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PART 4/4

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT

Accompanying the document

Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and he Committee of the Regions a Clean Air Programme for Europe

Proposal for a Directive of the European Parliament and of the Council on the limitation of emissions of certain pollutants into the air from medium combustion plants

Proposal for a Directive of the European Parliament and of the Council on the reduction of national emissions of certain atmospheric pollutants and amending Directive 2003/35/EC

Proposal for a Council Decision on the acceptance of the Amendment to the 1999 Protocol to the 1979 Convention on Long-Range Transboundary Air Pollution to Abate Acidification, Eutrophication and Ground-level Ozone

{COM(2013) 917 final}
{COM(2013) 918 final}
{COM(2013) 919 final}
{COM(2013) 920 final}
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APPENDIX 7.4 EMISSION REDUCTIONS REQUIRED OF THE MEMBER STATES IN 2025 AND 2030 TO ACHIEVE THE IMPACT REDUCTION OBJECTIVES OF THE CENTRAL CASE OPTION 6C*

2025 central case; emission ceilings in Kilotons; % reduction vs 2005

Country	SO2	% red	NOx	% red	NH3	% red	VOC	% red	PM2,5	% red
Austria	12	-52%	71	-69%	50	-20%	90	-47%	11	-54%
Belgium	46	-67%	123	-58%	62	-16%	88	-44%	15	-46%
Bulgaria	81	-91%	63	-62%	58	-11%	55	-61%	14	-60%
Croatia	9	-86%	27	-64%	20	-31%	38	-52%	5	-65%
Cyprus	1	-97%	7	-68%	5	-23%	4	-53%	1	-73%
Czech Rep.	65	-68%	114	-61%	52	-35%	113	-55%	23	-47%
Denmark	9	-56%	63	-65%	44	-40%	54	-59%	11	-62%
Estonia	20	-70%	18	-55%	9	-23%	26	-31%	10	-48%
Finland	63	-30%	110	-45%	27	-20%	95	-45%	18	-37%
France	103	-77%	453	-66%	463	-31%	571	-49%	154	-43%
Germany	295	-46%	517	-63%	318	-46%	715	-42%	73	-41%
Greece	52	-90%	130	-68%	41	-28%	92	-68%	16	-71%
Hungary	17	-86%	53	-66%	48	-38%	63	-57%	11	-61%
Ireland	13	-81%	54	-64%	89	-14%	43	-33%	9	-32%
Italy	93	-76%	447	-66%	298	-29%	566	-54%	85	-42%
Latvia	3	-47%	22	-39%	13	-1%	30	-57%	9	-52%
Lithuania	11	-74%	29	-54%	40	-10%	34	-59%	7	-55%
Luxembourg	1	-44%	13	-73%	5	-25%	5	-58%	2	-47%
Malta	0,2	-98%	1	-86%	1	-26%	3	-32%	0,2	-79%
Netherlands	30	-57%	134	-65%	111	-24%	135	-34%	15	-38%
Poland	332	-74%	398	-50%	243	-29%	286	-53%	154	-31%
Portugal	23	-79%	76	-72%	55	-22%	118	-48%	19	-69%
Romania	55	-92%	111	-64%	115	-29%	171	-63%	44	-61%
Slovakia	20	-78%	42	-55%	17	-41%	45	-41%	12	-62%
Slovenia	5	-88%	17	-66%	14	-26%	15	-62%	2	-73%
Spain	152	-89%	418	-72%	256	-30%	488	-48%	61	-61%
Sweden	30	-22%	82	-62%	43	-20%	136	-35%	21	-33%
Un. Kingdom	153	-82%	450	-70%	240	-22%	550	-50%	46	-47%
EU-28	1697	-79%	4043	-65%	2740	-30%	4630	-50%	848	-48%

2030 central case; emission ceilings in Kilotons; % reduction vs 2005

Country	SO2	% red	NOx	% red	NH3	% red	VOC	% red	PM2,5	% red
Austria	11	*-54%*	60	*-74%*	51	*-20%*	89	*-48%*	11	*-55%*
Belgium	44	*-68%*	112	*-62%*	62	*-16%*	89	*-44%*	15	*-46%*
Bulgaria	53	*-94%*	55	*-67%*	58	*-11%*	51	*-63%*	12	*-64%*
Croatia	9	*-87%*	25	*-68%*	21	*-30%*	36	*-55%*	5	*-67%*
Cyprus	1	*-97%*	6	*-71%*	5	*-21%*	4	*-54%*	1	*-73%*
Czech Rep.	59	*-72%*	99	*-67%*	51	*-36%*	111	*-56%*	22	*-49%*
Denmark	9	*-58%*	55	*-70%*	43	*-41%*	53	*-59%*	10	*-64%*
Estonia	19	*-71%*	16	*-61%*	9	*-21%*	24	*-37%*	10	*-52%*
Finland	63	*-30%*	99	*-51%*	28	*-18%*	91	*-47%*	17	*-41%*
France	98	*-78%*	395	*-71%*	458	*-32%*	559	*-50%*	141	*-48%*
Germany	258	*-53%*	435	*-69%*	312	*-47%*	705	*-43%*	70	*-43%*
Greece	38	*-92%*	110	*-73%*	41	*-28%*	89	*-69%*	17	*-72%*
Hungary	16	*-88%*	46	*-70%*	49	*-37%*	61	*-58%*	11	*-63%*
Ireland	11	*-84%*	35	*-77%*	89	*-14%*	42	*-33%*	9	*-35%*
Italy	92	*-76%*	390	*-70%*	301	*-29%*	554	*-55%*	81	*-45%*
Latvia	3	*-47%*	19	*-47%*	13	*2%*	30	*-56%*	8	*-54%*
Lithuania	12	*-72%*	26	*-58%*	44	*-1%*	33	*-60%*	6	*-57%*
Luxembourg	1	*-44%*	10	*-79%*	5	*-25%*	5	*-59%*	2	*-48%*
Malta	0,2	*-98%*	1	*-89%*	1	*-27%*	3	*-31%*	0,1	*-80%*
Netherlands	28	*-59%*	121	*-68%*	109	*-25%*	133	*-35%*	15	*-39%*
Poland	278	*-78%*	338	*-58%*	244	*-29%*	280	*-54%*	140	*-38%*
Portugal	23	*-79%*	65	*-76%*	56	*-20%*	119	*-48%*	19	*-69%*
Romania	51	*-93%*	100	*-68%*	113	*-30%*	165	*-64%*	41	*-64%*
Slovakia	20	*-79%*	39	*-59%*	17	*-41%*	45	*-41%*	12	*-62%*
Slovenia	5	*-89%*	14	*-72%*	14	*-26%*	15	*-63%*	2	*-74%*
Spain	151	*-89%*	354	*-77%*	255	*-30%*	488	*-48%*	62	*-60%*
Sweden	32	*-16%*	75	*-65%*	43	*-19%*	131	*-38%*	20	*-34%*
Un. Kingdom	128	*-85%*	391	*-74%*	244	*-21%*	545	*-50%*	46	*-48%*
EU-28	1513	*-81%*	3490	*-70%*	2734	*-30%*	4551	*-51%*	806	*-51%*

APPENDIX 7.5 EMISSION REDUCTIONS COST EFFECTIVE IN INDIVIDUAL SECTORS IN 2025 AND 2030 TO ACHIEVE THE IMPACT REDUCTION OBJECTIVES OF THE CENTRAL CASE OPTION 6C*

2025 central case; emissions in Kilotons; % reduction vs Baseline (Option 1)

Sector										
	SO2	*% red*	NOx	*% red*	NH3	*% red*	VOC	*% red*	PM2,5	*% red*
Power generation	671	*-19%*	860	*-19%*	17	*-30%*	132	*-23%*	30	*-50%*
Domestic combustion	255	*-36%*	504	*0%*	20	*0%*	390	*-52%*	359	*-31%*
Industrial combustion	388	*-35%*	616	*-31%*	5	*-14%*	77	*0%*	43	*-40%*
Industrial Processes	347	*-39%*	167	*-2%*	60	*-19%*	773	*-5%*	147	*-26%*
Fuel extraction	0		0		0		290	*-5%*	7	*0%*
Solvent use	0		0		0		2328	*-10%*	0	
Road transport	5	*0%*	1210	*0%*	48	*0%*	293	*0%*	104	*0%*
Non-road machinery	31	*-15%*	684	*-9%*	1	*-45%*	271	*-13%*	37	*-8%*
Waste	1	*-76%*	1	*-82%*	173	*0%*	75	*-13%*	64	*-29%*
Agriculture	0	*-100%*	1	*-96%*	2416	*-27%*	0	*-100%*	58	*-66%*
total	1697	*-31%*	4043	*-12%*	2740	*-25%*	4630	*-17%*	848	*-33%*

2030 central case; emissions in Kilotons; % reduction vs Baseline (Option 1)

Sector										
	SO2	*% red*	NOx	*% red*	NH3	*% red*	VOC	*% red*	PM2,5	*% red*
Power generation	520	*-18%*	720	*-20%*	15	*-33%*	117	*-28%*	25	*-53%*
Domestic combustion	217,9	*-35%*	470	*0%*	19	*0%*	362	*-51%*	323,7	*-30%*
Industrial combustion	390	*-36%*	633	*-32%*	5	*-15%*	85	*0%*	45	*-40%*
Industrial Processes	348	*-40%*	167	*-2%*	60	*-20%*	778	*-5%*	149	*-26%*
Fuel extraction	0		0		0		275	*-5%*	6	*0%*
Solvent use	0		0		0		2342	*-10%*	0	
Road transport	5	*0%*	887	*0%*	46	*0%*	257	*0%*	102	*0%*
Non-road machinery	31	*-15%*	611	*-8%*	1	*-45%*	262	*-7%*	33	*-5%*
Waste	1	*-77%*	1	*-84%*	173	*0%*	74	*-12%*	64	*-29%*
Agriculture	0	*-100%*	1	*-96%*	2415	*-27%*	0	*-100%*	58	*-66%*
total	1513	*-32%*	3490	*-14%*	2734	*-25%*	4551	*-17%*	806	*-33%*

APPENDIX 7.6 IMPACT REDUCTIONS IN THE MEMBER STATES IN 2025 AND 2030 IN THE CENTRAL CASE OPTION 6C* COMPARED TO OPTION 1

2025 central case; impact % reduction vs baseline (Option 1)

Country	PM human mortality, years of life lost, million		Premature deaths due to ozone		Forest area exceeding acidification limits		Ecosystem area exceeding eutrophication limits	
		% red		% red		% red		% red
Austria	2,56	-20%	287	-7%	0		8338	-52%
Belgium	4,55	-17%	247	-6%	19	-36%	1	-95%
Bulgaria	2,97	-18%	508	-5%	0		11576	-19%
Croatia	1,37	-19%	199	-9%	51	-83%	21830	-11%
Cyprus	0,52	-2%	41	-2%	0		2528	0%
Czech Rep.	4,21	-21%	343	-7%	377	-59%	1183	-31%
Denmark	1,41	-16%	120	-5%	10	-72%	4144	-2%
Estonia	0,39	-8%	27	-4%	0		3197	-29%
Finland	1,19	-7%	68	-4%	0		5476	-31%
France	21,03	-15%	1596	-5%	403	-87%	87546	-28%
Germany	28,17	-18%	2525	-6%	865	-80%	33851	-33%
Greece	5,08	-17%	604	-5%	73	-63%	54080	-2%
Hungary	3,95	-22%	486	-8%	432	-60%	15898	-17%
Ireland	0,77	-10%	48	-2%	0	-91%	409	-33%
Italy	25,18	-23%	3369	-6%	2	-96%	38408	-32%
Latvia	0,72	-14%	62	-5%	587	-45%	22755	-15%
Lithuania	1,16	-15%	98	-4%	5380	-7%	18142	-4%
Luxembourg	0,19	-17%	11	-8%	3	-97%	1084	-3%
Malta	0,12	-7%	18	-5%	0		0	
Netherlands	6,16	-15%	316	-5%	3376	-12%	3530	-9%
Poland	21,88	-23%	1079	-7%	7435	-61%	45381	-24%
Portugal	2,73	-26%	423	-5%	132	-30%	30385	-7%
Romania	8,92	-23%	983	-7%	0	-100%	84115	-5%
Slovakia	2,09	-24%	185	-8%	44	-92%	18489	-6%
Slovenia	0,62	-27%	76	-10%	0	-100%	500	-77%
Spain	12,79	-21%	1506	-4%	4	-92%	191606	-5%
Sweden	1,68	-8%	164	-4%	4205	-20%	32800	-27%
Un. Kingdom	15,18	-25%	1121	-5%	394	-59%	1743	-57%
EU-28	177,58	-20%	16509	-6%	23791	-50%	738994	-17%

2030 central case; impact % reduction vs baseline (Option 1)

Country	PM human mortality, years of life lost, million		Premature deaths due to ozone		Forest area exceeding acidification limits		Ecosystem area exceeding eutrophication limits	
		% red		*% red*		*% red*		*% red*
Austria	2,45	*-20%*	274	*-7%*	0		7121	*-56%*
Belgium	4,40	*-17%*	241	*-5%*	11	*-62%*	1	*-95%*
Bulgaria	2,84	*-18%*	491	*-6%*	0		11576	*-19%*
Croatia	1,35	*-19%*	190	*-9%*	47	*-84%*	21622	*-10%*
Cyprus	0,55	*-2%*	42	*-2%*	0		2528	*0%*
Czech Rep.	3,99	*-21%*	329	*-7%*	271	*-66%*	1068	*-36%*
Denmark	1,36	*-15%*	117	*-4%*	10	*-70%*	4128	*-2%*
Estonia	0,39	*-8%*	26	*-4%*	0		3062	*-31%*
Finland	1,17	*-6%*	67	*-3%*	0		5060	*-31%*
France	19,70	*-15%*	1539	*-5%*	216	*-91%*	81731	*-31%*
Germany	26,72	*-19%*	2439	*-6%*	615	*-83%*	32316	*-35%*
Greece	4,97	*-16%*	595	*-5%*	75	*-50%*	53785	*-2%*
Hungary	3,85	*-22%*	465	*-8%*	430	*-60%*	15882	*-14%*
Ireland	0,74	*-9%*	47	*-4%*	0	*-91%*	381	*-35%*
Italy	24,19	*-22%*	3259	*-6%*	2	*-96%*	36140	*-34%*
Latvia	0,71	*-12%*	61	*-3%*	577	*-45%*	22428	*-15%*
Lithuania	1,15	*-14%*	95	*-5%*	5357	*-7%*	18044	*-5%*
Luxembourg	0,18	*-17%*	11	*0%*	3	*-97%*	1071	*-4%*
Malta	0,12	*-7%*	17	*-6%*	0		0	
Netherlands	5,94	*-14%*	308	*-5%*	3213	*-14%*	3508	*-10%*
Poland	20,55	*-23%*	1040	*-7%*	5693	*-65%*	43383	*-26%*
Portugal	2,72	*-25%*	415	*-5%*	132	*-30%*	30318	*-7%*
Romania	8,74	*-22%*	955	*-7%*	0	*-100%*	82945	*-6%*
Slovakia	2,04	*-24%*	177	*-8%*	42	*-91%*	18206	*-6%*
Slovenia	0,60	*-26%*	73	*-9%*	0	*-100%*	417	*-78%*
Spain	12,69	*-21%*	1473	*-4%*	1	*-97%*	188858	*-6%*
Sweden	1,66	*-8%*	159	*-4%*	4012	*-19%*	30859	*-29%*
Un. Kingdom	14,59	*-23%*	1103	*-5%*	338	*-59%*	1572	*-60%*
EU-28	170,35	*-20%*	16007	*-6%*	21047	*-50%*	718011	*-18%*

APPENDIX 7.7 INDICATIVE EMISSION TRAJECTORY TOWARDS ACHIEVING THE LONG-TERM OBJECTIVE IN 2050

SO2 emissions, kiloton. Indicative beyond 2025

	2025	2030	2035	2040	2045	2050
Austria	12	11	9	8	8	7
Belgium	46	43	40	38	35	33
Bulgaria	81	61	46	34	26	20
Croatia	9	8	7	6	5	5
Cyprus	1	1	1	1	1	1
Czech Rep.	65	53	43	34	28	22
Denmark	9	9	8	8	7	7
Estonia	20	18	17	16	15	14
Finland	63	55	49	43	38	33
France	103	94	87	79	73	67
Germany	295	245	203	169	140	116
Greece	52	40	31	24	20	15
Hungary	17	15	14	12	11	10
Ireland	13	10	8	7	5	4
Italy	93	85	77	70	64	58
Latvia	3	3	2	2	2	2
Lithuania	11	10	10	9	9	8
Luxembourg	1	1	1	1	1	1
Malta	0	0	0	0	0	0
Netherlands	30	27	24	22	19	17
Poland	332	252	191	145	110	83
Portugal	23	21	19	17	15	13
Romania	55	44	36	29	23	19
Slovakia	20	18	17	16	15	14
Slovenia	5	4	4	3	3	3
Spain	152	134	119	105	93	82
Sweden	30	30	29	28	27	26
Un. Kingdom	153	127	105	88	73	60
EU-28	1697	1437	1217	1030	873	739

NOx emissions, kiloton. Indicative beyond 2025

	2025	2030	2035	2040	2045	2050
Austria	71	60	50	42	36	30
Belgium	123	108	95	84	73	64
Bulgaria	63	54	47	41	35	30
Croatia	27	22	17	14	11	9
Cyprus	7	6	5	4	4	3
Czech Rep.	114	96	81	69	58	49
Denmark	63	56	49	43	38	34
Estonia	18	15	12	10	8	7
Finland	110	92	77	64	53	44
France	453	391	338	292	252	218
Germany	517	438	372	315	268	227
Greece	129	116	103	93	83	74
Hungary	53	45	38	32	28	23
Ireland	54	45	38	31	26	22
Italy	447	399	357	319	285	255
Latvia	22	18	15	13	11	9
Lithuania	29	24	19	16	13	11
Luxembourg	13	10	7	6	4	3
Malta	1	1	1	1	1	0
Netherlands	134	124	115	107	99	91
Poland	398	336	283	238	201	169
Portugal	76	68	60	54	48	43
Romania	111	95	81	69	59	50
Slovakia	42	37	33	29	25	22
Slovenia	17	13	11	9	7	6
Spain	418	348	289	241	200	167
Sweden	82	74	66	60	54	49
Un. Kingdom	450	383	327	279	238	203
EU-28	4043	3481	2997	2581	2222	1913

VOC emissions, kiloton. Indicative beyond 2025

	2025	2030	2035	2040	2045	2050
Austria	90	78	68	60	52	45
Belgium	88	81	75	69	64	59
Bulgaria	55	45	38	31	26	21
Croatia	38	34	30	27	25	22
Cyprus	4	4	3	3	2	2
Czech Rep.	113	98	84	73	63	54
Denmark	54	48	43	38	34	30
Estonia	26	21	16	13	10	8
Finland	95	82	71	61	52	45
France	571	517	468	423	383	347
Germany	715	653	597	545	498	455
Greece	92	80	69	60	52	45
Hungary	63	55	47	41	36	31
Ireland	43	36	30	26	22	18
Italy	566	505	450	401	357	318
Latvia	30	24	20	16	13	11
Lithuania	34	29	24	20	17	14
Luxembourg	5	5	4	3	3	3
Malta	3	2	2	2	2	1
Netherlands	135	123	112	102	93	85
Poland	286	241	203	171	144	122
Portugal	118	108	99	90	83	76
Romania	171	143	120	100	84	70
Slovakia	45	40	35	30	26	23
Slovenia	15	14	12	11	10	9
Spain	488	451	417	385	356	329
Sweden	136	123	111	100	90	81
Un. Kingdom	550	508	470	434	401	370
EU-28	4630	4155	3728	3346	3002	2694

PM2,5 emissions, kiloton. Indicative beyond 2025

	2025	2030	2035	2040	2045	2050
Austria	11	11	10	9	9	8
Belgium	15	15	14	14	13	13
Bulgaria	14	12	10	9	7	6
Croatia	5	4	4	3	3	2
Cyprus	1	1	1	1	1	1
Czech Rep.	23	19	16	13	11	9
Denmark	11	9	8	7	6	5
Estonia	10	7	5	3	2	1
Finland	18	15	13	11	9	8
France	154	141	130	119	109	100
Germany	73	68	63	58	54	50
Greece	16	15	14	14	13	13
Hungary	11	10	9	8	8	7
Ireland	9	8	7	7	6	5
Italy	85	74	65	57	50	43
Latvia	9	6	5	3	2	2
Lithuania	7	6	5	4	3	3
Luxembourg	2	2	2	2	1	1
Malta	0	0	0	0	0	0
Netherlands	15	14	13	12	11	10
Poland	154	117	89	68	51	39
Portugal	19	18	17	16	15	14
Romania	44	36	29	24	19	16
Slovakia	12	11	9	8	7	6
Slovenia	2	2	2	2	2	2
Spain	61	58	54	51	48	46
Sweden	21	19	17	16	14	13
Un. Kingdom	46	44	41	39	37	34
EU-28	848	750	663	586	518	458

NH3 emissions, kiloton. Indicative beyond 2025

	2025	2030	2035	2040	2045	2050
Austria	50	46	42	38	35	32
Belgium	62	59	56	53	50	48
Bulgaria	58	56	54	52	51	49
Croatia	20	18	17	15	14	13
Cyprus	5	4	4	4	3	3
Czech Rep.	52	50	48	46	44	43
Denmark	44	42	40	38	36	34
Estonia	9	8	8	7	7	6
Finland	27	26	24	22	20	19
France	463	436	411	387	365	343
Germany	318	296	275	256	238	222
Greece	41	38	36	34	33	31
Hungary	48	45	42	39	36	33
Ireland	89	84	80	76	72	68
Italy	298	280	264	249	234	221
Latvia	13	12	11	10	10	9
Lithuania	40	39	35	32	29	26
Luxembourg	5	4	4	4	4	4
Malta	1	1	1	1	1	1
Netherlands	111	107	104	101	98	95
Poland	243	226	211	196	183	170
Portugal	55	53	51	49	47	45
Romania	115	103	92	83	74	67
Slovakia	17	16	15	14	13	12
Slovenia	14	13	12	11	10	9
Spain	256	240	225	211	198	185
Sweden	43	41	39	38	36	34
Un. Kingdom	240	233	225	218	211	204
EU-28	2740	2579	2428	2286	2151	2025

ANNEX 8 SENSITIVITY ANALYSES AND RISK ASSESSMENTS

The interim objectives established in Chapter 6 are tested for robustness against variations of real-world conditions away from the assumptions used in the modelling exercise. This is done by conducting a series of sensitivity analyses.

1. TESTING THE ROBUSTNESS OF THE CENTRAL CASE FOR CHANGES TO THE TARGET YEAR

The target year of 2025 should be tested to ensure that it does not introduce any economic sub-optimality vis-a-vis a later target year (of 2030). The following options were identified.

	Option 1	Option 2	Option 3
Central Target Year	2025	2030	2030, with intermediate milestone for 2025

The sub-optimality test is done in two steps:

The first step test is to compare impact reduction costs in 2025 and in 2030 to determine if structural changes occurring during the period make certain cheaper pollution reduction options available in 2030, which were not in 2025. This has been addressed firstly by examining if the wedge between baseline and maximum technically feasible reduction becomes wider in 2030 than in 2025, which would indicate that additional potential measures come on stream; and secondly by calculating the cost-effectiveness of avoided premature deaths in 2025 and 2030 for Options 6A, 6B, 6C and 6D.

		1.Baseline	6A	6B	6C	6E.MTFR
2025	Premature deaths	307000	286000	265000	245000	225000
	cost, million €		221	1202	4629	47007
	reduction potential					82000
	cost per avoided premature death, M€		0,010	0,028	0,074	0,57
2030	Premature deaths	304000	284000	263000	243000	218000
	cost, million €		212	1032	4182	50582
	reduction potential					86000
	cost per avoided premature death, M€		0,010	0,025	0,69	0,59

While the baseline impacts are almost unchanged (1% lower) in 2030 than in 2025, the further reduction potential increases slightly (86 vs. 80 thousand premature deaths avoided). Average reduction costs per additional life saved are in the same range in 2030 and in 2025 for all gap closure levels. In fact, the 2025 and 2030 options include exactly the same technical measures, and the reason why average cost-effectiveness shows marginal changes between the two years is that the shares of the same measures in the overall reduction strategy change. Indeed the largest differences between the 2025 and 2030 options are in the residential combustion sector, where costs fall some 30% due to less pollution control measures needed as a consequence of fuel switching away from coal. On the other hand, intensification of small-scale biomass use makes the costs to close the entire gap to the technical potential (MTFR) higher than in 2025. It is concluded that the structural changes occurring between 2025 and 2030 do not make cheaper reduction options available.

The second step is to compare the technical measures required to achieve the gap-closure in 2025 with the structural changes occurring between 2025 and 2030: any measures that emerge as cost effective in 2025 but are not necessary in 2030 are in principle regret measures, as they would give raise to stranded costs on the extended (2030) timetable because certain declining activities are shut down or replaced.

As a rough illustrative example, consider the above methodology applied to coal-fired power generation. Broadly speaking a regret investment is where an abatement measure is applied to meet the 2025 reduction target, but the plant in question is retired between 2025 and 2030, and hence no abatement on it would be needed in 2030. But note that the investment is only a regret investment if the abatement equipment *itself* needs to be retired prematurely - if the equipment would in any case come to the end of its natural life before the plant was retired, there would be no wasted investment. Thus, regret investments are those equipment sets that are applied to plants that will be retired between 2025 and 2030, and where the equipment itself is retired early as a result. To identify these, we first take the number of sets (defined as thermal power capacity) of abatement equipment applied to meet the 2025 target, and check how many are still operational in 2030 (assuming they are applied gradually to the coal capacity over the period 2015-2025, and have a certain normal working life). We then compare these 2025 'survivors' with the number of sets of abatement equipment needed on a 2030 scenario to control the entire existing capacity. The excess constitutes the regret investments. The analysis was performed for each sector, and as a headline indicator for potential regret measures, the annualised costs are presented.

The following analysis refers to the central case option 6C* defined in **Error! Reference source not found.** of section 6.3.2; any emerging regret measures should be interpreted as an upper limit for any options less ambitious than 6C*. In this scenario, the rapid capital turnover assumed in the draft PRIMES2012-3 energy scenario, a small share of the additional measures of Option 6C* could turn out as regret investments in 2030. In total, these questionable measures affect 7 kt of SO2 (i.e., 1.2% of the additional 6C* reductions), of which 5 kt in the UK, 0.5 kt NOx (0.4% of the 6C* reductions) and 2.3 kt PM2.5 (2.5% of the 6C* improvements). Costs associated with these regret measures account for 0.6% of the costs of the 6C* Option. However, 50% of these costs emerge in a single country, the UK, where the PRIMES 2012-3[1] reference scenario suggests an almost complete phase-out of coal from power generation between 2025 and 2030. For the remaining 27 Member States, regret measures account on average for 0.3% of the costs of all 6C* measures.

Considering also the uncertainties around the baseline projection, it is concluded that the emission controls of the 6C* Option lead to only marginal potential regret investments.

2. INTERACTION WITH THE CLIMATE AND ENERGY PACKAGE

The previous section addresses the needs for air policy to carefully take into account the possible mismatches with investment cycles. This is even more important in the light of the future climate and energy policy framework, which may be expected to result in even deeper restructuring of the energy system than foreseen in the most recent PRIMES 2012-3 reference

[1] The current analysis is based on the most recent available reference energy scenario, which is the January 2013 draft that was consulted with the Member States in early 2013.

scenario, which already assumes the achievement of rather ambitious renewable energy targets by 2020 as well as substantial progress in energy efficiency, if not full achievement of the 20% target. It is therefore important to examine the possible interactions between air pollution reduction policy and a climate and energy policy of greater stringency. The effects of climate change mitigation policy in the main sectors in the relevant short-to-medium timescale, and the resulting interactions with air pollution reduction, are summarised as follows:

- Road transport sector: decarbonisation of the transport sector can operate at multiple levels, including the improvement of public transport options to reduce the overall vehicle/ton-km demand; the development of alternative vehicles and vehicle infrastructure, such as hybrids, plug-in hybrids and electric vehicles (hydrogen fuel cell vehicles in the longer term); and the promotion of available vehicles with lower fuel consumption. All these options are win-win solutions for climate and air quality, with the exception of the promotion of light-duty diesel vehicles which –though marginally better than gasoline vehicles on fuel efficiency- in the current situation emit a disproportionately higher amount of NOx. Recent advancements in gasoline engine technology (Gasoline Direct Injection, or GDI) have also enabled the development of highly fuel efficient gasoline engines, which however emit a large number of ultrafine particles (particle emissions from conventional gasoline engines are quasi-nil). In conclusion, decarbonisation of the transport sector can deliver strong benefits also for air quality, but conventional vehicles will maintain an important share of the market in the foreseeable future and will still need effective pollution control, in particular to manage the air quality implications of diesels and GDI.

- Non-road transport: Since in the short term technological breakthrough are not expected and currently there are limited technical options to specifically reduce NOx and PM emission from commercial aviation, only marine shipping is considered. LNG is a viable option to reduce CO2 emissions and at the same time SO2 and NOx emissions with no or reduced need for after-treatment. In principle, investment for pollution abatement installed on ships could become redundant if the vessel or its engine were scrapped a few years later to be substituted by LNG technology. However, the commissioning of large ships is planned long enough in advance to take into adequately account the lifetime of pollution abatement equipment.

- Residential sector: in a decarbonising world, the residential sector will reduce its energy use by more efficient (electrical) energy using products, by improving the energy performance of buildings for temperature control, and by using carbon-lean and carbon-free heating technologies. Among these options, all are win-win solutions for climate and air quality, with the exception of the promotion of domestic use of biomass. Uncontrolled combustion of biomass, in fact, is a potent source of fine particles, black carbon, and poly-aromatic hydrocarbons. A certain share of domestic biomass use can be compatible with air quality objectives, but a prerequisite is that expansion of such capacity happen with high standards in place: in order to avoid the potential high costs to replace highly polluting stoves and boilers a few years after installation, it must be considered a matter of priority to put in place stringent emission standards for small-scale appliances before they capture higher market shares. The contrary would generate sunk costs or unacceptable public health outcome.

- Electricity supply sector: decarbonisation of the power sector includes improved conversion efficiency, e.g. by expanded CHP capacity, switching to lower carbon fuels, switching to renewable sources, and more efficient and smarter transmission grids. Renewable sources are not only carbon neutral but also pollution free, again with the exception of biomass; however, strict regulation for large combustion plants can be an effective enabling factor for tapping the biomass potential while limiting to a minimum the detrimental consequences on human health. It is noteworthy, however, that a possible greater share of decentralised power sources in future could increase the share of combustion in installations smaller than 50MWTh, which are currently not regulated at EU level. Again, it will be important to have in place adequately high emission standards before such capacity expansion occurs, as it would be much more costly to retrofit the same installations at a later time. Biomass caveat aside, switching from coal plants to natural gas or to carbon-free sources provides substantial co-benefits for air quality. In principle, investment for pollution abatement installed on existing coal plants could be made redundant if there was a plan to shut down the plant a few years later and to substitute it by alternative technology. However, planning and building new power plants requires a long time, and national energy plans (which may include turning off old coal plants) can provide the necessary stability to take rational investment decisions on pollution abatement equipment taking into account its useful lifetime.

- Industry: substitution possibilities in energy intensive industries are more limited than in the power sector, as primary processes in iron & steel or cement making cannot be easily substituted by different techniques. The refinery sector is a special case, as decarbonisation will substantially reduce demand for oil products with consequent impacts for activity in the sector. However, the transition will take a long time, and the effect of climate policy on the demand for refinery products can be forecast sufficiently in advance to effectively plan the operation and investment requirements of the existing refining capacity.

- Solvents: solvent applications are not significantly affected by climate mitigation policy; there are no evident trade-offs between climate and air pollution policy. Limiting VOC emissions, conversely, reduces ozone formation which is also a potent short-lived climate forcer.

- Agriculture: most of air pollution reduction measures addressing agriculture are related to technical measures to control ammonia emissions. These measures are largely applicable irrespective of the livestock numbers or of other key parameters influencing methane emissions, and the interactions between climate and air policies as regards agricultural measures are not significant, with the exception of the win-win effect of methane reduction, which is not only a greenhouse gas but also a precursor of hemispheric background ozone.

In conclusion, there are substantial interactions between climate change and air pollution policies. A more ambitious climate policy is expected to make reaching the new air quality objectives cheaper by removing highly polluting sources such as coal plants or reducing domestic coal use; however, expanded biomass combustion can result in detrimental health impacts unless sufficiently stringent emission standards are put in place. Some sectors, such as the power and refineries sectors, may face in principle the risk that accelerated decarbonisation of electricity supply and of the transport sector could result in early retirement of large capacities and make redundant any additional pollution abatement investments on those plants. However, any future low-carbon economy roadmap scenario would seek to develop a cost-effective pathway to the agreed climate targets taking into account the need to minimise stranded cost risks; furthermore, the time horizon of the proposed air quality policy targets (2025-2030) will give sufficient time for plant operators to develop rational investment plans that give full value to the invested capital.

3. Emission reductions delivered by further climate change mitigation policy

The Commission work programme for 2013 foresees a new climate and energy framework for the 2030 time horizon which should deliver benefits in terms of air quality. The form of this policy is not clear at the time of writing, but the following analysis has assumed a reduction in domestic GHG emissions below 1990 levels by 25% in 2020 and by 40% in 2030.[2]

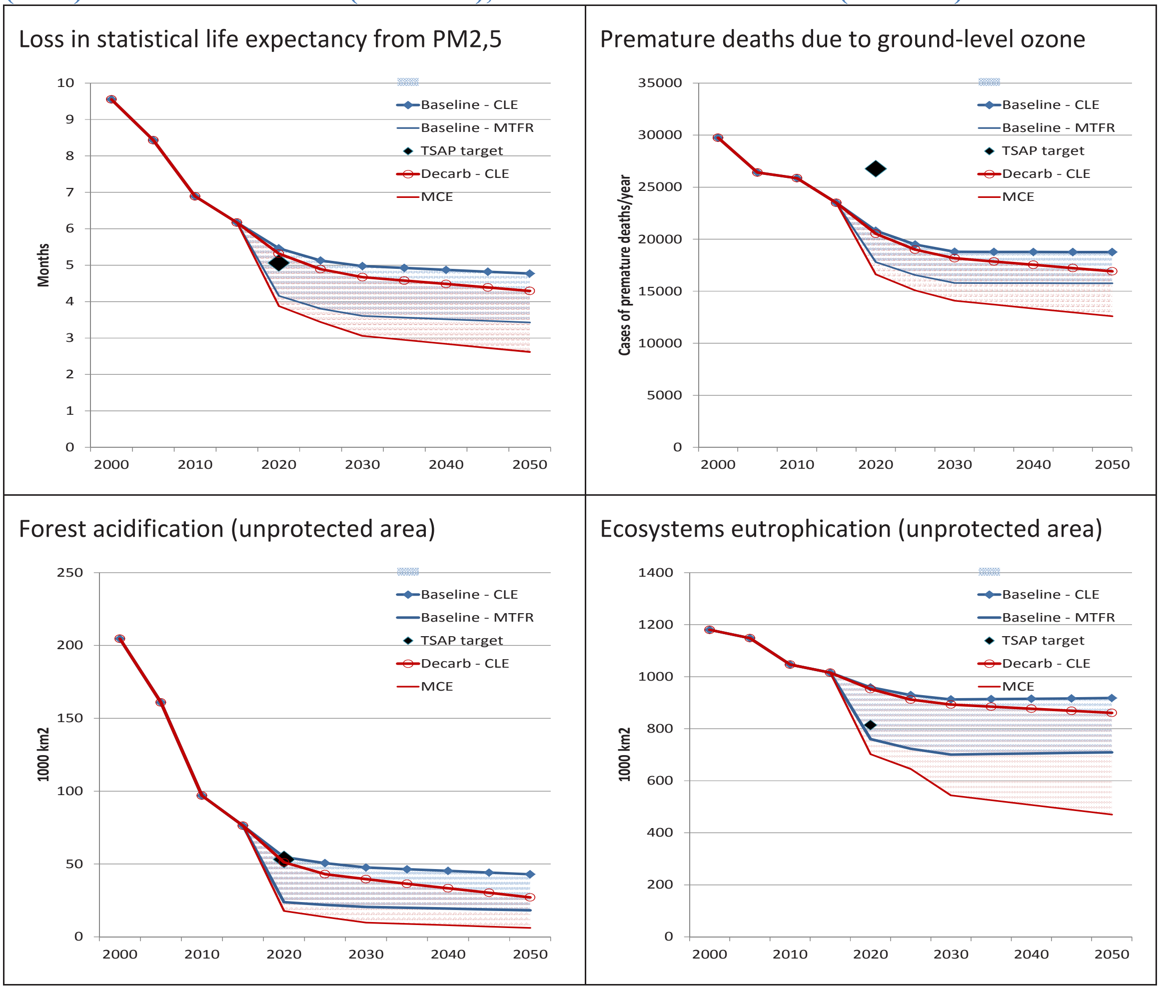
Based on this, decarbonisation measures alone could reduce health impacts from PM2,5 by approximately 5% in 2030 and 10% in 2050 compared to the current legislation baseline. This compares with reductions from additional air pollution measures of around 30% in both years. Decarbonisation of the economy has a more substantial impact on acidification and ground-level ozone, delivering as much as two thirds of the MTFR reductions by 2050. Decarbonisation would reduce eutrophication impacts only marginally.

Thus while the impacts of decarbonisation are clearly positive for air, the limited reductions PM and eutrophication mean that climate policy alone would not be sufficient to achieve the long-term air quality objective by 2050.

The following charts show the impact reductions that would be achieved by the baseline in the absence of further policies , by climate decarbonisation policy, by air pollution control measures (MTFR), and by a Maximum control effort (MCE) trajectory that combines decarbonisation and air pollution control measures; the additional reduction potential on eutrophication is in this case due to assumptions on hypothetical behavioural change reducing meat consumption in Europe:

2 Recent IIASA analysis (See Chapter 3.1, TSAP Report #6, IIASA, 2012B) based on the Global Climate Action/ effective technology scenario developed for the low carbon economy roadmap (SEC(2011) 288 final)

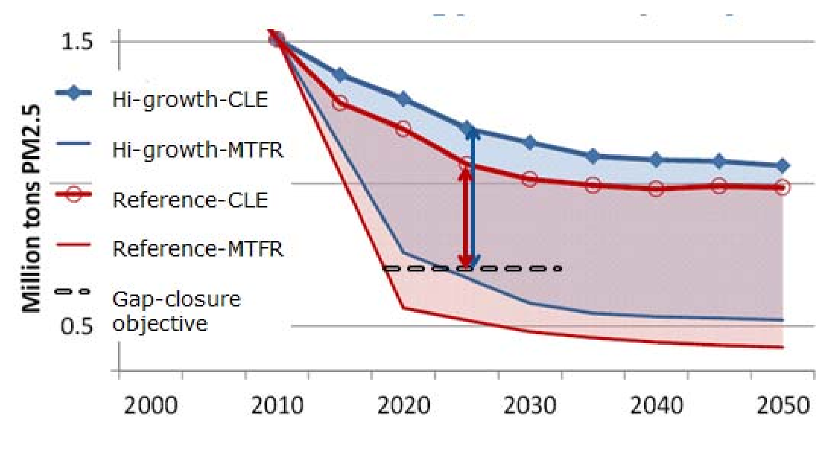
Figure A8.1: Impact reductions in the long term under different trajectories: current legisaltion (CLE) baseline and MTFR (blue lines), decarbonisation and MCE (red lines)



4. CHANGES TO THE GROWTH PROJECTIONS AND TO PROGRESS IN ENERGY EFFICIENCY AND RENEWABLES

Emissions are strongly correlated with economic activity, and higher growth would entail higher levels of baseline emissions. Interim objectives, although initially defined in terms of gap closure, will for policy purposes be expressed in terms of absolute impacts. Thus the objectives must be tested to ensure that the absolute impact reductions in question are still achievable on a higher-growth scenario. The concept is illustrated in Figure A8.2 below.

Figure A8.2: Achievability of environmental objectives on a higher growth scenario



The red lines illustrate the wedge between current legislation emissions and MTFR in the reference case. The blue lines represent the same wedge under a higher growth assumption. The gap closure target defined under reference projections would become in a higher growth case closer to the MTFR and consequently more expensive as additional measures would be required to achieve it.

To do this, emission reductions and associated control costs for achieving the environmental targets of the central scenario in absolute terms (i.e., in absolute YOLLs, km2, etc.) are calculated again starting from an alternative baseline representing higher growth. The scenario chosen for this purpose is the previous PRIMES 2010 reference scenario, which assumes GDP in 2025 and 2030 approximately 7% higher than in the PRIMES 2012-3 reference case (or an average annual growth rate 0,35% higher). Achievability of the targets under the PRIMES 2010 trajectory has been checked for different scenario variants that would achieve 75% gap closure on the PM mortality objective and increasingly stringent objectives on ozone and eutrophication targets. The conclusions are a fortiori valid for options closer to the baseline trajectory.

In addition to the PRIMES 2010 trajectory, sensitivity analyses were also done with PRIMES energy results of the 2012-3 EU "Baseline with adopted measures" scenario. This is a scenario done for climate policy purposes, which is similar to the corresponding reference scenario except in assumptions on renewable energy and energy efficiency policies. The 2012-3 reference case assumes that the EU renewable energy targets will be fully met and that the Energy Efficiency Directive (EED) adopted in 2012 is fully implemented. In the Baseline with adopted measures the deployment of renewables depends on currently adopted national policies and measures and the EED is not included insofar as effects on GHG emissions depend on the way in which transposition into national measures will take place. The analysis indicates therefore how much more expensive it would be to meet air pollution reduction objectives if progress on renewables and energy efficiency would turn out to be less than in the reference case.

Under the PRIMES2012-3 Baseline trajectory, the entire range of objectives would still be achievable, albeit at moderately higher costs (6-8% more for eutrophication reductions in the range 80-90% gap closure. Summary figures for these sensitivity analyses are presented in table A8.1.

Table A8.1: Impact reduction targets and emission control costs (million €/yr) in 2025 of different targets optimized for the trajectories PRIMES 2012-3 reference, PRIMES 2012-3 baseline, and PRIMES 2010 reference. Changes in costs are compared to current legislation costs. INF indicates target infeasible.

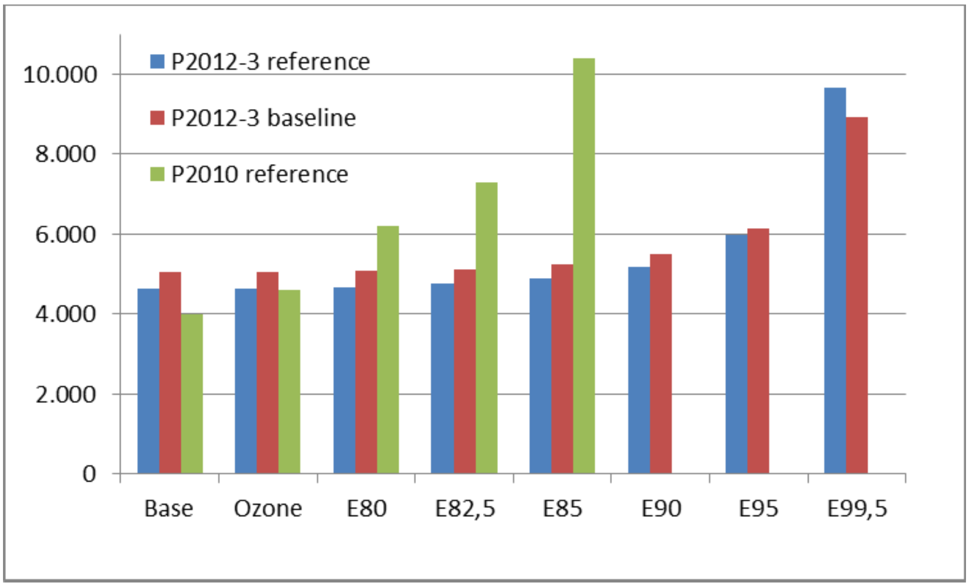
	Base	Ozone	E80	E82,5	E85	E90	E95	E99,5
Gap closure:								
PM mortality	75%	75%	75%	75%	75%	75%	75%	75%
Ozone	NA	46%	46%	46%	46%	46%	46%	46%
Eutrophication	NA	NA	80%	82,50%	85%	90%	95%	99,50%
compliance cost								
P2012-3 reference	4.629	4.648	4.680	4.766	4.884	5.195	5.971	9.653
P2012-3 baseline	5.036	5.053	5.069	5.127	5.228	5.493	6.150	8.936
P2010 reference	3.988	4.600	6.201	7.304	10.409	INF	INF	INF

However, it must be noted that the PRIMES 2010 and PRIMES 2012 scenarios differ in much more than only growth projections. The projected energy mix is different, for instance as a reflection of the improved understanding of the outcome of existing energy and climate mitigation policies and the inclusion of recent energy trends. As a result, PRIMES 2010 provides valuable information and a useful test of the feasibility of objectives in an uncertain future, but the interpretation of comparative emission control costs in detail requires further discussion:

For the ‘health only’ target (base), additional emission control costs (on top of those for current legislation) amount to 4.6 billion €/yr for the PRIMES 2012 scenario, and to close to 4 billion € under the P2010 trajectory. This would be counter-intuitive for an alternative scenario driven by higher growth only, and is a consequence of the higher use of biomass in the residential sector in P2012, which causes more emissions of primary PM2.5 which, when originating from small sources, are more expensive to abate than the emissions of secondary PM2.5 precursors (i.e., SO_2, NO_x, etc.) targeted in the P2010 case.

However, costs eventually increase faster for additional improvements of, eutrophication under P2010 (Figure A8.3). For the P2012 case, costs for further eutrophication improvements rise slowly until about 90% gap closure. For the P2010 trajectory, additional costs on top of the health-only case rapidly increase from 1.6 for the 80% case to 5.8 billion €/yr for the 85% case, while the range of 90% and beyond would not be feasible.

Figure A8.3: Variation of emission control costs (on top of the costs for the CLE scenarios) for achievements of health and environmental targets under the P2012 reference and baseline, and P2010 trajectories



While in the PRIMES 2012-3 reference case the pollution control expenditure increases by €32M and €118M respectively when moving to 80% and 82,5% eutrophication gap closure (even less in the PRIMES 2012-3 baseline), with the PRIMES 2010 assumptions the costs increase by €1,6bn and €2,7bn respectively.

<u>This striking difference is entirely due to higher livestock number projections in the PRIMES 2010 scenario, which in turn drive higher ammonia emissions and higher costs to bring them down to the target levels identified by the pollution reduction objectives of the various options:</u> on PRIMES 2010, the introduction of 80% and 82,5 eutrophication gap closure requires additional costs to control ammonia of €2,1bn and 2,9bn respectively (even higher than the €1,6bn and 2,7bn total cost increase, meaning that some other sectors would reduce their effort slightly). With 85% eutrophication gap closure, the ammonia reduction potential would be almost entirely exhausted, driving additional NOx reductions for almost €4bn to reach this eutrophication reduction target. For the same reason, stricter eutrophication reduction targets would <u>not be achievable on PRIMES 2010.</u>

The analysis presented above examines whether or not certain levels of environmental objectives would be feasible under economic growth and energy system assumptions diverging from the central ones, and how costly it would be to achieve them. A further question is the feasibility and compliance cost relate to the individual emission reduction commitments identified as most cost-effective under reference assumptions. In this context, the cost of achieving the emission ceilings of the central case option 6C* (see Annex 7, Appendix 7.4) has been calculated under the PRIMES 2012-3 "Baseline with adopted measures" assumptions (see above). All ceilings have been assessed to be within the feasible range; Table A8.2 summarises the resulting compliance costs.

Table A8.2: Costs of achieving the C6* emission ceilings in the EU28 in 2025 under the PRIMES 2012-3 reference and baseline with adopted measures assumptions

				EU-28	**4680**	**5774**	**1094**
SNAP sector	**ref**	**BL**	**diff.**	**SNAP sector**	**ref**	**BL**	**diff.**
Power generation	500	536	36	Solvent use	63	69	5
Domestic sector	1611	2609	998	Road transport	0	0	0
Industrial combust.	610	650	40	Non-road mobile	142	169	27
Industrial processes	384	393	9	Waste treatment	9	9	0
Fuel extraction	6	6	0	Agriculture	1356	1334	-22
				All Economy	**4680**	**5774**	**1094**

Table A8.2 shows that compliance costs would be 1094 M€/yr (23% higher), almost entirely (998 M€/year) for pollution abatement in residential combustion, demonstrating the high synergetic potential of energy efficiency measures to curb energy demand and associated pollution from buildings.

5. BURDEN SHARING BETWEEN MEMBER STATES

Option 6C* (**Error! Reference source not found.**) would require some 0,03% of the EU's GDP for expenditure in additional pollution abatement measures. However, the distribution of effort across Member States varies from 0,003% of GDP in Sweden to 0,168% of GDP in Bulgaria. This is a reflection both of different absolute GDP levels (the cost of the same piece of equipment would represent a higher share of GDP in a lower-income country); and of differences in past effort (a smaller reduction potential in countries with a longer pollution control tradition).

The effect of capping the direct additional expenditure as a percentage of GDP was assessed. The reduced costs for the capped Member States entails increased costs for other Member States, in particular neighbouring Member States upwind of those that reduce their effort, in order to meet the same objectives, and lower cost-effectiveness overall.

Table A8.3: Costs of achieving the C6* emission ceilings in the Member States in 2025 under the PRIMES 2012-3 reference and baseline with adopted measures

	Option 6C*		C15 (<= 0.16%)		C16 (<=0.15%)			changes relative to Option 6C*		
	M€	% of GDP	M€	% of GDP	M€	% of GDP			<0,16%	<0,15%
Austria	100,0	0,028	99,3	0,028	222,1	0,062		Austria	-1%	122%
Belgium	114,5	0,026	114,4	0,026	95,6	0,022		Belgium	0%	-16%
Bulgaria	80,7	0,168	76,7	0,160	71,9	0,150		Bulgaria	-5%	-11%
Croatia	39,8	0,064	39,0	0,063	93,3	0,150		Croatia	-2%	135%
Cyprus	1,2	0,006	1,0	0,005	1,0	0,005		Cyprus	-14%	-16%
Czech Rep.	118,6	0,059	117,5	0,059	300,8	0,150		Czech Rep.	-1%	154%
Denmark	32,5	0,011	32,5	0,011	44,3	0,015		Denmark	0%	36%
Estonia	7,4	0,034	7,4	0,035	7,8	0,036		Estonia	0%	5%
Finland	13,7	0,006	13,7	0,006	15,3	0,007		Finland	0%	12%
France	378,0	0,015	378,1	0,015	461,1	0,019		France	0%	22%

Germany	855,8	0,029	855,9	0,029	2.189,4	0,075		Germany	0%	156%
Greece	82,3	0,034	109,1	0,045	361,0	0,150		Greece	32%	338%
Hungary	93,0	0,080	101,3	0,087	173,8	0,150		Hungary	9%	87%
Ireland	26,1	0,012	26,0	0,012	20,2	0,009		Ireland	0%	-23%
Italy	595,2	0,033	594,1	0,033	1.653,3	0,091		Italy	0%	178%
Latvia	19,9	0,075	19,9	0,075	19,7	0,075		Latvia	0%	-1%
Lithuania	28,0	0,073	27,8	0,073	57,2	0,150		Lithuania	-1%	104%
Luxembourg	2,9	0,005	2,9	0,005	1,6	0,003		Luxembourg	0%	-45%
Malta	0,4	0,005	0,4	0,005	0,3	0,004		Malta	-5%	-17%
Netherlands	62,7	0,009	62,7	0,009	60,7	0,008		Netherlands	0%	-3%
Poland	736,7	0,142	736,8	0,142	780,3	0,150		Poland	0%	6%
Portugal	92,2	0,046	92,3	0,046	88,7	0,045		Portugal	0%	-4%
Romania	265,7	0,159	268,1	0,160	251,4	0,150		Romania	1%	-5%
Slovak Rep.	86,0	0,090	85,3	0,089	143,3	0,150		Slovak Rep.	-1%	67%
Slovenia	50,5	0,112	50,4	0,112	49,6	0,110		Slovenia	0%	-2%
Spain	268,6	0,019	268,4	0,019	270,0	0,019		Spain	0%	1%
Sweden	15,8	0,003	15,8	0,003	14,6	0,003		Sweden	0%	-8%
Un. Kingdom	512,0	0,023	512,0	0,023	616,6	0,028		Un. Kingdom	0%	20%
EU-28	4.680,2	0,030	4.708,6	0,031	8.065,0	0,052		EU-28	1%	72%
Maximum		0,168		0,160		0,150				

Table A8.3 shows the cost changes per Member state and for the EU28 when setting an upper bound to the maximum effort per country to a fixed percentage of GDP, while ensuring that all four main environmental objectives (PM-health, ozone, eutrophication and acidification) are met in each country. Setting a limit of 0,16% would in primis reduce the effort for Bulgaria for € 4M, and require a redistribution of effort resulting in costs for the EU28 28 M€ higher overall. Limiting the maximum effort at 0,15% would further save Bulgaria 5 M€ and Romania 17 M€, but overall costs for the EU would balloon to €3,7bn higher. This indicates that the scope for limiting individual efforts while maintaining the environmental and health benefits of option 6C* in all Member States is negligible, and confirms that the effort required on option 6C* is well balanced across Member States.

6. FURTHER EMISSION CONTROLS FROM INTERNATIONAL MARITIME SHIPPING

This section examines whether further reductions of ship emissions (i.e. beyond the emission reductions that will be delivered by the recently amended Directive on the sulphur content of marine fuels 2012/33/EU, and existing international standards in relation to SOx and NOx emissions as established in Annex VI to the MARPOL Convention) could emerge as cost-effective means for achieving the environmental objectives of the revised TSAP, i.e., to what extent they could substitute more expensive measures at land-based sources. The environmental objectives are those of the central case option 6C*.

For the purpose of this sensitivity analysis, two alternative scenarios cases are calculated: Scenario SN1 assumes sulphur and nitrogen emission control areas (SECAs and NECAs) in the 200 nautical miles zones (EEZ, Exclusive Economic Zone) of all EU countries. This would result in a 50% reduction of shipping SO_2 emissions relative to the baseline, and a 24% cut in NO_x. Scenario SN2 excludes further SECAs and foresees only the introduction of NECAs in EEZ of all EU countries (24% cut in NOx).

Table A8.4: SO_2 and NOx emission from marine activities in 2005 and 2025; baseline, a scenario with SECAs and NECAs in the EU's EEZs, and a variant with NECAs only; unit: kilotons

SO2	Baseline		SN1	SN2	NOx	Baseline		SN1	SN2
	2005	2025	SECA-NECA	NECA only		2005	2025	SECA-NECA	NECA only
Baltic Sea	130	7	7	7	Baltic Sea	220	193	131	131
Bay of Biscay	282	72	16	72	Bay of Biscay	474	457	311	311
Black Sea	27	7	6	7	Black Sea	47	42	38	38
Celtic Sea	14	2	1	2	Celtic Sea	22	19	13	13
Mediterranean Sea	764	183	104	183	Mediterranean Sea	1294	1186	963	963
North Sea	309	16	16	16	North Sea	518	476	323	323
Rest of NE Atlantic (within EMEP grid)	31	8	8	8	Rest of NE Atlantic (within EMEP grid)	54	51	51	51
Rest of NE Atlantic (outside EMEP grid)	112	28	14	28	Rest of NE Atlantic (outside EMEP grid)	192	184	144	144
Total	1668	321	171	321	Total	2821	2606	1973	1973

The additional measures for SECAs and NECAs reduce costs for these land-based sources in 2025 by 814 million €/yr in the SN1 scenario, and by 528 million €/yr in Scenario SN2 (Table A8.5). At the same time, the estimated costs for the NECA[3] are of 564 million €/yr in 2025. For SECAs in the 200 nm zones of all EU countries, cost estimates range between 1.3 billion €/yr in case scrubber-based compliance is used and 2.8 billion €/yr for use of low sulphur fuel.

Compared to the 6C*, total emission control costs (of land-based and marine sources) would increase by 10-40% in the SN1 case, and by less than 1% in SN2 with NECA only.

In conclusion, with the current assumptions on costs for low sulphur fuels, packages of SECAs and NECAs in the 200 nm zones of the EU Member States would be overall more expensive than some land-based measures available to achieve the targets of the base case. Scrubber-based compliance would substantially reduce the SECA costs, but would not close the cost-effectiveness gap in full compared to land-based emission reductions; note that this assessment is based on the reduction of impacts on land and does not take into consideration any of the additional benefits for the marine/coastal environment.

On the other hand, emission reductions associated with the designation of NECAs would be essentially as cost-effective as emission reductions on land, with a less than 1% difference in total pollution control costs which is well within the uncertainty range of the costs estimates, and indicates seaborne NOx reductions as an economically attractive option for the future.

Table A8.5: Comparison of emissions (kilotons) and emission control costs (million €/yr) of scenarios SN1 and SN2 for the reduction of emissions from international marine shipping. Changes in emissions refer to 2005, changes in costs to the costs of Option 1 (Baseline.)

	2005	Option 1	base case	SN1	SN2

[3] " Specific evaluation of emissions from shipping including assessment for the establishment of possible new emission control areas in European Seas (VITO, 2013)

SO2	7874	2520	1769	1773	1767
		-68%	-77%	-77%	-77%
NOx	11358	4588	4020	4125	4107
		-60%	-65%	-64%	-64%
PM2.5	1706	1274	859	859	865
		-25%	-49%	-49%	-49%
NH3	3942	3733	2765	2860	2842
		-5%	-30%	-27%	-28%
VOC	9312	5558	4593	4659	4619
		-40%	-51%	-50%	-50%
Costs for land-based		87673	+4745	+3931	+4217
Costs ships Low S fuel			0	+2771	+564
Total costs			+4745	+6702	+4781
Costs ships FGD			0	+1283	+564[4]
Total costs			+4745	+5214	+4781

Preliminary analysis of the cost-benefit outlook for the establishment of NECA in the Baltic sea leads indeed to conclude that NECAs could deliver substantial net benefits. The following table shows a summary of the costs and benefits (source: VITO 2013 and own elaboration) of NECA in the Baltic sea:

Table A8.6: Summary cost-benefit outlook for the establishment of NECA in the Baltic sea

Baltic sea	Tons Nox removed	control cost, M€	benefit per ton, low	benefit, low, M€	CBA, low	benefit per ton, high	benefit, high, M€	CBA, high
2020	29,6	32,6	3500	103,6	3,2	8900	263,4	8,1
2030	93,6	74,9	3500	327,6	4,4	8900	833,0	11,1

With a marginal benefit of reducing NOx emissions at sea between €3,500 and €8,900 per ton removed[5], the benefit-to-cost ratio for the establishment of NECA in the Baltic Sea can then be estimated between 3,2 and 8,1 in 2020 and between 4,4 and 11,1 in 2030; the economic impact assessment for the designation of a NECA in the North Sea (Danish Environment Protection Agency 2012)[6] estimated for the North Sea a benefit-to-cost ratio in the same range (1,6-6,8) although lower[7] than the Baltic estimate.

Reducing NOx emissions from international shipping in the EU sea areas could in sum deliver substantial benefits, and Member States that do so would need to take less action on land-based sources to meet the health and environmental objectives of the NECD. Since the emission reduction commitments of the NECD do not cover international maritime traffic emission, the possibility to allow a voluntary offset mechanism has been envisaged. Under such mechanism, a Member State that takes measures achieving demonstrable emission

4 The cost estimate for the NECA-only scenario is the same for low-sulphur fuel and scrubber-based compliance, as these two sub-options are relevant for SECA but not for NECA.

5 Latest update (EMRC, forthcoming) of previous values from the analysis supporting the TSAP 2005, (AEA, 2005), ranging between €2,500 and €6,900

6 Danish Ministry of the Environment, 2012

7 The study uses however outdated damage cost figures (AEA, 2005). The most recent update (EMRC, forthcoming) would yield a benefit-to-cost ratio 70-80% higher.

reductions in an area within the 200 nm of it coastline would be allowed to deduct a certain percentage (hereinafter "offset ratio") of the emission reductions achieved in that sea area from its calculated emissions for the purpose of compliance with the NECD. The following analysis is based –by way of example- on the case of designation of the sea areas within 200 nm of the EU coastline as NECA, and addresses two questions: a) since emissions occurring at sea -being farther away from population and terrestrial ecosystems- are on average less damaging than land-based emissions, which offset ratio could be allowed, while guaranteeing the integrity of the NECD's environmental objectives? And b) how much would the Member States' NOx control costs be reduced? Tables A8.7 and A8.8 address questions a and b respectively. In this analysis it is assumed that all Member States would designate their territorial waters + EEZ as NECA; since the Member States do not currently report emissions in their EEZ, the analysis assumes that the emission reductions achieved in each of the sea areas of table A8.3 is allocated to the neighbouring Member States proportionally to their EEZ surfaces in that sea area. Three options are explored for the offset ratio: 50%, 33% and 20%

Table A8.7: integrity of environmental objectives with NECA offsets: Member states not meeting the environmental improvements delivered by Option 6C*

2025	Offset ratio 50%	Offset ratio 33%	Offset ratio 20%
PM Health	AT, BG, HR, CY, HU, IT, SI, ES, GR, PT, RO, SK	AT, BG, HR, CY, HU, IT, SI, ES	IT (<1%)
Ozone	BE, HR, CY, DE, LU, MA, NL, SI, SE	CY	none
Eutrophication	none	none	none
Acidification	HU, IT, PT, RO, SI	SI	none

As shown in table A8.7, allowing an offset ratio of 50% would substantially compromise the achievement of environmental objectives in the majority of Member States. At the 33% offset ratio level, the impact would be rather modest, although some land-locked Member States (which do not obtain any offset on their NOx reduction commitment) would be affected. At the 20% offset level, only one Member State (Italy) would experience a very modest impact on the PM-health objective.

Table A8.8: NOx offsets and compliance cost savings with NECA offset ratios of 50, 33 and 20%, vs emission reduction commitments of Option 6C*

2025	6C* ceiling	Ceilings relative to 6C*				Expenditure relative to 6C*		
	kt NOx	50% o.r.	33% o.r.	20% o.r.		50% o.r.	33% o.r.	20% o.r.
Austria	71	0,0	0,0	0,0		0,0	0,0	0,0
Belgium	123	0,4	0,3	0,2		-0,7	-0,5	-0,3
Bulgaria	63	1,1	0,7	0,4		-1,9	-1,3	-0,8
Croatia	27	3,9	2,6	1,6		-3,8	-3,0	-2,3
Cyprus	7	6,9	4,5	2,7		0,0	0,0	0,0
Czech Rep.	114	0,0	0,0	0,0		0,0	0,0	0,0
Denmark	63	11,0	7,3	4,4		-2,4	-2,4	-2,2
Estonia	18	2,6	1,7	1,0		0,0	0,0	0,0
Finland	110	6,1	4,0	2,4		0,0	0,0	0,0
France	453	25,4	16,8	10,2		-34,4	-28,2	-21,0
Germany	517	6,1	4,0	2,4		-18,1	-12,5	-7,6

Greece	129	34,6	22,8	13,8	-1,1	-1,1	-1,1
Hungary	53	0,0	0,0	0,0	0,0	0,0	0,0
Ireland	54	1,0	0,7	0,4	-1,4	-1,0	-0,7
Italy	447	37,6	24,8	15,0	-77,7	-61,3	-46,9
Latvia	22	2,1	1,4	0,8	-0,4	-0,4	-0,3
Lithuania	29	0,4	0,3	0,2	-0,3	-0,2	-0,1
Luxembourg	13	0,0	0,0	0,0	0,0	0,0	0,0
Malta	1	3,9	2,6	1,5	0,0	0,0	0,0
Netherlands	134	7,7	5,1	3,1	-5,2	-4,9	-3,2
Poland	398	2,3	1,5	0,9	-4,2	-2,8	-1,7
Portugal	76	29,8	19,7	11,9	-14,7	-13,5	-10,5
Romania	111	0,9	0,6	0,4	-1,8	-1,2	-0,7
Slovak Rep.	42	0,0	0,0	0,0	0,0	0,0	0,0
Slovenia	17	0,0	0,0	0,0	0,0	0,0	0,0
Spain	418	46,4	30,6	18,5	-39,3	-31,7	-23,8
Sweden	82	12,0	7,9	4,8	-0,3	-0,3	-0,3
Un. Kingdom	450	36,3	23,9	14,5	-20,5	-16,8	-12,9
EU-28	4043	278,5	183,8	111,4	-228,2	-183,0	-136,6

Table A8.8 shows that at offset ratios of 50%, 33% and 20%, total pollution control costs for land sources would decrease in 2025 by 228, 183 and 137 M€/yr (EU28). Note that in the case of smaller insular or peninsular member states (e.g. GR, CY, MT) the potential offsets may be much larger than the NOx emission reductions required by the NECD. In such cases the offset would result in much smaller pollution control cost reduction for land sources. The functioning of the offset mechanism is elucidated through the case of NECA designation, but the application of the mechanism should not be limited to this measure or to NOX only: other measures going beyond EU legislation –for instance to shift from fuel oil to LNG, or to provide clean shore-side electricity to ships at berth- could also be eligible for offsetting NOx, SO2 and PM emissions.

7. POLICY INSTRUMENTS TO ACHIEVE THE INTERIM TARGETS: SOURCE CONTROLS AT EU LEVEL

This section examines the cost implications of implementing some of the measures identified as cost effective in the central emission reduction scenario as EU-wide source control measures rather than only setting emission ceilings through the NEC Directive and leaving the choice of technical measures entirely up to the Member States.

Leaving to the Member States the full decision as to which emission sources to control could in principle deliver the most flexible application of the technical measures best suited for the specific local conditions. However, EU source controls would help levelling the playing field and improving administrative efficiency; indeed in the public consultation 94% of government respondents advocated more stringent source controls at EU level.[8] Requiring the application of harmonised measures at EU level would result in a certain cost-effectiveness decrease, which may be well justified if proportionate in relation to the benefits. Several groups of measures have been identified, and the additional implementation cost estimated if

[8] Either alone (34%) or in combination with more stringent NEC ceilings (57%)

they were taken at EU-wide scale compared to the 6C* Option implemented exclusively through the NEC Directive.[9] The following cases were examined:

- EU-wide source controls in agriculture
- EU-wide source controls for medium combustion plants (less than 50 MWth)
- Selection of measures that could be covered by updated Best Available Techniques (BAT) Conclusions under the Industrial Emissions Directive (IED) for the following activities: (i) Chemicals production and solvents use, (ii) Cement & Lime production, (iii) Glass manufacturing, (iv)Petroleum Refining

7.1. EU-wide source controls in agriculture

A recent review under the IED[10] concluded that reducing emissions from manure spreading offers the highest benefit-to-cost ratio. As a first analysis of this option, with a view to determining if and how ammonia emissions should be controlled at EU level, the following scenarios have been analysed:

- A1: Harmonised introduction of low-emission manure application techniques throughout the EU (for all farms with size larger than 15 Livestock Units)
- A2: Harmonised introduction of low-emission manure application techniques throughout the EU for all farms with size larger than 15 Livestock Units, as well as covered storage of manure and low-emission housing (new constructions only) for all animals except cattle

- The central case option 6C* for 2025, as benchmark case
- Option 6C* combined with the A1 measures taken EU-wide
- Option 6C* combined with the A2 measures taken EU-wide

The summary results are shown in table A8.9:

Table A8.9: Emission reductions delivered and costs implied by EU-wide packages of ammonia control measures for manure management

	cost vs baseline	cost vs 6C*	NH3 emission reduction
Measures A1	35	NA	92
Measures A2	54	NA	104
option 6C*	4.680	-	918
option 6C*+ A1	4.682	2	918
option 6C* +A2	4.691	11	918

The packages of measures A1 and A2 would deliver around 10% of the total ammonia emission reductions required by option 6C*, at a low cost (average ammonia removal cost between less than 400 € and 500 € per ton).

9 Note that measures related to product standards are always assumed to be taken at EU-wide scale due to single market provisions. These include: emission standards for road vehicles and non-road machinery; solvent content of consumer products; minimum standards under the Ecodesign directive.

10 COM(2013) 286.

If national emission ceilings (delivering the objectives of option 6C*) were complemented by EU-wide mandatory measures defined by scenarios A1 or A2, the loss of economic efficiency would be insignificant: respectively 2 or 11 M€ compared with total emission control costs of the 6C* option of 4680 M€/year (0,05 to 0,2%). This reflects the very attractive cost-effectiveness of the considered manure management measures essentially at all locations.

7.2. EU-wide source controls for Medium Combustion Plants (MCP)

Chapter 7 presents and analyses in detail the policy options to regulate air emissions from MCP (plants between 1 and 50 MW rated thermal input) at EU level. Chapter 7 concludes that a legislative instrument setting objectives that are proportionate and well-justified from a cost-benefit point of view could deliver yearly the reduction of 135 kiloton SO_2, 107 kiloton NO_x and 45 kiloton PM at the cost of 382 M€ (precise figures refer to 2025). Some of the associate technical measures, however, are already included in the bundle of measures that deliver the emission reductions of the policy options considered by this Impact Assessment. Table A8.10 compares the emission reductions, costs and average pollutant removal costs for MCP in Option 6C* and in the preferred option for EU-wide MCP controls described in Annex 12.

Table A8.10: Emission reductions delivered and costs implied by an EU-wide legislative instrument to control air emissions from MCP

	EU-wide MCP instrument			MCP measures in Option 6C*		
	kiloton abated	expenditure (M€)	average removal cost (€/ton)	kiloton abated	expenditure (M€)	average removal cost (€/ton)
SO2	135	183	1400	79	104	1316
NOx	107	83	800	108	86	796
PM	45	116	2500	13	30	2308
Total		382			220	

Note that the detailed analysis of Annex 12 is based on bottom-up information independent of the GAINS model-based analysis of the general Impact Assessment; these two approaches are complementary and give an indication of the uncertainties. Notwithstanding the uncertainties, the average removal costs are in good matching in the two cases. Pollution abatement expenditure is higher in the EU-wide instrument case for all pollutants except NO_x. In summary, the preferred Option for a EU-wide MCP control instrument would entail for the MCP segment extra costs of the order of 162 M€/year, around 3% of the total expenditure entailed by the central case Option 6C*.

7.3. Updated BAT Conclusions under the IED

Emission standards for industrial sectors expressed as emission levels associated with Best Available Techniques are established in the BAT conclusions of the BREFs (BAT Reference documents) under the Industrial Emissions Directive (IED). The BREFs are periodically revised to reflect updated information on state of the art techniques for pollution control.

Sensitivity cases have been investigated to explore the impact of implementing packages of measures in some specific sectors at EU-wide level, as could be the case if the underlying techniques were defined as BAT in the relevant BAT conclusions. The sectors identified are: Cement & lime, glass, refineries, Chemicals, and solvent using activities; the measures, selected on the basis of clear cost-effectiveness demonstrated through the modelling in the majority of the Member States, are the following:

- In the cement & lime sector: further (stage 2) SO2 control; further (stage 2 and 3) NOx control; high-efficiency dedusters
- In the glass sector: further (stage 2) SO2 control; high-efficiency dedusters
- In the petroleum refining sector: further (stage 3) SO2 control; high-efficiency dedusters; use of low-sulphur fuel oil; leak detection and repair programmes; covers on oil-water separators; flaring
- In the chemicals sector: further (stage 3) SO2 control in sulphuric acid production; high-efficiency dedusters in fertilizers production; leak detection and repair programmes
- In the solvents sector: incineration in application of adhesives and in polystyrene processing; use of water-based preservatives in wood products; use of water-based coatings in leather coating

The results for packages of measures in the 6 sectors grouped in 3 clusters are the following:

Table A8.11: Costs implied by harmonised EU-wide measures in specific sectors covered by the IED

EU28, M€	central case 6C*	Cement & lime, glass	Refineries	Chemicals and solvents
power generation	500	-15	-68	-3
Domestic	1611	-3	64	0
Industrial combustion	610	85	29	0
Industrial processes	384	0	-2	2
Fuel extraction	6	0	0	0
Solvent use	63	0	-3	1
Road transport	0	0	0	0
Non-road sources	142	0	0	0
Waste	9	0	0	0
Agriculture	1356	-5	3	1
Total	4680	62	24	1

Additional costs compared to Option 6C* are:

- 85M€ in the cement& lime and in the glass sector, replacing measures for 15 M€ in the power sector, 3 M€ in the domestic sector, and 5 M€ in agriculture; the total balance is additional 62 M€, or 1,4 % of the 6C* costs
- 29M€ in the petroleum refining sector, replacing measures for 2 M€ in other industries and 3 M€ in solvent applications; the total balance is additional 24 M€, or 0,5 % of the 6C* costs
- 2M € in the chemicals sector and 1M € in solvent applications, replacing measures for 3M € in the power sector; the total balance is almost neutral (+1M€)

ANNEX 9 SECTORIAL IMPACTS & COMPETITIVENESS PROOFING

1. CONTEXT AND DEFINITIONS

Competitiveness is a measure of an economy's ability to provide its population with high and rising standards of living and high rates of employment on a sustainable basis. In this analysis the concern is to establish the extent to which the proposed policy will (or could) impact on the competitive position of firms within the EU compared with firms operating in the rest of the world. In some cases firms operate both within the EU and outside the EU and if the proposed policy were likely to encourage those firms to switch production outside of the EU that would be considered a weakening of the EU's competitive position.

This annex complements the impact assessment accompanying the review of the Thematic Strategy on Air Pollution (TSAP review). One of the main objectives of the Review is to set a course that would –in the period beyond 2020- make further progress towards the resolution of problems associated with exposure to air pollution. This will require taking different actions depending on the sector involved and the kind of activity controlled, but in general would result in improving the air pollution standards of marketed products in their use phase (such as motor vehicles or heating appliances) or investing in pollution abatement equipment to reduce the amount of pollution generated by productive processes.

Investing in pollution abatement obviously represents a financial burden for the firms that have to make those investments, and different sectors may be more or less able to absorb that burden depending on the volume of investment needed, on the exposure to competition internationally (foreign producers of the same commodity) and also within the European market (domestic producers of potential substitutes).

2. SCOPING OF THE COMPETITIVENESS ANALYSIS

The objectives proposed by the TSAP review are defined in terms of reduction of health and environmental impacts, and of emission reductions by Member State and by pollutant required to deliver the impact reductions; at this stage, it is up to the Member States to decide in which sectors to reduce emissions; however, the TSAP review also identifies the technical measures that would be most cost effective to reduce emissions in each MS and thereby suggests a cost-effective burden sharing by sector. The Review also suggests that some of the measures could be cost-effectively taken also as EU-wide source controls, which could deliver additional co-benefits in terms of administrative certainty and level playfield, but it will be ultimately up to the co-legislators to decide which share of emission reductions should be delivered by EU measures, and which by national action.

In conclusion, the technical measures and costs per sector identified by the Review are only one of the possible ways to meet the objectives, and at implementation may and will change. None the less, this annex discusses those measures that are determined to be the most cost-effective way to meet the pollution reduction objectives of the Review.

The broad goal of this competitiveness analysis is to understand how meeting the proposed objectives of the TSAP review may affect individual economic sectors, whether specific sectors are particularly affected, and to identify possible mitigating measures that could reduce the burden on those sectors.

To do so, a sector-specific analysis is presented, where the cost-effective technical measures that may be taken in each sector to meet the proposed air quality objectives are presented, along with a brief analysis of the markets that supply pollution abatement technologies.

Implications of the direct costs of these proposed measures in terms of international trade flows and for SMEs are addressed as much as possible.
Pollution control measures, associated sectorial costs and impacts are discussed for three different levels of health and environmental improvements objectives in 2025; these levels correspond to policy options 6A, 6B and 6C of Chapter 6.
Broader economic impacts in terms of macro-economic aggregates are presented in Annex 7, to which this Annex is a complement.

3. Supply of abatement technology

A brief analysis of the supply of abatement technology has been included in order to assess if there is the potential for a single supplier or single MS to benefit from enactment of the proposed regulation. If the regulation were found to favour one particular supply company, sector or member state this might be regarded as implying an (unintended) competition impact that would warrant further exploration.

Abatement technologies to reduce air emissions are manufactured by a range of companies ranging from the engineering or chemical companies to the energy specialist. For example, the energy giants Siemens (DE), Hitachi Europe GMBH (DE) and Alstom (FR) all provide multiple abatement techniques for various pollutants (NOx, SOx, dust and others). Other leading engineering European companies such as ABB (CH), Andritz (AT) and Fluor (UK) provide a wide range of abatement technologies such as SCR, FGD and electrostatic precipitators (ESP).

Some manufacturers are more specialised, that is the case of the Belgian Carmeuse, which is specialised in limestone product used for sulphur abatement and the Italian company Ansaldo which is specialised in in-furnace emission reduction systems (low NOx burners, air staging etc.). CMI (BE) is specialised in the design and construction of heat recovery steam generators. Similarly, Howden (UK) is a leading provider of rotary regenerative heat exchangers which are used for FGD and SCR. The British company Johnson Matthey is a leader in providing chemical catalysts. Finally, the Swiss Hug Engineers is a leader in diesel particulate filters and catalytic exhausts. All of these companies are large and have got multiple offices in and, for some, outside of the European Union. Whilst a majority of the abatement technologies manufacturers are large companies, there is a significant number of SMEs involved in the installations or the fitting of these technologies. Moreover, some more specific (specialist) technologies, particularly relevant for combustion engines, may be developed by smaller manufacturers.

This brief analysis supports the general conclusion that there is no one dominant supplier or dominant approach across the installations captured by the proposed regulation.

4. Demand for abatement technologies: detailed measures and expenditure per sub-sector

The type of additional pollution abatement measures identified through the modelling as the most cost-effective ones include:

- For SO2 abatement: controls on industrial process emissions; low sulphur coal/briquettes for small stoves; FGD/low S fuels for industrial furnaces; FGD for refineries and coke plants.

- For NOx abatement: SCR for cement plants; SCR/SNCR for mid-size boilers in power sector and industry; controls on some industrial process emissions
- For NH3 abatement: efficient application of urea fertilizer, or replacement by nitrate fertilizer; low nitrogen feed (pigs, dairy cows, poultry); low emission application of liquid and solid manures; closed storage of manures and new low emission housing (pigs, poultry)
- For primary PM control: modern biomass stoves with lower emissions and higher energy efficiency; reduction of agricultural waste burning; PM controls on some industrial processes
- For VOC control: modern biomass stoves with lower emissions and higher energy efficiency; further substitution with low solvent and water based products and processes; reduced agricultural waste burning

5. Sectorial Market Analysis

Potentially significant competitiveness effects are assumed to be felt most significantly in sectors where international competition is greatest, specifically;

- Iron&steel
- Chemicals
- Petroleum refining
- Agriculture
- Other Energy intensive industries: e.g. glass sector

The GEM-E3 analysis (see Annex 7 for more details) has estimated the impacts in terms of trade flow for all sectors included in the analysis. The results are presented in the following table:

Table A9.1: EU28 import and export changes by sector on options 6A-6C

	6A		*6B*		*6C*	
Sectorial Imports in EU28 , % change						
	base	*health*	base	*health*	base	*health*
Agriculture	0,01%	0,02%	0,07%	0,08%	0,28%	0,30%
Electric Goods	0,00%	0,01%	0,02%	0,03%	0,08%	0,10%
Transport equipment	0,00%	0,01%	0,01%	0,03%	0,04%	0,07%
Petroleum Refining	0,00%	0,01%	0,01%	0,03%	0,04%	0,06%
Ferrous and non-ferrous metals	0,00%	0,01%	0,01%	0,03%	0,03%	0,06%
Chemical Products	0,00%	0,01%	0,01%	0,03%	0,05%	0,07%
Other energy intensive	0,00%	0,01%	0,00%	0,01%	0,01%	0,03%
Other Equipment Goods	0,00%	0,00%	0,01%	0,01%	0,02%	0,04%
Consumer Goods Industries	0,00%	-0,01%	-0,02%	0,00%	0,01%	0,00%
Sectorial Exports in EU28, % change						
	base	*health*	base	*health*	base	*health*
Agriculture	-0,03%	-0,02%	-0,11%	-0,09%	-0,47%	-0,44%
Electric Goods	0,00%	0,02%	0,02%	0,05%	0,10%	0,14%

Transport equipment	0,00%	0,02%	0,01%	0,04%	0,05%	0,10%
Petroleum Refining	-0,02%	-0,02%	-0,07%	-0,06%	-0,20%	-0,19%
Ferrous and non-ferrous metals	0,00%	0,02%	-0,02%	0,01%	-0,02%	0,03%
Chemical Products	0,00%	0,01%	0,00%	0,02%	0,00%	0,03%
Other energy intensive	0,00%	0,01%	-0,01%	0,01%	-0,03%	-0,01%
Other Equipment Goods	0,00%	0,03%	0,02%	0,07%	0,09%	0,16%
Consumer Goods Industries	0,00%	0,01%	-0,01%	0,01%	-0,06%	-0,03%

On options 6A-6C, imports to the EU of agricultural commodities would increase 0,01% to 0,3%, while exports would decrease -0,03 to-0,47%. Increased labour productivity due to health benefits ("health" case) could offset part of the export losses due to production cost increases due to the cost of compliance with air pollution reduction requirements. In terms of sectorial output (Table A9.2), on options 6A-6C the agricultural sector could lose between 0,01% and 0,20%. However, this result does not take into account the effects of increased crop yield due to ground-level ozone concentration reduction, which is estimated to be worth around €270M on option 6C, in the range of 0,1% of the total EU agricultural output, nor possible support schemes for the sector, discussed below in the sector-specific analysis. Similar conclusions can be drawn for the petroleum refining sector, although the magnitude of impacts –in particular on option 6C- is lower. The maximum output loss on option 6C would in this case be limited to -0,1%. None of the other sectors would incur substantial net losses, either because no significant effort is required of them on the policy options considered, or because they benefit from supplying pollution abatement equipment (chemical products as well as manufacturers of equipment).

Table A9.2: EU28 output changes by sector on options 6A-6C

	6A		*6B*		*6C*	
	Sectorial output inpact in the EU28, % change					
	base	*health*	base	*health*	base	*health*
Agriculture	-0,01%	0,00%	-0,06%	-0,04%	-0,22%	-0,20%
Chemical Products	0,00%	0,01%	0,01%	0,03%	0,03%	0,05%
Consumer Goods Industries	0,00%	0,00%	-0,01%	0,00%	-0,04%	-0,01%
Electric Goods	0,00%	0,02%	0,03%	0,05%	0,10%	0,13%
Ferrous and non-ferrous	0,00%	0,01%	-0,01%	0,02%	0,00%	0,03%
Petroleum Refining	-0,01%	0,00%	-0,03%	-0,02%	-0,10%	-0,08%
Other energy intensive	0,00%	0,01%	-0,01%	0,01%	-0,02%	0,01%
Other Equipment Goods	0,00%	0,01%	0,02%	0,05%	0,06%	0,11%
Transport equipment	0,00%	0,01%	0,01%	0,04%	0,04%	0,09%

indicators calculated as relative changes do not differ significantly for 2025 and 2030. Exact figures reported are for 2025.

The market sectors affected are identified above; in the following sections, for each of them basic information on market structure including breakdown by firm size and is provided along with the overall and average gross value added and turnover typical of firms of each size group by number of employees, and impacts on specific sectors and sub-sectors are taken individually.

5.1. Metals (iron and steel; and non-ferrous metals)

Employment in the steel sector reached a peak of around 1 million in the EU during the 1970's. Employment has declined to just over 400,000 in 2008 and the sector continues to face stiff competition from the new global steel producers of Eastern Asia, notably Korea and China. In spite of this stiff competition steel exports exceed imports. Basic data on the EU steel industry follows[11]:

- EU share of global steel exports (top ten exporters) in 2010: 14 %.
- Biggest markets for EU steel exports in 2010 (in decreasing order of importance): Turkey, USA, Algeria, Switzerland, Russia, India.
- EU steel imports fell by about 50% from 40.2 million tonnes in 2008 to 20.7 million tonnes in 2009. In comparison, the steel exports from the EU only fell by 11% from 35 million tonnes in 2008 to 31 million tonnes in 2009, thus turning the EU steel trade balance to surplus after several years of deficit. In 2010 this surplus halved when imports grew by 30% to almost 27 million tonnes and exports increased only by 5% to 33.7 million tonnes in total.

The above data indicates that the average value of steel imported was around €670 per tonne (value divided by tonnage) while the value of steel exported was nearly 1,000 € per tonne. This is a strong indicator that the steel exported is of a higher quality (perhaps because of finishing or fabrication differences) than imported steel. Some of the decline in steel imports may be attributable to economic down turn although as can be seen exports held up comparatively well.

The following figures show steel imports and exports from 2006 projected forward to 2014. The EU has, since 2009 maintained a healthy trade surplus in steel but it is also apparent that it is a globally traded commodity that has the potential to be impacted by price. It is likely that in general steel producers in the EU are price takers and therefore have limited capacity for passing cost, although the EU does have specialist steel fabrication facilities and these may provide some shelter from non EU competition.

[11] http://ec.europa.eu/trade/creating-opportunities/economic-sectors/industrial-goods/steel/#stats

Figure A9.1: EU27 imports of steel. Source: Eurofer, 2013[12]

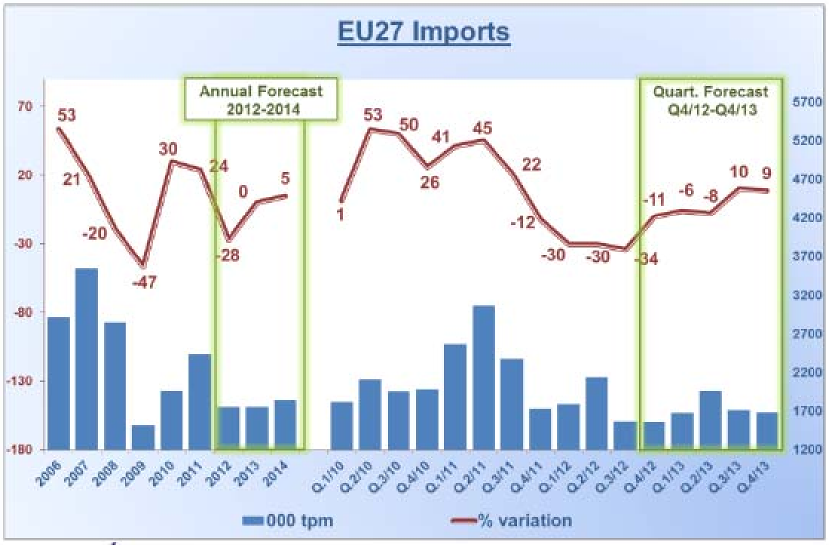
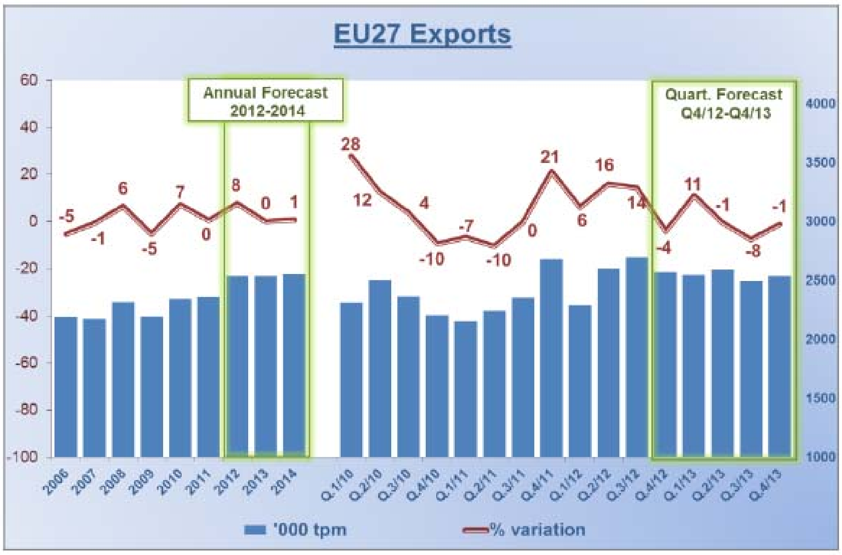


Figure A9.2: EU27 exports of steel. Source: Eurofer, 2013



Non-ferrous metals (principally Aluminium, Copper and Zinc) are important in manufacturing and production supply chains. The EU has limited raw material and mineral deposits, and the principal source is waste and scrap recycling. The EU has developed considerable specialism in these areas but the demand for such metals is greater than can be met through these routes. As a result the EU imports some €8 billion more than it exports (2009 figures). Basic data on the EU non-ferrous metals sector follows[13]:

- Imports (2009): €34 billion / Exports (2009): €26 billion (trade balance: - €8 billion).
- The share of the non-ferrous metals sector in EU manufacturing value added is 1.37 % (€23.4bn.).

[12] http://www.eurofer.org/index.php/eng/Issues-Positions/Economic-Development-Steel-Market
[13] http://ec.europa.eu/trade/creating-opportunities/economic-sectors/industrial-goods/non-ferrous-metals/

- The share in employment is 1.0 % (334 800 people).
- Turnover of the sector was €139 billion (2.0 %).

Basic metals industries (iron & steel; and non-ferrous metals)		**Yearly costs, total and per subsector, M €**					
		total	**coke**	**natural gas**	**hard coal**	**HFO**	**Additional most cost-effective measures**
Iron &Steel, combustion	6A	1,21			1,04	0,17	low sulphur coal (0,6%); low sulphur fuel oil (0,6%); high efficiency deduster
	6B	46,51	3,25		40,21	3,05	low sulphur coal (0,6%); low sulphur fuel oil (0,6%), high efficiency deduster, combustion modification, wet FGD
	6C	90,54	3,64	4,49	72,81	9,60	low sulphur coal (0,6%); low sulphur fuel oil (0,6%), high efficiency deduster, combustion modification, wet FGD
Iron & Steel, pig iron blast furnace	6A	0,61					Stage 2 & 3 SO2 controls for process emissions
	6B	4,38					Stage 3 SO2 controls for process emissions, EP (1 field)
	6C	6,28					Stage 3 SO2 controls for process emissions, EP (1 field), high efficiency deduster, good practices
I&S, Basic Oxygen furnace	6A	0,22					EP (1 field)
	6B	8,22					EP (1 field), high efficiency deduster
	6C	9,45					high efficiency deduster
I&S, Cast iron	6A	0,02					EP (1 field)
	6B	3,24					EP (1 field), high efficiency deduster, good practices
	6C	7,40					high efficiency deduster, good practices
I&S, Coke oven	6A	1,22					Stage 3 SO2 controls for process emissions
	6B	4,00					Stage 1, 2 &3 SO2 controls for process emissions, high efficiency deduster, good practices
	6C	8,39					Stage 1 &3 SO2 controls for process emissions, high efficiency deduster, good practices
I&S, Sinter plant	6A	4,16					Stage 1 & 2 SO2 controls for process emissions
	6B	17,81					Stage 2 & 3 SO2 controls for process emissions
	6C	39,54					Stage 3 SO2 controls for process emissions
Non ferrous metals, combustion	6A	0,63				0,63	high efficiency deduster
	6B	2,61			0,20	2,41	high efficiency deduster
	6C	6,83			2,08	4,75	high efficiency deduster
Non ferrous metals, aluminium	6A	1,51					high efficiency deduster in primary aluminium
	6B	1,52					high efficiency deduster in primary and secondary aluminium
	6C	1,52					high efficiency deduster in primary and secondary aluminium
Non ferrous metals, other	6A	1,43					Stage 2 SO2 controls for process emissions
	6B	15,71					Stage 1, 2 & 3 SO2 controls for process emissions
	6C	61,05					Stage 2 & 3 SO2 controls for process emissions

FGD: Flue Gas Desulphurisation; EP: Electrostatic Precipitator; combustion modification: limestone sorbent addition to solid fuel combustion.

Different stages of process emission controls are related to the production technologies, are site specific and depend onseveral parameters including raw material quality. Stages 1-3 group these measures by progressively increasing costs.

CODE	NACE_R2/SIZE_EMP	By size of company					
C241	Manufacture of basic iron and steel and of ferro-alloys	Total	0-9 employees	10-19 employees	20 -49 employees	50 -249 employees	250+ employees
Number of enterprises		:	:	353	140	170	196
Turnover		144.289,96	:	:	1.945	10.646	129.285
Gross Value Added		22.109	219,72	304	312	1.463	19.793
Turnover per company					13,89	62,62	659,62

Source: Generated from Eurostat database query on turnover and number of enterprises (2010 values used).

The annual costs of the set of measures in the iron and steel industry identified as being the most cost-effective under the policy scenarios analysed is the following:

- In option 6A: 8 M €, equal to 0,006% of sectorial turnover and 0,04% of GVA
- In option 6B: 84 M€, equal to 0,06% of sectorial turnover and 0,4% of GVA
- In option 6C: 160 M€, equal to 0,11% of sectorial turnover and 0,72% of GVA

The largest share of this expenditure is for abatement of emissions in combustion units, in basic oxygen furnaces, and in sinter plants. Basic oxygen furnaces and sinter plants are generally embedded in large size industrial installations and are not expected to be a direct concern of SMEs. In all cases the additional required effort is less than 1% of GVA; the iron & steel sector also benefits from direct gains in terms of net output through demand for fabricated metal products as investment goods for pollution abatement.

CODE	NACE_R2/SIZE_EMP	By size of company					
C242	Manufacture of basic precious and other non-ferrous metals	Total	0-9 employees	10-19 employees	20 -49 employees	50 -249 employees	250+ employees
Number of enterprises		3.583	2.284	377	260	419	183
Turnover		103.109	1.900	:	4.577	31.313	63.204
Gross Value Added		16.347	600	:	633	4.054	10.398
Turnover per company		28,78	0,83		17,6	74,73	345,38

Source: Generated from Eurostat database query on turnover and number of enterprises (2010 values used).

The annual costs of the set of measures in the non-ferrous metals industry identified as being the most cost-effective under the policy scenarios analysed is the following:

In option 6A: 3,5 M €, equal to 0,003% of sectorial turnover and 0,02% of GVA

- In option 6B: 20 M€, equal to 0,02% of sectorial turnover and 0,12% of GVA
- In option 6C: 70 M€, equal to 0,07% of sectorial turnover and 0,44% of GVA

Most of this expenditure is for abatement of smelter process emissions (SO2). In all cases the additional required effort is less than 0,5% of GVA.

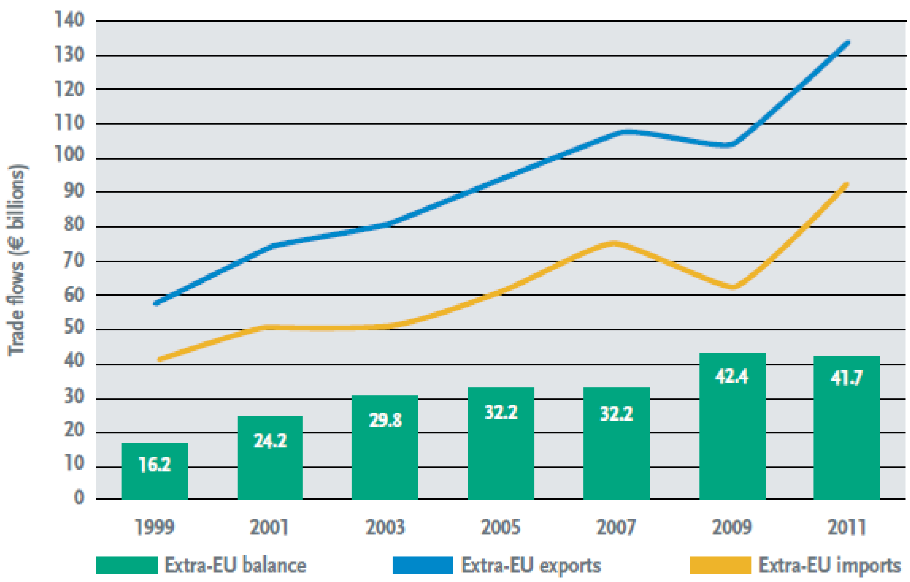
5.2. Chemicals

The chemicals sector is one of Europe's most competitive industrial sectors. Its work is focused on the manufacture of chemicals and the chemical transformation of materials into new substances or products. It covers a huge range of operations and outputs from basic organic and inorganic chemical products, through fertilizers, basic plastics, synthetics, rubbers, paints and varnishes to highly specialized consumer chemicals and polymers. Basic data on the EU chemicals sector follows[14]:

- EU chemicals exports in 2009: €118 billion.
- EU chemicals imports in 2009: €75 billion.
- Biggest markets for EU chemical exports: US, Canada, Switzerland, Asia (China, India, Japan and ASEAN countries).
- Accounting for around 30% of the total world chemicals production, the EU is the world's most important producer of chemicals. In 2008 it produced €566 billion worth of chemicals. More than one third of world's top thirty chemical companies have their headquarters in the EU. The largest European producer of chemicals is Germany, which accounts for about 25% of EU production. Around 30,000 chemical companies employ a total staff of about 1.2 million people in the EU. Another three million employees work in sectors using output of the chemical industry and thus depend on its competitiveness.
- The EU trades more than 40% of all chemicals traded globally, compared with circa 15% for the NAFTA countries and circa 30% for Asia.

The figure below shows the growing importance of chemicals in the EU economy with both imports and exports growing progressively since 1999.

Figure A9.3: EU27 chemicals sector trade balance



Source: Cefic (2012): http://www.cefic.org/Documents/FactsAndFigures/2012/International-Trade/Facts-and-Figures-2012-Chapter-International-Trade.pdf

[14] http://ec.europa.eu/trade/creating-opportunities/economic-sectors/industrial-goods/chemicals/

Chemical industry

		Yearly costs, total and per subsector, M €					
		total	**biomass**	**natural gas**	**oil products**	**coal**	**Additional most cost-effective measures**
N - fertilizer production	6A	0,00					
	6B	2,54					
	6C	63,08					Combination of STRIP
Combustion in boilers	6A	0,33	0,14	0,00	0,07	0,12	
	6B	1,39	0,45	0,09	0,29	0,56	Combustion modification on oil and gas industrial boilers and furnaces; High efficiency deduster; Low sulphur fuel oil (0.6 %S);Low sulphur coal (0.6 %S)
	6C	20,27	7,54	2,21	2,34	8,18	Combustion modification on: oil and gas industrial boilers and furnaces, and solid fuels fired industrial boilers and furnaces; High efficiency deduster; Selective non-catalytic reduction on solid fuels fired industrial boilers and furnaces; Good housekeeping: industrial oil boilers; wet FGD; In-furnace control - limestone injection; Low sulphur fuel oil (0.6 %S)
Other combustion	6A	2,84	0,31	0,00	0,85	1,67	Low sulphur coal (0.6 %S); Low sulphur fuel oil (0.6 %S); wet flue gases desulphurisation; High efficiency deduster; EP (1 field)
	6B	7,27	0,88	0,14	2,23	4,03	Low sulphur coal (0.6 %S); Low sulphur fuel oil (0.6 %S); wet FGD; In-furnace control - limestone injection; Combustion modification on: oil and gas industrial boilers and furnaces, and solid fuels fired industrial boilers and furnaces; Selective catalytic reduction on solid fuels fired industrial boilers and furnaces; High efficiency deduster
	6C	22,82	2,60	3,48	9,89	6,85	Low sulphur coal (0.6 %S); Low sulphur fuel oil (0.6 %S); wet FGD; In-furnace control - limestone injection; Combustion modification on: oil and gas industrial boilers and furnaces, and solid fuels fired industrial boilers and furnaces; selective catalytic and non-catalytic reduction on solid fuels fired industrial boilers and furnaces; selective catalytic reduction on oil and gas industrial boilers and furnaces; Good housekeeping: industrial oil boilers; High efficiency deduster
Organic chemical industry - downstream units	6A	0,26					
	6B	0,85					Leak detection and repair program, stage IV
	6C	1,30					Leak detection and repair program, stage IV
Products incorporating solvents	6A	0,01					
	6B	0,06					Basic emissions management techniques
	6C	0,94					Basic emissions management techniques
Polystyrene processing	6A	0,00					6% Pentane expandable beads (85%) and recycled EPS waste (15%)
	6B	0,17					6% Pentane expandable beads (85%) and recycled EPS waste (15%)
	6C	4,21					6% Pentane expandable beads (85%) and recycled EPS waste (15%); Combination of the above options
Ind. Process: Nitric acid	6A	0,00					

	6B	0,12	
	6C	2,87	Process emissions - stage 1 NOx control
Ind. Process: Sulfuric acid	6A	7,67	Process emissions - stage 2 SO2 control
	6B	22,19	Process emissions - stage 1, 2 and 3 SO2 control
	6C	58,80	Process emissions - stage 2 and 3 SO2 control

Combination of STRIP: stripping and absorption techniques in the chemical industry for N-fertilizers production
FGD: Flue Gas Desulphurisation; EP: Electrostatic Precipitator

CODE	NACE_R2/SIZE_EMP	By size of company					
C20	Manufacture of chemicals and chemical products	Total	0-9 employees	10-19 employees	20 -49 employees	50 -249 employees	250+ employees
Number of enterprises		28.611	18.067	3.379	2.993	2.844	853
Turnover		490.000	14.682	12.142,36	28.547	121.000	313.629
Gross Value Added		111.000	2.667,27	2.912	7.164	26.000	72.257
Turnover per company		17,13	0,81	3,59	9,54	42,55	367,68

Source: Generated from Eurostat database query on turnover and number of enterprises (2010 values used).

The annual costs of the set of measures in the chemicals industry identified as being the most cost-effective under the policy scenarios analysed is the following:

In option 6A: 12 M €, equal to 0,002% of sectorial turnover and 0,003% of GVA

- In option 6B: 32 M€, equal to 0,01% of sectorial turnover and 0,03% of GVA
- In option 6C: 174 M€, equal to 0,04% of sectorial turnover and 0,16% of GVA

In all cases the additional required effort is less than about one quarter of a % point of GVA of the Chemical sector.

Additional expenditure for pollution control in combustion installations may raise to up to 20% of the figures above; additional expenditure for process emission abatement would mainly be for NOx control in Nitrogen fertiliser production, and SO2 control in sulphuric acid plants.

- <u>N-Fertilizers production and trade</u>

INDICATORS/CODE (M€)	Mineral or chemical fertilizers, nitrogenous, n.e.c.	Fertilizers containing N, P and K, > 10% N	Fertilizers containing N, P and K, <= 10% N	TOTAL	% over production value
Exports value	29,1	465,9	64,0	559,0	12
Imports value	4,7	398,2	116,8	519,7	11
Production value	1.200,0	2.537,5	1.017,1	4.754,5	

Source: Generated from Eurostat database (2010 values used).

Additional costs for emission control could affect N-fertilizers trade fluxes due to the significant trade volumes (both imports and exports) of this commodity. In option 6C the additional control costs in this subsector would be of the order of 1% of the total production value.

- <u>Sulphuric acid production and trade</u>

INDICATORS/CODE (M€)	Chlorosulphuric acid	Sulphuric acid	TOTAL	% over production value
Exports value	0,42	77,93	78,34	21
Imports value	2,88	7,03	9,90	3
Production value	4,00	365,17	369,17	

Source: Generated from Eurostat database (2010 values used).

The EU is a net exporter of sulphuric acid (~18% of EU production value in 2010). There is a potential risk that additional costs for this sub sector (up to about 10% of the production value in option 6C) may be difficult to pass over to foreign traders.

5.3. Refining

The mineral oil and gas refinery industry is an important and strategic industry for the EU providing 42 % of the EU energy requirements and employing over 100 000 people.

Installations are broadly distributed around Europe. Refinery installations are typically very large and fully integrated plants, well connected to pipelines and infrastructure networks. Companies operating in the European refining sector can be categorised into 4 classes:

- So-called 'Majors' (Total, Shell, BP, Exxon) EU and non EU based companies operating worldwide in the exploration refining and distribution sectors
- Other EU based companies e.g. Repsol (ES), ENI (IT), Preem (SE), some of them historically stated-owned , operating on a more limited scope
- Smaller companies e.g, Motor Oil, Lyondell Basell, also operating on a more limited scope, mostly in refining activities (less upstream activities) which may be specialized (petrochemicals);
- National companies from non-EU countries operating European refinery plants, e.g. from crude-oil producers such as. Kuwait, Venezuela, Saudi Arabia and more recently Russia (Lukoil) or others like China (PetroChina)

There has been intense restructuring of the EU refining sector over the last 5 years with the emergence of new players from Asia and the Middle East. It is important to note that regions able to directly supply the European market with refined products (Russia, Middle East) are significantly increasing their refining capacities. Moreover, many EU refineries are 30 to 40 or more years old and therefore face financial and technological challenges to adapt to the current market situation due to their initial process configuration which is not flexible enough. Basic data on the EU refinery sector follows[15]:

- After Asia, leading with 25 %, the largest refining regions are North America and Europe with close to 20 % of the global capacity each
- In 2010, the EU countries together operated 104 oil refineries, corresponding to a refining capacity of 778 million Tons/day
- In 2009 the volume of oil processed in EU refineries was 660 million Tons/day (= 85% of total capacity). There is a situation of structural over-capacity. Approximately 20% of capacity was unused in the EU. As a result, in the period 2011-2012, 10% of the capacity

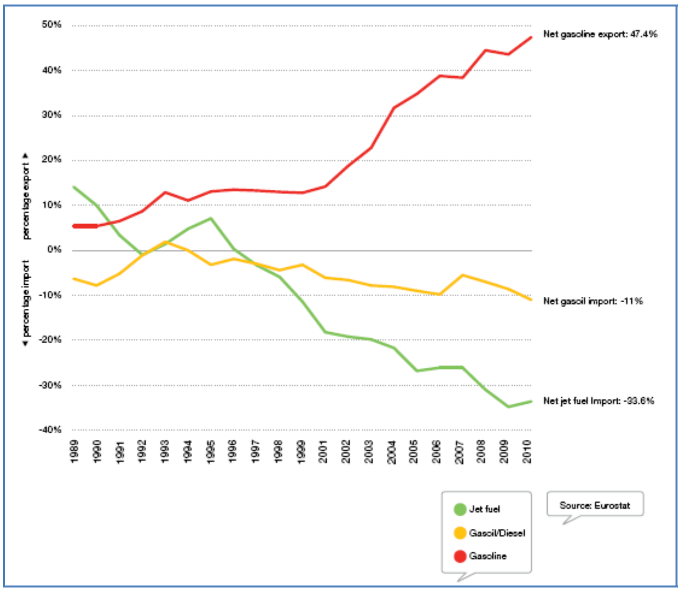
[15] Source: JRC- IPTS (2012)

has been lost due to closures and restructuring of the refining sector. In Europe over the last 20 years there has been a slow but steady increase in unused refining capacity, partially due to the delocalisation of the industry, the relatively weak demand and the progressive specialisation of the demand on middle distillates directly importable from neighbouring areas. Recently, the EU, is the only region that has seen a fall in both demand (-0.9 %) and refining capacity (-2 %) in 2010. This has led to a temporary increase of the refining utilisation rate

- The transport sector and in particular road transport (being almost fully dependent on oil) remains the most energy consuming sector. In the EU, as much as 77.5% of goods are transported by road which implies that industry depends on refined products
- EU gasoline and diesel exports in 2010 were 95 million tonnes per year and imports 288 million tonnes per year.
- There are growing production/consumption imbalances at the level of individual products. In particular the shift over the last decade of motor fuels from gasoline to diesel has resulted in a production deficit of diesel (10%) and a surplus of gasoline (40%) in the EU
- The diesel deficit is covered to a large extent by imports from Russia (35% of diesel imports) and the gasoline is exported mainly to the USA (40%)

The figure below shows the trend of growing gasoline surplus and gasoil deficit.

Figure A9.4: EU's foreign trade as a percentage of demand



Source: EUROPIA, 2011

Petroleum refining industry			
		Yearly costs, total and per subsector, M €	
		total	**Additional most cost-effective measures**
Extraction, processing and distribution of liquid fuels	6A	0,00	
	6B	0,00	
	6C	6,58	Improved ignition systems on flares; Vapour balancing on tankers and loading facilities

Combustion	6A	28,55	Low sulphur fuel oil (0.6 %S)
	6B	50,16	Low sulphur fuel oil (0.6 %S); Combustion modification on industrial boilers and furnaces
	6C	216,86	Low sulphur fuel oil (0.6 %S); wet FGD; high efficiency FGD; high efficiency deduster & good housekeeping; Combustion modification on industrial boilers and furnaces
Ind. Process: Crude oil & other products - input to Petroleum refineries	6A	3,45	Process emissions - stage 1 SO2 control; EP 1 field
	6B	52,78	Process emissions - stage 1, 2 & 3 SO2 control; EP 1 & 2 field; Leak detection and repair program, stage II
	6C	117,78	Process emissions - stage 2 & 3 SO2 control; high efficiency deduster
Steam cracking (ethylene and propylene production)	6A	0,00	Leak detection and repair program, stage II
	6B	0,07	Leak detection and repair program, stage II; COWS
	6C	0,79	Leak detection and repair program, stage I and II; COWS

COWS: Covers on Oil/Water separators; FGD: Flue gas Desulphurisation; EP: Electrostatic Precipitator

CODE	NACE_R2/SIZE_EMP	By size of company					
C19	Manufacture of coke and refined petroleum products	Total	0-9 employees	10-19 employees	20 -49 employees	50 -249 employees	250+ employees
Number of enterprises		1.120	623	147	113	117	97
Turnover		500.187	3.104	907	9.607	13.514	472.985
Gross Value Added		23.514	238,88	111	375	1.377	21.400
Turnover per company		446,60	4,98	6,17	85,02	115,50	4.876,14

Source: Generated from Eurostat database query on turnover and number of enterprises (2010 values used).

The annual costs of the set of measures in the refining industry identified as being the most cost-effective under the policy scenarios analysed is the following:

In option 6A: 32 M €, equal to 0,006% of sectorial turnover and 0,13% of GVA

- In option 6B: 103 M€, equal to 0,02% of sectorial turnover and 0,43% of GVA
- In option 6C: 342 M€, equal to 0,07% of sectorial turnover and 1,45% of GVA

The largest share of this expenditure is for abatement of emissions in combustion installations and in process installations treating crude oil and other products. Both are generally embedded in large size industrial installations and are not expected to be a direct concern of SMEs. Investment for process emission abatement would mainly be for SO2 control.

In options 6A and 6B the additional required effort is less than 0.5 % of GVA and in 6C is less than 1.3 %.

5.4. Agriculture and livestock rearing

The EU is the world's largest importer and exporter of agricultural products. Europe imports mostly basic agricultural commodities, but its exports are based on high quality farm products and other processed agricultural products. Basic data on the EU agriculture sector follows[16]:

- Total trade in agricultural products amounted to almost €153 billion in 2007, split between EU imports from third countries of €77.4 billion and exports of €75.1 billion.

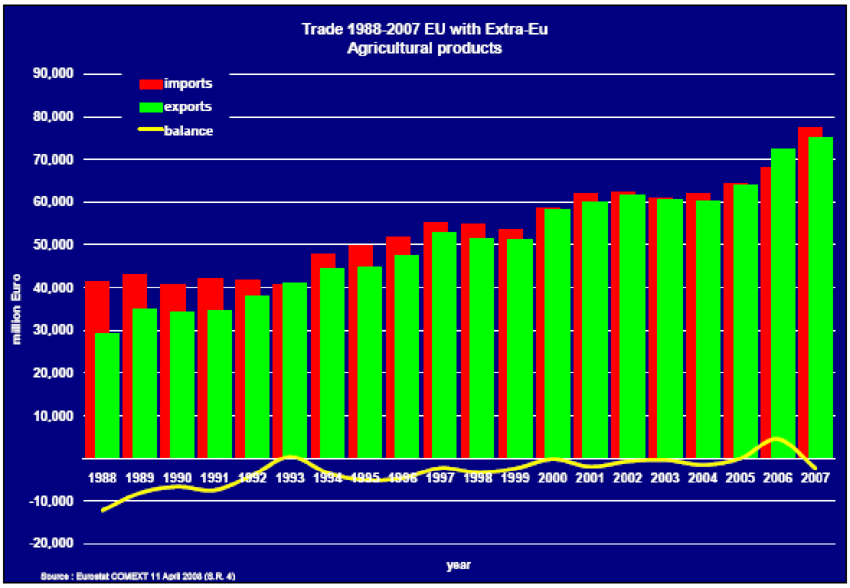
16 http://ec.europa.eu/trade/creating-opportunities/economic-sectors/agriculture

- Since the 1995 enlargement to EU15, imports have increased by 55% and exports by 68%.
- Over the years, the trade deficit has been reduced from more than €10 billion in 1988 to €5 billion in 1995 with an all-time low in 2005, when it amounted to only €27 million. In 2006, for the first time, the EU had a trade surplus of €4.5 billion but the trade balance went back again to negative in 2007 (€2.4 billion).
- The EU is the first importer from developing countries.
- In 2007, the 10 largest suppliers to the EU accounted for 55% of total imports of agricultural products into the EU. **Brazil** ranked first with €12 billion (16%) followed by the **US** (9%) and **Argentina** (8%).
- The EU's ten most important customers for agricultural products accounted for 56% of total exports. The **US** was the largest customer, absorbing some 19% of EU exports, followed by **Russia** and **Switzerland** (10% and 7% respectively).

As regards trade projections, the EU is expected to maintain its position as a net exporter of pig and poultry meat and a net importer of beef and sheep meat.[17] Regardless that pig and beef are under heavy competition from third countries and are expected to decline over the coming years, mostly due to high labour costs, but partly due to animal welfare and environmental forthcoming legislation and associated costs.

The figure below shows the growth of agriculture products imports and exports in the EU economy since 1989.

Figure A9.5: EU agricultural sector trade balance



In 2010, Agricultural output was 348.934 M€ and GVA at basic prices was 145.305 M€ (Eurostat data).

[17] EC,,2012B: 'Prospects for Agricultural Markets and Income in the EU 2012-2022'.

Agriculture		Yearly costs, total and per subsector, M €	Additional most cost-effective measures
Dairy cows - liquid (slurry) systems	6A	13,4	LNF, LNA and CS variously combined
	6B	27,9	LNF, LNA and CS variously combined
	6C	142,0	LNF, LNA, CS and SA variously combined
Dairy cows - solid systems	6A	2,6	LNF, LNA_high and LNA_low variously combined
	6B	9,6	LNF, LNA_high and LNA_low variously combined
	6C	19,4	LNF, LNA_high and LNA_low variously combined
Other cattle - liquid (slurry) systems	6A	8,1	Combination of CS and LNA
	6B	11,8	Combination of CS and LNA
	6C	81,1	Combination of CS and LNA
Pigs - liquid (slurry) systems	6A	18,4	LN, LNA CS and SA variously combined
	6B	59,8	LN, LNA CS and SA variously combined
	6C	544,8	LNF, LNA, CS, SA and BF variously combined; Biofiltration
Pigs - solid systems	6A	1,5	Combination of LNF and LNA_high
	6B	4,0	LNF, LNA_high and LNA_low variously combined
	6C	8,9	LNF, LNA_high and LNA_low variously combined
Other poultry	6A	1,6	LNF, LNA and SA variously combined
	6B	17,9	LNF, LNA, SA and CS variously combined
	6C	136,5	LNF, LNA, SA, CS and BF variously combined; Animal house adaption; Biofiltration
Laying hens	6A	0,5	LNF, LNA, SA and CS variously combined
	6B	8,4	LNF, LNA, SA and CS variously combined
	6C	45,6	LNF, LNA, SA, CS, BF variously combined; Biofiltration; Animal house adaption
Fertilizer use - urea	6A	0,0	
	6B	141,2	Urea substitution
	6C	323,2	Urea substitution
Waste: Agricultural waste burning	6A	11,9	Reduced open burning of agricultural residues
	6B	11,9	Reduced open burning of agricultural residues
	6C	11,9	Reduced open burning of agricultural residues

LNA: Low ammonia application of manures

LNA_Low efficiency methods include slit injection, trailing shoe, slurry dilution, band spreading for liquid slurry, and incorporation of solid manure by ploughing into the soil the day after application

LNA_High efficiency methods involve the immediate incorporation by ploughing within four hours after application, deep and shallow injection of liquid manure and immediate incorporation by ploughing (within 12 hours after application) of solid manure

LNF: Low nitrogen feed

CS: Covered storage of manures

SA: Low emission housing

BF: Air purification

The annual costs of the set of measures in agriculture identified as being the most cost-effective under the policy scenarios analysed is the following:

- In option 6A: 59 M €, equal to 0017,% of sectorial output and 0,04% of GVA
- In option 6B: 285 M€, equal to 0,08% of sectorial output and 0,2% of GVA
- In option 6C: 1292 M€, equal to 0,38% of sectorial output and 0,9% of GVA

It is estimated that for option 6C, the total extra costs for the Pigs liquid systems subsector will be 41% of the total expenditure (1292 M€). This will be partly compensated by increased income from larger crop yields due to lower concentrations of ground-level ozone.

The EU produces around 22 million tonnes of pork meat annually, making it the world's second largest producer after China. Pig meat represents 21% of overall livestock production value. In several EU member states pig meat sector is the largest meat production sector, and two thirds of pig meat production in the EU is produced in 6 countries[18]. Key sector characteristics of EU27 are presented below:

	Pigs
Number of holdings (1000s)	2,750
Number of pigs (1000s)	152,000
Production (1000s tonnes of meat)	12,000
Production (1000s heads)	164,000
Production value of meat (€ million)	31,000
Regular labour force	641,000

Source: Eurostat (2010 or most recent year).

In Option 6C, the additional expenditure for the Pig industry (liquid and solid systems) is estimated at 553,6 M€, representing 1.8% of the meat production value.

Regarding the type of enterprises affected, pig production is generally an intensive, indoor, large scale business with a relatively low level of variability in production systems. Both pig and poultry play an important role in mixed livestock small holdings throughout the EU, particularly in the EU 12, but this system represents little in terms of overall herd size and still much less in terms of contribution to overall production. Poultry production in the EU is highly industrialised, with around 60% of chickens reared intensively in large purpose-built facilities, operated by large companies.

In Option 6C, 25% of the total expenditure on ammonia control measures is for mineral fertilizers (urea substitution), affecting the arable crop sector. This sector can be divided into the following:

[18] Germany, Spain, France; Poland, Denmark, the Netherlands

	Production value at basic price (M€)
CEREALS (including seeds)	44.580,76
INDUSTRIAL CROPS	16.977,92
FORAGE PLANTS	25.041,00
VEGETABLES AND HORTICULTURAL PRODUCTS	49.855,58
POTATOES (including seeds)	10.102,68
FRUITS	23.345,36
WINE	12.948,57
OLIVE OIL	3.947,52
OTHER CROP PRODUCTS	2.076,99
CROP OUTPUT	188.875,38

Source: Eurostat database (2010 values).

Costs for urea substitution would be 141M€ in option 6B and 323 M€ in 6C, equal to 0,07% and 0,17% of crop output, respectively. 19% of the total expenditure for option 6C is related to cattle, including dairy cows (liquid and solid systems) and other cattle (liquid slurry systems).

In 2010, the total economic turnover for the EU dairy industry was €117 billion, representing about 13% of the turnover for the total food and drink industry in Europe (€900 billion), and employing about 400,000 people, or 10%, of the 4 million working in the sector[19].

Option 6C costs for dairy cows systems sum up 161 M€, representing 0.13% of EU dairy industry 2010 turnover.

Medium term prospects for milk and dairy products appear favourable due to the continuing expansion of world demand. Global population and economic growth, and increasing preference for dairy products are expected to be the main drivers, fuelling EU exports and sustaining commodity prices.

Milk production in the EU is not as competitive as in some other parts of the world, due to the cost of milk quotas, animal welfare regulations and relatively high costs of land, buildings and labour[20]. However, fresh milk products are mainly produced and consumed locally due to their short shelf-life and are therefore not significantly exposed to EU-external trade.

Regarding Beef industry, in 2011 the total indigenous production of beef in the EU-27 was 8,371 thousand tonnes (13% of the world beef and veal production); 350 thousand tonnes of production was exported[21]. In 2010, the total economic turnover was around €90 billion, representing about 10% of the turnover for the total food and drink industry in Europe (€900 billion).

In Option 6C, expenditure in the sector "other cattle different from dairy cows" totals 81M€, or 0.09% of beef industry turnover for 2010.

[19] IUF Dairy Industry Research, http://cms.iuf.org/sites/cms.iuf.org/files/European%20Union%20Dairy%20Industry.pdf

[20] 'Competitiveness of the EU dairy industry' (LEI Wageningen UR, 2009).

[21] EC, 2011: ‘Prospects for Agricultural Markets and Income in the EU 2011-2020’.

Historically, the EU has been a major beef exporter. However, the year 2003 marked the shift in the EU beef trade balance, with beef and veal imports exceeding exports to date[22], due to reduced production and policy changes. While the trade balance was strengthened in 2010 and 2011, production has been declining steadily. The main underlying reason is that EU beef production is currently less competitive compared with third countries (primarily the MERCOSUR group), due to relatively more expensive feed and labour conditions, smaller livestock supplies, high levels of bio- security regulation, and smaller economies of scale[23]. In future, the competitive disadvantage of EU beef producers is likely to continue, albeit some competitiveness factors such as labour cost may even out.

In option 6C, additional expenditure in the poultry industry including laying hens and other poultry totals 182 M€, 14% of total additional ammonia control costs, representing 0,73% of the sector output.

The EU produces around 11 million tonnes of poultry meat annually and well over 35 billion eggs (Eurostat – figure is a minimum value as it excludes countries expected to be important producers, such as Italy and the UK). In value terms, poultry meat represents 13% of livestock production value, and eggs 4%. Poultry meat is the second most popular meat in the EU, representing 25% of EU meat consumption overall.[24] Key sector characteristics are presented in A9.3.

Table A9.3: Key characteristics of EU27 poultry industry (2010 or most recent prior to 2010 where not available). Source: Eurostat (except where specified in the notes)

	Broilers	Laying hens	Total
Number of holdings (1000s)	2,200	4,100	4,800(1)
Number of hens (1000s)	876,000	510,000	1,620,000(2)
Production (1000s tonnes of meat/eggs)	>> 6,100(3) ~ 11,000 (5)	>> 3,600(4) ~ 6,900(6)	n/a
Production (1000s heads/eggs)	>> 4,360,000(3)	>> 35,000,000(4)	n/a
Production value of meat/eggs (€ million)	17,000	7,700	24,700
Regular labour force (specialist poultry)(7)	n/a	n/a	1,000,000

Notes: (1) Total number of holdings is lower than the sum of its components as many holdings have both broilers and laying hens. (2) The total number of hens is higher than the sum of broilers and laying hens as there are also poultry classified as "other". (3) Meat production given as minimum values as Eurostat only has such data for 10-12 Members States. (4) Eggs production given as minimum values as Eurostat data excludes countries expected to be important producers, such as Italy and the UK. (5) JRC (2010) estimate. (6) http://www.compassionlebensmittelwirtschaft.de/wp-content/uploads/2012/05/Info-1-Egg-production-in-the-EU.pdf (7) It is likely that the actual labour force will be higher than this, as non-specialists are likely to be employed in poultry rearing, slaughter etc.

22 European Commission, DG Agriculture and rural development. Webpage: Beef and Veal. http://ec.europa.eu/agriculture/markets/beef/index_en.htm

23 European Commission, (2007), DG Enterprise and Industry, 'Competitiveness of the European Food Industry: An Economic and Legal Assessment 2007'. (EC, 2006)

24 Sources: 'Evaluation of the livestock sector's contribution to the EU greenhouse gas emissions (GGELS), Final report' (JRC,2010); 'Prospects for agricultural markets and income in the EU 2011–2020' (EC, 2011); 'Egg production in the EU' (Compassion in World Farming, 2012).

The EU is a net exporter of poultry meat, with over a quarter of production exported. EU exports increased significantly in the period 2008-2011, due to increasing demand from Asia, Africa and the Middle-East, combined with a relatively weak Euro. Exports are expected to gradually decrease again up to 2020, as the Euro strengthens. Main exports markets include Asia, Africa and the Middle-East, while sources of imports are Brazil and with Thailand being an increasingly important source of imports. The EU is also a net exporter of eggs (188,000 tonnes exported and 35,000 imported in 2009[25]); EU imports are limited by Salmonella legislation and imports are thus only allowed from Switzerland, Norway and Croatia[26].

Poultry production in the EU is highly industrialised, with around 60% of chickens reared intensively in large purpose-built facilities, operated by large companies that control all stages of production – breeding, hatching, feedstuff manufacture, and meat delivery. Some 40% are produced by independent farmers, generally under contract to a processor. The situation for laying hens is similar, with 60% of laying hen population reared in farms with > 40,000 heads (despite such farms making up only 0.1% of all farms).

In terms of contributions to emission reductions and of economic impacts on farms of different sizes, the following table presents a breakdown of ammonia emission reducitons in options 6A, 6B and 6C. Farm sizes are grouped by livestock units (LSU[27]), and in all cases it is assumed that very small farms of less than 15 LSU are exempted from all measures.

NH3 reductions

6A	15-50 LSU	50-500 LSU	>500 LSU
Cattle	18,20%	62,40%	19,40%
Pigs	4,70%	5,30%	90,00%
Poultry	0,10%	1,50%	98,40%
6B	15-50 LSU	50-500 LSU	>500 LSU
Cattle	17,00%	68,70%	14,30%
Pigs	4,30%	18,50%	77,20%
Poultry	0,10%	1,30%	98,60%
6C	15-50 LSU	50-500 LSU	>500 LSU
Cattle	17,50%	71,20%	11,30%
Pigs	5,80%	36,50%	57,70%
Poultry	1,30%	17,80%	80,90%

In Option 6C, small farms between 15 and 50 LSU cost-effectively deliver around 20% of ammonia emission reductions from cattle farming, 9% of the reductions from pig farming, and 2,5% from poultry farms; the cost shares borne by farms of the same sizes are comparable to the emission reduction shares. Although the implementation of specific measures remains under the responsibility of the Member States, this analysis shows that poultry farms below 50 LSU can be exempted without significantly compromising the environmental objectives of Option 6C (about 1 KT more ammonia would be emitted).

25 Compassion in World Farming, 2012

26 EUWEP, 2011.

27 Following Eurostat definition

However, for pigs and especially cattle, the share of emission reductions from farms below 50 LSU is larger, representing ammonia emission reductions of about 15 and 48 KT respectively, with associated emission control costs estimated at around 30 and 45 M€/year. Given that the potential for cost-effective ammonia reduction measures is very substantial in this segment, adequate support measures can be channelled through the EU rural development policy, provided that the Member States themselves give priority to air pollution.

5.5. Power sector

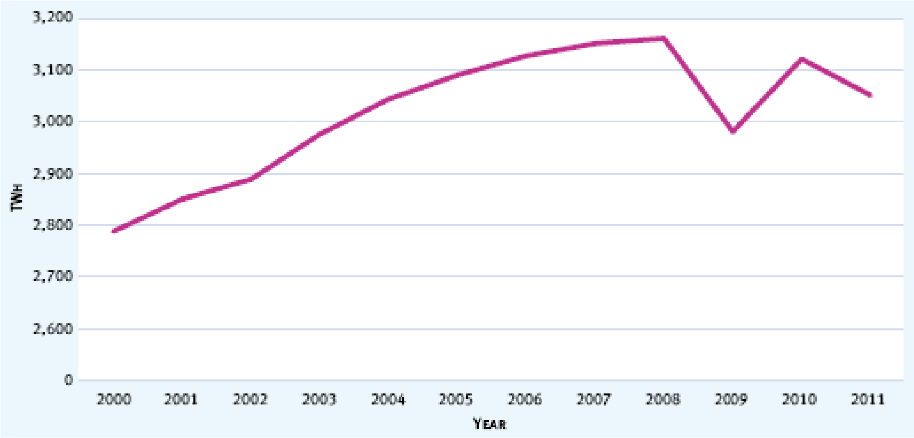
The European electricity mix is becoming more diverse: by 2020 renewable electricity is set to make up 35% of European power production, with fossil fuel fired plants increasingly operating as back-up. This step change implies a need for significant investment in power generation and transport capacity – and a coherent policy framework to support such investment and the necessary innovation.

Thermal generation - coal, gas and nuclear - today represents the backbone of the European power system. Challenges to thermal generation include climate change, supply security and volatile fossil fuel prices. Thermal generators also have specific features that are becoming more important as the share of variable (i.e. not constantly available) renewables grows. Basic data on the EU power sector follows[28]:

- European electricity sector gathers 3.500 companies and 2.000 distribution companies, with 800.000 employees.
- European electricity capacity s 900 GW and the annual generation 3.800 TWh
- After a decade of growth and a partial recovery in 2010 after the economic crisis of 2009, electricity demand fell again in 2011 as the European economy struggled with the prolonged sovereign debt crisis (Figure A9.7)
- The EU’s renewables capacity increased yet again in 2011, reaching 34% of total installed capacity. Renewables progressively move to the centre of electricity systems and both capacity and generation are expected to be substantially higher in 2020 than today (Figure A9.8). By 2020 45% of all power plants will be renewable based, generating some 31% of Europe’s electricity. Low-carbon electricity from nuclear and renewables will account for 56% of all electricity generated.

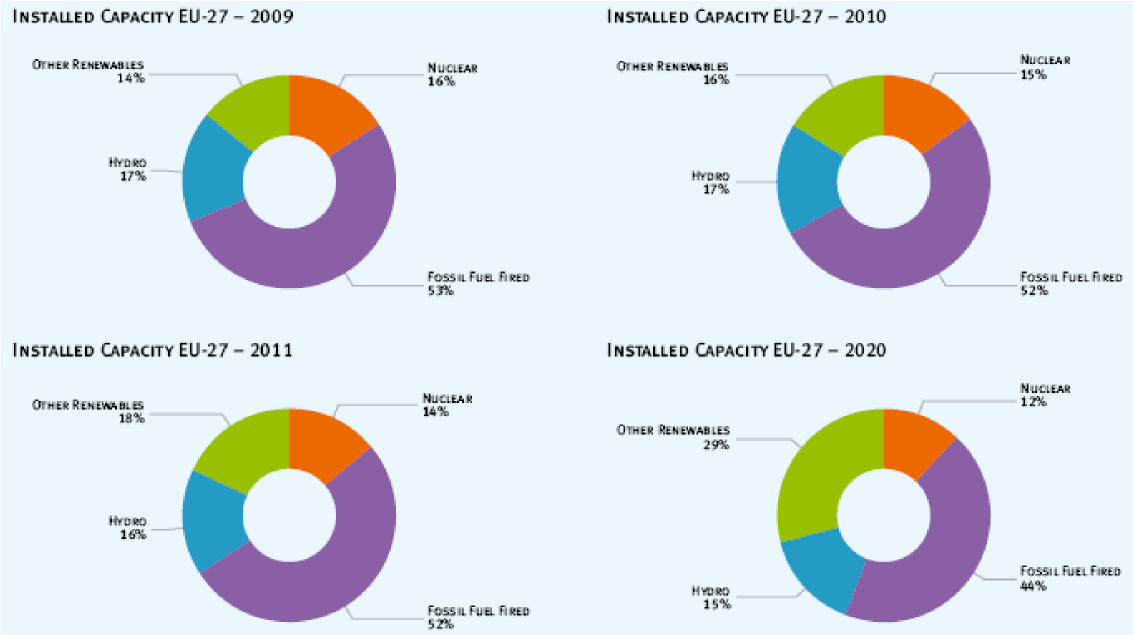
[28] Source: EURELECTRIC, 2012

Figure A9.6: Electricity demand (including network losses) in the EU 27, 2000-2011



Source: EURELECTRIC, 2012

Figure A9.7: Evolution of installed capacity in the EU-27



Source: EURELECTRIC, 2012

Power sector

		Yearly Costs, total and per subsector, M €						
		Total	**Coal**	**Biomass**	**Natural gas (incl. other gases)**	**Oil products**	**Waste fuel, renewable**	**Additional most cost-effective Measures**
Other Energy Sector – combustion	6A	1,05	1,03	0,00	0,00	0,00	0,02	Low sulphur fuel oil (0.6 %S); Low sulphur coal (0.6 %S); Combustion modification on solid fuels fired industrial boilers and furnaces; EP (1 field)
	6B	3,87	3,84	0,00	0,00	0,00	0,03	Low sulphur fuel oil (0.6 %S); wet FGD; In-furnace control - limestone injection; Low sulphur coal (0.6 %S); EP1 (field); Combustion modification on: oil and gas, and solid fuels fired industrial boilers and furnaces boilers and furnaces; Selective catalytic reduction on solid fuels fired industrial boilers and furnaces; High efficiency deduster
	6C	32,04	8,62	0,06	9,96	13,35	0,06	Low sulphur fuel oil (0.6 %S); wet FGD; In-furnace control - limestone injection; Low sulphur coal (0.6 %S); Combustion modification on oil and gas, and solid fuels fired industrial boilers and furnaces; Selective non-catalytic reduction on oil and gas, and on solid fuels fired industrial boilers and furnaces; Selective catalytic reduction on solid fuels fired industrial boilers and furnaces; High efficiency deduster; Good housekeeping: industrial oil boilers
Power & district heat plants with internal combustion engines	6A	0,04	-	-	0,00	0,04	-	Low sulphur fuel oil (0.6 %S); Euro 4, 5 and 6; Stage 5 and 2 control
	6B	0,58	-	-	0,00	0,58	-	Low sulphur fuel oil (0.6 %S); Euro 4, 5 and 6; Stage 5 and 3A control
	6C	1,29	-	-	0,00	1,29	-	Low sulphur fuel oil (0.6 %S); Euro 5 and 6; Stage 5 control

Power & district heat plants, existing; coal/lignite fired, large units (> 50 MW th)	6A	11,84	11,84	-	-	-	-	Low sulphur coal (0.6 %S); Combustion modification on existing brown coal power plants; High efficiency deduster
	6B	34,38	34,38	-	-	-	-	Low sulphur coal (0.6 %S); wet FGD; Combustion modification on existing hard and brown coal power plants; High efficiency deduster
	6C	51,24	51,24	-	-	-	-	Low sulphur coal (0.6 %S); wet FGD; Combustion modification on existing hard and brown coal power plants; Selective catalytic reduction on existing hard coal power plants; High efficiency deduster
Power & district heat plants existing, non-coal; for GAS - boilers	6A	0,81	-	0,81	0,00	0,00	0,00	Combustion modification on existing oil and gas power plants; EP (1 field)
	6B	16,90	-	16,40	0,00	0,50	0,00	Combustion modification on existing hard coal, and oil and power plants; wet FGD; High efficiency deduster
	6C	39,39	-	32,63	4,39	2,29	0,08	Wet FGD; Combustion modification on existing hard coal and oil and gas power plants; High efficiency deduster; Good housekeeping: industrial oil boilers
Power & district heat plants, existing; coal/lignite fired, small units (< 50 MW th)	6A	0,36	0,36	-	-	-	-	Low sulphur coal (0.6 %S); Combustion modification on existing brown coal power plants; High efficiency deduster
	6B	1,27	1,27	-	-	-	-	Low sulphur coal (0.6 %S); wet FGD; Combustion modification on existing brown coal power plants; High efficiency deduster
	6C	4,15	4,15	-	-	-	-	Low sulphur coal (0.6 %S); wet FGD; Combustion modification on existing brown coal power plants; High efficiency deduster
Power & district heat plants new, non-coal; for GAS - turbines	6A	1,77	-	1,77	-	0,00	0,00	EP (1 field)
	6B	17,75	-	17,75	-	0,00	0,00	High efficiency deduster
	6C	57,73	-	41,58	-	1,18	14,97	Selective non-catalytic reduction on other biomass and waste fuels for new powerplants; Selective catalytic reduction on new oil and gas power plants; High efficiency deduster
Power & district heat plants, new; coal/lignite fired, large units (> 50 MW th)	6A	0,13	0,13	-	-	-	-	Wet FGD
	6B	1,65	1,65	-	-	-	-	Wet FGD; High efficiency FGD; High efficiency deduster
	6C	78,17	78,17	-	-	-	-	Wet FGD; High efficiency FGD; Selective catalytic reduction on new hard and brown coal power plants; High efficiency deduster

CODE	NACE_R2/SIZE_EMP	By size of company					
D351	Electric power generation, transmission and distribution	Total	0-9 employees	10-19 employees	20 -49 employees	50 -249 employees	250+ employees
Number of enterprises		45.037	41.883	708	704	697	441
Turnover		951.226	64.466	18.224	49.911	169.011	648.105
Gross Value Added		174.597	11.291	2.589	5.034	16.691	138.593
Turnover per company		21,12	1,54	25,74	70,90	242,48	1469,63

Source: Generated from Eurostat database query on turnover and number of enterprises (2010 values used).

As can be seen from the above table the turnover of the largest firms in electric power generation is far higher than for the other sectors / uses identified, this reflects the concentration of the industry in a small number of substantial operators and a larger number of small niche operators (renewables). The former means that additional investment entailed by the policy would not likely affect SMEs.

The annual costs of the set of measures in the power sector identified as being the most cost-effective under the policy scenarios analysed is the following:

- In option 6A: 16 M €, equal to 0,002% of sectorial turnover and 0,01% of GVA
- In option 6B: 76 M€, equal to 0,01% of sectorial turnover and 0,04% of GVA
- In option 6C: 264 M€, equal to 0,03% of sectorial turnover and 0,15% of GVA

The largest proportion of this expenditure is for emissions abatement in new large units (> 50 MWth) of power and district heat plants coal/lignite fired, and in non-coal new power and district heat plants for gas turbines. Both are generally large size industrial installations and are not expected to be a direct concern of SMEs. In all cases the additional required effort is less than 0,2 % of GVA.

5.6. Other energy intensive industries

These include the pulp and paper sector, the cement sector, the lime sector, and the glass sector. Basic data on the EU energy intensive industries follows[29]:

5.6.1. Pulp and paper sector

- According to the latest structural data available, there were 19,377 firms employing 715,000 people in the sector in 2006.
- In 2006, "pulp manufacturing" represented 5% of added value and 2% of employment, "paper manufacturing" 39% and 29% and "articles of paper and paperboard" 56% and 69% respectively
- Apart from a slight fall in 2005, production in the "pulp, paper and paper products" sector increased steadily by more than 12% between 2002 and 2007. However, in 2008, production was 2.5% lower than in 2007, and turnover in 2008 was almost the same as in 2007, marking a change in the trend from previous years. Employment fell by 15% between 2000 and 2008.
- The EU is a net exporter of paper and paper articles, with a trade surplus of €11.5 billion in 2008. It is a net importer of pulp, with a trade deficit of €3.5 billion in the same year.
- In 2007, the EU accounted for 21.3% of the world pulp production of 194.2 Mt. but remains a net importer, mostly from the Americas. 80% of the pulp imported into the EU comes from Brazil, the US, Canada and Chile. Pulp producers in the southern hemisphere are playing an ever-increasing role, due to lower material and labour costs, and this is leading to a situation in which the pulp and paper companies, including European ones, are investing in these countries

[29] Sources: http://ec.europa.eu/enterprise/sectors/wood-paper-printing/index_en.htm
http://ec.europa.eu/enterprise/sectors/metals-minerals/non-metallic-mineral-products/index_en.htm

- For paper, the EU was the world's largest producer in 2007, providing 26% of the global total of 394 Mt. The main destinations for EU paper exports and paper articles are Russia, the US and Switzerland, which account for 12%, 10% and 9.5% of total EU27 exports respectively. Imports from Asia are developing rapidly, and in 2008 China became the third EU supplier for paper and paper articles, following Switzerland and the US. Imports from China have risen by 76% since 2005

5.6.2. Cement sector

The majority of EU cement producers are operating on a global level, with the USA as a major trading partner. Depending entirely on the demand of the building and civil engineering requirements, the cement industry provides direct employment in local areas and through a wide network of indirect jobs and activities related to the main manufacturing process. Environmental concerns are of paramount importance for the sector, and innovation includes the use of wastes as alternative raw materials and fuels.

- Output in the cement industry has been climbing steadily in recent years, up 23% between 1998 and 2007. Total tonnage produced in EU 27 in 2006 amounted to just over 267.1 million tonnes, with a value of € 19 billion. This represented approximately half of one per cent of total value added and a quarter of one per cent of numbers employed in total manufacturing
- Employment has been decreasing steadily over recent years, and in 2006, it is estimated that there were 56.500 direct jobs (EU 27)
- In 2007, 3% of production was exported outside the EU, whilst non-EU 27 imports supplied 7% of consumption
- The main destination for EU 27 cement and clinker exports is traditionally the USA, because of its unstable domestic demand. Imports, three-quarters of which are clinker, come mainly from far eastern Asian countries, like China, Thailand, and the Philippines
- Where European cement producers have identified demand for cement in non-EU countries, they have generally invested in manufacturing sites in those countries. As such, EU companies now own almost 60% of US production capacity, and have significant production facilities in the rest of the world

5.6.3. Lime sector

The EU lime industry is characterised by the existence of several big EU producers operating on an international stage, giving them access to global best practice and technology, and markets for a wide range of applications. Lime production technology and efficiency have evolved over several thousand years, to the extent that they represent the best possible in terms of environmental performance. Production of lime fell at the end of the 1980s as a result of changes in patterns of consumption, specifically the biggest consumer, the steel industry. Production started to grow again in the mid-1990s with the growing use of environmental applications, such as water, sludge, soil, acid gas, and disinfection treatments. Apart from these two applications, lime is also used in construction and clay soil stabilisation, chemicals, paper, food, feed, and healthcare, etc.

- In EU 27 in 2006, production was estimated at 28 million tonnes, roughly 12% of the 227 million tonnes produced worldwide. This was worth a value of some € 2.5 billions

- Numbers employed are estimated at 11.000

- Lime is a heavy product with a relatively low selling price, so transport costs dictate over what distance it can normally be transported on a regular basis under viable conditions. Only a very small percentage of total production is exported, and this is mainly to neighbouring countries. Where the biggest producer has identified potential markets, it has usually taken the decision to invest in production capacity in those markets

5.6.4. Glass sector

The glass industry is characterised by the existence of several large EU-based companies competing on world markets, economies of scale, the quality of its products, its capacity for technological innovation, and its skilled labour force. The European glass industry is made up of a number of distinct sectors, manufacturing products for a wide range of uses. The sectors are container glass which accounts for about 60% of output, flat glass (30%), and others.

- Total production in EU27 in 2007 is estimated to have reached 37.55 million tonnes, up on the 36.43 million tonnes produced in 2006. This represented about 30% of total world glass production. It was worth in the region of €39 billion (about €38.5 billion in 2006), representing about 32% of the value of total world production

- Numbers employed in 2006 is estimated at just under 237.000

- 70% of all glass products are produced in just 5 member States: Germany, France, Italy, Spain, and the UK

- About 80% of output is traded with other Member States. The figure for extra-EU trade is much lower, and EU exports were double the tonnage of imports into the EU in 2003. By 2007, this had changed to a situation whereby the EU (27) was a net importer, due principally to an increase of imports from outside the EU. There are many countries which the EU glass industry sees as having trading potential where there are tariff barriers.

Non-metallic minerals and pulp and paper sectors

Yearly costs, total and per subsector, M €

		total	**Coal**	**Biomass**	**Natural gas**	**Oil products**	**Additional most cost-effective Measures**
Paper and pulp production, combustion	6A	0,01	0	0	0	0,01	Low sulphur fuel oil (0.6 %S)
	6B	0,14	0	0,01	0	0,13	Low sulphur fuel oil (0.6 %S); combustion modification on solid fuels fired industrial boilers and furnaces
	6C	8,81	2,33	5,73	0,32	0,43	Low sulphur fuel oil (0.6 %S); combustion modification: on solid fuels fired industrial boilers and furnaces and on oil and gas industrial boilers and furnaces; high efficiency deduster; EP (1 field); wet FGD
Paper and pulp production, other combustion	6A	0,3	0,18	0,04	0	0,08	Low sulphur coal (0.6 %S); Low sulphur fuel oil (0.6 %S); wet FGD; EP (1 field); high efficiency deduster
	6B	1,68	0,62	0,49	0	0,57	Low sulphur coal (0.6 %S); low sulphur fuel oil (0.6 %S); wet FGD; In-furnace control - limestone injection; high efficiency deduster; EP (1 field); combustion modification on oil and gas and on solid fuels fired industrial boilers and furnaces; selective catalytic reduction on solid fuels fired industrial boilers and furnaces
	6C	6,17	1,36	1,85	0,7	2,26	Low sulphur coal (0.6 %S); Low sulphur fuel oil (0.6 %S); high efficiency deduster; EP; good housekeeping: industrial oil boilers; wet FGD; in-furnace control - limestone injection; combustion modification: on oil and gas and on solid fuels fired industrial boilers and furnaces; selective catalytyc and non-catalytic reduction on solid fuels fired industrial boilers and furnaces; selective catalytic reduction on oil and gas industrial boilers and furnaces

Paper and pulp mills	6A	1,09					Process emissions - stage 1 and 2 SO2 control
	6B	7,01					Process emissions - stage 1, 2 and 3 SO2 control
	6C	17,4					Process emissions - stage 1, 2 and 3 SO2 control
Cement combustion	6A	0,24	0,00	0,00	0,00	0,24	
	6B	1,04	0,02	0,00	0,00	1,02	Low sulphur coal (0.6 %S); combustion modification on solid fuels fired industrial boilers and furnaces
	6C	15,88	2,96	0,19	0,30	12,43	Low sulphur diesel oil - stage 2 (0.045 % S); wet FGD; in-furnace control - limestone injection; High efficiency deduster; combustion modification on: oil and gas and on solid fuels fired industrial boilers and furnaces; selective catalytic and non-catalytic reduction on solid fuels fired industrial boilers and furnaces
Cement production	6A	0,33					Process emissions - stage 2 SO2 control
	6B	40,84					Process emissions - stage 1 and 2 NOx control; high efficiency deduster; process emissions - stage 1 and 2 SO2 control
	6C	235,16					Process emissions - stage 2 and 3 NOx control; high efficiency deduster; process emissions - stage 1, 2 and 3 SO2 control
Glass combustion	6A	0,10	0,00	0,00	0,00	0,10	
	6B	0,46	0,01	0,00	0,00	0,45	Low sulphur coal (0.6 %S); Combustion modification on solid fuels fired industrial boilers and furnaces
	6C	6,95	1,29	0,09	0,13	5,44	Low sulphur diesel oil - stage 2 (0.045 % S); wet FGD; in-furnace control - limestone injection; high efficiency deduster; combustion modification on: oil and gas and on solid fuels fired industrial boilers and furnaces; selective catalytic and non-catalytic reduction on solid fuels fired industrial boilers and furnaces
Glass production	6A	1,25					High efficiency deduster; EP (1 field)
	6B	7,01					High efficiency deduster; process emissions - stage 1, 2 and 3 SO2 control
	6C	25,21					High efficiency deduster; process emissions - stage 1, 2 and 3 SO2 control
Lime combustion	6A	0,09	0,00	0,00	0,00	0,09	
	6B	0,38	0,01	0,00	0,00	0,38	Low sulphur coal (0.6 %S); combustion modification on solid fuels fired industrial boilers and furnaces
	6C	5,81	1,08	0,07	0,11	4,55	Low sulphur diesel oil - stage 2 (0.045 % S); wet FGD; in-furnace control - limestone injection; High efficiency deduster; combustion modification on: oil and gas and on solid fuels fired industrial boilers and furnaces; selective catalytic and non-catalytic reduction on solid fuels fired industrial boilers and furnaces
Lime production	6A	2,81					Process emissions - stage 1 and 2 SO2 control
	6B	10,3					Process emissions - stage 2 NOx control; process emissions - stage 1 and 2 SO2 control
	6C	42,49					Process emissions - stage 1, 2 and 3 NOx control; high efficiency deduster; process emissions - stage 1, 2 and 3 SO2 control
Other combustion	6A	0,08	0,00	0,00	0,00	0,08	
	6B	0,37	0,01	0,00	0,00	0,36	Low sulphur coal (0.6 %S); Combustion modification on solid fuels fired industrial boilers and furnaces
	6C	5,60	1,04	0,07	0,11	4,38	Low sulphur diesel oil - stage 2 (0.045 % S); wet FGD; in-furnace control - limestone injection; High efficiency deduster; combustion modification on: oil and gas and on solid fuels fired industrial boilers and furnaces; selective catalytic and non-catalytic reduction on solid fuels fired industrial boilers and furnaces
Other (gypsum, PVC…) production	6A	4,74					High efficiency deduster; EP (1 field)
	6B	10,91					High efficiency deduster; EP (1 field)
	6C	14,4					High efficiency deduster; EP (1 field); stripping and vent gas treatment

FGD: Flue Gas Desulphurisation; EP: Electrostatic Precipitator

CODE	NACE_R2/SIZE_EMP	By size of company					
C171	Manufacture of pulp, paper and paperboard	Total	0-9 employees	10-19 employees	20 -49 employees	50 -249 employees	250+ employees
Number of enterprises		:	1.228	:	200	:	209
Turnover		80.000	:	506,51	1.855,53	13.791,76	60.617,98
Gross Value Added		:	:	124,94	415,94	2.937,7	12.989,51
Turnover per company					9,28		290,04

Source: Generated from Eurostat database query on turnover and number of enterprises (2010 values used).

The annual costs of the set of measures in the pulp and paper industry identified as being the most cost-effective under the policy scenarios analysed is the following:

- In option 6A: 1 M €, equal to 0,002% of sectorial turnover and 0,009% of GVA
- In option 6B: 9 M€, equal to 0,01% of sectorial turnover and 0,05% of GVA
- In option 6C: 32 M€, equal to 0,04% of sectorial turnover and 0,2% of GVA

The percentages above are calculated without taking into account turnover and GVA of companies with less than 10 employees.

The pulp manufacturing industry consists for the most part of large and very large firms, often multi-nationals, which are frequently involved with paper operations. They are very capital-intensive industries, as a new state-of-the-art pulp mill costs around €1 billion, or even more if it is part of a paper mill. Paper mills for "commodity grades" of paper, i.e. those intended for further cutting into sheets or rolls or subsequent conversion into products, are most often also large or very large and also quite capital-intensive, especially if there are several paper machines on one site. Plants producing speciality grades may be smaller. Conversely, most converting mills, i.e. those producing usable paper products, are SMEs.

None of the cases required additional effort bigger than 0.2% of the GVA.

The largest share of this expenditure is for the control of SO2 process emissions in paper and pulp mills. Regarding paper and pulp production, the higher costs are in combustion of biomass.

CODE	NACE_R2/SIZE_EMP	By size of company					
C235	Manufacture of cement, lime and plaster	Total	0-9 employees	10-19 employees	20 -49 employees	50 -249 employees	250+ employees
Number of enterprises		:	:	103	102	118	80
Turnover		21.373	448	301	1.030	4.401	15.193
Gross Value Added		7.877	88,5	79	281	1.461	5.967
Turnover per company				2,92	10,10	37,30	189,92

Source: Generated from Eurostat database query on turnover and number of enterprises (2010 values used).

The annual costs of the set of measures in the cement, lime and plaster industry identified as being the most cost-effective under the policy scenarios analysed is the following:

- In option 6A: 8 M €, equal to 0,04% of sectorial turnover and 0,1% of GVA
- In option 6B: 63 M€, equal to 0,3% of sectorial turnover and 0,8% of GVA
- In option 6C: 313 M€, equal to 1,5% of sectorial turnover and 4% of GVA

Most of this expenditure belongs to the cement production industry for abatement measures of NOx and SO2 emissions (in case A3 75% of the expenditure is on this sector).

- <u>Cement production and trade</u>

INDICATORS/CODE (M€)	Cement clinker	Portland cement	Other hydraulic cements	TOTAL	% over production value
Exports value	189,2	383,6	71,5	644,3	5
Imports value	146,7	173,3	31,8	351,8	2

Production value	694,9	11.579,3	1.931,8	14.205,9	

Source: Generated from Eurostat database (2010 values used).

The table above shows that cement imports represents only 2% of the total cement production value; this indicates that the European cement sector has sufficient headroom to absorb additional pollution control measures, even if option 6C may require the commitment of substantial additional resources from this sector.

CODE	NACE_R2/SIZE_EMP	By size of company					
C231	Manufacture of glass and glass products	Total	0-9 employees	10-19 employees	20 -49 employees	50 -249 employees	250+ employees
Number of enterprises		:	:	1.289	882	713	230
Turnover		:	:	1.502	2.962	11.115	26.839
Gross Value Added		:	667	:	1.000	3.499	9.339
Turnover per company				1,17	3,36	15,59	116,69

Source: Generated from Eurostat database query on turnover and number of enterprises (2010 values used).

The annual costs of the set of measures in the glass industry identified as being the most cost-effective under the policy scenarios analysed is the following:

- In option 6A: 1,4 M €, equal to 0,003% of sectorial turnover and 0,01% of GVA
- In option 6B: 7,5 M€, equal to 0,02% of sectorial turnover and 0,05% of GVA
- In option 6C: 32 M€, equal to 0,08% of sectorial turnover and 0,2% of GVA

The majority of this expenditure is for the control of SO2 process emissions in glass production. None of the cases required additional effort bigger than 0.2% of the GVA.

6. Conclusions

Potential impacts on competitiveness concentrate in sectors that -being more exposed to international competition- will have more difficulty passing through additional costs to their markets, such as refineries, chemicals, iron & steel and agriculture. .It is likely that at least a sub set of these users will have difficulty in passing costs through to their current markets. Of these sectors, the most significantly affected would be agriculture and petroleum refining; in all these cases, however, the additional resources that would be committed under the policy options considered would be below or in the order of the 1% threshold of Gross Value Added, indicating headroom to absorb the additional costs.

Considering the type of installations and abatement measures involved, impacts on SMEs are considered significant for agricultural measures and for measures in medium-scale combustion plants.

Possible mitigation could focus on actions targeted at the specific sectors most likely to face international competition and measures for reducing impacts on SMEs. Applying exemptions/derogations to those sectors/uses facing the greatest international competition could be considered.

SMEs could be affected in the medium combustion plants (MCP) segment and in agriculture. SME impacts related to MCP are taken in Annex 12. For agriculture, all farms below the 15 animal heads are assumed to be exempted from further ammonia control measures. This threshold could be extended to poultry farms below 50 heads without significantly compromising the environment. For cattle farms below 50 heads, the earmarking by the Member States of appropriate resources under the rural development policy could provide the sector with adequate financing. For pig farms below 50 heads, both options (exemptions or financing through the rural development policy) could be considered by the Member States.

ANNEX 10 CONTROLLING METHANE EMISSIONS

In 2005, agricultural activities (mainly livestock farming) emitted almost half of the methane (CH_4) emissions in the EU-28. Another one third of emissions originated from waste treatment (from solid waste disposal and wastewater treatment), and 14% from fuel extraction and distribution (i.e., coal mining and distribution of natural gas).

1. PROJECTED METHANE EMISSIONS ASSUMING NO CHANGE TO CURRENT POLICIES

Methane emissions in the EU are expected to decline by more than 20% in 2025 compared to 2005 due to existing policies. Over the last years, EU countries have implemented a number of measures to reduce methane emissions in the future, which are summarised in table A10.1:

Table A10.1: recent measures to reduce methane emissions in the EU

Sector	*Member States*	*Technique applied*
Agriculture	Denmark	Community-scale anaerobic digestion for manure applied to 3.2% of dairy cows, 1.6% of other cattle, and 32% of pigs
Coal mining	Several countries	Gas recovery with flaring applied to between 28% and 63% of emissions from mining
Gas distribution networks	EU15	Replacement of 60% of grey cast iron networks and increased leakage control
Gas transmission pipelines	Estonia, Lithuania	Reduced leakage at compressor stations, applied to 20%
Gas and oil production and processing	EU15	Flaring of emissions from oil and gas production and processing
Energy combustion	Several countries	Wood burning in domestic sector -replacement and change of boilers to more energy and emission efficient boilers
Transport	Several countries	Fuel efficiency improvements
Municipal solid waste	Several countries	Treatment through large-scale composting, recycling, incineration, or landfill with gas recovery, complying with the Landfill Directive
Industrial wastewater	EU28	Extended aerobic treatment of industrial wastewater from food-, paper-, and organic chemical manufacturing industries
Domestic wastewater	EU28	Extended collection and treatment of domestic wastewater partly with gas recovery

Source: Lena Höglund-Isaksson, Wilfried Winiwarter and Pallav Purohit (2013) Non-CO_2 greenhouse gas emissions, mitigation potentials and costs in EU-28 from 2005 to 2050, Part I: GAINS model methodology, 30 September 2013, IIASA, Laxenburg.

These measures are projected to deliver a decline of more than 20% of CH_4 emissions by 2020 compared to 1990 and 24% in 2030 compared to 2005 in the baseline (reference projections including meeting renewable targets and the effort sharing decision).

Especially large reductions occur for waste treatment, where the progressing implementation of current EU legislation on solid waste disposal and waste water management, particularly in the new Member States, will lead to a sharp decline of CH_4 emissions in the coming years of more than 50% in 2030

The second largest contributions to emission reductions will come from energy i.e. improved gas distribution networks, for which losses will be cut by about 45% up to 2030 as well as the reduced use and production of coal and gas. In contrast, emissions from the agricultural sector are to decrease by some 2 % compared to 2005 (Table A10.2).

Table A10.2: Baseline emissions of CH4 by SNAP sector (kilotons)

	2005	2025	2030
Power generation	246	149	136
Domestic sector	1185	659	556
Industrial combustion	123	81	69
Industrial processes	663	641	632
Fuel extraction	2043	1170	1033
Solvents	0	0	0
Road transport	129	15	12
Off-road transport	15	15	14
Waste treatment	6657	3759	3598
Agriculture	9447	9511	9453
Sum	20508	16001	15504

2. Differences between Member States

There are large differences in the evolution of methane emission between Member States. Many new Member States will reduce their CH_4 emissions by 30-47%, mainly as a result of the implementation of EU waste management regulations and the on-going upgrades of gas distribution networks. In contrast, emissions in most old Member States would decline less, as much of the waste management legislation has already been implemented in the past. Also, emissions from the agricultural sectors contribute a larger share to total emissions, and this sector is not expected to dramatically reduce its emissions in the future. For instance, only marginal changes are anticipated for, e.g, Belgium, Denmark and Ireland.

Table A10.3: Baseline emissions of CH4 by country (kilotons and change relative to 2005)

	2005	reference 2025	reference 2030	ref % of 2005 2025	ref % of 2005 2030
AUS	290	232	236	20%	20%
BELG	336	295	292	12%	13%
BULG	370	205	198	45%	46%
CROA	146	126	125	14%	14%
CYPR	39	32	38	18%	3%
CZRE	495	366	363	26%	27%
DENM	268	247	249	8%	7%
ESTO	49	48	46	3%	7%
FINL	216	189	190	12%	12%
FRAN	2983	2453	2437	18%	18%
GERM	2647	1821	1722	31%	35%
GREE	483	333	316	31%	35%
HUNG	428	243	226	43%	47%
IREL	610	600	595	2%	2%
ITAL	1965	1432	1394	27%	29%

LATV	87	68	67	22%	23%
LITH	161	126	120	22%	25%
LUXE	22	17	17	20%	21%
MALT	10	8	7	26%	32%
NETH	827	612	595	26%	28%
POLA	1773	1617	1564	9%	12%
PORT	570	458	445	20%	22%
ROMA	1245	1033	1009	17%	19%
SKRE	215	149	147	31%	31%
SLOV	103	83	80	20%	23%
SPAI	1635	1395	1371	15%	16%
SWED	280	226	231	19%	18%
UNKI	2234	1587	1423	29%	36%
EU28	20508	16001	15504	22%	24%

Source: IIASA

3. FURTHER REDUCTION POTENTIAL BEYOND THE BASELINE

Table A10.4 reports methane emissions by Member State in 2005, projected emissions in 2025 and 2030, and further emission reduction potential at zero cost for 2025 and 2030.

Table A10.4: CH_4 emission by Member State (kilotons and change relative to 2005) in the baseline and by taking further measures (at zero cost or all available)

	2005	reference 2025	reference 2030	at zero costs 2025	at zero costs 2030	ref % of 2005 2025	ref % of 2005 2030	zerocost 2025	zerocost 2030
AUS	290	232	236	231	231	20%	20%	21%	20%
BELG	336	295	292	250	249	12%	13%	25%	26%
BULG	370	205	198	185	174	45%	46%	50%	53%
CROA	146	126	125	105	100	14%	14%	28%	31%
CYPR	39	32	38	28	32	18%	3%	28%	18%
CZRE	495	366	363	349	343	26%	27%	30%	31%
DENM	268	247	249	206	205	8%	7%	23%	24%
ESTO	49	48	46	40	38	3%	7%	18%	23%
FINL	216	189	190	184	184	12%	12%	15%	15%
FRAN	2983	2453	2437	2254	2234	18%	18%	24%	25%
GERM	2647	1821	1722	1723	1610	31%	35%	35%	39%
GREE	483	333	316	308	292	31%	35%	36%	40%
HUNG	428	243	226	209	195	43%	47%	51%	55%
IREL	610	600	595	565	566	2%	2%	7%	7%
ITAL	1965	1432	1394	1227	1173	27%	29%	38%	40%
LATV	87	68	67	57	54	22%	23%	34%	37%
LITH	161	126	120	103	94	22%	25%	36%	42%
LUXE	22	17	17	16	16	20%	21%	25%	27%
MALT	10	8	7	8	7	26%	32%	26%	32%
NETH	827	612	595	557	555	26%	28%	33%	33%
POLA	1773	1617	1564	1260	1174	9%	12%	29%	34%
PORT	570	458	445	416	404	20%	22%	27%	29%
ROMA	1245	1033	1009	940	918	17%	19%	25%	26%
SKRE	215	149	147	137	127	31%	31%	36%	41%
SLOV	103	83	80	77	74	20%	23%	25%	28%
SPAI	1635	1395	1371	1189	1078	15%	16%	27%	34%
SWED	280	226	231	225	229	19%	18%	20%	18%

UNKI	2234	1587	1423	1476	1315	29%	36%	34%	41%
EU28	20487	16001	15504	14324	13672	22%	24%	30%	33%

The baseline would cut methane emissions 221 in 2025 compared to 2005 and 24% in 2030. with a very broad variability for individual Member States, ranging from a 45% reduction in Bulgaria to a 2% reduction in Ireland. These changes not only result from changes in livestock but also from changes in the energy pattern such as changes in the production of gas and oil. Beyond the baseline reduction, a further 8% reduction could be delivered at zero cost with measures that are either cost neutral or pay for themselves through energy recovery, bringing the 2025 emissions to 30% below the 2005 level, with reductions between 7% and 51% at Member State level. In 2030 emission reductions at EU level could be 33% compared to 2005 based on a conservative assumption of using only currently available technologies.

ANNEX 11 DETAILED ANALYSIS OF SPECIFIC OBJECTIVES RELATED TO THE NECD

This Annex refers to the impacts of the policy options directly related to possible changes to the NEC D other than the costs and benefits related to the impact reduction options which have been described in Chapter 6 of this impact assessment.

1. OBJECTIVES

Chapter 4 outlined objectives where specific action under the NECD is relevant:

- *Facilitate action on residual local compliance problems;*
- *Promote enhanced policy co-ordination at Member State and regional/local level;*
- *Incorporate Gothenburg Protocol obligations into EU legislation and ratify the protocol;*
- *Proportionately tap the pollution reduction potential of contributing sectors;*
- *Address background pollution; and,*
- *Improve the information base for assessing policy implementation and effectiveness.*

  In addition, options for simplification and clarification are explored in the spirit of smarter regulation.

2. POLICY OPTIONS

In order to address the specific objectives outlined above, the following thematic areas (TAs) and issues and options were identified:

TA1 – Establish and implement NEC D national programmes for improved air quality governance

Option 1: Maintain the existing requirements for programmes and simply update the dates for the new reduction commitments for 2020 and 2025/30.

Option 2: **National programmes light –** as for Option 1, but in addition requiring that coherence with other relevant plans and programmes be ensured, in particular the air quality plans required under the AAQD 2008/50/EC and climate and energy policy/programmes.

Option 3: **Comprehensive coherent national air pollution control programmes** – as for Option 2 but in addition requiring that benefits for air quality be maximised, that the programmes be developed and reported in a harmonised way, that the effectiveness of programmes be reviewed regularly, and that corrective action be taken where needed to meet the commitment.

TA2 - Establish and report emission inventories and projections for relevant pollutants

Option 1: Strict minimum to monitor achievements of all proposed reduction commitments related to any (new) pollutant for which a reduction commitment would be established, emission inventories and projections would have to be established and reported.

Option 2: Coherence with the Convention on Long-Range Transboundary Air Pollution (CLRTAP) requirements, including the establishment and reporting to the Commission and the EEA of all emission/projection data under the CLRTAP protocols and decisions of the CLRTAP Executive Body, and in accordance with the EMEP reporting plan (except POPs which are covered by EU POPs regulation[30]).

TA3 – Establish environment monitoring and indicators

Option 1: No change of legislation, i.e. no obligation to monitor air pollution effects.

Option 2: Ecosystem monitoring representative of sensitive ecosystem types in the respective Member State, coordinated with the effects oriented monitoring programmes of the LRTAP Convention.

Option 3: Targeted ecosystem monitoring, focusing on Natura 2000 [31] protected areas for which EU legislation requires Member States to maintain a good conservation status.

Option 4: Comprehensive monitoring of air pollution health and ecosystem effects. Effects on ecosystems would be monitored both for protected areas and other ecosystems, while air pollution health monitoring would be required through collection of national health statistics.

TA4 – Simplify and streamline reporting legislation

Option 1: No change of legislation

Option 2: "Easy" simplification and harmonisation, by streamlining with the requirement under the PRTR Regulation[32] and the Monitoring Mechanism Regulation (MMR)[33], as well as reporting under the IED.

Option 3: Comprehensive streamlining, including the establishment of a fully harmonised EU system for reporting of emissions of "classical" air pollutants and greenhouse gases.

TA5 – ***Establish EU action on short-lived climate pollutants (SLCP)***

Option 1: No change of legislation

Option 2: Coherence with CLRTAP: focus on taking action from sources with significant emissions of black carbon when implementing the PM2.5 ceiling.

[30] EU POPs Regulation (EC) No 850/2004 of the European Parliament and of the Council of 29 April 2004 on persistent organic pollutants and amending Directive 79/117/EEC

[31] **92/43/EEC** Habitats Directive

[32] Regulation (EC) No 166/2006

[33] Regulation (EU) of the European Parliament and of the Council of 21 May 2013
on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC

Option 3: Comprehensive SLCF policy action on black carbon, and tropospheric ozone.

3. IMPACT ANALYSIS

Methodology

The analysis follows the guidelines for impact assessments[34]. General considerations on the likely environmental, social and economic impacts, in particular administrative burden, are included. In addition the obstacles for compliance (in implementing the obligation) and opportunities for better regulation, in particular simplification have been analysed to the extent possible.

Environmental impacts

In addition to implementing the cost-effective reduction commitments to achieve the objectives of the TSAP 2013 the options are qualitatively analysed with respect to environmental performance[35]. Those are related to, *inter alia*:

- ensuring the availability of better quality and more complete data and information (data quality/completeness);
- enabling better compliance with domestic and international targets, commitments and requirements (compliance with domestic and/or international commitments);
- enabling future policy actions on air quality and short-lived climate pollutants (future policy development/implementation).

Compliance aspects and opportunities for better regulation

A qualitative analysis is provided of the degree of difficulty Member States would face in complying with a given option[36]. To the extent applicable the policy options are also qualitatively assessed for coherence with the better regulation objective[37], which aims to simplify and streamline legislation.

Economic impacts

Economic impacts of obligations for the MS, SMEs and industry are assessed only for measures that are additional to already existing EU legislation and international law. (Thus the economic impacts of obligations already existing under the CLRTAP and its protocols, for instance, are not assessed.)[5]

The administrative burden on Member States is quantified on the basis of the EU "Standard Cost Model" for those cases where the costs have been deemed to be significant. For most options it has not been possible to distinguish the costs for implementing a substantive obligation such as installing and running new ecosystem monitoring stations from the costs of providing the resulting information to the Commission. In those instances the sum of the two is given and termed "administrative burden".

34 http://ec.europa.eu/governance/impact/index_en.htm

35 Ratings: + or – is used to denote positive or negative impacts respectively, = signifies no impact, +/- low impact, ++/--, medium (significant) impact.

36 Ratings in terms of likeliness: low (LL), medium (ML) and high (HL).

37 Ratings in the range from negative, no influence and positive (--, 0, ++).

Social impacts
Most options assessed in this annex will have minor social impacts, if any, and so these are not specifically addressed. The main (positive) social impact of the options is better public information on air quality issues.

Impacts on employment, industry and SMEs
The impacts of the pollution reduction options on employment, industry and SMEs are given in Chapter 6 and Annex 9. There are only negligible additional impacts and (substantive and administrative) costs on those sectors as a result of the options analysed in this annex, since the information needs from the sectors (such as activity data and information related to abatement technologies) are already covered by EU legislation, in particular under the PRTR Regulation and the MMR.

Administrative burden calculation

The EU Standard Cost Model was used to assess the costs on public authorities in the Member States. The costs were estimated for the preferred option and when possible also for the other options covered in this annex. Both recurring (annual) and one-off (initial) costs were assessed.

The costing model was developed in two steps. In a first step 4 Member State experts were contacted providing their estimates on labour time necessary to implement the relevant options with identified significant administrative cost. This input was generalised into a costing model for the EU28. The details on the calculations of additional costs are given in the appendix to this annex.

4. Specific impacts of the policy options

TA1 - Establish and implement NEC D national programmes for air quality governance
The following impacts were assessed for each option:

Environmental impacts

The extent to which the option rectifies the current lack of coordination between different administrative levels in developing and implementing national programmes, improves identification of cost-effective measures at the national and local level, and so improves compliance prospects (or at least reduces total policy costs due to efficient combinations of measures).

Compliance and better regulation

The extent to which Member States would face an additional burden to transpose the legal requirement involved (for instance for Option 1, MS have already transposed the national programmes obligations and so compliance would not be an issue). Also, the extent to which better regulation opportunities are facilitated (in terms of streamlining administration and better coordinating efforts to reach the air quality objectives).

Economic impacts

There are no direct costs for industry and SMESs. The costs are entirely administrative on the public administration and the Commission and EEA. The administrative burden effort required of the MS to implement the option in practice has been quantified for the options (see appendix).

Comparison of options

The table below summarises the performance of the options in relation to the impacts assessed. Overall, Option 3 fully resolves the problems identified in the ex-post evaluations of the NEC Directive and in this IA.

Summary for TA 1 – National programmes

TA1 – National programmes	Environ-mental impacts	Com-pliance	Economic impacts	Better regulation	Admin burden
Option 1 - Only update the dates	=	LL	- -	0	Initial cost € 4.8 million Annual cost € 0.17 million
Option 2 - National programmes light	=	ML	0	++	Initial cost € 4.8 million Annual cost € 0.17 million
Option 3 - Comprehens ive national programmes	++	ML	++ Lower cost than cost-optimum technical measures	++	Initial cost € 5.2 million Annual cost € 0.18 million

It should be noted that the current LIFE+ programme may contribute to covering the costs related to MSs needs to develop national assessment tools for air quality assessment and management as part of their programme development.

TA2 Establish and report emission inventories and projections for relevant pollutants

Option 1: Strict minimum to monitor achievements of all proposed reduction commitments for pollutants. That is, for any new pollutant for which a reduction commitment would be provided, emission inventories and projections would have to be established and reported.

Environmental impacts

This is a necessary minimum to document compliance with the related reduction objectives.

Compliance and better regulation

Member States have already transposed the legal requirement in order to fulfil their obligations under CLRTAP and so compliance should not be an issue. Opportunities for better regulation are likely to be negligible.

Economic impacts

None (already required under international obligations (CLRTAP)).

Administrative burden

No change of administrative burden has been identified for the MS. The Commission and the EEA may have slightly decreased administrative burden due to harmonised reporting of emissions and projections for these substances, which facilitates EU reporting to the CLRTAP.

In summary

Overall this option partly resolves the problems identified in the ex-post evaluations of the NEC Directive and in this IA.

Option 2: Coherence with CLRTAP requirements, including the establishment and reporting to the Commission and the EEA of all emission/projection data under the CLRTAP protocols and decisions of the CLRTAP Executive Body, and in accordance with the EMEP reporting plan (except POPs which are covered by EU POPs regulation).

Environmental impacts

The requirement of producing the emission inventories and projections defined in EMEP reporting plan are covered under the CLRTAP to which the MS are Parties. The environmental impacts of this option are nevertheless likely to be significant since it provides complete information to EU citizens on emissions and projections for all classical air pollutants, including short-lived climate pollutants.

Compliance and better regulation

Member States have already transposed the legal requirement in order to fulfil their obligations under CLRTAP and so compliance should not be an issue. Opportunities for better regulation are likely to be significant particularly in the long term through better EU internal coordination between the MS and EU institutions (Commission and EEA).

Economic impacts

None (already required under international obligations).

Administrative burden

No change of administrative burden has been identified for the MS. The Commission and the EEA will gain in effectiveness due to harmonised MS reporting of emissions and projections for air pollutants, which facilitates EU reporting to the CLRTAP.

In summary

Overall this option fully resolves the problems identified in this IA.

Summary for TA 2 – Emission inventories/projections

TA2 – Emission inventories/ projections	Environmental Impacts	Compliance	Economic impacts	Better regulation
Option 1 Strict minimum	+	LL	0	0
Option 2 Coherence with CLRTAP	++	LL	+	0

TA3 – Establish environment monitoring and indicators

Option 1: No change of legislation, i.e. no obligation to monitor air pollution effects.

Environmental impacts

The emission reduction commitments are designed to reduce environmental impacts, and without data on the state of the environment, ex post assessment of the real impacts of the policy will remain extremely difficult. This will also substantially hamper future policy development.

Compliance and better regulation

Not applicable for compliance. Many opportunities for better regulation may be lost due to poor coordination between MS undertaking voluntary activities under the CLRTAP.

Economic impacts

None.

Administrative burden

Not applicable.

In summary

Overall this option does not address the problems and objectives identified in this IA.

Option 2: Ecosystem monitoring in sensitive ecosystems coordinated with the effects-oriented programmes of the LRTAP Convention.

Environmental impacts

Impact monitoring in protected ecosystems will allow assessment of the effectiveness of air policy and create synergy with the objectives and programmes under the LRTAP Convention. The option will substantially increase the knowledge base approach of the that Convention and help future EU policy development addressing transboundary air pollution and ecosystem effects.

Compliance and better regulation

Compliance obstacles are likely to be low. Most Member States have partly or fully implemented such monitoring programmes as part of their commitment under the LRTAP Convention.

Economic impacts

The economic impacts are on the public administration and assessed as administrative burden.

Administrative burden

The administrative cost includes the complementary setting up and operation of the monitoring compared to already existing monitoring of ecosystems, and the provision of the required information to the Commission and other bodies. The total cost for the monitoring in ecosystems is small although significant and detailed in annex A.

Option 3: Targeted ecosystem monitoring, focusing on Natura 2000[38] protected areas for which EU legislation requires Member States to maintain a good conservation status.

Environmental impacts

Impact monitoring in protected ecosystems will allow assessment of the effectiveness of air policy and of the progress towards the protection of Natura 2000 sites (including ex post evaluation of overall policy effectiveness). The latter will substantially help future policy development in both AQ and nature and habitats protection.

Compliance and better regulation

Compliance obstacles are likely to be low. Opportunities for better regulation occur for better coordination in MS when defining and implementing management plans for the Natura 2000 areas in areas where air pollution is significantly influencing ecosystems by acidification and eutrophication.

Economic impacts

The economic impacts are on the public administration and assessed as administrative burden.

Administrative burden

The administrative cost includes the setting up and operation of the monitoring (similar to a substantive cost) and the provision of the required information to the Commission and other bodies. The total cost for the monitoring in ecosystems is significant and detailed in annex A.

In summary

Overall this option provides the minimum respond to the problems and objectives pursued in this IA.

Option 4: Comprehensive monitoring of air pollution health and ecosystem effects. Effects on ecosystems would be monitored both for protected areas and other ecosystems, while air pollution health monitoring would be required through collection of national health statistics.

Environmental impacts

Full information would be made available on the effectiveness of air pollution policy in reducing ecosystem and health impacts, and on progress towards national and EU objectives. Future policy development/implementation would greatly improve and allow also ex-post evaluation of the air quality impacts on human health and the environment.

Compliance and better regulation

Compliance obstacles are likely to be high since the collection of health data is mainly national policy (subsidiarity) and related to health expenditures.

[38] **92/43/EEC** Habitats Directive

Opportunities for better regulation may be large for MS when defining and implementing management plans for public health and the environment.

Economic impacts

The economic impacts are on the public administration and assessed as administrative burden.

Administrative burden

The administrative cost includes the setting up and operation a comprehensive health and environment monitoring is likely to be significantly higher than Option 2, particularly for public health monitoring. The total cost for the monitoring in ecosystems is significant and higher than the Option 2 and detailed in annex A.

In summary

Overall this option provides a comprehensive response to the problems and objectives pursued in in this IA. However, this option is likely to pose significant challenges to implement and with high costs.

Summary for TA 3 – Environment monitoring

TA3 – environment monitoring	Environ-mental impacts	Com-pliance	Economic impacts	Better regulation	Admin burden
Option 1 - No change	- -	n.a.	0	- -	n.a.
Option 2 – Ecosystem monitoring coordinated with LRTAP Convention	++	LL	(-)	+	Initial cost € 1,5 million. Annual cost € 2.4 million
Option 3 – Targeted Natura 2000 ecosystem monitoring	++	LL	(-)	++	Initial cost € 4.5 million Annual cost € 7.5 million
Option 4 - Comprehensive monitoring	++	HL	(- -)	++	Initial cost € 4.5 million Annual cost € 7.5 million Health monitoring excluded

TA4 – Simplify and streamline reporting legislation

Option 1: **No change** of legislation

In summary

No distinctive environmental, compliance, economic or administrative implications, but overall this option does not pursue the objective for better regulation.

Option 2: "Easy" simplification and harmonisation, by streamlining with the requirement under the PRTR and MMD, as well as reporting under the IED. Ensuring coherence in MSs reporting under different pieces of EU legislation.

Environmental impacts

Streamlining of reporting instruments has positive and significant environmental impacts particularly in providing internally coherent data for national authorities, EU citizens and the EU as a whole.

Future policy development/implementation would greatly improve and also allow effective ex-post evaluation of air related policy (classical air pollutants and greenhouse gases).

Compliance and better regulation

Compliance obstacles are likely to be low. Opportunities for better regulation occur related to better coordination in MS. However at the EU institution level (Commission and EEA) the opportunities for better regulation will be limited.

Economic impacts

No economic impacts have been identified.

Administrative burden

The administrative cost for the public administration is likely to be insignificant. The administrative cost for the EU institutions will remain at the same level as today.

In summary

Overall this option provides the minimum response to the problems and objectives pursued in this IA.

Option 3: Comprehensive streamlining, including the establishment of a fully harmonised EU system for reporting of emissions of "classical" air pollutants and greenhouse gases.

Environmental impacts

A full harmonisation of reporting at the level of MS and EU will have great positive environmental benefits for national health and environmental authorities, EU citizens and the EU as a whole.

Future policy development/implementation would greatly improve and also allow comprehensive ex-post evaluation of the air quality policy.

Compliance and better regulation

Compliance obstacles are likely to be medium since the full harmonisation will require significant effort in MS and in the EU. Opportunities for better regulation may be large for MS and the EU.

Economic impacts

No economic impacts have been identified.

Administrative burden

The administrative cost for the public administration is likely to be small in the long term but significant in its initial phase for some MS. The administrative cost for the EU institutions (like the EEA) may be reduced.

In summary

Overall this option provides a comprehensive response to the problems and objectives pursued in in this IA. However, this option is likely to pose some challenges to implement at this stage due to costs and efforts required.

Summary for TA 4 – Simplify and streamline

TA4 – Simplify and streamline reporting	Environmental Impacts	Compliance	Economic impacts	Better regulation
Option 1 No change	=	0	n.a.	n.a.
Option 2 "Easy" streamlining	+	LL	0	+
Option 3 Comprehensive	++	ML	=	++

TA5 – Establish EU action on short-lived climate pollutants (SLCPs)

Option 1: No change of legislation

Overall this option does not address the problems objectives identified in the IA, namely to advance policy on short lived climate forcers.

Option 2: Coherence with CLRTAP and specifically the 2012 amendment of the CLRTAP Gothenburg Protocol.

Environmental impacts

The environmental impacts are likely to be significant and positive since MS will also have to take appropriate measures to reduce black carbon emissions, being harmful for human health and climate in the short term.

Future policy development/implementation will gain significantly from increased experience in applying measures not covered by EU legislation so far.

Compliance and better regulation

Compliance obstacles are unlikely (requirement under international obligations). Opportunities for better regulation are likely to exist but small for MS and the EU.

Economic impacts

Economic impacts are likely to be small if any.

Administrative burden

The administrative cost exists but is small since increased monitoring of black carbon emissions will be required. A detailed assessment is given in annex A.

In summary

Overall this option offers opportunities for MS at low or no cost, largely maintaining the subsidiarity in the precise choice of measure.

Option 3: Comprehensive SLCF policy action on black carbon, and tropospheric ozone.

Environmental impacts

The environmental impacts are likely to be significant and positive since MS will also have to take appropriate measures to reduce black carbon and methane emissions (an ozone precursor), being harmful for human health and climate in the short term.

Future policy development/implementation will gain significantly from increased experience in applying measures not covered by EU legislation so far and will allow the EU to promote international action on short-lived climate forcers.

Compliance and better regulation

Compliance obstacles are likely to be moderate since comprehensive action will demand resources and efforts in MS and EU institutions. Opportunities for better regulation are likely to be significant but for MS and the EU in better coordination of policy on air pollution and climate change.

Economic impacts

Economic impacts are likely to be significant but small (and not assessed here).

Administrative burden

The administrative cost is small since increased monitoring of black carbon emissions will be required. A detailed assessment is given in annex A.

In summary

Overall this option offers opportunities for MS at low cost, largely maintaining the subsidiarity in the precise choice of measure.

Summary for TA 5 – Action on SLCF

TA5 – EU action on SLCF	Environ-mental impacts	Com-pliance	Economic impacts	Better regulation	Admin burden
Option 1 - No change	=	n.a.	0	0	n.a.
Option 2 – Action on black carbon	+	LL	0	0	Initial cost €0.20 million
Option 3 - Compreh ensive action	++	ML	(not assessed)	+	Initial cost €0.20 million

5. OPTION COMPARISON

The comparison of options for each of the identified topic areas is based on qualitative criteria related to the effectiveness, the efficiency and coherence in achieving the specific objectives defined in section 4.3. The ratings applied are no effect (0), low (L), medium (M) and high (H).

Table on comparison of options

		Effectiveness	Efficiency	Coherence
TA1 – National programmes	Option 1	L	L	0
	Option 2	M	M	M
	Option 3	H	H	M
TA2 – Emission inventories/ projections	Option 1	L	L	L
	Option2	H	M	H
TA3 – environment monitoring	Option 1	0	0	0
	Option 2	M	H	M
	Option 3	M	M	H
	Option 4	H	M	H
TA4 – Simplify and streamline reporting	Option 1	0	0	0
	Option 2	M	M	M
	Option 3	H	M	H
TA5 – EU action on SLCF	Option 1	0	0	0
	Option 2	M	M	M
	Option 3	H	M	H

6. PREFERRED OPTION FOR REVISING THE NEC D

The preferred option combines the aspects of effectiveness, efficiency and coherence with those of issues on overall cost, compliance, subsidiarity and balance between costs and benefits.

Table on preferred options

	Preferred option	**Estimated cost (administrative burden)**
TA1 – National programmes	Option 3: Comprehensive coherent national air pollution control programmes –requiring that benefits for air quality be maximised …	Initial cost:€ 5.2 million Annual cost: € 0.18
TA2 – Emission inventories/ projections	Option 2: Coherence with CLRTAP requirements …	Insignificant
TA3 – environment monitoring	Option 2: Ecosystem monitoring coordinated with LRTAP Convention	Initial cost: € 1.5 million Annual cost: € 2.4 million
TA4 – Simplify and streamline reporting	Option 2: "Easy" simplification and harmonisation, Ensuring coherence in MSs reporting	Insignificant
TA5 – EU action on SLCF	Option 2: Coherence with CLRTAP and specifically the 2012 amendment of the CLRTAP Gothenburg Protocol.	Initial cost: € 0.20 million

7. MONITORING AND EVALUATION

The preferred options relate to changes in MS obligations with regard to the establishment and reporting of

- national air pollution control programmes;
- coherent emission inventories and projection for air pollutants;
- and ecosystem effects monitoring in protected areas;

The Commission supported by the EEA, will continue to annually collate the received data and information. This information will be discussed with the MS to systematically review and improve the effectiveness of the policy.

In addition, the CLRTAP regularly undertakes in-depth reviews of emission inventories and projections provided by the EU and its MS on which the EU will build any further efforts of improvements of the relevant legislation and practices.

APPENDIX 11.1 STANDARD COST MODEL FOR ASSESSMENT OF ADMINISTRATIVE BURDEN

The overall costs incurred on Member States public administrations, SMEs, industry and others related to the choices of options may be defined as substantive costs and administrative costs. The substantive costs for the options related to the choice of pollution reduction options are given in Chapter 6. This appendix summarises the additional costs for the options detailed in Appendix 11.2. Most of the options have no significant costs. Some of the analysed options are in reality a mix of substantive costs and administrative costs, such as the implementation of ecosystem monitoring.

No additional administrative burden has been identified for SMEs and industry. The entire additional cost for the preferred combined option will be on public administration.

The MS labour costs are based on 2010 statistics from EUROSTAT as the average cost for the (ISCO) categories 2 and 3[39].

Options related to national programmes – TA1

The estimated amount of administrative burden to prepare and implement national programmes varies between MSs depending on the MS size, the level of internal work of the administration as compared to outsourced work and the level of emission reductions aimed in the programmes. Based on interviews with experts from Member States (IE, BE, NL and DE) a simplified costing model was develop that sets the number of workdays to develop and adopt the national programme depending on country size (small MS below 10 million inhabitants, medium MS 10 to 30 million inhabitants, and large MS with more than 30 million inhabitants) as well as the national labour cost rates. The estimates for work days are upper estimates for MSs and may in several cases be significant below the tabled levels.

Table A11.1: Number of days for the preparation of initial national air pollution control programme

MS size/ outsource	High degree of outsourcing	No outsourcing
Small MS	1000	800
Medium MS	1200	1100
Large MS	1400	1300

Table A11.2: Number of days per year for the maintenance of national air pollution control programme

MS size/outsource	High degree of outsourcing	No outsourcing
Small MS	200	100

[39] EUROSTAT.

Medium MS	250	200
Large MS	300	250

To the extent known, the degree of outsourcing of work in the specific MS was accounted for- if not directly available such information (on high degree of outsourcing) was taken from the IA for the Monitoring Mechanism Regulation[40]. The administrative costs for complying with the requirement to consult with the public or neighbouring MSs were assessed to be insignificant in comparison to the efforts required to map measures and assess their effectiveness and costs. The preferred option for TA 1 Option 3 assumes a revision of the plans on average every 5 years. The estimated costs refer to the initial costs and average annual costs thereafter. Based in the interviews with MS the administrative costs for Option 1 and 2 were estimated to be only some 10 per cent less than for Option 3.

Options related to ecosystem monitoring - TA3

Member States cost for the monitoring of ecosystem effects are based on information from voluntary activities under the CLRTAP (see also consultant report "NEC CBA Report 3"[41]). As some of the monitoring under the CLRTAP (in particular dry deposition of nitrogen to ecosystems) can be very costly this impact assessment focuses on a core set of parameters for assessing air pollution ecosystem damage. The preferred option is to focus on obtaining information of air pollution effects on sensitive ecosystems in the respective Member State coordinated with effects-oriented ecosystems monitoring under the LRTAP Convention. Forests, grasslands and fresh water ecosystems are vulnerable and sensitive to air pollution. The number of ecosystems types defined under the Natura 2000 framework (categories 3, 6 and 9) has been used as a proxy of the number representative ecosystems types by Member State.

Each Member State would have to complement current effects-based ecosystem monitoring compared to current programmes under the LRTAP Convention and maintain at least one site per defined habitat type in these categories (table A11.3). Again the national labour costs were used to assess the costs for setting up, maintaining, analysing samples and reporting data.

Table A11.3: Number of habitat categories defined by Member States in categories 3 "Fresh water habitats" 6. " Natural and semi natural grassland formations" and 9 "Forests" that serve as a proxy for sensitive ecosystems

Member State	No of habits in category 3, 6 and 9	Member State	No of habits in category 3, 6 and 9	Member State	No of habits in category 3, 6 and 9
Austria	44	Germany	42	Poland	39
Belgium	26	Greece	44	Portugal	42
Bulgaria	49	Hungary	30	Romania	51

[40] SEC (2011) 1407 final
[41] AEA, 2008

Croatia	42	Ireland	18	Slovakia	42
Cyprus	19	Italy	65	Slovenia	32
Czech Republic	38	Latvia	26	Spain	53
Denmark	21	Lithuania	27	Sweden	39
Estonia	25	Luxembourg	19	U. K.	28
Finland	32	Malta	9		
France	59	Netherlands	22		

As all Member States are parties to the LRTAP Convention they also participate in the effects-oriented monitoring programmes. It is therefore assumed that half of the sensitive ecosystem types are covered by on-going activities and that only complementing the current network with new sites entails administrative costs. The required working days per new site were taken from NEC CBA Report 3 and defined for the setting up of the site, annual sampling and reporting. The costs for chemical and physical analysis of samples were taken from the same report and adjusted for by the national labour costs (using the U.K. estimates to normalise) as outlined above.

Table A11.4: Cost for individual samples for the assessment of ecosystem damage[42] as assessed for the U.K, see Appendix 11.3

Parameter	Frequency per year	Cost per sample/ parameter	Average annual cost
ANC	1	360	360
BS	0,25	360	90
Al, Al(KCl)	0,25	300	75
NO3 leach	1	216	216
C/N	0,25	576	144
N/P, N/K	0,25	1200	300
Arginine in foliage	0,5	300	150
Growth	1	1200	1200
			2535

Options related to action on short lived climate forcers –TA5

Member States comprehensively report emissions and projections under CLRTAP for all main classical air pollutants. The 2012 amendment to the Gothenburg Protocol includes an obligation to establish and report emissions and projections of black carbon but that amendment is not yet in force. EMEP is currently revising the guidelines and the guidebook for emission inventories and projections and planned to be part of CLRTAP reporting obligations from 2014 onwards. This impact assessment considers the obligation related to black carbon as additional. It should

[42] Taken from NEC CBA Report 3, (AEA, 2008)

be noted that the substantive cost related to the TA5 Option 2 refers to give priority to emission reduction measures which also significantly reduce black carbon is covered in the achievement of the overall reduction objectives for PM2.5 and thus part of the cost estimates in section xx.

Other significant administrative costs for MSs' administrations related to TA5 Option 2 occur only the first year for the updating and validation of the national inventory/projection system. The following years the additional costs to maintain and report are insignificant. It is assumed that the update and validation the first year corresponds to 40 days of work.

APPENDIX 11.2 ADMINISTRATIVE COSTS BY MEMBER STATE OF PREFERRED OPTIONS (€)

	National program		Ecosystem monitoring		BC inventories
Member State	initial cost, €	annual cost, €	initial cost, €	annual cost, €	initial cost, €
Austria	222085	5552	109932	166683	11104
Belgium	394518	16438	76931	116646	13151
Bulgaria	22320	558	12304	18656	1116
Croatia	55040	1376	26006	39432	2752
Cyprus	165799	4145	35439	53735	8290
Czech Republic	93942	3416	29208	44286	3416
Denmark	267896	6697	63290	95964	13395
Estonia	50927	1273	14323	21717	2546
Finland	204219	5105	73519	111472	10211
France	380044	16288	144145	218559	10858
Germany	379406	14593	110320	167271	11674
Greece	191100	6949	68796	104311	6949
Hungary	47155	1179	15915	24131	2358
Ireland	287148	11486	46518	70532	11486
Italy	338020	13001	152109	230633	10401
Latvia	35857	896	10488	15903	1793
Lithuania	35232	881	10702	16226	1762
Luxembourg	300853	7521	64307	97505	15043
Malta	92708	2318	9387	14232	4635
Netherlands	256846	10274	50856	77109	10274
Poland	112595	4331	30401	46095	3464
Portugal	163571	5948	56209	85226	5948
Romania	47873	1741	19976	30289	1741
Slovakia	57533	1438	27184	41218	2877
Slovenia	105522	2638	37988	57599	5276
Spain	273002	11700	93016	141034	7800
Sweden	276734	11069	97134	147278	11069
UK	362428	15533	65237	98915	10355

APPENDIX 11.3 MONITORING OF EFFECTS OF POLLUTANTS IN THE ENVIRONMENT

A. Geographical coverage of ecosystem monitoring sites

Member States should ensure that their network of monitoring sites covers at least a representative selection of all 'natural habitat types of Community interest' as listed under points "3. Freshwater habitats", 6. ”Natural and semi-natural grassland formations” and "9. Forests" of Annex I to Directive 92/43/EEC.

B. Key indicators, monitoring requirements and methodologies to use at monitoring sites in freshwater ecosystems.

Mandatory Indicators (unit)	Related effect	Minimum frequency	Existing monitoring networks
acid neutralizing capacity: ANC (µeq/L)	Biological damage, including sensitive receptors (micro- and macrophytes and diatoms); loss of fish stock or invertebrates.	Sampling from yearly (in autumn turnover) to monthly (streams),	ICP Waters, national networks, data provided for ICP Modelling and Mapping to calculate critical loads.

C. Key indicators, monitoring requirements and methodologies to use at monitoring sites in terrestrial ecosystems.

Mandatory indicators (unit)	Related effect	Minimum frequency	Existing monitoring networks
soil base saturation: BS (per cent)	Loss of soil nutrients (nutrient imbalances, growth reduction, susceptibility to other stress factors)	Every 4 years,	ICP Forests, ICP Integrated Monitoring, national networks, data provided for ICP Modelling and Mapping to calculate critical loads.
Soil acidity Exchangeable Al, Al_{KCl} (mg/g)	Soil CEC, soil acidity, nutrient availability	Every 4 year	ICP Integrated Monitoring
soil nitrate leaching $NO_{3,leach}$ (µeq/L/year)	Nitrogen saturation, nutrient imbalances, changes in vegetation structure, loss of biodiversity	Every year	ICP Forests, ICP Integrated Monitoring, national networks, data provided for ICP Modelling and Mapping

carbon-nitrogen ratio C/N (g/g)	Nitrogen saturation, nutrient imbalances, changes in vegetation structure, loss of biodiversity, links to climate change.	Every 4 years	to calculate critical loads.
Nutrient balance in foliage: (N/P, N/K, N/Mg) (g/g)	Nitrogen saturation, nutrient imbalances, changes in vegetation structure, loss of biodiversity	Every 4 years,	ICP Forests, ICP Integrated Monitoring, national networks, data provided for ICP Modelling and Mapping to calculate critical loads.
Arginin in foliage: (µmol/g)	Soil nitrogen status	Every 2 years	ICP Integrated Monitoring
Caused by ozone: Growth/yield reduction and leaf/foliar damage (per cent) Exceedance of flux-based critical levels (mmol m^{-2} projected leaf area)	Reduced biomass, reduced yield quantity and quality, reduced photosynthesis capacity, links to global change.	Every year, Hourly input parameters during growing season (ozone concentration, climate, soil water)	ICP Vegetation, ICP Forests, national networks.

[1]ICP manuals (except ICP Modelling and Mapping) provide information on site selection criteria, and additional indicators to make a proper assessment of ecosystem status

ANNEX 12 DETAILED ANALYSIS FOR MEDIUM COMBUSTION PLANTS (MCP)

1. RATIONALE FOR ACTION

The policy options described in Chapter 6 of this Impact Assessment entail the adoption of pollution control measures at the level of each Member State selected on the basis of highest cost-effectiveness. The resulting combination of measures includes further emission controls in the MCP sector. Annex 8 provides details on the estimated emission reductions and associated emission control costs for the MCP sector under the central case policy option 6C* described in Chapter 6.6.2 of the Impact Assessment. These emission reductions are estimated at 79 kiloton sulphur dioxide (SO_2), 108 kiloton nitrogen oxides (NOx), and 13 kiloton PM2,5 (PM), for total additional emission control costs of 220 M€/year.

This Annex sets out the deeper impact analysis of options to deliver emission reductions from MCP through an EU-wide legislative instrument. Introductory sections below also provide more details on the characteristics of the sector, already existing measures at Member State and international level and the data sets used.

2. CHARACTERISTICS OF THE SECTOR

2.1. Definition of MCP for the purpose of this assessment

The combustion of fuels (gas, liquid, and solid fuels, including biomass) is one of the main sources of emissions of NOx and, in case of solid and liquid fuels, particulate matter PM and SO2. Combustion plants are operated with a wide range of capacities, depending on their application. The “large” combustion plants (i.e. those having a rated thermal input of 50 MW or more) are mainly used for electricity generation, district heating and industrial applications. These plants are covered by several pieces of EU environmental law and their pollutant emissions are controlled via permit conditions based on the application of BAT and cannot exceed the EU-wide limits set for dust, NOx and SO2 in the Industrial Emissions Directive 2010/75/EU (IED) and its predecessors, Directive 2008/1/EC on Integrated Pollution Prevention and Control (IPPC) and Directive 2001/80/EC on Large Combustion Plants (LCP).

At the other end of the capacity spectrum are the “small” combustion plants, with a capacity of less than 1 MW, which are predominantly used for domestic or residential heating. Some of these plants are covered by the Ecodesign Directive 2009/125/EC. The implementing rules adopted in this context, while initially focusing primarily on energy efficiency, will also include product standards limiting emissions of air pollutants (NOx, PM, carbon monoxide (CO), etc depending on the type of plant and fuel used) in view of the outstanding air quality challenges described in Chapter 3 and Annex 4. This work is currently ongoing.

The combustion plants considered in this Annex (as in Chapter 7) are those falling between the two categories described above. These "medium" combustion plants with a rated thermal input between 1 and 50 MW are used for a wide variety of applications, including electricity generation, domestic/residential heating and cooling, providing heat/steam for industrial processes, etc. Therefore, MCP should be considered not as a single sector but as a cross-sectoral activity relevant for the industrial, tertiary/commercial and residential/domestic sectors alike. Furthermore, a number of different technologies are concerned including boilers, heaters, engines and turbines. The focus of this assessment is on hot water and steam boilers, industrial process heaters, combined heat and power (CHP) plants, gas, dual fuel and diesel engines and gas turbines, in order to provide a basis for defining consistent regulatory approaches. However, it does not cover industrial dryers, process kilns and furnaces in which there is direct contact between the combustion waste gases and the materials processed or produced (such as cement clinker, lime, ceramics or asphalt kilns, wood dryers, glass furnaces, non-ferrous metals furnaces, coke ovens, etc.), chemical reactors, and waste incineration or co-incineration plants. That is because these relate to different technologies some of which are being considered for regulation separately (e.g. furnaces).

It is furthermore noted that emissions of air pollutants from MCP are not yet regulated at an EU level except where these plants are part of an installation covered by the IED either as a "directly associated activity" to an IED activity operated within the installation (e.g. combustion plants providing heat or steam to an industrial process listed in Annex I of IED) or where the plant is part of a wider combustion activity on site with a total rated thermal input of 50 MW or more (in line with the aggregation rule set out in the chapeau to Annex I of the IED).

2.2. Development of an EU-wide dataset

As part of recent studies, data on combustion plants smaller than 50 MW was gathered directly from the Member States. This included data on numbers, capacities, fuel consumption and emissions from the plants, as well as information on relevant national legislation (where applicable), combustion techniques used, abatement measures typically applied, and the degree to which the combustion plants may already be regulated under the IED.

From these Member State data and through extrapolation based on a number of assumptions, an EU wide dataset concerning MCP was developed with which possible control options were assessed. Based also on the above mentioned characteristics of the sector, the dataset was separated into three capacity classes of 1-5 MW, 5-20 MW and 20-50 MW rated thermal input, each covering a comparable share of the fuel used and emissions from the MCP segment. However, the number of plants within each of the three classes is very different (see Table A12.1). While there are more than 100,000 combustion plants between 1 and 5 MW, the group between 5 and 20 MW counts 23,000 plants, while there are only about 5,000 plants between 20 and 50 MW). Also, the combustion technologies, dominant fuel types and application of certain technical measures to abate emissions may differ between these categories. By considering the three classes separately, the impacts of the various options could be considered in more detail, in particular where they might depend on the number of plants affected or on the technical applicability of certain measures.

Data was also collected on the combustion technology used. However, very limited information could be found on this, and there was significant variation for the Member States that have provided an indication of the split. Due to this limitation the technology types have been categorised into two groups: "boilers" and "turbines and engines". For Member States where no indication of the distribution between these two categories has been identified, the split has been assumed to be 80% boilers and 20%

turbines and engines for each of the three size categories, which is based on the average of the available data.

2.3. Reference situation in 2010

The reference dataset mentioned above has been compiled from sources dating from 2008 to 2012, and has therefore been taken to offer a good basis for establishing a detailed reference case for 2010 to underpin the present assessment.

Table A12.1 provides an overview of the reference situation (2010) of MCP operated in the EU-27 (number of plants, capacity, fuels used, emissions of SO2, NOx, and PM[43]).

It shows that the dominant fuel used in MCP is natural gas with 67% of the total fuel use (64% for 1-5 MW, 73% for 5-20 MW and 60% for 20-50 MW). Solid (biomass, coal) and liquid fuels each have a share of about 12%. In some countries the main fuel used differs significantly from the overall EU average (AMEC 2013b). It also shows that, whilst the three capacity classes are comparable in terms of total rated thermal input (40% for plants 1-5 MW, 34% for plants 5-20 MW and 26% for plants 20-50 MW), the 1-5 MW group outnumbers the other ones in terms of plant numbers (80%).

Table A12.1: Medium size combustion plants in EU-27 – reference situation 2010

Rated thermal input:	1-5 MW	5-20 MW	20-50 MW	*Total 1-50 MW*
Number of plants	113809	23868	5309	*142986*
Total rated thermal input (GW)	274	232	177	*683*
Annual fuel consumption (PJ/year):	1971	2325	1410	*5705*
Biomass	163	160	182	*505*
Other solid fuel	49	46	74	*169*
Liquid fuel	213	290	206	*709*
Natural gas	1268	1704	844	*3816*
Other gaseous fuel	277	125	104	*506*
SO_2 emissions (kt/year)	103	130	68	*301*
NO_x emissions (kt/year)	210	227	117	*554*
PM emissions (kt/year)	17	20	16	*53*

The three classes are also quite comparable in terms of emissions for the three pollutants considered. The 5-20 MW segment has the highest emissions (38-43% depending on the pollutant), closely followed by the 1-5 MW (32-38%) and the 20-50 MW (21-30%) segments. This reflects the fuel use split across capacity classes and the fact that the larger plants are more often and/or more strictly regulated at Member State level.

This is illustrated further in Figures A12.1 and A12.2.

43 Throughout this Annex, emission data concerning particulate matter is expressed as PM (particulate matter of any size). The relationship between PM and PM2.5 is complex and depends on the fuel used, the combustion technology and the abatement measures applied. For the existing stock of MCP a rough estimate is that the ratio between PM2.5 and PM is within the 30%-80% range. For the analysis presented in Chapter 7 of the Impact Assessment a factor of 50% is considered.

Figure A12.1: Number of MCP and capacity (2010)

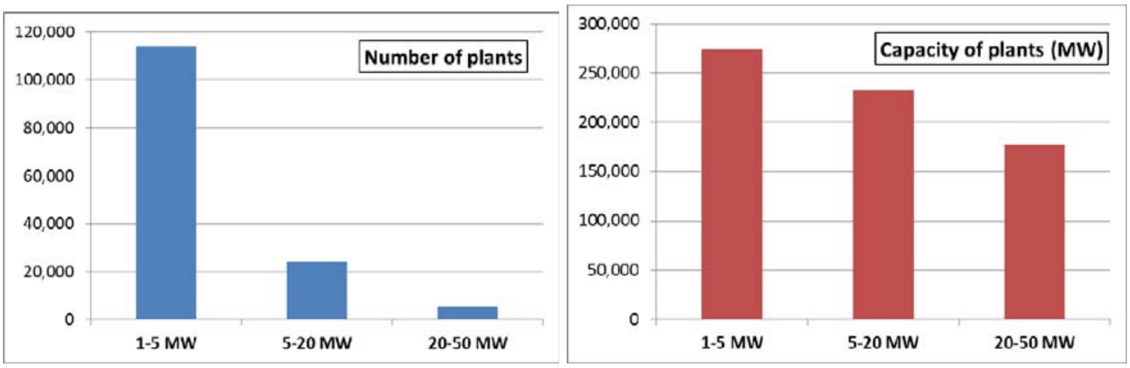


Figure A12.2 – Emissions (ktonnes/year) from MCP per capacity class for EU-27 (2010)

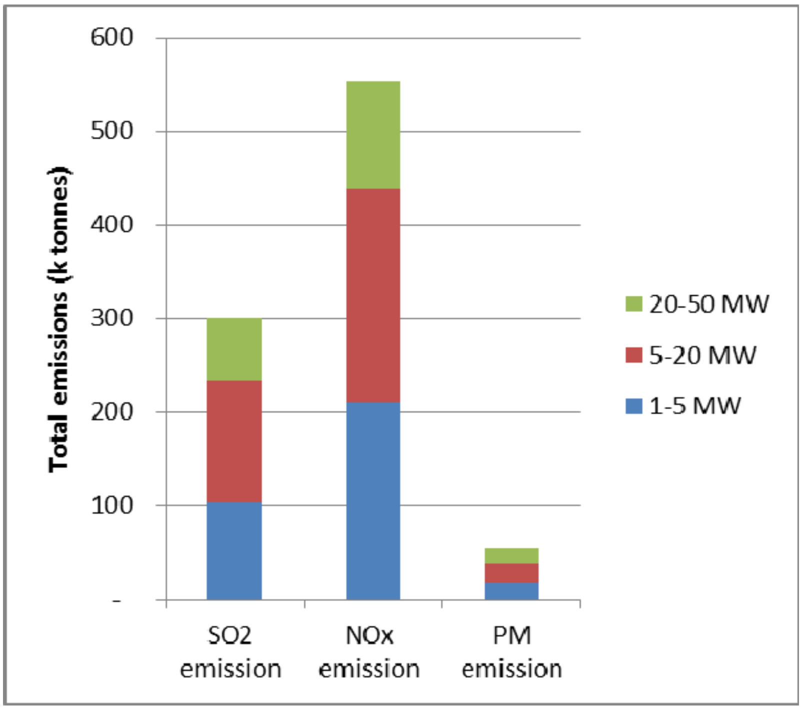


Table A12.2 provides a more detailed overview per Member State of the number of MCP and their total rated thermal input, split over the three size classes and Table A12.3 provides a similar overview of the 2010 emissions of SO_2, NOx and PM.

Table A12.2: Number of plants and capacity per Member State (2010)

	Number of plants			Total capacity (MWth)		
Size category	1-5 MW	5-20 MW	20-50 MW	1-5 MW	5-20 MW	20-50 MW
AT	2.516	441	110	5.979	5.193	3.471
BE	2.926	904	147	6.668	8.687	4.739
BG	1.670	434	73	3.968	4.136	2.305
CY	172	36	3	370	260	114
CZ	4.068	748	175	8.492	7.166	5.247
DE	35.500	3.480	767	84.354	33.170	26.227
DK	6.020	1.564	263	14.303	14.910	8.674
EE	537	174	29	1.203	1.794	1.025
EL	254	66	11	604	629	366
ES	5.811	1.510	254	13.807	14.392	8.373
FI	136	140	133	550	2.100	6.430
FR	13.399	2.951	1.600	31.839	28.124	52.744
HU	1.967	511	86	4.675	4.873	3.822
IE	1.397	363	61	3.319	3.460	2.013
IT	6.268	1.629	274	14.894	15.526	9.300
LT	889	231	39	2.112	2.202	1.281
LU	137	36	6	326	340	198
LV	641	144	28	1.926	1.898	1.157
MT	72	9	-	157	62	-
NL	6.995	2.250	110	21.000	23.000	3.700
PL	5.628	1.462	246	13.372	13.939	8.238
PT	778	202	34	1.848	1.927	1.176
RO	790	370	102	1.595	2.722	3.090
SE	916	784	198	2.749	9.405	6.913
SI	2.018	168	18	4.864	1.783	501
SK	1.986	581	91	4.223	5.114	2.695
UK	10.317	2.681	451	24.516	25.555	13.300
Total	113.809	23.868	5.309	273.714	232.367	177.099

Table A12.3: Emissions (ktonnes/year) per Member State (2010)

Emissions 2010 (kt/year)												
	1-5 MW			5-20 MW			20-50 MW			*TOTAL 1-50 MW*		
	SO2	NOx	PM	SO2	NOx	PM	SO2	NOx	PM	*SO2*	*NOx*	*PM*
AT	2.1	1.8	0.1	0.1	1.5	0.0	0.1	2.5	0.1	*2.3*	*5.9*	*0.2*
BE	5.1	15.3	1.4	6.6	19.9	1.9	3.6	10.9	1.0	*15.4*	*46.1*	*4.3*
BG	3.3	4.1	0.5	5.4	6.7	0.7	1.6	2.4	0.3	*10.3*	*13.2*	*1.6*
CY	0.6	0.1	0.6	0.4	0.1	0.3	0.5	2.0	0.0	*1.5*	*2.2*	*0.9*
CZ	1.8	1.9	0.3	1.2	2.0	0.3	4.1	2.2	0.2	*7.1*	*6.1*	*0.9*
DE	26.0	76.0	2.5	10.2	29.9	1.0	8.1	23.6	0.8	*44.3*	*129.5*	*4.3*
DK	11.5	8.5	1.5	19.1	11.3	2.0	4.5	8.8	1.2	*35.1*	*28.6*	*4.6*
EE	4.4	0.6	1.1	0.6	0.8	1.0	4.0	0.5	1.4	*9.1*	*1.8*	*3.5*
EL	0.5	0.6	0.1	0.8	1.0	0.1	0.2	0.4	0.1	*1.5*	*2.0*	*0.2*
ES	7.5	12.1	1.0	12.5	20.1	1.3	1.5	4.1	0.4	*21.5*	*36.3*	*2.6*
FI	0.6	1.7	0.2	1.8	1.9	0.3	3.7	4.4	0.3	*6.0*	*8.0*	*0.9*
FR	9.8	19.2	2.0	8.7	17.0	1.8	8.0	10.3	2.5	*26.5*	*46.5*	*6.2*
HU	1.6	2.9	0.1	2.6	4.7	0.1	2.1	2.7	0.3	*6.4*	*10.3*	*0.5*
IE	5.3	4.3	0.7	8.8	7.1	0.9	2.1	2.2	0.6	*16.2*	*13.7*	*2.2*
IT	9.4	12.9	0.8	15.6	21.5	0.9	3.7	9.1	0.7	*28.7*	*43.6*	*2.5*
LT	2.2	2.2	0.3	3.7	3.7	0.3	0.9	1.3	0.2	*6.8*	*7.3*	*0.8*
LU	0.0	0.2	0.0	0.0	0.4	0.0	0.0	0.2	0.0	*0.0*	*0.8*	*0.0*
LV	0.9	1.7	1.5	1.3	2.6	1.8	0.5	1.5	0.5	*2.7*	*5.8*	*3.7*
MT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	*0.0*	*0.1*	*0.0*
NL	0.0	8.6	0.0	0.0	11.7	0.0	0.0	1.6	0.0	*0.0*	*21.9*	*0.0*
PL	0.8	9.4	0.3	13.0	18.7	2.0	11.0	5.4	4.0	*24.8*	*33.4*	*6.2*
PT	1.7	2.4	0.5	2.9	3.9	0.8	1.0	2.6	0.4	*5.5*	*8.9*	*1.7*
RO	0.7	1.4	0.1	2.0	3.8	0.3	1.5	3.7	0.3	*4.2*	*8.8*	*0.7*
SE	0.2	1.8	0.3	2.2	5.6	0.5	0.7	3.5	0.2	*3.1*	*10.9*	*1.1*
SI	0.1	1.4	0.1	0.2	0.2	0.1	0.1	0.5	0.0	*0.4*	*2.1*	*0.3*
SK	0.1	0.7	0.2	0.2	1.1	0.1	0.2	1.2	0.1	*0.6*	*3.0*	*0.4*
UK	7.0	18.7	1.0	9.4	30.1	1.6	4.0	9.0	0.6	*20.4*	*57.8*	*3.1*
EU-27	103.3	210.5	17.2	129.6	227.3	20.0	67.6	116.7	16.2	*300.5*	*554.5*	*53.4*

Table A12.4 provides an overview of EU-27 emissions in 2010 split per fuel type. For this assessment, five different fuel types have been assumed (the same ones that have to be reported on by Member States under the LCP Directive 2001/80/EC and the IED). The category “other solid fuel” covers coal and lignite, while “gaseous fuel other than natural gas” mainly concerns biogas, which is predominantly used in Germany. It shows that different fuel groups are associated with the largest share of emissions of the three pollutants concerned: SO_2 emissions are mainly related to the use of liquid fuels (some 62%), NOx emissions are strongly associated with natural gas firing and PM emissions are highest from biomass firing, in particular for the smaller combustion plants (up to 20 MW).

Table A12.4: Emissions per fuel type for EU-27 (2010) (ktonnes per year)

Emissions 2010 (kt/year) per fuel type						
EU-27	BIOMASS	OTHER SOLID FUEL	LIQUID FUEL	NATURAL GAS	GASEOUS FUEL OTHER THAN NATURAL GAS	*TOTAL*
Capacity class	SO2					
1-5 MW	13.8	16.8	64.5	-	8.1	*103.3*
5-20 MW	8.7	26.1	91.2	-	3.5	*129.6*
20-50 MW	10.4	21.7	30.4	-	5.1	*67.6*
TOTAL 1-50 MW	*33.0*	*64.7*	*186.1*	*-*	*16.7*	*300.5*
	NOx					
1-5 MW	22.6	11.7	21.5	134.4	20.1	*210.5*
5-20 MW	17.4	7.5	30.1	163.7	8.7	*227.3*
20-50 MW	14.7	9.1	13.6	72.8	6.6	*116.7*
TOTAL 1-50 MW	*54.7*	*28.3*	*65.2*	*370.9*	*35.4*	*554.5*
	PM					
1-5 MW	7.7	2.3	7.2	-	-	*17.2*
5-20 MW	8.3	4.0	7.8	-	-	*20.0*
20-50 MW	4.4	5.5	6.2	-	-	*16.2*
TOTAL 1-50 MW	*20.4*	*11.8*	*21.2*	*-*	*-*	*53.4*

2.4. Overview of current regulation

2.4.1. EU legislation

Currently, there is no EU legislation specifically addressing air emissions of polluting substances from combustion plants between 1 and 50 MW except for the cases set out below.

As mentioned, combustion units with a rated thermal input less than 50 MW may already be regulated under Directive 2010/75/EU on industrial emissions (IED) as part of installations where the combustion is a directly associated activity with a technical connection to the IED activity as well as where the total on-site combustion capacity is exceeding 50 MW. In those cases, the installation has to be operated in accordance with a permit issued by the competent authorities in the Member States, which contains conditions including emission limit values or equivalent provisions for the key polluting substances that are emitted, as well as monitoring requirements. These conditions have to be based on the application of the best available techniques (BAT).

Data was collected from Member States to identify the share of MCP that are part of IED installations. Although it is apparent that this may be the case for a greater proportion of 20-50 MW combustion plants compared to plants below 20 MW, the available information was not sufficiently robust to allow a quantitative estimate of the proportions per Member State.

A rough estimate is that 5% of plants in the 1-5 MW class, 10% of plants in the 5-20 MW class and 40% of plants in the 20-50 MW class are part of IED installations and, therefore, subject to the obligation to be covered by a BAT-based permit.

Council Directive 1999/32/EC of 26 April 1999 relating to a reduction in the sulphur content of certain liquid fuels[44] requires Member States to ensure that heavy fuel oils are not used within their territory if their sulphur content exceeds 1% by mass. Until 31 December 2015, heavy fuel oils having a higher sulphur content may be used under certain conditions in combustion plants which do not fall under Directive 2001/80/EC (Large Combustion Plant Directive) when their monthly average SO_2 emissions do not exceed 1 700 mg/Nm³ (3% reference oxygen content)[45]. As from 1 January 2016, the same exemption applies under the abovementioned conditions for heavy fuel oils burned in combustion plants which do not fall within the scope of Chapter III of IED. In practice this means that SO_2 emissions from liquid fuel fired medium size combustion plants shall not be higher than 1 700 mg/Nm³. This Directive also sets a limit of 0,1% by mass for the sulphur content of gas oil.

2.4.2. Gothenburg Protocol

The Protocol to abate acidification, eutrophication and ground-level ozone (Gothenburg Protocol) was adopted in 1999 by the Parties to the Convention on Long-Range Transboundary Air Pollution (CLRTAP).[46] It entered into force in 2005 and sets emission ceilings for 2010 for four air pollutants: sulphur, nitrogen oxides, volatile organic compounds and ammonia. It also sets emission limit values for the key source categories (stationary, mobile and products). The Gothenburg Protocol was amended in 2012 to include national emission reduction commitments to be achieved in 2020 and beyond (See also Chapter 3 and Annex 4). Several of the annexes containing emission limit values to be adhered to by Parties were revised with updated sets of emission limit values and emission ceilings for fine particulate matter were added. The source-related annexes mostly cover combustion plants over 50 MW, but for some categories the threshold is lower than 50 MW. Annexes which are relevant to MCP can be summarised as follows:

- Annex IV: limit for sulphur content of gas oil: <0.1% by January 2008 (transposed in EU legislation via Directive 1999/32/EC, see above);
- Annex V (NOx): limit values for new stationary engines (gas engines and dual fuel engines greater than 1MW and diesel engines greater than 5MW) : limits vary between 95 and 225 mg/Nm³ (15% O_2) depending on the engine type and fuel used; exemptions may be granted for plants running less than 500 hours per year or plants used in particular local conditions;
- Annex X (dust[47]): non-binding emission levels for solid and liquid fuel fired boilers and process heaters between 1 and 50 MW: these levels vary between 20

[44] OJ L 121, 11.5.1999, p. 13, as last amended by Directive 2012/33/EU of the European Parliament and of the Council of 21 November 2012 (OJ L 327, 27.11.2012, p.1)

[45] 1700 mg/Nm³ represents the maximum emission level that would result from firing heavy fuel oil containing 1% sulphur (unabated emissions).

[46] http://www.unece.org/env/lrtap/multi_h1.html

[47] "dust" is a term used in Annex X, Part A of the Gothenburg Protocol (as amended in 2012) in the context of particular matter emissions, with the following explanation given: "In this section only, "dust" (…) means the

and 50 mg/Nm³ depending on the size and plant age (at various reference oxygen contents, depending on the fuel type).

Compliance with the emission limit values is not the only compliance option for Parties. Alternatively '*different emission reduction strategies that achieve equivalent overall emission levels for all source categories together*' may be applied. The Protocol nevertheless requires that, '*Each Party should apply best available techniques (…) to each stationary source covered by [the] annexes[…] , and, as it considers appropriate, measures to control black carbon as a component of particulate matter[…]. .*

2.4.3. Member States' national legislation

Several Member States have already taken action to reduce air pollution from MCPs in view of meeting present air quality standards and emission ceilings. From earlier information gathering it was clear that the emission limits applied nationally (or regionally) differed significantly across Member States. Some Member States have recently revised their legislation thereby establishing more stringent limit values for MCP.

Table A12.5 summarises the most recently information gathered on Member States' national legislation regulating combustion plants below 50 MW. It shows that at least 15 Member States are regulating all or part of the MCP, through a permit, emission limit values and/or monitoring requirements. In addition, some Member States set permit conditions for these plants on a case-by-case basis.[48]

mass of particles, of any shape, structure or density, dispersed in the gas phase at the sampling point conditions which may be collected by filtration under specified conditions after representative sampling of the gas to be analysed, and which remain upstream of the filter and on the filter after drying under specified conditions." Hence, the term is equivalent with the term "PM" used elsewhere in this Annex.

[48] No information was obtained for Bulgaria, Croatia, Denmark, Greece, Hungary, Italy, Latvia, Lithuania, Luxembourg and Malta.

Table A12.5: Overview of national legislation regulating combustion plants below 50 MW

MS	Legislation	Permitting	Emission limits	Monitoring obligations
AT	BGBI.II Nr. 312/2011 concerning furnaces which are not steam boilers BGBI Nr.19/1989 idf. BGBL. II Nr. 153/2011 concerning steam boilers and gas turbines <50 MW.	No	✓	✓
BE/ FL	VLAREM II (Order of the Flemish Government of 1 June 1995 concerning General and Sectoral provisions relating to Environmental Safety).	✓	✓	✓
BE / WA	Unknown reference	Unknown	✓	✓
CY	The Control of Atmospheric Pollution (Non Licensable Installations) Regulation of 2004 (P.I. 170/2004)» as amended in 2008 by Regulations of 2008 (P.I. 198/2008)	No	✓	✓
CZ	Government Ordinance No. 146/2007 Coll. In wording No. 476/2009 Coll. (ELVs) Decree No. 205/2009 Coll. In wording No. 17/2010 Coll. (Monitoring)	No	✓	✓
EE	Välisõhu kaitse seadus, Vastu võetud 05.05.2004 RT I 2004, 43, 298 (ambient air protection act)	✓	✓ (permit specific)	✓ (permit specific)
FI	Environmental Protection Act Government Decree on environmental protection requirements for energy production installations with a total fuel capacity < 50 MW	✓	✓	Unknown
FR	Inspection des Installations Classées (Permitting – separate regimes for 2-20MW and 20-50MW) NOR: ATEP9760321A Version consolidée du 15/12/2008 (ELVs 2-20MW) ELVs for >20MW (various regulations, depending on age of plant)	✓	✓	✓
DE	(Verordnung über kleine und mittlere Feuerungsanlagen - 1. BImSchV (ELVs) Technical Instructions on Air Quality Control – TA Luft (24 July 2002) (Monitoring)	✓	✓	✓
IE	Air Pollution Act 1987 (IPPC related activities)	Only for IPPC related activities		
NL	BEES-B (Existing installations <50MW_{th}) BEMS (New installations and existing installations from 2017 on)	✓	✓ (general binding rules)	✓
PL	Environmental Protection Law (Permits) Emission standards regulation (ELVs for 1-50MW_{th}) Rozporzñdzenie Ministra Ârodowiska (Monitoring)	Not required	✓	✓
PT	Decree-Law 78/2004[49] Ordinance 675/2009[50]	✓	✓	✓
RO	Ministerial Order no 1798/2007 for the approval of the procedure of issuing the environmental permit ELVs in accordance with Ministerial Order no. 462/1993 – Technical conditions regarding air protection, Annex 2	✓	✓	✓
SK	References unknown	✓	✓	✓
SI	UREDBO o emisiji snovi v zrak iz malih in srednjih kurilnih naprav	✓	✓	✓

49 http://dre.pt/pdf1s/2004/04/080A00/21362149.pdf
50 http://dre.pt/pdf1sdip/2009/06/11900/0410804111.pdf

MS	Legislation	Permitting	Emission limits	Monitoring obligations
SE	Permit conditions for plants are set on a case-by-case basis.	Unknown	Case-by-case basis	?
ES	ELVs are set by Autonomous Communities. General binding rules do not exist.	X	X	X
UK	Environmental Permitting, England and Wales (2010) – Part B Regulations apply to boilers 20-50MW_{th}	✓ (>20MW)	✓ (>20MW)	✓ (>20MW)

3. POLICY OPTIONS

Based on the needs defined as part of the central impact and emission reduction case in chapter 6 and the developed insights of the MCP sector as well as stakeholder inputs (also reported in in the main impact assessment), a set of policy options have been identified. These have been defined in terms of the emission levels hat would be set and the regulatory procedures that would be followed.

3.1. Options determining the emission levels

Five policy options have been considered that differ in environmental emission level for reducing the emissions of SO_2, NOx and PM from MCPs:

- **Emission level option 1: no EU action**
  This default option assumes continuation of current policy measures at Member State level and no further measures for controlling emissions of SO_2, NOx or PM from MCP in the EU. It serves as a reference to calculate the impacts of the other policy options.
- **Emission level option 7A: "most stringent MS"**
  Under option 7A, EU wide emission limit values for SO_2, NOx and PM are set for all MCP (both new and existing) at the level of the most stringent legislation which is currently applicable in Member States for existing plants (for each of the fuel types and size classes considered).
- **Emission level option 7B: "LCP"**
  Option 7B is the application of the EU wide ELVs for all MCP (both new and existing) which are set out in the IED for existing combustion plants with a rated thermal input between 50 and 100 MW (Part 1 of Annex V of the IED).
- **Emission level option 7C: "primary NOx"**
  A variation of the option 7B, affecting only NOx, such that the only abatement measures required to be taken up for NOx would be combustion modifications (primary measures) and no secondary (end-of-pipe) measures. For SO_2 and PM the emission levels under this option are the same as for option B.
- **Emission level option 7D: "Gothenburg"**
  Option 7D is a variant of option 7C, whereby EU wide ELVs for NOx, SO2 and PM are differentiated for new and existing plants. It has been designed following analysis of previous options and to consider possible additional lower cost options (see section 3.3.5 on mitigation measures). It takes into account (i) that a longer application deadline could be set for existing plants than new plants (e.g. ELVs enter into force in 2022 for existing plants instead of 2018 when it would apply for new plants); (ii) that MCPs operating a limited amount of hours (less than 300

hours/year) are exempted from complying with the ELVs for all the pollutants to avoid excessive costs for minimal benefit, (iii) that secondary abatement measures for NOx will be cheaper to implement in new built plants as compared to retrofitting existing stock (see section 3.1.2); (iv) the need to align ELVs with those set out in the amended Gothenburg Protocol.

- **Emission level option 7E: "SULES"**
  Option 7E is a variation of option 7D, where the ELVs for new plants have been set according to the existing or future applicable ELVs for most stringent Member States.

A summary of the emission values corresponding to the above described assumptions and used for assessing the impacts of the different options is given in Appendix 12.1.

3.2. Regulatory options

Apart from the emission level options set out in section 2.1, which determine the environmental outcome, four different regulatory options have been considered and assessed. They vary mainly in terms of the administrative approach (and cost) through which MCP would be regulated, in particular whether or not a permit would be required.

- **Regulatory option R1: "integrated permit"**
  Under this option derived from the IPPC permitting regime, the operators of the combustion plants would be required to obtain an integrated permit issued by competent authorities in the Member States for operating the plant. This permit would cover all relevant environmental impacts of the plant's operation. In addition to the EU-wide emission limit values for emissions of SO2, NOx and PM to air the permit may also, where relevant, set conditions concerning emissions to water and soil, as well as for energy use and waste generation. The public would have a right to participate in the decision-making process and this is also taken into account for the assessment.

- **Regulatory option R2: "air emissions permit"**
  Under this option, the operators of the combustion plants would be required to obtain a permit issued by competent authorities in the Member States, which would cover only emissions to air coming from the plant's operation. In addition to the EU-wide emission limit values for SO2, NOx and PM, the permit would also set the associated requirements for monitoring and reporting.

- **Regulatory option R3: "registration"**
  Under this option, combustion plant operators would have to notify operation of the MCP (and the key administrative and technical information) for registration by the competent authorities in the Member States. The authorities would keep a register of the notified plants. The plants would be subject to the EU-wide emission limit values and monitoring requirements for SO2, NOx and PM.

- **Regulatory option R4: "general binding rules"**
  Under this option, MCP operators would not be obliged to obtain a permit, nor to notify competent authorities. Plants would be subject to the EU-wide emission limit values for SO2, NOx and PM to air and associated monitoring requirements.

The requirement under options R1 and R2 for each plant to have a permit would allow the consideration of the need for stricter conditions in order to ensure compliance with local air quality standards. In contrast with option R4 option R3 would allow mapping emissions of medium size plant and therefore improve knowledge and emission inventories, which would not be possible with option R4.

4. IMPACT ANALYSIS

4.1. Methodology, assumptions and uncertainties

4.1.1. Main methodology

The environmental, economic and social impacts of the options described in the previous section have been assessed on the basis of both quantitative and qualitative analysis. Impacts under emission level options 7A-7E were compared to those under option 1 (no EU action). For the administrative costs, the impacts of the regulatory approaches R1 to R4 were considered.

Emission reductions (reflecting environmental benefits), compliance costs (implementation of emission abatement measures), emission monitoring costs and administrative costs were calculated through a bottom-up modelling, using the database referred to in section 1.2 and described in more detail in the following sections.

The assessment of the abatement measures uptake, annualised compliance costs and emission reductions has been performed separately for the three capacity classes (1-5, 5-20 and 20-50 MW) to reflect differences in emission levels and abatement measures applied. The emissions and costs have been estimated on the basis of the information gathered for the reference year 2010, projecting forward to 2025 and 2030. These 2025 and 2030 forecasts have been estimated by scaling the 2010 results by Member State, using fuel type specific growth factors, which were developed using PRIMES 2012 data on fuel consumption. The total fuel consumed across all of the sectors of interest for MCP has been calculated for each Member State by fuel type. The growth factor is calculated as the difference between the fuel consumption in the projection year (2025 or 2030) and the reference year (2010). The factor can be negative as the fuel consumption projections incorporate projected improvements in efficiency and turn-over of plants. Fuel consumption by MCP has been assumed to change in direct proportion to changes in fuel consumption for the relevant sectors as a whole within the Member State.

Impacts for options 7A, 7B and 7C were calculated for both the years 2025 and 2030[51]. It is however generally noted that the trends for both years are very similar, with emissions and costs either the same or just a few per cent lower in 2030 as compared to 2025. These differences are primarily related to changes in activity[52] as the ELVs are not differentiated for new and existing plants, For options 7D and 7E impacts have been calculated for 2025 only but some differences are expected for 2030 as some of the ELVs for new plants are tighter than those for existing plants (and there will be a greater proportion of new plants in 2030 compared to 2025). Differences between 2025 and 2030 for option 7D are expected to be relatively minor as differences in costs will be mostly due to new engines and turbines - in 2030 they would represent about 3.4% of the total plants. The difference is expected to be much more pronounced for option 7E where variations between the ELVs applied for new and existing plants are large.

[51] The analysis had been conducted under the assumption that all plants operated will comply with the EU wide ELVs set under the options at the time of the projection year (either 2025 or 2030)

[52] Annex 5 of the Impact Assessment 'Detail description of Future air quality projections Assuming No Change in Current Policies'.

To avoid over complexity and to ease the comparison of options, only the results for 2025 will be presented and discussed, the full set of results obtained (for both the years 2025 and 2030) are reported in Appendices 12.2 and 12.3.

The bottom-up approach used for calculating the potential emission reductions and associated costs for MCP relies on an installation dataset (number of plants, fuels used, emissions, legislation in place) built up from Member State data and subsequently gap-filled, on literature data and expert judgement for applicable control measures and associated compliance costs. Inevitably, this involves a number of uncertainties and limitations, in particular concerning the input data and the modelling applied.

4.1.2. *Uncertainties with respect to input data*

The principal points to note concerning the installation dataset are the following:

- Greater uncertainty is associated with the data for smaller capacity classes due to their reliance on a greater proportion of extrapolation;
- Estimates for some of the larger Member States could have a disproportionate effect on the overall EU figures;
- Very limited information has been provided on sectoral breakdown and technology split and so for many Member States an average split had to be applied;
- Certain similar abatement techniques were combined into one group (e.g. different types of combustion modification).

4.1.3. *Modelling assumptions*

The approach for projecting emission reductions and costs was based on the current estimated plant stock (numbers, capacity, emissions etc.) dataset and then projected forward to 2025/2030 using PRIMES 2012 fuel consumption and activity data. The modelling further included the following assumptions:

Option 1 takes into account current legislation in each Member States. This option has been refined in the course of the assessment when modelling options 7D and 7E for 2025, to better take into account future emission limit values that have already been adopted by certain Member States. As a result, the compliance costs for options 7A, 7B and 7C may be slightly overstated for some Member States.

Control measures already implemented by Member States under their current legislation have been included under option 1. It is not necessarily the case that all of the combustion plants which are part of IED installations and hence should be covered by an integrated permit are already subject to such legislation. Although it may be expected that emission limits will already have been set in the permits for those plants, it could not be generally assessed at what level those limits would be set, except where national law is prescribing the limits (see section 1.4). Hence, only where such a limit was explicitly prescribed, MCP which are part of IED installations are assumed to be covered by it already. As a result, the overall costs and benefits associated with the policy options may be overstated for some Member States.

The administrative cost assessment assumes a static number of plants from 2010 until 2030 in the absence of any data on how this may change (total fuel consumption decreases by 13% over this period using the PRIMES 2012 data for combustion overall but this has been assumed to be related to energy efficiency improvements rather than a decline in plant numbers). Some Member States have reported that they expect the number of smaller plants to increase as there is a push for more decentralised heat and power supply. This could lead to an underestimation of the potential administrative costs.

In emission level options 7D and 7E new and existing plants have been modelled separately taking into account the ELVs that apply for each in the Member States in relation to national law (where available). In the calculations an average plant lifetime of 30 years has been assumed, corresponding to annual replacement rate (plant turnover) of 3.3%. The analysis assumes that the ELVs would apply to new plants from 2018 and to existing plants from 2022; the longer lead time for existing plant would allow planning any necessary upgrades within the normal investment cycle. In 2025 it is assumed that approximately 27% of plants in the EU would be new and have to meet the ELVs specified for new plants. The model considers that measures on new plants are 40% cheaper than measures on existing plants (retrofitting) for secondary (end-of-pipe) measures, and 60% for primary measures.

Options 7D and 7E take into account exemptions for plants operating less than 300 hours/year. This results in a reduction in costs in equal proportion (17,5%), while emissions are estimated to increase by only 1% due to the low number of operating hours (see details in section 3.3.6 on mitigation measures).

4.2. Environmental impacts

For each of the options 7A-7E, the emission reductions for SO_2, NO_x and PM in 2025 were assessed compared to "no EU action".

4.2.1. *SO2 emissions*

Table A12.6 presents the SO_2 emission forecasts for 2025. Without further EU action, SO_2 emissions of MCP are projected to decrease by 127 ktonnes (42%) due to changes in fuel mix (shift from coal to biomass) and activity. Under all the options 7A-7E total additional SO_2 emission reductions in 2025 (in comparison with option 1) are all very similar, ranging from 127 to 139 ktonnes.

Table A12.6: SO2 emissions (kt/year)

Emission level option:	2010	1: no EU action	7A: most stringent MS	7B: LCP and 7C: Primary NOx	7D: Gothenburg	7E: SULES
1-5 MW	103	58	**9**	**13**	**13**	**11**
5-20 MW	130	67	**12**	**17**	**13**	**12**
20-50 MW	68	49	**14**	**17**	**14**	**13**
TOTAL 1-50 MW	301	174	**35**	**47**	**39**	**37**
*Total emission **reduction** compared to "no EU action"*			***139***	***127***	***135***	***137***

4.2.2. *NOX emissions*

Table A12.7 presents the NO_X emission forecasts for 2025. Without further EU action, NO_X emissions of MCP are projected to decrease by 99 ktonnes (18%) due to changes in fuel mix and activity. In comparison with option 1, option 7B would further reduce emission by 303 ktonnes and under option 7A, the additional reduction would even be 338 ktonnes (i.e. 74% of 2025 emissions without EU action). When only primary NOx measures would be required (option 7C), the emission reduction compared to option 1 would be limited to 76 ktonnes (i.e. 17% of 2025 emissions without EU action). Differentiating measures between new and existing plants as under option 7D would reduce emissions by 107 ktonnes compared to a 'no EU action' scenario, while with option 7E reductions of 159 ktonnes are achieved.

Table A12.7: NOx emissions (kt/year)

Emission level option:	**2010**	**1: no EU action**	**7A: most stringent MS**	**7B: LCP**	**7C: primary NOx**	**7D: Gothenburg**	**7E: SULES**
1-5 MW	210	170	**46**	**63**	**140**	**131**	**112**
5-20 MW	227	188	**47**	**62**	**149**	**140**	**119**
20-50 MW	117	98	**24**	**42**	**90**	**78**	**66**
TOTAL 1-50 MW	554	455	**117**	**167**	**379**	**348**	**297**
Total emission ***reduction*** *compared to "no EU action"*			***338***	***288***	***76***	***107***	***159***

4.2.3. *PM emissions*

Table A12.8 presents the PM emission forecasts for 2025. Without further EU action, PM emissions are projected to decrease by a mere 5 ktonnes by 2025, due to changes in fuel mix (reduction in coal use is neutralised by increase in biomass use) and activity. As for SO_2, total additional PM emission reductions achieved by all options 7A-7E in comparison with option 1 are all very similar, ranging from 42 to 45 ktonnes.

Table A12.8: PM emissions (kt/year)

Emission level option:	**2010**	**1: no EU action**	**7A: most stringent MS**	**7B: LCP and 7C: Primary NOx**	**7D: Gothenburg**	**7E: SULES**
1-5 MW	17	13	**1**	**2**	**1**	**1**
5-20 MW	20	20	**1**	**2**	**1**	**1**
20-50 MW	16	14	**1**	**2**	**1**	**1**
TOTAL 1-50 MW	53	48	**3**	**6**	**3**	**3**
Total emission ***reduction*** *compared to "no EU action"*			***45***	***42***	***45***	**45**

4.2.4. *Overview of pollutant abatement achieved by the emission level options*

The table below show a summary of emission reductions achieved in the various abatement level options. It shows that the highest emission reductions -compared to the baseline Option 1- would be achieved for all pollutants under emission level option 7A. While reductions for PM and SO_2 do not substantially differ in the various options, NOx reductions vary considerably. Option 7C would deliver the least reductions for NOx, albeit still in the order of 76 kilotons/year. Option 7D reduces NOx emissions much less than options 7A and 7B but still very significantly: 107 kilotons/year. The additional 20 kilotons/year reduction of option 7D compared to option 7C is due to the stricter ELVs set for new combustion plants, in particular for engines and turbines to comply with the Gothenburg requirements. Option 7E delivers a total NOx reduction of 159 kilotons/year, where additional reduction compared to option 7D are achieved thanks to more stringent NOx emission limit values for new plants.

Emission reduction (kt/y)	2025				
Option:	**7A**	**7B**	**7C**	**7D**	**7E**
SO2	139	127	127	135	137
NOx	338	288	76	107	159
PM	45	42	42	45	45

4.3. Economic impacts

4.3.1. *Compliance costs*

To estimate the compliance costs due to the introduction of EU wide emission limit values as under options 7A-7E it was assessed whether additional abatement measures would have to be implemented within the combustion plants concerned compared to the situation without EU action. A set of compliance costs was developed for implementing a range of the most pertinent and applicable abatement measures on the basis of literature data available (Amec, 2013 and references therein). Capital and operational costs have been annualised using default values of a 4% discount rate and an annualisation period of 15 years. A model was applied to automatically identify which abatement measure would be required to achieve the emission levels defined under the different options.

Total costs per Member State were derived from the cost per plant multiplied by the number of plants for each fuel type. The number of plants per fuel type in a Member State was estimated using the percentage fuel mix applied to the total number of plants. When calculating total compliance costs per Member State, account has been taken of the extent to which emissions from medium combustion plants are already regulated under national legislation currently in place. Table A12.9 presents a summary of the average total compliance costs for EU 27 for options 7A-7E for the year 2025.

Table A12.9: Overview of incremental annualised compliance costs (€m/year)

Pollutant	Emission level option:	7A: most stringent MS	7B: LCP	7C: primary NOx	7D: Gothenburg	7E: SULES
SO_2	1-5 MW	210	90	90	83	100
	5-20 MW	123	68	68	72	80
	20-50 MW	44	27	27	28	30
	TOTAL 1-50 MW	377	185	185	183	210
NO_X	1-5 MW	1119	821	27	36	187
	5-20 MW	1018	785	18	35	178
	20-50 MW	543	311	3	12	91
	TOTAL 1-50 MW	2680	1,918	48	83	456
PM	1-5 MW	84	55	55	46	46
	5-20 MW	77	41	41	42	45
	20-50 MW	77	27	27	28	35
	TOTAL 1-50 MW	238	123	123	116	126
TOTAL	1-5 MW	1413	966	171	165	332
	5-20 MW	1218	895	127	149	302
	20-50 MW	665	365	57	68	156
	TOTAL 1-50 MW	3296	2226	355	382	790

The table shows that most of the compliance costs under options 7A and 7B are associated with NOx abatement, something that is indeed also reflected also in option 7E, where stringent NOx ELVs are set for new plants.

Option 7C requires combustion modifications but no secondary NOx measures, resulting in drastically lower compliance costs (around 10% of option 7A). The low costs are kept also under option 7D. In this case total compliance costs are only 2% higher than in emission level option 7C and about 12% of the costs under option 7A.

Table A12.10 provides more detail on the distribution of abatement costs between new and existing plants for the different combustion plant types, as studied in options 7D and 7E.

It can be seen that compliance costs for NOx in emission level option 7D are 83M€/year, of which about half of them allocated to new engines and turbines, in particular for the two categories 1-5MW and 5-20MW. Compliance costs for NOx in emission level option 7E rise to 456M€/year, most of them allocated to new boilers, in particular for the two categories 1-5MW and 5-20MW.

In option 7D cost associated to new boilers (7M€) are assumed to be half of those to retrofit existing boilers (13M€). Costs for new engines and turbines (47M€) where secondary measures are taken to comply with Gothenburg requirements are three times higher than for existing engines and turbines where no secondary measures would be required (16M€). In option 7E costs for new boilers are much higher than the one for existing boilers, due the more stringent emission limit values applied.

Table A12.10: Detailed overview of annualised compliance costs for NOx under options 7D and 7E (€m/year)

Figures rounded for presentation purposes (this might lead to minor differences in the totals)

Annualised compliance costs for NOx (€m/year)	Category	New boilers	Existing Boilers	New engines and turbines	Existing engines and turbines	TOTAL
Option 7D: Gothenburg	1-5 MW	3	6	19	7	36
	5-20 MW	2	6	21	7	35
	20-50 MW	1	2	7	2	12
	TOTAL 1-50 MW	**7**	**13**	**47**	**16**	**83**
Option 7E: SULE	1-5 MW	148	6	26	7	187
	5-20 MW	138	6	28	7	178
	20-50 MW	73	2	15	2	91
	TOTAL 1-50 MW	**359**	**13**	**68**	**16**	**456**

For comparison the compliance costs for NOx abatement per new plants in emission level options 7D and 7E are reported in Table A12.11.

Table A12.11: Annualised compliance costs for NOx for new plants under options 7D and 7E (€/plant)

	New boilers		New engines and turbines	
Emission level option	**7D**	**7E**	**7D**	**7E**
1-5 MW	140	6000	3100	4200
5-20 MW	440	26800	16000	21700
20-50 MW	1,10	63700	25100	52300
TOTAL 1-50 MW	225	11600	6000	8800

Compliance costs per Member State per emission level option 7D are reported in the tables of Appendix 12.4.

4.3.2. *Emission monitoring costs*

The introduction of emission limits for MCP also requires setting emission monitoring requirements, which allow verifying compliance with those limits. This involves either the use of on-site monitoring equipment (in case of continuous monitoring) or periodic monitoring by qualified experts using certified monitoring equipment and appropriate standardised sampling, measurement and analytical methods.

Based on a review of available information from existing national legislation as well as the IED requirements for 50-100 MW combustion plants, only periodic monitoring was assumed to be a reasonable option as the costs of continuous monitoring are considered prohibitively high.

The costs of a single emission monitoring campaign are summarised in the Table A12.12.

For this assessment, the monitoring frequency applied for combustion plants in the range 1-20 MW was once per three years and for combustion plants between 20 and 50 MW it was once per year. The resulting total annualised costs for operators are also reported in Table A12.12

Table A12.12: Costs of emission monitoring (NOx, SO2 and PM) –per monitoring event and total annualised costs

Costs for operators	Per monitoring event * (€)	Annualised costs (m€/year)
20-50 MW	7200	4
5-20 MW	4100	6
1-5 MW	2400	15

* For natural gas fired plants only NOx monitoring would be required and costs per monitoring event are assumed to be only 50% of the above mentioned costs.

4.3.3. *Administrative costs*

As described in section 2, MCP can be regulated in different manners in order to ensure that the emission limit values imposed are implemented and complied with. The different regulatory options R1 to R2 differ in the way the administrative procedures for regulating the plants (or broader installations) are set up and hence will result in different administrative costs for both the operators and authorities involved.

Regulatory options R1 and R2

For assessing the administrative costs of those options, the following elements have been considered:

Cost of bringing installations under the regulation: a one-off cost when a permit is granted:

- operators: costs incurred in understanding the legal requirements, preparing applications, responding to requests for information from regulators, etc;
- authorities: costs of producing application materials, consulting the public, determining the application, etc;

Cost of periodic reconsideration of permits: one-off cost when permit is reconsidered;

Ongoing subsistence costs:

- operators: administrative costs (i.e. non-technical) of providing monitoring reports, accommodating site visits by inspectors, reporting changes in operation, etc;
- authorities: costs of checking compliance, maintaining systems to make information available to the public, updating permit conditions (without amounting to a full reconsideration of the permit), etc;

Soil and groundwater baseline survey: one-off cost at the point of applying for a permit (noting that under this option an integrated approach would apply and not only air emissions would be regulated).

A summary of costs applied for calculating these administrative costs in option R1 is provided in Table 12.13. For the costs of bringing installations under the regulation, periodic reconsideration of permits and annual subsistence costs, these figures are mainly based on the information given in Annex 8 of the European Commission's Impact Assessment for the Proposal for a Directive on industrial emissions[53]. The cost data presented in that impact assessment have been uplifted to 2012 prices from assumed 2006 price levels.

For option R2, where only air emissions are regulated, administrative costs related to other environmental media (e.g. cost for soil & groundwater baseline survey, in Table 12.13) do not occur and have been excluded. As in this option no public participation is foreseen the costs for authorities, presented in Table A12.13, have been reduced by 25% in the calculations.

[53] SEC(2007) 1679.

Table A12.13: Elements of administrative costs under regulatory Option R1 (Integrated permit) and Option R2 (Emission permit)

		(€ per installation unless stated)
Cost of bringing installations under the regulation (one-off)		
Cost for operators	20-50 MW	23200
	5-20 MW	18500
	1-5 MW	13900
Cost for authorities	20-50 MW	10900
	5-20 MW	8800
	1-5 MW	6600
Cost of periodic reconsideration of permits (one-off)		
Cost for operators	20-50 MW	2900
	5-20 MW	2300
	1-5 MW	1700
Cost for authorities	20-50 MW	5800
	5-20 MW	4600
	1-5 MW	3500
Annual subsistence costs (ongoing)		
Cost for operators	20-50 MW	3500
	5-20 MW	2800
	1-5 MW	2100
Cost for authorities	20-50 MW	6900
	5-20 MW	5600
	1-5 MW	4200
Soil & groundwater baseline survey (only option R1)		
Cost for operators	All	4400 per survey

Regulatory options R3 and R4

Under regulatory options R3 and R4, plant operators would not need to apply for, and maintain, a permit. Therefore, no administrative costs are associated with permit application and reconsideration. Furthermore, as only air emissions would be regulated under these options, administrative costs related to other environmental media would not occur. However, given that notification and some form of periodic emission monitoring would be required, administrative costs associated with preparing, reporting and reviewing of the monitoring reports would be borne by operators and authorities. Therefore for assessing the administrative costs of these options only on-going subsistence costs have been considered. A summary of the cost figures applied under option R3 is given in Table A12.14. These figures are mainly based on the information given in Annex 8 of the European Commission’s Impact Assessment for the Proposal for a Directive on industrial emissions.

For option R4, where no notification or register is kept by authorities, the costs have been reduced by 25% with respect to option R3.

Table A12.14: Regulatory option R3 (Registration) and R4 (General binding rules): elements of administrative costs

		Option R3 (€ per installation)	Option R4 (€ per installation)
Annual Subsistence Costs (on-going)			
Cost for operators	20-50 MW	1800	1350
	5-20 MW	1000	750
	1-5 MW	400	300
Cost for authorities	20-50 MW	2700	2025
	5-20 MW	1400	1050
	1-5 MW	500	375

Total administrative costs

When calculating total administrative costs per Member State based on the above mentioned costs per plant, account has been taken of the extent to which those plants would already be covered by permitting or monitoring regimes under national legislation currently in place. This approach is summarised in Table A12.15. The one-time costs of bringing installations under the regulation, periodic reconsideration of permits and the soil and groundwater baseline survey have been annualised over 20 years.

Table A12.15: Different components of administrative costs included in the assessment

Should the following administrative costs be applied?	No national legislation in place	National legislation in place		Plants which are part of IED installations
		With permitting	Without permitting	
Reg. Option R1 and R2 (Permitting)				
Permit Application Costs	Yes 100% option R1 75% option R2	No	Yes[1] 50% option R1 38% option R2	No
Permit Revision Costs	No	Yes 100% option R1 75% option R2	No	Yes 100% option R1 75% option R2
Annual Subsistence Costs under a Permitting Regime	Yes 100% option R1 75% option R2	No	Yes[1] 50% option R1 38% option R2	No
Soil & groundwater baseline survey	Yes for option R1 No for option R2	Yes for option R1 No for option R2	Yes for option R1 No for option R2	No
Reg. Option R3 and R4 (without permitting)				
Annual subsistence costs	Yes 100% option R3 75% option R4	No	No	No

Note [1]: For Member States with national legislation without permitting, permit application costs and subsistence costs under Regulatory Options R1 and R2 were assumed to be 50% less compared to Member States without national legislation. This is taking into consideration that operators and authorities in these Member States with national legislation already incur some level of costs associated with the regulations.

The sum of annualised administrative costs for operators and authorities under the four regulatory options, are provided in Table A12.16.

Table A12.16: Total annualised administrative costs (€m per year, 2012 prices)

	Regulatory option:	R1	R2	R3	R4
Operators	1-5 MW	124	67	4	3
	5-20 MW	34	20	3	2
	20-50 MW	7	3	2	0
	TOTAL 1-50 MW	**165**	**90**	**9**	**5**
Authorities	1-5 MW	104	78	6	5
	5-20 MW	31	24	4	3
	20-50 MW	9	4	2	1
	TOTAL 1-50 MW	**144**	**106**	**12**	**9**
Total	1-5 MW	228	145	10	8
	5-20 MW	65	44	7	5
	20-50 MW	16	7	4	1
	TOTAL 1-50 MW	**309**	**196**	**21**	**14**

4.3.4. *Total costs*

An overview of the total costs (compliance, monitoring, administrative) for operators is presented in Table A12.17, based on the figures from Tables A12.9, A12.12 and A12.16.

The total annualised costs for operators under the different options considered (emission level and regulatory) and their possible combinations range from 385 to 3486 M€.

Total costs in emission level options 7A, 7B and 7E are mainly determined by the compliance costs, while those are much less under options 7C and 7D.

Emission level option 7A would lead to an additional compliance cost in 2025 of nearly 3300 M€/year, which is about 1.5 times higher than option 7B. Under either of these options, more than 80% of costs are associated with NOx abatement measures due to the need to apply secondary measures in a high number of natural gas fired plants.

Total costs for option 7C and 7D, under regulatory options R3 and R4 are comparable and in the order of 400 M€. Under the same regulatory options (R3 and R4), emission level option 7E doubles the total costs to more than 800M€.

Table A12.17: Total annualised costs for operators (€m/year, figures rounded for presentation purposes)

Capacity	Year	2025																			
	Ambition level option:	Option 7A: most stringent MS				Option 7B: LCP				Option 7C: primary NOx				Option 7D: Gothenburg				Option 7E: SULES			
	Regulatory option:	R1	R2	R3	R4	R1	R2	R3	R4	R1	R2	R3	R4	R1	R2	R3	R4	R1	R2	R3	R4
1-5 MW	Admin cost	124	67	4	3	124	67	4	3	124	67	4	3	124	67	4	3	124	67	4	3
	Monitoring cost	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
	Compliance cost	1413	1413	1413	1413	966	966	966	966	171	171	171	171	165	165	165	165	332	332	332	332
	Total cost	*1552*	*1495*	*1432*	*1431*	*1105*	*1048*	*985*	*984*	*310*	*253*	*190*	*189*	*304*	*247*	*184*	*183*	*471*	*414*	*351*	*350*
5-20 MW	Admin cost	34	20	3	2	34	20	3	2	34	20	3	2	34	20	3	2	34	20	3	2
	Monitoring cost	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
	Compliance cost	1218	1218	1218	1218	895	895	895	895	127	127	127	127	149	149	149	149	302	302	302	302
	Total cost	*1258*	*1244*	*1227*	*1226*	*935*	*921*	*904*	*903*	*167*	*153*	*136*	*135*	*189*	*175*	*158*	*157*	*342*	*328*	*311*	*310*
20-50 MW	Admin cost	7	3	2	0	7	3	2	0	7	3	2	0	7	3	2	0	7	3	2	0
	Monitoring cost	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Compliance cost	665	665	665	665	365	365	365	365	57	57	57	57	68	68	68	68	156	156	156	156
	Total cost	*676*	*672*	*671*	*669*	*376*	*372*	*371*	*369*	*68*	*64*	*63*	*61*	*79*	*75*	*74*	*72*	*167*	*163*	*162*	*160*
TOTAL 1-50 MW	Admin cost	165	90	9	5	165	90	9	5	165	90	9	5	165	90	9	5	165	90	9	5
	Monitoring cost	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
	Compliance cost	3296	3296	3296	3296	2226	2226	2226	2226	355	355	355	355	382	382	382	382	790	790	790	790
	Total cost	*3486*	*3411*	*3330*	*3326*	*2416*	*2341*	*2260*	*2256*	*545*	*470*	*389*	*385*	*572*	*497*	*416*	*412*	*980*	*905*	*824*	*820*

Whilst the integrated permitting option results in administrative costs of 165 M€/year, this is strongly reduced under the "lighter" regulatory options. A system of notification/registration and common rules under option R3 would allow reducing the administrative burden from avoided permit application costs, and the benefits of a standardised approach replacing permit conditions that vary from one authority to another.

Although the regulatory options considered do not have a direct environmental impact, the requirement under regulatory options R1 and R2 for each plant to have a permit would allow the consideration of the need for stricter conditions in order to ensure compliance with local air quality standards.

Also, concerning the regulatory options without a permit, option R3 would allow mapping emissions of medium size plant and therefore improving knowledge and emission inventories, which would not be possible with option R4.

4.3.5. *Impacts on small and medium-sized enterprises (SMEs)*

Data gathered from consultations with stakeholders indicates that about 75% of the MCP can be assumed to be operated within SMEs (about 53% in small and 23% in medium size enterprises). This varies between around 50% for 20-50 MW plants to more than 80% of 5-20 MW plants[54].

The direct economic impacts of potential legislation on SMEs can be assessed by comparing the total costs incurred per plant against the level of financial resources available to the operator for investment. Information available in Eurostat Structural Business Statistics includes gross operating surplus (GOS), which is the capital available to companies which allows them to repay their creditors, to pay taxes and eventually to finance all or part of their investment[55]. Considering that GOS can be used for financing investment, an indication of the economic impact is given by comparing the costs per plant against GOS per operator.

An assessment of the extent to which SMEs might be affected has been performed combining the sectorial distribution data gathered from consultations with stakeholders with the sectorial enterprise size data from Eurostat.

An indication of the total annual cost per enterprise as a proportion of GOS is given in Table A12.18.

In general, the economic impact on SMEs respect to GOS varies from 0.1 to 22%, depending on the option chosen and the size category of the plant.

High impacts, in the order of 10%, are incurred by small enterprises for all regulatory options and emission level options 7A and 7B and raise to 20% for

[54] For those sectors where Eurostat provides enterprise size categories, it is extremely unlikely that the sector-wide average proportion of micro-size enterprises (i.e. 71% to 94%) would be observed for 1-50 MW combustion plants. It is anticipated that this high proportion of micro enterprises relate to much smaller combustion plants (i.e. <1 MW) which are outside of the scope of the options considered in this study although some might operate in the smallest capacity class considered (i.e. 1-5 MW). Furthermore, in a number of cases, such combustion plants are typically a part of a bigger complex requiring more than 9 employees to maintain and operate, and therefore it is highly unlikely that any micro-size enterprises would operate them

[55] http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Glossary:Gross_operating_surplus_(GOS)_-_NA

small enterprises operating a MCP in the category 20-50MW if emission level 7A is chosen.

For options 7C and 7D the impacts ranges from 0.1% to 2.5%, the highest figure again for small enterprises operating an MCP in the category 20-50MW. It is assumed that about 35% of MCPs in the 20-50MW category are run by small enterprises.

It should be noted that as explained under the description of the regulatory options [see section 2], several simplified requirements intentionally based on an approach entailing simplified permitting/registration (with respect, for instance, to requirements set in the Industrial Emission Directive) have been already taken into account in their design. In addition, the options considered in relation to emission monitoring and reporting have also been moderated, in view of the high number of SMEs concerned.

Additional mitigation measures aiming to further reduce economic impacts on SMEs under the various options have been also investigated. Several potential mitigating measures implemented in EU legislation have been identified and are in the section below.

Table A12.18: Total annual cost per enterprise as a proportion (%) of GOS

2025	Emission level option:	7A: most stringent MS				7B: LCP				7C: primary NOx				7D:Gothenburg				7E:SULES			
Enterprise size	**Regulatory option:**	**R1**	**R2**	**R3**	**R4**	**R1**	**R2**	**R3**	**R4**	**R1**	**R2**	**R3**	**R4**	**R1**	**R2**	**R3**	**R4**	**R1**	**R2**	**R3**	**R4**
Small	1-5 MW	2.8	2.7	2.6	2.6	2.0	1.9	1.8	1.8	0.6	0.5	0.3	0.3	0.6	0.5	0.3	0.3	0.9	0.8	0.6	0.6
	5-20 MW	13.7	13.6	13.4	13.4	10.2	10.0	9.9	9.9	1.8	1.7	1.5	1.5	2.1	1.9	1.7	1.7	3.7	3.6	3.4	3.4
	20-50 MW	21.7	21.5	21.5	21.4	12.0	11.9	11.9	11.8	2.2	2.1	2.0	2.0	2.5	2.4	2.4	2.3	5.3	5.2	5.2	5.1
Medium	1-5 MW	0.7	0.7	0.6	0.6	0.5	0.5	0.4	0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2
	5-20 MW	2.7	2.7	2.7	2.7	2.0	2.0	2.0	2.0	0.4	0.3	0.3	0.3	0.4	0.4	0.3	0.3	0.7	0.7	0.7	0.7
	20-50 MW	5.5	5.5	5.5	5.5	3.1	3.0	3.0	3.0	0.6	0.5	0.5	0.5	0.6	0.6	0.6	0.6	1.4	1.3	1.3	1.3

4.3.6. *Measures to mitigate impacts on SMEs*

The Commission's 2013 Communication on *Smart Regulation – Responding to the needs of small and medium-sized enterprises*[56] recognises that it may not always be possible or desirable to provide exemptions or lighter requirements for particular types of enterprises (including SMEs): *"It is acknowledged by SMEs and their representatives that SMEs cannot expect to be above the law. [...]Exemptions or lighter provisions for smaller businesses will not undermine overall public policy objectives pursued through the relevant regulations, for example in public and workplace health and safety, food safety or environmental protection."* [extract from COM(2013) 122 final]

The pollutants addressed in this impact assessment are mainly health related and location specific and providing blanket exemptions or derogations would work against the objectives of this legislative measure. Therefore, mitigation measures are examined with a view to identify those that would reduce the financial and administrative burden on SMEs whilst not running counter to the set objectives of the specific policy, and being enforceable at a reasonable cost.

4.3.6.1. *Phased implementation*

Phased implementation with a longer lead-in time for some companies can allow such companies more time to adapt and align their compliance actions with their 'normal' investment cycle. The IED (and its predecessors e.g. IPPC and LCP Directives) contain phased implementation requirements for existing installations in order to give those already in operation sufficient time to make the necessary upgrades and comply with their permits. Under this approach, the compliance costs are slightly reduced as companies have more scope to integrate achieving compliance into their investment cycle. Specifically, a lower proportion of older plants would be rendered prematurely obsolete as a result of the regulatory change. The eventual benefits would be unchanged on a per annum basis, but would be reduced overall due to the delay in accruing them. There is a slight risk with such an approach in that some operators may subsequently hold off replacing an existing plant with a new one thus reducing the overall benefits in the short term (i.e. they may choose to run their existing plant up to the deadline for compliance before replacing it) but the longer term benefits would be the same and a phased implementation should reduce overall economic impacts.

4.3.6.2. *Sectoral exemptions or derogations*

The main existing policy in which sectoral exemptions and derogations have been applied is the EU Emissions Trading System[57] (EU ETS). Industries covered by the EU ETS, which are deemed to be exposed to a significant risk of 'carbon leakage' receive a higher share of free allowances in the third trading period between 2013 and 2020. The EU ETS establishes a complex methodology for determining such sectors, where the criteria are based on percent of costs incurred by the sector respect to its gross added value (GVA) or the intensity of trade respect to third countries. It also establishes that a list of sectors at risk should be drawn up and revised every three years. The first carbon leakage list was adopted by the

[56] COM(2013) 122 final

[57] Directive 2009/29/EC, previously Directive 2003/87/EC.

Commission at the end of 2009 and amended in 2011 and 2012. These exemptions do not affect the environmental effectiveness of the EU ETS (which is determined by the overall cap) although they reduce the cost burden on certain sectors.

Any analogous approach for air pollutants emitted from MCP would however affect health and environmental impacts, because the only feasible sectoral approach would be to exempt specific sectors from the scope of the policy altogether. Measures have already been assessed regarding the implementation costs for all plant as a proportion of GOS, which provides a basis to reduce the burden. However there are no identifiable sectors for which the residual impact is particularly high[58]. Also given the much smaller economic impact of the MCP compared with the EU ETS, further measures on sectoral exemption would be disproportionate.

4.3.6.3. *Size-related exemptions and derogations*

The regulatory burden on SMEs can be lightened via exemptions or derogations for specific enterprises on the basis of their number of employees, turnover and/or balance sheet[59]. This could apply to the smallest (i.e. micro) enterprises only or include others within the SME definition. The Commission's 2013 Communication on *Smart Regulation – Responding to the needs of small and medium-sized enterprises*[60] identifies some examples of SME exemptions that have been proposed by the Commission and are now in the EU legislative procedure. The challenge for following this approach is that for MCPs the burden of costs are often shared between the owner of the MCP that may be a separate company to its operator. Given the significant variation in such shared set-ups across the EU, any attempts to separate out SME's from larger enterprises may inadvertently reduce the cost-effectiveness of the policy tool.

Micro-enterprises are extremely unlikely to be affected given that MCPs would normally not be operated by enterprises of very small size.

4.3.6.4. *Exemptions or derogations based on operating hours and/or emissions*

Softening the regulatory burden on specific companies is also possible via exemptions or derogations on the basis of metrics such as activity, product specifications, environmental impact indicators and the like. While this approach does not specifically target SMEs, the benefits of the exemption would be most relevant for those companies with the least resources available to shoulder any potential increase in regulatory burden, a category which is deemed more likely to include a higher proportion of SMEs (relative to the category of larger companies). For the policy options under consideration, a possible starting point would be current Member State legislation in the field. For instance, a number of Member

[58] Option 7D couple with regulatory option R3 would have an impact on SMEs that ranges from 0.1% to max 2.5% of GOS. In the case of EU ETS *'a sector is deemed to be exposed to a significant risk of carbon leakage when additional costs induced by the implementation of the directive would lead to a substantial increase of production costs, calculated as a proportion of GVA of at least 5%'.*
[59] In line with the SME definitions provided in Recommendation (2003/361/EC).
[60] COM(2013) 122 final

States have legislation in place covering combustion plants below 50 MW that exempt plants if they operate a low number of hours (e.g. <300 hours per year). The aim of this is to exempt back-up and emergency plants from having to make costly upgrades (and incurring administrative burden) with limited environmental benefit. Exempting plants with low operating hours and/or low overall emissions would have the potential to substantially reduce overall costs without impacting as much on the overall benefits. In order to assuring that any potential health benefits are safeguarded less strict measures could be still required for certain pollutants (e.g. less strict ELVs for PM).

Based on data provided by the Member States, 10-25% of MCP operates less than 300 hours per year. The analysis assumes, therefore, that 17.5% of plants (mid-point of the range 10-25%) would be exempted. This results in a reduction in costs in equal proportion (17,5%), while emissions are estimated to increase by only 1% due to the low number of operating hours.

4.3.6.5. *Financial support*

Reducing disproportionate burden on SMEs, while safeguarding delivering the policy objectives may also be achieved through the provision by Member States of financial support to particular companies (e.g. SMEs), in order to help meet the regulatory requirements. Such financial support may be direct (e.g. loans or support schemes) or indirect (e.g. reduced fees). Under these approaches, compliance costs for SMEs would be reduced, with no impact on benefits. Costs to Member States through the provision of financial support would be higher, depending on the specific support measures adopted.

4.3.6.6. *Non-financial support*

Support could be provided by the Commission and/or Member States in the form of guidance, template application/reporting forms and/or help desks to help companies understand how to comply with regulatory requirements and to make decisions on what actions are necessary. It might be possible and helpful to establish an approved abatement technology supplier list that companies could easily consult e.g. via a dedicated website. While not explicitly targeting SMEs, it is expected that SMEs would benefit most from such support, as they have fewer resources at their disposal to understand and implement new regulatory requirements. This approach would slightly reduce the transaction costs companies incur to meet the regulatory requirements, although it would entail some costs for competent authorities and/or the Commission (depending on who produced, delivered and administered the support scheme). The environmental benefits would be likely to increase slightly as regulatory compliance rates would increase and companies could possibly implement the necessary changes sooner.

4.3.6.7. *Conclusion on mitigation measures*

The mitigation measures selected as appropriate for a regulatory measure to control air pollutant emissions from MCP are listed in Table A12.19; where action would be at EU level these measures have been integrated in the design of certain policy options.

Table A12.19: Selected mitigation measures

Mitigation measure	Description
Phased implementation	Included in options 7D and 7E: New plants need to comply with set ELVs as of 2018, existing in 2022.
Derogations for existing installations	Included in options 7D and 7E: ELVs for new plants are set stricter than the one for existing plants.
Exemptions or derogations based on operating hours	Included in options 7D and 7E: Exemption for existing combustion plants which do not operate more than 300 hours per year (for PM emission an upper "safeguard" limit could be set).
Simplified permitting and reporting obligations	Included in options R2, R3, R4: Option R2 takes into consideration a light permitting regime, while no permit but only registration is considered in option R3 and simply notification under option R4.
Simplified monitoring obligations	Included in options (R1 to R4): Lighter monitoring requirements than those set in the Industrial Emission Directive are considered for all the options (R1 to R4). In all the options (R1 to R4) lighter monitoring requirements are set for the smaller plants: every three years for plants in the categories 1-5 and 5-20MW, annually for 20-50 MW plants.
Financial and non-financial support	Financial and non-financial support could be envisaged by Member State.

4.3.7. *Impacts on intra-EU competition*

Analysis of possible effects on competition (principally within the EU) of the various options shows that the overall effect of the additional costs on competition within and between sectors is relatively modest. This is because of the general applicability of the options, which bring the requirements for MCP more in line with those already imposed on larger installations. Clearly the absolute impacts would differ under the various options, i.e. depending on the levels at which ELVs are established and the regulatory approach taken. However, all of the options should have only very limited effects on liberalisation rules, no significant effect increasing barriers to entry and no effect on commercial rights. There is no one dominant supplier or dominant approach across the installations concerned. It is not envisaged that the options considered would impact on sectoral rules, unless specific exemptions were proposed. Neither option would appear to interfere with existing rules or corporate law. Member States will be affected in a similar way and base assumption would be that starting from the same level each country's average cost would be approximately the same, and that the differences are largely attributable to levelling up from a low base rather than any intrinsic country effect.

4.3.8. *Impacts on international competitiveness, trade, and investment flows*

The majority of MCP are used in local contexts meeting local heat and/or energy needs and those are unlikely to directly face international competition. There could be however some significant impact on competitiveness for certain industry sectors, particularly food and drink manufacturers and the greenhouse sector. These sectors face stiff competition from outside the EU. It is likely that at least a sub set of these users will have difficulty in passing on costs to their current markets and in the case of greenhouses there are well established competitors ready to compete from outside the EU. In food production the increasing commoditisation of the industry creates pressures for some producers and increases in costs will be difficult to pass on. Possible mitigation could focus on actions targeted at those specific sectors and are likely to be similar to the measures considered for reducing impacts on SMEs. Applying exemptions to those sectors / uses facing the greatest international competition could be an option and although quality and product differentiation may protect food and industry from some of the competition those arguments may be harder to make for greenhouses which compete with areas with abundant sunshine and warmth.

4.4. Social Impacts

The implementation of the proposed MCP instrument on the one hand will lead to costs for the companies that need to invest in pollution abatement equipment, but on the other hand generates income for the firms that manufacture and install the same equipment. The EU has a well-established abatement technology supply chain as the majority of the technologies currently being applied by larger combustion plants are also relevant for these smaller plants.

Where firms are able to pass on costs to downstream consumers, the additional production costs can be expected to have a small negative effect on real income through raising aggregate price levels, resulting in a reduction in consumption and consequently in employment.

Although general equilibrium effects may tip the balance one side or the other, a reasonable assumption is that that the overall effect would be fairly neutral.

It is acknowledged that certain specific sectors such as the food and drink sector and greenhouses, that find it difficult to pass on costs to consumers in light of international competition, could be adversely affected resulting in a reduction of production and, therefore, employment within the EU.

5. COMPARISON OF POLICY OPTIONS AND SELECTION OF PREFERRED OPTION

The comparison of options is based on qualitative or quantitative criteria related to the effectiveness, the efficiency and coherence in achieving the specific objectives defined in section 4.3 of the impact assessment, as follows:

1. Effectiveness:
   - Emission reduction;
2. Efficiency:
   - Pollutant abatement cost;
3. Coherence:

- EU compliance with international obligations;
- Administrative costs; Impacts on SMEs.

5.1. Emission reduction

The emission reductions of the options compared with "no EU action" in 2025 are (kt/y):

Option:	7A	7B	7C	7D	7E
SO2	139	127	127	135	137
NOx	338	288	76	107	159
PM	45	42	42	45	45

All options have the potential to make a substantial contribution to reducing the emission of pollutants.

5.2. Pollutant abatement cost

Table A12.20 summarises the pollutant abatement cost (€/t of pollutant reduced) for the five emission level options 7A-7E. The average abatement cost is calculated as the compliance cost divided by the associated emission reduction for each pollutant. This is compared to the range of damage costs avoided by reducing the same emissions (EMRC 2013, to be published). This shows that the abatement costs compare favourably with the damage costs under all options except for NOx where only options 7C, 7D and 7E are favourable from a cost-benefit perspective.

Table A12.20: Removal costs and avoided damage costs (€/t)

	Abatement cost per ton of pollutant reduced (€/t)					**Damage costs (€/t)**
Emission level option:	**7A**	**7B**	**7C**	**7D**	**7E**	
SO2	2600	1400	1400	1400	1500	7600 – 21200
PM	5200	2900	2900	2500	2800	14750-41650*
NO_X	7600	6300	500	800	2,900	5500-13900

* To allow comparison in this table, damage costs for PM2.5 (29500-83300€/t) have been reduced by half to account for the complex relationship between PM and PM2.5 (see footnote 1 to section 1.3 of this annex)

However, the costs associated to option 7E have a high sensitivity to the reference date chosen. Whereas for options 7A to 7D the costs for 2025 and 2030 are very close, this is not the case for option 7E where very stringent standards apply to new plants and costs increase with the rate of replacement of existing plants by new plants. In 2025 it is assumed that 27% of the plants will have been replaced; further replacement of existing plants by new plants after 2025 would entail significant additional NOx abatement costs in the order of 200-300€/ton per boiler and 3,900€/ton per engine or turbine.

5.3. EU compliance with international obligations

Out of the three options 7C, 7D and 7E that have the most favourable cost-benefit profile both options 7D and 7E allow the EU to fully comply with its international obligations under the Gothenburg Protocol. Option C does not allow such compliance for certain types of engines.

5.4. Administrative costs

The choice of the regulatory option has a limited impact on the cost-benefit ratio but is an important driver for administrative costs. The requirement under regulatory options R1 and R2 for each plant to have a permit would lead to higher administrative costs representing 18-29% of total costs but would also allow the consideration of the need for stricter conditions in order to ensure compliance with local air quality standards. Administrative costs are significantly lower for R3 (registration) and R4 (general binding rules) representing 1-2% of total costs. Unlike option R4, option R3 would allow mapping emissions of medium size plant and therefore improving knowledge and emission inventories.

5.5. Impacts on SMEs

By combining the emission level of options 7C or 7D having the most favourable cost-benefit profile with the low administrative cost regulatory options R3 or R4 the impact on SMEs are limited to 0.1 – 2.4% of the GOS. With emission level option 7E the impact on SMEs would reach 0.2 - 5.2% of GOS.

5.6. Option comparision summary

The comparison of options for each of the identified topic areas is based on qualitative criteria related to the effectiveness, the efficiency and coherence in achieving the specific objectives defined in section 4.3 of the impact assessment. The ratings applied are no effect (0), low (L), medium (M), high (H) and not applicable (NA).

	7A	7B	7C	7D	7E	R1-R2	R3-R4
Effectiveness	H	H	H	H	H	NA	NA
Efficiency	L	H	H	H	M	NA	NA
Coherence	L	L	M	H	M	L	H

The more detailed breakdown for the three criteria used to assess coherence is:

	7A	7B	7C	7D	7E	R1-R2	R3-R4
Administrative costs	NA	NA	NA	NA	NA	L	H

	7A	7B	7C	7D	7E	R1-R2	R3-R4
EU compliance with international obligations	**H**	**L**	**L**	**H**	**H**	**NA**	**NA**
Impacts on SMEs	**L**	**L**	**H**	**H**	**L**	**L**	**H**

In addition, unlike option R4, option R3 would allow mapping emissions of medium combustion plants and therefore improving knowledge and emission inventories, which would facilitate policy evaluation.

A summary table, showing the baseline and impacts of the options in 2025 is presented below (figures refer to regulatory option R3)

No EU action		Baseline 2025				
SO2 emissions (kt/y)		174				
NOx emissions (kt/y)		455				
PM emissions in (kt/y)		48				
Impact of policy options: emissions		7A	7B	7C	7D	7E
SO2 emission reduction (kt/y)		139	127	127	135 (79)•	137
NOx emission reduction (kt/y)		338	288	76	107 (108)•	159
PM* emission reduction (kt/y)		45	42	42	45 (26)•	45
Impact of policy options: costs		7A	7B	7C	7D	7E
Compliance costs for operators (M€/y)		3296	2226	355	382	790
Impact of policy options: total annual cost per enterprise as a proportion (%) of GOS		7A	7B	7C	7D	7E
Small enterprises	1-5 MW	2.6	1.8	0.3	0.3	0.6
	5-20 MW	13.4	9.9	1.5	1.7	3.4
	20-50 MW	21.5	11.9	2.0	2.4	5.2
Medium enterprises	1-5 MW	0.6	0.4	0.1	0.1	0.2
	5-20 MW	2.7	2.0	0.3	0.3	0.7
	20-50 MW	5.5	3.0	0.5	0.6	1.3

*for technical reasons this is expressed as total particulate matter; to be divided by a factor 2 to convert to PM2.5

Number in brackets (xx)* are calculated by IIASA 6C*, PM emission have been multiplied by a factor 2 to convert from PM2.5

5.7. Preferred option

The comparison indicates that the most favourable approach is emission level option 7D combined with regulatory option R3. This has a very favourable cost-benefit profile, combines low compliance costs with low administrative costs, allows the EU to fully comply with its international obligations, and limits the economic impacts on SMEs. This combination also incorporates the mitigation measures selected in section 3.3.6.7.

Whilst options 7D and R3 come out as most favourable for taking action at EU level, in particular situations such as for instance air quality management zones in non-compliance with the AAQD limit values, Members States and local authorities might need to adopt stricter abatement measures, such as those reflected in the emission level option 7E.

6. MONITORING AND EVALUATION

Monitoring of the implementation and impact of measures on MCP will be based on streamlined and targeted reporting requirements on the Member States focusing on the key data which are necessary to assess the extent to which the objectives of the legislation are being achieved. The Commission will evaluate the results of this policy in 2023. On that basis the legislation will be revised as necessary.

The following indicators will be monitored:

Objective	**Indicator**	**How monitored/calculated**	**Responsible authority**	**Reporting/review**
Emission reductions from MCP	Sectoral emissions of SO2, NOx, PM	Reporting of national emission totals from MCP estimated on the basis of plant registrations	Designated national authorities (reported by the MS)	MS interim reporting in tri-annual reporting in 2020 Review in 2023 based on MS implementation reports

APPENDIX 12.1 EMISSION VALUES FOR THE DIFFERENT OPTIONS

Emission values used for options 7A, 7B,and 7C

Option	Rated thermal input (MW)	SO_2 (mg/Nm^3)				NO_X (mg/Nm^3)					PM (mg/Nm^3)		
		Solid Biomass	Other solid fuel	Liquid fuel	Other gaseous fuel	Solid Biomass	Other solid fuel	Liquid fuel	Natural gas	Other gaseous fuel	Solid Biomass	Other solid fuel	Liquid fuel
Boilers (reference oxygen content: 3% in case of gaseous and liquid fuels and 6% in case of biomass and other solid fuels)													
Option 7A Most stringent MS	1-5	200	200	200	5	200	100	120	70	150	8	50	5
	5-20	200	200	200	5	145	100	120	70	164	5	20	5
	20-50	200	200	200	5	145	100	120	70	164	5	20	5
Option 7B: LCP	1-5	200	400	350	35	300	300	450	100	200	30	30	30
	5-20	200	400	350	35	300	300	450	100	200	30	30	30
	20-50	200	400	350	35	300	300	450	100	200	30	30	30
Option 7C: Primary NOx	1-5	200	400	350	35	700	880	650	290	290	30	30	30
	5-20	200	400	350	35	680	680	630	280	280	30	30	30
	20-50	200	400	350	35	680	680	490	490	250	30	30	30
Engines and turbines (reference oxygen content: 15%)													
Option 7A Most stringent MS	1-5	-	-	200	5	-	-	46	33	48	-	-	3
	5-20	-	-	200	5	-	-	46	33	33	-	-	3
	20-50	-	-	200	5	-	-	46	33	33	-	-	3
Option 7B: LCP	1-5	-	-	350	35	-	-	450	75	110	-	-	30
	5-20	-	-	350	35	-	-	450	75	110	-	-	30
	20-50	-	-	350	35	-	-	450	75	110	-	-	30
Option 7C: Primary NOx	1-5	-	-	350	35	-	-	470	250	210	-	-	30
	5-20	-	-	350	35	-	-	560	250	210	-	-	30
	20-50	-	-	350	35	-	-	430	310	250	-	-	30

Emission values used for option 7D

SO_2 (mg/Nm^3) *existing combustion plants*

Boilers (reference oxygen content: 3% in case of gaseous and liquid fuels and 6% in case of solid fuels)						
	Rated thermal input (MW)	**SO_2 (mg/Nm^3)**				
		Solid Biomass	**Other solid fuels**	**Other liquid fuels than HFO**	**Heavy Fuel Oil (HFO)**	**Gaseous fuels other than natural gas**
	1<50	200	400	170	350	35
Engines and gas turbines (reference oxygen content: 15%)						
	Rated thermal input (MW)	**SO_2 (mg/Nm^3)**				
				Liquid fuels		**Gaseous fuels other than natural gas**
	1<50	-	-	60		15

NOx (mg/Nm3) existing combustion plants

Boilers (reference oxygen content: 3% in case of gaseous and liquid fuels and 6% in case of solid fuels)							
	Rated thermal input (MW)	**NO_X (mg/Nm^3)**					
		Solid Biomass	**Other solid fuel**	**Other liquid fuels than HFO**	**Heavy Fuel Oil (HFO)**	**Natural gas**	**Gaseous fuels other than natural gas**
	1 - <50	650	650	200	650	200	250
Engines and gas turbines (reference oxygen content: 15%)							
	Rated thermal input (MW)	**NO_X (mg/Nm^3)**					
				Liquid fuels		**Natural gas**	**Gaseous fuels other than natural gas**
Gas Engines	1<50	-	-	-		190	190
Diesel Engines	1<50			1,850 (construction commenced before 17 May 2006) 190 (construction commenced on or after 18 May 2006)		-	-
Dual fuel engines	1<50			1,850		380	380
Gas turbines	1<50			200		150	200

PM (mg/Nm3) existing combustion plants

Boilers (reference oxygen content: 3% in case of gaseous and liquid fuels and 6% in case of solid fuels)					
Rated thermal input (MW)	PM (mg/Nm^3)				
	Solid Biomass	Other solid fuels	Other liquid fuels than HFO	Heavy Fuel Oil (HFO)	
1<50	30	30	30	30	-
Engines and gas turbines (reference oxygen content: 15%)					
Rated thermal input (MW)	PM (mg/Nm^3)				
			Liquid fuels		
1<50	-	-	10		-

SO2 (mg/Nm3) new combustion plants

Boilers (reference oxygen content: 3% in case of gaseous and liquid fuels and 6% in case of solid fuels)					
Rated thermal input (MW)	SO_2 (mg/Nm^3)				
	Solid Biomass	Other solid fuels	Other liquid fuels than HFO	Heavy Fuel Oil (HFO)	Gaseous fuels other than natural gas
1<50	200	400	170	350	35
Engines and gas turbines (reference oxygen content: 15%)					
Rated thermal input (MW)	SO_2 (mg/Nm^3)				
			Liquid fuels		Gaseous fuels other than natural gas
1<50	-	-	60		15

NOx (mg/Nm3) new combustion plants

Boilers (reference oxygen content: 3% in case of gaseous and liquid fuels and 6% in case of solid fuels)							
	Rated thermal input (MW)	NO_X (mg/Nm^3)					
		Solid Biomass	Other solid fuel	Other liquid fuels than HFO	Heavy Fuel Oil (HFO)	Natural gas	Gaseous fuels other than natural gas
	1 - <50	300	300	200	300	100	200

Engines and gas turbines (reference oxygen content: 15%)						
	Rated thermal input (MW)	NO_X (mg/Nm^3)				
				Liquid fuel	Natural gas	Gaseous fuels other than natural gas
Gas, Dual Fuel and Diesel Engines	1<50	-	-	190	95	190
Gas turbines	1<50			75	50	75

PM (mg/Nm3) new combustion plants

Boilers (reference oxygen content: 3% in case of gaseous and liquid fuels and 6% in case of solid fuels)					
	Rated thermal input (MW)	PM (mg/Nm^3)			
		Solid Biomass	Other solid fuels	Liquid fuels	
	1<50	20	20	20	-

Engines and gas turbines (reference oxygen content: 15%)					
	Rated thermal input (MW)	PM (mg/Nm^3)			
				Liquid fuels	
	1<50	-	-	10	-

Emission values used for option 7E
(emission values for existing plants are the same as for option 7D)

Rated thermal input (MW)	SO_2 (mg/Nm[3])				NO_X (mg/Nm[3])					particulate matter (mg/Nm[3])		
	Solid Biomass	Coal, lignite and other solid fuel	Liquid fuel	Gaseous fuel other than natural gas	Solid Biomass	Coal, lignite and other solid fuel	Liquid fuel	Natural gas	Gaseous fuel other than natural gas	Solid Biomass	Coal, lignite and other solid fuel	Liquid fuel
Combustion plants other than engines and gas turbines **(reference oxygen content: 3% in case of gaseous and liquid fuels and 6% in case of solid biomass, coal, lignite and other solid fuels)**												
1-5	150	200	200	5	200	100	120	70	70	8	5	5
5-20					145				70	5	5	
20-50												
Engines and gas turbines **(reference oxygen content: 15%)**												
1-50	-		60	2	-		46	33	33			3

APPENDIX 12.2 EMISSION FOR 2025 AND 2030 FOR OPTIONS 7A, 7B AND 7C.

SO2 emissions (kt/year)

Emission level option:	2010	2025			2030		
		1: No EU action	7B: LCP	7A: most stringent MS	1: No EU action	7B: LCP	7A: most stringent MS
1-5 MW	103	58	13	9	56	12	9
5-20 MW	130	67	17	12	65	16	12
20-50 MW	68	49	17	14	45	15	13
TOTAL 1-50 MW	301	174	47	35	166	44	34

NOx emissions (kt/year)

Emission level option:	2010	2025				2030			
		1: no EU action	7C: primary NOx	7B: LCP	7A: most stringent MS	1: no EU action	7C: primary NOx	7B: LCP	7A: most stringent MS
1-5 MW	210	170	140	63	46	175	136	61	45
5-20 MW	227	188	149	62	47	192	147	61	47
20-50 MW	117	98	90	42	24	97	89	41	24
TOTAL 1-50 MW	554	455	379	167	117	463	372	163	116

PM emissions (kt/year)

	2010	2025			2030		
Emission level option:		1: No EU action	7B: LCP	7A: most stringent MS	1: No EU action	7B: LCP	7A: most stringent MS
1-5 MW	17	13	2	1	16	2	1
5-20 MW	20	20	2	1	19	2	1
20-50 MW	16	15	2	1	13	2	1
TOTAL 1-50 MW	53	48	6	3	48	6	3

APPENDIX 12.3 OVERVIEW OF ANNUALISED COMPLIANCE COSTS (€M/YEAR) UNDER OPTIONS 7C, 7B AND 7A (INCREMENTAL COSTS TO OPTION 1)

Pollutant	Capacity class Emission level option:	2025			2030		
		7C: primary NOx	7B: LCP	7A: most stringent MS	7C: primary NOx	7B: LCP	7A: most stringent MS
SO_2	1-5 MW	90	90	210	86	86	188
	5-20 MW	68	68	123	64	64	113
	20-50 MW	27	27	44	25	25	40
	TOTAL 1-50 MW	185	185	377	174	174	341
NO_X	1-5 MW	27	821	1,119	27	811	1,075
	5-20 MW	18	785	1,018	18	773	994
	20-50 MW	3	311	543	3	314	534
	TOTAL 1-50 MW	48	1,918	2,680	48	1,898	2,603
PM	1-5 MW	55	55	84	53	53	82
	5-20 MW	41	41	77	41	41	75
	20-50 MW	27	27	77	26	26	75
	TOTAL 1-50 MW	123	123	239	121	121	232
Total	1-5 MW	171	966	1,413	166	950	1,345
	5-20 MW	127	895	1,218	123	878	1,183
	20-50 MW	57	365	665	54	365	649
	TOTAL 1-50 MW	355	2,225	3,296	343	2,193	3,176

APPENDIX 12.4 ANNUALISED COMPLIANCE COSTS (€M/YEAR) PER MEMBER STATE UNDER OPTION 7D

SO_2 compliance costs TOTAL 1-50 MW (€m/yr)	Option 7D 2025	NOx compliance costs TOTAL 1-50 MW (€m/yr)	Option 7D 2025	PM compliance costs TOTAL 1-50 MW (€m/yr)	Option 7D 2025
AT	5,3	AT	0,7	AT	0,5
BE	7,8	BE	5,9	BE	4,8
BG	1,4	BG	3,7	BG	3,7
CY	0,6	CY	0,1	CY	0,2
CZ	3,4	CZ	0,3	CZ	2,1
DE	63,9	DE	13,9	DE	18,8
DK	9,6	DK	4,0	DK	8,9
EE	4,7	EE	0,5	EE	2,9
EL	0,2	EL	0,4	EL	0,3
ES	8,1	ES	8,2	ES	6,4
FI	2,8	FI	0,9	FI	1,9
FR	29,0	FR	9,2	FR	18,2
HU	3,5	HU	2,8	HU	2,2
IE	10,0	IE	3,1	IE	8,6
IT	2,4	IT	7,0	IT	1,2
LT	3,5	LT	1,5	LT	2,2
LU	-	LU	0,2	LU	-
LV	0,9	LV	0,8	LV	3,8
MT	0,1	MT	-	MT	-
NL	-	NL	0,4	NL	0,1
PL	13,8	PL	1,9	PL	9,2
PT	2,3	PT	0,7	PT	3,6
RO	2,6	RO	2,6	RO	4,0
SE	2,2	SE	2,7	SE	5,9
SI	0,1	SI	0,9	SI	1,2
SK	0,2	SK	0,4	SK	2,3
UK	4,6	UK	10,6	UK	2,6

ANNEX 13 REFERENCES

AEA, 2005. Damages per tonne emission of PM2.5, NH3, SO2, NOx and VOCs from each
EU25 Member State (excluding Cyprus) and surrounding seas.
http://ec.europa.eu/environment/archives/cafe/activities/pdf/cafe_cba_externalities.pdf

AEA, 2008. Analysis of the Costs and Benefits of Proposed Revisions to the National Emission Ceilings Directive.
http://ec.europa.eu/environment/air/pollutants/pdf/necd_cba_3.pdf

AEAT, 2007. Assessment of the benefits and costs of the potential application of the IPPC Directive (EC/96/61) to industrial combustion installations with 20-50 MW rated thermal input. Final Report to the European Commission.
http://www.cafe-cba.org/assets/ippc_ec_thernal_input.pdf

AMEC, 2012A. Collection and analysis of data to support the Commission in reporting in line with Article 73(2)(a) of Directive 2010/75/EU on industrial emissions on the need to control emissions from the combustion of fuels in installations with a total rated thermal input below 50 MW. Final Report for the European Commission.

AMEC, 2012B. Analysis and summary of the Member States' emission inventories 2007-2009 and related information under the LCP Directive (2001/80/EC). Final Report for the European Commission.

AMEC, 2013. Analysis of the impacts of various options to control emissions from the combustion of fuels in installations with a total rated thermal input below 50. To be published.

Compassion in World Farming, 2012. Egg production in the EU - Information sheet.
http://www.compassionlebensmittelwirtschaft.de/wp-content/uploads/2012/05/Info-1-Egg-production-in-the-EU.pdf.pdf

CSES, 2013. Fitness Check of the Legal Framework for the Type-Approval of Motor Vehicles.
http://ec.europa.eu/enterprise/sectors/automotive/files/projects/report-cses-fitness-check_en.pdf

Danish Ministry of the Environment, 2012. Economic Impact Assessment for the establishment of a NECA in the North Sea, Environmental Project no. 1427.
http://www2.mst.dk/Udgiv/publications/2012/06/978-87-92903-20-4.pdf

EC, 2006. Competitiveness of the European Food Industry: An Economic and Legal Assessment 2007.
http://ec.europa.eu/enterprise/sectors/food/files/competitiveness_study_en.pdf

EC, 2011. Prospects for Agricultural Markets and Income in the EU 2011-2020.
http://ec.europa.eu/agriculture/publi/caprep/prospects2011/fullrep_en.pdf

EC, 2012A. Consultation on options for revision of the EU Thematic Strategy on Air Pollution and related policies.
http://ec.europa.eu/environment/consultations/air_pollution_en.htm

EC, 2012B. Prospects for Agricultural Markets and Income in the EU 2012-2022.
http://ec.europa.eu/agriculture/publi/caprep/prospects2012/fullrep_en.pdf

ECN, 2008. Onderbouwing actualisatie BEES B: Kosten en effecten van de voorgenomen wijziging van het besluit emissie-eisen stookinstallaties B.
http://www.ecn.nl/docs/library/report/2008/e08020.pdf

Ecologic Institute, 2011. Final report for the assessment of the 6th environmental action programme.
http://www.ecologic.eu/files/attachments/Projects/2010/ecologic_6eap_report.pdf

Ecorys, 2013A. Report on the consultation on options for revision of the EU Thematic Strategy on Air Pollution and related policies.
http://ec.europa.eu/environment/air/pdf/review/TSAP%20Consultation%20report.pdf

Ecorys, 2013B. Services to assess the reasons for non-compliance with the ozone target values set by Directive 2008/50. To be published.

EEA, 2010. Air pollution — SOER 2010 thematic assessment.
http://www.eea.europa.eu/soer/europe/air-pollution

EEA, 2012A. Air Quality in Europe - 2012 Report.
http://www.eea.europa.eu/publications/air-quality-in-europe-2012

EEA, 2012B. Evaluation of progress under the EU National Emission Ceilings Directive - Technical report No 14/2012.
http://www.eea.europa.eu/highlights/publications/evaluation-progress-nec-2012

EEA, 2012C. Air pollution by ozone across Europe during summer 2012.
http://www.eea.europa.eu/publications/air-pollution-by-ozone-across-EU-2012

EEA, 2013A. European Union emission inventory report 1990–2011 under the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP).
http://www.eea.europa.eu/publications/eu-emission-inventory-report-lrtap

EEA, 2013B. Air Implementation Pilot, Lessons learnt from the implementation of air quality legislation at urban level.
http://www.eea.europa.eu/publications/air-implementation-pilot-2013

EEA,2013C. NEC Directive status report 2012.
http://www.eea.europa.eu/publications/nec-directive-status-report-2012/at_download/file

EGTEI, 2010. Options for limit values for emissions of dust from small combustion installations < 50 MWth.
http://www.unece.org/fileadmin/DAM/env/documents/2010/eb/wg5/wg47/Informal%20documents/Info.%20doc%209_Options%20for%20PM%20ELVs%20for%20SCI%20%20final.pdf

EMRC, 2013. Cost-benefit Analysis of Policy Scenarios for the Revision of the Thematic Strategy on Air Pollution. To be published.

Entec UK, 2005. National Emission Ceilings Directive Review Task 1: In-depth analysis of the NEC national programmes.
http://ec.europa.eu/environment/air/pollutants/pdf/final_report.pdf

Entec, 2009. Study to inform on-going discussions on the proposal for a Directive on industrial emissions. Part 1: Combustion Activities. Final Report to the European Commission.

Environment Agency Austria, 2012. Review of the Air Quality Directive and the 4th Daughter Directive, Service request no 6 under FW contract ENV.C.3/FRA/2009.0008. Final report 2012.
http://ec.europa.eu/environment/air/pdf/review/SC6_final_report_v121210[1].pdf

EURELECTRIC, 2012. Power Statistics & Trends 2012 - synopsis.
http://www.eurelectric.org/media/69408/synopsis_2012_hr-2012-180-0001-01-e.pdf

Eurobarometer, 2013. Attitudes of Europeans towards air quality.
http://ec.europa.eu/public_opinion/archives/flash_arch_360_345_en.htm#360

Europia, 2011. Annual Report.
https://www.europia.eu/Content/Default.asp?PageID=412&DocID=35264

EUWEP, 2011. The EU Egg Industry - Welfare of Laying Hens, Presentation to Multi-Stakeholders Meeting on Implementation of Council Directive 1999/74/EC (Brussels,
19 January 2011).
http://ec.europa.eu/food/animal/welfare/farm/docs/19012011_4%20Industry%27s%20perspective%20-%20Williams.pdf

Finland's environmental administration, 2003. (Summary of) Best Available Techniques in Small 5-50 MW Combustion Plants in Finland. provided by personal communication with Competent Authority, 22.12.2008.
http://www.environment.fi/default.asp?contentid=23847&lan=fi

HTAP, 2010. Executive Summary of the LRTAP Task Force on Hemispheric Transport of Air Pollution (HTAP).
http://www.htap.org/

IIASA, 2012A. The potential for further controls of emissions from mobile sources in Europe.
http://ec.europa.eu/environment/air/pdf/review/TSAP-TRANSPORT-v2-20121128.pdf

IIASA, 2012B. TSAP-2012 Baseline: Health and Environmental Impacts.
http://ec.europa.eu/environment/air/pdf/tsap_impacts.pdf

IIASA, 2012C. Factors determining recent changes of emissions of air pollutants in Europe.
http://ec.europa.eu/environment/air/pdf/review/TSAP-DISTANCE-20120612[1].pdf

IIASA, 2012D. Future emissions of air pollutants in Europe – Current legislation baseline and the scope for further reductions.
http://ec.europa.eu/environment/air/pdf/review/TSAP-BASELINE-20120613[1].pdf

IIASA, 2012E. Emissions from households and other small combustion sources and their reduction potential.
http://ec.europa.eu/environment/air/pdf/review/TSAP-SMALL_SOURCES-20120612[1].pdf

IIASA, 2012F. Emissions from agriculture and their control potentials.
http://ec.europa.eu/environment/air/pdf/review/TSAP-AGRI-20121129_v21.pdf

IIASA, 2013A. Policy Scenarios for the Revision of the Thematic Strategy on Air Pollution.
http://ec.europa.eu/environment/air/pdf/review/TSAP-Report-10.pdf

IIASA, 2013B. Modelling compliance with NO2 and PM10 air quality limit values in the GAINS model.
http://ec.europa.eu/environment/air/pdf/review/TSAP-Report-.pdf

JRC, 2007. Small combustion installations: Techniques, emissions and measures for emission reduction. European Commission - Joint Research Centre.
http://publications.jrc.ec.europa.eu/repository/handle/111111111/229

JRC, 2010. Evaluation of the livestock sector's contribution to the EU greenhouse gas emissions (GGELS), Final report.
http://ec.europa.eu/agriculture/analysis/external/livestock-gas/full_text_en.pdf

JRC-IPTS, 2013. Market based instruments to reduce air emissions from household heating appliances: Analysis of scrappage policy scenarios. To be published.

LEI Wageningen UR, 2009, Competitiveness of the EU dairy industry.
http://www.lei.dlo.nl/publicaties/PDF/2009/2009-011.pdf

Norwegian Meteorological Institute, 2012A. Transboundary Acidification, Eutrophication
and Ground Level Ozone in Europe in 2010.
http://emep.int/publ/reports/2012/status_report_1_2012.pdf

Norwegian Meteorological Institute, 2012B.Transboundary air pollution by main pollutants (S, N, O3) and PM in 2010 - Belgium.
http://www.emep.int/publ/reports/2012/Country_Reports/report_BE.pdf

Sutton, M. A. et al., 2011. The European Nitrogen Assessment: Sources, Effects and Policy Perspectives. Cambridge University Press.

TFEIP, 2012. Black carbon inventory study.
http://tfeip-secretariat.org/2012-tfeip-meeting-bern/

TNO, 2012A. Survey of view of stakeholders, experts and citizens on the review of EU Air Policy. Part II: Detailed results.
http://ec.europa.eu/environment/air/pdf/review/Survey%20AQD%20review%20-%20Part%20II%20Detailed%20results.pdf

TNO, 2012B. Final report of the PM Workshop Brussels 18-19 June 2012. http://ec.europa.eu/environment/air/pdf/review/TNOreport_FinalMinutesPMWorkshop.pdf
Uk Government, 1993. Clean Air Act 1993.
http://www.legislation.gov.uk/ukpga/1993/11/contents

UNECE, 2011. Air Pollution Studies No20: Policy-relevant science questions.
http://www.unece.org/index.php?id=25373

UNEP, 2008. Atmospheric Brown Cloud Regional Assessment.
www.unep.org/pdf/ABCSummaryFinal.pdf

UNEP, 2011. Near-term climate protection and clean air benefits: actions for controlling short lived climate forcers.
http://www.unep.org/publications/ebooks/slcf/

VITO, 2011. Beste Beschikbare Technieken (BBT) voor nieuwe, kleine en middelgrote stookinstallaties, stationaire motoren en gasturbines gestookt met fossiele brandstoffen.
http://www.emis.vito.be/bbt-studie-stookinstallaties-en-stationaire-motoren-nieuwe-kleine-en-middelgrote

VITO, 2013. Specific evaluation of emissions from shipping including assessment for the establishment of possible new emission control areas in European Seas.
http://ec.europa.eu/environment/air/pdf/review/Main%20Report%20Shipping.pdf

WHO, 2013A. REVIHAAP and HRAPIE projects.
http://www.euro.who.int/en/what-we-do/health-topics/environment-and-health/air-quality/activities/health-aspects-of-air-pollution-and-review-of-eu-policies-the-revihaap-and-hrapie-projects

WHO, 2013B. Review of Evidence on Health Aspects of Air Pollution - REVIHAAP Project.
http://www.euro.who.int/__data/assets/pdf_file/0004/193108/REVIHAAP-Final-technical-report.pdf