

Further Scenarios for Reducing Acidification and Ground-level Ozone relating to ship emissions

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March 2000

Following the decision of the International Maritime Organisation (IMO) to declare the North Sea an SO_x control area, it is of interest to assess what effect this may have on the results of earlier optimised scenarios for reducing acidification and ground-level ozone in Europe. Two illustrative scenarios, K9 and K10, are presented, in which it is assumed that in the North Sea and the Baltic Sea the fuels used by ships would have a maximum sulphur content of 1.5%.

In order to facilitate assessment of the resulting emission ceilings, the following tables contain the differences to REF8 emissions, which are the levels achieved by implementing only current legislation and/or the Gothenburg protocol. The appropriate column (K-REF8) indicates the additional emission reduction emerging from the respective optimisation run starting at the level of REF8. A further column, headed K-K[1|2], shows whether the new K scenarios result in lower (negative numbers) or higher (positive numbers) emission ceilings compared to the corresponding scenario (K1 or K2) without any SO₂ emission control on international maritime transport.

In presenting the costs of these scenarios, REF7 has been used as the reference point in order to allow an easy comparison with the costs given in the 7th Interim Report. This means, in practice, that the additional costs given in Table 3.3 and Table 3.4 include costs for measures taken in order to achieve the Gothenburg protocol ceilings, in as much as they are more ambitious than the CLE case.

1. Scenario K9

Scenario K9 is identical to the K1 scenario (EU-15 area) except that SO₂ emissions from international maritime transport in the North Sea and Baltic Sea are fixed at levels corresponding to the use of fuels with a 1.5% S content (Table 1.1).

Table 1.1: Emissions of SO₂ from international maritime transport, kilotons

Sea Region	Scenarios K1 and K2	Scenarios K9 and K10
Baltic Sea	72	43
North Sea	439	264
Remaining NE Atlantic Ocean	641	641

The cost-minimal emissions resulting from the K9 scenario are given in Table 1.2 and Table 1.3. These tables also show the differences in emissions between scenario K9 and both the revised Reference scenario (REF8) and the K1 scenario.

Table 1.2: Emissions of NO_x and VOC for the K9 scenario (emissions in kilotons, percentage changes relate to 1990)

	NO _x				VOC			
	K9	Change	K9-REF8	K9-K1	K9	Change	K9-REF8	K9-K1
Austria	91	-53%	-12	0	142	-60%	-17	0
Belgium	127	-64%	-54	0	102	-73%	-42	0
Denmark	127	-54%	0	0	85	-53%	0	0
Finland	152	-45%	0	0	110	-48%	0	0
France	674	-64%	-184	0	926	-61%	-174	-1
Germany	1073	-60%	-8	0	925	-70%	-70	0
Greece	343	-1%	-1	0	236	-30%	-25	0
Ireland	63	-44%	-2	0	55	-50%	0	0
Italy	903	-56%	-97	0	965	-53%	-194	0
Luxembourg	7	-68%	-3	0	6	-68%	-1	0
Netherlands	266	-51%	0	0	154	-69%	-37	0
Portugal	255	-16%	0	0	149	-49%	-53	0
Spain	714	-39%	-133	0	644	-36%	-25	0
Sweden	148	-56%	0	0	219	-57%	-22	0
UK	1176	-59%	-5	0	1023	-62%	-177	0
EU-15	6119	-54%	-499	0	5740	-59%	-837	-1
Albania	36	50%	0	0	41	32%	0	0
Belarus	255	-37%	0	0	309	-17%	0	0
Bosnia-H	60	-25%	0	0	48	-6%	0	0
Bulgaria	266	-25%	0	0	185	-5%	0	0
Croatia	87	6%	0	0	90	-13%	0	0
Czech Republic	286	-48%	0	0	220	-50%	0	0
Estonia	73	-13%	0	0	49	9%	0	0
Hungary	198	-10%	0	0	137	-33%	0	0
Latvia	84	-28%	0	0	53	-16%	0	0
Lithuania	110	-28%	0	0	92	-17%	0	0
Norway	156	-29%	0	0	195	-34%	0	0
Poland	879	-28%	0	0	800	0%	0	0
R. of Moldova	66	-24%	0	0	42	-16%	0	0
Romania	437	-16%	0	0	504	0%	0	0
Russia	2653	-24%	0	0	2786	-21%	0	0
Slovakia	130	-41%	0	0	140	-7%	0	0
Slovenia	45	-25%	0	0	40	-27%	0	0
Switzerland	79	-52%	0	0	144	-48%	0	0
FYR Macedonia	29	-26%	0	0	19	0%	0	0
Ukraine	1222	-35%	0	0	797	-31%	0	0
Yugoslavia	152	-28%	0	0	139	-2%	0	0
Non-EU	7302	-28%	0	0	6832	-21%	0	0
TOTAL	13421	-43%	-499	0	12572	-45%	-837	-1

Table 1.3: Emissions of SO₂ and NH₃ for the K9 scenario (emissions in kilotons, percentage changes relate to 1990)

	SO ₂				NH ₃			
	K9	Change	K9-REF8	K9-K1	K9	Change	K9-REF8	K9-K1
Austria	39	-58%	0	0	66	-14%	0	0
Belgium	77	-77%	-29	1	60	-38%	-14	0
Denmark	55	-70%	0	0	69	-43%	0	0
Finland	116	-49%	0	0	31	-23%	0	0
France	252	-80%	-148	33	727	-10%	-53	6
Germany	464	-91%	-86	1	441	-42%	-109	18
Greece	546	8%	0	0	73	-9%	0	0
Ireland	42	-76%	0	2	116	-9%	0	0
Italy	500	-70%	0	0	419	-9%	0	0
Luxembourg	4	-71%	0	1	7	0%	0	0
Netherlands	50	-75%	0	0	105	-55%	-23	0
Portugal	170	-51%	0	0	73	-5%	0	0
Spain	774	-65%	0	0	353	0%	0	0
Sweden	67	-44%	0	0	57	-7%	0	0
UK	585	-85%	-40	83	274	-17%	-23	10
EU-15	3740	-77%	-304	120	2871	-21%	-222	34
Albania	55	-24%	0	0	35	9%	0	0
Belarus	480	-43%	0	0	158	-28%	0	0
Bosnia-H	415	-15%	0	0	23	-26%	0	0
Bulgaria	846	-54%	0	0	108	-23%	0	0
Croatia	70	-61%	0	0	30	-25%	0	0
Czech Republic	283	-85%	0	0	101	-6%	0	0
Estonia	175	-36%	0	0	29	0%	0	0
Hungary	546	-40%	0	0	90	-25%	0	0
Latvia	104	-14%	0	0	35	-19%	0	0
Lithuania	107	-50%	0	0	81	1%	0	0
Norway	22	-58%	0	0	21	-9%	0	0
Poland	1397	-53%	0	0	468	-7%	0	0
R. of Moldova	117	-41%	0	0	42	-11%	0	0
Romania	594	-55%	0	0	210	-28%	0	0
Russia	2343	-53%	0	0	894	-30%	0	0
Slovakia	110	-80%	0	0	39	-35%	0	0
Slovenia	27	-87%	0	0	21	-9%	0	0
Switzerland	26	-40%	0	0	63	-13%	0	0
FYR Macedonia	81	-24%	0	0	16	-6%	0	0
Ukraine	1457	-61%	0	0	592	-19%	0	0
Yugoslavia	269	-54%	0	0	82	-9%	0	0
Non-EU	9523	-56%	0	0	3138	-21%	0	0
TOTAL	13263	-65%	-304	120	6009	-21%	-222	34

2. Scenario K10

Scenario K10 is identical to the K2 scenario (EU-15 plus ten accession countries) except that SO₂ emissions from international maritime transport in the North Sea and Baltic Sea are fixed at levels corresponding to the use of fuels with a 1.5% S content (Table 1.1).

The resulting K10 scenario emissions are presented in Table 3.1 and Table 3.2. Again, these tables also show the differences in emissions between scenario K10 and both the revised Reference scenario (REF8) and the earlier K2 scenario.

3. Costs and Environmental Impacts of the K1, K9 and K10 Scenarios

Control costs for the three scenarios K1, K9 and K10 are compared in Table 3.3 and Table 3.4. In these tables the costs are shown in relation to the costs of the earlier Reference scenario (labelled REF7 here) appropriate to the H1 scenario, in order to facilitate comparison with H1 costs. Two further tables, Table 3.5 and Table 3.6, indicate the differences in emission control costs between the K scenarios and H1.

The environmental impacts of this series of scenarios are summarised in Table 3.7 - Table 3.9, which provide country statistics of ecosystems protection against acidification, population ozone exposure indices and vegetation ozone exposure indices, respectively.

Table 3.1: Emissions of NO_x and VOC for the K10 scenario (emissions in kilotons, percentage changes relate to 1990)

	NO _x				VOC			
	K10	Change	K10-REF8	K10-K2	K10	Change	K10-REF8	K10-K2
Austria	98	-49%	-5	2	159	-55%	0	7
Belgium	133	-62%	-48	0	103	-72%	-41	0
Denmark	127	-54%	0	0	85	-53%	0	0
Finland	152	-45%	0	0	110	-48%	0	0
France	703	-62%	-155	23	931	-61%	-169	0
Germany	1078	-60%	-3	0	958	-69%	-37	-27
Greece	344	0%	0	0	261	-22%	0	0
Ireland	63	-44%	-2	0	55	-50%	0	0
Italy	902	-56%	-98	-1	1014	-51%	-145	-20
Luxembourg	6	-73%	-4	0	6	-68%	-1	0
Netherlands	266	-51%	0	0	157	-68%	-34	0
Portugal	255	-16%	0	0	149	-49%	-53	0
Spain	704	-39%	-143	-1	644	-36%	-25	0
Sweden	148	-56%	0	0	241	-53%	0	0
UK	1181	-58%	0	5	1111	-58%	-89	6
EU-15	6161	-54%	-457	30	5983	-58%	-594	-33
Albania	36	50%	0	0	41	32%	0	0
Belarus	255	-37%	0	0	309	-17%	0	0
Bosnia-H	60	-25%	0	0	48	-6%	0	0
Bulgaria	247	-30%	-19	0	175	-10%	-10	0
Croatia	87	6%	0	0	90	-13%	0	0
Czech Republic	188	-66%	-98	0	187	-58%	-33	5
Estonia	73	-13%	0	0	49	9%	0	0
Hungary	165	-25%	-33	0	137	-33%	0	0
Latvia	84	-28%	0	0	53	-16%	0	0
Lithuania	110	-28%	0	0	92	-17%	0	0
Norway	156	-29%	0	0	195	-34%	0	0
Poland	816	-33%	-63	0	477	-40%	-323	0
R. of Moldova	66	-24%	0	0	42	-16%	0	0
Romania	380	-27%	-57	1	464	-8%	-40	0
Russia	2653	-24%	0	0	2786	-21%	0	0
Slovakia	121	-45%	-9	-1	140	-7%	0	0
Slovenia	45	-25%	0	0	40	-27%	0	0
Switzerland	79	-52%	0	0	144	-48%	0	0
FYR Macedonia	29	-26%	0	0	19	0%	0	0
Ukraine	1222	-35%	0	0	797	-31%	0	0
Yugoslavia	152	-28%	0	0	139	-2%	0	0
Non-EU	7024	-31%	-278	0	6426	-25%	-406	5
TOTAL	13185	-44%	-735	30	12410	-45%	-999	-28

Table 3.2: Emissions of SO₂ and NH₃ for the K10 scenario (emissions in kilotons, percentage changes relate to 1990)

	SO ₂				NH ₃			
	K10	Change	K10-REF8	K10-K2	K10	Change	K10-REF8	K10-K2
Austria	38	-59%	-1	0	66	-14%	0	0
Belgium	77	-77%	-29	1	60	-38%	-14	0
Denmark	55	-70%	0	0	69	-43%	0	0
Finland	116	-49%	0	0	31	-23%	0	0
France	252	-80%	-148	33	727	-10%	-53	6
Germany	464	-91%	-86	1	441	-42%	-109	15
Greece	546	8%	0	0	73	-9%	0	0
Ireland	42	-76%	0	2	116	-9%	0	0
Italy	500	-70%	0	0	419	-9%	0	0
Luxembourg	4	-71%	0	1	7	0%	0	0
Netherlands	50	-75%	0	0	105	-55%	-23	0
Portugal	170	-51%	0	0	73	-5%	0	0
Spain	774	-65%	0	0	353	0%	0	0
Sweden	67	-44%	0	0	57	-7%	0	0
UK	585	-85%	-40	83	274	-17%	-23	10
EU-15	3739	-77%	-305	119	2871	-21%	-222	32
Albania	55	-24%	0	0	35	9%	0	0
Belarus	480	-43%	0	0	158	-28%	0	0
Bosnia-H	415	-15%	0	0	23	-26%	0	0
Bulgaria	836	-55%	-10	0	108	-23%	0	0
Croatia	70	-61%	0	0	30	-25%	0	0
Czech Republic	283	-85%	0	0	101	-6%	0	0
Estonia	175	-36%	0	0	29	0%	0	0
Hungary	297	-67%	-249	-3	84	-30%	-6	0
Latvia	104	-14%	0	0	35	-19%	0	0
Lithuania	107	-50%	0	0	81	1%	0	0
Norway	22	-58%	0	0	21	-9%	0	0
Poland	1397	-53%	0	129	468	-7%	0	0
R. of Moldova	117	-41%	0	0	42	-11%	0	0
Romania	154	-88%	-440	-10	210	-28%	0	0
Russia	2343	-53%	0	0	894	-30%	0	0
Slovakia	92	-83%	-18	-8	39	-35%	0	0
Slovenia	15	-93%	-12	0	19	-17%	-2	-1
Switzerland	26	-40%	0	0	63	-13%	0	0
FYR Macedonia	81	-24%	0	0	16	-6%	0	0
Ukraine	1457	-61%	0	0	592	-19%	0	0
Yugoslavia	269	-54%	0	0	82	-9%	0	0
Non-EU	8793	-59%	-730	108	3130	-21%	-8	-1
TOTAL	12532	-67%	-1035	227	6001	-21%	-230	31

Table 3.3: Control costs (above REF7) of NO_x/VOC and SO₂ reductions for the K1, K9, K2 and K10 scenarios (million EURO/year)

	NO _x /VOC					SO ₂				
	REF7 costs	K1	K9	K2	K10	REF7 costs	K1	K9	K2	K10
Austria	902	70	70	34	23	191	0	0	1	1
Belgium	1278	460	460	381	379	426	122	119	122	119
Denmark	484	0	0	0	0	138	17	17	17	17
Finland	642	0	0	0	0	247	0	0	0	0
France	7383	792	793	735	562	1276	132	83	132	83
Germany	10549	953	953	563	736	3264	239	235	239	235
Greece	1048	14	14	2	2	434	0	0	0	0
Ireland	477	1	1	1	1	132	10	9	10	9
Italy	7868	307	306	241	259	1776	17	17	17	17
Luxembourg	71	13	13	26	26	13	0	0	0	0
Netherlands	1731	144	144	114	114	340	19	19	19	19
Portugal	1349	42	42	42	42	181	4	4	4	4
Spain	5658	56	56	64	65	809	0	0	0	0
Sweden	1125	101	101	76	76	316	0	0	0	0
UK	6695	653	653	341	324	1269	290	164	290	165
EU-15	47258	3607	3606	2621	2609	10813	851	667	851	669
Albania	0	0	0	0	0	0	0	0	0	0
Belarus	0	20	20	20	20	0	4	4	4	4
Bosnia-H	1	0	0	0	0	0	0	0	0	0
Bulgaria	4	10	10	31	31	153	0	0	0	0
Croatia	1	3	3	3	3	52	0	0	0	0
Czech Republic	568	43	43	178	167	411	36	36	36	36
Estonia	0	0	0	0	0	0	0	0	0	0
Hungary	420	7	7	34	34	166	0	0	92	108
Latvia	0	49	49	49	49	0	0	0	0	0
Lithuania	0	31	31	31	31	0	0	0	0	0
Norway	567	5	5	5	5	56	5	5	5	5
Poland	2487	0	0	161	160	855	0	0	44	0
R. of Moldova	0	0	0	0	0	0	0	0	0	0
Romania	2	3	3	26	25	155	0	0	130	134
Russia	21	0	0	0	0	694	0	0	0	0
Slovakia	331	0	0	2	2	91	11	11	15	25
Slovenia	93	64	64	64	64	35	24	24	29	29
Switzerland	831	0	0	0	0	118	0	0	0	0
FYR Macedonia	1	0	0	0	0	0	0	0	0	0
Ukraine	0	43	43	43	43	328	8	8	8	8
Yugoslavia	3	0	0	0	0	88	0	0	0	0
Non-EU	5332	278	278	647	636	3202	87	87	362	348
TOTAL	52590	3885	3884	3268	3245	14015	938	754	1213	1017

Table 3.4: Control costs (above REF7) for NH₃ reductions and for all pollutants for the K1, K9, K2 and K10 scenarios (million EURO/year)

	NH ₃					All pollutants				
	REF7 costs	K1	K9	K2	K10	REF7 costs	K1	K9	K2	K10
Austria	0	1	1	1	1	1093	72	72	36	25
Belgium	0	309	307	309	307	1704	891	886	812	805
Denmark	0	2	2	2	2	623	20	19	20	19
Finland	0	0	0	0	0	889	0	0	0	0
France	0	41	33	41	33	8659	965	909	908	678
Germany	0	789	519	746	519	13813	1981	1707	1548	1490
Greece	0	0	0	0	0	1482	14	14	2	2
Ireland	9	139	139	139	139	618	151	150	150	150
Italy	0	9	9	9	9	9644	333	332	267	285
Luxembourg	15	-6	-6	-6	-6	98	7	7	21	20
Netherlands	196	658	620	658	621	2267	821	783	790	753
Portugal	0	0	0	0	0	1530	46	46	46	46
Spain	28	0	0	0	0	6495	56	56	64	65
Sweden	113	-106	-106	-106	-106	1554	-5	-5	-29	-29
UK	0	23	12	23	12	7964	966	829	654	501
EU-15	361	1860	1531	1815	1532	58433	6318	5804	5288	4810
Albania	0	0	0	0	0	0	0	0	0	0
Belarus	0	2	2	2	2	0	26	26	26	26
Bosnia-H	0	0	0	0	0	1	0	0	0	0
Bulgaria	0	7	7	7	7	157	17	17	38	38
Croatia	0	3	3	3	3	52	6	6	6	6
Czech Republic	0	10	10	10	10	979	89	89	224	213
Estonia	0	0	0	0	0	0	0	0	0	0
Hungary	0	107	107	173	173	586	113	113	299	315
Latvia	0	0	0	0	0	0	49	49	49	49
Lithuania	0	0	0	0	0	0	31	31	31	31
Norway	0	0	0	0	0	623	11	11	11	11
Poland	0	180	180	180	180	3342	179	179	384	340
R. of Moldova	0	2	2	2	2	0	2	2	2	2
Romania	0	616	616	616	616	157	619	619	772	776
Russia	0	0	0	0	0	715	0	0	0	0
Slovakia	0	8	8	8	8	423	19	19	25	35
Slovenia	0	0	0	0	1	128	88	88	93	94
Switzerland	0	5	5	5	5	949	5	5	5	5
FYR Macedonia	0	0	0	0	0	1	0	0	0	0
Ukraine	0	24	24	24	24	328	75	75	75	75
Yugoslavia	0	0	0	0	0	92	0	0	0	0
Non-EU	0	965	965	1032	1033	8534	1331	1331	2041	2017
TOTAL	361	2825	2496	2847	2565	66967	7649	7135	7329	6827

Table 3.5: Differences in control costs of NO_x/VOC and SO₂ reductions between the K scenarios and the H1 scenario (million EURO/year)

	NO _x /VOC				SO ₂			
	K1	K9	K2	K10	K1	K9	K2	K10
Austria	-49	-49	-85	-96	0	0	1	1
Belgium	1	1	-78	-80	-5	-8	-5	-8
Denmark	0	0	0	0	12	12	12	12
Finland	0	0	0	0	0	0	0	0
France	53	54	-4	-177	-4	-53	-4	-53
Germany	-95	-95	-485	-312	-5	-9	-5	-9
Greece	-324	-324	-336	-336	0	0	0	0
Ireland	-3	-3	-3	-3	-10	-11	-10	-11
Italy	-96	-97	-162	-144	17	17	17	17
Luxembourg	9	9	22	22	-1	-1	-1	-1
Netherlands	-67	-67	-97	-97	0	0	0	0
Portugal	-15	-15	-15	-15	4	4	4	4
Spain	43	43	51	52	-9	-9	-9	-9
Sweden	14	14	-11	-11	0	0	0	0
UK	-373	-373	-685	-702	-9	-135	-9	-134
EU-15	-901	-902	-1887	-1899	-10	-194	-10	-192
Albania	0	0	0	0	0	0	0	0
Belarus	20	20	20	20	4	4	4	4
Bosnia-H	0	0	0	0	0	0	0	0
Bulgaria	10	10	31	31	0	0	0	0
Croatia	3	3	3	3	0	0	0	0
Czech Republic	43	43	178	167	36	36	36	36
Estonia	0	0	0	0	0	0	0	0
Hungary	7	7	34	34	0	0	92	108
Latvia	49	49	49	49	0	0	0	0
Lithuania	31	31	31	31	0	0	0	0
Norway	5	5	5	5	5	5	5	5
Poland	0	0	161	160	0	0	44	0
R. of Moldova	0	0	0	0	0	0	0	0
Romania	3	3	26	25	0	0	130	134
Russia	0	0	0	0	0	0	0	0
Slovakia	0	0	2	2	11	11	15	25
Slovenia	64	64	64	64	24	24	29	29
Switzerland	0	0	0	0	0	0	0	0
FYR Macedonia	0	0	0	0	0	0	0	0
Ukraine	43	43	43	43	8	8	8	8
Yugoslavia	0	0	0	0	0	0	0	0
Non-EU	278	278	647	636	87	87	362	348
TOTAL	-623	-624	-1240	-1263	77	-107	352	156

Table 3.6: Differences in control costs for NH₃ reductions and for all pollutants between the K scenarios and the H1 scenario (million EURO/year)

	NH ₃				All pollutants			
	K1	K9	K2	K10	K1	K9	K2	K10
Austria	1	1	1	1	-47	-47	-83	-94
Belgium	-158	-160	-158	-160	-162	-167	-241	-248
Denmark	2	2	2	2	14	13	14	13
Finland	0	0	0	0	0	0	0	0
France	0	-8	0	-8	49	-7	-8	-238
Germany	-65	-335	-108	-335	-166	-440	-599	-657
Greece	0	0	0	0	-324	-324	-336	-336
Ireland	119	119	119	119	107	106	106	106
Italy	9	9	9	9	-70	-71	-136	-118
Luxembourg	-6	-6	-6	-6	3	3	17	16
Netherlands	-83	-121	-83	-120	-150	-188	-181	-218
Portugal	0	0	0	0	-11	-11	-11	-11
Spain	0	0	0	0	34	34	42	43
Sweden	-106	-106	-106	-106	-92	-92	-116	-116
UK	0	-11	0	-11	-382	-519	-694	-847
EU-15	-286	-615	-331	-614	-1196	-1710	-2226	-2704
Albania	0	0	0	0	0	0	0	0
Belarus	2	2	2	2	26	26	26	26
Bosnia-H	0	0	0	0	0	0	0	0
Bulgaria	7	7	7	7	17	17	38	38
Croatia	3	3	3	3	6	6	6	6
Czech Republic	10	10	10	10	89	89	224	213
Estonia	0	0	0	0	0	0	0	0
Hungary	107	107	173	173	113	113	299	315
Latvia	0	0	0	0	49	49	49	49
Lithuania	0	0	0	0	31	31	31	31
Norway	0	0	0	0	11	11	11	11
Poland	180	180	180	180	179	179	384	340
R. of Moldova	2	2	2	2	2	2	2	2
Romania	616	616	616	616	619	619	772	776
Russia	0	0	0	0	0	0	0	0
Slovakia	8	8	8	8	19	19	25	35
Slovenia	0	0	0	1	88	88	93	94
Switzerland	5	5	5	5	5	5	5	5
FYR Macedonia	0	0	0	0	0	0	0	0
Ukraine	24	24	24	24	75	75	75	75
Yugoslavia	0	0	0	0	0	0	0	0
Non-EU	965	965	1032	1033	1331	1331	2041	2017
TOTAL	679	350	701	419	135	-379	-185	-687

Table 3.7: Ecosystems with acid deposition above their critical loads for acidification for the revised Reference (REF8), K1, K9, K10 and H1 scenarios

	Ecosystems area, 1000 hectares				
	REF8	K1	K9	K10	H1
Austria	126	90	94	87	99
Belgium	110	54	54	54	52
Denmark	7	5	5	5	6
Finland	1142	1130	1123	1110	1150
France	116	89	89	89	88
Germany	1206	697	712	691	727
Greece	0	0	0	0	0
Ireland	9	9	9	9	9
Italy	60	55	56	56	58
Luxembourg	4	1	1	1	1
Netherlands	161	79	79	79	76
Portugal	1	1	1	1	1
Spain	18	18	18	18	17
Sweden	1449	1374	1333	1312	1420
UK	884	651	714	715	649
EU-15	5292	4252	4286	4225	4351
Albania	0	0	0	0	0
Belarus	968	952	950	842	1033
Bosnia-H	0	0	0	0	131
Bulgaria	0	0	0	0	0
Croatia	0	0	0	0	0
Czech Republic	214	153	155	136	285
Estonia	10	9	9	8	10
Hungary	44	44	44	39	54
Latvia	0	0	0	0	0
Lithuania	77	77	77	76	77
Norway	2320	2141	2103	2086	2239
Poland	922	824	817	700	1117
R. of Moldova	29	29	29	17	29
Romania	50	50	50	17	51
Russia	4048	4043	4044	3978	4060
Slovakia	236	233	233	177	261
Slovenia	5	5	5	4	19
Switzerland	48	38	39	39	40
FYR Macedonia	0	0	0	0	0
Ukraine	506	488	487	362	636
Yugoslavia	0	0	0	0	2
Non-EU	9475	9086	9040	8480	10043
TOTAL	14767	13337	13326	12705	14395

Table 3.8: Population exposure indices for the revised Reference (REF8), K1, K9, K10 and H1 scenarios

	Cumulative population exposure index (million persons.ppm.hours)				
	REF8	K1	K9	K10	H1
Austria	2	2	2	2	2
Belgium	29	22	22	22	23
Denmark	2	1	1	1	1
Finland	0	0	0	0	0
France	75	52	52	53	53
Germany	117	97	97	90	99
Greece	3	3	3	3	2
Ireland	1	0	0	0	0
Italy	55	38	38	40	38
Luxembourg	1	1	1	1	1
Netherlands	32	26	26	26	27
Portugal	9	6	6	6	6
Spain	7	4	4	4	4
Sweden	0	0	0	0	0
UK	63	47	47	49	45
EU-15	397	300	300	298	300
Albania	0	0	0	0	0
Belarus	0	0	0	0	1
Bosnia-H	0	0	0	0	0
Bulgaria	0	0	0	0	1
Croatia	3	2	2	2	2
Czech Republic	9	8	8	5	8
Estonia	0	0	0	0	0
Hungary	10	10	10	8	10
Latvia	0	0	0	0	0
Lithuania	0	0	0	0	0
Norway	0	0	0	0	0
Poland	30	27	27	20	29
R. of Moldova	0	0	0	0	1
Romania	4	4	4	2	5
Russia	5	5	5	5	6
Slovakia	5	5	5	4	5
Slovenia	1	1	1	1	1
Switzerland	1	0	0	1	0
FYR Macedonia	0	0	0	0	0
Ukraine	8	7	7	6	13
Yugoslavia	2	2	2	1	2
Non-EU	81	73	73	56	85
TOTAL	478	373	373	353	385

Table 3.9: Vegetation exposure indices for the revised Reference (REF8), K1, K9, K10 and H1 scenarios

	Cumulative vegetation exposure index (1000 km ² .excess ppm.hours)				
	REF8	K1	K9	K10	H1
Austria	237	212	212	203	213
Belgium	130	114	114	114	115
Denmark	43	36	36	33	36
Finland	0	0	0	0	0
France	2198	1805	1805	1845	1816
Germany	1060	937	937	903	944
Greece	160	151	151	147	137
Ireland	5	3	3	4	3
Italy	1124	998	998	997	996
Luxembourg	13	11	11	11	11
Netherlands	71	62	62	62	63
Portugal	292	254	254	254	233
Spain	1323	1110	1111	1106	1093
Sweden	10	9	9	8	9
UK	129	100	100	110	96
EU-15	6793	5804	5804	5796	5765
Albania	52	49	49	47	48
Belarus	46	44	44	37	69
Bosnia-H	151	141	141	133	143
Bulgaria	258	254	254	229	270
Croatia	202	189	189	181	191
Czech Republic	277	255	255	227	263
Estonia	0	0	0	0	0
Hungary	376	359	359	317	370
Latvia	3	2	2	1	4
Lithuania	10	8	8	5	17
Norway	1	1	1	1	1
Poland	730	689	689	578	721
R. of Moldova	49	49	49	45	54
Romania	574	560	560	494	594
Russia	890	882	882	862	960
Slovakia	198	189	189	164	196
Slovenia	89	82	82	80	82
Switzerland	79	68	68	70	68
FYR Macedonia	37	36	36	33	36
Ukraine	1064	1048	1048	987	1166
Yugoslavia	233	223	223	202	230
Non-EU	5319	5127	5127	4693	5483
TOTAL	12112	10930	10931	10489	11247