ecosystems area [1)]		**Baseline Current legislation**	**The Thematic Strategy scenario**
Austria	35563	96%	86%	77%
Belgium	6615	93%	61%	34%
Cyprus	4806	48%	64%	49%
Czech Rep.	18364	95%	77%	36%
Denmark	3031	53%	37%	11%
Estonia	24326	12%	6%	4%
Finland	238698	25%	14%	6%
France	179227	96%	79%	55%
Germany	106908	96%	94%	92%
Greece	13714	76%	73%	51%
Hungary	10763	31%	24%	15%
Ireland	8791	12%	3%	0%
Italy	119679	62%	48%	27%
Latvia	29982	54%	38%	15%
Lithuania	13182	85%	81%	62%
Luxembourg	935	96%	82%	51%
Malta[2)]				
Netherlands	3244	67%	61%	51%
Poland	91265	86%	79%	64%
Portugal	11053	30%	12%	1%
Slovakia	18213	89%	60%	28%
Slovenia	4249	94%	88%	75%
Spain	84278	65%	50%	32%
Sweden	184369	26%	16%	8%
UK	73791	13%	5%	0%
EU-25	**1285046**	**57%**	**46%**	**32%**

[1]) Ecosystems area for which critical loads data have been supplied

[2]) Data for Malta are not available

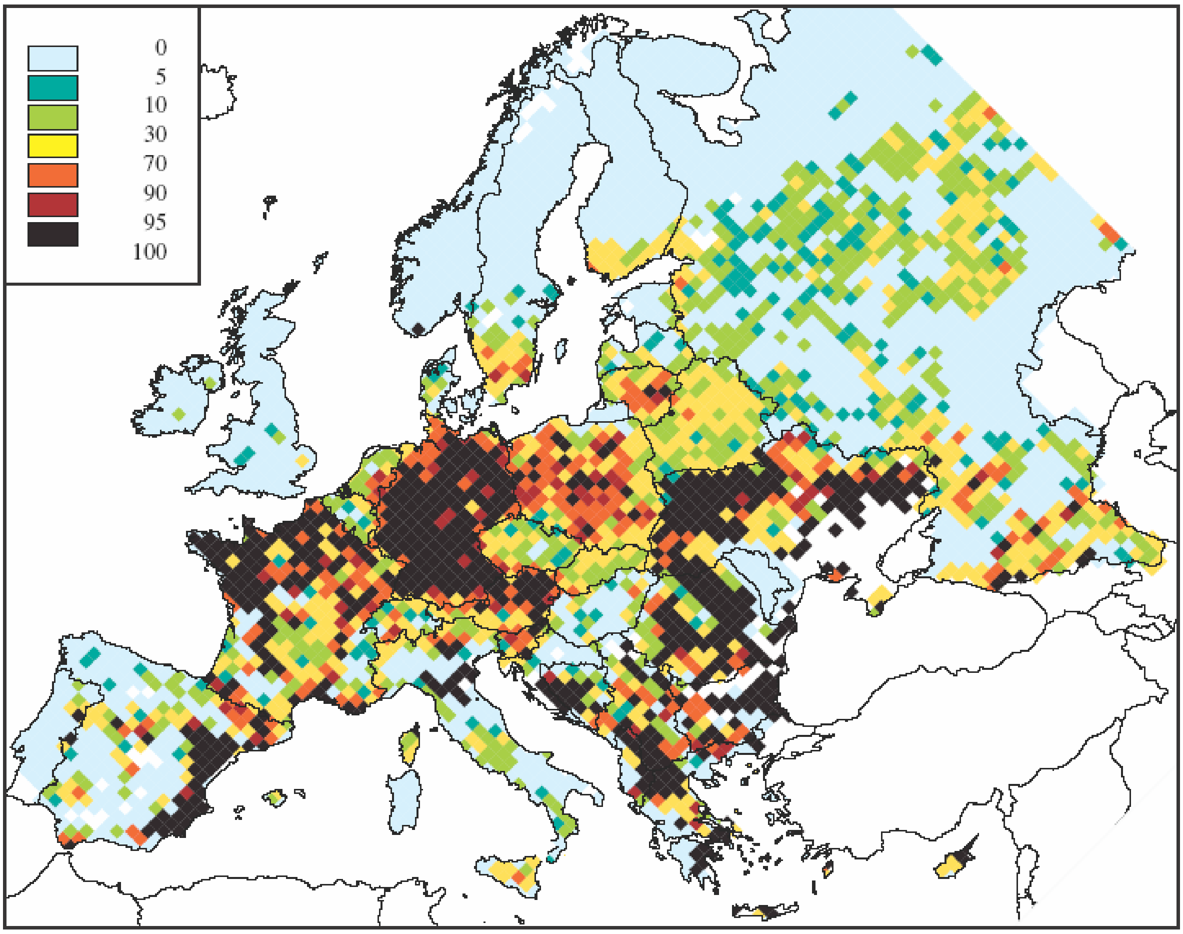

Figure 4.3: Percentage of total ecosystems area receiving nitrogen deposition above the critical loads for eutrophication for the emissions of the Thematic Strategy scenario in 2020. Calculation results for the meteorological conditions of 1997, using grid-average deposition.

4.3 Health effects attributable to exposure to ground-level ozone

Table 4.5: Estimates of premature deaths attributable to the exposure to ozone (cases per year). These calculations are based on regional scale ozone calculations (50*50 km) and for the meteorological conditions of 1997. A cut-off value of 35 ppb has been applied to the impact assessment.

	2000	**2020**	
		Baseline Current legislation	**The Thematic Strategy scenario**
Austria	422	316	287
Belgium	381	345	337
Cyprus	33	32	31
Czech Rep.	535	390	348
Denmark	179	161	153
Estonia	21	22	21
Finland	58	60	56
France	2663	2171	1973
Germany	4258	3316	3057
Greece	627	568	542
Hungary	748	573	511
Ireland	74	79	76
Italy	4507	3556	3328
Latvia	65	65	61
Lithuania	66	64	60
Luxembourg	31	26	24
Malta	22	20	19
Netherlands	416	369	356
Poland	1399	1112	1005
Portugal	450	437	412
Slovakia	239	177	157
Slovenia	112	82	75
Spain	2002	1687	1518
Sweden	197	189	178
UK	1423	1705	1665
EU-25	**20927**	**17522**	**16246**

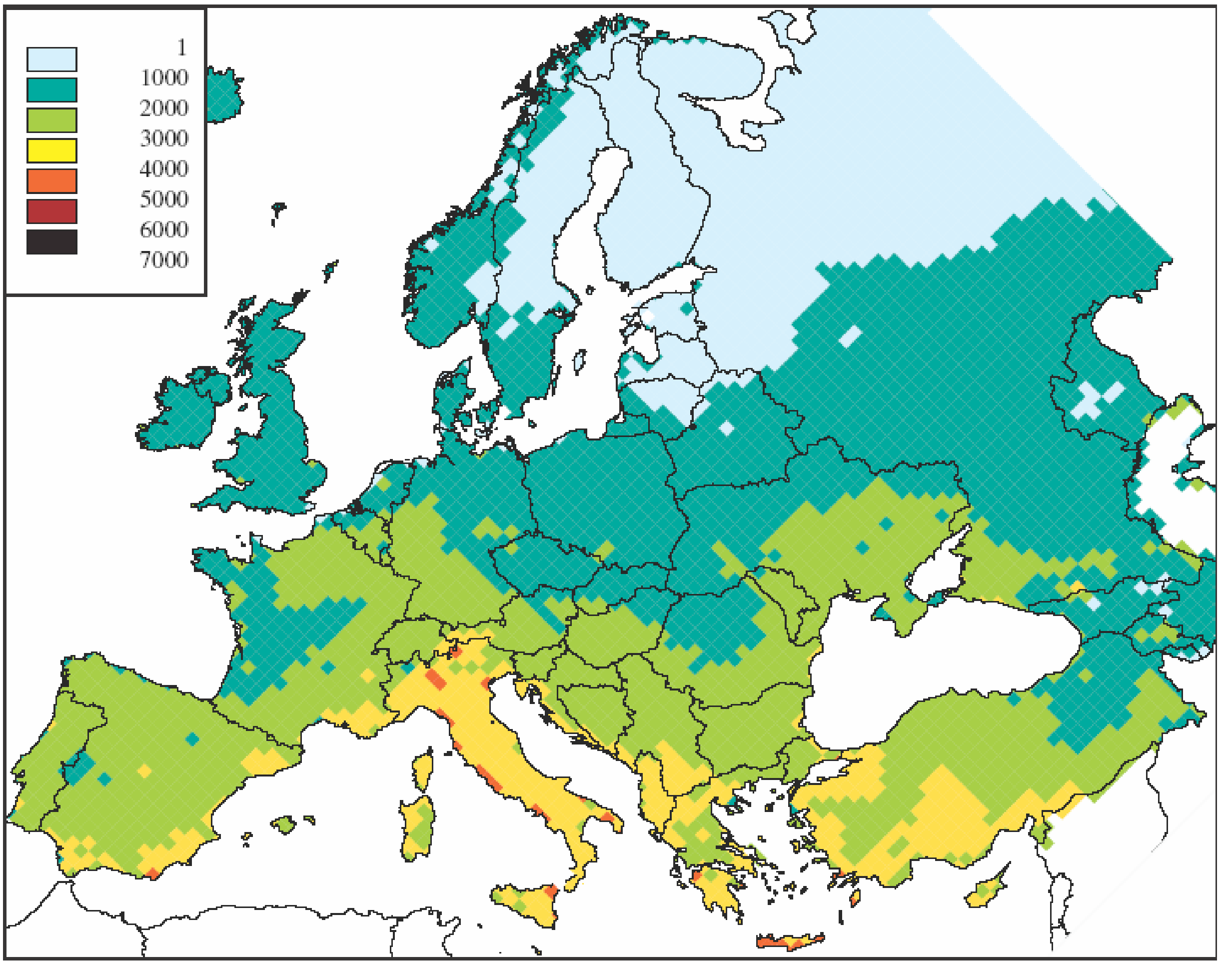

Figure 4.4: Health-relevant ozone exposure expressed as SOMO35 (ppb.days), for the emissions of the Thematic Strategy scenario in 2020. Calculation results for the meteorological conditions of 1997.

4.4 Vegetation impacts from ground-level ozone

Table 4.6: Forest area (km^2) where the critical levels for ozone are exceeded. Results calculated for 1997 meteorology.

	Ecosystems area	*2000*	*2020* Baseline Current legislation	The Thematic Strategy scenario
Austria	38733	38733	38733	38733
Belgium	5983	5983	5983	5974
Cyprus	1370	1370	1370	1370
Czech Rep.	25255	25255	25255	25255
Denmark	3959	3895	3247	3189
Estonia	24252	457	0	0
Finland	246376	772	0	0
France	142391	142272	141563	131881
Germany	106613	106613	106237	106217
Greece	32773	32773	32773	32416
Hungary	19004	19004	19004	19004
Ireland	2774	2713	666	294
Italy	91525	91523	91523	91523
Latvia	29933	2659	193	193
Lithuania	22714	9232	1148	872
Luxembourg	1054	1054	1054	1054
Malta	9	9	9	9
Netherlands	3018	3018	3016	2979
Poland	97249	97249	92543	62418
Portugal	28558	28542	28340	26600
Slovakia	21048	21048	21048	14809
Slovenia	13371	13371	13371	13371
Spain	109150	109150	109150	108215
Sweden	294724	55960	13667	5040
UK	17013	14406	8624	7303
EU-25	**1378847**	**827061**	**758517**	**698718**

Table 4.7: Percent of forest area where the critical levels for ozone are exceeded. Results calculated for 1997 meteorology.

		2000	2020	
	Ecosystems area (km²)		**Baseline Current legislation**	**The Thematic Strategy scenario**
Austria	38733	100%	100%	100%
Belgium	5983	100%	100%	100%
Cyprus	1370	100%	100%	100%
Czech Rep.	25255	100%	100%	100%
Denmark	3959	98%	82%	81%
Estonia	24252	2%	0%	0%
Finland	246376	0%	0%	0%
France	142391	100%	99%	93%
Germany	106613	100%	100%	100%
Greece	32773	100%	100%	99%
Hungary	19004	100%	100%	100%
Ireland	2774	98%	24%	11%
Italy	91525	100%	100%	100%
Latvia	29933	9%	1%	1%
Lithuania	22714	41%	5%	4%
Luxembourg	1054	100%	100%	100%
Malta	9	100%	100%	100%
Netherlands	3018	100%	100%	99%
Poland	97249	100%	95%	64%
Portugal	28558	100%	99%	93%
Slovakia	21048	100%	100%	70%
Slovenia	13371	100%	100%	100%
Spain	109150	100%	100%	99%
Sweden	294724	19%	5%	2%
UK	17013	85%	51%	43%
EU-25	**1378847**	**60%**	**55%**	**51%**

4.5 Acid deposition to forest ecosystems

Table 4.8: Forest area (km^2) with acid deposition above the critical loads for acidification. Results calculated for 1997 meteorology, using ecosystem-specific deposition. Critical loads data base of 2004 (Hettelingh et al., 2004). These calculations are based on the meteorological conditions of 1997 and thus differ slightly from the computations of the CAFE baseline scenario, which were based on the meteorological conditions of four different years.

		2000	**2020**	
	Ecosystems area (km^2) [1)]		**Baseline Current legislation**	**The Thematic Strategy scenario**
Austria	34573	5241	1625	801
Belgium	6526	3618	1643	1002
Cyprus	1854	0	0	0
Czech Rep.	18344	14815	5485	1553
Denmark	3009	956	172	43
Estonia	21252	62	0	0
Finland	236139	3802	2220	1746
France	168823	20951	7091	4144
Germany	103113	74572	44339	23469
Greece	13714	82	0	0
Hungary	10763	415	117	34
Ireland	4166	1957	959	722
Italy	92577	2083	657	244
Latvia	28941	174	130	2
Lithuania	12438	357	118	55
Luxembourg	934	328	128	13
Malta[2)]				
Netherlands	3778	3335	3045	2658
Poland	88281	52104	17356	927
Portugal	11053	285	53	18
Slovakia	18211	4130	1247	523
Slovenia	4190	116	0	0
Spain	84269	876	34	0
Sweden	180911	42912	27734	22979
UK	19822	9717	4632	2353
EU-25	**1167682**	**242887**	**118785**	**63288**

[1]) Ecosystems area for which critical loads data have been supplied

[2]) Data for Malta are not available

Table 4.9: Percent of forest area with acid deposition above the critical loads for acidification. Results calculated for 1997 meteorology, using ecosystem-specific deposition. Critical loads data base of 2004 (Hettelingh et al., 2004). These calculations are based on the meteorological conditions of 1997 and thus differ slightly from the computations of the CAFE baseline scenario, which were based on the meteorological conditions of four different years.

	Ecosystems area (km^2) [1)]	2000	2020 Baseline Current legislation	2020 Ecosystems area [1)]
Austria	34573	15.2%	4.7%	2.3%
Belgium	6526	55.4%	25.2%	15.4%
Cyprus	1854	0.0%	0.0%	0.0%
Czech Rep.	18344	80.8%	29.9%	8.5%
Denmark	3009	31.8%	5.7%	1.4%
Estonia	21252	0.3%	0.0%	0.0%
Finland	236139	1.6%	0.9%	0.7%
France	168823	12.4%	4.2%	2.5%
Germany	103113	72.3%	43.0%	22.8%
Greece	13714	0.6%	0.0%	0.0%
Hungary	10763	3.9%	1.1%	0.3%
Ireland	4166	47.0%	23.0%	17.3%
Italy	92577	2.3%	0.7%	0.3%
Latvia	28941	0.6%	0.5%	0.0%
Lithuania	12438	2.9%	1.0%	0.4%
Luxembourg	934	35.1%	13.7%	1.4%
Malta[2)]				
Netherlands	3778	88.3%	80.6%	70.4%
Poland	88281	59.0%	19.7%	1.1%
Portugal	11053	2.6%	0.5%	0.2%
Slovakia	18211	22.7%	6.9%	2.9%
Slovenia	4190	2.8%	0.0%	0.0%
Spain	84269	1.0%	0.0%	0.0%
Sweden	180911	23.7%	15.3%	12.7%
UK	19822	49.0%	23.4%	11.9%
EU-25	**1167682**	**20.8%**	**10.2%**	**5.4%**

[1]) Ecosystems area for which critical loads data have been supplied

[2]) Data for Malta are not available

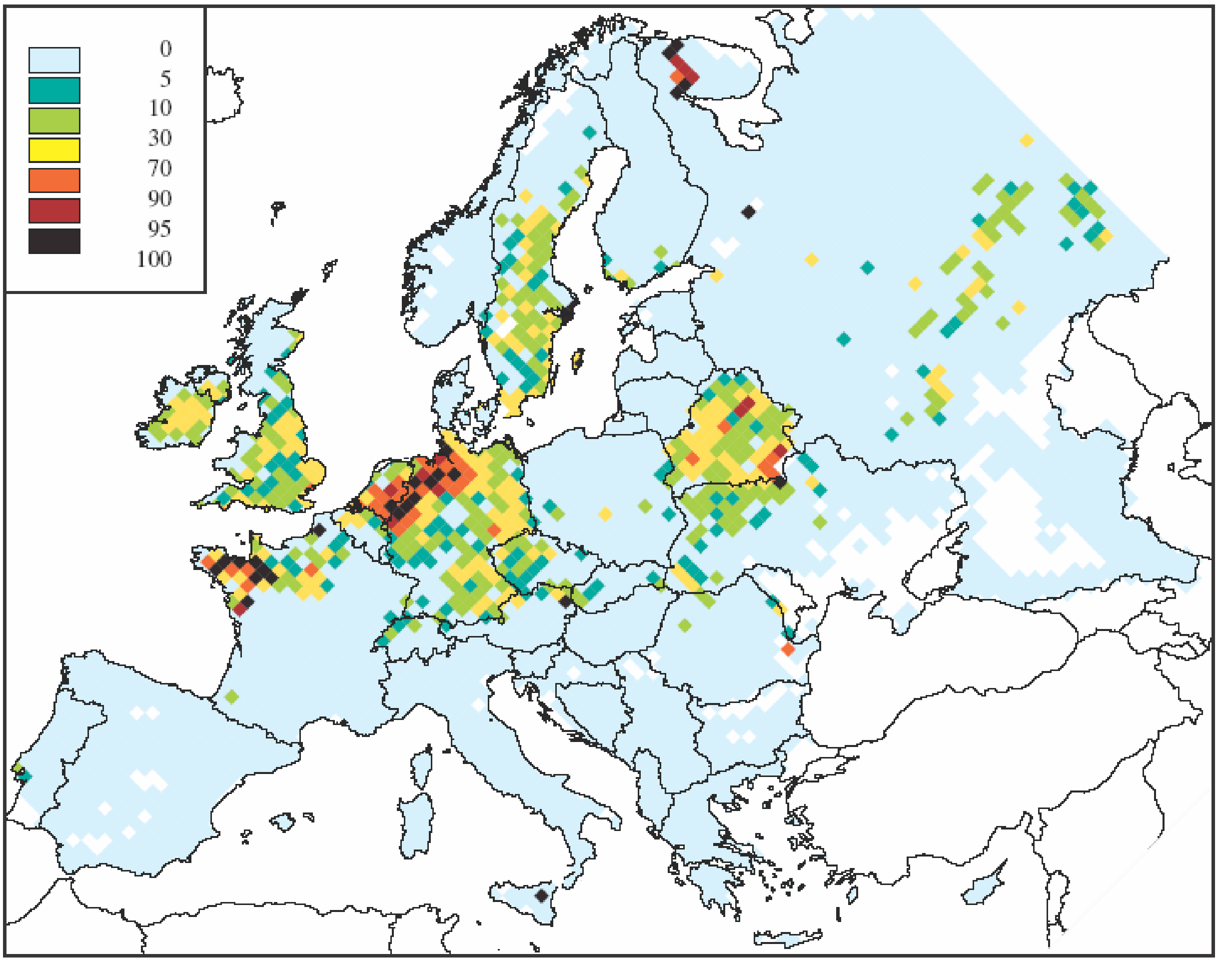

Figure 4.5: Percentage of forest area receiving acid deposition above the critical loads for the emissions of the Thematic Strategy scenario in 2020. Calculation results for the meteorological conditions of 1997, using ecosystem-specific deposition to forests.

4.6 Acid deposition to semi-natural ecosystems

Table 4.10: Area of semi-natural ecosystems (km^2) with acid deposition above the critical loads for acidification. Results calculated for 1997 meteorology, using ecosystem-specific deposition. Critical loads data base of 2004 (Hettelingh et al., 2004). These calculations are based on the meteorological conditions of 1997 and thus differ slightly from the computations of the CAFE baseline scenario, which were based on the meteorological conditions of four different years.

		2000	**2020**	
	Ecosystems area (km^2) 1)		**Baseline Current legislation**	**Ecosystems area 1)**
France	10014	3760	903	247
Germany	3946	2687	1615	902
Ireland	4609	474	108	47
Italy	26085	3	0	0
Netherlands	1296	817	620	307
UK	49700	15288	4597	1852
EU-25	**95651**	**23029**	**7843**	**3355**

[1]) Ecosystems area for which critical loads data have been supplied

Table 4.11: Percent of the area of semi-natural ecosystems with acid deposition above the critical loads for acidification. Results calculated for 1997 meteorology, using ecosystem-specific deposition. Critical loads data base of 2004 (Hettelingh et al., 2004).

		2000	**2020**	
	Ecosystems area (km^2) 1)		**Baseline Current legislation**	**Ecosystems area 1)**
France	10014	37.6%	9.0%	2.5%
Germany	3946	68.1%	40.9%	22.9%
Ireland	4609	10.3%	2.3%	1.0%
Italy	26085	0.0%	0.0%	0.0%
Netherlands	1296	63.0%	47.8%	23.7%
UK	49700	30.8%	9.3%	3.7%
EU-25	**95651**	**24.1%**	**8.2%**	**3.5%**

[1]) Ecosystems area for which critical loads data have been supplied

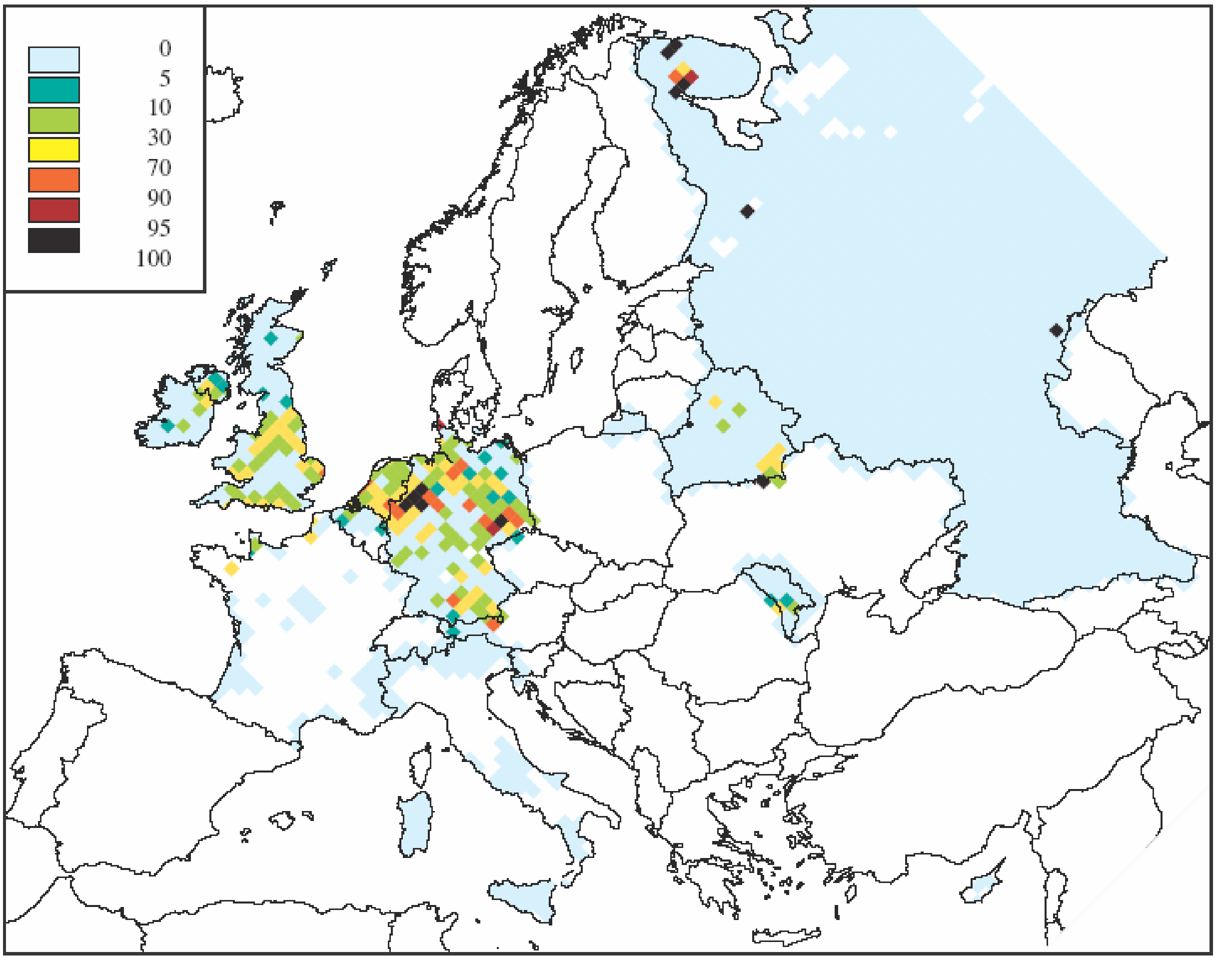

Figure 4.6: Percentage of the area of semi-natural ecosystems receiving acid deposition above the critical loads for the emissions of the Thematic Strategy scenario in 2020. Calculation results for the meteorological conditions of 1997, using ecosystem-specific deposition.

4.7 Acid deposition to freshwater bodies

Table 4.12: Catchments area (km^2) with acid deposition above the critical loads for acidification. Results calculated for 1997 meteorology, using grid-average deposition. Critical loads data base of 2004 (Hettelingh et al., 2004). These calculations are based on the meteorological conditions of 1997 and thus differ slightly from the computations of the CAFE baseline scenario, which were based on the meteorological conditions of four different years.

		2000	**2020**	
	Ecosystems area (km^2) [1)]		**Baseline Current legislation**	**The Thematic Strategy scenario**
Finland	30886	229	201	195
Sweden	204069	30427	21386	18254
UK	7757	625	287	164
EU-25	**242712**	**31280**	**21874**	**18613**

[1]) Ecosystems area for which critical loads data have been supplied

[2]) Maximum technically feasible emission reductions assumed for all European countries (including non-EU countries)

Table 4.13: Percent of catchments area with acid deposition above the critical loads for acidification. Results calculated for 1997 meteorology, using grid-average deposition. Critical loads data base of 2004 (Hettelingh et al., 2004).

		2000	**2020**	
	Ecosystems area (km^2) [1)]		**Baseline Current legislation**	**Ecosystems area (km^2) [1)]**
Finland	30886	0.7 %	0.7 %	0.6%
Sweden	204069	14.9 %	10.5 %	8.9%
UK	7757	8.1 %	3.7 %	2.1%
EU-25	**242712**	**12.9 %**	**9.0 %**	**7.7%**

[1]) Ecosystems area for which critical loads data have been supplied

[2]) Maximum technically feasible emission reductions assumed for all European countries (including non-EU countries)

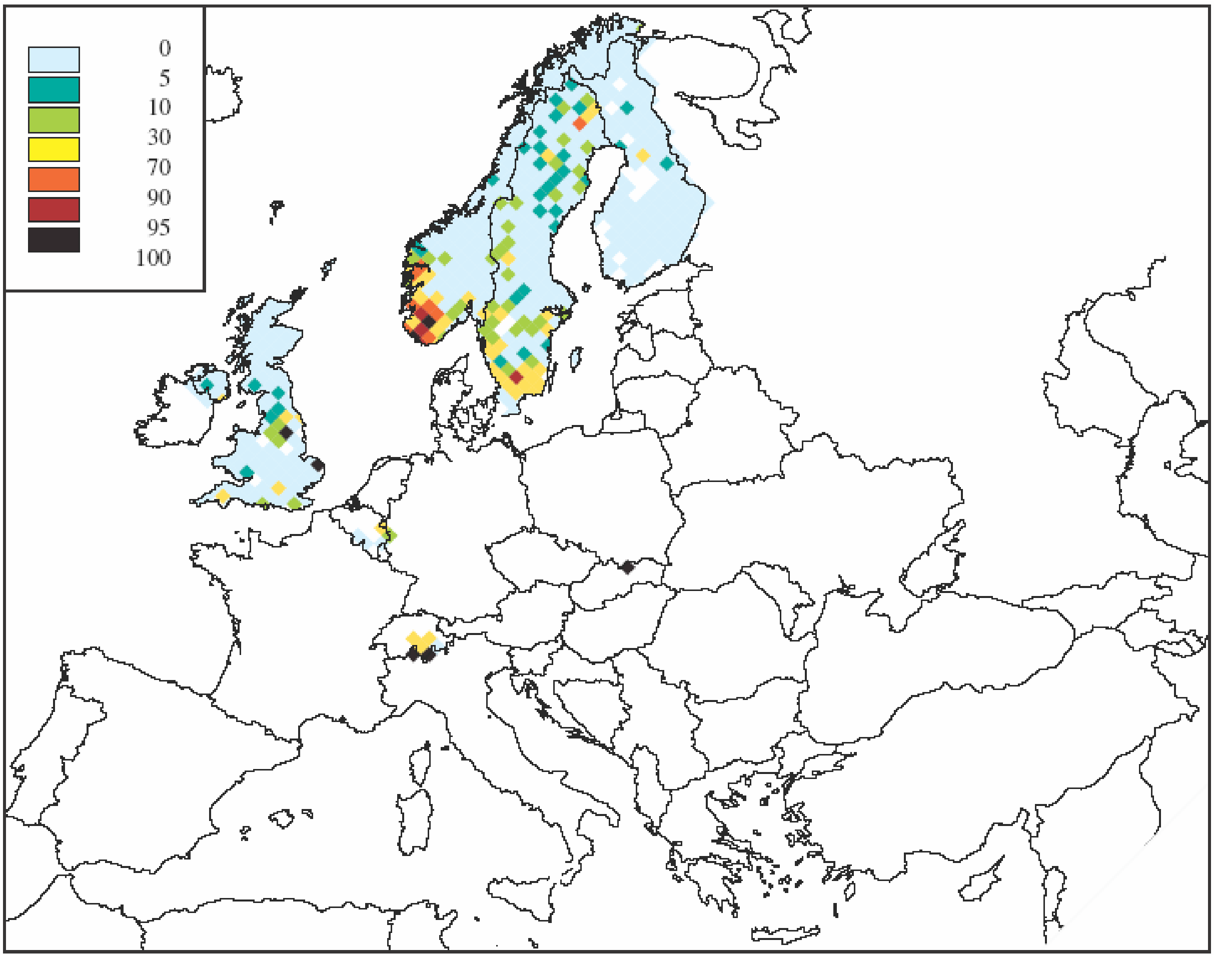

Figure 4.7: Percentage of freshwater ecosystems area receiving acid deposition above the critical loads for the emissions of the Thematic Strategy scenario in 2020. Calculation results for the meteorological conditions of 1997, using grid-average deposition.

References

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