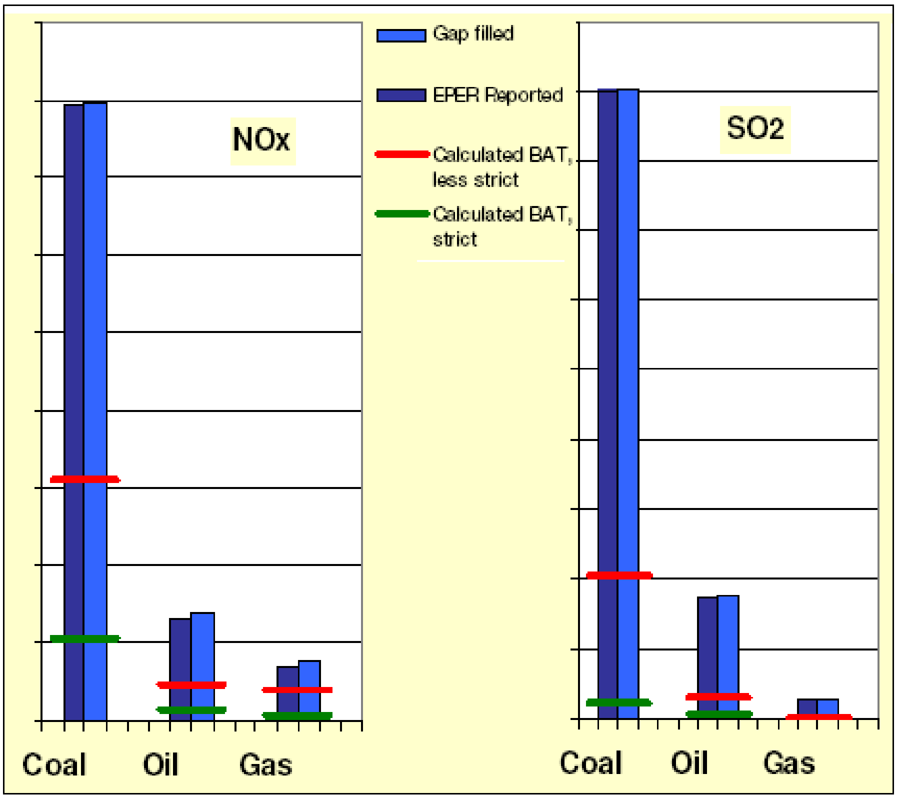
Statistical analyses on EPER data to identify potential theoretical IPPC benefits
–
preliminary results



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1 Introduction

This study is part of the work being carried in the context of the IPPC Review to contribute to a policy effectiveness analysis of the IPPC Directive. Since in the Directive no measurable environmental objectives are included (i.e. no targets or deadlines are included as objectives, no estimation of the potential outcome of BAT implementation is available); the challenge consists of quantifying the theoretical potential environmental benefits of the implementation of BAT and compare them with the emissions data reported under EPER.

The current report concentrates on the emission reductions that might be achieved on a national and EU scale by full implementation of Best Available Techniques (BAT) in individual combustion installations following the conclusions in the BREF[1] documents.

The results in this report are based on the EPER 2001 dataset which is currently availble for analysis. In January 2007 the analysis will be expanded by using the 2004 data in EPER and an uncertainty analysis will be carried out.

The study does not deal with the legal implementation of the IPPC provisions in national law or in actual permits issued under national regulations. It is assumed that these provisions are implemented in all Member States.

In parallel to this study, IIASA is performing a similar assessment for the combustion sector using the RAINS model.

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[1] Best Available Techniques reference documents

2 Approach

2.1 Identifying the main fuel types of the LCPs in EPER

The EPER data set[2] contains emission data on 9733 facilities. In 1232 of these, Annex 1 activity 1.1, Combustion installations > 50 MW were reported, in 880 facilities this activity was marked as "main activity".

In EPER no information is included on the type of fuel being used in these combustion facilities. Therefore additional data from the SENCO database [Ref 1] were used to identify the main type of fuel combusted in the "large combustion plant (LCP) facilities. The SENCO database labels facilities as coal-, oil- or gas fired power plants. By using this fuel type information, the uncertainty in the result can be reduced compared to the results obtained through a statistical approach, where the type of fuel would be derived from the relative emissions of several pollutants.

With the SENCO database the main fuel usage of a large number of facilities was identified. The SENCO database provides information on the type of fuel for 354 out of the 880 facilities in EPER (main activity 1.1), see Table 2-1 below.

Table 2-1 Overview of available data through cross-linking EPER facilities with combustion (activity 1.1) as main activity and installations in the SENCO database

Fuel type (SENCO)	**Number of EPER Annex 1.1 facilities linked to SENCO fuel type**	**Of which reporting (in EPER)**				
		CO_2	**NOx**	**SO_2[3]**	CO_2 and NO_x	CO_2, NO_x and SO_2
Known fuel type						
• Natural gas	92	92	85	17	85	17
• Oil	66	66	56	47	56	46
• Coal	196	196	190	170	190	168
Total	354	354	331	234	331	231
Unknown	526					
Total	880					

There is quite a number of facilities where the SENCO database did not identify the type of fuel used (the 526 unknown in Table 2-1). However, because SENCO uses the IAECR coal power station database [Ref 3], we can assume that most, if not all coal fired LCPs in EPER are included (196). The remaining facilities which are labelled as "unknown fuel" will therefore most probably be oil or gas fired. Since the type of fuel is not known, these facilities however are not included in the analysis.

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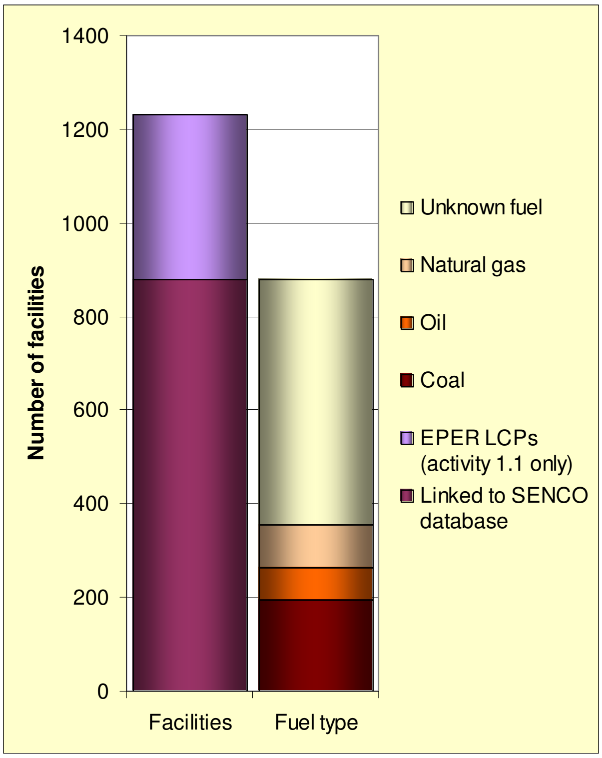
[2] For this analysis we used the data set as available to TNO for the drafting of the 2004 EPER Review report. For some countries, data have been updated slightly since then.

[3] This report uses SO_2 when addressing the emission of sulphur oxides, in EPER these are referred to as SOx.

The facilities included in the evaluation are the EPER facilities with main activity 1.1 (Annex 1 of EPER) for which the fuel type could be identified through a cross-linking with the SENCO database. The total number of facilities included in the evaluation is: 354, being 41% of the total number of facilities in EPER reporting emissions which have as main activity 1.1. See Table 2-1. Table 2-2 provides the percentage of the EPER combustion plant emissions included in the facilities used in this study.



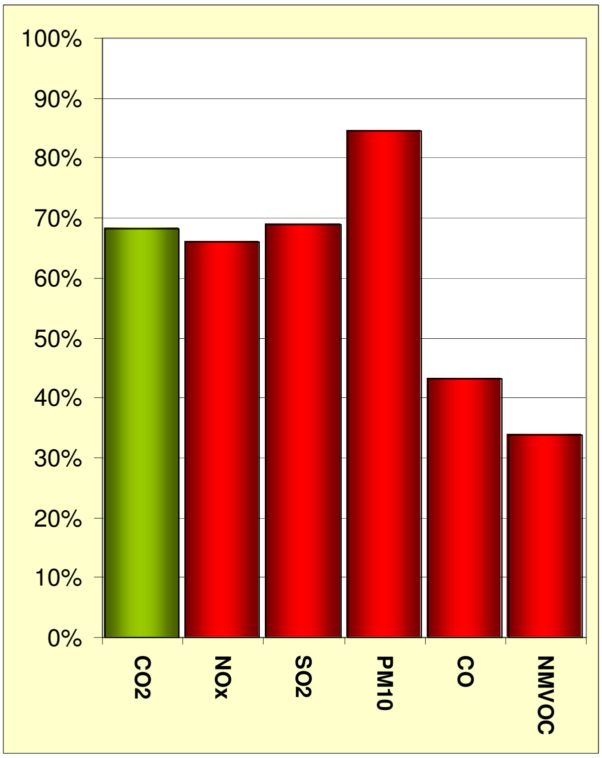


Figure 1 Number of EPER facilities selected (linked to a fuel type) in relation to all 880 combustion (activity 1.1) facilities (left) and coverage of emissions by selection (right)

Table 2-2 Emissions of the 354 EPER facilities selected (linked to a fuel type) in relation to all 880 combustion (activity 1.1) facilities (kg)

Pollutant	Emission from selected facilities	Total reported emission of all Annex 1.1 facilities (activity 1.1 as main activity)	% coverage of selection
CO	128 941 000	298 232 000	43%
CO2	667 840 000 000	977 563 000 000	68%
NMVOC	3 085 000	9 119 000	34%
NOx	992 619 000	1 506 361 000	66%
PM10	65 535 300	77 397 600	85%
SO_2	2 210 226 000	3 212 008 000	69%

2.2 Estimation of the quantity of fuel combusted by the LCPs

The SENCO database does contain data on the volume of fuel combusted. The origin of these data however is not clear to us. In addition a number of records in the database has information on the installed capacity, but browsing through these data showed that it is limited and probably not very reliable.

To estimate the quantity of fuel used in each of these facilities, we calculated the fuel use from the CO_2.emissions reported under EPER and the fuel specific emission factors. For each of the facilities the fuel types used are derived from the link with the SENCO database. The emission factors used are given in Table 2-3. CO_2 emission factors are rather precise and therefore the estimate of the fuel volumes combusted are preferred over the data as available in the SENCO database.

Table 2-3 Fuel dependent CO_2 emission factors (g/GJ)

		Pollutant					
Fuel	**Capacity**	**CO**	**CO2**	**NMVOC**	**NOx**	**PM10**	**SO_2**
Coal	50 - 100	89.1	95000 (89500 - 99700)	29.7	123	91.7	26.1
	100 - 300						
	> 300				116		
Gas	50 - 100	13.8	55000 (54300 - 58300)	5	133	0.175	
	100 - 300						
	> 300	14.5			151		
Oil	50 - 100	15.7	77000 (75500 - 78800)	9.23	180	19.5	0.5
	100 - 300						48.8
	> 300			10	208		42
	Source	Corinair Guidebook	IPCC 2006 Guidelines	Corinair Guidebook	Corinair Guidebook	CEPMEIP	BREF LCP (typical) emissions

2.3 Gap filling: estimating emissions not reported by the facilities

The analysis includes the emissions to air of CO_2, NO_x, SO_2, NMVOC, CO, and PM_{10}. However, out of the 354 facilities included in this analysis, a certain number does not report emissions for the pollutants NOx, SO_2, NMVOC, CO, and PM_{10} (Table 2-1). The emissions of these pollutants might be below the threshold and therefore need not to be reported. Since we now have estimated fuel combusted for each facility, we are able to estimate emissions not reported by each facility using the emission factors of Table 2-3 and check whether or not these emissions indeed might be below the EPER threshold[4] (and therefore reported under EPER).

To select emission factors from the table above, a capacity range for each of the individual facilities must be selected. Since the capacity information in the SENCO database is rather incomplete and contains a number of problems, we derived the

[4] EPER decision (2000/479/EC), Annex A1

capacity class from the estimated fuel combusted, assuming a load of each combustion plant of 5000 hours per year. We believe that this is a realistic estimate for coal and probably also oil fired LCPs, since most of these will be used in base load applications.

Table 2-4 provides an overview of the number of facilities within the selected set of EPER facilities that should have reported emissions, but did not do so (“missing”). This result should be regarded with care, since the estimate will have a relatively high uncertainty. Nevertheless, it can be concluded that for this set of facilities:

- Reporting of NOx and SO_2 seems to be rather complete.
- For a considerable number of facilities, emission reports of CO, NMVOC and PM10 might be missing. In the case of PM10 these emissions may be abated since in quite a number of facilities dust filters might have been installed. Abatement techniques for CO and NMVOC however are much less penetrated in the combustion plants.

Table 2-4 Estimation of missing air pollutant reporting in the 2001 EPER data set (for the selected set of facilities)

NOx (threshold: 100 ton/yr)	**Gas**	**Oil**	**Coal**	**Total**
Reports	85 (of 92)	56 (of 66)	190 (of 196)	331 (of 354)
Reported emission (ton)	70 609	130 787	791 223	992 619
Estimated emission (ton)	77 498	138 437	794 655	1 010 589
Missing emission (ton)	6 889	7 650	3 432	17 970
SO_2 (threshold: 150 ton/yr)	**Gas**	**Oil**	**Coal**	**Total**
Reports	17 (of 92)	47 (of 66)	170 (of 196)	234 (of 354)
Reported emission (ton)	56 417	352 342	1 801 467	2 210 226
Estimated emission (ton)	56 417	356 197	1 805 436	2 218 051
Missing emission (ton)	-	3 855	3 969	7 825
NMVOC (threshold: 100 ton/yr)	**Gas**	**Oil**	**Coal**	**Total**
Reports	2 (of 92)	1 (of 66)	11 (of 196)	14 (of 354)
Reported emission (ton)	498	342	2 245	3 085
Estimated emission (ton)	6 465	10 291	145 841	162 596
Missing emission (ton)	5 967	9 949	143 596	159 511
PM10 (threshold: 50 ton/yr)	**Gas**	**Oil**	**Coal**	**Total**
Reports	4 (of 92)	14 (of 66)	91 (of 196)	109 (of 354)
Reported emission (ton)	925	3 095	61 515	65 535
Estimated emission (ton)	1 126	18 169	181 396	200 691
Missing emission (ton)	201	15 074	119 881	135 156
CO (threshold: 500 ton/yr)	**Gas**	**Oil**	**Coal**	**Total**
Reports	7 (of 92)	8 (of 66)	30 (of 196)	45 (of 354)
Reported emission (ton)	5 630	13 158	110 153	128 941
Estimated emission (ton)	20 873	21 447	363 470	405 790
Missing emission (ton)	15 243	8 289	253 317	276 849

Reports: Number of LCPs reporting emissions of the pollutant, number between brackets is total number of facilities
Reported emission: Reported emissions of the specific pollutant
Estimated emission: Estimated emissions above the EPER reporting threshold
Missing emission: Difference between estimated emissions and emissions reported under EPER

2.4 Review and estimate emissions corresponding to BAT performance for each facility

For all facilities the reported emissions were compared on a facility level with the emissions expected when using BAT, using the following approach:

1) Emissions which are not reported under EPER were estimated using the emission factors of Table 2-3.This might occur when emissions are below the EPER threshold values, but this is not necessarily the case. Table 2-4 shows that in a number of cases these emissions might be above threshold and should have been reported.

2) BAT emissions from all the facilities were estimated using the volume of the fuel combusted estimate, the main fuel type and the BAT associated (fuel-specific) emission factors. The BAT associated emission factors are derived from the BAT conclusions of the LCP BREF and associated emission levels for combustion installations, as shown in Annex I.

3) Wherever the reported emissions are already below the estimated BAT emissions, the reported emissions are used.

Notes:

- The IPPC BREF document for large combustion plants (BREF LCP, May 2005,[Ref 4]) does not define emission limit values, but instead refers to techniques which are considered as being BAT. For these BAT techniques associated emission levels (AELs) are given. For this analysis, the values intended to use in the RAINS estimation (see Annex 1) are being used for the BAT emission factors. The conversion of the AELs to fuel related emission factors is also described in Annex 1.
- BREF does not provide PM10 BAT AELs. We have assumed that the ”dust” emission factors in the BREF actually refer to PM10.

3 Result

3.1 Implied emission factors

The fuel combusted has been estimated on the basis of the CO_2 emissions and the fuel type as identified in the SENCO database. Since for all facilities NOx reporting is available and most facilities have also reported SO_2 emissions if these are above the thresholds, implied emission factors for SO_2 and NOx for these facilities can be calculated.

The low implied emission factors for SO_2 on the left side of in Figure 2 are due to combustion of natural gas. The frequency distribution of NO_x implied emission factors is very similar to the one reported by Pulles and Heslinga [Ref 5]

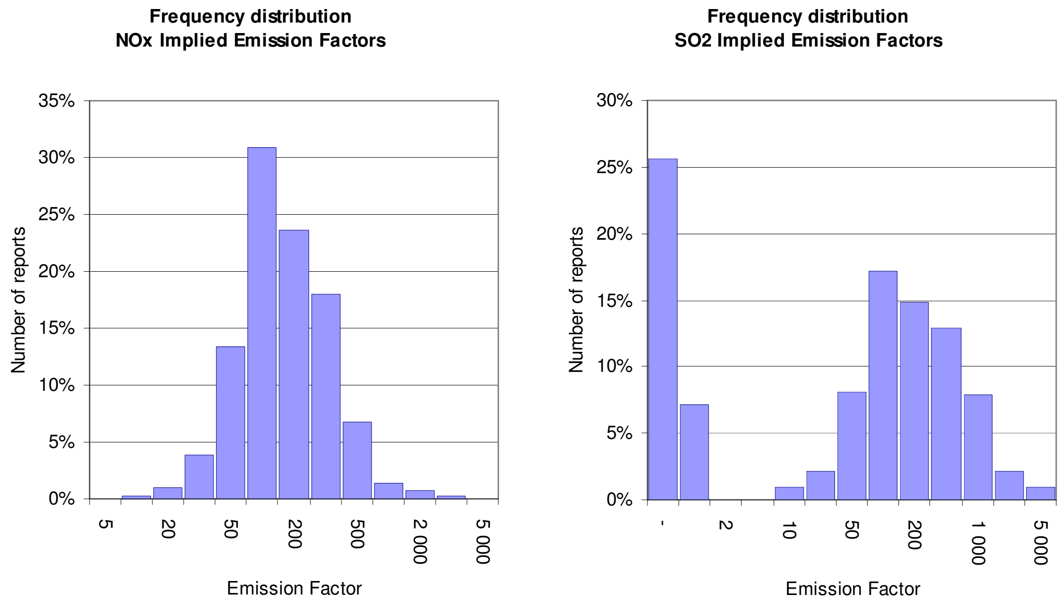


Figure 2 Implied emission factors for NO_x and SO_2 in the EPER facilities as reported in 2001

Comparison of the frequency distributions of implied emission factors for these pollutants with the ones for BAT as given in [Ref 4] shows that for both pollutants more than half of the facilities still have higher emission rates than what is complying with BAT:

- For NOx, BAT emission factors are in the order of 15 to 150 g/GJ, depending on fuel and plant capacity, whereas many implied emission factors are in the range above 50 g/GJ.
- For SO_2, BAT emission factors are in the same order of magnitude as the NOx ones, but many observed implied emission factors are above 100, or even above 1000 g/GJ.

The next paragraph describes the results of calculations estimating the potential emission decrease if all facilities would achieve BAT performance.

3.2 Implementation of BAT

3.2.1 *Above BAT emission*

Table 3-1 presents the number of facilities that show implied emission factors higher than the "BAT Less Strict" ones as derived in Annex 1. For each facility the implied emission factors were calculated by dividing the emission as reported for each pollutant by the estimated quantity of fuel used. These implied emission factors then are compared with the BAT, less strict emission factors derived in Annex 1. As is indicated in Table 2-1, not all facilities report emissions for every pollutant. Facilities that did not report a specific pollutant are not included in

The table shows that, in 2001, many facilities, reporting emissions of pollutants included in this study, operated in conditions that do not achieve the less strict BAT associated emissions levels as defined in the BREF document.

Table 3-1 Number of emission reports with emission factors above BAT, less strict.

Number of facilities	Gas	Oil	Coal	Total	Reported the pollutant
Reports	*92*	*66*	*196*	*354*	
of these:					
NOx reported above BAT less strict	65	48	167	280	331
SO2 reported above BAT less strict	17	43	112	172	234
PM10 reported above BAT less strict	4	12	53	69	109
NMVOC reported above BAT less strict	2	1	8	11	14
CO reported above BAT less strict	6	4	22	32	45

- The first row gives the total number of emission reporting facilities. Of these, the indicated number of facilities show implied emission factors above the BAT, less strict ones in Annex 1.
- The rightmost column gives the total number of facilities reporting emissions of each specific pollutant.

3.2.2 *NO_x and SO_2*

For NO_x and SO_2 the EPER dataset seems to be rather complete (Table 2-4). On the other hand the implied emission factors for many facilities seem to be higher than the emission factors associated with BAT techniques (Figure 2). Figure 3 and Figure 4 shows the results of the analysis for all LCPs included in this analysis. Figure 3 gives a total overview, whereas Figure 4 shows the cumulative distribution over all facilities.

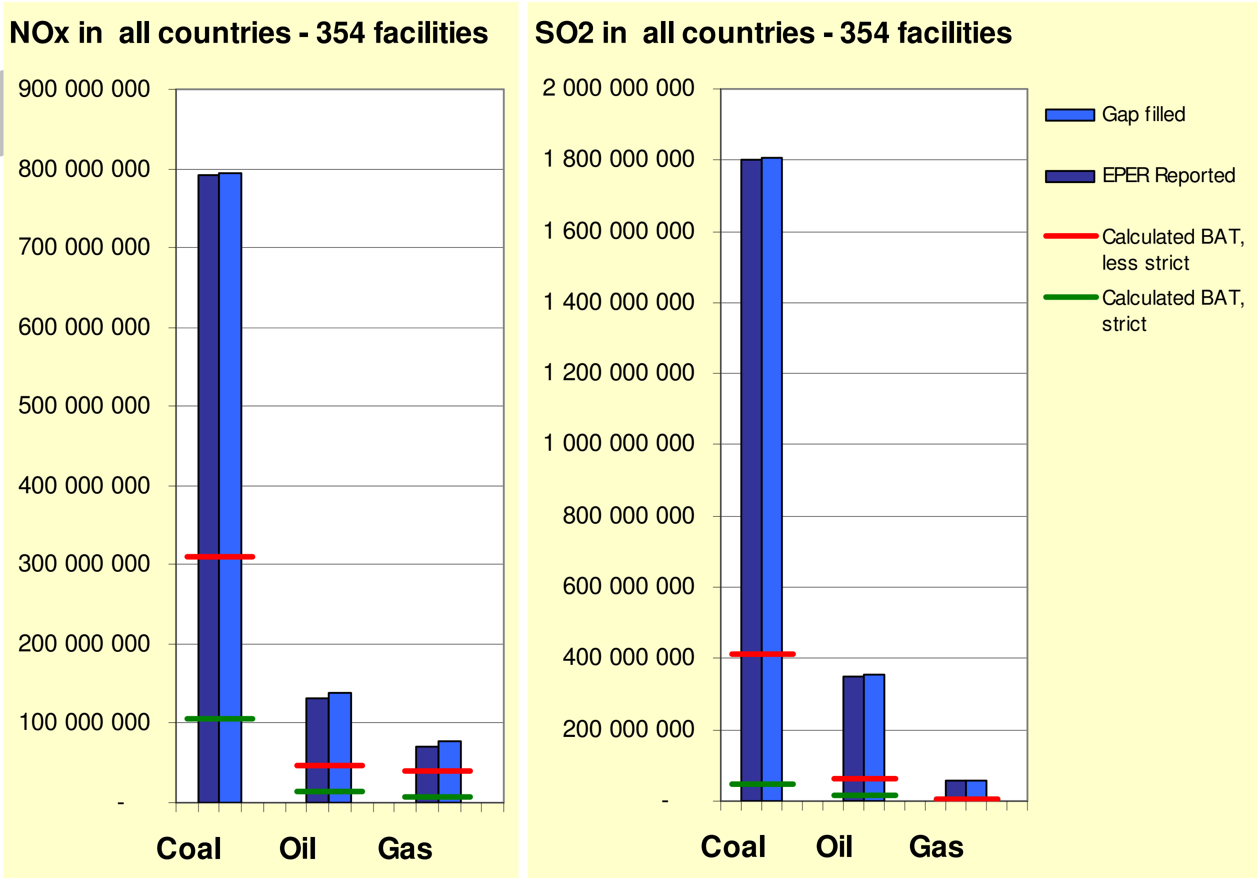


Figure 3 Reported emissions, gap filling and calculated BAT emissions for NO_x and SO_2

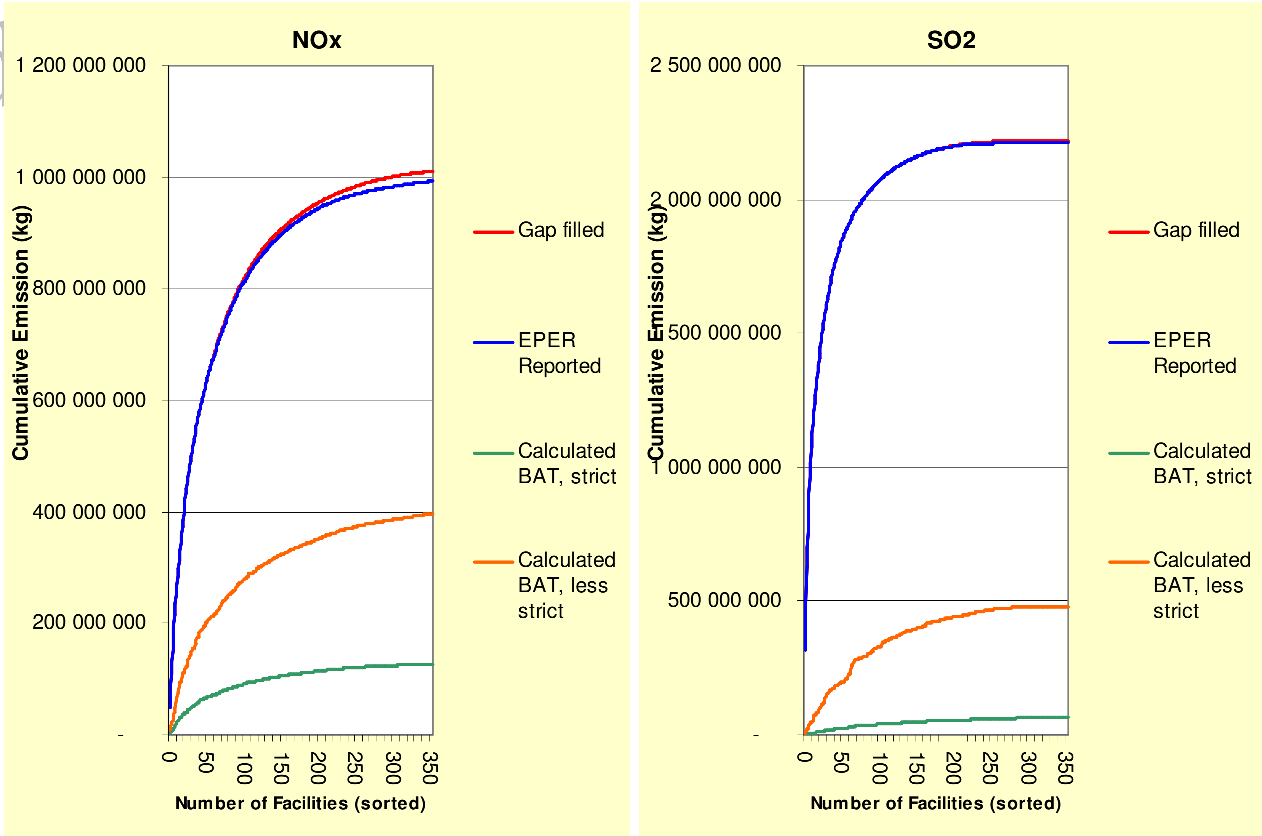


Figure 4 Reported cumulative emissions plotted, gap filling and calculated BAT emissions for NO_x and SO_2

We observe the following:

- The emissions of NOx from the large combustion plants, as reported in EPER 2001 would be more than a factor of two lower if all plants would perform according to BAT. In the more strict interpretation of the BAT the emissions could even be a factor of five lower.
- The effect of introducing BAT in all facilities would decrease the SO_2 emissions from the large combustion plants, included in EPER even further.
- Since the cumulative graph for SO_2 shows a steeper increase as compared to the graph for NO_x, it can be concluded that fewer facilities contribute to the SO_2 emissions than to the NO_x emissions. For NO_x the 25 largest facilities contribute 45 % of the emissions of the facilities falling under this analysis and for SO_2 68 %. The 50 largest contributing facilities show a share of 62 % for NO_x and 83 % for SO_2. For the 100 largest facilities these numbers are 80 % for NO_x and 93 % for SO_2. The potential reductions therefore can be achieved at fewer facilities for SO_2 as compared to NO_x.

In Annex 2 the analyses of Figure 3 the same analyses are shown for individual Member States. Although for some countries the number of LCPs included is rather small clear differences between countries are shown:

1) For some countries emission abatement at LCPs seem to be well on its way to fully implementing the BAT requirements. This is the case for

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NO_x	**SO_2**
Austria	Austria
Germany	Germany
Sweden	Sweden

2) For most other countries, emissions are much higher than the expected BAT performance with a factor of two to three if the less stringent BAT AELS ranges would be implemented.

Note: linking the SENCO database to the EPER facilities did not yield facilities in Luxemburg since these are not included in the EPER 2001 dataset.

3.2.3 *Other pollutants*

The level of reporting of the other pollutants (CO, NMVOC and PM10) is not very high (Table 2-4). To obtain a first estimate of the potential benefit of the introduction of BAT for these pollutants we "gap filled" the EPER data set, using the calculated fuel combusted and the emission factors as given in Table 2-3.

Table 3-2 presents the results of this analysis. As was observed above (Table 2-4) gap filling did not add significant emissions to the reported emissions of CO_2, NOx and SO_2. Our estimates for the emissions of CO, NMVOC and PM10 that are not reported in EPER amount to 62, 85 and 68% of the total emissions respectively.

The estimated PM10 emissions are also to be reviewed with care since abatement techniques as filters remove dust without influencing emissions of other components.

Table 3-2 Gap filling the EPER data set and analysis of the potential benefits of IPPC BAT implementation

	SO_2	**NOx**	**CO**	**PM10**	**NMVOC**
Reported in EPER (kton)	2210	993	129	66	3
Gap filled (ktons)	2218	1011	406	201	163
Not reported (%)	0.35%	1.8%	68%	67%	98%
With BAT (kton)	169	224	124	26	14
With less strict BAT (kton)	478	397	138	49	14
With more strict BAT (kton)	65	128	120	14	14

In Table 3-2 we also include an estimate of the expected emissions if BAT was introduced.. The estimated reductions, however reflect mainly the difference of the emission factors as given in Table 2-3. If we assume that these emission factors are realistic, considerable emission reductions are also possible for these pollutants.

4 Discussion

4.1 Applicability of the method

By combining emission data from the EPER data set with information on the fuel types, used in individual large combustion plants, we are able to estimate the fuel combusted in each of the individual facilities, using the reported CO_2 emissions. This approach could be used with 354 of the 880 combustion plants (main activity 1.1) in the 2001 EPER data set.

From the estimated fuel use and the reported NO_x and SO_2 emissions implied emission factors could be derived. The frequency distribution of observed NO_x emission factors is consistent with an earlier study [Ref 5]. Both frequency distributions of implied emission factors also show consistency with emission factors available in the EMEP/Corinair Guidebook.

From this we conclude that the approach could provide realistic results. However, the variability of emission factors is quite large, which might lead to considerable uncertainties. This variance is partly caused by the fact that some facilities will already have implemented abatement techniques, while others have not done so. The EPER data set does not provide the level of abatement already implemented at individual facilities. However, we could assume that those facilities that show the lower range of implied emission factors probably already have implemented such abatement techniques.

4.2 Completeness of reporting

Our gap filling procedure allows us to assess the completeness of reporting by individual facilities for the pollutants included in this report. The result of this analysis (Table 2-4) shows that reporting for CO_2, NOx and SO_2 is rather complete. Emission reports for CO, NMVOC and PM10 might be missing in many facilities. We estimated that, as a maximum, about two thirds of the emissions of CO and PM10 are not reported, although they could be above threshold.

4.3 Benefits of BAT introduction

When replacing the implied emission factors by the ones associated with BAT for NO_x and SO_2, we observe that the emissions from large combustion plants could still be considerably reduced. A decrease by a factor of two or more seems to be possible.

For SO_2 more than 50 LCPs show implied emission factors higher than 1000 g/GJ, whereas the BAT emission factors for this pollutant are in the order of 20 to 150 g/GJ. Introduction of abatement on these relatively few large facilities would already decrease the emissions considerably. Reporting for the other pollutants is not good enough to draw clear conclusions. Our conclusions would be drawn on the basis of assumed emission factors, rather than on the observed and reported emissions.

5 Signature

Apeldoorn, 09 December 2006 TNO Built Environment ad Geosciences

H.S. Buijtenhek Group leader	W.A.J. Appelman Author

6 References

[Ref 1] OJ L 257, 10.10.1996, p. 26-40

[Ref 2] SENCO database, LPS data for EU25, database received oct 24th, 2006, SENCO, Sustainable Environment Consultants (SENCO), UK

[Ref 3] IAECR database, The International Energy Agency Coal Research coal power station database

[Ref 4] IPPC Reference Document on Best Available Techniques for large combustion plants, (IPPC BREF LCP) may 2005

[Ref 5] Pulles T and D Heslinga, On the variability of air pollutant emissions from gas-fired industrial combustion plants, Atmospheric Environment, 38, 3829-3840, 2004

Annex 1 BAT associated emission factors derived from BAT emission values

The IPPC BREF document for large combustion plants (BREF LCP, May 2005, [Ref 4]) does not define emission limit values, but instead refers to techniques and associated emission levels (AEL's) which are considered as being BAT. For these BAT emission ranges are given. For this analysis the values intended to use in the RAINS estimation as described in the Technical Annex are being used for the BAT emission factors. The conversion of emission ranges to fuel related emission factors is done by assuming defaults for the amount of flue gasses generated by combustion of coal, oil and gas.

The AEL's are derived from the LCP BREF and consistent with the AEL's suggested by IIASA for use in the Rains assessment, see Table 6-1

Table 6-1 BAT associated emission levels (AEL's) in (mg/Nm3)

Pollutant	**Type**		**Fuel**		
		Capacity	**Coal**	**Gas**[5]	**Oil**
CO	AEL (BREF, less strict)	> 300	50	50	50
		100 – 300	50	50	50
		50 – 100	50	50	50
	AEL (BREF, strict)	> 300	50	5	50
		100 – 300	50	5	50
		50 – 100	50	5	50
NMVOC (BREF LCP, p 127)	AEL (BREF, less strict)	> 300	5	5	5
		100 – 300			
		50 – 100			
	AEL (BREF, strict)	> 300			
		100 – 300			
		50 – 100			
NO_x	AEL (BREF, less strict)	> 300	150	100	150
		100 – 300	200	100	200
		50 – 100	300	100	450
	AEL (BREF, strict)	> 300	50	20	50
		100 – 300	90	20	50
		50 – 100	90	20	150
Dust (PM10)	AEL (BREF, less strict)	> 300	20	5	20
		100 – 300	25	5	25
		50 – 100	30	5	30
	AEL (BREF, strict)	> 300	5	5	5
		100 – 300	5	5	5
		50 – 100	5	5	5
SO_2	AEL (BREF, less strict)	> 300	200	10	200
		100 – 300	250	10	250
		50 – 100	400	10	350
	AEL (BREF, strict)	> 300	20	10	50
		100 – 300	100	10	100
		50 – 100	150	10	100

The with BAT AELs (mg/Nm3) are converted to emission factors (g/GJ) using default flue gas amounts and the caloric values as shown in Table 6-2 with the equation:

$$EF(g/GJ) = \frac{AEL(mg/Nm^3) \times Flue\ gas\ per\ unit\ fuel(m^3/unit)}{1000 \times Energy\ content(GJ/unit)}$$

The BAT associated emission factors are listed in table 8.

[5] The emission levels of dust by using natural gas as a fuel are normally well below 5 mg Nm3 and SO2 emissions are well below 10 mg Nm3 (15 % O2) without any additional technical measures being applied [BREF LCP].

Table 6-2 Factors used to convert emission values from BAT to energy related emission factors.

Fuel type	**Flue gasses per unit fuel**	**Energy content**
Coal	11000 m3/ton	29.30 GJ/ton
Oil	12000 m3/ton	41.00 GJ/ton
Natural Gas	10000 m3/m3	31.65 GJ/1000 m3

Table 6-3 Fuel dependant emission factors (g/GJ) associated with BAT LCP (from top to bottom: less strict and more strict BAT)

Sum of brEF_Lower		Pollutant					
Fuel	Capacity	CO	CO2	NOx	PM10	SO2	NMVOC
Coal	> 300	18.8	95 000.0	18.8	1.9	7.5	1.9
	100 - 300	18.8	95 000.0	33.8	1.9	37.5	1.9
	50 - 100	18.8	95 000.0	33.8	1.9	56.3	1.9
Gas	> 300	1.6	55 000.0	6.3	1.6	3.2	1.6
	100 - 300	1.6	55 000.0	6.3	1.6	3.2	1.6
	50 - 100	1.6	55 000.0	6.3	1.6	3.2	1.6
Oil	> 300	14.6	77 000.0	14.6	1.5	14.6	1.5
	100 - 300	14.6	77 000.0	14.6	1.5	29.3	1.5
	50 - 100	14.6	77 000.0	43.9	1.5	29.3	1.5

Sum of brEF_Upper		Pollutant					
Fuel	Capacity	CO	CO2	NOx	PM10	SO2	NMVOC
Coal	> 300	18.8	95 000.0	56.3	7.5	75.1	1.9
	100 - 300	18.8	95 000.0	75.1	9.4	93.9	1.9
	50 - 100	18.8	95 000.0	113.0	11.3	150.0	1.9
Gas	> 300	15.8	55 000.0	31.6	1.6	3.2	1.6
	100 - 300	15.8	55 000.0	31.6	1.6	3.2	1.6
	50 - 100	15.8	55 000.0	31.6	1.6	3.2	1.6
Oil	> 300	14.6	77 000.0	43.9	5.9	58.5	1.5
	100 - 300	14.6	77 000.0	58.5	7.3	73.2	1.5
	50 - 100	14.6	77 000.0	132.0	8.8	102.0	1.5

Annex 2 BAT emissions per country

The reduction potential (fraction of emissions abated) of implementation BAT for NO_x and SO_2 is presented on country level in the table below and following graphs.

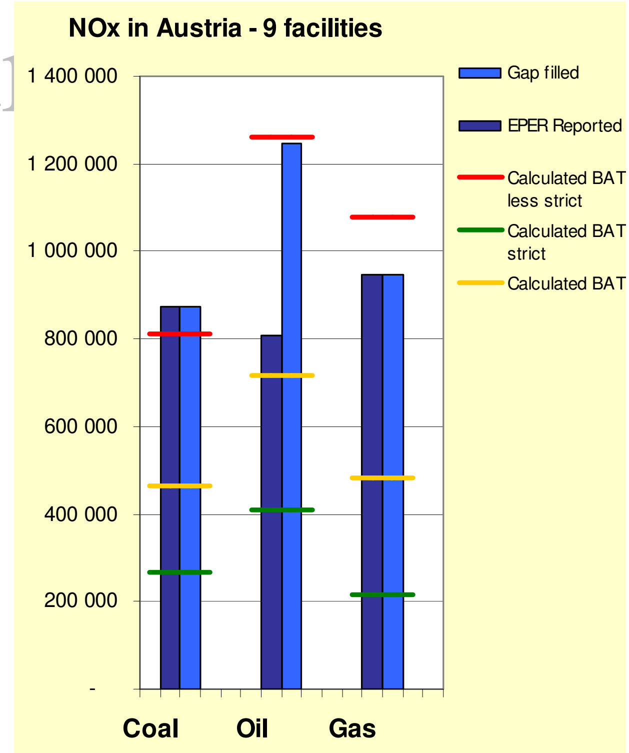
Table 6-4 Reduction potential (fraction of emissions abated) of NO_x and SO_2 emissions through BAT implementation of BAT for the selected facilities.

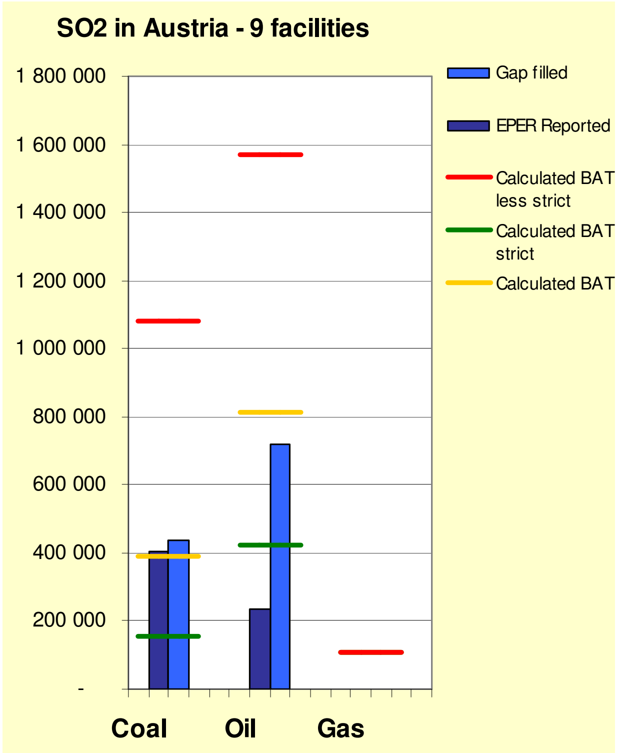
Country[6]	**Number of facilities**	**Pollutant**	**Reduction potential through implementation of BAT in %**							
			Strict BAT				**Less strict BAT**			
			Total	**coal**	**oil**	**gas**	**Total**	**coal**	**oil**	**gas**
All countries	354	NOx	87%	87%	89%	90%	61%	61%	67%	48%
		SO_2	97%	98%	96%	93%	78%	77%	83%	93%
Austria	9	NOx	71%	70%	67%	77%	*	7%	*	*
		SO_2	40%	64%	41%		*	*	*	
Belgium	16	NOx	89%	89%	87%	81%	64%	68%	49%	5%
		SO_2	95%	96%	40%		60%	62%	*	
Denmark	19	NOx	87%	86%		92%	59%	59%		60%
		SO_2	77%	76%		87%	*	*		87%
Finland	28	NOx	88%	88%	90%	84%	64%	65%	70%	22%
		SO_2	92%	93%	91%		50%	48%	66%	
France	22	NOx	94%	93%	97%	91%	82%	79%	91%	54%
		SO_2	96%	97%	92%		77%	78%	74%	
Germany	110	NOx	72%	72%	75%	86%	17%	16%	12%	31%
		SO_2	87%	87%	58%	78%	*		*	78%
Greece	9	NOx	88%	85%	97%	94%	62%	55%	92%	69%
		SO_2	99%	99%	99%	99%	88%	87%	95%	99%
Ireland	10	NOx	93%	93%	90%	95%	77%	80%	71%	73%
		SO_2	98%	98%	98%	95%	87%	82%	93%	95%
Italy	61	NOx	84%	86%	82%	91%	50%	57%	46%	54%
		SO_2	95%	97%	94%	96%	78%	72%	78%	96%
Netherlands	9	NOx	85%	86%		79%	45%	59%		*
		SO_2	81%	87%			*	*		
Portugal	6	NOx	93%	92%	94%	90%	77%	76%	82%	51%
		SO_2	98%	98%	98%		90%	83%	94%	
Spain	27	NOx	94%	94%	95%	90%	82%	81%	85%	50%
		SO_2	99%	99%	96%	97%	93%	93%	84%	97%
Sweden	6	NOx	88%	57%	76%	96%	63%	*	27%	79%
		SO_2	39%	53%	*		*	*		
United Kingdom	22	NOx	92%	93%	92%	88%	73%	78%	68%	40%
		SO_2	98%	99%	95%	67%	89%	89%	87%	67%

* reported emissions already below expected BAT emissions

[6] The EPER 2001 dataset does not contain facilities with Annex 1.1. as a main activity in Luxemburg.

Austria





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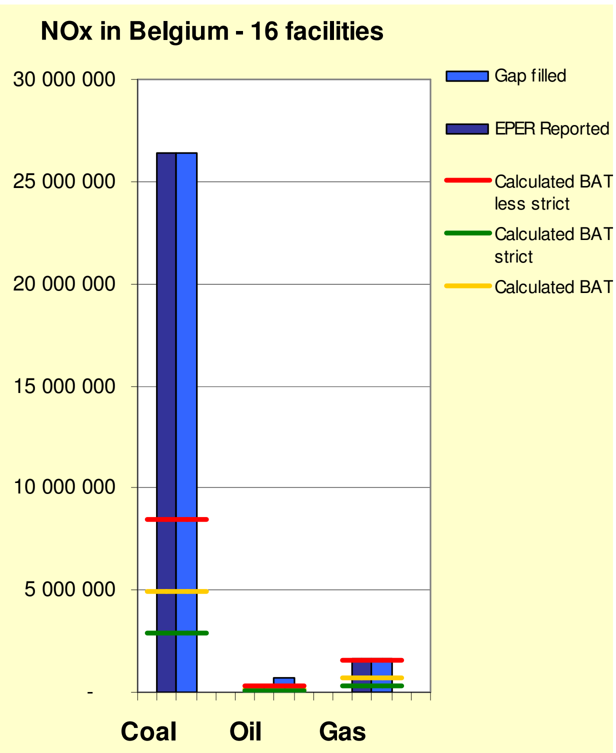

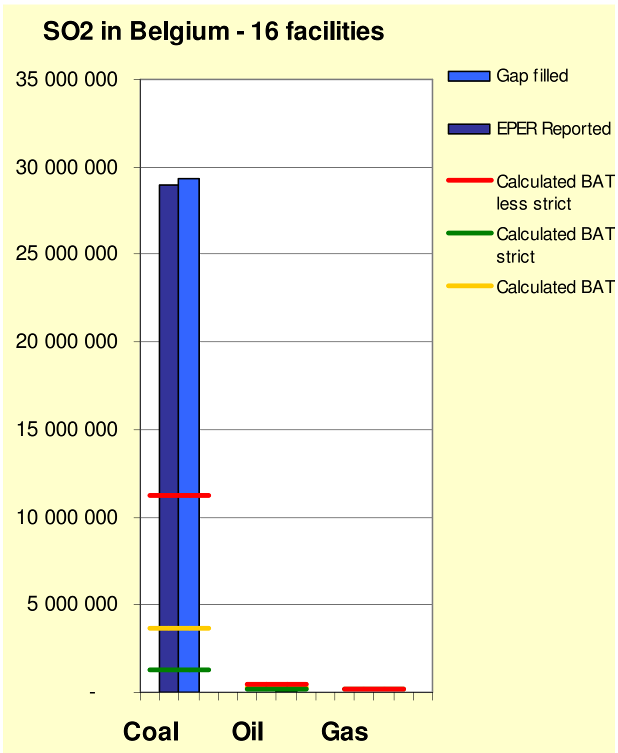

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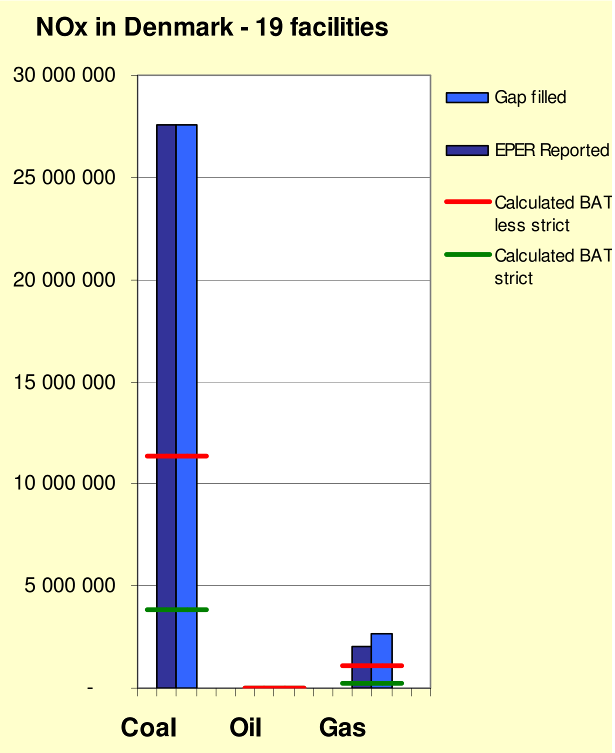

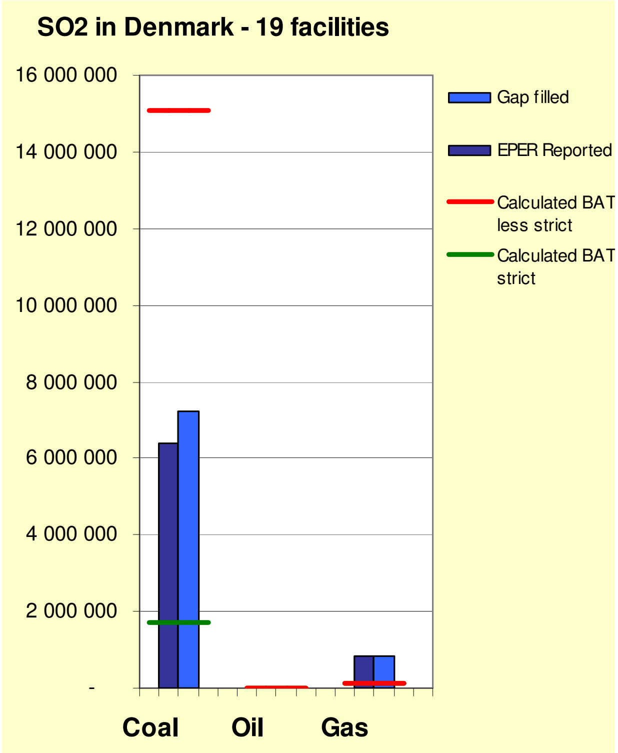

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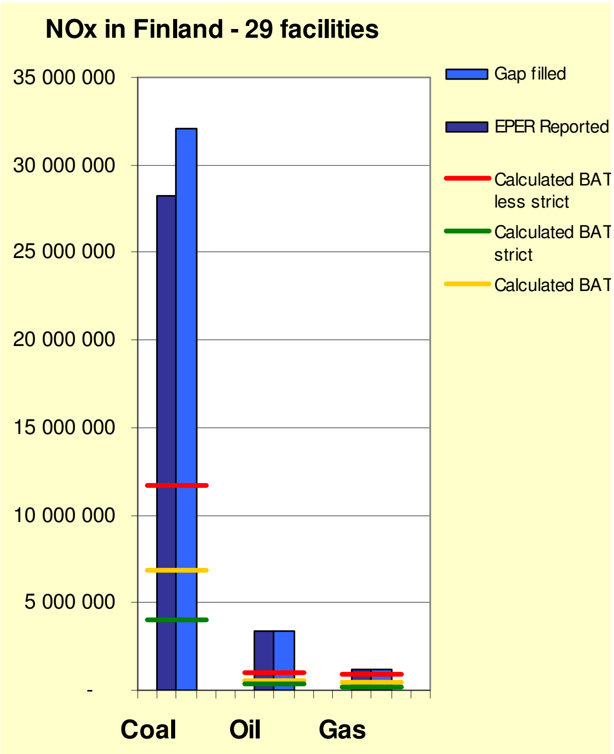

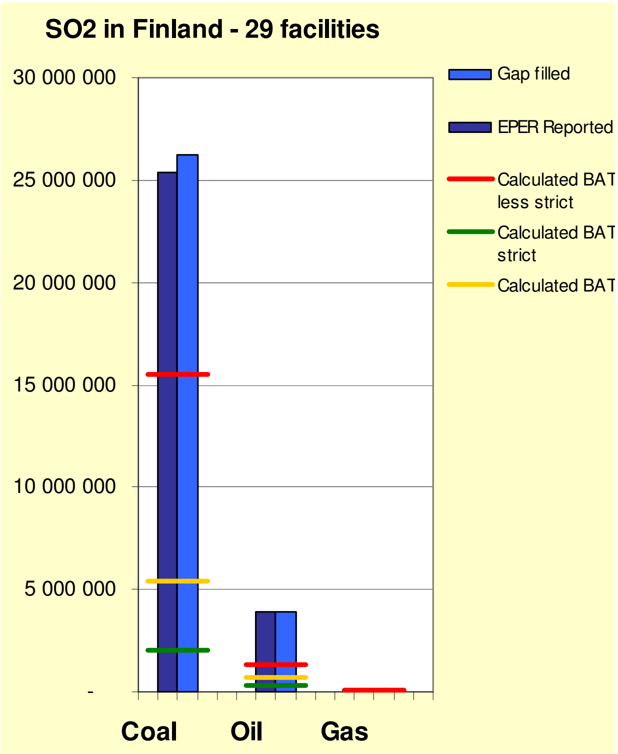

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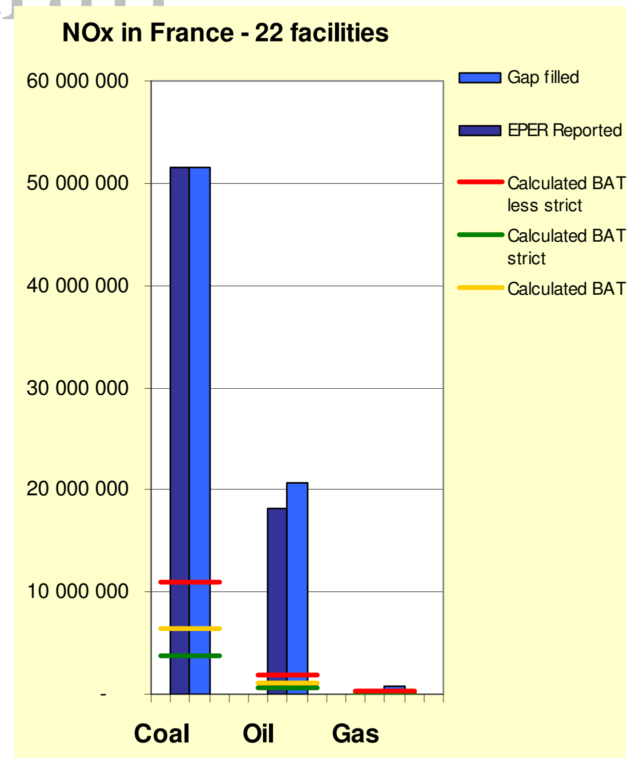

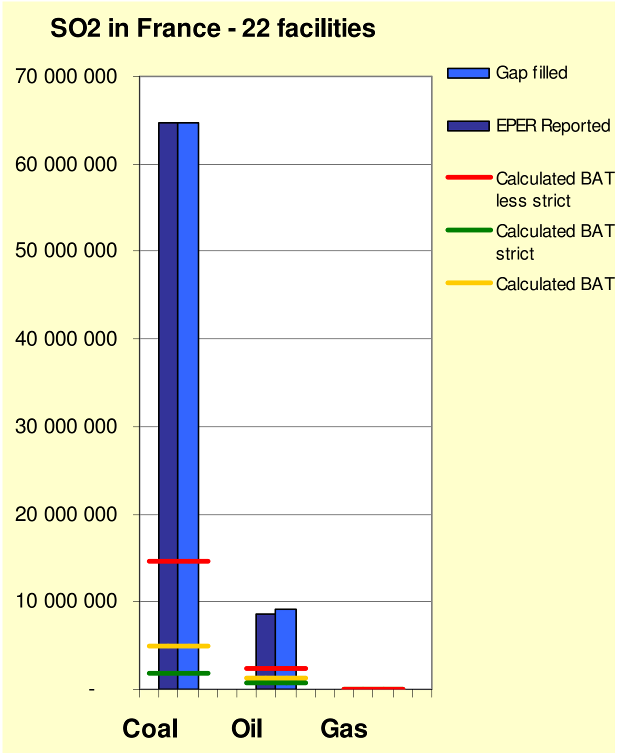

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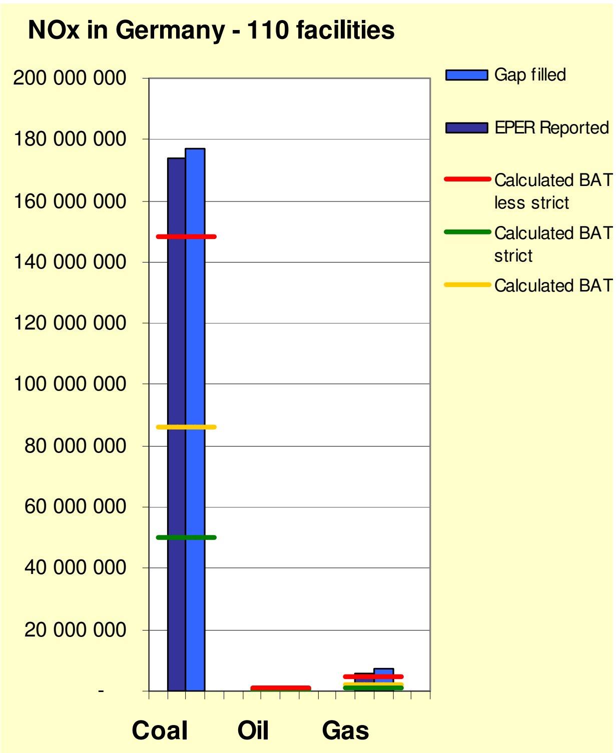

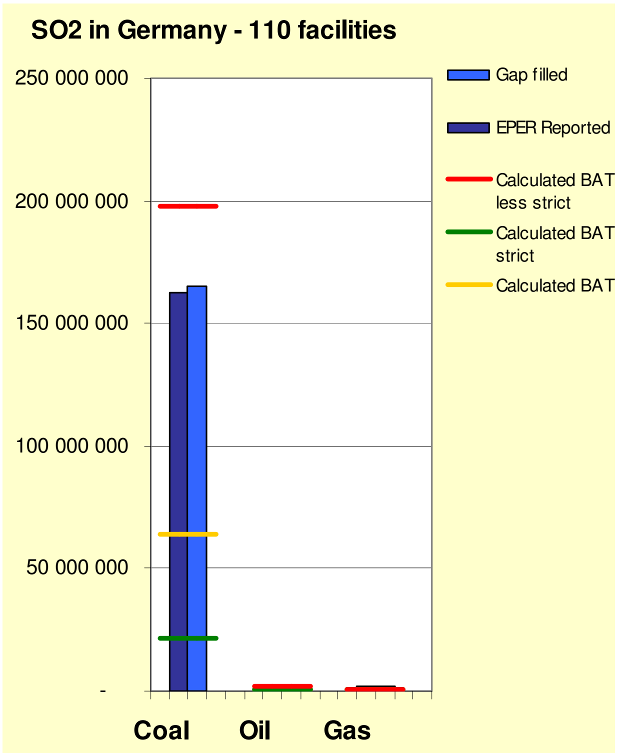

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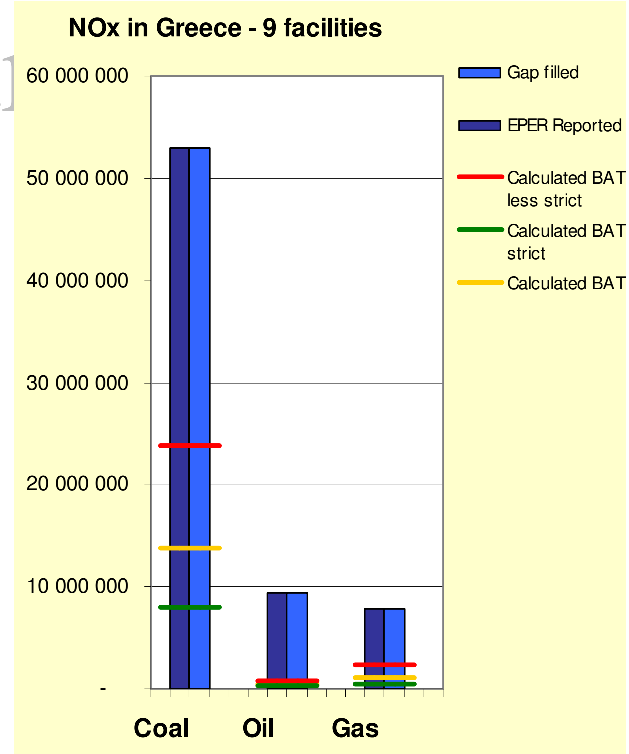

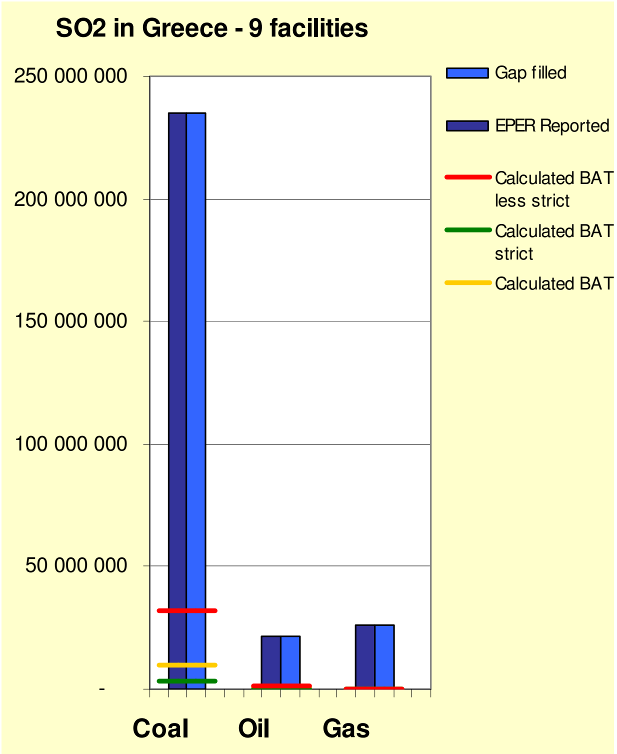

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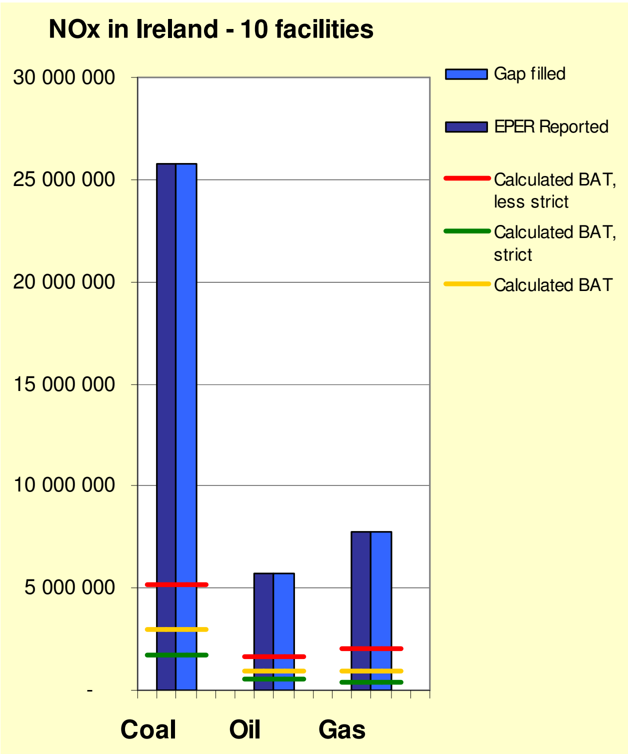

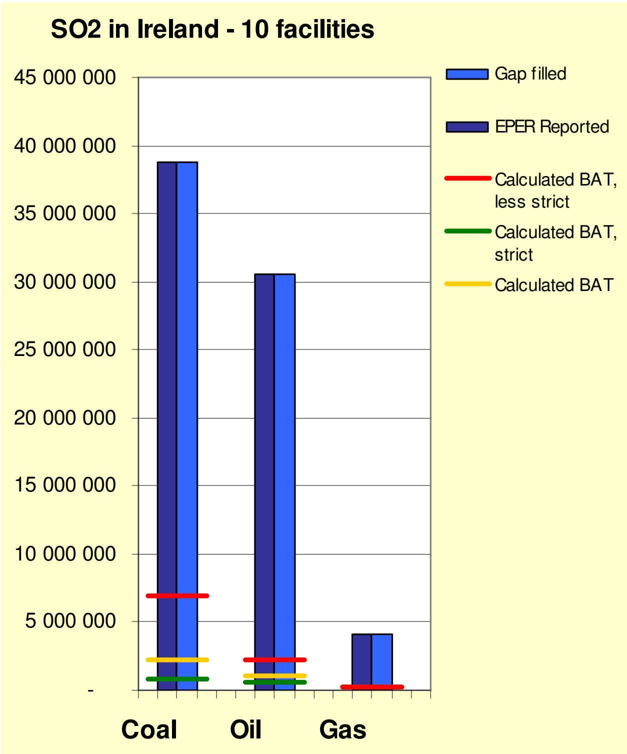

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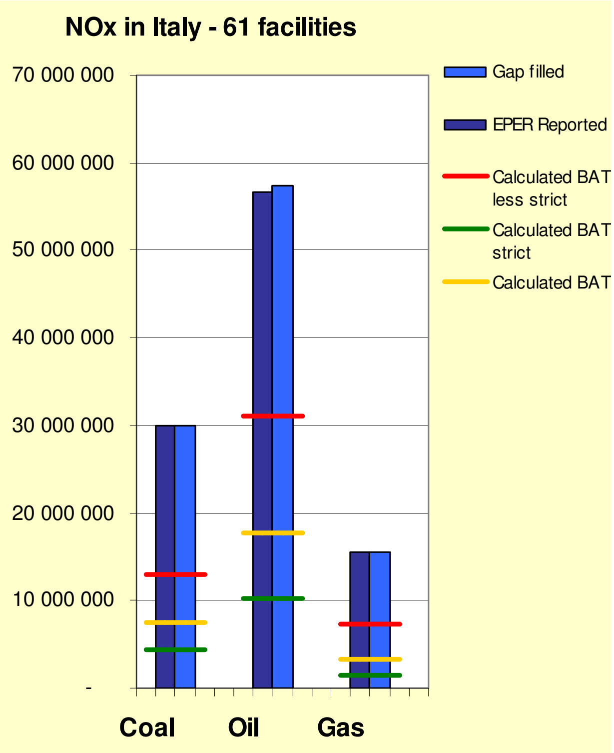

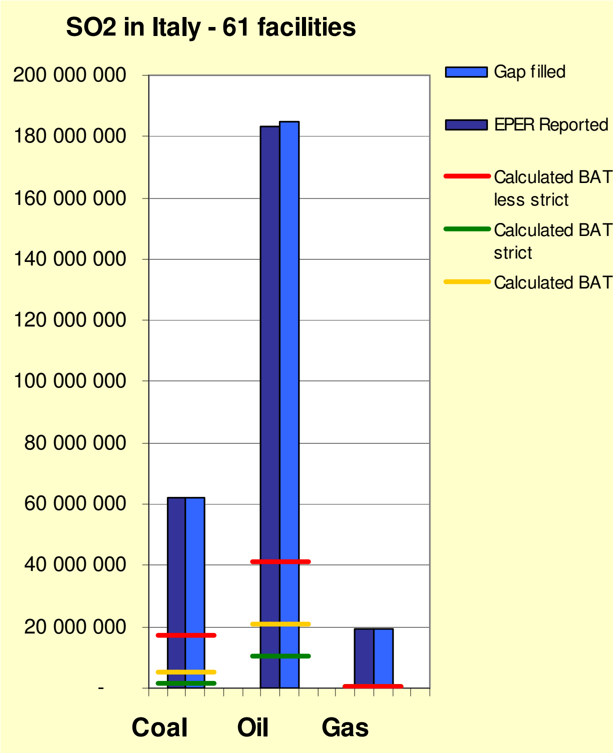

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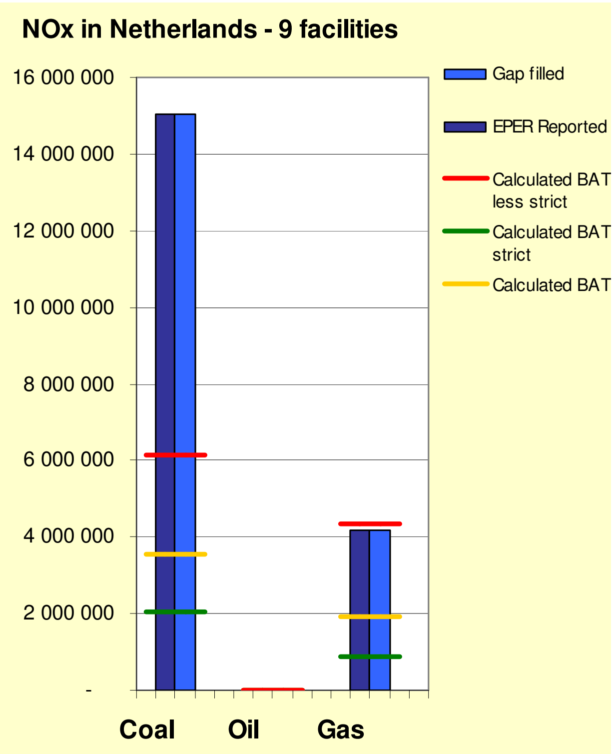
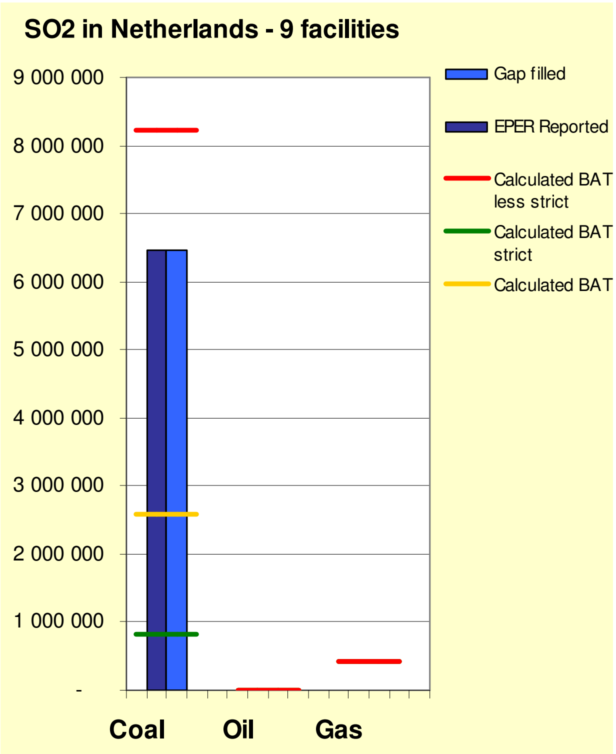
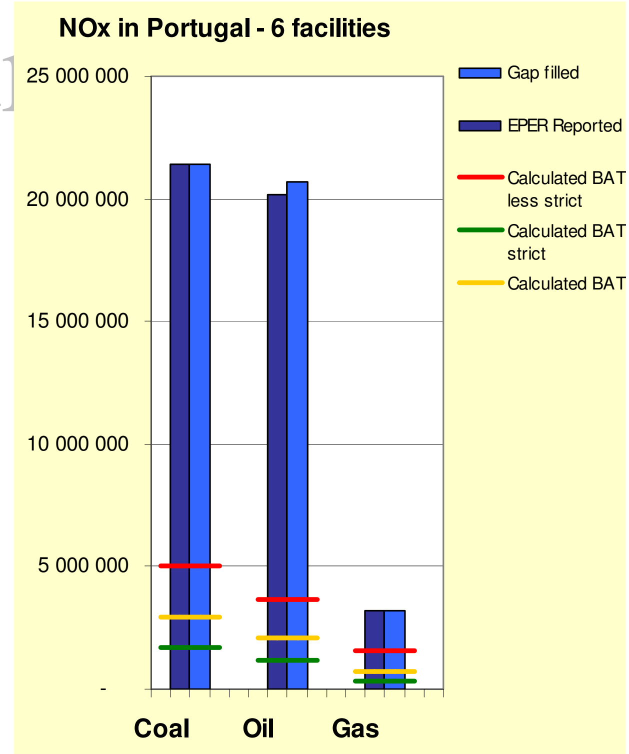
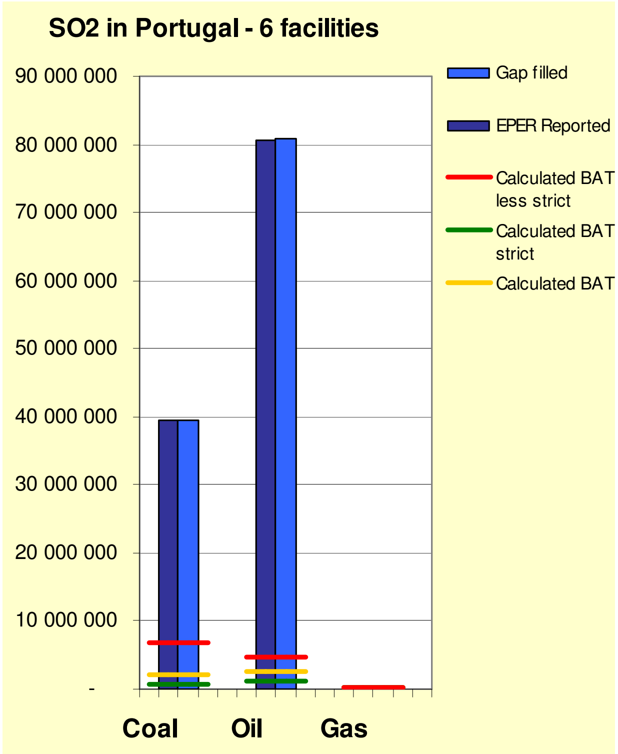


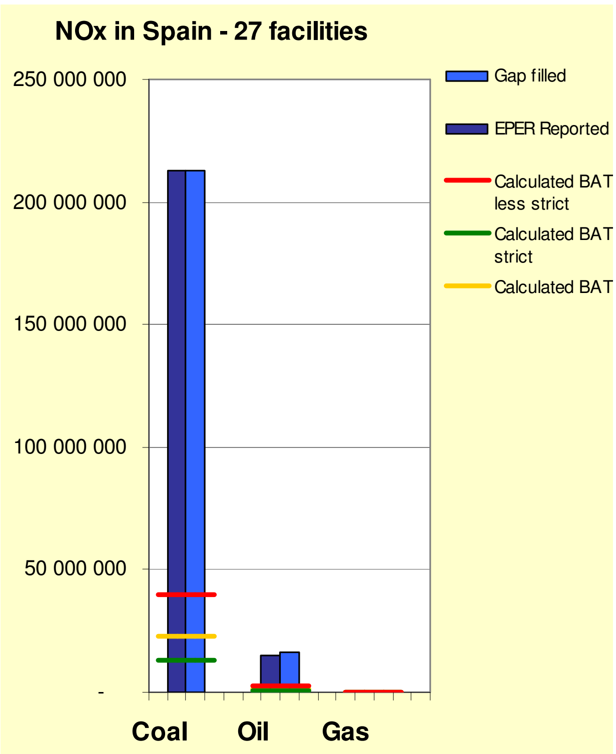


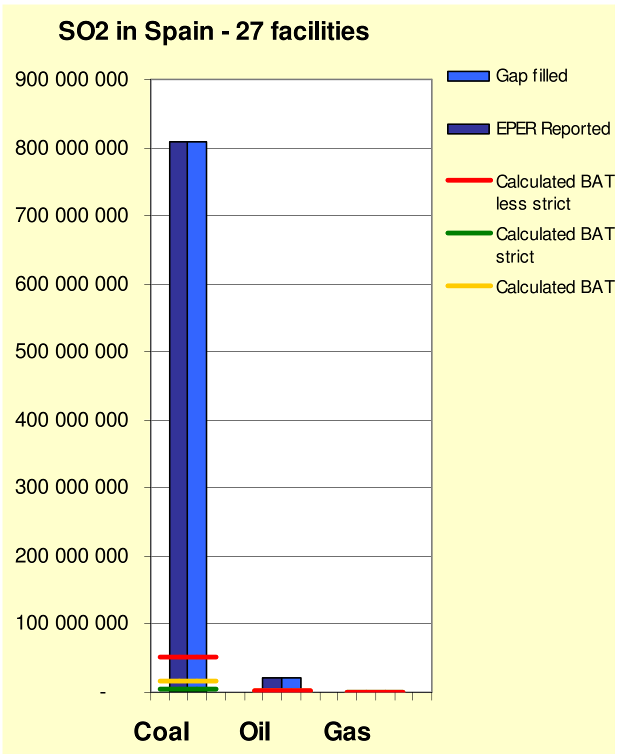
Portugal





Spain





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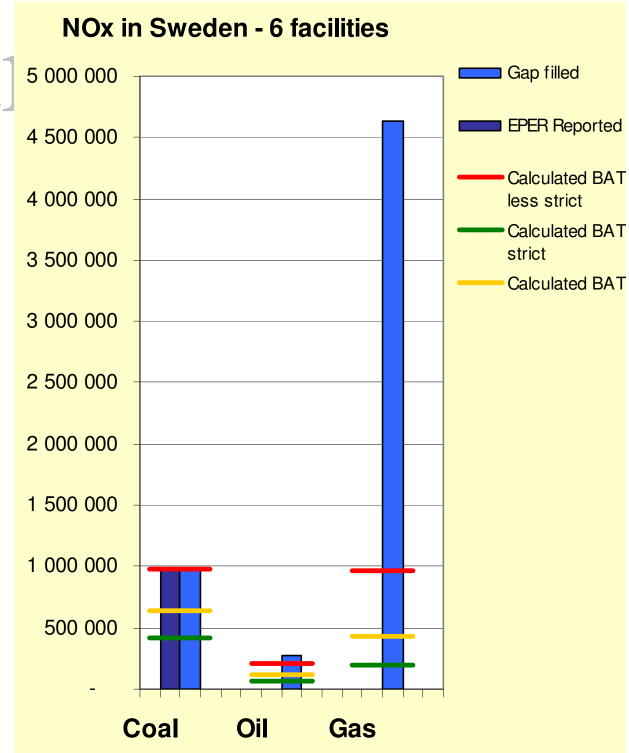

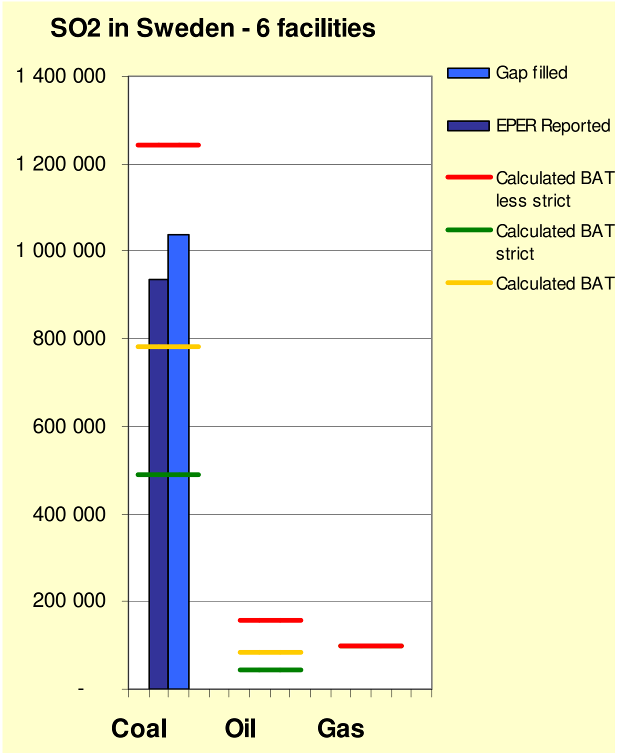

United Kingdom