A Review of Air Emission Inventories for Shipping Reported by Countries Under the LRTAP Convention

Report for UBA

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1 Introduction

This report reviews the emissions from water-borne transport (referred to as “shipping”) reported by countries to LRTAP. The shipping sector is covered by the following NFR source categories:

1A3di(i)	International maritime navigation
1A3di(ii)	International inland waterways
1A3dii	Domestic water-borne navigation (including inland waterways)
1A4ciii	Fishing
1A5b	Remaining water-borne mobile emissions including military

As 1A5b covers other non-water borne mobile emissions, including military aviation, this sector was not included in the review because the military shipping emissions could not be reviewed separately from the other component parts.

The review considered:

- Completeness in terms of the time-series reported and the pollutants covered
- Consistency – whether the data appear feasible in terms of
  - their relationship with other reported statistical data
  - their implied emission factors
  - the trends in emissions
- Transparency in terms of the data sources used and methodology reported

Section 2 summarises the completeness of the shipping inventories reported by each country and, where known, the approach used.

Section 3 summarises the levels of shipping emissions reported by each country for key pollutants divided, where possible, into the different NFR categories and compares these with fuel consumption data reported in Eurostat. It also presents aggregated emission factors implied by reported emissions for all shipping and fuel consumption (i.e. implied emission factors).

Section 4 gives an overview for each country based on the analysis covered in Sections 2 and 3 and shows trends in the time-series of emissions of key pollutants for total shipping emissions (including international) and compares these with trends in total fuel consumption for each individual country.

2 Completeness

Table 1 summarises the completeness of the shipping emissions reported by each country and where possible comments on the methodology used as reported in the IIR. In particular, the approach that was used (Tier 1, 2 or 3) in line with reporting guidelines is shown.

Table 1: Summary of shipping emissions inventory reported by countries to LRTAP

Country	Time-series	Pollutants	Comments on reporting	Comments on Methodology
Albania	1993-2009	5 of the main pollutants only (NMVOC, NOx, PM_{10}, $PM_{2.5}$, SOx)	Only figures for national navigation reported	No IIR available
Armenia	No data reported. No IIR available			
Austria	1990-2009	All main pollutants, PAHs, 2 POPs, 3 metals	Figures for international inland waterways and national navigation	Tier 2 method for international using national fuel statistics, country-specific EF. More detailed method believed to be used for national shipping, but no details given in IIR
Belarus	No data or information reported			
Belgium	1990-2009	All main pollutants, PAHs, 1 POPs, 8 metals	Separate figures for international maritime and international inland waterways, national navigation and fishing	Believed to be Tier 2 using regional energy data and mix of country-specific EFs and factors from Guidebook. Some uncertainty in terminology used for international inland waterways and national navigation used in IIR
Bulgaria	No data reported. IIR states emissions up to 1999 are believed to be allocated to 1A2. No fuels data after 1999. Improvements planned to re-allocate from 1A2 and split between marine bunkers and national navigation			

Croatia	1990-2009	All main pollutants except PM_{10}, includes 3PAHs and 6 metals	Separate figures for international and domestic shipping	Tier 1 based on national fuel statistics and default EFs
Cyprus	2008, 2009	5 of the main pollutants only	Only figures for International navigation reported	Tier 3 approach for international shipping emissions using a bottom-up method based on port callings for different vessel types, but only accounts for in-port emissions. Improvements are planned to cover time-series before 2008
Czech Republic	2001-2009	All main pollutants, 5PAHs, 2POPs, 9 metals	Only figures for national navigation reported	No details given in IIR, but believed to be method based on national fuel consumption statistics. Probably Tier 1.
Denmark	1990-2009	All main pollutants, 5PAHs, 1POPs and 9 metals	Separate figures for international and domestic shipping and fishing	Detailed Tier 3 bottom-up method used for ferries combined more simple method based on national fuel sales/consumption data for international navigation and fishing
Estonia	1990-2009	All main pollutants, 3PAHs, 1POPs and 6 metals	Separate figures for international and domestic shipping	Tier 1 method using default EFs and national fuel statistics
Finland	1990-2009	All main pollutants and 1 POPs	Separate figures for international and domestic shipping and fishing	Detailed Tier 3 bottom-up method based on shipping movement and ports data
France	1990-2009	All main pollutants, 5PAHs, 3POPs	Separate figures for international and domestic shipping and	Tier 2 approach using combination of national fuel statistics, other

		and 9 metals	fishing	activity data and default EFs
Georgia	No data reported. No IIR available			
Germany	1990-2009	All main pollutants, 2PAHs, 1POPs and 9 metals (only for international)	Separate figures for international and domestic shipping and fishing	Tier 1 approach is used for domestic and international navigation using national energy statistics and country-specific EFs. A more detailed Tier 2 approach is used for fishing.
Greece	2002-2009	4 of the main pollutants only (CO, NMVOC, NOx, SOx)	Separate figures for international (from 2004) and domestic shipping	No IIR available
Hungary	2003-2009	6 of the main pollutants only	Only figures for national navigation reported	No information given in IIR
Iceland	1990-2008	4 of the main pollutants only (CO, NMVOC, NOx, SOx), 2 PAH, 1POPs	Separate figures for international and domestic shipping and fishing	No IIR available
Ireland	1990-2009	All main pollutants, 5PAHs, 2POPs and 9 metals. Note data for domestic shipping are incomplete for 2009: all main pollutants missing	Separate figures for international and domestic shipping	No details in IIR, but believed to be Tier 1 using country-specific EFs and national fuel statistics
Italy	1990-2009	All main pollutants, total PAHs and 8 metals	Separate figures for international and domestic shipping and fishing	Details given in NIR, rather than IIR. Tier 3 approach using detailed port/shipping movement data combined with national fuel statistics and country-specific EFs

Latvia	1990-2009	All main pollutants, 3PAHs, 1POPs and 6 metals	Separate figures for international and domestic shipping and fishing	Tier 1 method using default EFs and national fuel statistics
Liechtenstein	No data reported. No IIR available			
Lithuania	2002-2009	All main pollutants, 5PAHs, 1POPs and 9 metals	Separate figures for international and domestic shipping	Tier 1 method using default EFs and national fuel statistics
Luxembourg	1990-2007	3 of the main pollutants only (NMVOC, NOx, SOx)	Figures for domestic shipping only	No IIR available
Macedonia	No data reported. No IIR available			
Malta	2000-2008	4 of the main pollutants (NOx, NMVOCs, CO, SOx), 8 metals	Separate figures for international (from 2001), domestic (from 2000) shipping and fishing (from 2002)	No IIR available
Moldova	1990 only	All the main pollutants, 3 PAHs, 2POPs, 1 metals	Only figures for International navigation reported	No IIR available
Monaco	2001-2009 for domestic, 2004-2009 for international	All main pollutants except PM, 7 metals	Separate figures for international and domestic shipping	Tier 1 method using default EFs and national fuel statistics
Montenegro	2006 and 2009	All main pollutants, 3POPs, 7 metals	Only figures for national navigation reported	No IIR available
Netherlands	1990-2009	All main pollutants, 6 POPs, 5 metals	Separate figures for international maritime and international inland waterways, national navigation and fishing	No IIR available
Norway	1990-2009	All main pollutants, 1PAHs, 1POPs and 6 metals	Separate figures for international and domestic shipping and fishing	Tier 2 approach using combination of national fuel statistics, other activity data for specific vessel

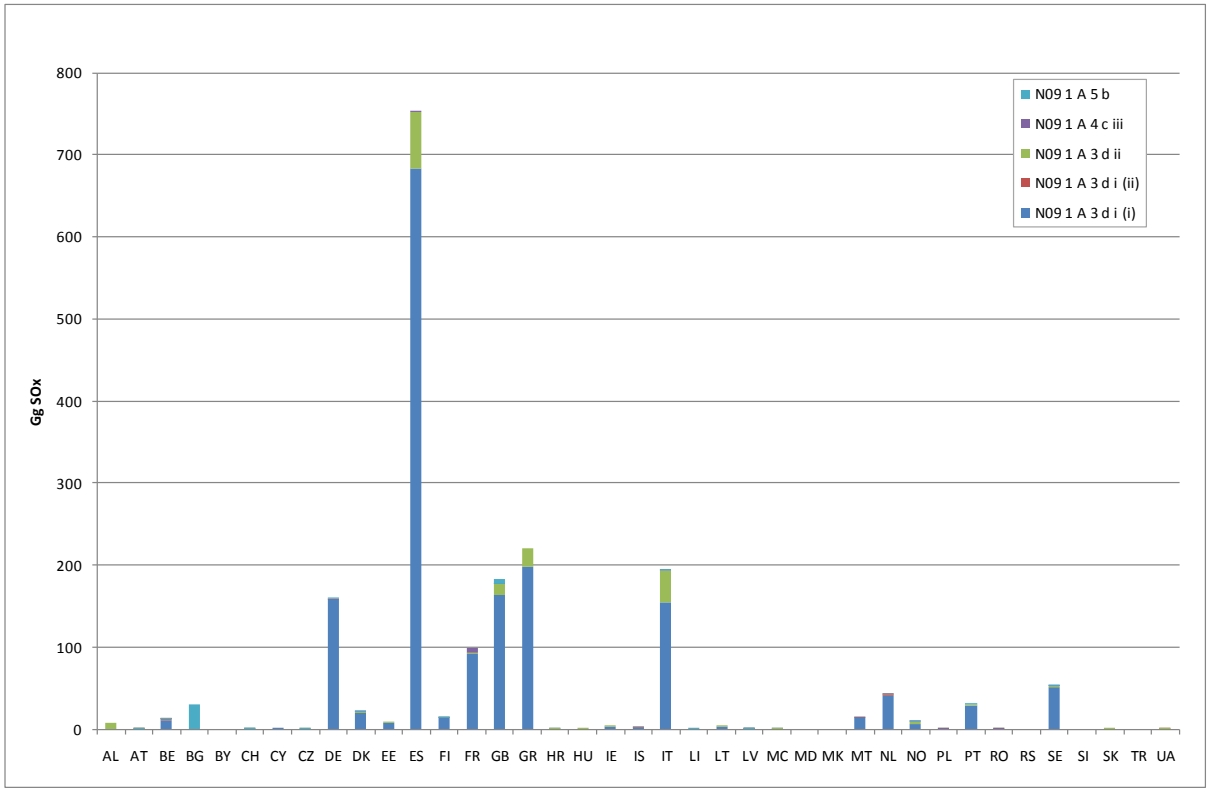
				types and countr-specific EFs
Poland	2001-2009	All main pollutants, 5PAHs, 1POPs and 3 metals	Separate figures for domestic shipping and fishing	Tier 1 method using default EFs and national fuel statistics
Portugal	1990-2009	All main pollutants, 1PAHs and 9 metals	Separate figures for international and domestic shipping	Tier 2 approach using national fuel statistics in combination with ship movement and ports data and country-specific EFs
Romania	2005-2009	Number of pollutants reported varies by year. For 2007: 3 of the main pollutants, 3 PAHs, 5 metals	Separate figures for domestic shipping and fishing	No IIR available
Russian Federation	No data reported. No IIR available			
Serbia	No data reported. No IIR available			
Slovakia	2000-2009	All main pollutants, 5PAHs, 2POPs and 6 metals	Only figures for national navigation reported	Tier 1 method using national fuel statistics and default EFs
Slovenia	No data or information reported			
Spain	1990-2009	5 of the main pollutants, 1PAHs, 2POPs and 9 metals	Separate figures for international and domestic shipping and fishing	No IIR available
Sweden	1990-2009	All main pollutants, 5PAHs, 3POPs and 9 metals	Separate figures for international and domestic shipping and fishing	Tier 1 method using national fuel statistics and country-specific EFs
Switzerland	1990-2009	All main pollutants, 5PAHs, 1POPs and 1 metal (Pb) reported for domestic shipping, only NOx, SO_2,	Separate figures for international and domestic shipping	Said to be Tier 2 approach, but uses a more detailed bottom-up method based on number of vessels and operating hours and

		NMVOCs and CO for international shipping		country-specific emission factors.
Turkey	2001 only	3 of the main pollutants only CO, NMVOC, NOx	Only figures for national navigation reported	No IIR available
Ukraine	2002-2009 (All sectors in 2009)	Number of pollutants reported varies by year and sector	Separate figures for international shipping from 2008 (separated for maritime and inland waterways in 2009), and domestic shipping, and fishing in 2009	No IIR available
United Kingdom	1990-2009	All main pollutants, 5PAHs, 2POPs and 9 metals	Separate figures for international and domestic shipping and fishing	Tier 3 approach using detailed shipping movement data for domestic and national fuel statistics for international combined with country specific EFs

3 Shipping Emissions Reported by Countries for 2008

Figures 1-4 show shipping emissions in 2008 reported by each country for SO_2, NO_x, PM_{10} and NMVOCs, respectively. Where available, emissions are broken down by NFR category. As a minimum, a breakdown in emissions between international (1A3di) and domestic (1A3dii) shipping emissions was examined. Figure 5 shows the corresponding data for fuel consumption reported in Eurostat for countries in 2008 shown as "Domestic navigation", "Fishing" and "International marine bunkers".[1] Official statistic on fuel consumption seemed the best way of showing whether the relative differences in emissions between countries seemed reasonable although other statistics are available in Eurostat and could be used, such as port movements and passenger and freight tonneage moved. Some, but not all countries reported fuel consumption data with their emissions, but not all the provided data were complete.

Figure 1: Emissions of SO_2 from shipping reported by countries for 2008



[1] http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/search_database

Figure 2: Emissions of NO_x from shipping reported by countries for 2008

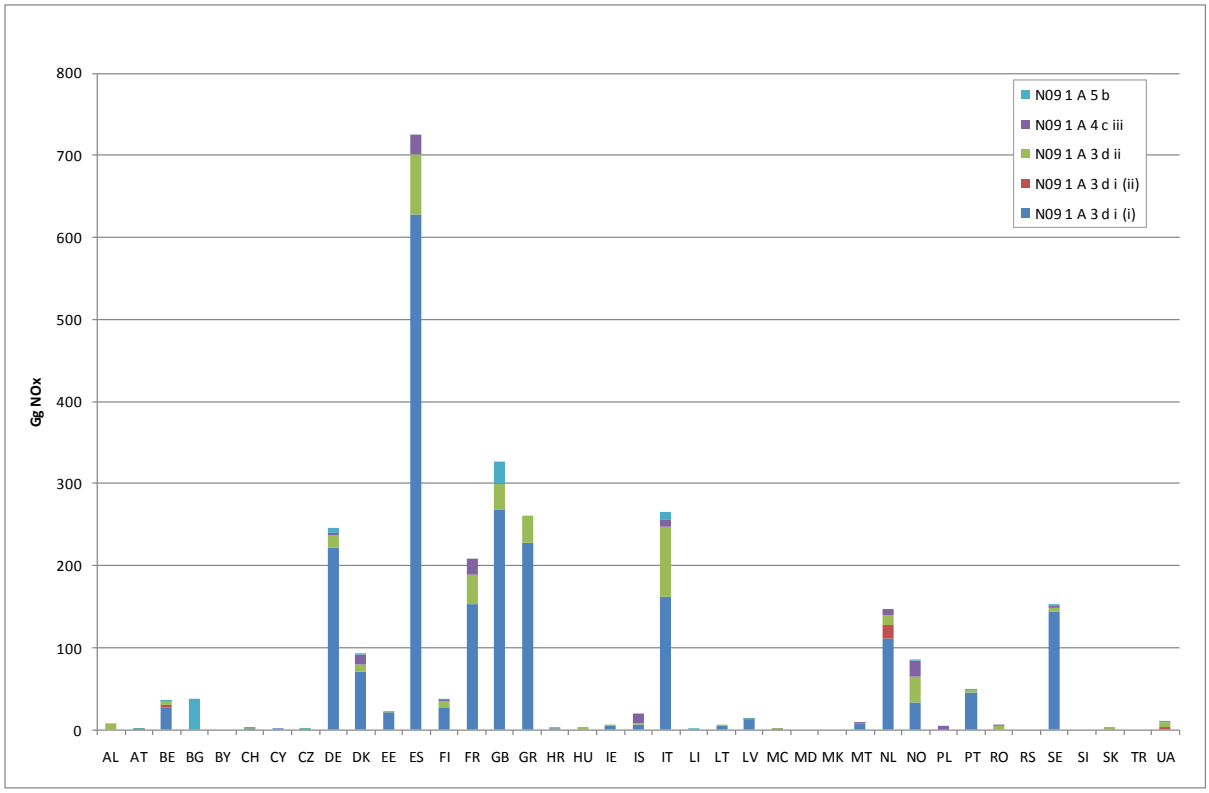


Figure 3: Emissions of PM_{10} from shipping reported by countries for 2008

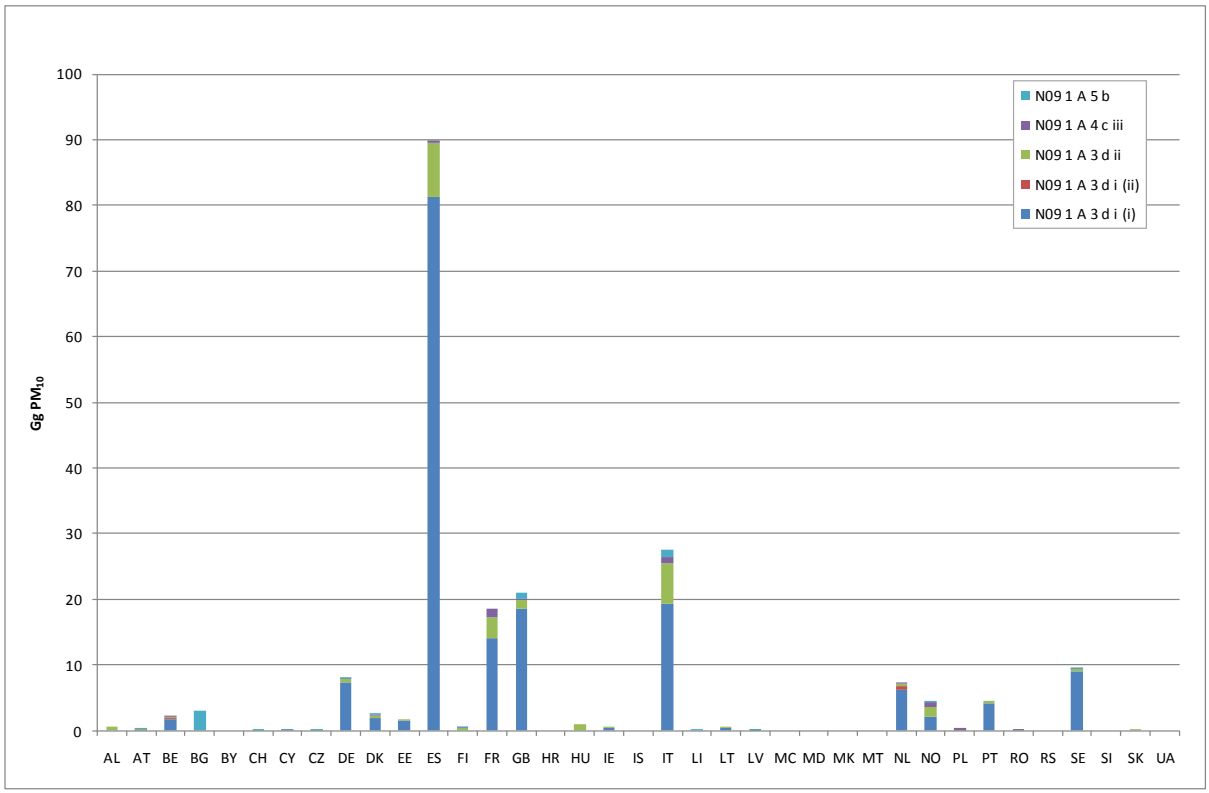


Figure 4: Emissions of NMVOCs from shipping reported by countries for 2008

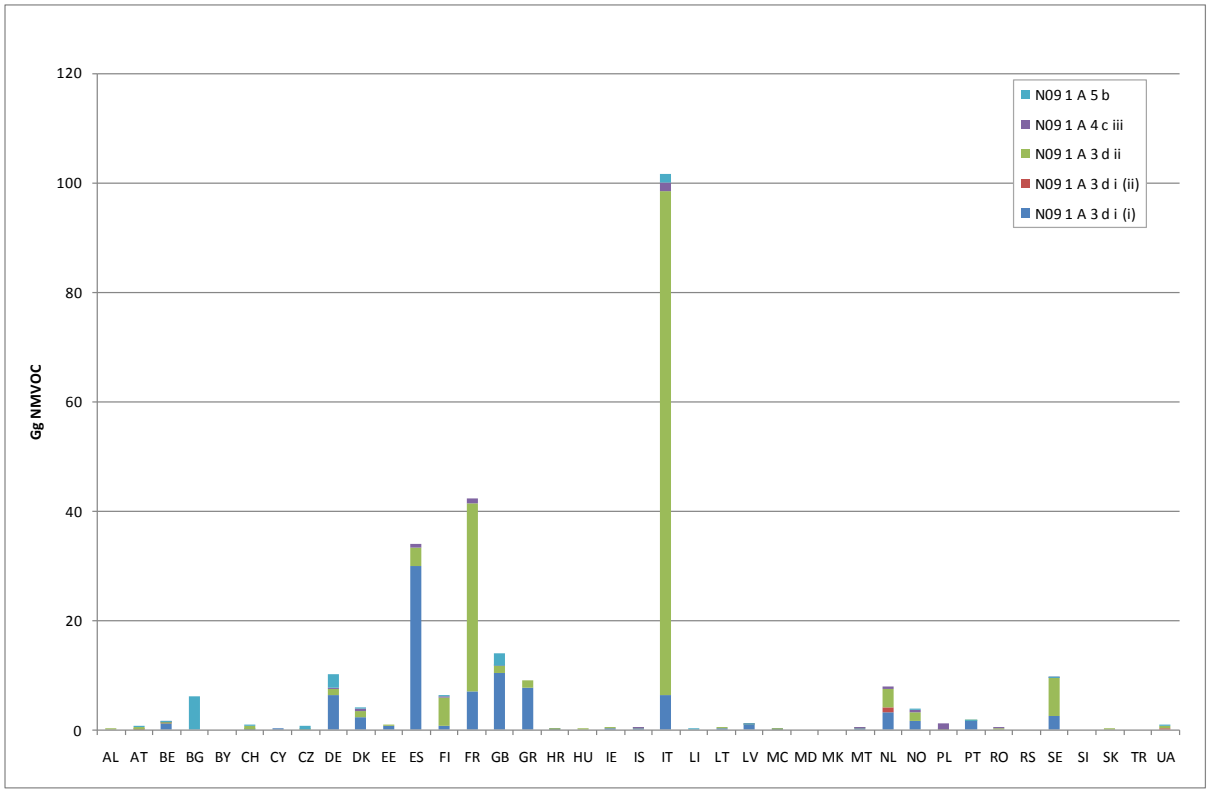
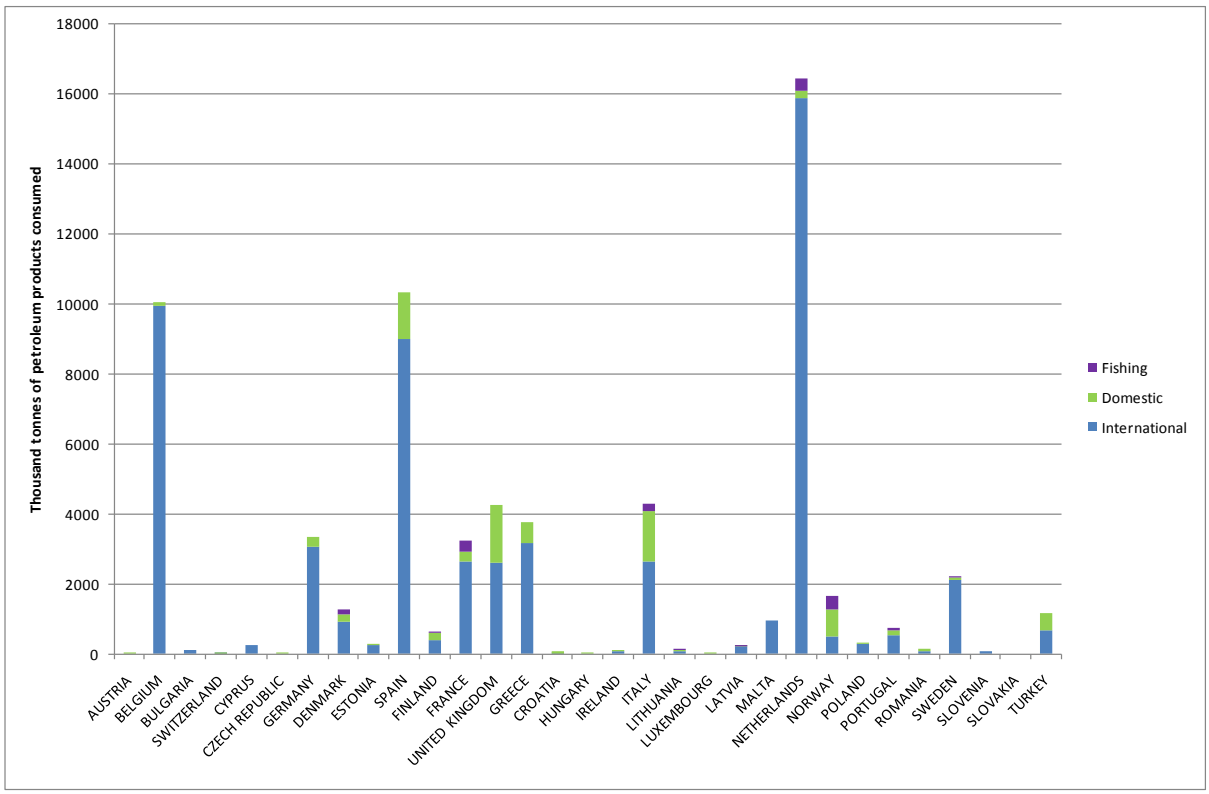


Figure 5: Fuel consumption for shipping reported for countries in Eurostat for 2008



For the pollutants SO_2, NO_x and PM_{10}, the trend in emissions between countries is broadly similar with particularly high emissions reported by Spain compared with other countries. The countries reporting the next highest emissions are generally Germany, France, Italy, Greece and the UK, though Germany seems to report proportionately smaller emissions of PM_{10}. The group of countries reporting the next highest level of emissions is made up of Denmark, Sweden, Norway, Netherlands and Portugal.

For all these pollutants, emissions from international shipping dominate emissions from domestic shipping. Italy and Spain tend to show the highest relative amount of emissions from domestic shipping.

For NMVOCs, the situation is rather different. Italy reports significantly higher emissions than other countries and moreover this is almost entirely due to emissions from domestic shipping activities. France has the next highest emissions also dominated by domestic shipping. Spain's emissions are the third highest but are dominated by international shipping with only a small contribution from domestic activities, followed by the UK, Germany, Sweden, Greece and Netherlands. Sweden and Netherlands also report a larger share of total shipping emissions occurring from domestic activities in 2008. The reason for the greater importance of domestic shipping activities to total shipping emissions for NMVOCs could be the use of gasoline for smaller vessels used in domestic activities (e.g. recreational craft). Gasoline engines are more significant sources of NMVOCs than engines using diesel or fuel oil for combustion. This would suggest Italy and France have particularly high levels of activities by recreational craft.

Comparing emissions in Figures 1-4 with shipping fuel consumption figures (Figure 5) reported by each country to Eurostat does reveal some inconsistencies. The most striking inconsistencies are with the Netherlands and Belgium which report particularly high fuel consumption not matched by high emissions when compared with other countries. This could indicate that Netherlands and Belgium are using different fuel consumption figures in their calculation of emissions to that which is reported to Eurostat. The high emissions for SO_2, NO_x and PM_{10} reported by Spain appear to be consistent with high fuel consumption reported to Eurostat when compared with other countries. Similarly, the relative emissions of shipping emissions reported by Germany, France, Greece, Italy and UK seem broadly consistent with the relative fuel consumption figures reported by these countries .

All countries show fuel consumption for international shipping to be higher or significantly higher than for domestic shipping. The fuel consumption for Italy and the UK indicates relatively high levels of fuel consumption for domestic shipping compared with international. Italy has the largest share of domestic fuel consumption and this is consistent with the trends shown by Italy's emissions in terms of the domestic/international split and provides support for the explanation given above for its relatively high proportion of NMVOC emissions occurring from domestic shipping. The international/domestic split in fuel consumption for the UK does not seem to be backed up by the split shown by the UK's emissions data.

The relationship between emissions and fuel consumption are explored further below.

Comparison with fuel consumption also provided a means of showing whether the magnitude of emissions reported by countries is reasonable. Figures 6-8 show implied emission factors for all shipping emissions reported by countries for SO_2, NO_x and PM_{10} in 2008, respectively. This is derived by dividing total shipping emissions (domestic, fishing and international) by total fuel consumption given in Eurostat for 2008.

Figure 6 shows the implied emission factors for SO_2. Also shown is a default factor assuming a 1.5% wt sulphur content of marine fuels. This is the fuel sulphur content limit that applies to all ships in Sulphur Emission Control Areas (SECAs) of the Baltic Sea and North Sea for 2008 and for all passenger vessels on regular service between EU ports, according to MARPOL Annex 6 and Sulphur in Marine Fuels Directive 2005/33/EC. It is also the Tier 1 default emission factors for ships using fuel oil with this sulphur content given in the EMEP/EEA Emission Inventory Guidebook (2009). Most countries have implied

emissions factors (IEFs) around this default factor. Some countries like Spain and Greece have higher factors, possibly because of shipping activities occurring outside the SECA. Many countries have much lower IEFs which may be due to preferential use of marine gas/diesel oil with much lower sulphur content, for example in areas where generally smaller vessels are used or where there is a significant proportion of inland waterways activities contributing to the overall shipping inventory. Another potential explanation for any departure from default factors would be where a country is using alternative fuel consumption data to that submitted to Eurostat.

Figure 6: Implied emission factors for SO_2 for all shipping emissions in 2008

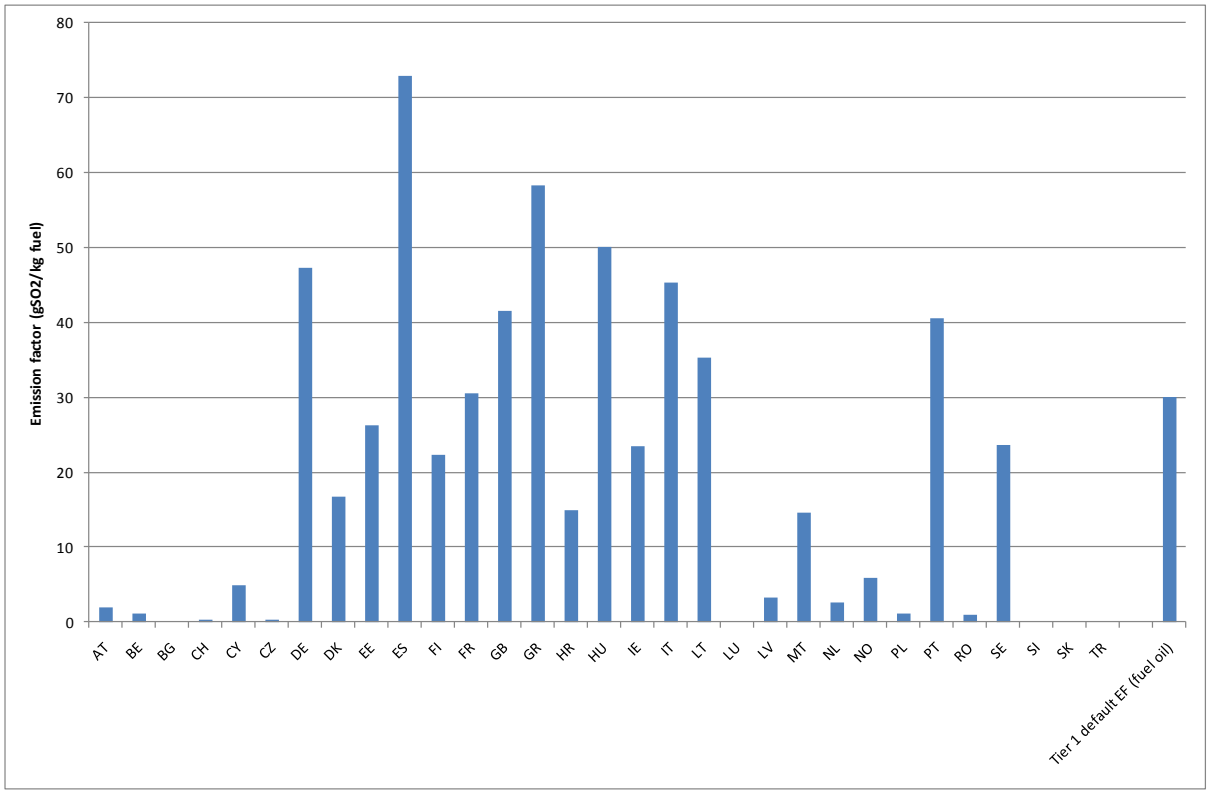


Figure 7 shows the corresponding IEFs for NO_x. Most countries appear to be consistent with the Tier 1 default factors for ships using fuel oil and marine gas/diesel oil, but there are some notable exceptions. The value for Hungary of 2,610 gNOx/kg fuel is way out of line and suggests a problem with Hungary's NO_x inventory, especially as the IEF for SO_2 appears to be reasonable. Some countries report particularly low IEFs for NO_x, notably Belgium, Cyprus, Malta and Poland. These countries generally have low IEFs for SO_2 as well. This could indicate lack of consistency between estimates of fuel consumption for shipping used in the country's inventories and the fuel consumption figures reported to Eurostat. The only other scenario which would lead to particularly low IEFs for both SO_2 and NO_x would be where shipping fuel consumption in the country is dominated by small vessels with gasoline engines, but this is thought unlikely to be the case.

Figure 7: Implied emission factors for NO_x for all shipping emissions in 2008

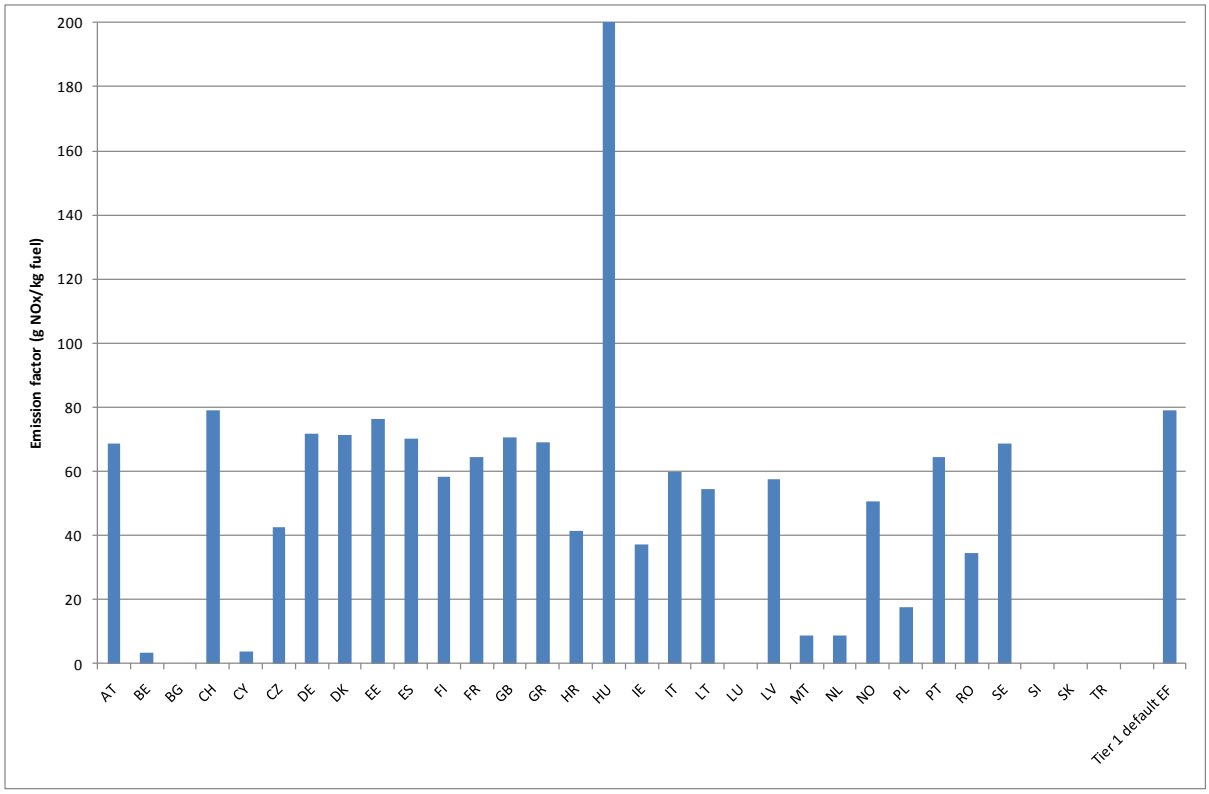
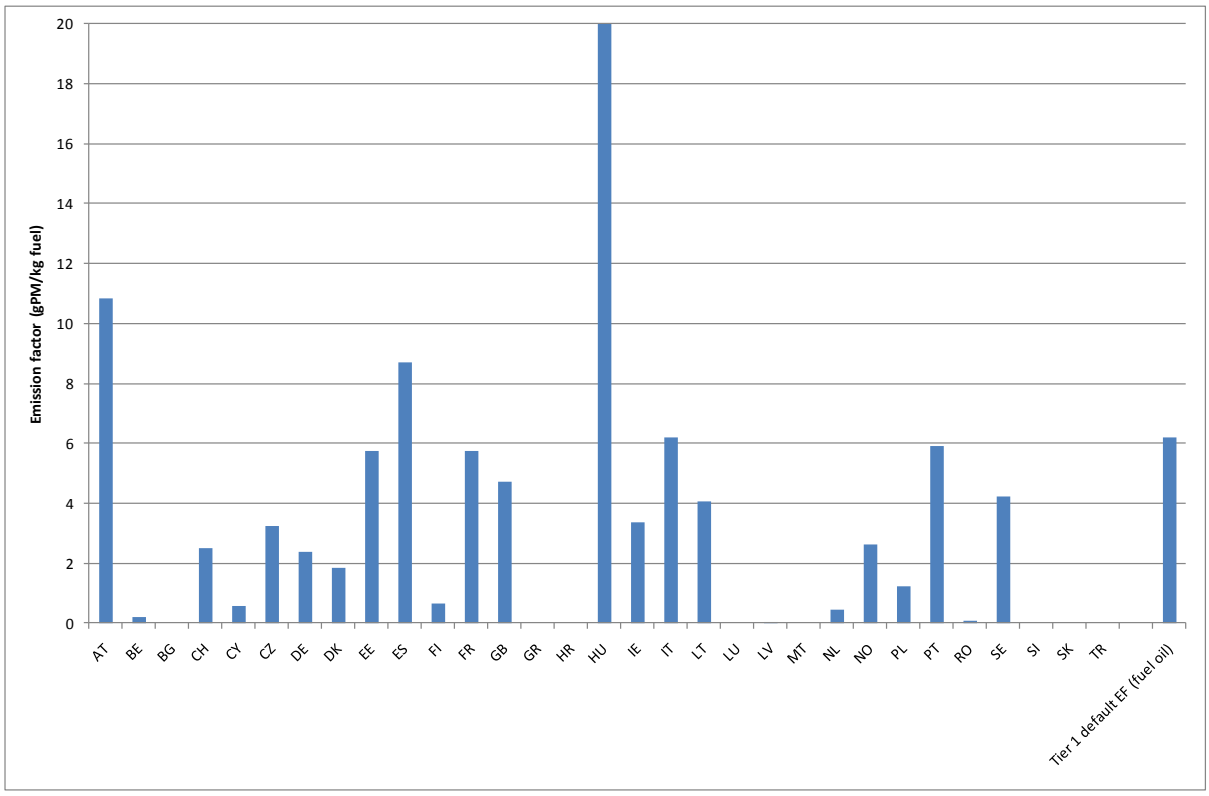


Figure 8 shows the corresponding IEFs for PM_{10}. There is a fairly wide variation in IEFs for this pollutant. Again, the figure for Hungary of 884 gPM/kg fuel is way out of line with the default value of 6 gPM/kg fuel. Austria also has a value higher than the default which is not expected given that the IEF for SO_2 was lower than the default implying low sulphur fuels are predominantly being used. Emission factors for PM are lower for low sulphur fuels and the default value refers to fuel oil. The value for marine gas/diesel oil is around 1.5 gPM/kg fuel. Most countries have IEFs for PM between the fuel oil and gas oil default values, but some countries that report PM emissions use much lower values, notably Belgium, Cyprus, Finland, Latvia, Netherlands and Romania. These countries (except Finland) are also associated with low IEF values for SO_2.

Figure 8: Implied emission factors for PM_{10} for all shipping emissions in 2008



4 A Country-Overview on Reported Shipping Emissions

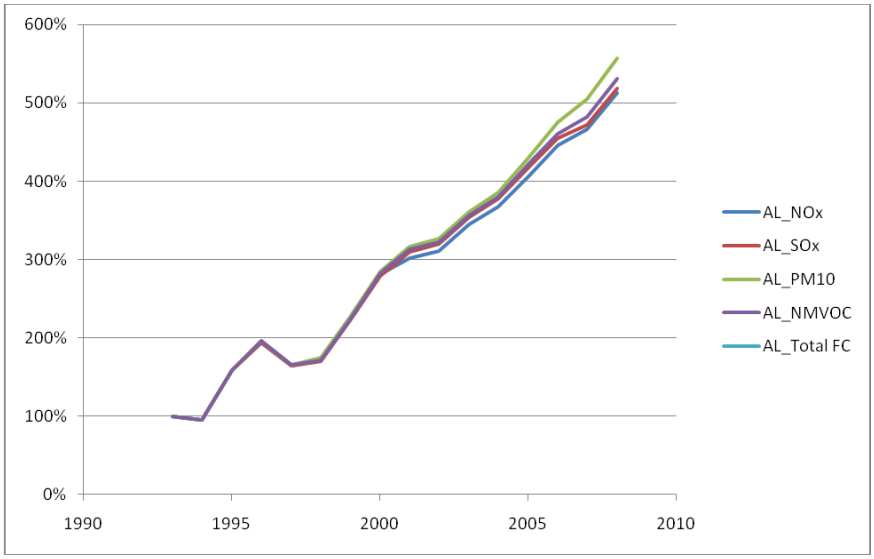
4.1 Introduction

This section gives an overview for each country based on the analysis covered in Sections 2 and 3, where emissions are reported. It also shows the relative trends in the reported emissions for total shipping emissions of SO_2, NO_x and PM (including international) and compares these with trends in total fuel consumption for each country as reported to Eurostat. The trends are relative to emissions and fuel consumption by each country reported for 1990 or if not available, the earliest year reported.

4.2 Albania

Albania's inventory covers only the main pollutants from 1993. Only figures for domestic shipping are reported and no IIR is available. Figure 9 shows the relative trend in emissions and fuel consumption. Emissions for all main pollutants follow a general upward trend and appear to be consistent with each other. There are no Eurostat fuel consumption data to compare against.

Figure 9: Trend in shipping emissions and fuel consumption for Albania

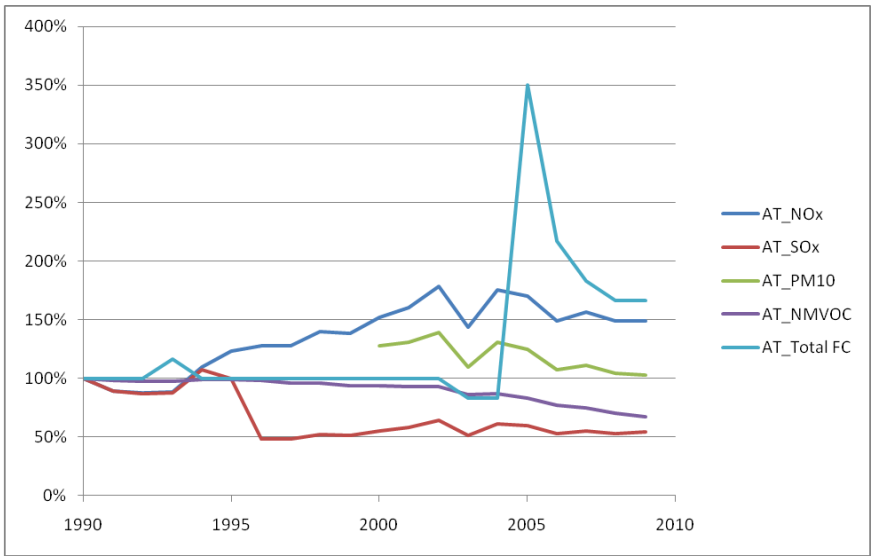


4.3 Austria

Austria reports emissions for all the main pollutants plus those for PAHs, 2 POPs and 3 metals for years between 1990-2009 so the inventory is considered complete. Austria is an inland country and emissions are reported separately for international inland waterways and domestic navigation. A fairly detailed Tier 2/3 method is used. For SO_2, NO_x and PM_{10}, 46% of the shipping emissions occur from domestic shipping, for NMVOCs the proportion is 87%. Fuel consumption reported to Eurostat is all allocated to domestic shipping. Implied

emission factors defined by the Eurostat fuels data are close to the default value for NO_x, but are much lower for SO_2 and rather higher for PM_{10}. Figure 10 shows the relative trends in SO_2, NO_x, PM_{10} and NMVOC emissions for all shipping since 1990 and compares these with trends in fuel consumption. There appears to be a step change in the fuel consumption data reported to Eurostat in 2005 which does not appear to have been used in the inventory. Overall, the Austrian inventory appears to be of fairly high quality.

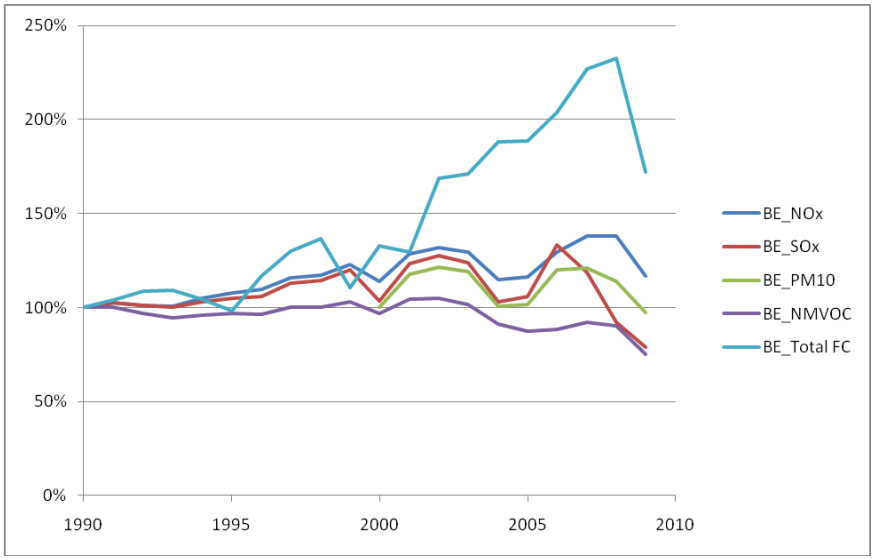
Figure 10: Trend in shipping emissions and fuel consumption for Austria



4.4 Belgium

Belgium reports emissions for all the main pollutants plus those for PAHs, 1 POPs and 8 metals for years between 1990-2009 so the inventory is considered complete. Emissions are reported separately for international maritime, international inland waterways, domestic navigation and fishing. A fairly detailed Tier 2 method is used. For SO_2, 2% of the shipping emissions occur from domestic shipping, for NO_x, PM_{10} and NMVOCs the proportion is 10-16%. Only 1% of the fuel consumption reported to Eurostat is allocated to domestic shipping. Implied emission factors defined by the Eurostat fuels data are much lower than the default values possibly indicating a lack of consistency in the emission estimates with fuels data reported to Eurostat. This may also be evident in the trends in emissions and fuel consumption. Belgium reports particularly high total fuel consumption not matched by high emissions when compared with other countries. Figure 11 shows the relative trends in SO_2, NO_x, PM_{10} and NMVOC emissions for all shipping since 1990 and compares these with trends in fuel consumption. Emissions have fluctuated, but remained fairly constant since 1990 whereas fuel consumption appeared to rise considerably in the early 2000s. Overall, the Belgian inventory appears to be of fairly high quality.

Figure 11: Trend in shipping emissions and fuel consumption for Belgium



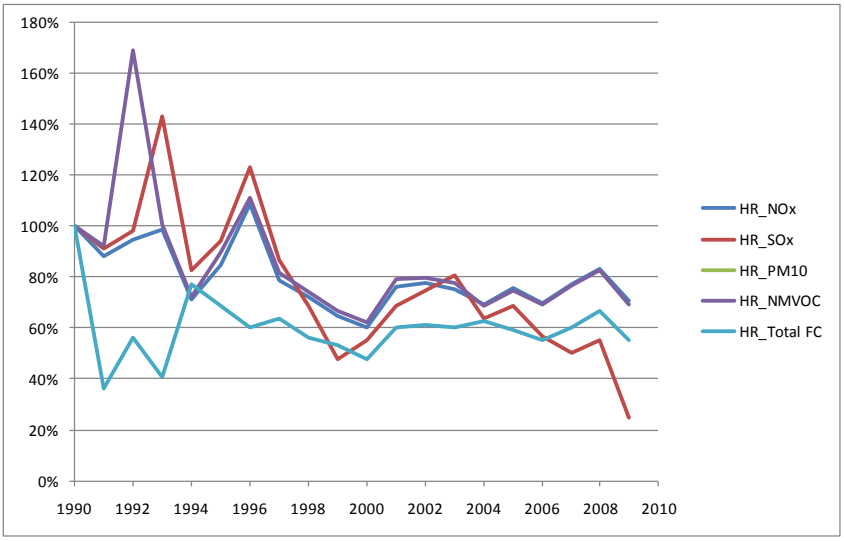
4.5 Bulgaria

Bulgaria does not report emissions from shipping. The IIR states that emissions may be allocated to NFR code 1A2. Improvements are planned to re-allocate and split marine bunkers and national navigation. Eurostat fuels data are available for Bulgaria. Consumption is very small compared with other countries and the trends very erratic.

4.6 Croatia

Croatia reports emissions for all the main pollutants except PM_{10} plus those for 3 PAHs and 6 metals for years between 1990-2009 so the inventory is considered fairly complete. Emissions are reported separately for international and domestic navigation. A Tier 1 method is used. For SO_2, 32% of the shipping emissions occur from domestic shipping, for NO_x and NMVOCs the proportion is 66% which is also the proportion of fuel consumption allocated to domestic shipping in 2008 as reported to Eurostat. The IEFs for NO_x and SO_2 are about half the default Tier 1 values. Figure 12 shows the relative trends in SO_2, NO_x and NMVOC emissions for all shipping since 1990 and compares these with trends in fuel consumption. The emission trends are broadly similar to each other and erratic, but show a general downward trend in the 1990s followed by a period of stabilisation. This is largely consistent with the trend in fuel consumption except during the period between 1991-95.

Figure 12: Trend in shipping emissions and fuel consumption for Croatia



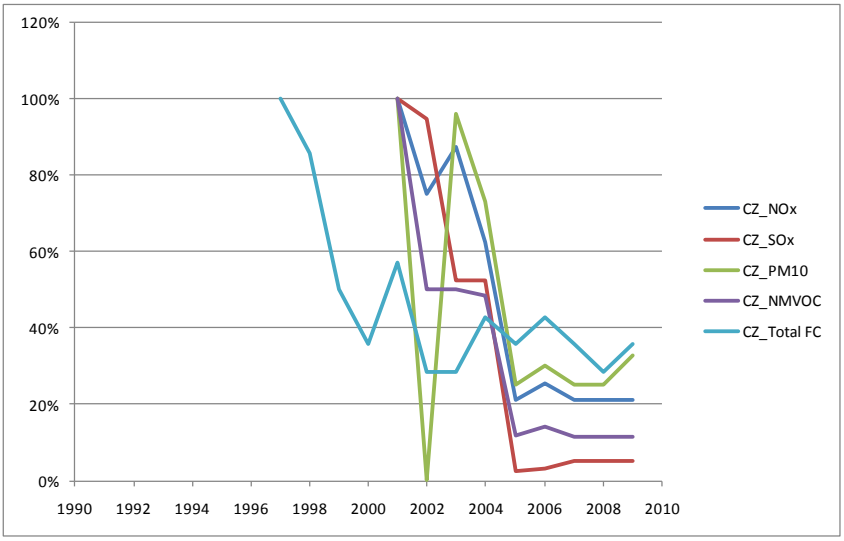
4.7 Cyprus

Cyprus reports emissions for 5 of the main pollutants and provides figures only for international navigation and for the years 2008 and 2009. The inventory is therefore incomplete as far as the time-series and coverage of domestic shipping is concerned. A detailed Tier 3 method is used for years where emissions are reported. Implied emission factors defined by the Eurostat fuels data are much lower than the default values possibly indicating a lack of consistency in the emission estimates with fuels data reported to Eurostat. A time-series in Eurostat fuels data are available for Cyprus showing an upward trend during the 1990s followed by a steep decline in the early 2000s and then an unexpected 5-fold increase between 2004 and 2005.

4.8 Czech Republic

Czech Republic reports emissions for all the main pollutants plus those for 5 PAHs, 2POPs and 6 metals for years between 2001-2009. Czech Republic is an inland country and only figures for national navigational are reported which is consistent with the fuel consumption in Eurostat only referring to domestic shipping. The inventory is therefore considered fairly complete from 2001, but incomplete for the longer time-series back to 1990. No details are given on methodology, but it is believed a Tier 1 approach based on national fuel consumption is used. The IEFs for NO_x and PM_{10} are around a half of the Tier default values, but the IEFs for SO_2 are much lower implying very low sulphur content fuels being used. Figure 13 shows the relative trends in SO_2, NO_x, PM_{10} and NMVOC emissions for all shipping since 2001 and compares these with trends in fuel consumption. The trends are similar for all pollutants showing a large decline between 2004 and 2005. This does not seem to be consistent with trends in fuel consumption since 2001 which, although generally downward, has changed at a slower rate.

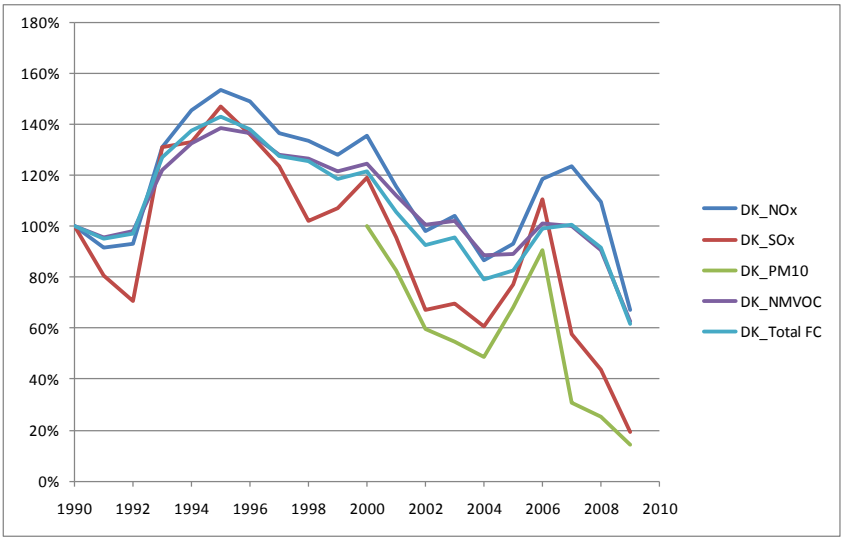
Figure 13: Trend in shipping emissions and fuel consumption for Czech Republic



4.9 Denmark

Denmarks reports emissions for all the main pollutants plus those for 5 PAHs, 2 POPs and 9 metals for years between 1990-2009 so the inventory is considered complete. Emissions are reported separately for international and domestic navigation and fishing. A detailed Tier 3 bottom-up method is used for passenger ferries combined with more simple methods based on national fuel statistics for international navigation and fishing. Around 20% of shipping emissions for NO_x and PM_{10} occur from domestic navigation which is largely consistent with the proportion of fuel consumption attributed to domestic according to Eurostat. For SO_2, the proportion is 9% and for NMVOCs is 42% indicating that lower sulphur fuels and gasoline vessels are used for domestic shipping. The IEFs for SO_2 and PM_{10} are lower than the Tier 1 default values, for NO_x it is very similar. Figure 14 shows the relative trends in SO_2, NO_x, PM_{10} and NMVOC emissions for all shipping since 1990 and compares these with trends in fuel consumption. The trends appear to be consistent with each pollutant and with Eurostat fuel consumption, with a rise occurring between 2004 and 2006 following a general downward trend since the mid 1990s. Overall, the Denmark inventory appears to be of high quality.

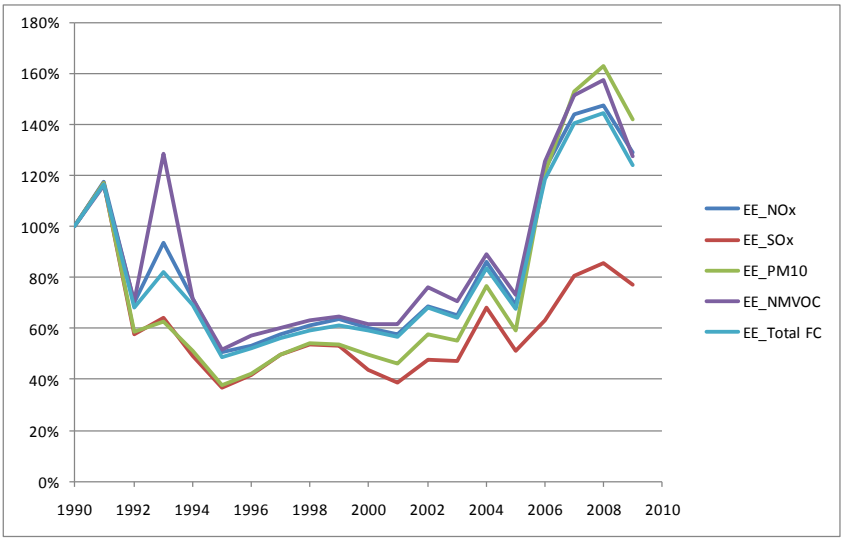
Figure 14: Trend in shipping emissions and fuel consumption for Denmark



4.10 Estonia

Estonia reports emissions for all the main pollutants plus those for 3 PAHs, 1 POPs and 6 metals for years between 1990-2009 so the inventory is considered complete. Emissions are reported separately for international and domestic navigation. A Tier 1 method is used using default emission factors and national fuel statistics. Around 5% of shipping emissions for NO_x and PM_{10} occur from domestic navigation which is largely consistent with the proportion of fuel consumption attributed to domestic shipping according to Eurostat. The figures are 1% for SO_2 and 17% for NMVOCs suggesting the use of low sulphur fuels and gasoline vessels for domestic activities. The IEFs are all very close to Tier 1 default values. Figure 15 shows the relative trends in SO_2, NO_x, PM_{10} and NMVOC emissions for all shipping since 1990 and compares these with trends in fuel consumption. The trends appear to be consistent with each pollutant and with Eurostat fuel consumption, with a sharp rise occurring between 2005 and 2006 following a fairly slow period of growth since the mid 1990s. Overall, the Estonia inventory appears to be of good quality.

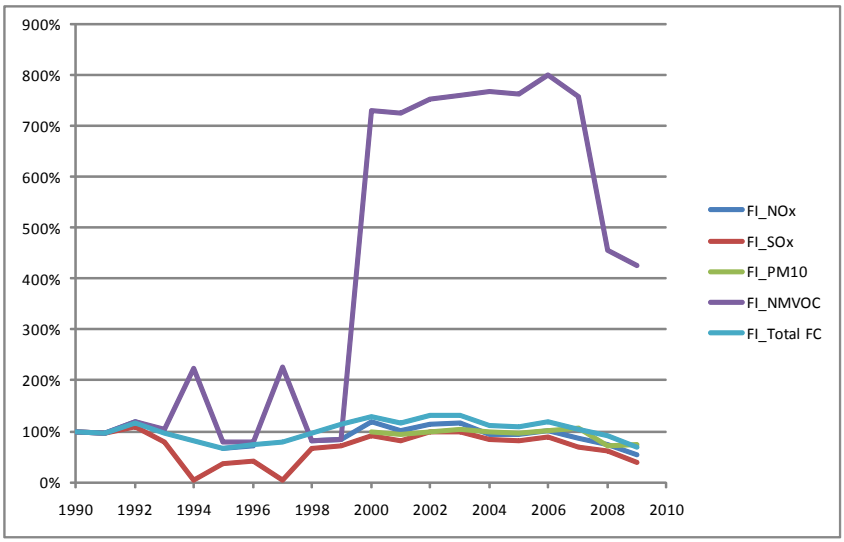
Figure 15: Trend in shipping emissions and fuel consumption for Estonia



4.11 Finland

Finland reports emissions for all the main pollutants plus those for 1 POPs for years between 1990-2009 so the inventory is considered largely complete. Emissions are reported separately for international and domestic navigation and fishing. A detailed Tier 3 bottom-up method based on shipping movement data is used. Around 28% of shipping emissions for NO_x occur from domestic navigation which is largely consistent with the proportion of fuel consumption attributed to domestic shipping according to Eurostat (35%). The figures are 8% for SO_2 and 88% for NMVOCs suggesting the use of low sulphur fuels and gasoline vessels for domestic activities. No figures for PM_{10} are reported for international navigation in 2008. The IEFs are all close to Tier 1 default values except for PM_{10} where they are much lower which may be because of the absence of reported PM_{10} emissions from international shipping whereas fuel consumption for this source is reported. Figure 16 shows the relative trends in SO_2, NO_x, PM_{10} and NMVOC emissions for all shipping since 1990 and compares these with trends in fuel consumption. Since 2000, the trends are all fairly flat and consistent with each other, with a decline appearing since 2007. However, there appears to be step-change in the NMVOC trend occurring from 2000 which cannot be explained.

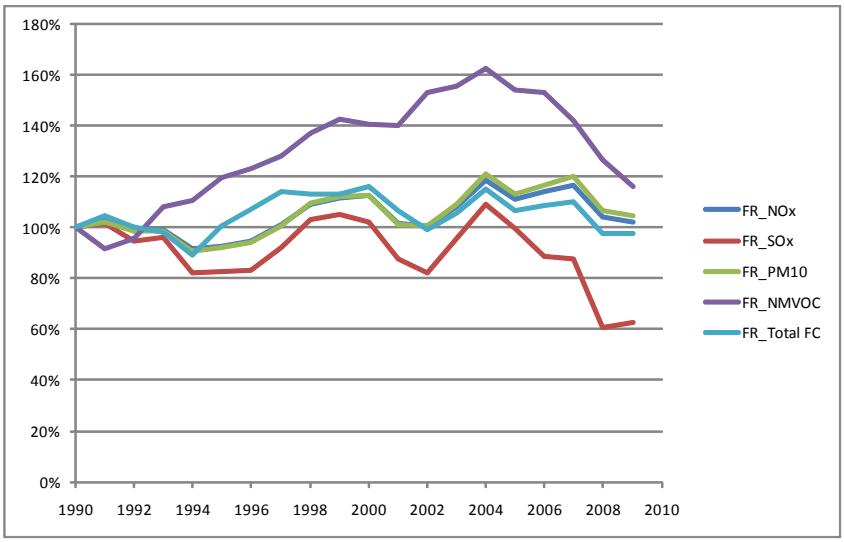
Figure 16: Trend in shipping emissions and fuel consumption for Finland



4.12 France

France reports emissions for all the main pollutants plus those for 5 PAHs, 3 POPs and 9 metals for years between 1990-2009 so the inventory is considered complete. Emissions are reported separately for international and domestic navigation and fishing. A Tier 2 method is used based on a combination of national fuel statistics and other shipping activity data. Around 25% of shipping emissions for NO_x and PM_{10} occur from domestic navigation which is largely consistent with the proportion of fuel consumption attributed to domestic shipping according to Eurostat (18%). The figures are 8% for SO_2 and 83% for NMVOCs suggesting the use of low sulphur fuels and gasoline vessels for domestic activities. France is among the top 6 emitters of shipping emissions in Europe and this is consistent with fuels data in Eurostat. The IEFs are all very close to Tier 1 default values. Figure 17 shows the relative trends in SO_2, NO_x, PM_{10} and NMVOC emissions for all shipping since 1990 and compares these with trends in fuel consumption. The trends are largely consistent with each other and with the trends in fuel consumption from Eurostat. Overall, the French inventory appears to be of high quality.

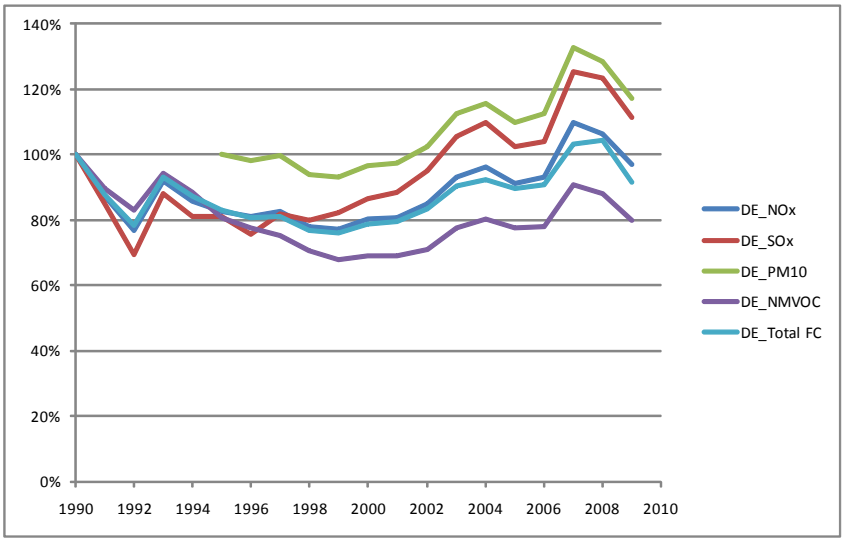
Figure 17: Trend in shipping emissions and fuel consumption for France



4.13 Germany

Germany reports emissions for all the main pollutants plus those for 2 PAHs, 1 POPs and 9 metals for years between 1990-2009 so the inventory is considered complete. Emissions are reported separately for international and domestic navigation and fishing. A Tier 1 method is used based on a national fuel statistics and country specific emission factors. A more detailed Tier 2 type approach is used for fishing based on number and useage of vessels. Around 7% of shipping emissions for NO_x and PM_{10} occur from domestic navigation which is consistent with the proportion of fuel consumption attributed to domestic shipping according to Eurostat. The figures are 1% for SO_2 and 16% for NMVOCs suggesting the use of low sulphur fuels and gasoline vessels for domestic activities. Germany is among the top 6 emitters of shipping emissions in Europe and this is consistent with fuels data in Eurostat. The IEFs are all close to Tier 1 default values, although the factor for SO_2 is 50% higher and that for PM_{10} is 65% lower than the default values. Figure 18 shows the relative trends in SO_2, NO_x, PM_{10} and NMVOC emissions for all shipping since 1990 and compares these with trends in fuel consumption. The trends are largely consistent with each other and with the trends in fuel consumption from Eurostat. Overall, the German inventory appears to be of good quality.

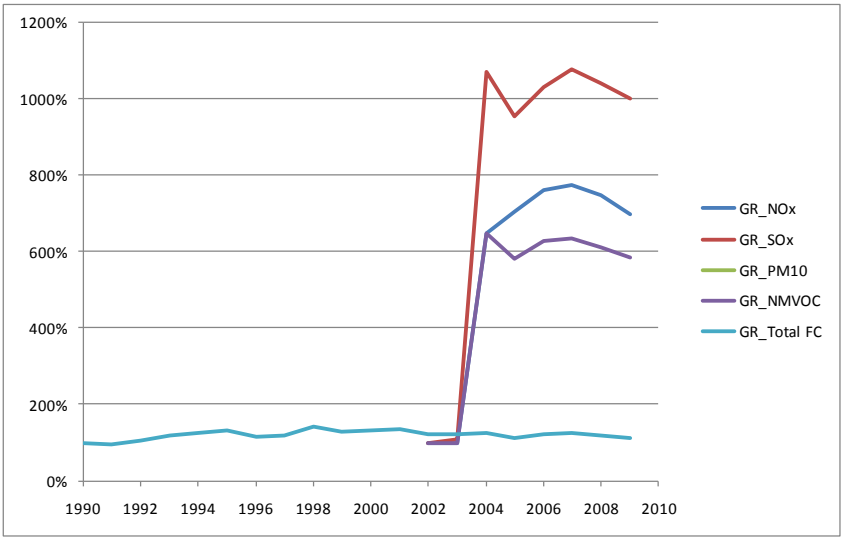
Figure 18: Trend in shipping emissions and fuel consumption for Germany



4.14 Greece

Greece reports emissions only for 4 of the main pollutants for years 2002-2009; it excludes PM_{10}. In terms of pollutant coverage and length of time-series, the inventory is therefore only partially complete. From 2004, emissions are reported separately for international and domestic navigation. No IIR is available and therefore it is not known what methodology is used. Between 10-16% of shipping emissions for each pollutant in 2008 occur from domestic navigation which is consistent with the proportion of fuel consumption attributed to domestic shipping according to Eurostat. Greece is among the top 6 emitters of shipping emissions in Europe and this is consistent with fuels data in Eurostat. The IEFs for NO_x are close to default values. For SO_2, the IEFs are about a factor of two larger implying higher sulphur content fuel being used. Figure 19 shows the relative trends in SO_2, NO_x and NMVOC emissions for all shipping since 2002 and compares these with trends in fuel consumption. The trends are largely consistent with each other, but there is unexplained step-change in emissions (a sharp rise) in emissions between 2003 and 2004 which cannot be explained. The Eurostat fuel consumption trend is fairly flat over the whole time period.

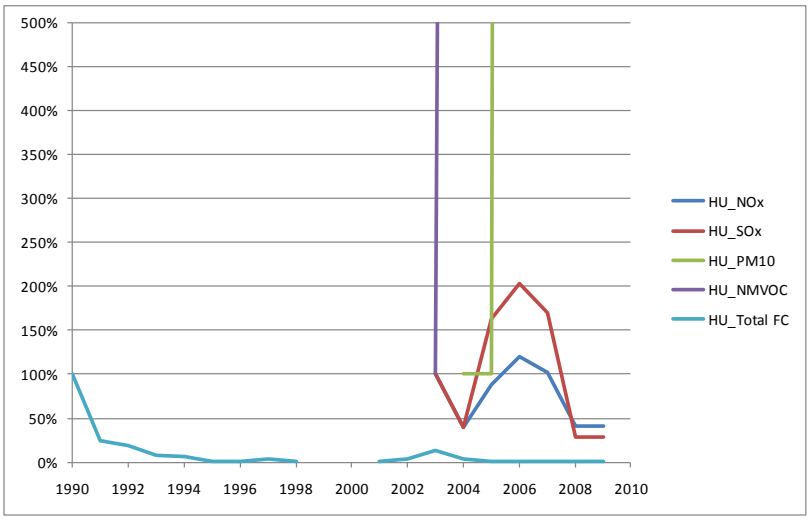
Figure 19: Trend in shipping emissions and fuel consumption for Greece



4.15 Hungary

Hungary reports emissions only for all the main pollutants for years 2003-2009. In terms of pollutant coverage and length of time-series, the inventory is therefore only partially complete. Hungary is an inland country and emissions are reported only for domestic navigation, as is also the case for fuel consumption reported to Eurostat. No IIR is available and therefore it is not known what methodology is used. The IEFs for NO_x and PM_{10} appear out of line with other countries and appear much larger than Tier 1 default values suggesting these ought to be re-examined. The IEF for SO_2 is also higher than the default, but only by 66%. The possibility exists that a different source of fuel consumption data are used for the emission calculations. Figure 20 shows the relative trends in SO_2, NO_x, PM_{10} and NMVOC emissions for all shipping since 2003 and compares these with trends in fuel consumption. There are several step-changes over the short time-series which cannot be explained, while there is also some doubt in the quality of the Eurostat fuel consumption data for Hungary as this shows a large drop to very small levels since the early 1990s. This might indicate a problem with the availability of reliable fuel consumption data for activities on Hungary's inland waterways.

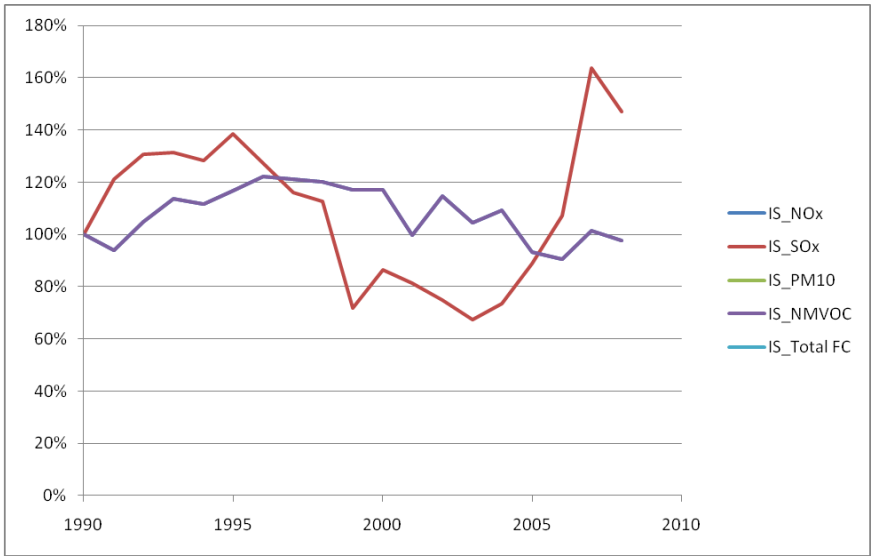
Figure 20: Trend in shipping emissions and fuel consumption for Hungary



4.16 Iceland

Iceland reports emissions for 4 of the main pollutants plus those for 2 PAHs and 1 POPs for years between 1990-2008; it excludes PM_{10}. No figures were available for 2009. Apart from this and the lack of data for PM_{10}, the inventory is considered largely complete. Emissions are reported separately for international and domestic navigation and fishing. No IIR is available and therefore it is not known what methodology is used. Around 60-72% of reported shipping emissions of each pollutant occur from domestic navigation. There are no Eurostat fuels data with which to compare the emissions data and derive IEFs. Figure 21 shows the relative trends in SO_2, NO_x and NMVOC emissions for all shipping since 1990. NO_x and NMVOCs follow the same trend. The trend in SO_2 is different and indicates a sharp rise in emissions from around 2003 not shown by the other pollutants.

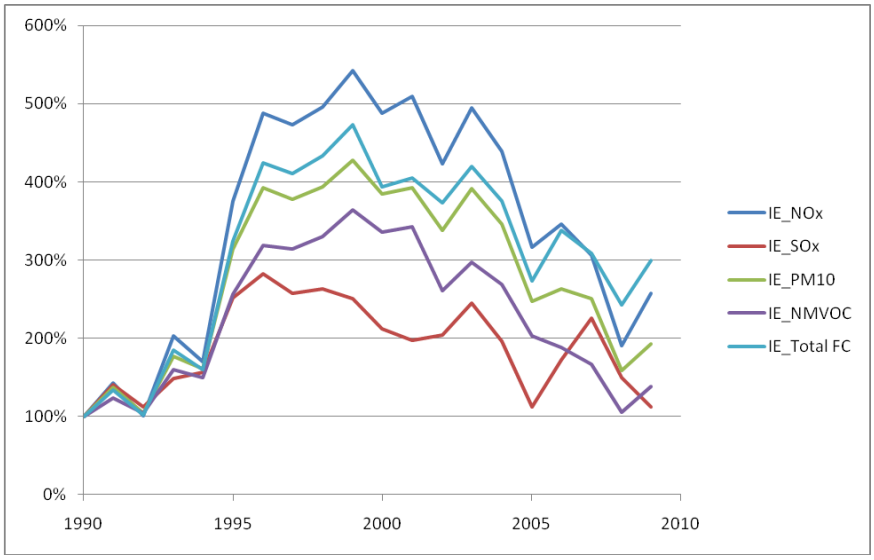
Figure 21: Trend in shipping emissions and fuel consumption for Iceland



4.17 Ireland

Ireland reports emissions for all the main pollutants plus those for 5 PAHs, 2 POPs and 9 metals for years between 1990-2008 and for this time period the inventory is considered complete. However the data are incomplete for 2009. Emissions are reported separately for international and domestic navigation. No methodological details are given in the IIR, but a Tier 1 approach using country-specific emission factors and national fuel statistics is believed to be used. Less than 2% of SO_2, NO_x and PM_{10} emissions are from domestic navigation, while the figure for NMVOCs is 4%. This does not seem consistent with Eurostat fuel consumption data which implies 21% of fuel consumption is attributed to domestic shipping. The IEF for SO_2 is slightly lower than default values while for NO_x and PM_{10} the IEFs are around a factor of two lower. Figure 22 shows the relative trends in SO_2, NO_x, PM_{10} and NMVOC emissions for all shipping since 1990 and compares these with trends in fuel consumption. The trends are largely consistent with each other and with the trends in fuel consumption from Eurostat showing a largely downward trend since the mid 1990s, though there are some differences in the trend for SO_2 in the late 2000s.

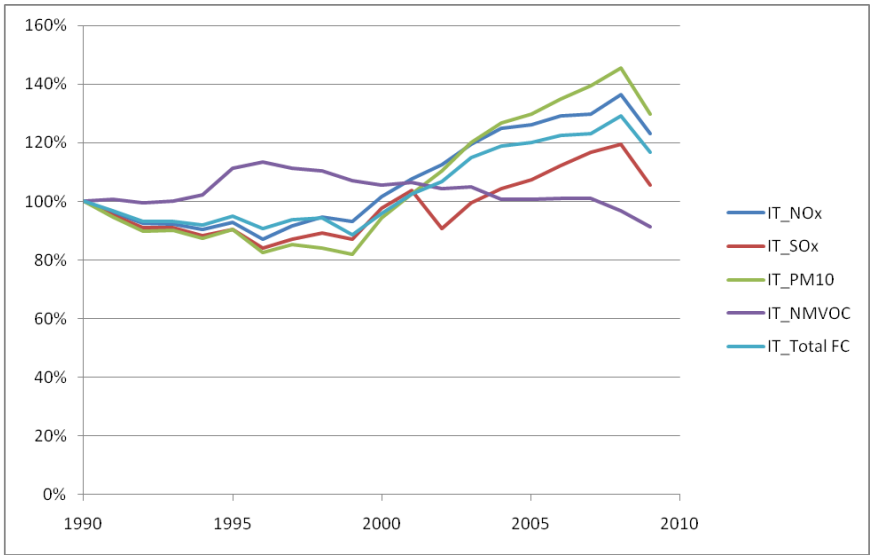
Figure 22: Trend in shipping emissions and fuel consumption for Ireland



4.18 Italy

Italy reports emissions for all the main pollutants plus total PAHs and 8 metals for years between 1990-2009 so the inventory is considered complete. Emissions are reported separately for international and domestic navigation and fishing. No methodology details are given in the IIR, but according to the NIR, a detailed Tier 3 method is used based on a combination of port/shipping movement data and national fuel statistics. Around 27-37% of shipping emissions for NO_x and PM_{10} occur from domestic navigation which is largely consistent with the proportion of fuel consumption attributed to domestic shipping according to Eurostat (39%). The figures are 20% for SO_2 and 94% for NMVOCs suggesting the use of low sulphur fuels and gasoline vessels for domestic activities. Italy is among the top 6 emitters of shipping emissions in Europe and this is consistent with fuels data in Eurostat. It is also by far the largest emitter of NMVOCs from shipping, mainly from domestic activities. The IEFs are close to Tier 1 default values. Figure 23 shows the relative trends in SO_2, NO_x, PM_{10} and NMVOC emissions for all shipping since 1990 and compares these with trends in fuel consumption. The trends are largely consistent with each other and with the trends in fuel consumption from Eurostat. Only NMVOCs follow a different temporal trend, probably because of the different contribution from gasoline powered vessels used for domestic activities. Overall, the Italian inventory appears to be of high quality.

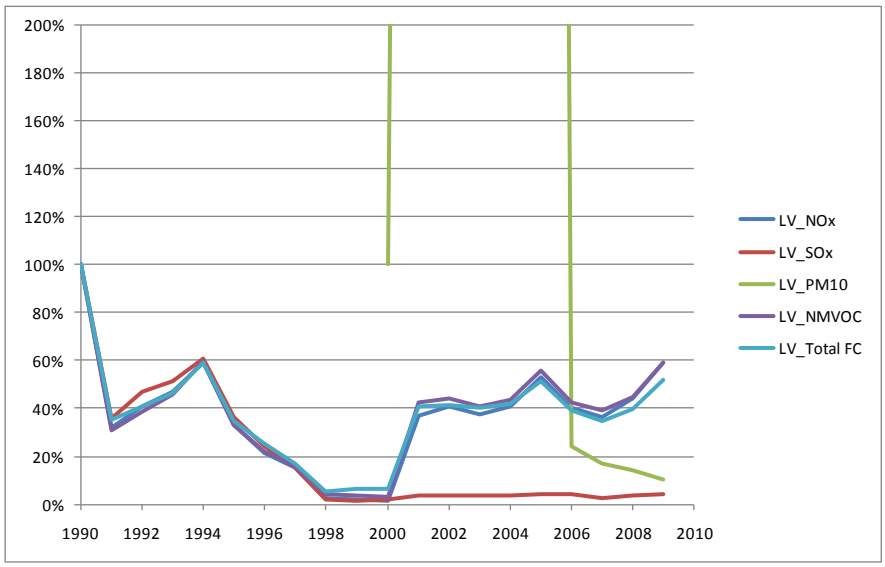
Figure 23: Trend in shipping emissions and fuel consumption for Italy



4.19 Latvia

Latvia reports emissions for all the main pollutants plus 3 PAHs, 1POPs and 6 metals for years between 1990-2009 so the inventory is considered complete apart from the lack of PM_{10} emissions reported before 2000. Emissions are reported separately for international and domestic navigation and fishing. A Tier 1 method is used using default emission factors and national fuel statistics. Around 5% of shipping emissions for SO_2 and NMVOCs occur from domestic navigation which is consistent with the proportion of fuel consumption attributed to domestic shipping according to Eurostat. The figures are 1% for NO_x, but no PM_{10} emissions are reported for international navigation in 2008. There would appear to be a problem with the PM_{10} inventory for Latvia in earlier years as seen below. The IEF for NO_x is close to the Tier 1 default value, but the value for SO_2 is lower indicating the use of low sulphur fuels. Figure 24 shows the relative trends in SO_2, NO_x, PM_{10} and NMVOC emissions for all shipping since 1990 and compares these with trends in fuel consumption. The trends for NO_x and NMVOCs are consistent with trends in fuel consumption while the larger reduction in SO_2 emissions may indicate a switch to low sulphur marine fuels. However, the inventory for PM_{10} appears problematic. Emissions of PM_{10} are only reported from 2000 and appear to show a sharp increase followed by a sudden decrease between 2005 and 2006 not shown by other pollutants.

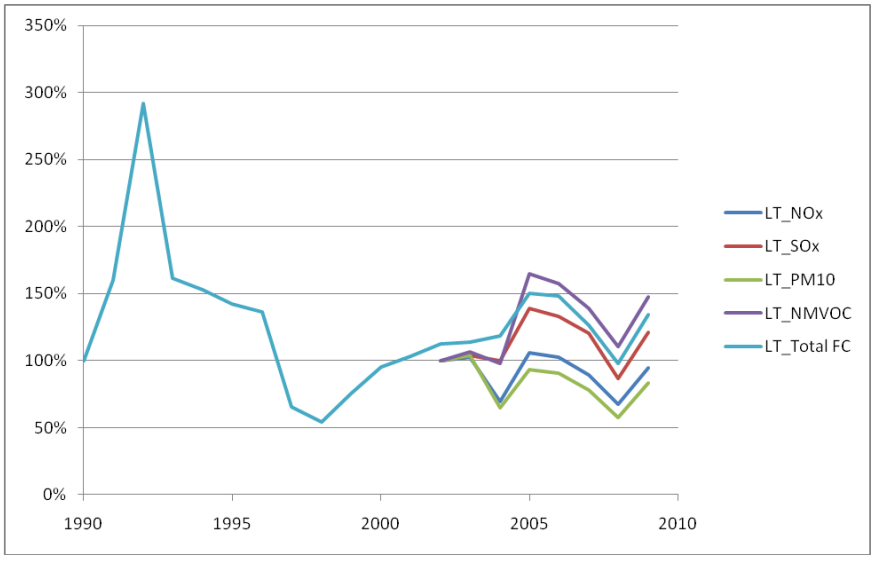
Figure 24: Trend in shipping emissions and fuel consumption for Latvia



4.20 Lithuania

Lithuania reports emissions for all the main pollutants plus 5 PAHs, 1POPs and 9 metals but only for years from 2002. The inventory is therefore considered complete in recent years, but not in terms of the historic time-series. Emissions are reported separately for international and domestic navigation. A Tier 1 method is used using default emission factors and national fuel statistics. Around 2-5% of shipping emissions for SO_2, NO_x and PM_{10} occur from domestic navigation which is largely consistent with the proportion of fuel consumption attributed to domestic shipping according to Eurostat (8%). The figure for NMVOCs is 10%. The IEFs are fairly similar to Tier 1 default values, but are somewhat lower for PM_{10}. Figure 25 shows the relative trends in SO_2, NO_x, PM_{10} and NMVOC emissions for all shipping since 2002 and compares these with trends in fuel consumption. The trends are largely consistent with each other and with the trends in Eurostat fuel consumption from 2002.

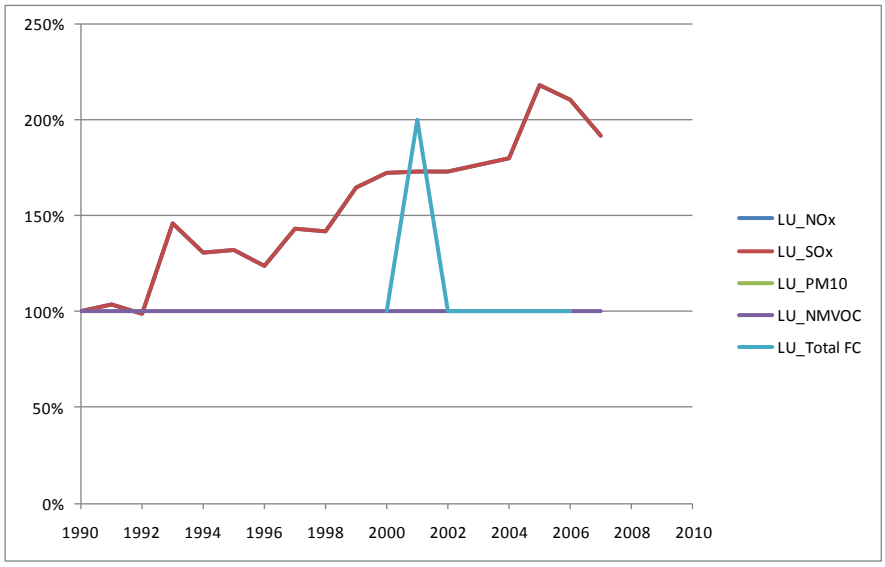
Figure 25: Trend in shipping emissions and fuel consumption for Lithuania



4.21 Luxembourg

Luxembourg reports emissions only for SO_2, NO_x and NMVOCs for years between 1990-2007. Luxembourg is an inland country and only figures for national navigational are reported which is consistent with the fuel consumption in Eurostat only referring to domestic shipping. The inventory is therefore considered fairly complete in terms of time-series and sectors covered, but incomplete in terms of pollutants covered. No IIR is available and therefore it is not known what methodology is used. Figure 26 shows the relative trends in SO_2, NO_x and NMVOC emissions for all shipping since 1990 and compares these with trends in fuel consumption. The Eurostat fuels data are only available from 2000 and remain constant except for a spurious increase by a factor of 2 in 2001. Emissions of SO_2 and NO_x follow identical upward trends indicating that they are unlikely to be based on fuel consumption data from Eurostat. NMVOC emissions are constant across the time series.

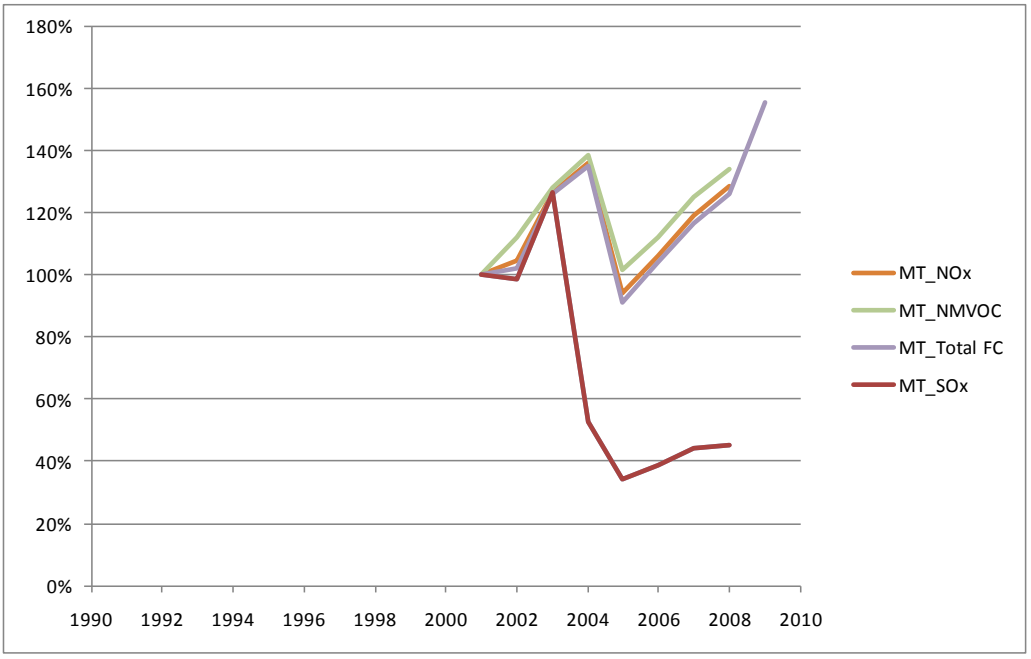
Figure 26: Trend in shipping emissions and fuel consumption for Luxembourg



4.22 Malta

Malta reports emissions for 4 of the the main pollutants and 8 metals, but excludes PM_{10} and reports only for the period 2000-2008. The inventory is therefore incomplete as far as the historic time-series and pollutant coverage is concerned. Emissions are reported separately for international and domestic navigation and fishing. No IIR is available and therefore it is not known what methodology is used. Around 0.2% of the shipping emissions for SO_2 occur from domestic navigation compared with 7% for NO_x and 27% for NMVOCs. Figures for Malta in Eurostat imply that all fuel is used for international shipping and that none is used for domestic shipping so there seems an inconsistency with the inventory for NO_x and NMVOCs. The IEFs for SO_2 and especially NO_x are lower than Tier 1 default values. Figure 27 shows the relative trends in SO_2, NO_x and NMVOC emissions for all shipping since 2001 and compares these with trends in fuel consumption. The trends for NO_x and NMVOC are largely consistent with each other and with the trends in Eurostat fuel consumption from 2001 whereas SO_2 shows a sharp decline after 2003 indicating the switch to lower sulphur fuels.

Figure 27: Trend in shipping emissions and fuel consumption for Malta



4.23 Moldova

Moldova reports emissions only for 1990 and only for international shipping, though it is an inland country. The inventory does include all the main pollutants, PAHs, POPs and metals for this year. No IIR is available and therefore it is not known what methodology is used for the 1990 emissions. There are no fuels data for Moldova in Eurostat.

4.24 Montenegro

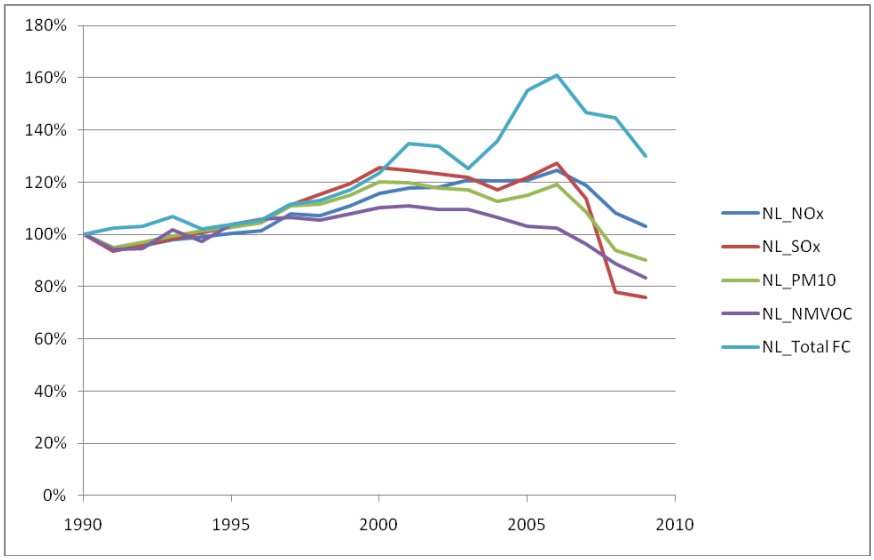
Montenegro reports emissions only for 2006 and 2009 and only for national navigation. The inventory does include all the main pollutants, POPs and metals for these years. No IIR is available and therefore it is not known what methodology is used. There are no fuels data for Montenegro in Eurostat.

4.25 Netherlands

Netherlands reports emissions for all the main pollutants plus 6 POPs and 5 metals for years between 1990-2009 so the inventory is considered complete. Emissions are reported separately for international maritime, international inland waterways, domestic navigation and fishing. No IIR is available and therefore it is not known what methodology is used. For SO_2, 2% of the shipping emissions occur from domestic shipping, which is largely consistent with the proportion of fuel consumption attributed to domestic shipping according to Eurostat (3%). For NO_x, PM_{10} and NMVOCs, the proportions are 13%, 9% and 48% respectively. According to Eurostat, Netherlands has the largest consumption of fuel in Europe, the majority for international navigation. The reported emissions (including international navigation) are not among the highest in Europe and as a consequence the IEFs are considerably smaller than the IEF defaults. This suggests that the method used to estimate emissions is not directly related to fuel consumption data reported to Eurostat. Having said this, Figure 28 shows the relative trends in SO_2, NO_x, PM_{10} and NMVOC emissions for all shipping since 1990 and these are fairly consistent with each other and the trends in Eurostat

fuel consumption. The sharper decline in the emission trends from 2005, particularly for SO_2, indicates the switch to lower sulphur content marine fuels and probably vessel engine types.

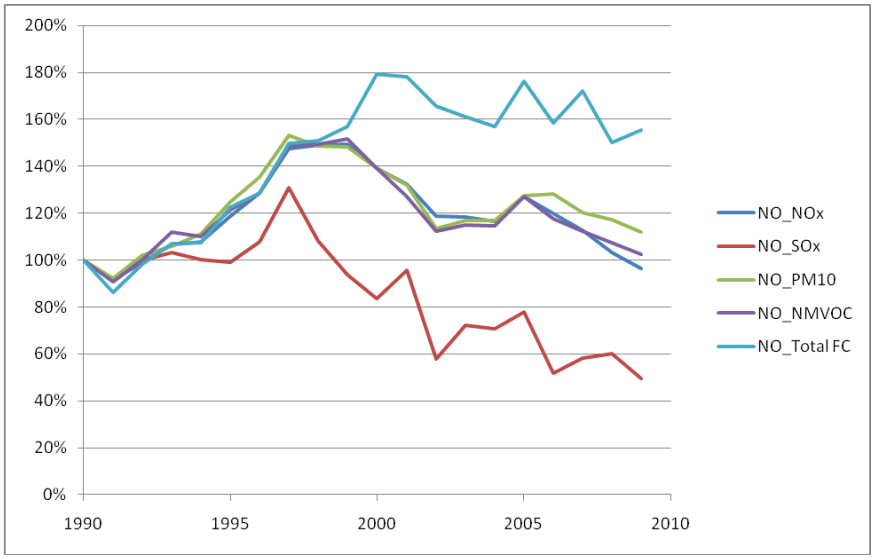
Figure 28: Trend in shipping emissions and fuel consumption for Netherlands



4.26 Norway

Norway reports emissions for all the main pollutants plus those for 1 PAH, 1 POPs and 6 metals for years between 1990-2009 so the inventory is considered complete. Emissions are reported separately for international and domestic navigation and fishing. A Tier 2 type approach is used based on a national fuel statistics and other activity data for specific vessel types and country-specific EFs. A high proportion of NO_x, PM and NMVOC emissions (50-60%) occur from domestic navigation which is consistent with the proportion of fuel consumption attributed to domestic shipping according to Eurostat (71%). For SO_2, the proportion is less (36%) indicating lower sulphur fuel used for domestic navigation. The IEFs are somewhat lower than Tier 1 default values, especially for SO_2 which tends to support the view that a relatively high proportion of activities use low sulphur marine diesel oil and gasoline engines. Figure 29 shows the relative trends in SO_2, NO_x, PM_{10} and NMVOC emissions for all shipping since 1990 and compares these with trends in fuel consumption. The trends are largely consistent with each other and with the trends in fuel consumption from Eurostat. Emissions appear to have declined since 2000 more rapidly than total fuel consumption, again suggesting a switch in the type of fuels and vessel engine types. Overall, the Norway inventory appears to be of good quality.

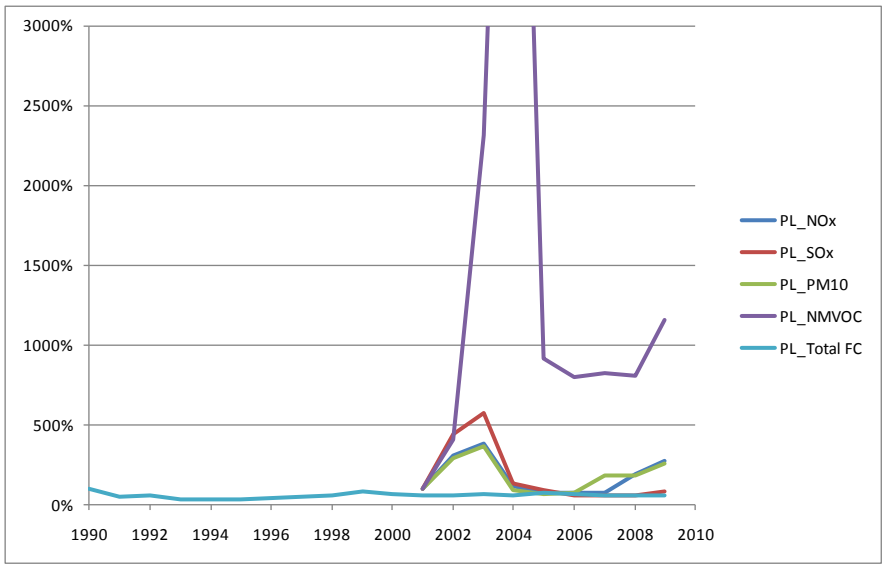
Figure 29: Trend in shipping emissions and fuel consumption for Norway



4.27 Poland

Poland reports emissions for all the main pollutants plus those for 5 PAHs, 1POPs and 3 metals for years between 2001-2009. Only figures for national navigational and fishing are reported, with no figures for international navigation. The inventory is therefore considered partially complete from 2001, but incomplete for earlier years. A Tier 1 method is used using default emission factors and national fuel statistics. According to figures in Eurostat, only 2% of fuel consumption is used for domestic navigation. The IEFs are considerably lower than IEF default values, but this would largely be due to the fact that the Eurostat figures used to derive IEFs include international navigation, absent in the emissions. Figure 30 shows the relative trends in SO_2, NO_x, PM_{10} and NMVOC emissions for all shipping since 2001 and compares these with trends in fuel consumption. The trends are difficult to interpret, as all pollutants, especially NMVOCs, show very high relative emissions for 2002-2004 compared with 2001 and later years which cannot be explained.

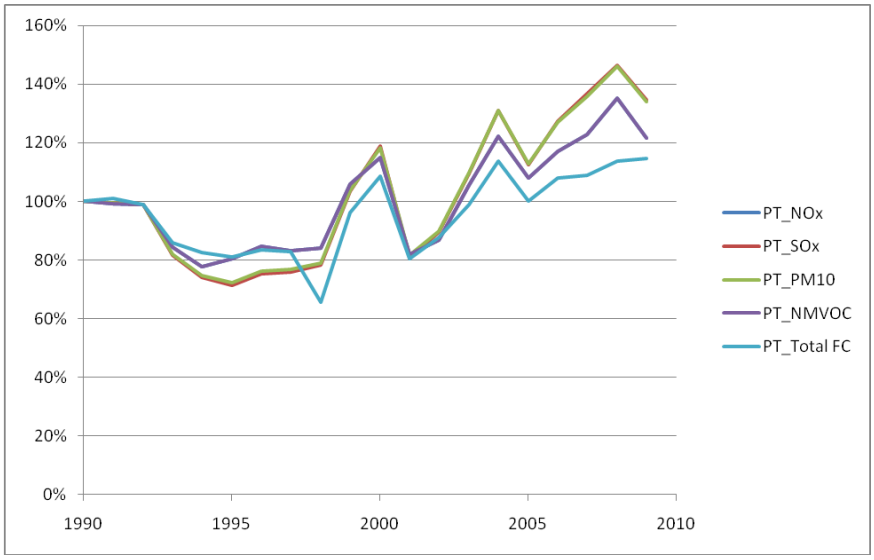
Figure 30: Trend in shipping emissions and fuel consumption for Poland



4.28 Portugal

Portugal reports emissions for all the main pollutants plus those for 1 PAH and 9 metals for years between 1990-2009 so the inventory is considered complete. Emissions are reported separately for international and domestic navigation. A Tier 2 approach is used combining ship movement and ports data with national fuel statistics and country-specific EFs. Around 5% of shipping emissions for all pollutants occur from domestic navigation which is lower than the proportion of fuel consumption attributed to domestic shipping according to Eurostat (27%). The IEFs are close to Tier 1 default values. Figure 31 shows the relative trends in SO_2, NO_x, PM_{10} and NMVOC emissions for all shipping since 1990 and compares these with trends in fuel consumption. The trends are consistent with each other and with the trends in fuel consumption from Eurostat. Overall, the Portugese inventory appears to be of good quality.

Figure 31: Trend in shipping emissions and fuel consumption for Portugal



4.29 Romania

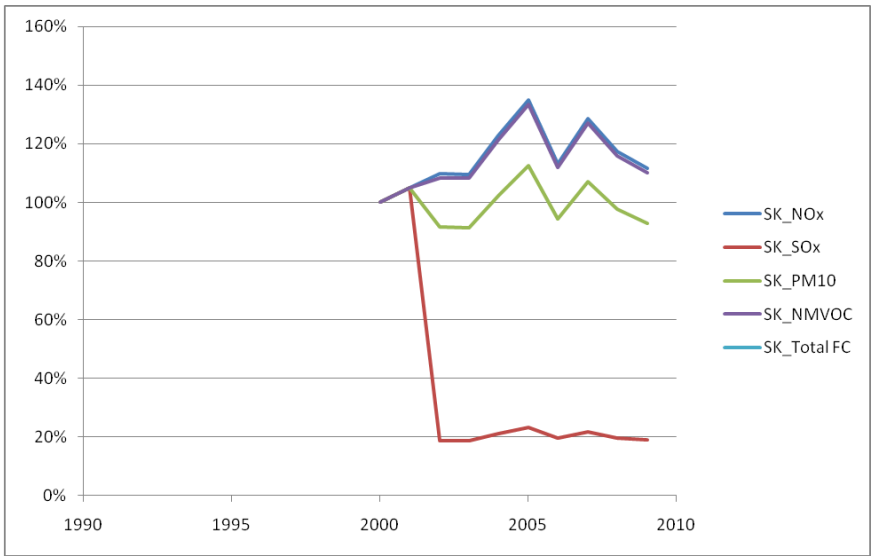
Romania reports emissions for all the main pollutants and 9 metals only from years between 2007-2009 and for 3 PAHs and 1POPs for years between 2005-2009. Only figures for national navigation and fishing are reported, with no figures for international navigation. The inventory is therefore considered partially complete from 2007, but incomplete for earlier years. No IIR is available and therefore it is not known what methodology is used. According to figures in Eurostat, 52% of fuel consumption is used for domestic navigation. The IEFs are less than Tier 1 default values, but this would largely be due to the fact that the Eurostat figures used to derive IEFs include international navigation, absent in the emissions. It is difficult to interpret the trend in emissions from 2007, but emissions of SO_2 and PM_{10} all show a large decrease between 2005 and 2006 which is not shown by Eurostat trends in fuel consumption.

4.30 Slovakia

Slovakia reports emissions for all the main pollutants plus those for 5 PAHs, 2POPs and 6 metals for years between 2000-2009. Slovakia is an inland country and only figures for national navigational are reported. The inventory is therefore considered fairly complete from 2000, but incomplete for the longer time-series back to 1990. A Tier 1 method is used using

default emission factors and national fuel statistics. There are no fuel consumption figures for Slovakia provided by Eurostat to enable a check on Slovakia's IEF values against Tier 1 defaults, nor to compare with the time-series trends in Slovakia's emissions. Figure 32 shows the relative trends in SO_2, NO_x and PM_{10} emissions since 2000. While NO_x and PM_{10} follow similar trends, SO_2 shows a marked decline from 2001 indicating a switch to lower sulphur marine fuels.

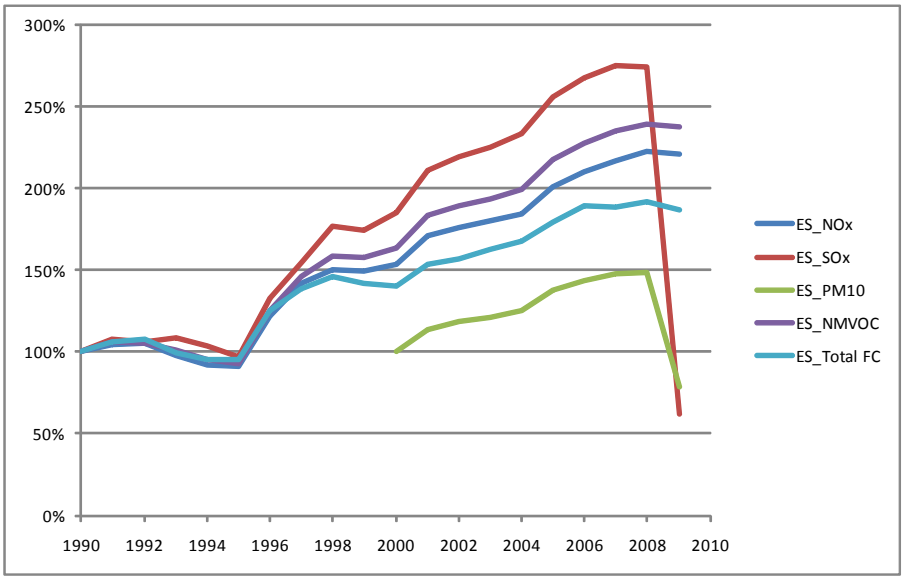
Figure 32: Trend in shipping emissions and fuel consumption for Slovakia



4.31 Spain

Spain reports emissions for all the main pollutants plus 1 PAH, 2POPs and 9 metals for years between 1990-2009 so the inventory is considered complete. Emissions are reported separately for international and domestic navigation and fishing. No IIR is available and therefore it is not known what methodology is used. Around 9-13% of shipping emissions occur from domestic navigation which is consistent with the proportion of fuel consumption attributed to domestic shipping according to Eurostat. Spain is among the top 6 emitters of shipping emissions in Europe and this is consistent with fuels data in Eurostat which show it to be the second highest consumer of marine fuels. The IEFs for NO_x and PM_{10} are fairly close to Tier 1 default values, but for SO_2, the IEF in 2008 is over a factor of two higher than default value and is the highest in Europe. Figure 33 shows the relative trends in SO_2, NO_x, PM_{10} and NMVOC emissions for all shipping since 1990 and compares these with trends in fuel consumption. The trends are largely consistent with each other and with the trends in fuel consumption from Eurostat. There is a very sharp decline in the inventory for SO_2 and to a lesser extent PM_{10} between 2008 and 2009 not shown by the other pollutants suggesting a switch to low sulphur content marine fuels taking place. Overall, the Spanish inventory appears to be of fairly good quality.

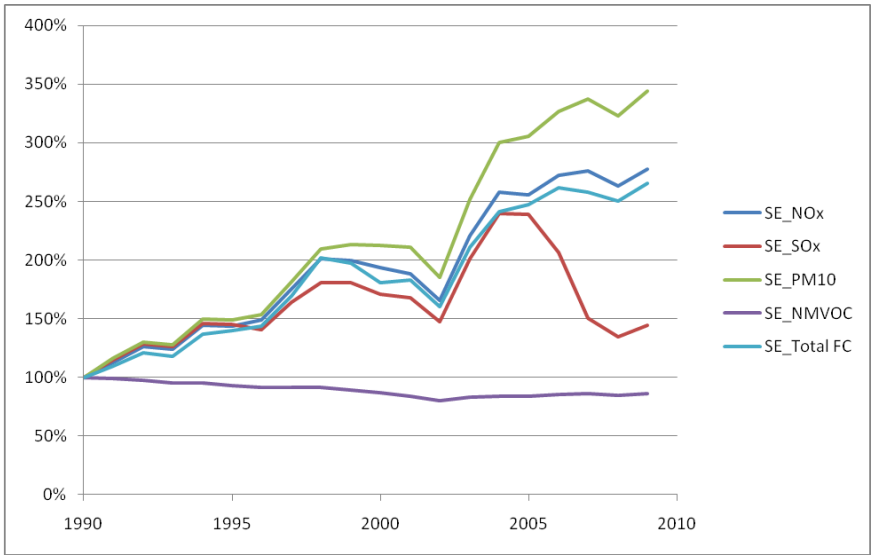
Figure 33: Trend in shipping emissions and fuel consumption for Spain



4.32 Sweden

Sweden reports emissions for all the main pollutants plus those for 5 PAHs, 3 POPs and 9 metals for years between 1990-2009 so the inventory is considered complete. Emissions are reported separately for international and domestic navigation and fishing. A Tier 1 method is used using country-specific emission factors and national fuel statistics. Around 3-5% of shipping emissions for SO_2, NO_x and PM_{10} occur from domestic navigation which is consistent with the proportion of fuel consumption attributed to domestic shipping according to Eurostat (5%). The figure for NMVOCs is 74% suggesting a large amount of domestic activity by vessels with gasoline engines. The IEFs are all close to Tier 1 default values. Figure 34 shows the relative trends in SO_2, NO_x, PM_{10} and NMVOC emissions for all shipping since 1990 and compares these with trends in fuel consumption. The trends for NO_x, PM_{10} and SO_2 are largely consistent with each other and with the trends in fuel consumption from Eurostat, with the trend in SO_2 being consistent with a reduction in the sulphur content of fuels from 2005. The trend in NMVOC emissions is very flat, again suggesting relatively high emissions from gasoline-powered vessels for domestic activities following a different trend compared with consumption of other marine fuels used for larger vessels. Overall, the Swedish inventory appears to be of good quality.

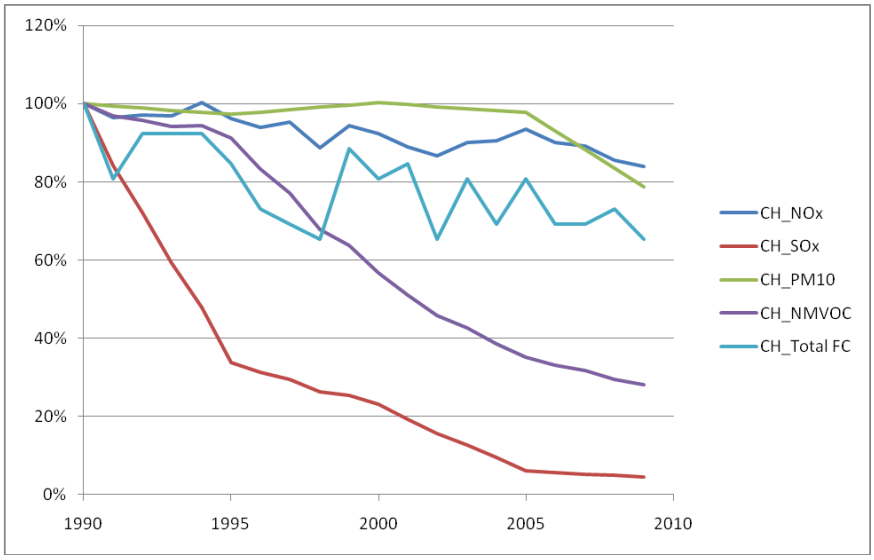
Figure 34: Trend in shipping emissions and fuel consumption for Sweden



4.33 Switzerland

Switzerland reports emissions from domestic shipping for all the main pollutants plus those for 5 PAHs, 1 POPs and 1 metal for years between 1990-2009 so the inventory is considered complete. Switzerland is an inland country, but does report emissions of NO_x, SO_2, NMVOCs and CO for international navigation. The IIR states a Tier 2 approach is used, but in fact a more detailed bottom-up method based on number of vessels and operating hours combined with country-specific emission factors actually appears to be used. Reflecting the inland nature of Switzerland, the proportion of emissions due to domestic navigation is high and ranges from 80% for NO_x to 97% for SO_2. According to figures in Eurostat, domestic navigation is responsible for only 47% of fuel consumption suggesting a slight inconsistency here. The IEFs for SO_2 and PM_{10} are much lower than Tier 1 default values indicating very low sulphur content fuel is the main fuel being used; for NO_x, the IEF is similar to Tier 1 default values. Figure 35 shows the relative trends in SO_2, NO_x, PM_{10} and NMVOC emissions for all shipping since 1990 and compares these with trends in fuel consumption. The trends are broadly similar to fuel consumption for NO_x and PM_{10}, but a larger decrease in emissions of SO_2 and NMVOCs is apparent over this time-horizon again suggesting the decline in the average sulphur content of fuels used for domestic activities and possibly the contribution of small, low fuel-consuming gasoline vessels with a different trend in activities.

Figure 35: Trend in shipping emissions and fuel consumption for Switzerland



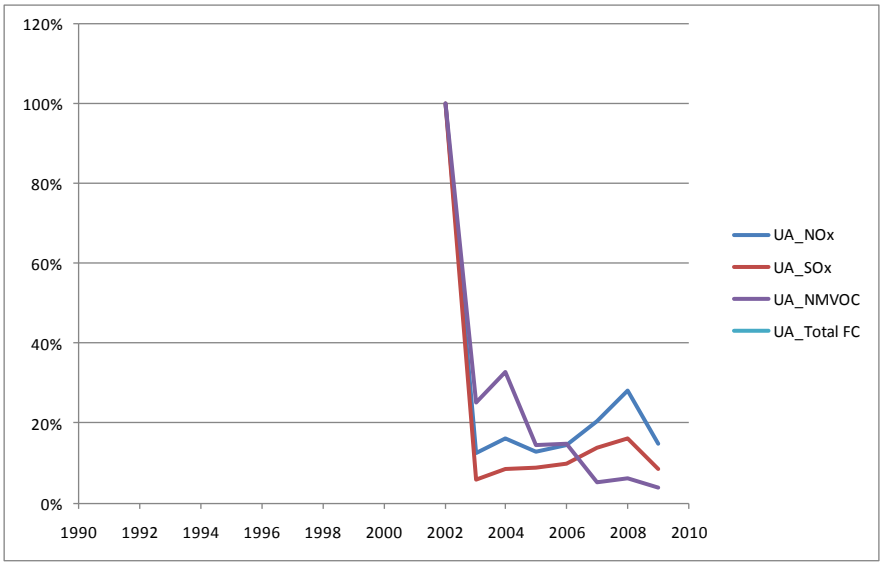
4.34 Turkey

Turkey only reports emissions for 3 pollutants, NO_x, NMVOCs and CO, for the year 2001. Emissions are also only reported for national navigation although according to Eurostat 58% of the fuel consumption is by international navigation in 2008. The inventory is therefore considered incomplete. No IIR is available and therefore it is not known what methodology is used for the 2001 calculations. Eurostat data on shipping fuel consumption are available for Turkey from 1990 to 2009.

4.35 Ukraine

Ukraine reports emissions from 2002-2009, but the completeness varies from year-to-year. Up to 2008, only domestic shipping emissions are reported. From 2008, emissions from international navigation are reported and in 2009 these are split between international maritime and inland waterways and fishing is included. For domestic shipping, emissions are reported for all the main pollutants, except PM_{10}, plus 4 metals are reported. The inventory is therefore considered partially complete in terms of pollutants, sectors and years covered. No IIR is available and therefore it is not known what methodology is used. The inventory figures suggest around 60% of emissions are from domestic navigation. There are no fuel consumption figures for Ukraine provided by Eurostat to enable a check on Ukraine's IEF values against Tier 1 defaults, nor to compare with the time-series trends in Ukraine's emissions. Figure 36 shows the relative trends in SO_2, NO_x and NMVOC emissions since 2002. There appears to be a sharp drop in emissions between 2002 and 2003, followed by a slow increase in NO_x and SO_2 to 2008.

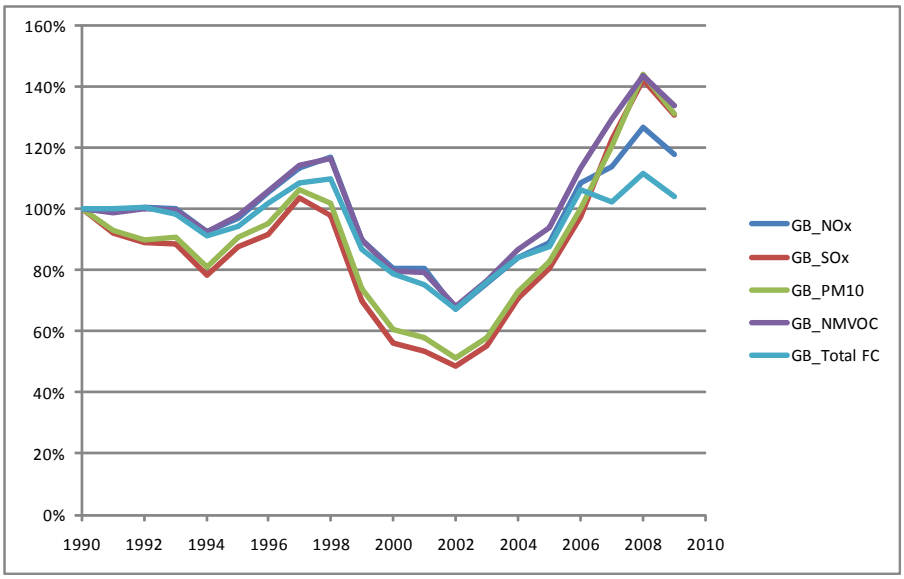
Figure 36: Trend in shipping emissions and fuel consumption for Ukraine



4.36 United Kingdom

The United Kingdom reports emissions for all the main pollutants plus those for 5 PAHs, 2 POPs and 9 metals for years between 1990-2009 so the inventory is considered complete. Emissions are reported separately for international and domestic navigation and fishing. A Tier 3 approach is used for domestic shipping and fishing based on detailed vessel movement data and country-specific emission factors while a combination of national fuel consumption statistics and country-specific factors are used for international navigation. Around 7-12% of shipping emissions occur from domestic navigation. This is less than the figure of 39% in Eurostat which is based on national energy statistics for domestic and international bunkers. The discrepancy is due to the fact that the inventory for domestic navigation and fishing is based on data on vessel movements indicating much lower fuel consumption than given by national energy statistics for domestic navigation. A fuel balance is then used to assign the remaining, much larger share of fuel consumption and hence emissions to international navigation leading to a different split in domestic/international consumption to that implied by figures in Eurostat. Overall, the United Kingdom is among the top 6 emitters of shipping emissions in Europe and this is consistent with total fuels data in Eurostat. The IEFs are close to Tier 1 default values. Figure 37 shows the relative trends in SO_2, NO_x, PM_{10} and NMVOC emissions for all shipping since 1990 and compares these with trends in fuel consumption. The trends are largely consistent with each other and with the trends in fuel consumption from Eurostat. Overall, the UK inventory appears to be of high quality.

Figure 37: Trend in shipping emissions and fuel consumption for United Kingdom



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