Cap adjustments in the EU-ETS according to Article 9a of the EU-ETS Directive

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1 Introduction

The European Emissions Trading Scheme (EU-ETS) is a cap and trade system. In order to be environmentally effective the cap in an emissions trading scheme should be ambitious. From 2013 onwards additional installations will be included in the EU-ETS. For the first time emissions from non-CO_2 gases from the production of nitric acid, adipic acid and primary aluminium will be included in the EU-ETS. The amount of additional emission allowances available in the trading scheme (cap adjustment) for these additional installations is regulated by Article 9a paragraph 2 of the revised EU-ETS Directive. In general the cap adjustment is based on the historic emissions of the installations that enter the scope of the EU-ETS. Member States notify historic emissions of these installations to the European Commission by 30 June 2010. For non-CO_2 gases Member States can notify a lower amount according to the reduction potential of non-CO_2 gases. This means that Member States have the possibility to decrease the amount of allowances available in the EU-ETS. This will increase the emission limits of the Member States for the sectors covered by the Effort Sharing Decision.[1] The aim of this paper is to inform the European Environment Agency (EEA), the European Commission and Member States about the abatement potential of these non-CO_2 gases and to make recommendations for an appropriate adjustment of non-CO_2 emissions data to be notified by Member States for the cap adjustment.

2 Methodology

The proposed adjustment factors for the non-CO_2 emissions are reflecting the reduction potential of these gases and the expectable emissions reduction until 2013 and beyond. Categories of activities which result in emissions of non-CO_2 gases to which the revised EU-ETS Directive applies are nitrous oxide (N_2O) emissions from the production of nitric acid, the production of adipic acid and the production of glyoxal and glyoxylic acid as well as emissions of perfluorocarbons (PFCs) from the production of primary aluminium. It is important to note that the abatement of industrial N_2O emissions is very cost efficient and relatively easy to implement; it is only necessary to install catalysts that destroy the N_2O emissions. A very impressive illustration of this abatement potential is shown by the numerous Clean Development Mechanism (CDM) and Joint Implementation (JI) projects that are carried out to abate industrial N_2O emissions. PFC emissions from primary aluminium production are also relatively easy to abate. PFC emissions are not generated during normal smelting operations, but only during malfunctions called anode effects. With the installation of modern process computers and optimized process handling the frequency of anode effects can be reduced drastically (Trimet 2008).

[1] Since Member States can overachieve their emission limits under the Effort Sharing Decision it could be argued that total abatement in the EU will be higher if Member States only notify a low cap adjustment for the EU-ETS (this leads to a higher Effort Sharing Decision emission limit).

It is difficult to predict the exact abatement potential that exists for non-CO_2 gases. In order to address this challenge a range for the appropriate adjustment of the cap is proposed. The abatement potential is estimated with the benchmark values currently discussed in the EU-ETS for the allocation in the period from 2013 to 2020.[2] The approach to estimate the abatement potential with the ambition of the benchmarks is consistent with the current cap adjustment that was used in for the unilateral inclusion of N_2O emissions in the period from 2008 to 2012 by the Netherlands. For the Netherlands the cap was also increased by the amount of allowances allocated. The revised ETS directive states that benchmarking values should be based on the average performance of the 10 % most efficient installations in the Community in the years 2007 and 2008 (EU 2009, Article 10a, paragraph 2). It could be argued that the average performance of the 10 % most efficient installations is not appropriate to estimate the abatement potential of all installations. However, for the following reasons it seems to be appropriate to use the discussed benchmarks to estimate the average abatement potential:

- Industrial non-CO_2 emissions can easily be destroyed by "end of pipe" technology (e.g. catalysts for the abatement of N_2O emissions). This explains why abatement of industrial N_2O emissions is easier compared to e.g. abatement in the energy sector.
- For N_2O emissions from nitric acid production the special situation exists that in many installations abatement technology in the EU was only installed at the end of the year 2008 or in 2009 in order to carry out JI projects. This means that the benchmarking curves available for the years 2007 and 2008 do not yet reflect the installation of very recent abatement technology.
- Some JI projects even report implied emission factors that are lower than the proposed benchmarking values (Lanxess 2009).

It can be concluded that the proposed benchmarking values are very suitable to estimate the abatement potential that is available. This approach also ensures that the same approach is taken for installations that were opted in the EU-ETS in the period from 2008 to 2012 and for installations that will enter the scope of the EU-ETS from 2013 onwards.

Data sources for this paper are the recent benchmarking study of the European Commission (Ecofys, FH-ISI, Öko-Institut (2009a-c)) and greenhouse gas emissions reported in GHG inventories under the UNFCCC (Submission 2010).[3] These inventories include historic emissions up to the year 2008. The emissions in the years 2007 and 2008 are used to calculate the appropriate cap adjustment in this analysis.

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[2] According to Article 10a of the revised EU-ETS directive it is planned to agree harmonized benchmarks for nitric acid, adipic acid and primary aluminium production by the end of the year 2010.

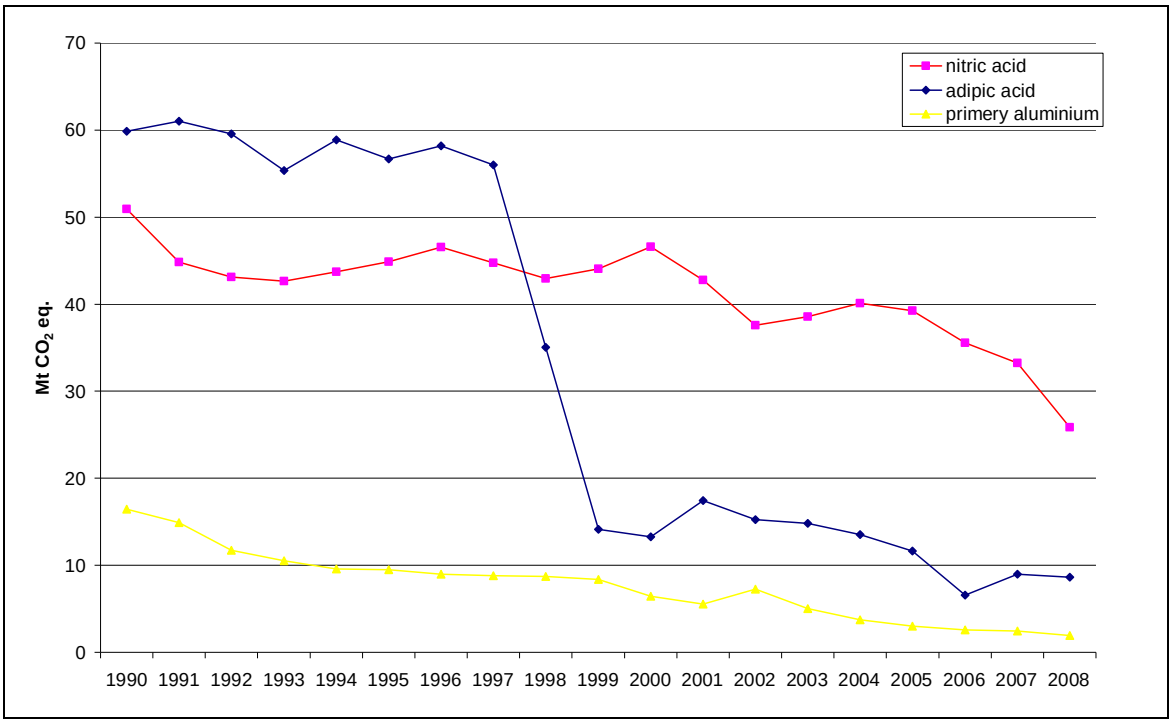
[3] The data from the inventories is the best data that is publicly available. However, it could be the case that the accuracy of emissions reported on an installation level is higher than the emissions reported in the inventories. Once data on installation level is available it would be very useful to compare this data source with the inventories.

Final benchmarking values will be decided in comitology by the end of the year 2010. Based on these data sources this technical paper can already give a good recommendation about the appropriate magnitude of the cap adjustment.

3 Historic emissions reported in the inventories

Based on inventory data from EU-27 Member States emissions of N_2O from nitric acid production decreased from 50 Mt. CO_2 eq. in 1990 to 26 Mt. CO_2 eq. in 2008. The N_2O emissions from adipic acid production remained stable at a level of about 58 Mt. CO_2 eq. until 1997 and decreased to about 9 Mt. CO_2 eq. in 2008. This can be explained by the installation of a first generation of catalysts. This sharp decrease of emissions illustrates the high abatement potential that exists in this sector. The emissions of PFCs from aluminium production for EU-27 amounted to 16 Mt. CO_2 eq. in 1990 and decreased to 2 Mt. CO_2 eq. in 2008. The total emissions of N_2O and PFC from these three source categories expressed in terms of carbon dioxide equivalent are reported to be 36 Mt. CO_2 eq. in the EU-27 inventories in 2008.

Figure 3-1 *Historic emissions of N_2O from nitric acid and adipic acid productionn and historic emissions of PFC from aluminium production for EU-27 from 1990 and 2008.*



Source: *UNFCCC (2010)*

This first analysis shows that the cap adjustment will be most relevant for N_2O emissions from nitric acid production; there has already been substantial abatement of N_2O emissions from adipic acid production in all Member States and PFC emissions from aluminium production have steadily decreased as well.

4 Nitric acid

4.1 Production and emissions

Greenhouse gas inventories include emissions data and also activity data, i.e. production quantities. In some cases data points are confidential. The production of nitric acid increased in some countries (e.g. Germany, Poland and others) and decreased in others (France).

Table 1 Production of nitric acid in the EU-27 from 1990 to 2008

Party	1990	2000	2005	2006	2007	2008
			kt nitric acid			
Austria	530	534	558	580	499	562
Belgium	1436	1769	1898	1873	1848	1802
Bulgaria	1213	C	C	484	712	C
Cyprus	0	0	0	0	0	0
Czech Republic	530	505	532	543	554	507
Germany	1698	1828	2530	2681	2864	2617
Denmark	450	433	NO	NO	NO	NO
Spain	1329	1074	857	717	626	634
Estonia	NO	NO	NO	NO	NO	NO
Finland	549	451	582	599	615	629
France	3200	3065	2757	2367	2355	2516
United Kingdom	2408	2030	1713	1468	1606	1294
Greece	511	355	252	204	203	169
Hungary	732	416	484	461	475	386
Ireland	339	260	NO	NO	NO	NO
Italy	1037	556	572	526	505	505
Lithuania	355	603	921	925	1188	1110
Luxembourg	NO	NO	NO	NO	NO	NO
Latvia	NO	NO	NO	NO	NO	NO
Malta	NO	NO	NO	NO	NO	NO
Netherlands	C	C	C	C	C	C
Poland	1577	2007	2219	2201	2270	2267
Portugal	C	C	C	C	C	C
Romania	1206	831	1037	822	963	883
Slovakia	401	407	498	564	489	509
Slovenia	NO	0	0	NO	NO	NO
Sweden	374	430	264	272	249	266
EU-27	19875	17556	17675	17286	18022	16655

Source: *UNFCCC (2010)*

The emissions are steadily decreasing. An impressive example is the Netherlands. In 2008 N_2O emissions from Nitric Acid production was opted into the EU-ETS. In 2007 the emissions were still 4.2 Mt. CO_2 eq.. In 2008 this was reduced to 0.6 Mt. CO_2 eq. (Table 2). It is very likely that this abatement was incentivised by the price signal of the EU-ETS, although this would need to be clarified with a look on production data which are confidential in the case of Netherlands.

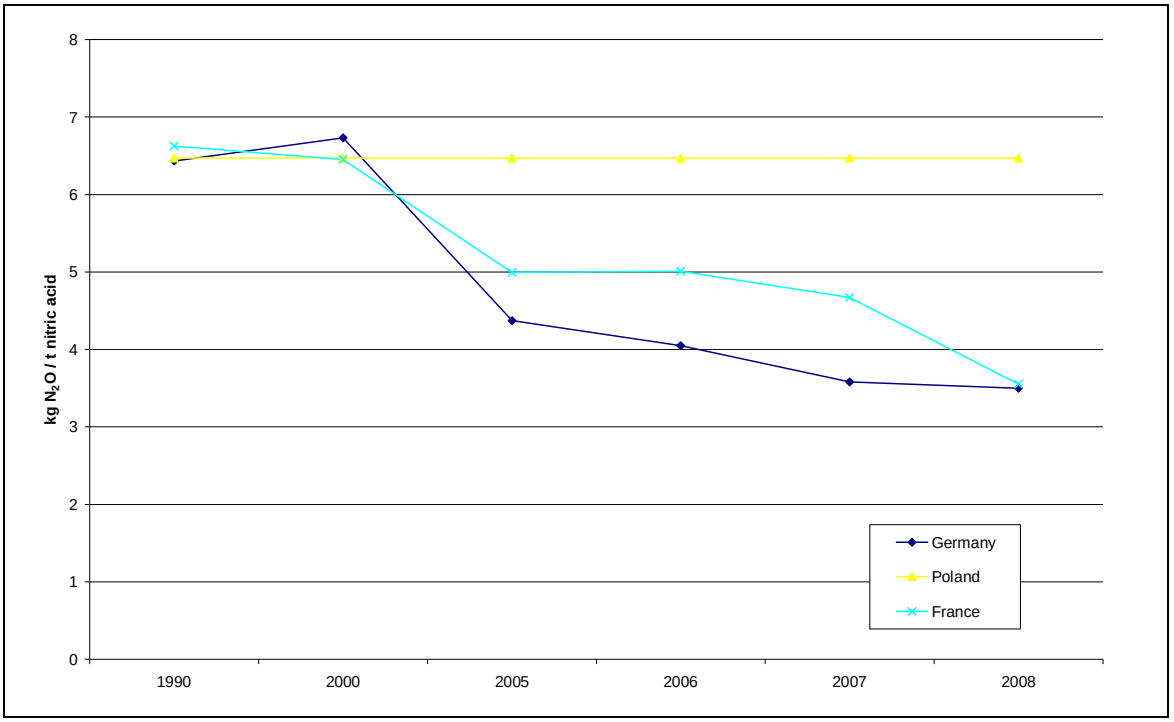
Table 2 Emissions from nitric acid production in the EU-27

Party	1990	2000	2005	2006	2007	2008
			Mt CO_2 eq			
Austria	0.9	1.0	0.3	0.3	0.3	0.3
Belgium	3.6	4.2	3.1	2.1	1.4	1.4
Bulgaria	2.3	1.3	1.0	0.9	1.3	0.8
Cyprus	NO	NO	NO	NO	NO	NO
Czech Republic	1.1	1.0	1.0	0.9	0.7	0.7
Germany	3.4	3.8	3.4	3.4	3.2	2.8
Denmark	1.0	1.0	NO	NO	NO	NO
Spain	2.8	2.1	1.4	1.2	1.0	1.0
Estonia	NO	NO	NO	NO	NO	NO
Finland	1.7	1.4	1.6	1.4	1.5	1.6
France	6.6	6.1	4.3	3.7	3.4	2.8
United Kingdom	3.9	4.4	2.0	1.8	1.8	1.5
Greece	1.1	0.8	0.5	0.4	0.4	0.4
Hungary	3.2	1.8	1.7	1.4	0.9	0.0
Ireland	1.0	0.8	NO	NO	NO	NO
Italy	2.1	1.3	1.7	1.2	1.1	0.4
Lithuania	0.8	1.3	2.0	2.0	2.6	2.4
Luxembourg	NO	NO	NO	NO	NO	NO
Latvia	NO	NO	NO	NO	NO	NO
Malta	NO	NO	NO	NO	NO	NO
Netherlands	6.3	5.9	5.7	5.6	4.3	0.6
Poland	3.2	4.0	4.5	4.4	4.6	4.5
Portugal	0.6	0.4	0.4	0.4	0.5	0.5
Romania	3.5	2.4	2.9	2.3	2.7	2.5
Slovakia	1.1	1.0	1.3	1.7	1.4	1.5
Slovenia	NO	0.0	0.0	NO	NO	NO
Sweden	0.8	0.6	0.4	0.5	0.2	0.3
EU-27	50.9	46.6	39.2	35.6	33.2	25.9

Source: *UNFCCC (2010)*

Based on the production data and the emissions data as reported in the inventories the implied emission factor per unit produced can be calculated. The result of the calculation for those countries that reported data both on production and emissions is shown in Figure 4-1 for the three countries with the highest absolute emissions. For Poland the reported implied emission factor is constant over time. France and Germany report a reduction of the implied emission factor. The fact that the implied emission factor used by Poland for reporting is constant over time implies that this country does not use plant specific data, but relies on default factors instead.

Figure 4-1 *Implied emission factor of N_2O from nitric acid production in the EU-27 in kg N_2O /t of nitric acid for selected Member States.*



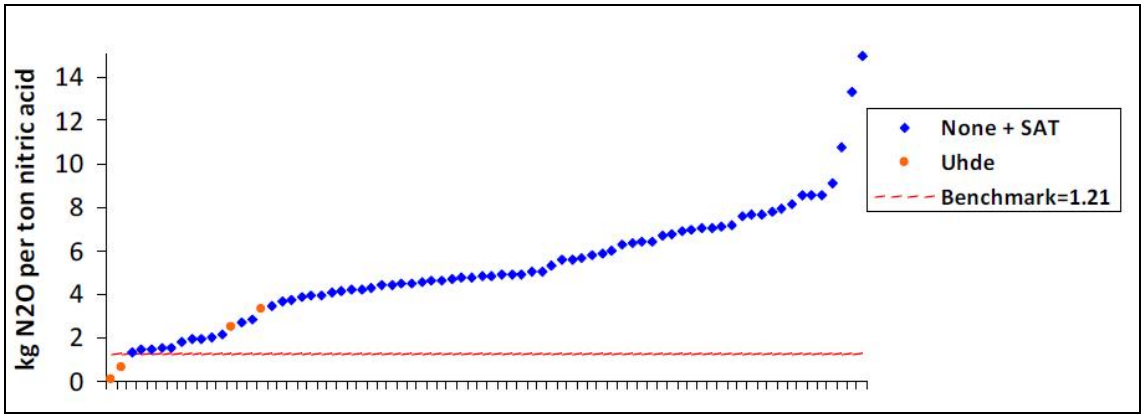
Source: *Calculations by Öko-Institut/ETC-ACC/EEA, based on UNFCCC (2010)*

4.2 Discussed benchmark values for production of nitric acid

The discussion about benchmarking in the EU-ETS allows some very interesting insight in the implied emission factors of all plants producing nitric acid in the EU-27. The EU-ETS directive states that the starting point to determine the benchmarks should be the average implied emission factors of the 10 % most efficient installations in the EU-27 (EU 2009, Article 10a, paragraph 2). The benchmarks for free allocation in the EU-27 will be agreed in comitology by 31 December 2010.

The information provided in Figure 4-2 shows the data that is currently available. Based on that information the benchmark would be 1.21 kg N_2O /t nitric acid produced, because these are the average emissions of the 10 % most efficient installations. However the discussion about benchmarks for free allocation could also lead to a lower benchmark. The most efficient plant in the EU-27 operates with so called “Uhde” technology. The implied emission factor of this plant is less than 0.3 kg N_2O per ton nitric acid produced. Since the discussion about final benchmark values will not be decided by the end of the year 2010 two scenarios are developed. In the first scenario the benchmark of 1.21 kg N_2O /t nitric acid is used to calculate the cap adjustment whereas the second scenario uses a benchmark of 0.3 kg N_2O /t nitric acid to calculate the cap adjustment.

Figure 4-2 *Implied emission factors of N_2O from nitric acid production plants in 2007/2008 in the EU-27*



Source: *Ecofys, FH-ISI, Öko-Institut 2009b*

4.3 Proposed cap adjustment for nitric acid production

Based on the implied emission factors reported in the inventories and the benchmark values under discussion in the EU-ETS it is possible to make recommendations for an appropriate cap adjustment for N_2O emissions from nitric acid production. On average the cap adjustment in the EU-ETS for nitric acid production should be 6 % if a benchmark of 0.3 kg N_2O /t nitric acid is applied and should be 24 % of the historic emissions in the EU-27[4] in the year 2007 and 2008 if a benchmark of 1.21 kg N_2O /t nitric acid is applied. The results are different for the EU-27 Member States. The results of the calculation are summarised in Table 3. No results are given for Austria and the Netherlands as their nitric acid production is already opted in the EU-ETS in phase II of the EU-ETS.

[4] Excluding emissions from Austria and the Netherlands. The nitric acid production from these states was already opted in the EU-ETS in phase II of the EU-ETS.

Table 3 *Calculated range of cap adjustment according to Article 9a due to the inclusion of nitric acid production*

	historic data				calculated cap adjustment as % of historic emissions		calculated cap adjustment in Mt CO_2 eq.	
	average emissions in 2005-2008	average emissions in 2007/2008	specific emissions 2005-2008	specific emissions 2007/2008	benchmark 1.21 kg N_2O/ t nitric acid	benchmark 0.3 kg N_2O/ t nitric acid	benchmark 1.21 kg N_2O/ t nitric acid	benchmark 0.3 kg N_2O/ t nitric acid
	Mt CO_2eq	Mt CO_2eq	kg N_2O/t	kg N_2O/t	%	%	Mt CO_2eq	Mt CO_2eq
Austria	already opted in							
Belgium	1.98	1.39	3.44	2.45	49%	12%	0.685	0.170
Bulgaria	1.01	1.07	6.00	6.00	20%	5%	0.216	0.054
Cyprus	no value	no value	no value	no value	no value	no value	no value	no value
Czech Republic	0.80	0.68	4.80	4.16	29%	7%	0.199	0.049
Germany	3.20	3.01	3.87	3.54	34%	8%	1.028	0.255
Denmark	no value	no value	no value	no value	no value	no value	no value	no value
Spain	1.15	0.99	5.23	5.07	24%	6%	0.236	0.059
Estonia	no value	no value	no value	no value	no value	no value	no value	no value
Finland	1.53	1.52	8.12	7.88	15%	4%	0.233	0.058
France	3.53	3.09	4.56	4.09	30%	7%	0.914	0.226
United Kingdom	1.75	1.61	3.72	3.59	34%	8%	0.544	0.135
Greece	0.45	0.40	7.00	7.00	17%	4%	0.070	0.017
Hungary	1.02	0.46	7.28	3.41	35%	9%	0.161	0.040
Ireland	no value	no value	no value	no value	no value	no value	no value	no value
Italy	1.10	0.73	6.70	4.69	26%	6%	0.189	0.047
Lithuania	2.25	2.49	7.00	7.00	17%	4%	0.431	0.107
Luxembourg	no value	no value	no value	no value	no value	no value	no value	no value
Latvia	no value	no value	no value	no value	no value	no value	no value	no value
Malta	no value	no value	no value	no value	no value	no value	no value	no value
Netherlands	already opted in							
Poland	4.49	4.55	6.47	6.47	19%	5%	0.851	0.211
Portugal	0.45	0.46	no value	no value	no value	no value	no value	no value
Romania	2.63	2.62	9.14	9.17	13%	3%	0.346	0.086
Slovakia	1.48	1.49	9.30	9.60	13%	3%	0.187	0.046
Slovenia	no value	no value	5.14	no value	no value	no value	no value	no value
Sweden	0.35	0.26	4.32	3.21	38%	9%	0.097	0.024
EU-27 w/o AT, NL	29.16	26.83	no value	no value	24%	6%	6.387	1.584

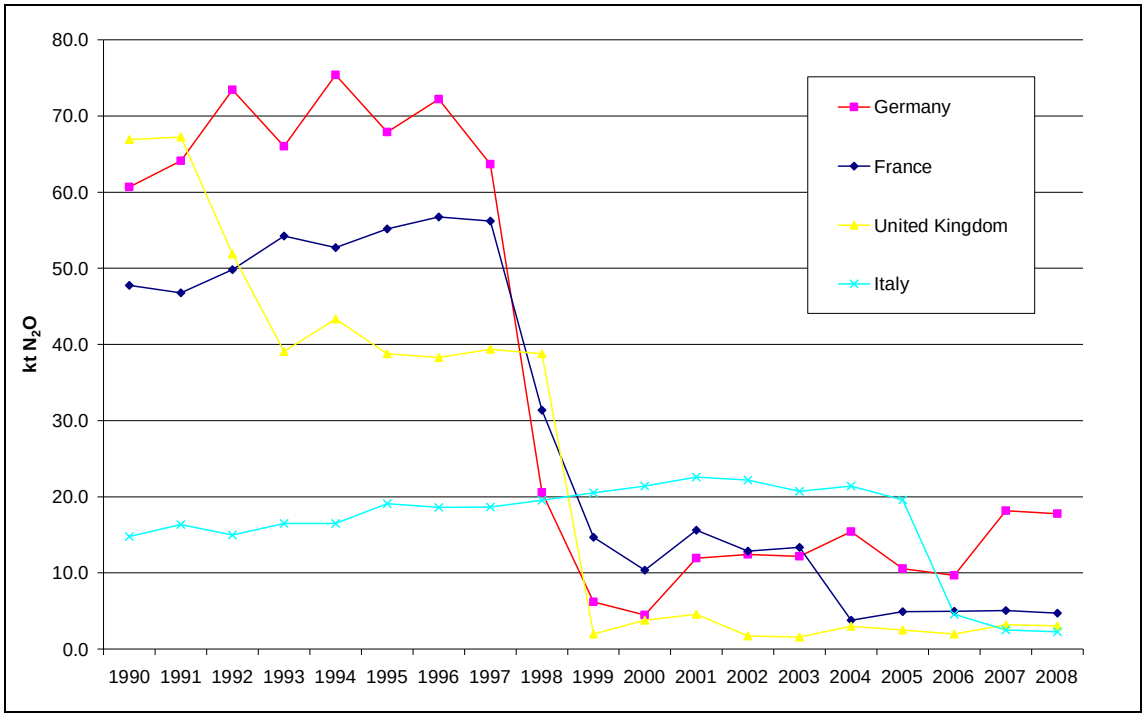
Source: *Calculations by Öko-Institut/ETC-ACC/EEA based on data from UNFCCC inventories, submission 2010 and Ecofys, FH-ISI, Öko-Institut 2009b*

5 Adipic acid

5.1 Production and emissions

Adipic acid is only produced in Germany, France, UK and Italy. The emissions of N_2O reported by these countries are presented in Figure 5-1. The decrease in emissions in France and Germany in 1998, in the UK in 1999 and in Italy in 2006 can be explained by installation of abatement technology.

Figure 5-1 *Emissions of N_2O from of adipic acid production from EU Member States.*



Source: *UNFCCC (2010)*

Other countries such as Romania and Poland do not report emissions from adipic acid production anymore (Table 4). The production was probably closed.

Table 4 Emissions from adipic acid production in the EU

Party	1990	2000	2005	2006	2007	2008
			Mt CO_2 eq			
Austria	NO	NO	NO	NO	NO	NO
Belgium	NO	NO	NO	NO	NO	NO
Bulgaria	NO	NO	NO	NO	NO	NO
Cyprus	NO	NO	NO	NO	NO	NO
Czech Republic	NO	NO	NO	NO	NO	NO
Germany	18.8	1.4	3.3	3.0	5.6	5.5
Denmark	NO	NO	NO	NO	NO	NO
Spain	NA	NA	NA	NA	NA	NA
Estonia	NO	NO	NO	NO	NO	NO
Finland	NO	NO	NO	NO	NO	NO
France	14.8	3.2	1.5	1.5	1.6	1.5
United Kingdom	20.7	1.2	0.8	0.6	1.0	0.9
Greece	NO	NO	NO	NO	NO	NO
Hungary	NO	NO	NO	NO	NO	NO
Ireland	NO	NO	NO	NO	NO	NO
Italy	4.6	6.6	6.1	1.4	0.8	0.7
Lithuania	NO	NO	NO	NO	NO	NO
Luxembourg	NO	NO	NO	NO	NO	NO
Latvia	NO	NO	NO	NO	NO	NO
Malta	NO	NO	NO	NO	NO	NO
Netherlands	NO	NO	NO	NO	NO	NO
Poland	0.4	NO	NO	NO	NO	NO
Portugal	NO	NO	NO	NO	NO	NO
Romania	0.6	0.9	NO	NO	NO	NO
Slovakia	NO	NO	NO	NO	NO	NO
Slovenia	NO	NO	NO	NO	NO	NO
Sweden	NO	NO	NO	NO	NO	NO
EU-27	59.9	13.3	11.6	6.6	9.0	8.6

Source: *UNFCCC (2010), Calculations by Öko-Institut/ETC-ACC/EEA*

Unfortunately Germany, France and the UK do not publish production figures due to confidentiality reasons. An implied emission factor per tonne of adipic acid produced is only provided by Italy. The Italian implied emission factor decreased from 300 kg N_2O /t adipic acid produced in 1990 to 30 kg N_2O/t adipic acid produced in 2008.

5.2 Discussed benchmark values for the production of adipic acid

Often there are only 1 or 2 adipic acid production plants in one country. Since the number of plants is so limited the operators of these plants did not provide a benchmarking curve due to confidentiality reasons (Ecofys/FH-ISI 2009b). The discussed benchmarking values for adipic acid production in the Ecofys/FH-ISI/Öko-Institut (2009b) study have been deduced from literature values. The benchmark value proposed by Cefic (the European Chemical Industry Council) is based on an abatement efficiency of 90% (30 kg N_2O /t adipic acid). The benchmark value deducted from the BREF notes[5] (based on an abatement technology efficiency of 98%) leads to a benchmark value of 6 kg N_2O /t

[5] According to the IPPC directive documents summarising the best available technology are prepared. These are called BREF notes.

adipic acid (Ecofys/FH-ISI 2009b). In Italy the implied emission factor can be calculated for all years based on data available in the inventories. For Germany, France and UK production data is unfortunately confidential. Therefore the implied emission factors of adipic acid production in Germany, France and UK have to be approximated by dividing the N_2O emissions reported in the inventories for the year 2005 and production data for the year 2005 from the most recent GAINS projections (Table 5). The implied emission factor for the year 2005 is about 9 kg N_2O /t adipic acid in the UK, 20 kg N_2O /t adipic acid in France and 34 kg N_2O /t adipic acid in Germany. It has to be noted that these values are only an approximation of the reality. This means that the following results for adipic acid should be interpreted with care. This indicates that the benchmark proposed by the chemical industry would lead to an over allocation for plants in France and the UK.

However, there are indications that in the years 2008 and 2009 abatement technology was installed in some facilities that lead to further emission reductions. The implied emission factor reported by an adipic acid production plant in Krefeld, Germany, that hosts a JI-project is reported to be only 0.05 kg N_2O /t adipic acid (Lanxess 2009). If CO_2 emissions from natural gas combustion are taken into account as well the implied emission factor of the adipic acid production plant in Krefeld increases to about 1 kg N_2O eq/t adipic acid (0.32 t CO_2 eq./ t adipic acid). The natural gas is used as a fuel in the catalyst. There are also JI-projects planned for other adipic acid production facilities (e.g. BASF in Ludwigshafen). In order to reflect this new development a sensitivity calculation was done using a benchmark of 1 kg N_2O eq/t adipic acid.

5.3 Proposed cap adjustment for adipic acid production

Given the fact that JI projects will lead to further emission reductions for adipic acid production it seems inappropriate to use the benchmark proposed by the chemical industry to calculate a cap adjustment for adipic acid production; it is higher than the historic emissions in most cases. Instead, the specific emissions of the benchmark value based on the BREF document and a benchmark value based on the performance of the Lanxess plant in Krefeld are used.

On average the cap adjustment in the EU-ETS for adipic acid production should be in the range of 3 % to 20 % of the average historic emissions in the EU-27 in the year 2007 and 2008 depending on the assumed abatement technologies (assumed benchmark). The assumed abatement technology has a huge influence on the results. In Germany the abatement potential is highest. However it is to be noted that it was only possible to approximate the implied emission factors based on data from GAINS. It was not possible to calculate exact figures. The results of the calculation are summarised in Table 5. No cap adjustment for UK was calculated as adipic acid production in the UK was closed in 2008.[6]

[6] E-mail from Thomas Dubois from Koch Industries at the 23rd of February 2010, the mother company of Invista. Invista produced Adipic Acid in the UK.

Table 5 *Calculated range of cap adjustment according to Article 9a due to the inclusion of adipic acid production*

	historic data			calculated cap adjustment as % of historic emissions		calculated cap adjustment in Mt CO_2 eq.	
	average emissions in 2005-2008 Mt CO_2eq	average emissions in 2007/2008 Mt CO_2eq	specific emissions 2005 kg N_2O/t	benchmark 6 kg N_2O/ t adipic acid %	benchmark 1 kg N_2O/ t adipic acid %	benchmark 6 kg N_2O/ t adipic acid Mt CO_2eq	benchmark 1 kg N_2O/ t adipic acid Mt CO_2eq
Germany	4.35	5.56	34.09	18%	3%	0.979	0.163
France	1.52	1.52	19.61	31%	5%	0.464	0.077
United Kingdom	production closed in 2008						
Italy	2.25	0.74	30.00	20%	3%	0.149	0.025
EU-27 w/o UK	8.12	7.82	29.49	20%	3%	1.592	0.265

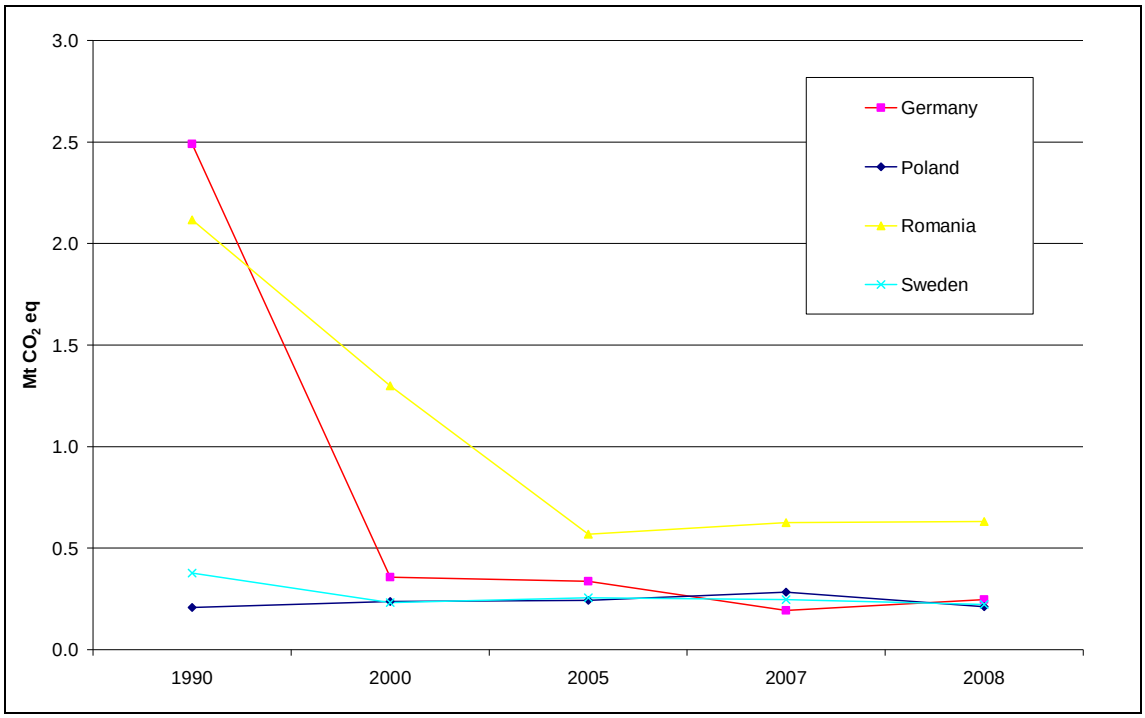
Source: *Calculations by Öko-Institut/ETC-ACC/EEA based on data from UNFCCC inventories, submission 2010 and Ecofys, FH-ISI, Öko-Institut 2009b*

6 Aluminium

6.1 Production and emissions

The most relevant emitters of PFC are Romania, Poland, Sweden and Germany (emissions in these countries where higher than or equal to 200 kt CO_2 eq. in 2007). The emissions reported by these countries are presented in Figure 6- 1. Emission data for all countries is included in Table 6.

Figure 6- 1 Emissions of PFC from aluminium production in the EU-27



Source: *UNFCCC (2010)*

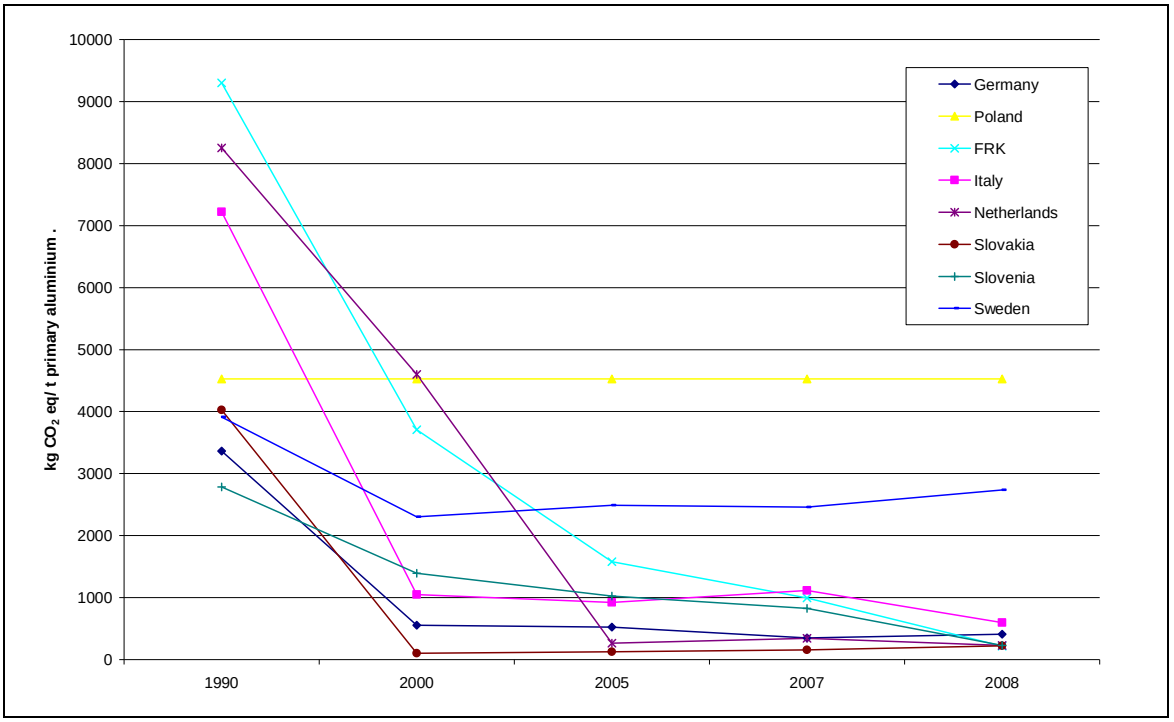
Table 6 Emissions of PFC from aluminium production in the EU-27

Party	1990	2000	2005	2007	2008
			Mt CO_2 eq		
Austria	1.05	NO	NO	NO	NO
Belgium	NO	NO	NO	NO	NO
Bulgaria	NA,NE,NO	NA,NE,NO	NA,NO	NA,NO	NA,NO
Cyprus	NO	NO	NO	NO	NO
Czech Republic	NO	NO	NO	NO	NO
Germany	2.49	0.36	0.34	0.19	0.25
Denmark	NO	NO	NO	NO	NO
Spain	0.88	0.37	0.14	0.12	0.12
Estonia	NO	NO	NO	NO	NO
Finland	NO	NO	NO	NO	NO
France	3.03	1.62	0.70	0.43	0.09
United Kingdom	1.33	0.26	0.06	0.08	0.12
Greece	0.26	0.15	0.07	0.06	0.07
Hungary	0.27	0.21	0.21	NO	NO
Ireland	NO	NO	NO	NO	NO
Italy	1.67	0.20	0.18	0.20	0.11
Lithuania	NO	NO	NO	NO	NO
Luxembourg	NO	NO	NO	NO	NO
Latvia	NO	NO	NO	NO	NO
Malta	NO	NO	NO	NO	NO
Netherlands	2.25	1.39	0.09	0.10	0.07
Poland	0.21	0.24	0.24	0.28	0.21
Portugal	NE	NO	NO	NO	NO
Romania	2.12	1.30	0.57	0.63	0.63
Slovakia	0.27	0.01	0.02	0.02	0.04
Slovenia	0.26	0.11	0.12	0.09	0.02
Sweden	0.38	0.23	0.26	0.25	0.22
EU-27	16.46	6.44	3.00	2.46	1.95

Source: *UNFCCC (2010)*

Based on production data and the emissions data as reported in the inventories the implied emission factors can be calculated. Most countries report implied emission factors of less than 1 t CO_2 eq. /t aluminium produced in 2008 (Figure 6-2). Only Poland and Sweden report figures that are considerably higher. Sweden reported implied emission factors of 2.7 t CO_2 eq. /t aluminium produced in 2008. Poland uses standard emission factors of the IPCC 2000 to estimate the PFC emissions from primary aluminium production (Polish NIR 2009).

Figure 6- 2 *Implied emission factors of PFC from aluminium production in the EU-27*

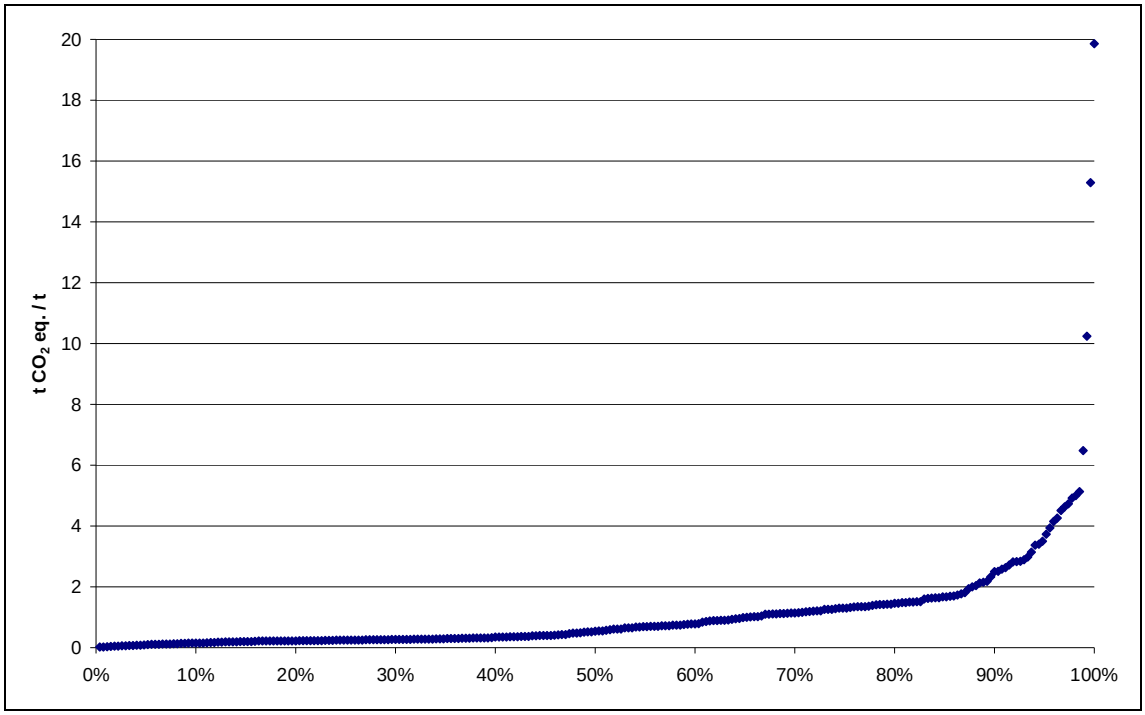


Source: *Calculations by Öko-Institut/ETC-ACC/EEA based on data from UNFCCC inventories, submission 2010*

6.2 Discussed benchmark values for aluminium production

The benchmarking values presented by Ecofys/FH-ISI (2009c) only include a benchmarking value for primary aluminium production that includes both direct CO_2 emissions and emissions from PFCs. Therefore, other ways need to be explored to estimate the abatement potential only for PFCs. The International Aluminium Institute publishes plant specific data for most of the aluminium production plants worldwide (IEA 2009). Unfortunately only very few installations from China reported their emissions. With the data of the reporting installations (these represent 60 % of all installations worldwide) a benchmarking curve can be constructed.

Figure 6- 3 *Implied emission factors of PFC from aluminium production of all installations reporting to the international Aluminium Institute (worldwide benchmark curve)*



Source: *Calculations by Öko-Institut/ETC-ACC/EEA based on implied emission factors reported by 270 primary aluminium smelters published by IAI 2009*

The 10 % most efficient installations in 2008 had average implied emission factors of only 0.09 t CO_2 eq. / t aluminium. It can be assumed that the efficiency achieved worldwide is a good proxy for the efficiency that can also be achieved by European producers. Therefore 0.09 t CO_2 eq. / t aluminium is used as an estimate for the cap adjustment for Member States.

6.3 Proposed cap adjustment for aluminium production

The cap adjustment in the EU-ETS for aluminium production should be in the range of only 2 % for Poland up to 17 % for Slovakia. The results of the calculation are summarised in Table 7.

Table 7 Calculated cap adjustment according to Article 9a due to the inclusion of aluminium production

	historic data				calculated cap adjustment as % of historic emissions	calculated cap adjustment in Mt CO_2 eq.
	average emissions in 2005-2008 Mt CO_2eq	average emissions in 2007/2008 Mt CO_2eq	specific emissions 2005-2008 t CO_2 eq /t	specific emissions 2007/2008 t CO_2 eq /t	benchmark 0.09 t CO_2 eq./ t aluminium %	benchmark 0.09 t CO_2 eq./ t aluminium Mt CO_2eq
Germany	0.24	0.22	0.41	0.38	24%	0.052
Spain	0.13	0.12	1.08	0.98	9%	0.011
France	0.45	0.26	1.03	0.61	15%	0.038
United Kingdom	0.10	0.10	0.28	0.30	30%	0.031
Greece	0.07	0.07	1.08	0.98	9%	0.006
Italy	0.16	0.16	0.86	0.86	11%	0.016
Netherlands	0.08	0.09	0.26	0.29	31%	0.027
Poland	0.25	0.25	4.53	4.53	2%	0.005
Romania	0.61	0.63	1.08	0.98	9%	0.058
Slovakia	0.03	0.03	0.18	0.19	48%	0.015
Slovenia	0.09	0.06	0.76	0.53	17%	0.009
Sweden	0.24	0.23	2.52	2.60	3%	0.008
EU-27	2.50	2.20	1.08	0.98	9%	0.202

Note: *The implied emission factors for Spain, Greece and Romania were not available. They have been approximated with the EU-27 average.*

Source: *Calculations by Öko-Institut/ETC-ACC/EEA based on data from UNFCCC inventories, submission 2010 and Ecofys, FH-ISI, Öko-Institut 2009a*

7 Conclusions

There are still impressive abatement potentials for the emissions of non-CO_2 gases from installations that will be included in the EU-ETS from 2013 onwards. In order to maintain the environmental integrity of the EU-ETS Member States should take this into account when they notify a cap increase for the inclusion of non-CO_2 gases. Based on the results in this technical paper recommendations for the cap adjustment can be made for most countries. The total emissions of N_2O and PFCs from nitric acid production, adipic acid production and aluminium production are reported to be 39 Mt. CO_2 eq. in the EU-27 inventories in 2007 and 35 Mt. CO_2 eq. in 2008 (Table 8).

Table 8 Comparison of historic emissions and appropriate cap adjustment

	1990	2000	2005	2006	2007	2008	cap adjustment with normal benchmarks	cap adjustment with ambitious benchmarks
	Mt CO_2 eq							
Nitric acid w/o AT, NL	43.67	39.76	33.31	29.68	28.66	24.99	6.39	1.58
Adipic acid w/o UK	39.14	12.10	10.87	5.96	7.98	7.67	1.59	0.27
Aluminium	16.46	6.44	3.00	2.58	2.46	1.95	0.20	0.20
Total	99.27	58.30	47.18	38.22	39.10	34.60	8.18	2.05

Note: *Emissions from Nitric Acid do not include data for Austria and the Netherlands as these installations were already opted in the EU-ETS in phase II. Emissions from Adipic Acid do not include data for the United Kingdom as production was closed down in 2008.*

Source: *Calculations by Öko-Institut/ETC-ACC/EEA*

Based on the calculations in this technical paper the total cap adjustment could be as low as 2 Mt. CO_2 eq. if Member States would take ambitious benchmarks to calculate the cap adjustment. The cap adjustment could be 8 Mt. CO_2 eq. in the EU-27 if Member States would take benchmarks with a normal ambition. These results indicate an EU-ETS cap increase of less then 20 % of the historic emissions reported in the inventories.

8 Abbreviations

AAU	Assigned amount units
BREF	Best Available Techniques Reference Document
C	Notation key: Confidential
CDM	Clean Development Mechanism
CER	Certified emission reduction
CITL	Community independent transaction log
CO_2	Carbon dioxide
CO_2 eq.	Carbon dioxide equivalent
EEA	European Environment Agency
ERU	Emission reduction unit
ESD	Effort Sharing Decision
ETS	Emissions Trading Scheme
EU	European Union
EU-27	Austria (AUT), Belgium (BEL), Bulgaria (BGR), Cyprus (CYP), Czech Republic (CZE), Denmark (DNK), Estonia (EST), Finland (FIN), France (FRA), Germany (DEU), Greece (GRC), Hungary (HUN), Ireland (IRL), Italy (ITA), Latvia (LVA), Lithuania (LTU), Luxemburg (LUX), Malta (MLT), the Netherlands (NLD), Poland (POL), Portugal (PRT), Romania (RO), Slovakia (SVK), Slovenia (SVN, Spain (ESP), Sweden (SWE) and the United Kingdom (GBE)
EU-ETS	European Emissions Trading Scheme
EUA	Allowance under the EU ETS
GHG	Greenhouse gas
IE	Notation key: Included elsewhere
JI	Joint Implementation
kg	kilogramme
kt	kilo tons (1000 tons)
Mt.	Million tons
N_2O	Nitrous Oxide
NO	Notation key: Not occurring

NE	Notation key: Not estimated
NA	Notation key: Not applicable
NSCR	Non-selective catalytic reduction
NO	Notation key: Not occuring
Non-ETS	Sectors not covered by the European Emissions Trading Scheme
PFCs	Perfluorocarbons
t	ton

9 References

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