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Morten Winther

Data sheet

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Abstract: This report documents the fuel consumption and emission inventory for navigation (national sea transport, fisheries and international sea transport) in Denmark, for the historical period 1990-2005 and the forecast period 2006-2030. The inventory follows the UNFCCC (United Nations Framework Convention of Climate Changes), and the UNECE CLRTAP (United Nations Economic Commission for Europe Convention of Long Range Transboundary Air Pollutants) convention rules. The emission components considered are SO_2, NO_X, VOC (NMVOC and CH_4) CO, CO_2, N_2O and particulates (TSP, PM_{10} and $PM_{2.5}$). International sea transport is the most dominant source of emissions from navigation. For national sea transport, a new time series of fuel consumption has been calculated which is considered as much more accurate than fuel sales data reported by the Danish Energy Authority (DEA). The introduction of engine age dependent fuel consumption and emission factors has improved the accuracy of the inventory time series results considerably. Results show a need for more strict fuel quality and NO_x emission standards for navigation in the future, in order to gain emission improvements in line with those achieved for other mobile sources.

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Preface

Emissions from ship engines are harmful to the environment both on a regional and global scale. Apart from the emission of the greenhouse gas CO_2, ship engines contribute significantly to anthropogenic emissions of NO_x, SO_x and PM. In atmospheric chemistry it is a well known fact that NO_x and VOC are precursors of ground level ozone, and that NO_x and SO_x emissions contribute to the formation of secondary particles in the atmosphere. Well-known health effects associated with PM, ozone and NO_x comprise respiratory diseases and premature death from heart and pulmonary diseases. Moreover, an important environmental effect of the NO_x and SO_x emission from ship engines is contribution to acidification of the environment. In addition, NO_x contributes to eutrophication of the terrestrial and aquatic environment, and ground level ozone is responsible for damage to vegetation.

Navigation is moreover an important source of emissions in terms of national emission totals. For national navigation (national sea transport, fisheries and recreational craft) in Denmark, the largest emission shares are noted for SO_2 and NO_x. The emission shares are 91% and 17%, respectively, in relation to the total for mobile sources in the Danish 2005 inventory. For international sea transport the emission contributions are large even compared with the overall Danish totals. If the contributions from international sea transport were included in the Danish national totals, in 2005 the fuel consumption (and CO_2) percentage addition would be 5%, and the corresponding NO_x and SO_2 percentage addition would amount to 34% and 167%, respectively.

In the context of national emissions reporting for the United Nations Framework Convention of Climate Changes (UNFCCC) and the United Nations Economic Commission for Europe Convention of Long Range Transboundary Air Pollutants (UNECE LRTAP), national sea transport includes ships sailing between two national ports, regardless of flag. Fisheries include national fishing vessels, and international sea transport includes ships regardless of flag sailing from a national port with a foreign destination (IPCC, 1997; EMEP/CORINAIR, 2006). International sea transport is excluded from the national emission totals reported to the conventions.

According to the guidelines for the UNFCCC and UNECE conventions, it is good practice to use fuel sales data to support the emission calculations when fleet activity based fuel consumption estimates are missing (IPCC, 1997; EMEP/CORINAIR, 2006).

In practice, all countries use the official fuel sales reported for national and international sea transport in their national inventories. However, prior to input data usage, modifications of the fuel sales figures are made individually by many countries as part of their inventory method. The adjustments involve different fuel consumption sectors in the country fuel sales statistics, in order to maintain the grand national energy balance, and the adjustments are made in situations when fuel sales figures

seem unrealistic compared with actual fleet activity, either in navigation subcategories or for navigation as a whole.

Outside the official national system for inventorying and annual emission reporting, several specific Danish studies have been made to quantify the fuel consumption and emissions from ships.

In 2001, inventories for 1995/1996 and 1999/2000 were made by Wismann (2001), estimating the fuel consumption and emissions for all sea transport in Danish waters. The project basis was outside the strict ship movement and fuel sales definitions in the conventions, and therefore the results were not directly usable as input for the official Danish inventory work. Other Danish projects were the assessment of the fuel consumption and emissions for ships in Danish ports (hotelling, manoeuvring, landing/loading) by Oxbøl et al. (2003), and the examination of air quality effects from cruise ship activities in the Port of Copenhagen by Olesen et al. (2005).

Until recently, the Danish inventory for navigation prepared by the National Environmental Research Institute of Denmark (NERI) used the fuel sales figures for national sea transport and international sea transport reported by the Danish Energy Authority (DEA), directly. On the basis of these data, a simple fuel based inventory was set up, enabling the production of national emission reports as required by the UNFCCC and UNECE conventions.

However, in a new project funded by the Danish Environmental Protection Agency (DEPA) in 2006, NERI has established an improved methodology for navigation in Denmark, covering national sea transport, fisheries and international sea transport. For national sea transport, the new inventory distinguishes between regional ferries[1], local ferries (small ferries) and other national sea transport, and the fuel consumption is estimated on the basis of fleet activity data and ferry-specific technical information. For fisheries and international sea transport, the new inventory remains fuel based.

This report explains the new Danish inventory for navigation in terms of fuel consumption and the emissions of SO_2, NO_x, NMVOC, CH_4, CO, CO_2, N_2O and particulates. The inventory period is 1990-2005, and in addition a 2006-2030 fuel consumption and emission forecast is presented. Cross-sector comparisons with other mobile sources are also made for the 2006-2020 projection period. An important task has been to gather data to support improved estimates for national sea transport. This involves sailing statistics and technical data for regional ferries, fuel consumption totals for local ferries and other national sea transport, and the establishment of new specific fuel consumption figures and emission factors for ship engines in general.

The fuel consumption and emission results are aggregated into subtotals for national and international sea transport, and fisheries, as required by the European Environment Agency (EEA) database system (CollectER).

[1] In service on major domestic ferry routes

Chapter 1 gives an overview of the inventory method. Chapter 2 gives a thorough documentation of the traffic and technical data for regional ferries, and technical assumptions for the remaining navigation categories. Chapter 3 explains the current fuel and emission legislation for ships. The actual fuel consumption and emission factors used in the inventory are given in Chapter 4, and the fuel consumption and emission calculation methods are described in Chapter 5. The calculated 1990-2005 results and the 2006-2030 forecast estimates are shown in Chapter 6, and discussions and conclusions are given in Chapter 7.

The project steering group consisted of Thomas Jensen, the Danish Energy Authority, and Ulrik Torp and Dorte Kubel, Danish Environmental Protection Agency.

Many thanks should be given to Hans Otto Kristensen, the Technical University of Denmark; Niels Kjemtrup and Sven Hemmingsen, MAN DIESEL; Tom Wismann; Jacob Geertinger, FORCE Technology; and Henrik Amdissen, Danish Fishermen's Association (Hanstholm), for data used in the project calculations. Also many thanks to Øyvind Endresen, Norske Veritas, for discussions during the writing of the paper.

Summary

This report documents the updated 1990-2005 fuel consumption and emission inventory for navigation in Denmark, following the UNFCCC (United Nations Framework Convention of Climate Changes), and the UNECE CLRTAP (United Nations Economic Commission for Europe Convention of Long Range Transboundary Air Pollutants) convention rules.

The Danish inventory covers national sea transport, fisheries and international sea transport. For national sea transport, the new inventory distinguishes between regional ferries, local ferries (small ferries) and other national sea transport, and the fuel consumption is estimated on the basis of fleet activity data and ferry-specific technical information. For fisheries and international sea transport, the new inventory is fuel based.

The emission components considered are SO_2, NO_X, VOC (NMVOC and CH_4) CO, CO_2, N_2O and particulates (TSP, PM_{10} and $PM_{2.5}$). In addition a fuel consumption and emission forecast is presented from 2006-2030 based on the official Danish energy projections. The calculated results for national sea transport, fisheries and international sea transport are stored in the European Environment Agency (EEA) database system (CollectER).

The report explains the current fuel and emission legislation for ships, and traffic and technical data for ferries and other ships. In the report, documentation is also given for the inventory fuel consumption data and fuel consumption/emission factors, and the inventory calculation approach.

Fuel consumption and emission legislation

For ship engines, emission limits for NO_x are agreed by the International Marine Organization (IMO) MARPOL 73/78 Annex VI, and the emission legislation is relevant for diesel engines with a power output larger than 130 kW installed on a ship constructed on or after 1th January 2000, and diesel engines with a power output larger than 130 kW which undergo major conversion on or after 1th January 2000.

The EU directives 93/12, 1999/32 and 2005/33 regulate the content of sulphur in marine gas oil. Futhermore, the directive 2005/33 prohibit the use of high sulphur fuels in SO_X emission control areas (SECA's) in the Baltic Sea and the North Sea. The SECA areas are also agreed by IMO in MARPOL 73/78 Annex VI.

Activity data

Detailed traffic from Statistics Denmark, and technical data from the Danish Ferry Historical Society (DFS) are used as activity data for regional ferries. For local ferries and other national sea transport, the new

inventory uses fuel consumption estimates calculated for single years, and a full fuel consumption coverage is established in a time series by means of appropriate assumptions. For fisheries and international sea transport, the new inventory uses fuel sales data from the Danish Energy Authority (DEA).

Fuel consumption and emission factors

Generally, the fuel consumption and emission factors are classified according to engine type (slow, medium and high speed, and gas turbines) and fuel type.

Fuel consumption factors come from the Danish TEMA2000 emission model, and NO_x emission factors predominantly come from the engine manufacturer MAN DIESEL, as a function of engine production year. The assumed sulphur contents in marine fuels have been used to estimate the emission factors for SO_2 and total particulates (PM) throughout the inventory period, and PM_{10} and $PM_{2.5}$ size fractions are obtained from MAN DIESEL. For CO and VOC constant emission factors from TEMA2000 is used, whereas N_2O emission factors and the NMVOC/CH_4 split is taken from EMEP/CORINAIR (2003).

Calculation procedure

For regional ferries, the fuel consumption and emissions are calculated as a product of number of round trips, sailing time per round trip, engine size, engine load factor and fuel consumption/emission factor. The estimates take into account the changes in emission factors and ferry specific data during the inventory period.

For the remaining navigation categories, the emissions are calculated simply as a product of total fuel consumption and average emission factors. For each inventory year, this emission factor average comprises the emission factors for all present engine production years, according to engine life times.

Fuel consumption and emission results

International sea transport is the most important source of fuel consumption and emissions for navigation. The share of total fuel consumption for this sector is 75% of total navigation in 2005, and for CO_2, N_2O and VOC (NMVOC and CH_4) the share is 76%. For CO the emission share is 78%, and for NO_x, PM (all three fractions) and SO_2 the emission shares are 80%, 95% and 96%, respectively.

For national sea transport, the shares of fuel consumption, CO_2 and N_2O (10%) are somewhat smaller than for fisheries (14%). This also the case for NO_x, VOC (NMVOC and CH_4) and CO; the respective emission shares are 8%, 9% and 8% for national sea transport, and 11%, 14% and 14% for fisheries. For SO_2 and PM (all three fractions) the emission share for fisheries is 2%, and for national sea transport, the SO_2 and PM (all three fractions) emission shares 3% and 2%, respectively.

The 1990-2005 emission trends follow the development in fuel consumption and emission factors. For international sea transport, the DEA reported fuel sales (and hence SO_2 emissions) decrease by 14%. For CO_2 and N_2O the emission reductions are 15%, and for VOC and CO the emission reductions are 5%. For NO_x and PM (all three size fractions) the emissions increase by 1 and 8%, respectively.

In the same time period fuel consumption, CO_2 and N_2O emissions decrease by 11% for national sea transport. Emission decreases are also calculated for VOC (2%), NMVOC (2%), CH_4 (3%), CO (1%), SO_2 (27%) and PM (37%, all size fractions), whereas for NO_x, the emissions increase by 10%. For fisheries, the total fuel consumption, and CO_2, N_2O, PM (all size fractions) and SO_2 emissions decrease by 17% from 1990-2005. The emissions of CO, NMVOC, CH_4 and NO_x change by -6%, -7%, -10% and 6%, respectively.

Also in the projection period, international sea transport is the most important source of fuel consumption and emissions. No change in the total fuel sales are foreseen from 2006-2030 in the DEA baseline energy forecast, and hence, zero or only smaller emission changes are expected in the same time period, except for SO_2 and PM. For these two components, the expected emission reductions are 57% and 72%, respectively, mainly due to the introduction of the SECA areas from 2007. Based on the DEA baseline energy forecast, for national sea transport and fisheries the total fuel consumption decrease by 2% and 5%, respectively, from 2006-2030. As for international sea transport, the only changes of significance occur for SO_2 and PM; these are -44% and -23% for national sea transport, and -52% and -12% for fisheries.

A cross sector comparison for Danish mobile sources from 2006-2020, show a need for more strict fuel quality and NO_x emission standards for navigation, in order to gain emission improvements in line with those achieved for other mobile sources.

Conclusion

This project uses new information of the development of NO_x emissions from ship engines, starting with production year 1949, and proceeding until the engines of today (2005). The emission data have been provided by the ship engine manufacturer MAN DIESEL, which have a 75% world market share of the ship engines produced. Emission data from this source ensures a fine representation of the emission factors used, and the inventory introduction of emission factors per engine production year is necessary for the more accurate assessments of the emission trends.

For national sea transport in Denmark, the fuel consumption estimates obtained with the new model are regarded as much more accurate than the DEA fuel sales data used in the previous model version. The large fluctuations in reported fuel sales cannot be explained by the actual development in the traffic between different national ports. The fuel discrepancies between estimated and reported sales are most likely explained by inaccurate costumer specifications made by the oil suppliers.

It is recommended to replace the current time series of fuel sales for national sea transport by the new bottom-up fuel consumption estimates calculated in this project. Such an updated time series for fuel consumption for national sea transport will introduce changes to the energy statistics for fisheries and industry, since the revealed differences between the sales figures and bottom-up estimates for national sea transport are balanced out by adjusting the sales figures for fisheries (for gas oil) and industry (heavy fuel oil).

Moreover, it would be very useful to implement a new project in which the fuel consumption and emissions for international sea transport in Denmark are calculated based on actual vessel movements, as has already been carried out for domestic ferries. Such project results would strongly support the work made by Danish policymakers dealing with the issue of bunker emissions allocation.

Sammendrag

Denne rapport indeholder de opdaterede danske opgørelser af energiforbrug og emissioner for skibstrafik i Danmark i perioden 1990-2005. Opgørelsen følger retningslinjerne for UNFCCC (United Nations Framework Convention of Climate Changes), og UNECE CLRTAP (United Nations Economic Commission for Europe Convention of Long Range Transboundary Air Pollutants) konventionerne.

Opgørelsen omfatter hovedkategorierne national søfart, fiskeri og international søfart. National søfart er yderligere inddelt i store færger, øfærger og øvrig national søfart, og energiforbruget er beregnet på basis af trafikstatistik og specifikke tekniske data. For fiskeri og international søfart bygger opgørelsen på salget af brændstof.

Rapporten indeholder emissionsresultater for SO_2, NOx, VOC (NMVOC og CH_4), CO, CO_2, N_2O, NH_3 og partikler (TSP, PM_{10} og $PM_{2.5}$), og derudover præsenteres en emissionsfremskrivning for perioden 2006-2030 der bygger på Energistyrelsens energiprognose. Resultaterne fra hver enkelt hovedkategori lægges ind i det Europæiske Miljøagenturs databasesystem CollectER, der samler hele den danske emissionsopgørelse.

I rapporten gennemgås også den eksisterende lovgivning for skibes brændstoffer og emissioner, samt de benyttede trafikale og tekniske data for færger og andre skibstyper. Derudover dokumenteres de anvendte data for energiforbrug, energi- og emissionsfaktorer samt opgørelsens beregningsmetode.

Lovgivning for brændstoffer og emissioner

Emissionsgrænseværdier for NO_x er vedtaget i FN's internationale søfartsorganisation IMO (International Marine Organization) MARPOL 73/78 Annex VI. Lovgivningen vedrører skibsmotorer med en effekt større end 130 kW installeret i skibe med byggedato fra og med 1. januar 2000, og dieselmotorer med en effekt større end 130 kW der har gennemgået en større ombygning fra og med 1. januar 2000.

Svovlindholdet i marin gas olie reguleres trinvist nedad i EU-direktiverne 93/12, 1999/32 and 2005/33, og derudover er der i direktiv 2005/33 forbud mod at anvende brændstoffer med højt svovlindhold i de såkaldte SECA (SO_X Emission Control Areas) områder i Østersøen og Nordsøen. SECA områderne er også vedtaget af IMO i MARPOL 73/78 Annex VI.

Aktivitetsdata

For store færger bruger opgørelsen detaljerede trafikdata fra Danmarks Statistik og færgespecifikke tekniske data fra Dansk Færgehistorisk Selskab for de enkelte færgeruter. For små færger og øvrig national søfart bruges beregnede energiforbrug for enkeltår, der justeres i en tidsserie

ved brug af passende antagelser. Som aktivitetsdata for fiskeri og international søfart bruges brændstofsalget fra Energistyrelsen.

Faktorer for energiforbrug og emissioner

Generelt grupperes energiforbrugs- og emissionsfaktorerne efter motortype (slow, medium og high speed, samt gasturbiner) og brændstoftype.

Energiforbrugsfaktorerne kommer fra den danske TEMA2000 model og emissionsfaktorerne for NO_x kommer hovedsageligt fra motorproducenten MAN DIESEL, som funktion af motorbyggeår. Antagelser vedr. svovlprocenter for marine brændstoffer igennem opgørelsesperioden er brugt til at beregne emissionsfaktorer for SO_2 og partikler (PM), og størrelsesfraktionerne for PM_{10} og $PM_{2.5}$ er oplyst af MAN DIESEL. For CO og VOC bruges konstante emissionsfaktorer fra TEMA2000, og kilden til emissionsfaktorerne for N_2O samt NMVOC/CH_4 procentfordelingen er EMEP/CORINAIR (2003).

Beregningsmetode

For store færger beregnes energiforbrug og emissioner for hver færge som produktet af antal dobbeltture, sejltid pr. dobbelttur, motorstørrelse, motorlastfaktor og energiforbrugs/emissionsfaktor. Beregningerne tager højde for udviklingen i energiforbrugs- og emissionsfaktorer, samt diverse færgespecifikke data igennem opgørelsesperioden. For de øvrige kategorier i opgørelsen beregnes emissionerne som produktet af det totale energiforbrug og gennemsnitlige emissionsfaktorer. For hvert år i opgørelsen er disse emissionsfaktorer midlet over emissionsfaktorerne for alle indgående motorbyggeår, afledt af den gennemsnitlige motorlevetid.

Resultater for energiforbrug og emissioner

International søtransport har langt de største andele af skibstrafikkens samlede energiforbrug og emissioner, og i 2005 er andelen for energiforbrug 75%. For CO_2, N_2O, og VOC (NMVOC og CH_4) er andelen 76%. For CO, NO_x, PM (alle størrelsesfraktioner) og SO_2 er emissionsandelene hhv. 78%, 80%, 95% og 96%.

For national søtransport er andelene for energiforbrug, CO_2 og N_2O (10%) noget lavere end for fiskeri (14%). Dette gælder også for NO_x, VOC (NMVOC og CH_4) og CO; her er emissionsandelene 8%, 9% og 8% for national søfart, og 11%, 14% og 14% for fiskeri. For SO_2 og PM (alle størrelsesfraktioner) udgør andelene 2% for fiskeri, og hhv. 3% og 2% for national søfart.

Emissionsudviklingen fra 1990-2005 styres af udviklingen i energiforbrug og emissionsfaktorer, og i denne periode angiver Energistyrelsen et fald i brændstofsalget til international søtransport på 14%, og SO_2 emissionen falder tilsvarende. Emissionsreduktionerne er 15% for CO_2 og N_2O, 5% for VOC og CO, hvorimod NO_x og PM emissionerne (alle størrelsesfraktioner) emissionerne stiger med hhv. 1% og 8%.

For national søfart falder energiforbruget, samt CO_2 og N_2O med 11% i samme periode. Emissionsreduktioner beregnes også for VOC (2%), NMVOC (2%), CH_4 (3%), CO (1%), SO_2 (27%) og PM (37%, alle størrelsesfraktioner). Omvendt stiger NO_x emissionen med 10%. I samme periode ses for fiskeri et fald i energiforbruget samt CO_2, N_2O, SO_2 og partikelemissionerne (alle størrelsesfraktioner) på 17%. Emissionsændringerne for CO, VOC (NMVOC og CH_4, og NO_X er hhv. -6%, -7%, -10% og 6%.

Også i prognoseperioden har international søtransport langt de største andele af skibstrafikkens samlede energiforbrug og emissioner. Iht. Energistyrelsens basisfremskrivning forventes brændstofsalget at være konstant fra 2006-2030, og undtagen for SO_2 og partikler beregner prognosen ingen eller kun små ændringer i emissionerne. Hvad SO_2 og partikler angår, beregnes emissionsfald på hhv. 57% og 72%, pga. oprettelsen af SECA områder fra 2007. Baseret på Energistyrelsens basisfremskrivning, forventes et fald i energiforbruget for national søfart og fiskeri på hhv. 2% og 5% fra 2006-2030. Som tilfældet er for international søfart, forventes der kun væsentlige emissionsændringer for SO_2 og partikler; her er de beregnede emissionsændringer hhv. -44% og -23% for national søfart, og hhv. -52% og -12% for fiskeri.

En emissionssammenligning for alle mobile kilder i Danmark er gjort for NO_x og SO_2 i perioden 2006-2020. Resultatet viser, at hvis skibsfarten skal opnå emissionsreduktioner på linie med andre sektorer, er der brug for skrappere miljøkrav mht. brændstofkvalitet og emissionsgrænseværdier for NO_x.

Konklusion

Dette projekt benytter ny sammenstillet viden om udviklingen i NO_X emissionerne fra skibsmotorer med byggeår fra 1949 og frem til i dag (2005). Emissionsfaktorerne er oplyst af motorproducenten MAN DIESEL, der har en verdensmarkedsandel for skibsmotorer på 75 %. Data fra denne kilde sikrer at opgørelsens emissionsfaktorer er repræsentative, og det er vigtigt at indregne faktorernes udvikling som funktion af motorbyggeår i opgørelsen, hvis emissionsresultaterne skal vurderes mere præcist.

For national søfart anses de nye beregnede energiforbrug for at være meget mere præcise end de solgte brændstofmængder der blev brugt i den tidligere version af opgørelsen. De store udsving i brændstofsalget kan ikke forklares ud fra den faktiske udvikling i skibstrafikken mellem danske havne. Den mest sandsynlige årsag til de store udsving i det rapporterede salg er fejl i energistatistikken, hvad angår angivelse af forbrugssektor.

På basis af dette projekts resultater anbefales det at de nye beregnede brændstofforbrug for national søfart erstatter den nuværende tidsserie i den danske energistatistik publiceret af Energistyrelsen. Udover national søfart vil en ny tidsserie for energiforbruget medføre ændringer i energistatistikken for fiskeri og industri, idet forskellene mellem det beregnede forbrug og opgjorte salg for national søfart udbalanceres i statistiksektorerne fiskeri (gas olie) og industri (tung olie).

Det vil være nyttigt at have nye detaljerede beregninger af brændstofforbruget for international søfart i Danmark pr. udsejlet distance, ganske som det er gjort for indenrigsfærgerne. Sådanne resultater vil udgøre et vigtigt fundament for det politiske arbejde der i øjeblikket foregår vedrørende fordeling af emissionerne for den internationale skibstrafik.

1 Methodology

According to the guidelines for the UNFCCC and UNECE conventions countries are encouraged to make bottom-up estimates of fuel consumption and emissions based on fleet activity data for navigation. It is, however, considered as good practice to use fuel sales data directly as an inventory basis for fuel based estimates, when fleet activity data are missing. If fleet activity based calculations are made, some sort of further adjustment is always necessary between different fuel consumption sectors in the country fuel sales statistics, in order to maintain the grand national energy balance.

This is relevant for national sea transport in Denmark. Here, the new bottom-up fuel consumption estimates lead, in turn, to changes in the energy statistics for fisheries (gas oil) and industry (heavy fuel oil), so the national energy balance can remain unchanged.

1.1 Activity data

For national sea transport, the new methodology presented in this report calculates the fuel consumption figures based on fleet activity estimates for regional ferries, local ferries and other national sea transport. Detailed traffic and technical data lie behind the fuel consumption and emission calculations for regional ferries, as explained in section 2.1. For local ferries, a bottom-up estimate of fuel consumption for one single year (1996) is used to establish the fuel consumption for all years in the inventory period, according to the development in local ferry traffic. For the remainder of the traffic between two Danish ports, new bottom-up estimates are calculated for two years (1995 and 1999), based on a database set up for Denmark in an earlier Danish project. Fuel consumption for other years in the inventory period is based on the 1995 and 1999 figures by using appropriate assumptions. For local ferries and other national sea transport further explanation is provided in section 2.2.

For fisheries, the main activity data consist of reported fuel sales from the DEA, which for gas oil, prior to inventory input, are adjusted with the difference between estimated and reported fuel sales for national sea transport. This fuel adjustment is further described in section 6.2. For international sea transport the fuel sales data are used directly as input data for fuel-based calculations, see section 2.2.

1.2 Specific fuel consumption and emission factors

Standard curves for specific fuel consumption figures and NO_x emission factors in g/kWh are used for regional ferries, as a function of engine production year. From these factors, fuel-related NO_x emission factors (g/GJ) are derived for the remaining categories: local ferries, other national sea transport, fisheries and international sea transport. In general, the SO_2 emission factors for gas oil rely on the sulphur limits in EU legislation. For heavy fuel oil, weighted SO_2 emission factors are based on fuel end-use information from the Danish energy statistics, by assuming

the sulphur content for two different heavy fuel qualities used in national sea transport and international sea transport. When the 'SO_x Emission Control Areas' (SECA) areas enter into force, a fuel sulphur content of 1.5% will be used for the less clean heavy fuel oil quality.

1.3 Calculation procedure

For regional ferries, fuel consumption and emissions are calculated for each ferry service/ferry combination as the product of the number of round trips, sailing time per round trip (hours), engine size (kW), engine load factor and fuel consumption, emission factor (g/kWh). Individual data for fuel type, engine type and engine production year are used for each regional ferry, as explained in section 2.1. For local ferries, other national sea transport, fisheries and international sea transport, the emissions are calculated as the product of total fuel consumption and average fuel-related emission factors (see section 2.2). The latter take into account engine type and average engine lifetime, which are assumed for each category.

2 Activity data

2.1 Regional ferries

The number of round trips per regional ferry route is obtained from Statistics Denmark (2006). Table 2 lists the number of return trips for the most important domestic regional ferry routes in Denmark in the period 1990-2005. For these ferry routes the following detailed traffic and technical data: ferry name, year of service, engine size (MCR), engine type, fuel type, average load factor, auxiliary engine size and sailing time (single trip) have been provided by the Danish Ferry Historical Society (DFS, 2006). In total, data for 75 different ferries are present in the dataset.

Table 2.1 Ferry routes comprised in the present project

Ferry service	Service period
Halsskov-Knudshoved	1990-1998
Hundested-Grenaa	1990-1996
Kalundborg-Juelsminde	1990-1996
Kalundborg-Samsø	1990-
Kalundborg-Århus	1990-
Korsør-Nyborg, DSB	1990-1997
Korsør-Nyborg, Vognmandsruten	1990-1998
København-Rønne	1990-2004
Køge-Rønne	2004-
Sjællands Odde-Ebeltoft	1990-
Sjællands Odde-Århus	1999-
Tårs-Spodsbjerg	1990-

All ferry traffic data are given in Annex I, and the number of round trips for the local ferries is derived as the round trip totals from Statistics Denmark minus the round trip totals for the regional ferry routes listed in Table 2.1. Data are missing for the traffic forecast part, and hence, data for 2005 are used also for future years, to support the fuel consumption and emission calculations. For regional ferries, an average engine lifetime of 30 years has been assumed in order to control for the decommissioning of engines in the forecast part of the model calculations.

For each ferry, Annex I also lists the relevant information as regards ferry route, name, year of service, engine size (MCR), engine type, fuel type, average load factor, auxillary engine size and sailing time (single trip).

Figure 2.1 shows the number of round trips for the most important ferry routes from 1990-2005.

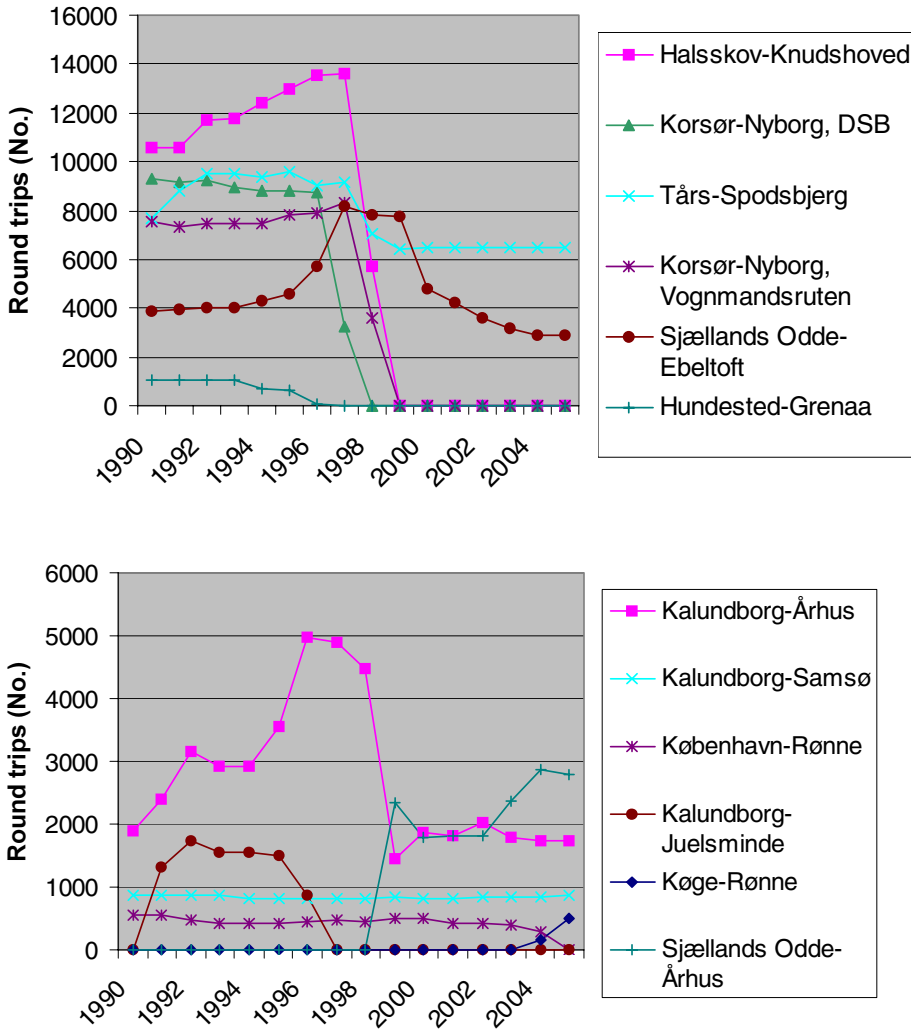


Figure 2.1 No. of round trips for the most important ferry routes in Denmark 1990-2005

It can be seen from Table 2.1 (and Figure 2.1) that several of the regional ferry routes were closed in the period from 1996-1998, mainly due to the opening of the Great Belt Bridge (connecting Zealand and Funen) in 1997. Hundested-Grenaa and Kalundborg-Juelsminde were closed in 1996, Korsør-Nyborg (DSB) closed in 1997, and Halsskov-Knudshoved and Korsør-Nyborg (Vognmandsruten) were closed in 1998. The ferry route Copenhagen-Rønne was replaced by Køge-Rønne in 2004, and from 1999 a new ferry connection was opened between Sjællands Odde and Århus.

2.2 Local ferries, other national sea transport, fisheries and international sea transport

2.2.1 Local ferries and other national sea transport

Fuel consumption figures for local ferries and other national sea transport used in the new Danish methodology are based on fleet activity estimates from a previous Danish study (local ferries) and new calculations based on already prepared databases from the same Danish study (other national sea transport).

For the local ferries, a bottom-up estimate of fuel consumption for 1996 has been taken from the Danish work in Wismann (2001). The latter project calculated fuel consumption and emissions for all sea transport in Danish waters in 1995/1996 and 1999/2000. In order to cover the entire 1990-2005 inventory period, the fuel figure for 1996 has been adjusted according to the developments in local ferry route traffic shown in Annex 1.

For the remaining part of the traffic between two Danish ports, other national sea transport, new bottom-up estimates for fuel consumption have been calculated for the years 1995 and 1999 by Wismann (2007). The calculations use the database set up for Denmark in the Wismann (2001) study, with actual traffic data from the Lloyd's LMIS database (not including ferries). The database was split into three vessel types: bulk carriers, container ships, and general cargo ships; and five size classes: 0-1000, 1000-3000, 3000-10000, 10000-20000 and >20000 DTW. The calculations assume that bulk carriers and container ships use heavy fuel oil, and that general cargo ships use gas oil.

Wismann (2007) estimates consumption of heavy fuel and gas oil in 1995 to be 0.38 and 0.46 PJ, respectively. In 1999, consumption of heavy fuel and gas oil calculated was lower; 0.36 and 0.39 PJ, respectively. The 11% lower fuel use in 1999 compared with 1995 corresponds with a decrease in vessel kilometres of 18%, and this supports the general fact that traffic between Danish ports has decreased in the last three or four decades (pers. comm. T. Wismann, 2007). It is moreover likely that the opening of the Great Belt Bridge connection in 1997 has played a role in the decline in the consumption of fuel from 1995 to 1999. Due to lack of data for years other than 1995 and 1999, a decision has been made to use the 1995 and 1999 figures for 1990-1995 and 1999 onwards, respectively, and to find the 1996-1998 fuel consumption figures from interpolation.

2.2.2 Fisheries

For fisheries, the new methodology remains fuel based. However, the input fuel data differ from the fuel sales figures previously used for this category. The changes are the result of further data processing of the reported gas oil sales for national sea transport and fisheries, prior to inventory input. For years when the fleet activity estimates of fuel consumption for national sea transport are smaller than reported fuel sold, fuel is added to fisheries in the inventory. Conversely, lower fuel sales in relation to bottom-up estimates for national sea transport means that fuel is being subtracted from the original fisheries fuel sales figure in order to make up the final fuel consumption input for fisheries.

2.2.3 International sea transport

For international sea transport, reported fuel sales data are used for Denmark directly, due to lack of fleet activity data to underpin the establishment of detailed fuel consumption estimates in a time series. In the case of international sea transport, the fuel sales data as such are regarded as very accurate for Denmark, and consist of fuel sold to ships (regardless of flag) in Danish ports with a foreign destination. The fuel sales data comprise audited information from the oil suppliers' monthly

reports, which are used to monitor the legal fuel reserve kept by the oil suppliers in each case (pers. comm. Peter Dal, DEA, 2007).

2.2.4 Assumptions regarding engine and fuel types

Based on expert judgement, rough assumptions have been made as regards engine type for the usage of heavy fuel and gas oil by local ferries, other national sea transport, fisheries and international sea transport. These data are listed in Table 2.2. Data for local ferries, other national sea transport and international sea transport are from Kristensen (2006), and data for fishing vessels are from The Danish Fishermen's Association (pers. comm. H. Amdissen, 2006). The same sources also indicate engine lifetimes of around 20 years for the local ferries, 30 years for other national sea transport/ international sea transport, and 20 and 10 years, respectively, for medium-speed and high-speed engines installed in fishing vessels.

Table 2.2 Split in engine types for the use of heavy fuel and gas oil

	Heavy fuel oil			Gas oil		
	Slow speed	Medium speed	High speed	Slow speed	Medium speed	High speed
RPM	50-150	400-800	1000-3000	50-150	400-800	1000-3000
Local ferries	-	-	-		50%	50%
Other national sea transport	75%	25%	-	25%	75%	-
Fisheries	-	-	-	-	50%	50%
International sea transport	75%	25%	-	25%	75%	-

3 Fuel and emission legislation

The engines used in navigation have to comply with NO_x emission limits agreed by the International Marine Organization (IMO) MARPOL 73/78 Annex VI. In terms of sulphur, EU directives give strict fuel quality standards for maritime fuels and prohibit the use of high sulphur fuels in SO_x emission control areas (SECAs) in the Baltic Sea and the North Sea. The SECA areas are also agreed by IMO in MARPOL 73/78 Annex VI.

3.1 IMO emission limits for NO_x

For NO_x, the emission legislation is relevant for diesel engines with a power output greater than 130 kW installed on a ship constructed on or after 1 January 2000, and diesel engines with a power output greater than 130 kW which have undergone major conversion on or after 1 January 2000.

For engine-type approval, the NO_x emissions are measured using a test cycle (ISO 8178), which consists of several steady-state modes with different weighting factors. The NO_x emission limits for ship engines relate to their rated engine speed (n) given in RPM (Revolutions per Minute). The limits are the following:

The limits are as follows:

17 g/kWh, n < 130 RPM

45 x $n^{-0.2}$ g/kWh, 130 ≤ n < 2000 RPM

9.8 g/kWh, n ≥ 2000 RPM

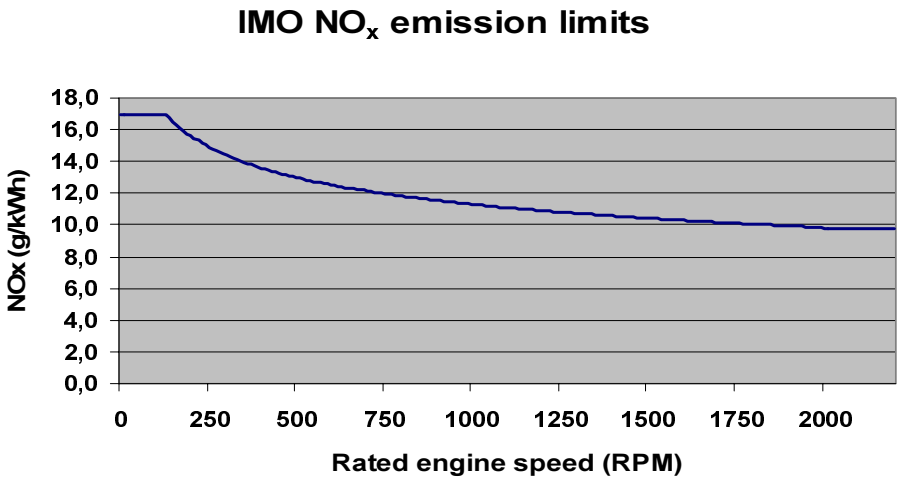


Figure 3.1 NO_x emission limits as a function of rated engine speed

3.2 Sulphur content in marine fuels

Table 3.1 gives an overview of the EU directives and IMO MARPOL Annex VI limit values for content of sulphur in marine fuels.

Table 3.1 Overview of the legislation in relation to marine fuel quality.

Legislation		Heavy fuel oil		MarineGas oil	
		S-%	Impl. date	S-%	Impl. date
EU-directive - 93/12		None		0.2[1]	1.10.1994
EU-directive - 1999/32		None		0.2	1.1.2000
EU-directive - 2005/33	SECA - Baltic sea	1.5	11.08.2006	0.1	1.1.2008
	SECA - North sea	1.5	11.08.2007	0.1	1.1.2008
	Outside SECA's	None		0.1	1.1.2008
MARPOL Annex VI	SECA – Baltic sea	1.5	19.05.2006		
	SECA – North sea	1.5	21.11.2007		
	Outside SECA	4.5	19.05.2006		

[1] Sulphur content limit for fuel sold inside EU

According to Directive 93/12, from 1 October 1994, it is not legal in the EU to sell marine gas oil with a sulphur content exceeding 0.2%. Marine gas oil with higher sulphur content can, however, be brought into the EU and be used for navigational purposes. From 1 January 2000, Directive 1999/32 prohibits any usage of marine gas oil in the EU with a sulphur content exceeding 0.2%, and from 1 January 2008 this sulphur limit is strengthened to 0.1% in Directive 2005/33.

From 19 May 2006, IMO MARPOL Annex VI prohibits the use of heavy fuel oil with sulphur levels exceeding 1.5% in the Baltic Sea, and the date that EU Directive 2005/33 enters into force is 11 August 2006. The latter directive sets the same sulphur limit for the North Sea SECA area by 11 August 2007 (MARPOL Annex VI date is 21 November 2007).

4 Fuel consumption and emission factors

Generally, the fuel consumption and emission factors are classified according to engine type and fuel type. In the case of regional ferries, fuel consumption and emission factors in g/kWh are used directly in the calculations, since for these vessels detailed traffic and ferry engine and operational data are present to support a detailed inventory approach.

For the remaining navigation sectors, the only activity data present are figures for total fuel consumption. To provide emission data for these parts of the emission inventory, fuel related emission factors are derived for each engine/fuel type, from the ratio between the g/kWh based emission factors and specific fuel consumptions.

4.1 Specific fuel consumption

The standard curves for specific fuel consumption, sfc (g/kWh), are shown in Figure 4.1 for slow-, medium- and high-speed engines, as a function of engine production year. For gas turbines, a mean fuel consumption figure of 240 g/kWh is used. All fuel consumption data come from the Danish TEMA2000 emission model (Ministry of Transport, 2000).

The fuel consumption trend graph was produced in the late 1990s for the Danish TEMA 2000 model, and because the regression curve is supported by actual fuel consumption factors for engines produced up until the mid 1990s, the graph is regarded as being the most accurate in relation to engines built during that period. For newer engines, the fuel consumption trend is established based on expert judgement. The graph is, however, still regarded as valid in relation to its use in estimating emission estimates for engines in situation which prevails today (Kristensen, 2006).

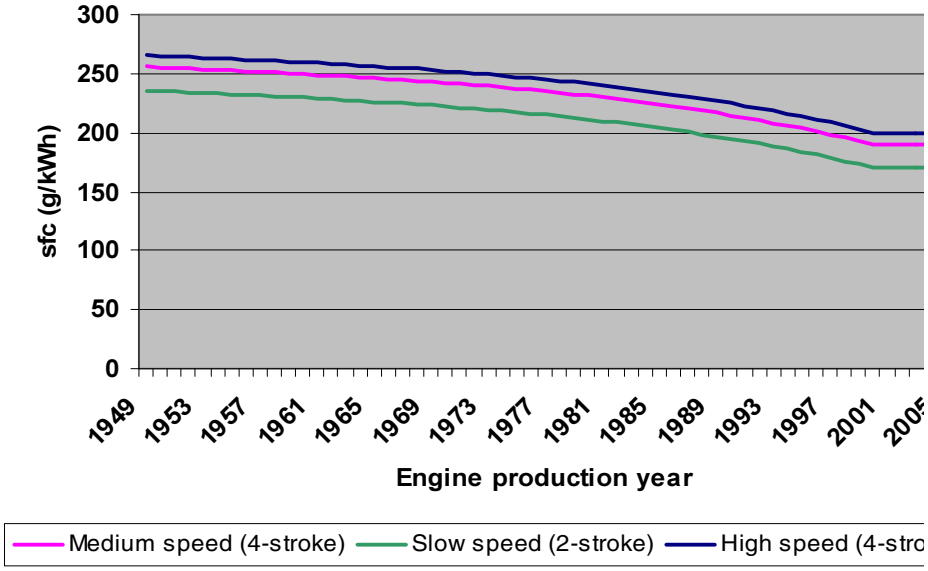


Figure 4.1 Specific fuel consumption for marine engines related to the engine production year (g/kWh)

From Figure 4.1 it is seen, that an increase in the engine efficiency of around 25%, has been achieved during the last 50 years. The fuel consumption data shown in Figure 4.1 are also listed in Annex II.

4.2 NO_x

The NO_x emission factors (g/kWh) for slow- and medium-speed engines come from MAN DIESEL (2006). The data are shown in Figure 4.2, together with NO_x emission factors for high-speed engines. For gas turbines, a mean NO_x emission factor of 4 g/kWh is used. The emission information for high-speed engines and gas turbines comes from the Danish TEMA2000 emission model (Ministry of Transport, 2000).

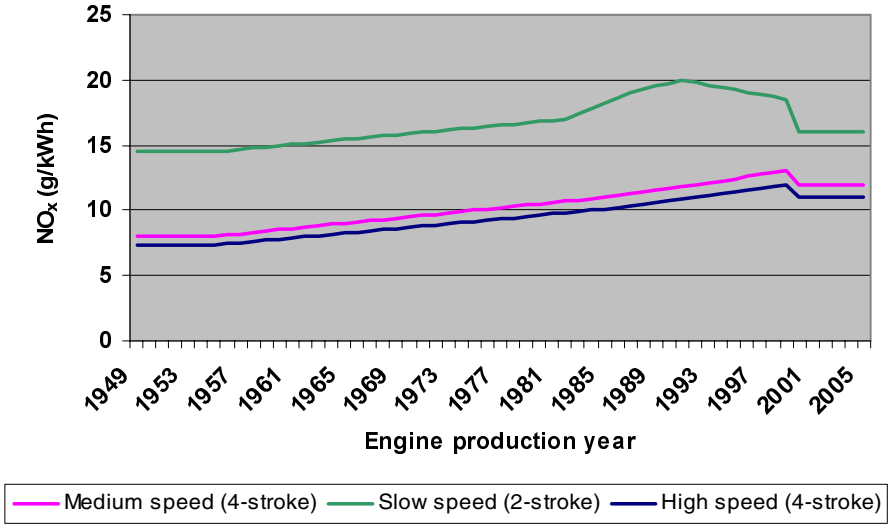


Figure 4.2 NO_x emission factors for ship engines per engine production year (g/kWh)

The increase in fuel efficiency up to 2000 caused the NO_x emission factors to increase. However, at the beginning of the 1990s (slow-speed engines) and by the end of the 1990s (medium-speed engines), NO_x emission performance is improved, mainly due to improved engine design. The emission improvements are of a sufficient size to enable the IMO NO_x emission requirements in 2000 to be met.

The NO_x emission factors in g/kg fuel shown in Figure 4.3 are derived as the ratio between specific fuel consumption and the NO_x emission factors from Figures 4.1 and 4.2, respectively. In order to obtain emission factors in g/GJ, the emission factors from Figure 4.3 are multiplied by the lower heating values (LHV in g/MJ; 40.9 for heavy fuel oil, 42.7 for gas oil).

The emission factors (in g/kg fuel and g/GJ) for all engine types and fuel types are listed in Annex II, as a function of engine production year.

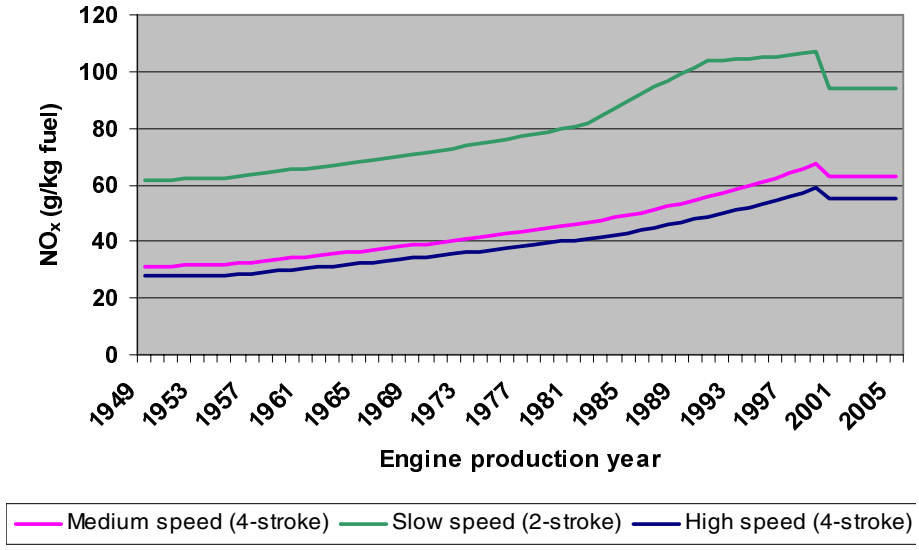


Figure 4.3 NO_x emission factors for ship engines per engine production year (g/kg fuel)

4.3 SO_2

Figure 4.4 shows the sulphur percentage figures for heavy fuel and gas oil used in the Danish inventory. The marine gas oil sulphur percentage is the same as the sulphur content limit given in EU Directive 93/12 (starting: 1 October 1994), 1999/32 (starting: 1 January 2000) and 2005/33 (starting: 1 January 2008). Prior to 1994, the sulphur level is assumed, based on information from Statoil (pers. comm. C. Thomsen, 2005). From 2008 onwards, the gas oil sulphur content is from EU Directive 2005/33.

For heavy fuel oil, the sulphur percentages have been calculated based on fuel end-use information from the DEA (2006b). A weighted average is calculated from two different heavy fuel qualities (1% and 3% for national sea transport and 1% and 3.5% for international sea transport). From 2006/2007[2], when the SECA areas enter into force, a fuel sulphur content of 1.5% is used for the less clean heavy fuel oil quality in the weighted sulphur percentage. The estimated 2007 fuel sulphur content for heavy fuel oil is used also for the years 2008 onwards.

[2] 2007 is used as the effective year in the inventory

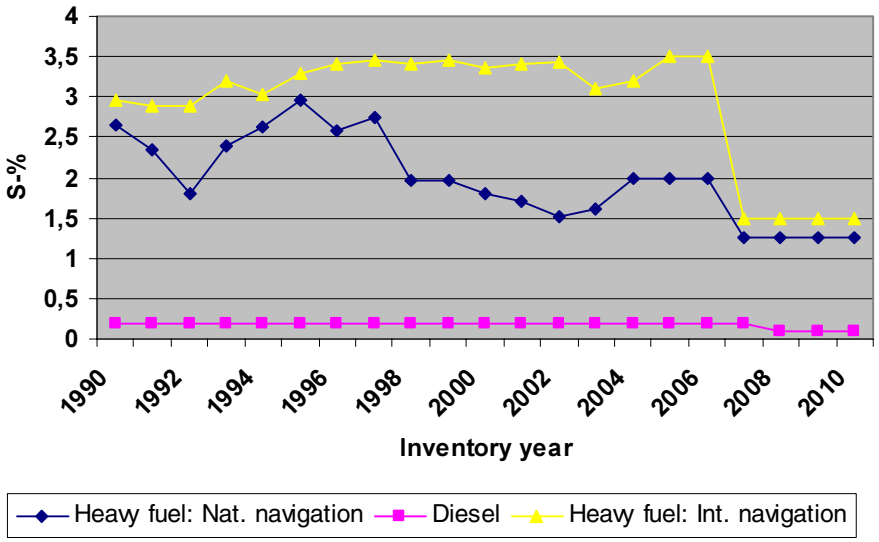


Figure 4.4 S-% for heavy fuel and marine gas oil per inventory year

In order to obtain emission factors in g/GJ, the sulphur percentages from Figure 4.4 are inserted in the following expression together with the lower heating value (LHV):

$$EF(SO_2) = \frac{2 \cdot 10^4 \cdot S\%}{LHV} \quad (1)$$

Where EF = emission factor in g/GJ, S% = sulphur percentage, and LHV = 40.9 MJ/kg fuel.

Equation 1 uses 2.0 kg SO_2/kg S, the chemical relation between burned sulphur and generated SO_2 provided in EMEP/CORINAIR (2006).

4.4 PM

The PM emission factors for diesel fuelled ship engines rely on the fuel sulphur content, S%:

$$EF(PM) = 0.854 \cdot e^{(S\% \cdot 0.745)} \quad (2)$$

The PM emission factor equation is taken from TEMA2000 (Trafikministeriet, 2000). The calculated PM emission factors are shown in Figure 4.5 per inventory year, and for each fuel type. The emission factors (in g/kg fuel and g/GJ) are listed in Annex II for heavy fuel (national and international sea transport) and gas oil.

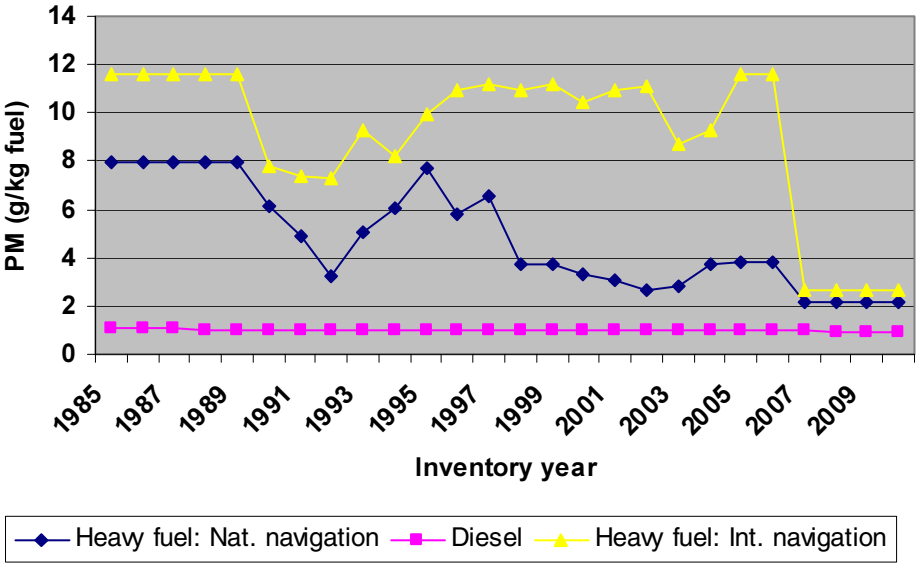


Figure 4.5 PM emission factors (g/kg fuel) for heavy fuel and marine gas oil per inventory year

Based on information from MAN DIESEL (N. Kjemtrup, 2006), the PM_{10} and $PM_{2.5}$ shares of total PM (=TSP) are 99 and 98.5%, respectively.

4.5 CO and VOC

In general the emission factors for CO and VOC in g/kWh are regarded as very uncertain. The general experience from the ship engine manufacturer's side is a decrease in CO and VOC when fuel efficiency improves (pers. comm. S. Henningsen, MAN Diesel, 2006). However, due to missing consistent emission data as a function of engine year, constant factors for all engine production years are chosen for the present inventory. The emission factors come from TEMA2000, and originates from the emission measurement programme carried out by Lloyds (1995). The CO and VOC emission factors are given in the following Table 4.1.

Table 4.1 CO and VOC emission factors

	Slow speed (g/kWh)	Medium speed (g/kWh)	High speed (g/kWh)	Gas turbines (g/kWh)	(g/kg)
CO	1.6	1.6	1.6	0.1	0.42
VOC	0.5	0.5	0.5	0.35	1.46
NMVOC	0.485	0.485	0.485	0.340	1.415
CH_4	0.115	0.115	0.115	0.011	0.044

The VOC split into NMVOC (97%) and CH_4 (3%) is taken from EMEP/CORINAIR (2003).

The CO and VOC emission factors (g/kg fuel) in Figure 4.6 are calculated as the ratio between the g/kWh based emission factors and specific fuel consumption. Bearing in mind the overall uncertainty of the (constant) emission factors in g/kWh, the time variations of the emission factors in Figure 4.6 are likewise uncertain. When constant emission factors

are used (in g/kWh), the calculated emission factors in g/kg fuel automatically increase, due to the improvements in specific fuel consumption (in g/kWh).

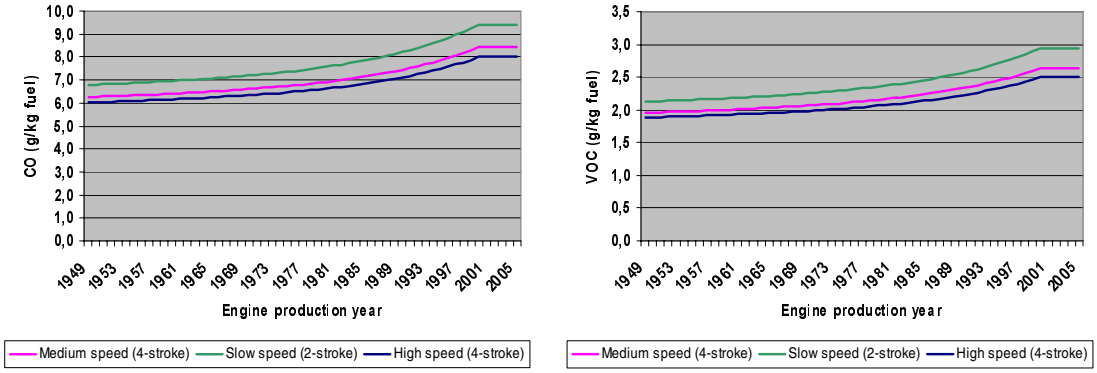


Figure 4.6 CO and VOC emission factors for ship engines per engine production year (g/kg fuel)

The CO, VOC, NMVOC and CH_4 emission factors (in g/kg fuel) for all engine types are listed in Annex II, as a function of engine production year.

4.6 CO_2

For CO_2, country specific emission factors from DEA are used; these are 78 g/MJ for heavy fuel oil and 74 g/MJ for gas oil.

4.7 N_2O

The N_2O emission factor of 0.2 g/kg fuel is taken from EMEP/-CORINAIR (2003). Converted into g/GJ, the emission factors become 4.89 for heavy fuel oil and 4.68 for gas oil.

Emission factors for all emission components 1990-2030 are given in Annex II, using the national inventory format CollectER.

5 Calculation procedure

For regional ferries, the calculations are fleet activity based and for each ferry service/ferry combination, the fuel consumption and emissions in year X are found as the product of the number of round trips, sailing time per round trip (hours), engine size (kW), engine load factor and fuel consumption/emission factor (g/kWh):

$$E(X) = \sum_i N_i \cdot T_i \cdot S_{i,j} \cdot P_i \cdot LF_j \cdot EF_{k,l,y} \quad (3)$$

Where E = fuel consumption/emissions, N = number of round trips, T = sailing time per round trip in hours, S = ferry share of ferry service round trips, P = engine size in kW, LF = engine load factor, EF = fuel consumption/emission factor in g/kWh, i = ferry service, j = ferry, k = fuel type, l = engine type, y = engine year.

For the remaining navigation categories, the fuel-based emission estimates are obtained as the product of total fuel consumption and average fuel-related emission factors based on engine type and average engine lifetime:

$$E(X) = \sum_i EC_{i,k} EF_{k,l,y} \quad (4)$$

Where E = fuel consumption/emissions, EC = energy consumption, EF = fuel consumption/emission factor in g/GJ fuel, i = category (local ferries, other national sea transport, fisheries, international sea transport), k = fuel type, l = engine type, y = average engine year.

The emission factor inserted in (4) is found as an average of the emission factors representing the engine ages which, for a given calculation year, X, are comprised by the average lifetime:

$$EF_{k,l,y} = \frac{\sum_{year=X}^{year=X-LT} EF_{k,l}}{LT_{k,l}} \quad (5)$$

6 Fuel consumption and emissions

According to the guidelines for the UNFCCC and UNECE conventions, countries are encouraged to make bottom-up estimates of fuel consumption and emissions based on fleet activity data for navigation. It is, however, considered as good practice to use fuel sales data directly as an inventory basis for fuel based estimates, when fleet activity data are missing. If fleet activity based calculations are made, some sort of further adjustment is always necessary between different fuel consumption sectors in the country fuel sales statistics, in order to maintain the grand national energy balance.

This is relevant for national sea transport in Denmark. Here, the new bottom-up fuel consumption estimates lead, in turn, to changes in the energy statistics for fisheries (gas oil) and industry (heavy fuel oil), so the national energy balance can remain unchanged.

The fuel consumption and emission results for national sea transport, fisheries and international sea transport are shown in Table 6.1 for 2005.

It should be noted that only the emission contributions from national sea transport and fisheries are included in the national totals, whereas the emissions from international sea transport emissions are reported as a memo item only.

Table 6.1 Fuel consumption and emission results for Danish navigation in 2005

Fuel type	Category	FC	SO_2	NO_x	NMVOC	CH_4	CO	CO_2	N_2O	TSP	PM_{10}	$PM_{2.5}$
		(PJ)	(tons)	(tons)	(tons)	(tons)	(tons)	(ktons)	(tons)	(tons)	(tons)	(tons)
Gas oil	Regional ferries	3.13	294	3871	151	5	375	232	15	73	72	72
Gas oil	Local ferries	0.61	57	796	33	1	110	45	3	14	14	14
Gas oil	Other nat. sea	0.39	37	585	21	1	71	29	2	9	9	9
Gas oil	Total nat. sea	4.14	387	5252	206	6	556	306	19	96	95	95
Gas oil	Fisheries	6.56	615	8837	367	11	1212	486	31	152	151	150
Gas oil	International sea	13.92	1304	20881	764	24	2522	1030	65	323	320	318
Gas oil	Grand total	24.61	2306	34969	1338	41	4289	1821	115	571	566	563
Heavy fuel	Regional ferries	0.32	312	436	18	1	61	25	2	30	29	29
Heavy fuel	Other nat. sea	0.36	352	733	22	1	72	28	2	33	33	33
Heavy fuel	Total nat. sea	0.68	664	1169	40	1	133	53	3	63	62	62
Heavy fuel	International sea	20.59	35241	41944	1241	38	4093	1606	101	5832	5774	5745
Heavy fuel	Grand total	21.27	35905	43113	1281	40	4225	1659	104	5895	5836	5807
Kerosene	Other nat. sea	0.00	0	0	0	0	0	0	0	0	0	0
Kerosene	Fisheries	0.00	0	0	0	0	0	0	0	0	0	0
Kerosene	Grand total	0.00	0	0	0	0	0	0	0	0	0	0
LPG	Other nat. sea	0.00	0	0	0	0	0	0	0	0	0	0
LPG	Fisheries	0.02	0	25	8	0	9	1	0	0	0	0
LPG	Grand total	0.02	0	26	8	0	9	1	0	0	0	0
	Overall total	45.91	38211	78108	2627	81	8524	3482	219	6466	6402	6369

For international sea transport, the share of total fuel consumption is 75%, and for CO_2, N_2O and VOC (NMVOC and CH_4) the share is 76%

For CO the emission share is 78%, and for NO_x, PM (all three fractions) and SO_2 the emission shares are 80, 95 and 96%, respectively, in 2005.

Since the emission factors for CO_2 and N_2O are given as constant values per kg fuel, and for CO and VOC as constant values per engine kWh, the emission shares for these four components are very similar to the fuel consumption share. For SO_2, PM (all three fractions) and NO_x, the high emission shares compared to the fuel consumption share are mainly due to a large use of heavy fuel oil by international sea transport. This fuel type is characterised by a high content of sulphur, and is predominantly being used by slow speed engines that have relatively higher NO_x emission factors.

The shares of fuel consumption, CO_2 and N_2O for national sea transport (10%) are somewhat smaller than for fisheries (14%). This also the case for NO_x, VOC (NMVOC and CH_4) and CO; the respective emission shares are 8%, 9% and 8% for national sea transport, and 11%, 14% and 14% for fisheries. For SO_2 and PM (all three fractions) the emission share for fisheries is only 2%, respectively, since no heavy fuel is being used by fishing vessels. For national sea transport, the SO_2 and PM (all three fractions) emission shares 3% and 2%, respectively.

6.1 Sector results for Danish navigation

6.1.1 National sea transport

The 1990-2005 fuel consumption and NO_x, SO_2 and PM emission results for regional ferries are shown in the Figures 6.1-6.4. All regional ferry fuel consumption and emission results are listed in Annex III, for the years 1990-2005.

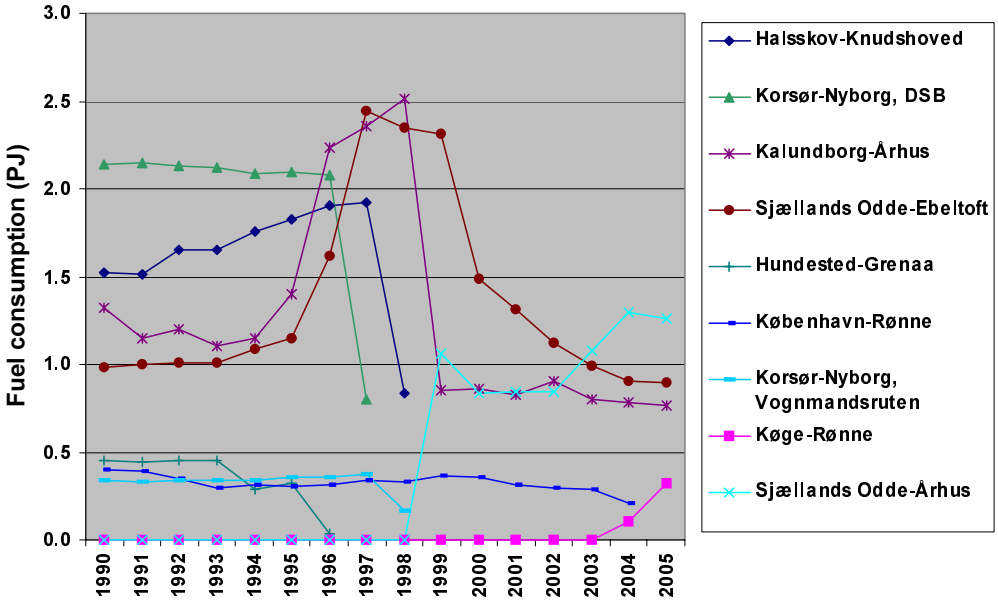


Figure 6.1 Fuel consumption per ferry route from 1990-2005

The fuel consumption for regional ferries decreases by 53% from 1990-2005, and in general terms the development in ferry fuel consumption corresponds to the development in ferry traffic. The main reason for the

fuel consumption reduction is the opening of the Great Belt Bridge connection in 1997, which consequently brings reduction in the ferry traffic (as explained in Chapter 2).

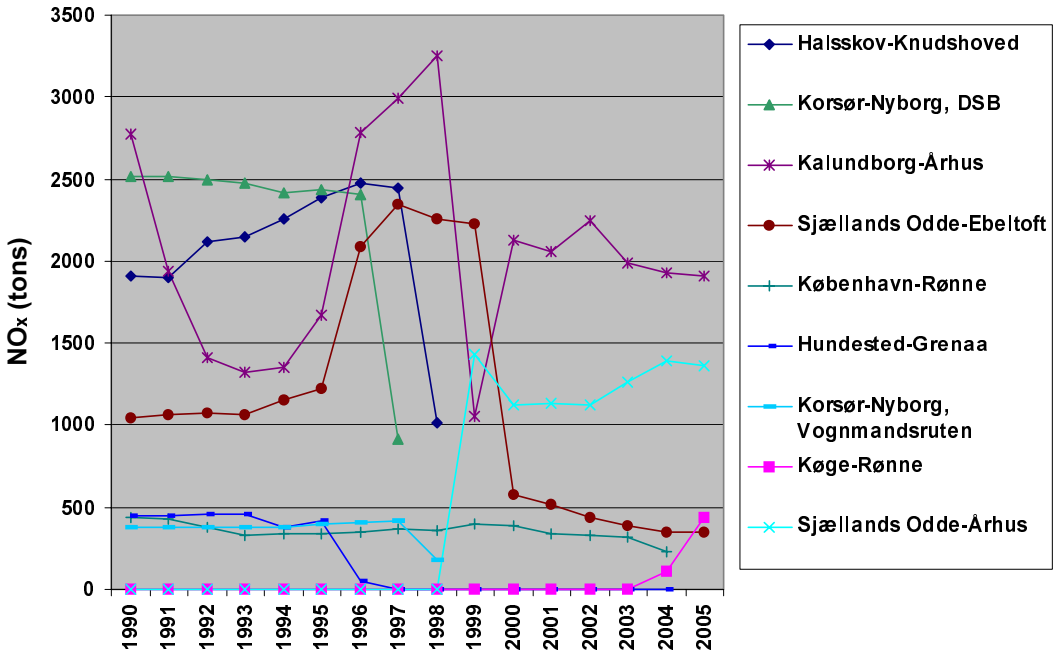


Figure 6.2 NO_x emissions per ferry route from 1990-2005

The total NO_x emissions reduce by 57% from 1990-2005. A sudden emission increase is seen for the Kalundborg-Århus ferry line in 2000, where ferries using slow speed engines enter into service. Conversely, a significant NO_x emission reduction is registered for the ferry line Sjællands Odde-Ebeltoft in 2000. From this year only new ferries equipped with gas turbine engines are in use.

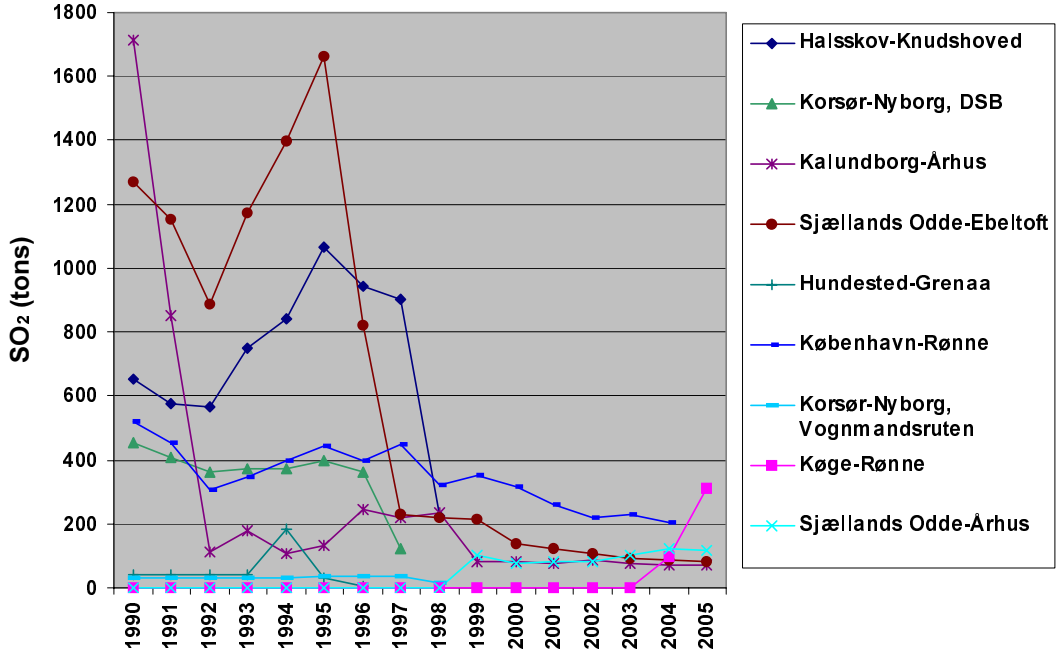


Figure 6.3 SO_2 emissions per ferry route from 1990-2005

The SO_2 and PM emissions rely on the amount of fuel being used and the fuel sulphur content. Significant emission reduction in the order of 87 and 83%, for SO_2 and PM (all three fractions), respectively are calculated from 1990-2005. For the ferry line Kalundborg-Århus there is a substantial reduction in the heavy fuel consumption from 1992, and from 1996 only gas oil is used. A shift away from the use of heavy fuel is also the explanation for the SO_2 and PM emission reductions in 1996 and 1997 for the Sjællands Odde-Ebeltoft ferry line. From 1998 onwards the ferry line between Zealand and Bornholm (København-Rønne, replaced by Køge-Rønne in 2004) is the largest source of SO_2 emissions, due to the use of heavy fuel as the only fuel type.

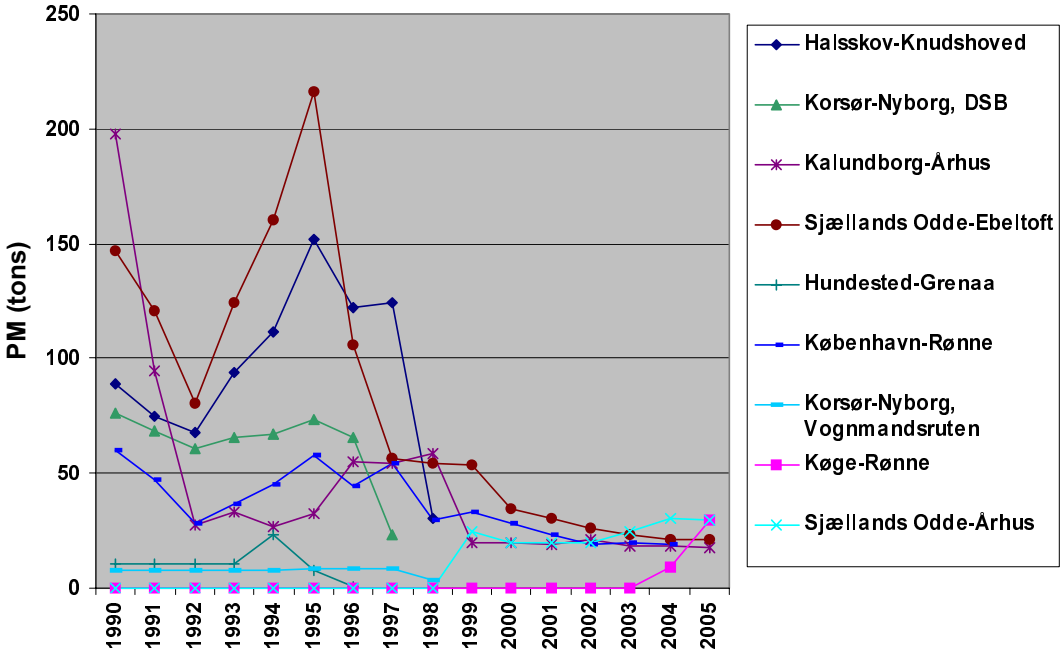


Figure 6.4 PM emissions per ferry route from 1990-2005

From 1990-2005, the emissions of CO_2 and N_2O decrease by 54%, which is slightly more than the total fuel consumption decline of 53%. This is due to the decrease in the use of residual oil for regional ferries in the 1990-2005 period; in g/GJ the CO_2 and N_2O emission factors for this fuel type are higher than for gas oil. Also for VOC and CO the 1990-2005 emission reductions (56 and 66%, respectively) are higher than the fuel consumption reductions. This is due to the decrease in the use of slow speed engines for regional ferries; in g/GJ the VOC (NMVOC and CH_4) and CO emission factors for this engine type are higher than for high speed and medium speed engines.

The 1990-2005 fuel consumption and emission results for the three national sea transport categories are shown in Figure 6.5. All fuel consumption and emission results are listed in Annex III.

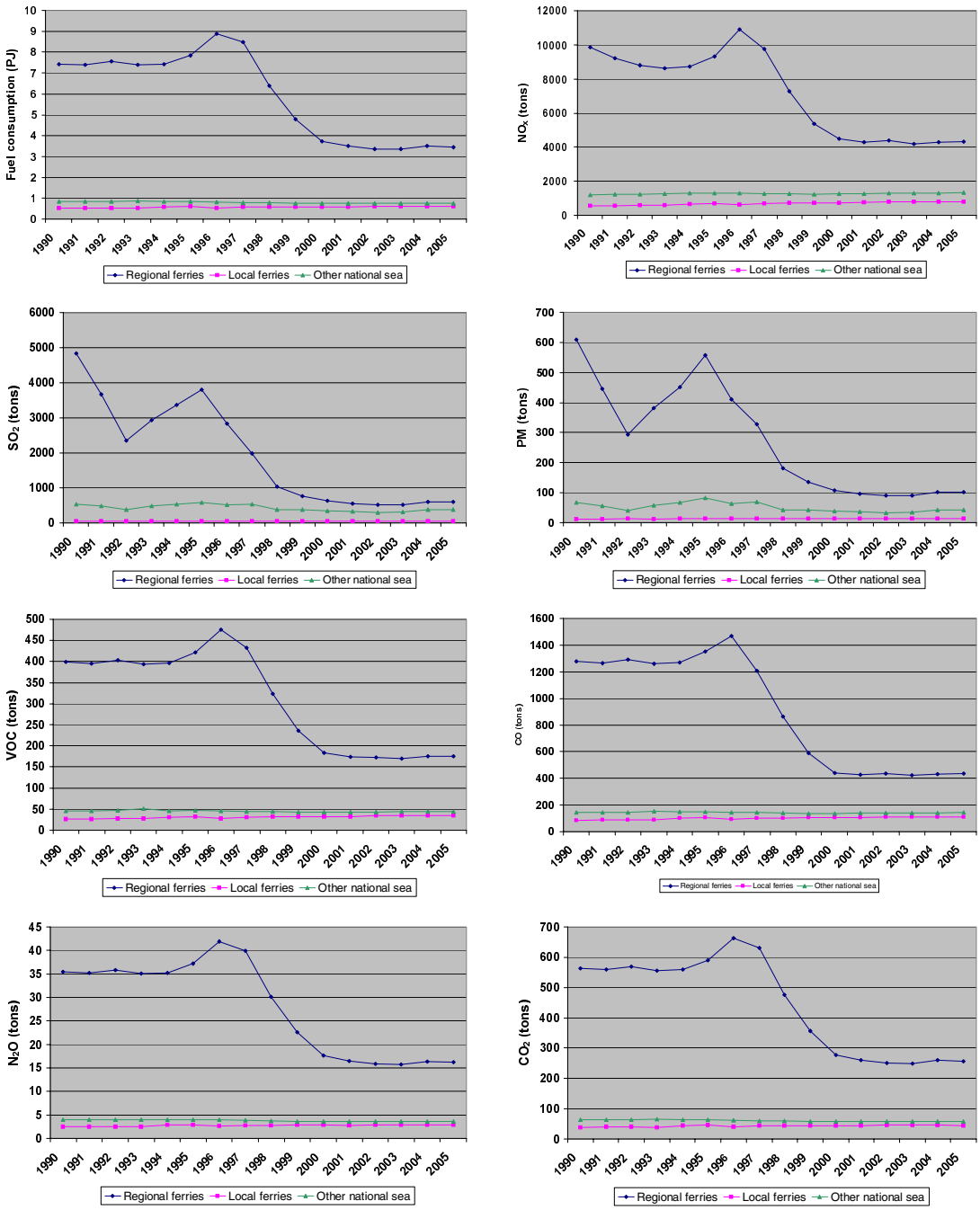


Figure 6.5 1990-2005 time series of fuel consumption and emissions for national sea transport

The fuel consumption development for local ferries follows the development in traffic, and an increase of 16% is calculated from 1990-2005. For CO_2, N_2O, SO_2 and PM (all size fractions) the emission increases are the same as for fuel consumption, due to the constant emission factors per fuel unit of gas oil. For CO and VOC (NMVOC and CH4), the emissions increase by 31%, due to the increase in the emission factors shown in Figure 4.6. The NO_x emissions increase is higher (49%), due to the development in average emission factors based on assumed engine life time.

For other national sea transport, the fuel consumption and emission changes calculated are less certain than the ferry estimates, due to the assumptions made for years other than 1995 and 1999. Results show a de-

crease in fuel consumption, CO_2 and N_2O emissions of 11% from 1990-2005, because of a lower level of traffic in 1995 compared with 1999. The the explanation for the emission development of NO_x (+10%), VOC (-2%; NMVOC: -2%, CH4: -3%) and CO (-1%) is the same as that for the local ferries. The CO and total VOC emission changes are not similar, and the same goes for NMVOC and CH_4. This is due to the different consumptions of LPG and kerosene in 1990 and 2005.

The SO_2 and PM (all size fractions) emissions decrease by 27% and 37%, respectively, due to a gradually diminishing share of heavy fuel oil with a high content of sulphur being sold.

The 2005 results for national sea transport are summarised per fuel type in Table 6.2.

Table 6.2 2005 fuel consumption and emission results for national sea transport

Fuel type	Fuel (PJ)	SO_2 (tons)	NO_X (tons)	NMVOC (tons)	CH_4 (tons)	CO (tons)	CO_2 (ktons)	N_2O (tons)	TSP (tons)	PM_{10} (tons)	$PM_{2.5}$ (tons)
Gas oil	4.14	387	5252	206	6	556	306	19	96	95	95
Heavy fuel	0.68	664	1169	40	1	133	53	3	63	62	62
Kerosene	0.00	0	0	0	0	0	0	0	0	0	0
LPG	0.00	0	0	0	0	0	0	0	0	0	0
Grand total	4.82	1052	6421	246	8	688	359	23	159	157	157

6.1.2 Fisheries

The fuel consumption and emission results for fisheries are shown in Table 6.3 for 2005.

Table 6.3 2005 fuel consumption and emission results for fisheries

Fuel type	FC (PJ)	SO_2 (tons)	NO_x (tons)	NMVOC (tons)	CH_4 (tons)	CO (tons)	CO_2 (ktons)	N_2O (tons)	TSP (tons)	PM_{10} (tons)	$PM_{2.5}$ (tons)
Gas oil	6.56	615	8837	367	11	1212	486	31	152	151	150
Kerosene	0.00	0	0	0	0	0	0	0	0	0	0
LPG	0.02	0	25	8	0	9	1	0	0	0	0
Grand total	6.58	615	8862	375	12	1221	487	31	152	151	150

The fuel consumption for fisheries is totally dominated by gas oil. This is also the case for the other historical years, and thus only totals for fuel consumption and emissions are depicted in Figure 5.8.

The emission trends for fisheries follow the development in fuel consumption and emission factors, and from 1990-2005 the fuel consumption and CO_2, N_2O, PM (all size fractions) and SO_2 emissions decrease by 17%. The emission decreases of CO (-6%), VOC (-8%; NMVOC: -7%, and CH_4: -10%), and NO_x (+6%) are different from the fuel consumption decline, and the main explanations are the same as for local ferries. As for other national sea transport, the CO and total VOC emission changes are not similar, and the same goes for NMVOC and CH_4. This is due to the different consumptions of LPG and kerosene in 1990 and 2005.

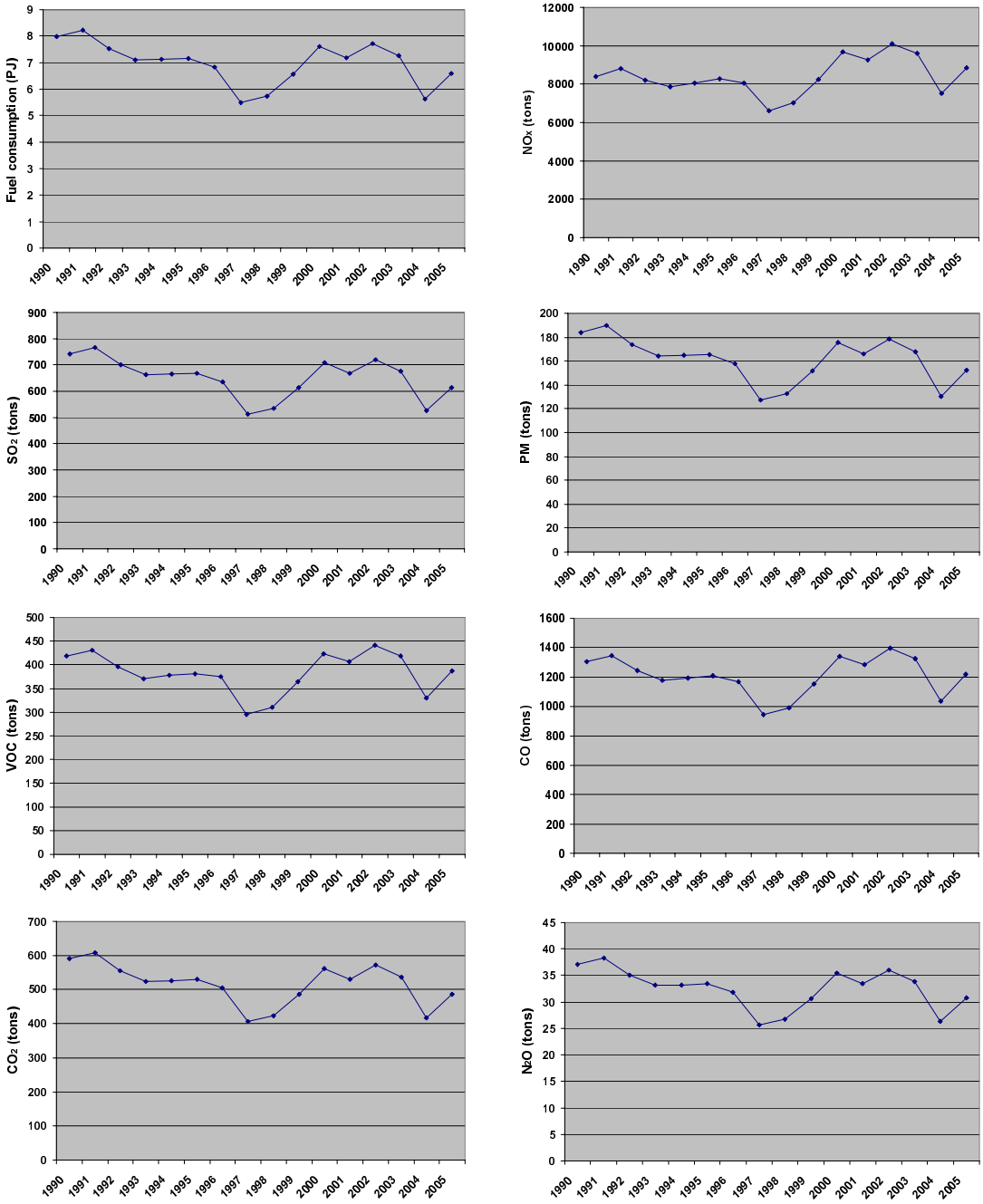


Figure 6.6 1990-2005 time series of fuel consumption and emissions for fisheries

6.1.3 International sea transport

The fuel consumption and emission results for international sea transport are shown in Table 6.4 for 2005.

Table 6.4 2005 fuel consumption and emission results for international sea transport

Fuel type	Fuel (PJ)	SO_2 (tons)	NO_x (tons)	NMVOC (tons)	CH_4 (tons)	CO (tons)	CO_2 (ktons)	N_2O (tons)	TSP (tons)	PM_{10} (tons)	$PM_{2.5}$ (tons)
Gas oil	13.92	1304	20881	764	24	2522	1030	65	323	320	318
Fuel	20.59	35241	41944	1241	38	4093	1606	101	5832	5774	5745
Grand total	34.51	36544	62825	2005	62	6615	2636	166	6155	6094	6063

From 1990-2005, the fuel consumption and SO_2 emissions decline by 14%, and for CO_2 and N_2O the emission reductions are 15%. The emission decreases of VOC and CO (5%) are smaller than the fuel consumption decline, due to the relatively higher emission factors for slow speed engines compared to the medium and high speed ones.

For PM (all three size fractions) there is an emission increase of 8%. For heavy fuel oil there has been an increase in sulphur percentage from 1990-2005 (Figure 4.4), and the PM emission factors derived from equation 2 (Figure 4.5) are more sensitive to the sulphur percentage than the emission factor for SO_2. In spite of the reductions of total fuel consumption, the NO_x emissions increase by 1%, due to the development in average emission factors based on assumed engine life time.

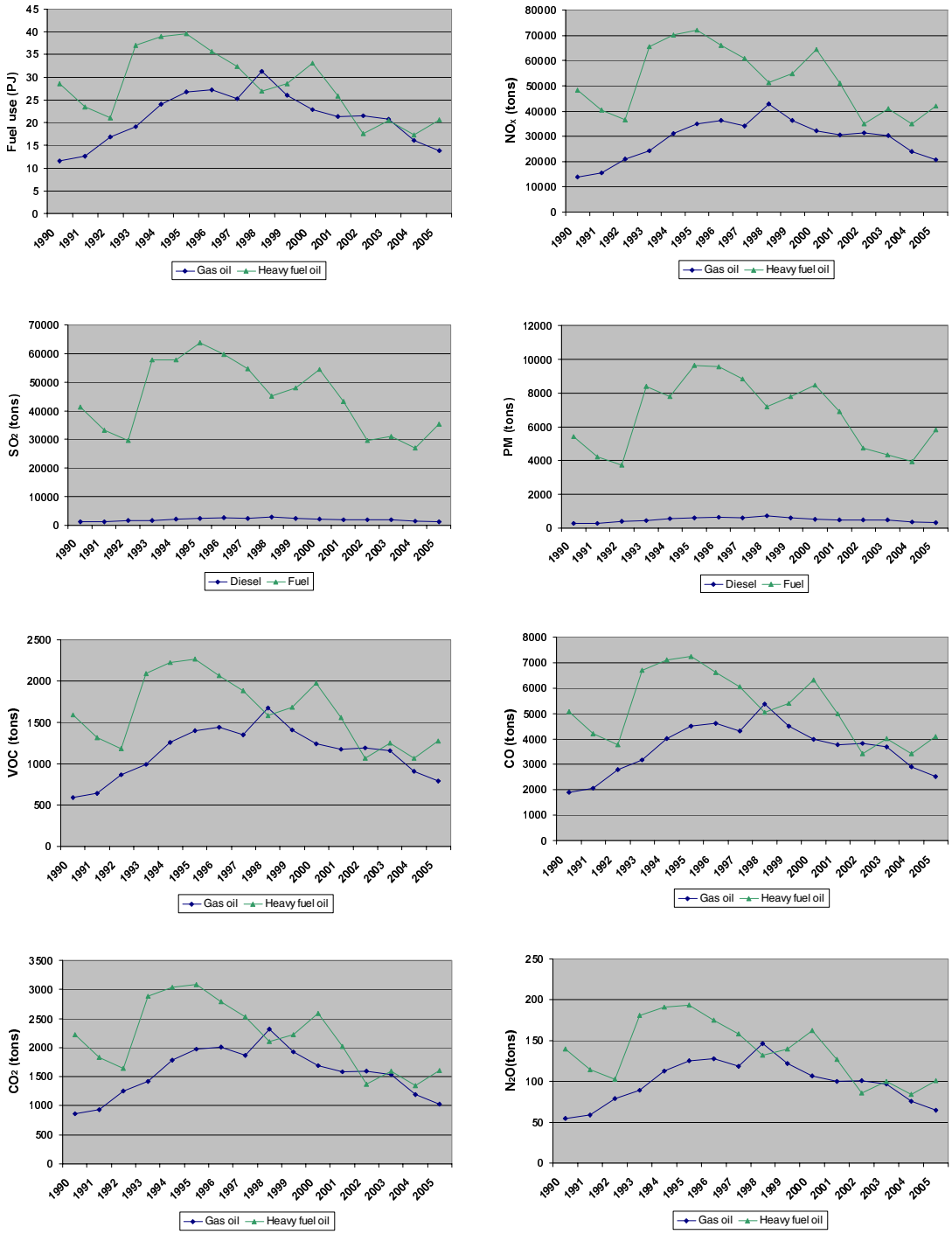


Figure 6.7 1985-2005 time series of fuel consumption and emissions for international sea transport

6.1.4 Total results

The total fuel consumption and emission results for 2005 are summarised in Table 6.5 per fuel type and inventory sector.

Table 6.5 Summary table for fuel consumption and emissions in 2005 per fuel type and inventory sector

Category	Fuel type	Fuel (PJ)	SO_2 (tons)	NO_x (tons)	NMVOC (tons)	CH_4 (tons)	CO (tons)	CO_2 (ktons)	N_2O (tons)	TSP (tons)	PM_{10} (tons)	$PM_{2.5}$ (tons)
Nat. sea	Gas oil	4.14	387	5252	206	6	556	306	19	96	95	95
Nat. sea	Heavy fuel	0.68	664	1169	40	1	133	53	3	63	62	62
Nat. sea	Kerosene	0.00	0	0	0	0	0	0	0	0	0	0
Nat. sea	LPG	0.00	0	0	0	0	0	0	0	0	0	0
Nat. sea	Total	4.82	1052	6421	246	8	688	359	23	159	157	157
Fisheries	Gas oil	6.56	615	8837	367	11	1212	486	31	152	151	150
Fisheries	Kerosene	0.00	0	0	0	0	0	0	0	0	0	0
Fisheries	LPG	0.02	0	25	8	0	9	1	0	0	0	0
Fisheries	Total	6.58	615	8862	375	12	1221	487	31	152	151	150
Int. sea	Gas oil	13.92	1304	20881	764	24	2522	1030	65	323	320	318
Int. sea	Heavy fuel	20.59	35241	41944	1241	38	4093	1606	101	5832	5774	5745
Int. sea	Total	34.51	36544	62825	2005	62	6615	2636	166	6155	6094	6063
	Grand total	45.91	38211	78108	2627	81	8524	3482	219	6466	6402	6369

6.2 Discrepancy between fuel sales and calculated fuel consumption for national sea transport

Figure 6.8 shows the fuel consumption calculated and the statistical fuel sales for 1990-2005, per fuel type and as totals for national sea transport.

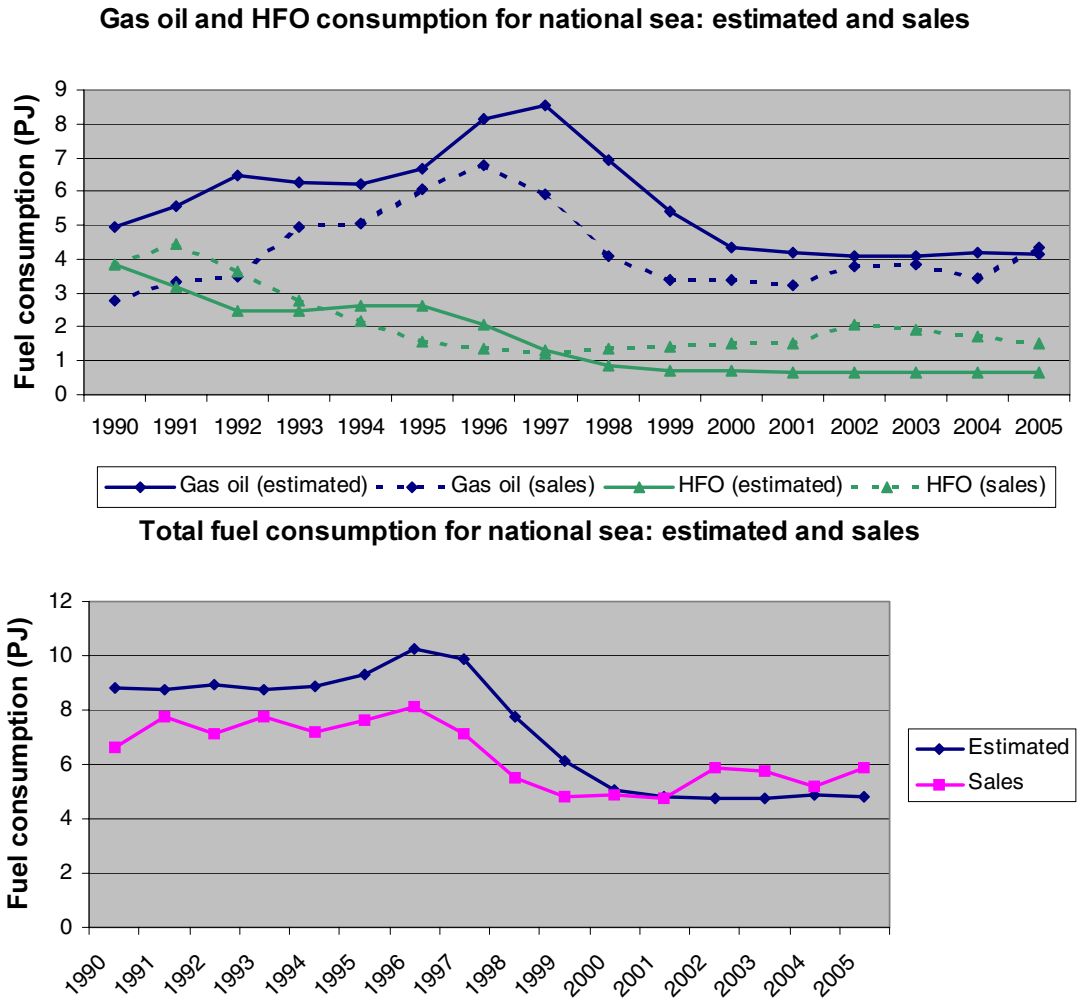


Figure 6.8 Calculated fuel consumption vs. statistical sales for national sea transport

For gas oil, the surplus of calculated fuel consumption is very large for the years until 1992, and from 1997-1999; only for 2005 the calculated gas oil fuel total becomes lower than statistical sales. For heavy fuel oil, only the years 1994-1997 show a surplus of calculated fuel, and from 1998 onwards the calculated fuel consumption is significantly lower than statistical sales. In terms of totals, calculated fuel consumption lies well above fuel sales up until 1999, and the greatest difference is noted for 1998 (42%). Small variations between calculated consumption and sales are found for 2000, 2001 and 2004; the differences are 4%, 2% and -6%, respectively. In 2002, 2003 and 2005 calculated fuel consumption is almost 20% below the sales total.

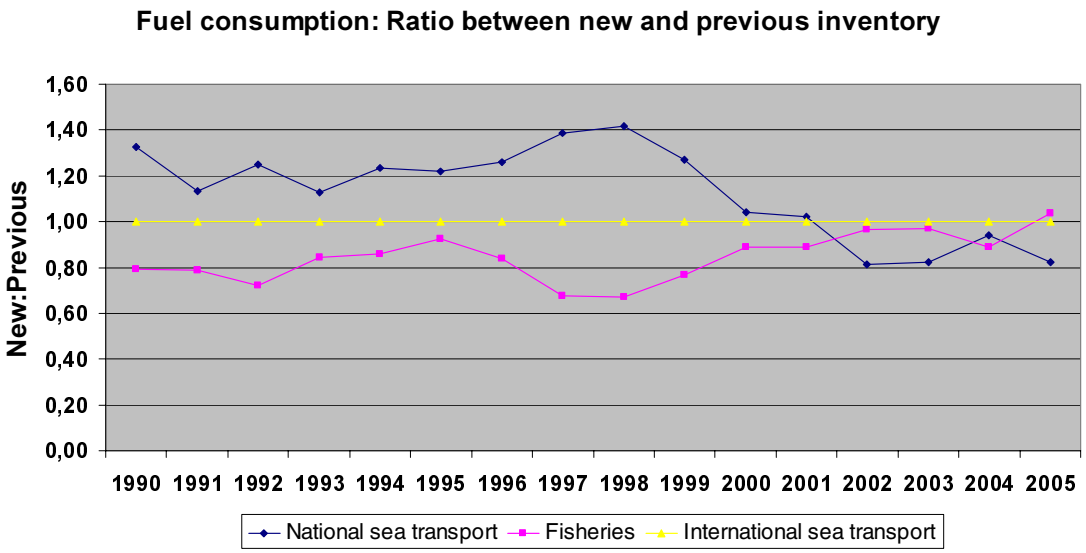
There are various potential reasons for the discrepancies between the fuel consumption and fuel sales figures. From the fuel suppliers' side, errors such as sector misallocations or incorrect fuel type descriptions may disturb the fuel balance, and general calculation uncertainties may bring a certain degree of inaccuracy to the fuel consumption figures arrived at. However, since the new bottom-up fuel consumption estimates for national sea transport are fleet activity based, these new estimates are regarded as more accurate than the fuel sales reported by the DEA.

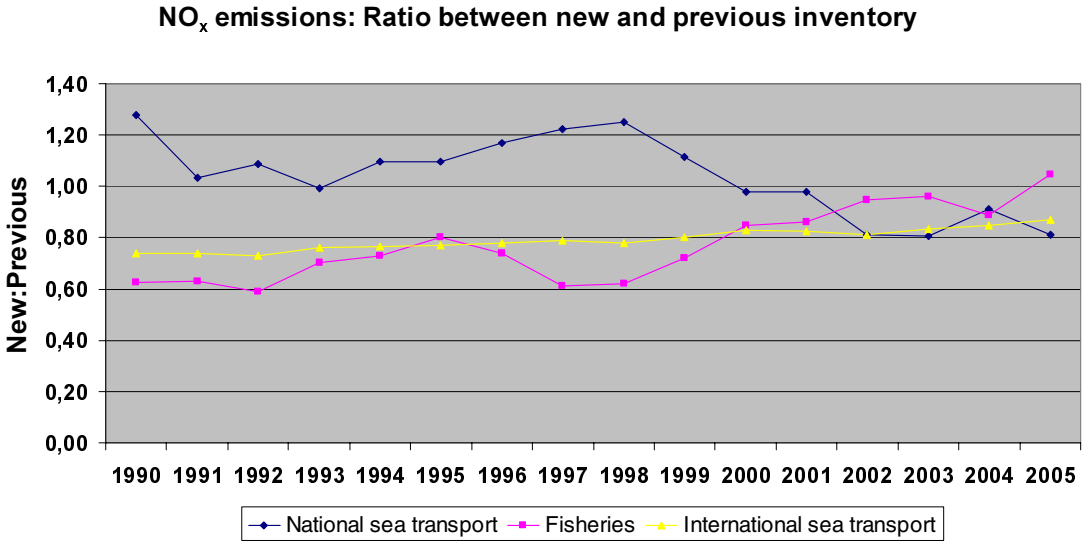
According to the DEA, the most likely reason for the discrepancies between estimated consumption and sales figures is inaccurate specification of the customer made by the oil suppliers. This inaccuracy can be caused by a sector misallocation in the sales statistics between national sea transport and fisheries for gas oil, and between national sea transport and industry for heavy fuel oil. (Peter Dal, DEA, personal communication, 2007).

As a consequence, in the new inventory a decision was made to change the time series for gas oil consumption for fisheries, which was previously based on the direct fuel sales reported in the Danish statistics for this sector. Compared with the earlier inventory, fuel consumption for fisheries reduced from 1990-2004 and increased in 2005, according to the differences between estimated gas oil consumption and reported sales for national sea transport, cf. Figure 6.8.

6.3 Differences between the new and the previous inventory for Danish navigation

Figure 6.9 displays the differences between the new and the previous inventory results for fuel consumption, NO_x and SO_2, shown as ratios for the years 1990-2005. The previous inventory was based on direct fuel sales reported in DEA statistics, and constant NO_x emission factors from the EMEP/CORINAIR guidebook (EMEP/CORINAIR, 2006), whose factors are taken directly from Lloyd's (1995). The SO_2 emission factors relied on older end-use sales data from the DEA for different heavy fuel oil qualities, which have been updated in the present project, resulting in minor emission factor changes.





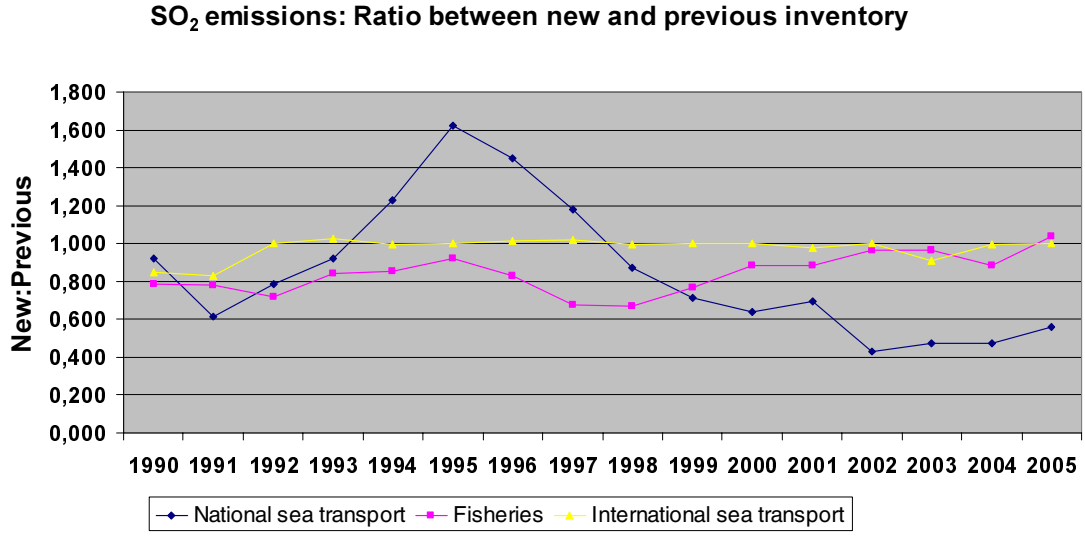


Figure 6.9 Ratios between new and old inventory results for fuel consumption, NO_x and SO_2.

For national sea transport, fuel consumption changes significantly in the new inventory compared to the fuel consumption basis in the previous inventory, as explained in section 6.2. In terms of NO_x, the inventory dif-

ferences are due to updated fuel consumption figures and NO_x emission factors in the new model, the emission impact from the former being the greatest. The development of the new NO_x emission factors from MAN Diesel is explained in section 4.2. The largest and smallest NO_x emission changes occur in 1990 (28%) and 1993 (-1%).

For SO_2, the emission trend is very sensitive to changes in heavy fuel consumption. This means that in 1994-1997, the new SO_2 estimates are lower than the previous estimates, due to smaller heavy fuel consumption in the new model compared with the previous figures based on sales, cf. Figure 6.8. The opposite is the case for 1990-1993, and from 1998 onwards. The largest and smallest emission changes for SO_2 are noted for 1995 (62%) and 1993 (-8%).

For fisheries, the consumption of gas oil is lower in the new inventory compared with the inventory figures used previously, for all years except 2005. The fuel consumption differences are due to the adjustments made between fisheries and national sea transport in the new inventory for gas oil, also explained in section 6.2. SO_2 emissions change in the same way as fuel consumption, due to constant emission factors. The largest and smallest changes between the new and the earlier results are noted for 1998 (-33%) and 2004 (4%). For NO_x, the largest and smallest changes, respectively, appear in 1992 (-41%) and 2005 (5%).

For international sea transport, fuel consumption remains unchanged in the new inventory; hence the emission reductions for NO_x and SO_2 are driven by emission factor changes. For NO_x, the emission reductions are quite significant in the 1990-2005 time period; the largest and smallest reductions obtained with the new inventory are noted for 1992 (27%) and 2005 (13%). For SO_2, the updates of the sulphur content for heavy fuel oil made in new inventory explain the emission changes (most visible for 1990, 1991 and 2003).

6.4 Input parameters from the new Danish inventory compared with other studies and the previous Danish inventory

The NO_x emission factors from the new Danish inventory correspond well with the factors from Whall et al. (2002) and Endresen et al. (2003) for slow-speed engines (Table 6.6). For the remaining engines types, the factors from the new Danish inventory are around 10-20% lower. For sfc fairly good agreement is evident between the new Danish factors and the factors from Whall et al. (2002) and Endresen et al. (2003), for slow- and medium-speed engines. The largest sfc differences are noted for high-speed engines (Endresen et al. 2003), and gas turbines (Whall et al. 2002), where sfc factors are around 20% higher than the figures used in the new Danish inventory.

Table 6.6 NO_x (g/kg) and sfc (g/kWh) per engine type from different studies

Study	Year		Unit	Slow speed	Medium speed	High speed	Gas turbines
Whall et al. 2002	2000	NO_x	g/kg	92[a]/93[b]	65[a]/66[b]	59[a]/60[b]	20
Endresen et al. 2003	2000	NO_x	g/kg	87	57	57	-
Danish inventory (prev.)	2000	NO_x	g/kg	87	57	57	16[c]
Danish inventory (new)	2000	NO_x	g/kg	89	51	53	17
Whall et al. 2002	2000	sfc	g/kWh	185[a]/195[b]	203[a]/213[b]	203[a]/213[b]	290[a]/305[b]
Endresen et al. 2003	2000	sfc	g/kWh	195	215	230	-
Danish inventory (new)	2000	sfc	g/kWh	200	219	211	240

[a] Heavy fuel oil; [b] marine gas oil; [c] Gas turbine engines are not considered in the previous NERI method

It is normal to expect differences between input data for different inventories. However, the aggregated sfc and NO_x emission factors derived from the new Danish inventory are based on precise information of engine production year for regional ferries, and engine type and lifetime assumptions for the remaining navigation categories. In this way, the final fuel consumption figures and emission factors take into account both engine type and age for all navigation categories in the Danish inventory. Consequently, the present approach is considered to be more accurate than the use of constant factors by other inventories.

Table 6.7 Aggregated factors for NO_x (g/kg), sfc (g/kWh) and fuel sulphur content used in different studies

Study	Year	NO_x (g/kg)	sfc (g/kWh)	S-%
Eyring et al. 2005	2001	76.4	212[a]	2.1
Corbett et al. 2003	2001	78.2	210	2.2
Endresen et al. 2003	2000	75.9	201[b]	2.2
Danish inventory (previous)	2000	81	-	1.8
Danish inventory (new)	2000	69	210	1.8

[a] Rough estimate from Endresen (pers. comm., 2007)
[b] Aggregated figure (based on an energy demand of 72% for transport vessels (sfc = 206 g/kWh) and 28% for non transport vessels (sfc = 221 g/kWh).

The total sfc factor from the new Danish model is very similar to the sfc factors derived from the other studies; whereas for NO_x the Danish total emission factor is around 10% lower (Table 6.7). The latter difference is due to the inventory variations regarding specific emission factors and fuel consumption shares per engine type. The main reason for the NO_x emission factor difference between the new and the earlier Danish inventory is due to a different fuel consumption weighting for slow-speed and medium-speed engines, and the fact that fuel combustion in gas turbines is not taken into consideration in the earlier Danish inventory.

Table 6.8 Table 7: Sulphur percentage of heavy fuel oil and marine gas oil used in different studies

Study	Year	Heavy fuel	Gas oil
Endresen et al. 2005 (Europe)	2002	2.41	0.54
Endresen et al. 2003[a]	2000	2.7	0.5
Whall et al. 2002	2000	2.7	0.5
Danish inventory (previous)	2000	3.5	0.2
Danish inventory (new)	2000	3.4	0.2

[a] values from EMEP/CORINAIR (1999), repeated in the 2006 version of the guidebook.

The sulphur content for all fuel is between 10% and 20% lower in the Danish inventories compared with the figures derived from the other studies. The reasons for these discrepancies are the specific fuel type mix for Danish navigation and different sulphur content per fuel type, as shown in Table 6.8. For heavy fuel oil, the sulphur content from the Danish inventory is based on end-use fuel sales data for two different fuel qualities, and sulphur contents are assumed in each case. The weighted sulphur content is around 40% higher than the figure for European fuel sales based on specific fuel samples, found by Endresen et al. (2005). Conversely, the latter source finds a sulphur content for marine gas oil which is around 170% higher than the sulphur content used in the Danish inventory. To determine how well the Danish data fits with the real national picture in terms of fuel sulphur content, it is desirable to obtain data from Danish bunker samples, in a similar way as carried out by Endresen et al. (2005).

As regards engine loads, the weighted average for %MCR used for regional ferries in the new Danish inventory is 0.80. This figure aligns well with the average engine loads assumed in other studies. Whall et al. 2002 use 80% for main engines at sea and 20% for in-port and manoeuvring conditions. EMEP/CORINAIR suggests 80% at sea, 20% for in-port and 40% for manoeuvring conditions. Endresen et al. 2003 use 70%. Eyring et al. (2005) use between 65 and 75% for non-cargo vessels.

6.5 Fuel consumption and emission forecast 2006-2030

The fuel consumption and emission results for the 2006-2030 forecast period (5-year intervals) are shown per inventory sector in Table 6.9 All fuel consumption and emission results are listed in Annex III.

Table 6.9 Forecast fuel consumption and emission results per inventory category for sea transport

Category	Year	Fuel (PJ)	SO_2 (tons)	NO_x (tons)	NMVOC (tons)	CH_4 (tons)	CO (tons)	CO_2 (ktons)	N_2O (tons)	TSP (tons)	PM_{10} (tons)	$PM_{2.5}$ (tons)
Nat. sea	2006	4.81	1051	6448	247	8	690	359	23	159	157	156
Nat. sea	2010	4.79	594	6544	249	8	698	357	23	124	123	122
Nat. sea	2015	4.77	594	6617	251	8	705	356	22	123	122	122
Nat. sea	2020	4.77	594	6626	253	8	710	356	22	123	122	122
Nat. sea	2025	4.77	594	6618	254	8	713	356	22	123	122	122
Nat. sea	2030	4.71	591	6207	254	8	713	351	22	122	121	120
Fisheries	2006	7.14	666	9666	408	13	1331	528	33	165	164	163
Fisheries	2010	6.73	314	9230	392	12	1278	498	31	145	143	142
Fisheries	2015	6.74	315	9351	397	12	1296	499	31	145	143	143
Fisheries	2020	6.74	315	9323	399	13	1301	499	31	145	143	143
Fisheries	2025	6.74	315	9321	399	13	1300	499	31	145	143	143
Fisheries	2030	6.80	317	9404	402	13	1312	503	32	146	145	144
Int. sea	2006	41.30	37140	73674	2396	74	7905	3138	198	6306	6243	6212
Int. sea	2010	41.30	16056	76174	2468	76	8140	3138	198	1759	1742	1733
Int. sea	2015	41.30	16056	78522	2549	79	8408	3138	198	1759	1742	1733
Int. sea	2020	41.30	16056	79297	2615	81	8628	3138	198	1759	1742	1733
Int. sea	2025	41.30	16056	78832	2660	82	8775	3138	198	1759	1742	1733
Int. sea	2030	41.30	16056	77895	2674	83	8821	3138	198	1759	1742	1733

Also in the projection period, international sea transport is the most important source of fuel consumption and emissions. From 2006-2030, no change in the total fuel consumption, and CO_2 and N_2O emissions are expected for this category. For NO_x, CO and VOC (NMVOC and CH_4), the projected emissions are expected to increase by 6, 12 and 12%, respectively, due to changes in the emission factors. Large emission decreases are expected for SO_2 (57%) and PM (72%, all three size fractions), mainly due to the SECA area limitation of the sulphur content in heavy fuels from 2007.

For national sea transport, the total fuel consumption, and CO_2 and N_2O emissions are expected to decrease by 2% from 2006-2030, and for CO, VOC (NMVOC and CH_4) and NO_x, the expected emission changes are 3%, 3% and –4%, respectively. Large emission reductions are expected for PM (23%, all three size fractions) and SO_2 (44%), mainly because of the heavy fuel sulphur content upper limit of 1.5% from the SECA areas, which are introduced in the calculations from 2007.

For fisheries, the total fuel consumption, and CO_2 and N_2O emissions are expected to decrease by 5% from 2006-2030, whereas emission changes of –3%, -1% and –1%, respectively, are expected for NO_x, CO and VOC (NMVOC and CH_4). For PM (all three size fractions) and SO_2, emission declines are expected to be 12 and 52%, respectively, due to the 50% reduction of sulphur content in gas oil from 2008.

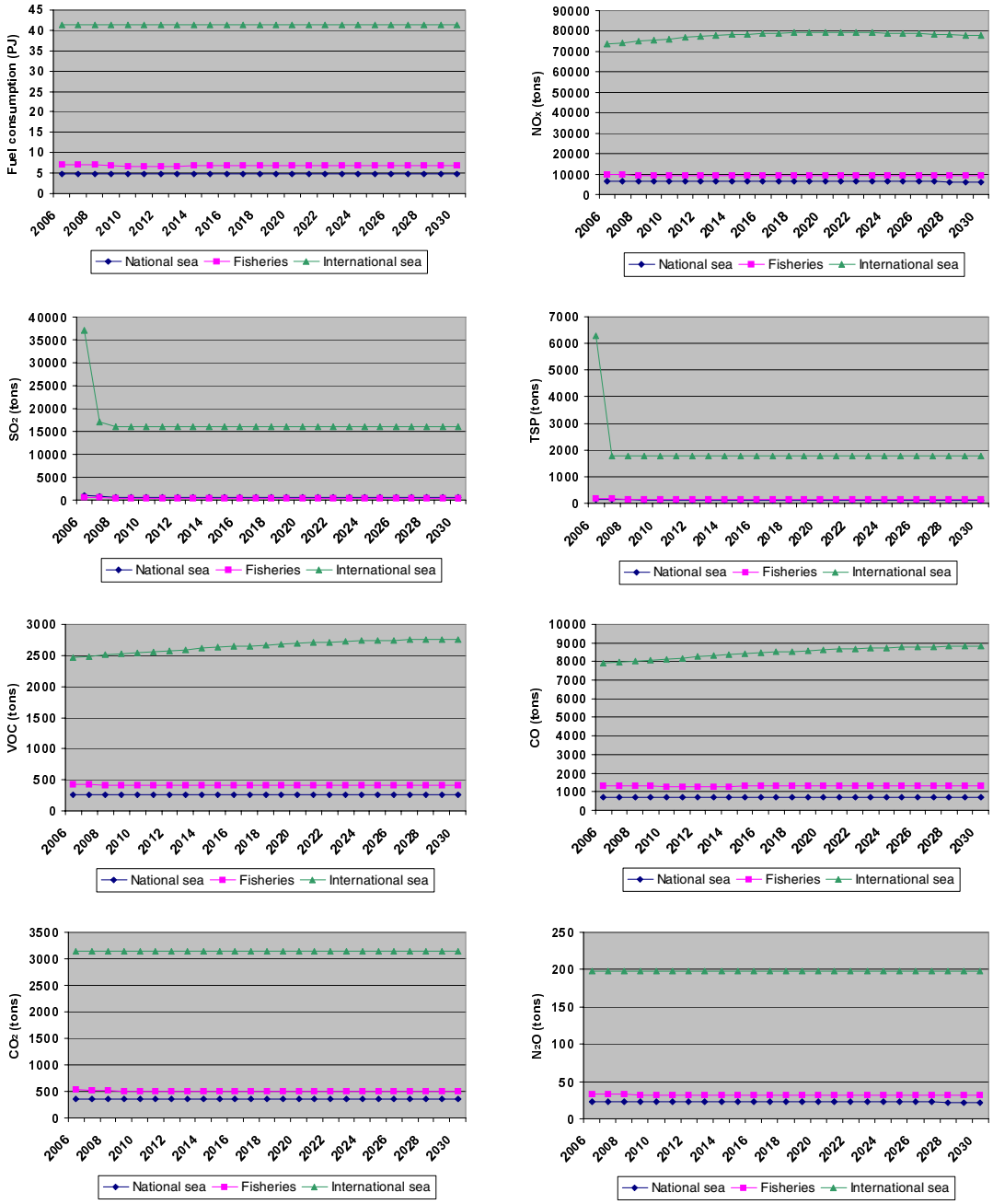


Figure 6.10 2006-2030 time series of fuel consumption and emissions per inventory category for sea transport

Figure 6.11 shows total Danish NO_x and SO_2 emissions from mobile sources in the forecast period 2006-2020, as presented by Illerup et al. (2007). The fuel consumption forecast from the DEA (not shown) remains at a constant level for national sea transport and fisheries (total national sea), and the 1% emission reduction for NO_x from 2006-2020 is caused solely by small changes in the NO_x emission factors. For other mobile sources, such as road transport and non-road working machinery (agriculture and industry), the expected NO_x emissions become significantly smaller. The emission reductions (59% for non-road and 67% for road) are due to the gradually strengthening emission standards for the engines used.

Already in 2011 the non-road working machinery group becomes a less significant source of NO_x emissions than total national sea transport, and in 2020 the NO_x emission from road transport is almost the same as that for total national sea transport. A strengthening of the NO_x emission standards in 2010 and 2015 is currently under discussion in the IMO, and the present forecast result shows that more strict emission standards will have to be decided for future engines if emission improvements are to be achieved in line with those calculated for other mobile sources.

For SO_2, total emissions from Danish mobile sources are largely dominated by the emission contributions from total national sea transport. Most of these emissions are due to a certain use of heavy fuel oil by vessels in the category 'other national sea transport'. The trend in SO_2 emission factors is explained in more detail in section 3.2.3. The calculated emissions from total national sea reduce substantially by the time that the defined SECA areas enter into force, and the maximum sulphur percentage of heavy fuel oil is set to 1.5%. Still, SO_2 emissions are at a level that indicates that navigation is the sector to address if the emissions from mobile sources are to be reduced even further in future.

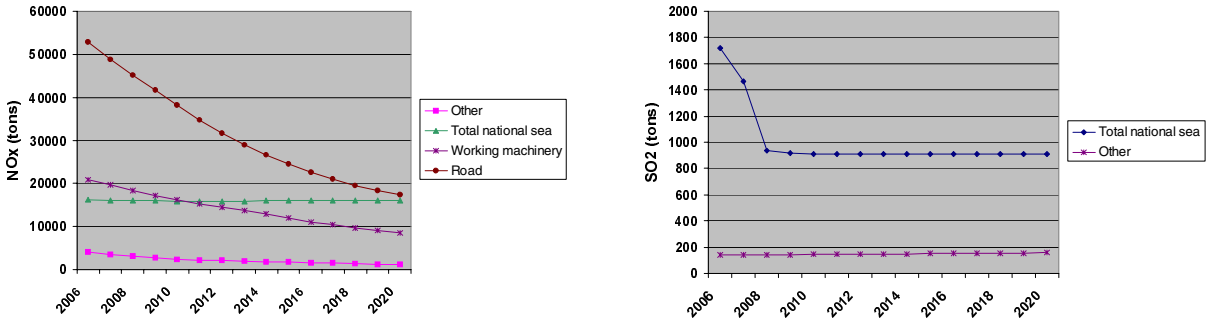


Figure 6.11 2006-2030 time series of NO_x and SO_2 emissions for Danish mobile sources

6.6 Uncertainties

Uncertainty estimates for fuel consumption and emissions are made according to the guidelines formulated in the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000).

The input for the uncertainty calculation is uncertainty factors for activity data and fuel consumption/emission factors uncertainties.

The uncertainty factor for the fuel used by regional ferries is calculated as:

$$U_A = \sqrt{U_L^2 + U_S^2 + U_F^2} \quad (8)$$

Where U_A = Fuel consumption uncertainty factor, U_L = load uncertainty factor and U_S = sailing time uncertainty factor and UF = specific fuel consumption uncertainty factor.

The uncertainty factors (95% confidence ratios) for average engine load (% MCR) and sailing time for regional ferries are shown in Table 6.10.

The uncertainty factors are based on expert judgement (Kristensen, 2006).

Table 6.10 Uncertainty factors for average engine load and sailing time

Category	% MCR	Sailing time	sfc	Fuel consumption uncertainty
	U_L	U_S	U_F	U_A
Regional ferries	10%	5%	5%	12%

The fuel consumption and emission factor uncertainties given as 95% confidence ratios are shown in Table 6.11. For fuel consumption the uncertainty factors for local ferries and other national sea transport are based on own judgements. For the remaining two categories default values from IPCCC (2000) have been used.

The emission factor uncertainties for CO_2, CH_4 and N_2O come from IPCC (2000) and for SO_2, NO_x, NMVOC, CO, NH_3 and TSP the uncertainty factors are used as proposed by the Good Practice Guidance for CLRTAP Emission Inventories (Pulles et al. 2001).

Table 6.11 Fuel consumption and emission factor uncertainties

Category	Fuel	SO_2	NO_x	NMVOC	CH_4	CO	CO_2	N_2O	TSP
Regional ferries	0.12	0.5	0.5	0.5	0.5	0.5	0.05	1000	0.5
Local ferries	0.20	0.5	0.5	0.5	0.5	0.5	0.05	1000	0.5
Other national sea transport	0.20	0.5	0.5	0.5	0.5	0.5	0.05	1000	0.5
Fisheries	0.02	0.5	0.5	0.5	0.5	0.5	0.05	1000	0.5
International sea transport	0.02	0.5	0.5	0.5	0.5	0.5	0.05	1000	0.5

In Table 6.12 the uncertainty results are shown, expressed as the 95% confidence ratios.

Table 6.12 uncertainty results (95% confidence ratios) for fuel consumption and emissions in 2005

Category	Fuel	SO_2	NO_x	NMVOC	CH_4	CO	CO_2	N_2O	TSP
Regional ferries	0.12	0.51	0.51	0.51	0.51	0.51	0.13	1000	0.51
Local ferries	0.20	0.54	0.54	0.54	0.54	0.54	0.21	1000	0.54
Other national sea transport	0.20	0.54	0.54	0.54	0.54	0.54	0.21	1000	0.54
Fisheries	0.02	0.50	0.50	0.50	0.50	0.50	0.05	1000	0.50
International sea transport	0.02	0.50	0.50	0.50	0.50	0.50	0.05	1000	0.50

7 Summary and discussion

This report explains the new emission inventory for navigation in Denmark, covering national sea transport, fisheries and international sea transport in the period from 1990-2005. The major fuel consumption as well as SO_2, NO_x, VOC (NMVOC and CH_4), CO, CO_2 , N_2O and PM emission results are shown, and explanations are given for the differences between statistical fuel sales and the fuel consumption data calculated by the inventory. The differences between the new and the previous Danish inventory are also explained in terms of fuel consumption and the most important emissions, SO_2 and NO_x. Moreover, the main inventory calculation parameters for the new inventory are compared to those used in other studies. Finally, an emission projection is presented for the 2006-2020 period, and for NO_x and SO_2 the forecasted emissions from domestic navigation are compared with the emissions from other Danish mobile sources.

International sea transport is the most important source of fuel consumption and emissions for navigation. The share of total fuel consumption for this sector is 75% in 2005, and for CO_2, N_2O and VOC (NMVOC and CH_4) the share is 76% For CO the emission share is 78%, and for NO_x, PM (all three fractions) and SO_2 the emission shares are 80%, 95% and 96%, respectively.

For national sea transport, the shares of fuel consumption, CO_2 and N_2O (10%) are somewhat smaller than for fisheries (14%). This also the case for NO_x, VOC (NMVOC and CH_4) and CO; the respective emission shares are 8%, 9% and 8% for national sea transport, and 11%, 14% and 14% for fisheries. For SO_2 and PM (all three fractions) the emission share for fisheries is 2%, and for national sea transport, the SO_2 and PM (all three fractions) emission shares 3% and 2%, respectively.

The 1990-2005 emission trends follow the development in fuel consumption and emission factors. For international sea transport, the fuel consumption and SO_2 emissions declines are 14%. For CO_2 and N_2O the emission reductions are 15%, and for VOC and CO the emission reductions are 5%. For NO_x and PM (all three size fractions) the emissions increase by 1 and 8%, respectively.

In the same time period fuel consumption, CO_2 and N_2O emissions decrease by 11%. Emission decreases are also calculated for VOC (2%), NMVOC (2%), CH_4 (3%), CO (1%), SO_2 (27%) and PM (37%, all size fractions), whereas for NO_x, the emissions increase by 10%. For fisheries, the total fuel consumption, and CO_2, N_2O, PM (all size fractions) and SO_2 emissions decrease by 17% from 1990-2005. The emissions of CO, NMVOC, CH_4 and NO_x change by -6%, -7%, -10% and 6%, respectively.

Also in the projection period, international sea transport is the most important source of fuel consumption and emissions. No change in the total fuel consumption, and zero or only smaller emission changes are expected from 2006-2030, except for SO_2 and PM. The expected emission reductions are 57% and 72%, respectively, for these two components,

mainly due to the introduction of the SECA areas from 2007. For national sea transport and fisheries the total fuel consumption decrease by 2% and 5%, respectively, from 2006-2030. As for international sea transport, only changes of significance occur for SO_2 and PM; these are -44% and -23% for national sea transport, and -52% and -12% for fisheries

Forecast results indicate that already in 2011, the non-road working machinery group becomes a smaller source than national sea transport in terms of NO_x emissions, and in 2020 the NO_x emission from road transport is almost the same as that for total national sea transport. For SO_2, most of the emissions from Danish mobile sources stem from a certain use of heavy fuel oil by vessels in the category 'other national sea transport'. Even though the introduction of SECA's reduces the SO_2 emissions substantially, they are still at a level that indicates that navigation is the sector to address if the SO_2 emissions from mobile sources are to be reduced even further in future.

The 2006-2020 emission forecasts show a need for more strict fuel quality and NO_x emission standards for navigation, in order to gain emission improvements in line with those achieved for other mobile sources.

For national sea transport in Denmark, the fuel consumption estimates obtained with the new model are regarded as much more accurate than the DEA fuel sales data used in the previous model version. The large fluctuations in reported fuel sales cannot be explained by the actual development in the traffic between different national ports. Also countries like Italy (2007), Belgium (2007) and Finland (2007) rely on estimated fuel figures instead of sales figures. The general uncertainties associated with fuel sales statistics are also highlighted by Olivier and Peters (1999), who summarise fuel consumption and CO_2 emissions globally.

There are different potential reasons for the differences between estimated fuel consumption and reported sales for national sea transport in Denmark. According to the DEA, the latter fuel differences are most likely explained by inaccurate costumer specifications made by the oil suppliers. This inaccuracy can be caused by a sector misallocation in the sales statistics between national sea transport and fisheries for gas oil, and between national sea transport and industry for heavy fuel oil (Peter Dal, DEA, personal communication, 2007). It would therefore be desirable for the Organization of Oil Suppliers in Denmark (OFR, www.ofr.dk) to review their procedures of sales registrations, and make any necessary changes.

As a side remark, fuel investigations for fisheries made prior to the initiation of the present project have actually pointed out a certain area of inaccuracy in the DEA statistics. No engines installed in fishing vessels use heavy fuel oil, even though a certain amount of heavy fuel oil is listed in the DEA numbers for some statistical years (H. Amdissen, Danish Fishermen's Association, personal communication, 2006).

Moreover two situations may occur which would lead to discrepancies in DEA fuel sales figures versus a perfect fuel base for bottom-up inventory calculations. Firstly, the fuelling pattern would be affected in a situation where a vessel makes a journey where the first part is a domestic trip, without fuelling from the start, and where the second part is in-

ternational. Another situation may occur if a vessel is fully loaded with fuel prior to a trip, for which the first leg is domestic and the following leg is international.

In terms of fuel consumption calculation, some uncertainty also exists in the model calculation parameters. Bearing in mind the model assumptions made, the fuel consumption trend calculated for national sea transport reflects the traffic pattern, and for 1999 the fuel consumption uncertainty for national sea transport as a whole is estimated to be 11% in 1999 (see Winther, 2007), based on the method proposed by the IPCC (2000). This margin of uncertainty only leaves room for a minor displacement of the curve for estimated fuel consumption, and cannot explain the large fluctuations in reported fuel sold.

It is recommended to replace the current DEA time series of fuel sales for national sea transport by the new bottom-up fuel consumption estimates calculated in this project. If this decision was made, a collaboration between NERI and the DEA could be established like the one that already exists between NERI and the DEA for aviation. Here, NERI calculates the jet fuel split for domestic and international flights (Winther, 2001). An updated time series for fuel consumption for national sea transport will introduce changes to the energy statistics for fisheries and industry, since the revealed differences between the sales figures and bottom-up estimates for national sea transport are balanced out by adjusting the sales figures for fisheries (for gas oil) and industry (heavy fuel oil).

For international transport, fuel sales data as such are regarded as highly accurate for Denmark, since they are compiled from audited information from the Danish oil suppliers. The fuel sales data are input directly into the inventory calculations, and this methodology approach follows good practice for the UNFCCC and UNECE conventions, when fleet activity data are missing.

However, instead of fuel-based estimates it would be very useful to implement a new project in which the fuel consumption and emissions for international sea transport in Denmark are calculated based on actual vessel movements, as has already been carried out for domestic ferries. Following good practice outlined in the UNFCCC and UNECE conventions, the movements should include only the first international leg for vessels starting from Danish ports, i.e. trips made by vessels starting from Danish ports with foreign ports as their first destination. Such project results would strongly support the work made by Danish policymakers dealing with the issue of bunker emissions allocation; fuel sales for Danish international sea transport only give what has been filled into the vessel fuel tanks, and not what has actually been used on the abovementioned trips.

Several fleet activity-based inventories on a global scale, despite the significant degree of disparity between their research results, point out uncertainties in international fuel statistics. Analyses carried out by Corbett and Köhler (2003) and Eyring et al. (2005) calculate much more fuel for international transport than reported by the International Energy Agency (IEA) and the Energy Information Administration (EIA). The authors question the accuracy of the sales reported and indicate problems with regard to the fuel definitions applied in the statistics. Endresen et al.

(2003) calculate a total fuel consumption for international sea transport which is much closer to international fuel statistics. However, in later work Endresen et al. (2005) examine fuel reports from the EIA and IEA and find that fuel consumption for navigation may be underreported in the statistics.

The differences in fuel results obtained by different research teams clearly demonstrate the difficulties and the complexity involved in making detailed fleet activity-based inventories. In recognition of this, the researchers active in this field are here encouraged to carry out more studies in order to reach better agreement in terms of input data and methodological assumptions. Development of harmonised calculation models would be a very helpful tool in support of the global policy work carried out by the IMO and UNFCCC in allocating bunker emissions internationally. The development of a consolidated global inventory baseline is also recommended by the International Council on Clean Transportation (ICCT) in their status report on air pollution and greenhouse gas emissions from ocean-going ships (Friedrich et al., 2007).

This project uses new information on trends in NO_x emissions from different types of ship engines, starting with the production year 1949 and proceeding up to the engines of today (2005). The emission data have been provided by the ship engine manufacturer MAN DIESEL, which have a 75% world market share in relation to ship engine production. Emission data from this source ensures a good representation of the emission factors used for the emission calculations.

Introduction of fuel consumption and emission factors as a function of engine production year is a major inventory improvement. This kind of disaggregated input data is used in many other parts of the inventories, e.g. road transport (COPERT III model: Ntziachristos and Samaras, 2000) and non-road machinery (Winther and Nielsen, 2006), and this level of detail is necessary in order to make proper assessments of the emission trends.

This project shows that if engine production year data exist for the vessels for which traffic and technical data are available, fuel consumption and emission calculations become a straightforward practice for inventory makers. This is also true in cases where assumptions have to be made in order to account for missing data, e.g. for engine type and lifetime; and also here accuracy of results is being improved.

However, a real improvement in the emission calculations in the present project would be the use of experimentally-determined transient factors in the model calculations, to account for the variations in engine loads which occur during the normal range of ship operation. Another area of further work is to investigate specific fuel consumption for the most modern engines and, if necessary, make appropriate updates to fuel consumption data, which currently is based on expert judgement for these engines.

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Annex 1

A.1.1 Annual traffic data for ferries (no. of round trips) for Danish domestic ferries

Ferry route	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Local ferries	176891	179850	181834	178419	202445	209129	182750	197489	200027	202054	201833	200130	208396	208501	206297	205564
Halsskov-Knudshoved	10601	10582	11701	11767	12420	12970	13539	13612	5732	0	0	0	0	0	0	0
Korsør-Nyborg, DSB	9305	9167	9237	8959	8813	8789	8746	3258	0	0	0	0	0	0	0	0
Tårs-Spodsbjerg	7656	8835	9488	9535	9402	9562	9000	9129	7052	6442	6477	6498	6468	6516	6497	6494
Korsør-Nyborg, Vognmandsruten	7512	7363	7468	7496	7502	7828	7917	8302	3576	0	0	0	0	0	0	0
Sjællands Odde-Ebeltoft	3908	3978	4008	3988	4325	4569	5712	8153	7851	7720	4775	4226	3597	3191	2906	2889
Kalundborg-Århus	1907	2400	3162	2921	2913	3540	4962	4888	4483	1454	1870	1804	2037	1800	1750	1725
Hundested-Grenaa	1026	1025	1032	1030	718	602	67	0	0	0	0	0	0	0	0	0
Kalundborg-Samsø	873	873	860	881	826	811	813	823	824	850	828	817	833	831	841	867
København-Rønne	558	545	484	412	427	426	437	465	458	506	491	430	413	397	293	0
Kalundborg-Juelsminde	0	1326	1733	1542	1541	1508	856	0	0	0	0	0	0	0	0	0
Køge-Rønne	0	0	0	0	0	0	0	0	0	0	0	0	0	0	154	488
Sjællands Odde-Århus	0	0	0	0	0	0	0	0	0	2339	1799	1817	1825	2359	2863	2795

A.1.2 Ferry data: Service, name, engine year, main engine MCR (kW), engine type, specific fuel consumption (sfc), aux. engine (kW)

Ferry service	Ferry name	Engine year	Main engine MCR (kW)	Engine type	Sfc (g/kWh)	Aux engine (kW)
Halsskov-Knudshoved	ARVEPRINS KNUD	1963	8238	Slow speed (2-stroke)	220	1666
Halsskov-Knudshoved	DRONNING MARGRETHE II	1973	8826	Medium speed (4-stroke)	230	1692
Halsskov-Knudshoved	HEIMDAL	1983	8309	Medium speed (4-stroke)	220	740
Halsskov-Knudshoved	KNUDSHOVED	1961	6400	Slow speed (2-stroke)	220	1840
Halsskov-Knudshoved	KONG FREDERIK IX	1954	6767	Slow speed (2-stroke)	225	1426
Halsskov-Knudshoved	KRAKA	1982	8309	Medium speed (4-stroke)	220	740
Halsskov-Knudshoved	LODBROG	1982	8309	Medium speed (4-stroke)	220	740
Halsskov-Knudshoved	PRINSESSE ANNE-MARIE	1960	8238	Slow speed (2-stroke)	220	1360
Halsskov-Knudshoved	PRINSESSE ELISABETH	1964	8238	Slow speed (2-stroke)	220	1360
Halsskov-Knudshoved	ROMSØ	1973	8826	Medium speed (4-stroke)	230	1728
Halsskov-Knudshoved	SPROGØ	1962	6400	Slow speed (2-stroke)	220	1840
Hundested-Grenaa	DJURSLAND	1974	9856	Medium speed (4-stroke)	230	900
Hundested-Grenaa	KATTEGAT	1995	23200	High speed (4-stroke)	205	1223
Hundested-Grenaa	KONG FREDERIK IX	1954	6767	Slow speed (2-stroke)	235	1375
Hundested-Grenaa	PRINSESSE ANNE-MARIE	1960	8238	Slow speed (2-stroke)	220	1360
Kalundborg-Juelsminde	Mercandia I	1989	2950	High speed (4-stroke)	220	0
Kalundborg-Juelsminde	Mercandia II	1989	2950	High speed (4-stroke)	220	0
Kalundborg-Juelsminde	Mercandia III	1989	2950	High speed (4-stroke)	220	0
Kalundborg-Juelsminde	Mercandia IV	1989	2950	High speed (4-stroke)	220	0
Kalundborg-Samsø	HOLGER DANSKE	1976	2354	High speed (4-stroke)	225	600
Kalundborg-Samsø	KALUNDBORG	1952	3825	Slow speed (2-stroke)	235	570
Kalundborg-Samsø	KYHOLM	1998	2940	High speed (4-stroke)	195	864
Kalundborg-Samsø	VESBORG	1995	1770	High speed (4-stroke)	200	494
Kalundborg-Århus	ASK	1984	8826	Medium speed (4-stroke)	215	2220
Kalundborg-Århus	ASK	1984	8826	Medium speed (4-stroke)	215	3000
Kalundborg-Århus	ASK	1984	9840	Medium speed (4-stroke)	215	3000
Kalundborg-Århus	CAT-LINK I	1995	17280	High speed (4-stroke)	205	1160
Kalundborg-Århus	CAT-LINK II	1995	17280	High speed (4-stroke)	205	1160
Kalundborg-Århus	CAT-LINK III	1995	22000	High speed (4-stroke)	205	800
Kalundborg-Århus	CAT-LINK III	1995	22000	High speed (4-stroke)	205	801
Kalundborg-Århus	CAT-LINK III	1995	22000	High speed (4-stroke)	205	802
Kalundborg-Århus	CAT-LINK IV	1998	28320	High speed (4-stroke)	205	920
Kalundborg-Århus	CAT-LINK V	1998	28320	High speed (4-stroke)	205	920
Kalundborg-Århus	KATTEGAT SYD	1979	7650	Medium speed (4-stroke)	225	1366
Kalundborg-Århus	KNUDSHOVED	1961	6400	Slow speed (2-stroke)	220	1840

Kalundborg-Århus	KONG FREDERIK IX	1954	6767	Slow speed (2-stroke)	225	1426
Kalundborg-Århus	KRAKA	1982	8309	Medium speed (4-stroke)	220	740
Kalundborg-Århus	MAREN MOLS	1996	11700	Slow speed (2-stroke)	180	2530
Kalundborg-Århus	METTE MOLS	1996	11700	Slow speed (2-stroke)	180	2530
Kalundborg-Århus	NIELS KLIM	1986	12474	Slow speed (2-stroke)	215	4440
Kalundborg-Århus	PEDER PAARS	1985	12474	Slow speed (2-stroke)	215	4440
Kalundborg-Århus	PRINSESSE ELISABETH	1964	8238	Slow speed (2-stroke)	220	1360
Kalundborg-Århus	ROSTOCK LINK	1975	8385	Medium speed (4-stroke)	230	2500
Kalundborg-Århus	SØLØVEN/SØBJØRNEN	1992	4000	High speed (4-stroke)	210	272
Kalundborg-Århus	URD	1981	8826	Medium speed (4-stroke)	215	2220
Kalundborg-Århus	URD	1981	8826	Medium speed (4-stroke)	215	3000
Kalundborg-Århus	URD	1981	9840	Medium speed (4-stroke)	215	3000
Korsør-Nyborg, DSB	ASA-THOR	1965	6472	Slow speed (2-stroke)	220	1305
Korsør-Nyborg, DSB	DRONNING INGRID	1980	18720	Medium speed (4-stroke)	220	2932
Korsør-Nyborg, DSB	DRONNING MARGRETHE II	1973	8826	Medium speed (4-stroke)	230	1692
Korsør-Nyborg, DSB	KONG FREDERIK IX	1954	6767	Slow speed (2-stroke)	225	1426
Korsør-Nyborg, DSB	KRONPRINS FREDERIK	1981	18720	Medium speed (4-stroke)	220	2932
Korsør-Nyborg, DSB	PRINS JOACHIM	1980	18720	Medium speed (4-stroke)	220	2932
Korsør-Nyborg, DSB	SPROGØ/KNUDSHOVED	1962	6400	Slow speed (2-stroke)	220	1840
Korsør-Nyborg, Vognmandsruten	Superflex Alfa	1989	2950	High speed (4-stroke)	220	0
Korsør-Nyborg, Vognmandsruten	Superflex Bravo	1989	2950	High speed (4-stroke)	220	0
Korsør-Nyborg, Vognmandsruten	Superflex Charlie	1988	2950	High speed (4-stroke)	220	0
København-Rønne	POVL ANKER	1979	12950	Medium speed (4-stroke)	233	2889
København-Rønne	POVL ANKER	1979	12950	Medium speed (4-stroke)	233	2889
Køge-Rønne	DUEODDE	2005	8640	Medium speed (4-stroke)	190	1545
Køge-Rønne	HAMMERODDE	2005	8640	Medium speed (4-stroke)	190	1545
Køge-Rønne	JENS KOFOED	1979	12950	Medium speed (4-stroke)	233	2889
Køge-Rønne	POVL ANKER	1979	12950	Medium speed (4-stroke)	233	2889
Sjællands Odde-Ebeltoft	MAI MOLS	1996	24800	Gas turbine	240	752
Sjællands Odde-Ebeltoft	MAREN MOLS	1975	12062	Medium speed (4-stroke)	230	1986
Sjællands Odde-Ebeltoft	MAREN MOLS 2	1996	11700	Slow speed (2-stroke)	180	2530
Sjællands Odde-Ebeltoft	METTE MOLS	1975	12062	Medium speed (4-stroke)	230	1986
Sjællands Odde-Ebeltoft	METTE MOLS 2	1996	11700	Slow speed (2-stroke)	180	2530
Sjællands Odde-Ebeltoft	MIE MOLS	1971	5884	Medium speed (4-stroke)	230	
Sjællands Odde-Ebeltoft	MIE MOLS 2	1996	24800	Gas turbine	240	752
Sjællands Odde-Århus	MADS MOLS	1998	28320	High speed (4-stroke)	205	920
Sjællands Odde-Århus	MAI MOLS	1996	24800	Gas turbine	240	752
Sjællands Odde-Århus	MAX MOLS	1998	28320	High speed (4-stroke)	205	920

Sjællands Odde-Århus	MIE MOLS	1996	24800	Gas turbine	240	752
Tårs-Spodsbjerg	FRIGG SYDFYEN	1984	1300	Medium speed (4-stroke)	220	780
Tårs-Spodsbjerg	ODIN SYDFYEN	1982	1180	Medium speed (4-stroke)	220	780
Tårs-Spodsbjerg	SPODSBJERG	1972	1530	Medium speed (4-stroke)	225	300
Tårs-Spodsbjerg	THOR SYDFYEN	1978	1176	Medium speed (4-stroke)	225	300

A.1.3 Ferry data: Sailing time (minutes per single trip)

Ferry service	Ferry name	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Halsskov-Knudshoved	ARVEPRINS KNUD	60	60	60	60	60	60	60	60	60							
Halsskov-Knudshoved	DRONNING MARGRETHE II	60	60	60	60	60	60	60	60	60							
Halsskov-Knudshoved	HEIMDAL	60	60	60	60	60	60	60	60	60							
Halsskov-Knudshoved	KNUDSHOVED	60	60	60	60	60	60	60	60	60							
Halsskov-Knudshoved	KONG FREDERIK IX	60	60	60	60	60	60	60	60	60							
Halsskov-Knudshoved	KRAKA	60	60	60	60	60	60	60	60	60							
Halsskov-Knudshoved	LODBROG	60	60	60	60	60	60	60	60	60							
Halsskov-Knudshoved	PRINSESSE ANNE-MARIE	60	60	60	60	60	60	60	60	60							
Halsskov-Knudshoved	PRINSESSE ELISABETH	60	60	60	60	60	60	60	60	60							
Halsskov-Knudshoved	ROMSØ	60	60	60	60	60	60	60	60	60							
Halsskov-Knudshoved	SPROGØ	60	60	60	60	60	60	60	60	60							
Hundested-Grenaa	DJURSLAND	160	160	160	160	160											
Hundested-Grenaa	KATTEGAT						90	90									
Hundested-Grenaa	KONG FREDERIK IX					170											
Hundested-Grenaa	PRINSESSE ANNE-MARIE					165											
Kalundborg-Juelsminde	Mercandia I	160	160	160	160	160	160	160									
Kalundborg-Juelsminde	Mercandia II	160	160	160	160	160	160	160									
Kalundborg-Juelsminde	Mercandia III	160	160	160	160	160	160	160									
Kalundborg-Juelsminde	Mercandia IV	160	160	160	160	160	160	160									
Kalundborg-Samsø	HOLGER DANSKE			120	120	120	120	120	120	120							
Kalundborg-Samsø	KALUNDBORG	120	120	120													
Kalundborg-Samsø	KYHOLM									110	110	110	110	110	110	110	110
Kalundborg-Samsø	VESBORG									120							
Kalundborg-Århus	ASK		195	195	195	195	195	195	195	195	195						
Kalundborg-Århus	CAT-LINK I						80	85	90	95							
Kalundborg-Århus	CAT-LINK II						80	85	90	95							
Kalundborg-Århus	CAT-LINK III							85	90	95							
Kalundborg-Århus	CAT-LINK IV									80	80						
Kalundborg-Århus	CAT-LINK V									80	80						
Kalundborg-Århus	KATTEGAT SYD										195						
Kalundborg-Århus	KNUDSHOVED		190														
Kalundborg-Århus	KONG FREDERIK IX		190	190	190	190	190	190									
Kalundborg-Århus	KRAKA									195							
Kalundborg-Århus	MAREN MOLS											160	160	155	155	155	155
Kalundborg-Århus	METTE MOLS											160	160	155	155	155	155
Kalundborg-Århus	NIELS KLIM	185	185														

Kalundborg-Århus	PEDER PAARS	185	185														
Kalundborg-Århus	PRINSESSE ELISABETH		185														
Kalundborg-Århus	ROSTOCK LINK										195						
Kalundborg-Århus	SØLØVEN/SØBJØRNEN		90	90	90	90	90	90									
Kalundborg-Århus	URD		195	195	195	195	195	195	195	195	195						
Korsør-Nyborg, DSB	ASA-THOR	65	65	65	65	65	65	65	65								
Korsør-Nyborg, DSB	DRONNING INGRID	65	65	65	65	65	65	65	65								
Korsør-Nyborg, DSB	DRONNING MARGRETHE II	65	65	65	65	65	65	65	65								
Korsør-Nyborg, DSB	KONG FREDERIK IX	75	75	75	75	75	75	75	75								
Korsør-Nyborg, DSB	KRONPRINS FREDERIK	65	65	65	65	65	65	65	65								
Korsør-Nyborg, DSB	PRINS JOACHIM	65	65	65	65	65	65	65	65								
Korsør-Nyborg, DSB	SPROGØ/KNUDSHOVED	75	75	75	75	75	75	75	75								
Korsør-Nyborg, Vognmandsruten	Superflex Alfa	70	70	70	70	70	70	70	70	70							
Korsør-Nyborg, Vognmandsruten	Superflex Bravo	70	70	70	70	70	70	70	70	70							
Korsør-Nyborg, Vognmandsruten	Superflex Charlie	70	70	70	70	70	70	70	70	70							
København-Rønne	JENS KOFOED	420	420	420	420	420	420	420	420	420	420	420	420	420	420	420	420
København-Rønne	POVL ANKER	420	420	420	420	420	420	420	420	420	420	420	420	420	420	420	420
Køge-Rønne	DUEODDE																375
Køge-Rønne	HAMMERODDE																375
Køge-Rønne	JENS KOFOED															375	375
Køge-Rønne	POVL ANKER															375	375
Sjællands Odde-Ebeltoft	MAI MOLS							45	45	45	45	45	45	45	45	45	45
Sjællands Odde-Ebeltoft	MAREN MOLS	100	100	100	100	100	100	100									
Sjællands Odde-Ebeltoft	MAREN MOLS 2							100	100	100	95						
Sjællands Odde-Ebeltoft	METTE MOLS	100	100	100	100	100	100	100									
Sjællands Odde-Ebeltoft	METTE MOLS 2							100	100	100	95						
Sjællands Odde-Ebeltoft	MIE MOLS	105	105	105	105	105	105	105									
Sjællands Odde-Ebeltoft	MIE MOLS 2							45	45	45	45	45	45	45	45	45	45
Sjællands Odde-Århus	MADS MOLS										60	65	65	65	65	65	65
Sjællands Odde-Århus	MAI MOLS													65	65	65	65
Sjællands Odde-Århus	MAX MOLS										60	65	65	65	65	65	65
Sjællands Odde-Århus	MIE MOLS													65	65	65	65
Tårs-Spodsbjerg	FRIGG SYDFYEN	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
Tårs-Spodsbjerg	ODIN SYDFYEN	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
Tårs-Spodsbjerg	SPODSBJERG	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
Tårs-Spodsbjerg	THOR SYDFYEN	45	45	45	45	45	17	45	45	45	45	45	45	45	45	45	45

A.1.4 Ferry data: Load factor (% MCR)

Ferry service	Ferry name	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Halsskov-Knudshoved	ARVEPRINS KNUD	85	85	85	85	85	85	85	85	85							
Halsskov-Knudshoved	DRONNING MARGRETHE II	85	85	85	85	85	85	85	85	85							
Halsskov-Knudshoved	HEIMDAL	85	85	85	85	85	85	85	85	85							
Halsskov-Knudshoved	KNUDSHOVED	85	85	85	85	85	85	85	85	85							
Halsskov-Knudshoved	KONG FREDERIK IX	85	85	85	85	85	85	85	85	85							
Halsskov-Knudshoved	KRAKA	85	85	85	85	85	85	85	85	85							
Halsskov-Knudshoved	LODBROG	85	85	85	85	85	85	85	85	85							
Halsskov-Knudshoved	PRINSESSE ANNE-MARIE	85	85	85	85	85	85	85	85	85							
Halsskov-Knudshoved	PRINSESSE ELISABETH	85	85	85	85	85	85	85	85	85							
Halsskov-Knudshoved	ROMSØ	85	85	85	85	85	85	85	85	85							
Halsskov-Knudshoved	SPROGØ	85	85	85	85	85	85	85	85	85							
Hundested-Grenaa	DJURSLAND	80	80	80	80	80											
Hundested-Grenaa	KATTEGAT						85	85									
Hundested-Grenaa	KONG FREDERIK IX					65											
Hundested-Grenaa	PRINSESSE ANNE-MARIE					85											
Kalundborg-Juelsminde	Mercandia I	75	75	75	75	75	75	75									
Kalundborg-Juelsminde	Mercandia II	70	70	70	70	70	70	70									
Kalundborg-Juelsminde	Mercandia III	70	70	70	70	70	70	70									
Kalundborg-Juelsminde	Mercandia IV	70	70	70	70	70	70	70									
Kalundborg-Samsø	HOLGER DANSKE			85	85	85	85	85	85	85							
Kalundborg-Samsø	KALUNDBORG	80	80	80													
Kalundborg-Samsø	KYHOLM									85	85	85	85	85	85	85	85
Kalundborg-Samsø	VESBORG									95							
Kalundborg-Århus	ASK		85	85	85	80	80	80	80	80	80						
Kalundborg-Århus	CAT-LINK I						95	90	90	85							
Kalundborg-Århus	CAT-LINK II						95	90	90	85							
Kalundborg-Århus	CAT-LINK III							95	95	90							
Kalundborg-Århus	CAT-LINK IV									95	95						
Kalundborg-Århus	CAT-LINK V									95	95						
Kalundborg-Århus	KATTEGAT SYD										85						
Kalundborg-Århus	KNUDSHOVED		85														
Kalundborg-Århus	KONG FREDERIK IX		85	85	85	85	85	85									
Kalundborg-Århus	KRAKA									85							
Kalundborg-Århus	MAREN MOLS											85	85	85	85	85	85
Kalundborg-Århus	METTE MOLS											85	85	85	85	85	85
Kalundborg-Århus	NIELS KLIM	85	85														

Kalundborg-Århus	PEDER PAARS	85	85															
Kalundborg-Århus	PRINSESSE ELISABETH		80															
Kalundborg-Århus	ROSTOCK LINK										80							
Kalundborg-Århus	SØLØVEN/SØBJØRNEN		90	90	90	90	90	90										
Kalundborg-Århus	URD		85	85	85	85	85	85	85	80	80							
Korsør-Nyborg, DSB	ASA-THOR	85	85	85	85	85	85	85	85									
Korsør-Nyborg, DSB	DRONNING INGRID	60	60	60	60	60	60	60	60									
Korsør-Nyborg, DSB	DRONNING MARGRETHE II	85	85	85	85	85	85	85	85									
Korsør-Nyborg, DSB	KONG FREDERIK IX	70	70	70	70	70	70	70	70									
Korsør-Nyborg, DSB	KRONPRINS FREDERIK	60	60	60	60	60	60	60	60									
Korsør-Nyborg, DSB	PRINS JOACHIM	60	60	60	60	60	60	60	60									
Korsør-Nyborg, DSB	SPROGØ/KNUDSHOVED	70	70	70	70	70	70	70	70									
Korsør-Nyborg, Vognmandsruten	Superflex Alfa	70	70	70	70	70	70	70	70	70								
Korsør-Nyborg, Vognmandsruten	Superflex Bravo	70	70	70	70	70	70	70	70	70								
Korsør-Nyborg, Vognmandsruten	Superflex Charlie	70	70	70	70	70	70	70	70	70								
København-Rønne	JENS KOFOED	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
København-Rønne	POVL ANKER	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Køge-Rønne	DUEODDE																	69
Køge-Rønne	HAMMERODDE																	69
Køge-Rønne	JENS KOFOED																-	-
Køge-Rønne	POVL ANKER																-	-
Sjællands Odde-Ebeltoft	MAI MOLS							80	80	80	80	80	80	80	80	80	80	80
Sjællands Odde-Ebeltoft	MAREN MOLS	75	75	75	75	75	75	75										
Sjællands Odde-Ebeltoft	MAREN MOLS 2							80	80	80	85							
Sjællands Odde-Ebeltoft	METTE MOLS	75	75	75	75	75	75	75										
Sjællands Odde-Ebeltoft	METTE MOLS 2							80	80	80	85							
Sjællands Odde-Ebeltoft	MIE MOLS	85	85	85	85	85	85	85										
Sjællands Odde-Ebeltoft	MIE MOLS 2							80	80	80	80	80	80	80	80	80	80	80
Sjællands Odde-Århus	MADS MOLS										90	85	85	85	85	85	85	85
Sjællands Odde-Århus	MAI MOLS													75	75	75	75	75
Sjællands Odde-Århus	MAX MOLS										90	85	85	85	85	85	85	85
Sjællands Odde-Århus	MIE MOLS													75	75	75	75	75
Tårs-Spodsbjerg	FRIGG SYDFYEN	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
Tårs-Spodsbjerg	ODIN SYDFYEN	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
Tårs-Spodsbjerg	SPODSBJERG	75	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
Tårs-Spodsbjerg	THOR SYDFYEN	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80

A.1.5 Ferry data: Round trip shares (%)

Ferry service	Ferry name	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Halsskov-Knudshoved	ARVEPRINS KNUD	21.1	20.2	19.7	19.8	20.6	18.6	18.8	17.6	20.0							
Halsskov-Knudshoved	DRONNING MARGRETHE II	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0							
Halsskov-Knudshoved	HEIMDAL	22.5	23.8	22.3	24.3	23.4	21.3	21.1	19.3	21.5							
Halsskov-Knudshoved	KNUDSHOVED	0.0	0.0	0.0	0.0	0.0	0.0	2.4	4.6	0.0							
Halsskov-Knudshoved	KONG FREDERIK IX	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0							
Halsskov-Knudshoved	KRAKA	24.3	25.4	22.7	23.4	21.1	20.4	20.3	19.9	21.0							
Halsskov-Knudshoved	LODBROG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.1	14.0							
Halsskov-Knudshoved	PRINSESSE ANNE-MARIE	0.0	0.0	0.0	0.0	0.0	5.5	2.4	0.0	0.0							
Halsskov-Knudshoved	PRINSESSE ELISABETH	0.0	0.0	0.0	2.5	0.1	0.0	0.0	0.0	0.0							
Halsskov-Knudshoved	ROMSØ	20.6	21.6	20.5	16.2	20.1	19.0	21.1	20.5	22.9							
Halsskov-Knudshoved	SPROGØ	9.1	9.0	14.8	13.8	14.7	14.9	13.9	11.0	0.6							
Hundested-Grenaa	DJURSLAND	100.0	100.0	100.0	100.0	50.0											
Hundested-Grenaa	KATTEGAT						100.0	100.0									
Hundested-Grenaa	KONG FREDERIK IX					5.0											
Hundested-Grenaa	PRINSESSE ANNE-MARIE					45.0											
Kalundborg-Juelsminde	Mercandia I	25.0	25.0	25.0	25.0	25.0	25.0	25.0									
Kalundborg-Juelsminde	Mercandia II	25.0	25.0	25.0	25.0	25.0	25.0	25.0									
Kalundborg-Juelsminde	Mercandia III	25.0	25.0	25.0	25.0	25.0	25.0	25.0									
Kalundborg-Juelsminde	Mercandia IV	25.0	25.0	25.0	25.0	25.0	25.0	25.0									
Kalundborg-Samsø	HOLGER DANSKE			95.0	100.0	100.0	100.0	100.0	100.0	92.0							
Kalundborg-Samsø	KALUNDBORG	100.0	100.0	5.0													
Kalundborg-Samsø	KYHOLM									6.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Kalundborg-Samsø	VESBORG									2.0							
Kalundborg-Århus	ASK		15.8	31.8	26.3	32.8	26.8	18.5	10.7	11.8	2.4						
Kalundborg-Århus	CAT-LINK I						17.2	25.4	27.5	11.4							
Kalundborg-Århus	CAT-LINK II						0.9	22.6	27.5	7.6							
Kalundborg-Århus	CAT-LINK III							8.5	23.6	19.1							
Kalundborg-Århus	CAT-LINK IV									22.9	25.8						
Kalundborg-Århus	CAT-LINK V									15.3	25.8						
Kalundborg-Århus	KATTEGAT SYD										2.4						
Kalundborg-Århus	KNUDSHOVED		4.0														
Kalundborg-Århus	KONG FREDERIK IX		4.0	0.0	6.6	0.0	0.0	1.5									
Kalundborg-Århus	KRAKA									2.4							
Kalundborg-Århus	MAREN MOLS											50.0	50.0	50.0	50.0	50.0	50.0

Kalundborg-Århus	METTE MOLS											50.0	50.0	50.0	50.0	50.0	50.0
Kalundborg-Århus	NIELS KLIM	50.0	19.8														
Kalundborg-Århus	PEDER PAARS	50.0	15.8														
Kalundborg-Århus	PRINSESSE ELISABETH		4.0														
Kalundborg-Århus	ROSTOCK LINK										21.8						
Kalundborg-Århus	SØLØVEN/SØBJØRNEN		20.8	36.4	34.2	34.3	28.2	5.0									
Kalundborg-Århus	URD		15.8	31.8	32.9	32.8	26.8	18.5	10.7	9.5	21.8						
Korsør-Nyborg, DSB	ASA-THOR	12.6	13.4	13.1	11.1	9.3	8.9	9.2	6.3								
Korsør-Nyborg, DSB	DRONNING INGRID	26.2	27.6	25.9	28.3	28.0	28.8	28.2	31.0								
Korsør-Nyborg, DSB	DRONNING MARGRETHE II	3.0	0.0	3.4	0.9	2.8	0.5	2.3	0.0								
Korsør-Nyborg, DSB	KONG FREDERIK IX	0.1	0.0	0.0	0.2	3.4	4.4	0.7	0.0								
Korsør-Nyborg, DSB	KRONPRINS FREDERIK	26.8	28.1	26.9	28.8	28.2	29.3	28.6	31.9								
Korsør-Nyborg, DSB	PRINS JOACHIM	25.2	26.6	25.4	26.9	26.9	27.4	27.1	27.8								
Korsør-Nyborg, DSB	SPROGØ/KNUDSHOVED	6.1	4.3	5.3	3.8	1.4	0.7	3.9	3.0								
Korsør-Nyborg, Vognmandsruten	Superflex Alfa	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0							
Korsør-Nyborg, Vognmandsruten	Superflex Bravo	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0							
Korsør-Nyborg, Vognmandsruten	Superflex Charlie	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0	34.0							
København-Rønne	JENS KOFOED	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
København-Rønne	POVL ANKER	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
Køge-Rønne	DUEODDE																25.0
Køge-Rønne	HAMMERODDE																35.0
Køge-Rønne	JENS KOFOED															50.0	20.0
Køge-Rønne	POVL ANKER															50.0	20.0
Sjællands Odde-Ebeltoft	MAI MOLS							21.0	35.0	35.0	35.0	50.0	50.0	50.0	50.0	50.0	50.0
Sjællands Odde-Ebeltoft	MAREN MOLS	40.0	40.0	40.0	40.0	40.0	40.0	15.0									
Sjællands Odde-Ebeltoft	MAREN MOLS 2							18.0	15.0	15.0	15.0						
Sjællands Odde-Ebeltoft	METTE MOLS	40.0	40.0	40.0	40.0	40.0	40.0	17.0									
Sjællands Odde-Ebeltoft	METTE MOLS 2							15.0	15.0	15.0	15.0						
Sjællands Odde-Ebeltoft	MIE MOLS	20.0	20.0	20.0	20.0	20.0	20.0	5.0									
Sjællands Odde-Ebeltoft	MIE MOLS 2							9.0	35.0	35.0	35.0	50.0	50.0	50.0	50.0	50.0	50.0
Sjællands Odde-Århus	MADS MOLS										50.0	95.0	90.0	95.0	60.0	60.0	35.0
Sjællands Odde-Århus	MAI MOLS													1.0	10.0	15.0	15.0
Sjællands Odde-Århus	MAX MOLS										50.0	5.0	10.0	3.0	20.0	10.0	35.0

Sjællands Odde-Århus	MIE MOLS													1.0	10.0	15.0	15.0
Tårs-Spodsbjerg	FRIGG SYDFYEN	41.0	40.0	39.0	38.0	36.0	36.0	36.0	32.0	33.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
Tårs-Spodsbjerg	ODIN SYDFYEN	41.0	40.0	39.0	38.0	36.0	36.0	36.0	32.0	33.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
Tårs-Spodsbjerg	SPODSBJERG	4.0	2.0	8.0	8.0	9.0	8.0	8.0	19.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Tårs-Spodsbjerg	THOR SYDFYEN	14.0	18.0	14.0	16.0	19.0	20.0	20.0	17.0	14.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Annex 2

A.2.1 Specific fuel consumption and NO_x emission factors (g/kWh) per engine year for diesel ship engines

Year	High speed 4-stroke sfc (g/kWh)	Medium speed 4-stroke sfc (g/kWh)	Slow speed 2-stroke sfc (g/kWh)	High speed 4-stroke NO_X (g/kWh)	Medium speed 4-stroke NO_X (g/kWh)	Slow speed 2-stroke NO_X (g/kWh)
1949	265.5	255.5	235.5	7.3	8.0	14.5
1950	265.0	255.0	235.0	7.3	8.0	14.5
1951	264.5	254.5	234.5	7.3	8.0	14.5
1952	264.0	254.0	234.0	7.3	8.0	14.5
1953	263.5	253.5	233.5	7.3	8.0	14.5
1954	263.0	253.0	233.0	7.3	8.0	14.5
1955	262.4	252.4	232.4	7.3	8.0	14.5
1956	261.9	251.9	231.9	7.4	8.1	14.6
1957	261.3	251.3	231.3	7.5	8.2	14.7
1958	260.7	250.7	230.7	7.6	8.3	14.8
1959	260.1	250.1	230.1	7.7	8.4	14.9
1960	259.5	249.5	229.5	7.8	8.5	15.0
1961	258.9	248.9	228.9	7.9	8.6	15.1
1962	258.2	248.2	228.2	8.0	8.7	15.1
1963	257.6	247.6	227.6	8.1	8.8	15.2
1964	256.9	246.9	226.9	8.2	8.9	15.3
1965	256.1	246.1	226.1	8.3	9.0	15.4
1966	255.4	245.4	225.4	8.3	9.1	15.5
1967	254.6	244.6	224.6	8.4	9.2	15.6
1968	253.8	243.8	223.8	8.5	9.3	15.7
1969	253.0	243.0	223.0	8.6	9.4	15.8
1970	252.1	242.1	222.1	8.7	9.5	15.9
1971	251.2	241.2	221.2	8.8	9.6	16.0
1972	250.3	240.3	220.3	8.9	9.7	16.1
1973	249.3	239.3	219.3	9.0	9.8	16.2
1974	248.3	238.3	218.3	9.1	9.9	16.3
1975	247.3	237.3	217.3	9.2	10.0	16.4
1976	246.2	236.2	216.2	9.3	10.1	16.4
1977	245.0	235.0	215.0	9.3	10.2	16.5

1978	243.8	233.8	213.8	9.4	10.3	16.6
1979	242.6	232.6	212.6	9.5	10.4	16.7
1980	241.3	231.3	211.3	9.6	10.5	16.8
1981	239.9	229.9	209.9	9.7	10.6	16.9
1982	238.5	228.5	208.5	9.8	10.7	17.0
1983	237.0	227.0	207.0	9.9	10.8	17.4
1984	235.5	225.5	205.5	10.0	10.9	17.8
1985	233.9	223.9	203.9	10.1	11.0	18.2
1986	232.2	222.2	202.2	10.2	11.1	18.6
1987	230.5	220.5	200.5	10.3	11.3	19.0
1988	228.6	218.6	198.6	10.5	11.4	19.3
1989	226.7	216.7	196.7	10.6	11.6	19.5
1990	224.8	214.8	194.8	10.7	11.7	19.8
1991	222.7	212.7	192.7	10.9	11.9	20.0
1992	220.5	210.5	190.5	11.0	12.0	19.8
1993	218.3	208.3	188.3	11.1	12.1	19.6
1994	216.0	206.0	186.0	11.3	12.3	19.4
1995	213.6	203.6	183.6	11.4	12.4	19.3
1996	211.0	201.0	181.0	11.5	12.6	19.1
1997	208.4	198.4	178.4	11.7	12.7	18.9
1998	205.7	195.7	175.7	11.8	12.9	18.7
1999	202.9	192.9	172.9	11.9	13.0	18.5
2000	199.9	189.9	169.9	11.0	12.0	16.0

A.2.2 CO, VOC, NMVOC and CH_4 emission factors (g/kg fuel) for ship engines

	High speed 4-stroke CO	Medium speed 4-stroke CO	Slow speed 2-stroke CO	High speed 4-stroke VOC	Medium speed 4-stroke VOC	Slow speed 2-stroke VOC
1949	6.03	6.26	6.79	1.88	1.96	2.12
1950	6.04	6.27	6.81	1.89	1.96	2.13
1951	6.05	6.29	6.82	1.89	1.96	2.13
1952	6.06	6.30	6.84	1.89	1.97	2.14
1953	6.07	6.31	6.85	1.90	1.97	2.14
1954	6.08	6.33	6.87	1.90	1.98	2.15
1955	6.10	6.34	6.88	1.91	1.98	2.15
1956	6.11	6.35	6.90	1.91	1.99	2.16
1957	6.12	6.37	6.92	1.91	1.99	2.16
1958	6.14	6.38	6.93	1.92	1.99	2.17
1959	6.15	6.40	6.95	1.92	2.00	2.17
1960	6.17	6.41	6.97	1.93	2.00	2.18
1961	6.18	6.43	6.99	1.93	2.01	2.18
1962	6.20	6.45	7.01	1.94	2.01	2.19
1963	6.21	6.46	7.03	1.94	2.02	2.20
1964	6.23	6.48	7.05	1.95	2.03	2.20
1965	6.25	6.50	7.08	1.95	2.03	2.21
1966	6.26	6.52	7.10	1.96	2.04	2.22
1967	6.28	6.54	7.12	1.96	2.04	2.23
1968	6.30	6.56	7.15	1.97	2.05	2.23
1969	6.32	6.58	7.17	1.98	2.06	2.24
1970	6.35	6.61	7.20	1.98	2.06	2.25
1971	6.37	6.63	7.23	1.99	2.07	2.26
1972	6.39	6.66	7.26	2.00	2.08	2.27
1973	6.42	6.69	7.29	2.01	2.09	2.28
1974	6.44	6.71	7.33	2.01	2.10	2.29
1975	6.47	6.74	7.36	2.02	2.11	2.30
1976	6.50	6.77	7.40	2.03	2.12	2.31
1977	6.53	6.81	7.44	2.04	2.13	2.33
1978	6.56	6.84	7.48	2.05	2.14	2.34
1979	6.60	6.88	7.53	2.06	2.15	2.35
1980	6.63	6.92	7.57	2.07	2.16	2.37
1981	6.67	6.96	7.62	2.08	2.17	2.38
1982	6.71	7.00	7.67	2.10	2.19	2.40
1983	6.75	7.05	7.73	2.11	2.20	2.42

1984	6.79	7.10	7.79	2.12	2.22	2.43
1985	6.84	7.15	7.85	2.14	2.23	2.45
1986	6.89	7.20	7.91	2.15	2.25	2.47
1987	6.94	7.26	7.98	2.17	2.27	2.49
1988	7.00	7.32	8.05	2.19	2.29	2.52
1989	7.06	7.38	8.13	2.21	2.31	2.54
1990	7.12	7.45	8.22	2.22	2.33	2.57
1991	7.18	7.52	8.30	2.25	2.35	2.59
1992	7.25	7.60	8.40	2.27	2.37	2.62
1993	7.33	7.68	8.50	2.29	2.40	2.66
1994	7.41	7.77	8.60	2.31	2.43	2.69
1995	7.49	7.86	8.72	2.34	2.46	2.72
1996	7.58	7.96	8.84	2.37	2.49	2.76
1997	7.68	8.06	8.97	2.40	2.52	2.80
1998	7.78	8.18	9.11	2.43	2.56	2.85
1999	7.89	8.30	9.26	2.46	2.59	2.89
2000	8.00	8.43	9.42	2.50	2.63	2.94

	High speed 4-stroke NMVOC	Medium speed 4-stroke NMVOC	Slow speed 2-stroke NMVOC	High speed 4-stroke CH_4	Medium speed 4-stroke CH_4	Slow speed 2-stroke CH_4
1949	1.83	1.90	2.06	0.06	0.06	0.06
1950	1.83	1.90	2.06	0.06	0.06	0.06
1951	1.83	1.91	2.07	0.06	0.06	0.06
1952	1.84	1.91	2.07	0.06	0.06	0.06
1953	1.84	1.91	2.08	0.06	0.06	0.06
1954	1.84	1.92	2.08	0.06	0.06	0.06
1955	1.85	1.92	2.09	0.06	0.06	0.06
1956	1.85	1.93	2.09	0.06	0.06	0.06
1957	1.86	1.93	2.10	0.06	0.06	0.06
1958	1.86	1.93	2.10	0.06	0.06	0.07
1959	1.86	1.94	2.11	0.06	0.06	0.07
1960	1.87	1.94	2.11	0.06	0.06	0.07
1961	1.87	1.95	2.12	0.06	0.06	0.07
1962	1.88	1.95	2.13	0.06	0.06	0.07
1963	1.88	1.96	2.13	0.06	0.06	0.07
1964	1.89	1.96	2.14	0.06	0.06	0.07
1965	1.89	1.97	2.14	0.06	0.06	0.07
1966	1.90	1.98	2.15	0.06	0.06	0.07

1967	1.90	1.98	2.16	0.06	0.06	0.07
1968	1.91	1.99	2.17	0.06	0.06	0.07
1969	1.92	2.00	2.17	0.06	0.06	0.07
1970	1.92	2.00	2.18	0.06	0.06	0.07
1971	1.93	2.01	2.19	0.06	0.06	0.07
1972	1.94	2.02	2.20	0.06	0.06	0.07
1973	1.95	2.03	2.21	0.06	0.06	0.07
1974	1.95	2.04	2.22	0.06	0.06	0.07
1975	1.96	2.04	2.23	0.06	0.06	0.07
1976	1.97	2.05	2.24	0.06	0.06	0.07
1977	1.98	2.06	2.26	0.06	0.06	0.07
1978	1.99	2.07	2.27	0.06	0.06	0.07
1979	2.00	2.09	2.28	0.06	0.06	0.07
1980	2.01	2.10	2.30	0.06	0.06	0.07
1981	2.02	2.11	2.31	0.06	0.07	0.07
1982	2.03	2.12	2.33	0.06	0.07	0.07
1983	2.05	2.14	2.34	0.06	0.07	0.07
1984	2.06	2.15	2.36	0.06	0.07	0.07
1985	2.07	2.17	2.38	0.06	0.07	0.07
1986	2.09	2.18	2.40	0.06	0.07	0.07
1987	2.10	2.20	2.42	0.07	0.07	0.07
1988	2.12	2.22	2.44	0.07	0.07	0.08
1989	2.14	2.24	2.47	0.07	0.07	0.08
1990	2.16	2.26	2.49	0.07	0.07	0.08
1991	2.18	2.28	2.52	0.07	0.07	0.08
1992	2.20	2.30	2.55	0.07	0.07	0.08
1993	2.22	2.33	2.58	0.07	0.07	0.08
1994	2.25	2.35	2.61	0.07	0.07	0.08
1995	2.27	2.38	2.64	0.07	0.07	0.08
1996	2.30	2.41	2.68	0.07	0.07	0.08
1997	2.33	2.44	2.72	0.07	0.08	0.08
1998	2.36	2.48	2.76	0.07	0.08	0.09
1999	2.39	2.51	2.81	0.07	0.08	0.09
2000	2.43	2.55	2.85	0.08	0.08	0.09

A.2.3 S-%, SO_2 and PM emission factors (g/kg fuel and g/GJ) per fuel type for diesel ship engines

FuelType	Year	Category	S [%]	SO_2 [g/kg]	TSP [g/kg]	PM_{10} [g/kg]	$PM_{2.5}$ [g/kg]
Heavy fuel	1990	National sea	2.64	52.8	6.10	6.04	6.01
Heavy fuel	1991	National sea	2.35	47.0	4.92	4.87	4.84
Heavy fuel	1992	National sea	1.8	36.0	3.26	3.23	3.22
Heavy fuel	1993	National sea	2.39	47.8	5.07	5.02	4.99
Heavy fuel	1994	National sea	2.62	52.4	6.01	5.95	5.92
Heavy fuel	1995	National sea	2.95	59.0	7.69	7.61	7.57
Heavy fuel	1996	National sea	2.57	51.4	5.79	5.74	5.71
Heavy fuel	1997	National sea	2.74	54.8	6.58	6.51	6.48
Heavy fuel	1998	National sea	1.97	39.4	3.71	3.67	3.65
Heavy fuel	1999	National sea	1.97	39.4	3.71	3.67	3.65
Heavy fuel	2000	National sea	1.81	36.2	3.29	3.26	3.24
Heavy fuel	2001	National sea	1.7	34.0	3.03	3.00	2.98
Heavy fuel	2002	National sea	1.51	30.2	2.63	2.60	2.59
Heavy fuel	2003	National sea	1.62	32.4	2.86	2.83	2.81
Heavy fuel	2004	National sea	1.98	39.6	3.73	3.70	3.68
Heavy fuel	2005	National sea	2	40.0	3.79	3.75	3.73
Heavy fuel	2006	National sea	2	40.0	3.79	3.75	3.73
Heavy fuel	2007	National sea	1.25	25.0	2.17	2.15	2.13
Heavy fuel	2008	National sea	1.25	25.0	2.17	2.15	2.13
Heavy fuel	1990	International sea	2.96	59.2	7.75	7.67	7.63
Heavy fuel	1991	International sea	2.89	57.8	7.35	7.28	7.24
Heavy fuel	1992	International sea	2.88	57.6	7.30	7.23	7.19
Heavy fuel	1993	International sea	3.2	64.0	9.26	9.17	9.13
Heavy fuel	1994	International sea	3.03	60.6	8.16	8.08	8.04
Heavy fuel	1995	International sea	3.3	66.0	9.98	9.88	9.83
Heavy fuel	1996	International sea	3.42	68.4	10.91	10.81	10.75
Heavy fuel	1997	International sea	3.45	69.0	11.16	11.05	10.99
Heavy fuel	1998	International sea	3.42	68.4	10.91	10.81	10.75
Heavy fuel	1999	International sea	3.45	69.0	11.16	11.05	10.99
Heavy fuel	2000	International sea	3.36	67.2	10.44	10.33	10.28
Heavy fuel	2001	International sea	3.42	68.4	10.91	10.81	10.75
Heavy fuel	2002	International sea	3.44	68.8	11.08	10.97	10.91
Heavy fuel	2003	International sea	3.11	62.2	8.66	8.58	8.53
Heavy fuel	2004	International sea	3.2	64.0	9.26	9.17	9.13
Heavy fuel	2005	International sea	3.5	70.0	11.58	11.47	11.41

Heavy fuel	2006	International sea	3.5	70.0	11.58	11.47	11.41
Heavy fuel	2007	International sea	1.5	30.0	2.61	2.58	2.57
Heavy fuel	2008	International sea	1.5	30.0	2.61	2.58	2.57
Gas oil	1990	-	0.2	4.0	0.99	0.98	0.98
Gas oil	1991	-	0.2	4.0	0.99	0.98	0.98
Gas oil	1992	-	0.2	4.0	0.99	0.98	0.98
Gas oil	1993	-	0.2	4.0	0.99	0.98	0.98
Gas oil	1994	-	0.2	4.0	0.99	0.98	0.98
Gas oil	1995	-	0.2	4.0	0.99	0.98	0.98
Gas oil	1996	-	0.2	4.0	0.99	0.98	0.98
Gas oil	1997	-	0.2	4.0	0.99	0.98	0.98
Gas oil	1998	-	0.2	4.0	0.99	0.98	0.98
Gas oil	1999	-	0.2	4.0	0.99	0.98	0.98
Gas oil	2000	-	0.2	4.0	0.99	0.98	0.98
Gas oil	2001	-	0.2	4.0	0.99	0.98	0.98
Gas oil	2002	-	0.2	4.0	0.99	0.98	0.98
Gas oil	2003	-	0.2	4.0	0.99	0.98	0.98
Gas oil	2004	-	0.2	4.0	0.99	0.98	0.98
Gas oil	2005	-	0.2	4.0	0.99	0.98	0.98
Gas oil	2006	-	0.2	4.0	0.99	0.98	0.98
Gas oil	2007	-	0.2	4.0	0.99	0.98	0.98
Gas oil	2008	-	0.1	2.0	0.92	0.91	0.91

FuelType	Year	Category	S [%]	SO_2 [g/GJ]	TSP [g/GJ]	PM_{10} [g/GJ]	$PM_{2.5}$ [g/GJ]
Heavy fuel	1990	National sea	2.64	1.291	0.149	0.148	0.147
Heavy fuel	1991	National sea	2.35	1.149	0.120	0.119	0.118
Heavy fuel	1992	National sea	1.8	0.880	0.080	0.079	0.079
Heavy fuel	1993	National sea	2.39	1.169	0.124	0.123	0.122
Heavy fuel	1994	National sea	2.62	1.281	0.147	0.146	0.145
Heavy fuel	1995	National sea	2.95	1.443	0.188	0.186	0.185
Heavy fuel	1996	National sea	2.57	1.257	0.142	0.140	0.140
Heavy fuel	1997	National sea	2.74	1.340	0.161	0.159	0.158
Heavy fuel	1998	National sea	1.97	0.963	0.091	0.090	0.089
Heavy fuel	1999	National sea	1.97	0.963	0.091	0.090	0.089
Heavy fuel	2000	National sea	1.81	0.885	0.080	0.080	0.079
Heavy fuel	2001	National sea	1.7	0.831	0.074	0.073	0.073
Heavy fuel	2002	National sea	1.51	0.738	0.064	0.064	0.063
Heavy fuel	2003	National sea	1.62	0.792	0.070	0.069	0.069

Heavy fuel	2004	National sea	1.98	0.968	0.091	0.090	0.090
Heavy fuel	2005	National sea	2	0.978	0.093	0.092	0.091
Heavy fuel	2006	National sea	2	0.978	0.093	0.092	0.091
Heavy fuel	2007	National sea	1.25	0.611	0.053	0.052	0.052
Heavy fuel	2008	National sea	1.25	0.611	0.053	0.052	0.052
Heavy fuel	1990	International sea	2.96	1.447	0.189	0.188	0.187
Heavy fuel	1991	International sea	2.89	1.413	0.180	0.178	0.177
Heavy fuel	1992	International sea	2.88	1.408	0.178	0.177	0.176
Heavy fuel	1993	International sea	3.2	1.565	0.227	0.224	0.223
Heavy fuel	1994	International sea	3.03	1.482	0.200	0.198	0.197
Heavy fuel	1995	International sea	3.3	1.614	0.244	0.242	0.240
Heavy fuel	1996	International sea	3.42	1.672	0.267	0.264	0.263
Heavy fuel	1997	International sea	3.45	1.687	0.273	0.270	0.269
Heavy fuel	1998	International sea	3.42	1.672	0.267	0.264	0.263
Heavy fuel	1999	International sea	3.45	1.687	0.273	0.270	0.269
Heavy fuel	2000	International sea	3.36	1.643	0.255	0.253	0.251
Heavy fuel	2001	International sea	3.42	1.672	0.267	0.264	0.263
Heavy fuel	2002	International sea	3.44	1.682	0.271	0.268	0.267
Heavy fuel	2003	International sea	3.11	1.521	0.212	0.210	0.209
Heavy fuel	2004	International sea	3.2	1.565	0.227	0.224	0.223
Heavy fuel	2005	International sea	3.5	1.711	0.283	0.280	0.279
Heavy fuel	2006	International sea	3.5	1.711	0.283	0.280	0.279
Heavy fuel	2007	International sea	1.5	0.733	0.061	0.061	0.060
Heavy fuel	2008	International sea	1.5	0.733	0.061	0.061	0.060
Gas oil	1990	-	0.2	0.094	0.023	0.023	0.023
Gas oil	1991	-	0.2	0.094	0.023	0.023	0.023
Gas oil	1992	-	0.2	0.094	0.023	0.023	0.023
Gas oil	1993	-	0.2	0.094	0.023	0.023	0.023
Gas oil	1994	-	0.2	0.094	0.023	0.023	0.023
Gas oil	1995	-	0.2	0.094	0.023	0.023	0.023
Gas oil	1996	-	0.2	0.094	0.023	0.023	0.023
Gas oil	1997	-	0.2	0.094	0.023	0.023	0.023
Gas oil	1998	-	0.2	0.094	0.023	0.023	0.023
Gas oil	1999	-	0.2	0.094	0.023	0.023	0.023
Gas oil	2000	-	0.2	0.094	0.023	0.023	0.023
Gas oil	2001	-	0.2	0.094	0.023	0.023	0.023
Gas oil	2002	-	0.2	0.094	0.023	0.023	0.023
Gas oil	2003	-	0.2	0.094	0.023	0.023	0.023
Gas oil	2004	-	0.2	0.094	0.023	0.023	0.023

Gas oil	2005	-	0.2	0.094	0.023	0.023	0.023
Gas oil	2006	-	0.2	0.094	0.023	0.023	0.023
Gas oil	2007	-	0.2	0.094	0.023	0.023	0.023
Gas oil	2008	-	0.1	0.047	0.022	0.021	0.021

A.2.4 Total fuel use, emission factors (g/GJ) in CollectER format from 1990-2030 for national sea transport, fisheries and international sea transport

		Year	Fuel use (GJ)	SO_2 (g/GJ)	NO_X (g/GJ)	NMVOC (g/GJ)	CH_4 (g/GJ)	CO (g/GJ)	CO_2 (kg/GJ)	N_2O (g/GJ)	NH_3 (g/GJ)	TSP (g/GJ)	PM_{10} (g/GJ)	$PM_{2,5}$ (g/GJ)	VOC (g/GJ)
National sea	Heavy fuel	1990	3842534	1291.0	1601.2	53.3	1.6	175.9	78.0	4.9	0.0	149.2	147.8	147.0	55.0
National sea	Heavy fuel	1991	3196891	1149.1	1491.9	53.0	1.6	174.7	78.0	4.9	0.0	120.2	119.0	118.4	54.6
National sea	Heavy fuel	1992	2472744	880.2	1358.5	52.6	1.6	173.6	78.0	4.9	0.0	79.8	79.0	78.6	54.3
National sea	Heavy fuel	1993	2472581	1168.7	1373.4	52.7	1.6	173.9	78.0	4.9	0.0	123.9	122.6	122.0	54.3
National sea	Heavy fuel	1994	2633076	1281.2	1373.1	52.8	1.6	174.0	78.0	4.9	0.0	147.0	145.6	144.8	54.4
National sea	Heavy fuel	1995	2653093	1442.5	1365.1	52.8	1.6	174.1	78.0	4.9	0.0	188.0	186.1	185.2	54.4
National sea	Heavy fuel	1996	2097250	1256.7	1454.4	53.2	1.6	175.4	78.0	4.9	0.0	141.7	140.2	139.5	54.8
National sea	Heavy fuel	1997	1323556	1339.9	1589.5	53.9	1.7	177.7	78.0	4.9	0.0	160.8	159.2	158.4	55.5
National sea	Heavy fuel	1998	861734	963.3	1550.7	54.0	1.7	178.3	78.0	4.9	0.0	90.6	89.7	89.2	55.7
National sea	Heavy fuel	1999	725857	963.3	1507.2	54.1	1.7	178.6	78.0	4.9	0.0	90.6	89.7	89.2	55.8
National sea	Heavy fuel	2000	715011	885.1	1523.1	54.4	1.7	179.6	78.0	4.9	0.0	80.4	79.6	79.2	56.1
National sea	Heavy fuel	2001	670906	831.3	1561.5	54.9	1.7	181.2	78.0	4.9	0.0	74.1	73.4	73.0	56.6
National sea	Heavy fuel	2002	658614	738.4	1580.3	55.3	1.7	182.3	78.0	4.9	0.0	64.3	63.7	63.3	57.0
National sea	Heavy fuel	2003	647046	792.2	1599.0	55.6	1.7	183.4	78.0	4.9	0.0	69.8	69.1	68.8	57.3
National sea	Heavy fuel	2004	672619	968.2	1589.2	55.7	1.7	183.7	78.0	4.9	0.0	91.3	90.4	89.9	57.4
National sea	Heavy fuel	2005	679330	978.0	1720.8	59.1	1.8	195.1	78.0	4.9	0.0	92.6	91.7	91.3	61.0
National sea	Heavy fuel	2006	679330	978.0	1729.7	59.4	1.8	195.9	78.0	4.9	0.0	92.6	91.7	91.3	61.2
National sea	Heavy fuel	2007	679330	611.2	1738.2	59.6	1.8	196.7	78.0	4.9	0.0	53.0	52.5	52.2	61.5
National sea	Heavy fuel	2008	679330	611.2	1746.4	59.9	1.9	197.5	78.0	4.9	0.0	53.0	52.5	52.2	61.7
National sea	Heavy fuel	2009	655891	611.2	1849.7	62.3	1.9	205.4	78.0	4.9	0.0	53.0	52.5	52.2	64.2
National sea	Heavy fuel	2010	655891	611.2	1857.5	62.5	1.9	206.3	78.0	4.9	0.0	53.0	52.5	52.2	64.5
National sea	Heavy fuel	2011	655891	611.2	1864.9	62.8	1.9	207.1	78.0	4.9	0.0	53.0	52.5	52.2	64.7
National sea	Heavy fuel	2012	655891	611.2	1871.9	63.0	1.9	207.8	78.0	4.9	0.0	53.0	52.5	52.2	65.0
National sea	Heavy fuel	2013	655891	611.2	1877.9	63.2	2.0	208.6	78.0	4.9	0.0	53.0	52.5	52.2	65.2
National sea	Heavy fuel	2014	655891	611.2	1882.8	63.5	2.0	209.4	78.0	4.9	0.0	53.0	52.5	52.2	65.4
National sea	Heavy fuel	2015	655891	611.2	1886.6	63.7	2.0	210.1	78.0	4.9	0.0	53.0	52.5	52.2	65.6
National sea	Heavy fuel	2016	655891	611.2	1889.3	63.9	2.0	210.8	78.0	4.9	0.0	53.0	52.5	52.2	65.9
National sea	Heavy fuel	2017	655891	611.2	1890.8	64.1	2.0	211.4	78.0	4.9	0.0	53.0	52.5	52.2	66.1
National sea	Heavy fuel	2018	655891	611.2	1891.3	64.3	2.0	212.1	78.0	4.9	0.0	53.0	52.5	52.2	66.3

National sea	Heavy fuel	2019	655891	611.2	1890.8	64.5	2.0	212.7	78.0	4.9	0.0	53.0	52.5	52.2	66.5
National sea	Heavy fuel	2020	655891	611.2	1889.3	64.6	2.0	213.2	78.0	4.9	0.0	53.0	52.5	52.2	66.6
National sea	Heavy fuel	2021	655891	611.2	1886.8	64.8	2.0	213.7	78.0	4.9	0.0	53.0	52.5	52.2	66.8
National sea	Heavy fuel	2022	655891	611.2	1884.0	64.9	2.0	214.2	78.0	4.9	0.0	53.0	52.5	52.2	66.9
National sea	Heavy fuel	2023	655891	611.2	1881.0	65.1	2.0	214.6	78.0	4.9	0.0	53.0	52.5	52.2	67.1
National sea	Heavy fuel	2024	655891	611.2	1877.8	65.2	2.0	215.0	78.0	4.9	0.0	53.0	52.5	52.2	67.2
National sea	Heavy fuel	2025	655891	611.2	1874.2	65.3	2.0	215.3	78.0	4.9	0.0	53.0	52.5	52.2	67.3
National sea	Heavy fuel	2026	655891	611.2	1870.4	65.3	2.0	215.6	78.0	4.9	0.0	53.0	52.5	52.2	67.4
National sea	Heavy fuel	2027	655891	611.2	1866.2	65.4	2.0	215.8	78.0	4.9	0.0	53.0	52.5	52.2	67.4
National sea	Heavy fuel	2028	655891	611.2	1861.7	65.4	2.0	215.9	78.0	4.9	0.0	53.0	52.5	52.2	67.5
National sea	Heavy fuel	2029	655891	611.2	1856.8	65.5	2.0	216.0	78.0	4.9	0.0	53.0	52.5	52.2	67.5
National sea	Heavy fuel	2030	655891	611.2	1856.8	65.5	2.0	216.0	78.0	4.9	0.0	53.0	52.5	52.2	67.5
National sea	Gas oil	1990	4942218	93.7	1100.3	50.7	1.6	167.2	74.0	4.7	0.0	23.2	23.0	22.9	52.2
National sea	Gas oil	1991	5574515	93.7	1112.2	51.0	1.6	168.1	74.0	4.7	0.0	23.2	23.0	22.9	52.5
National sea	Gas oil	1992	6472418	93.7	1119.4	51.2	1.6	168.9	74.0	4.7	0.0	23.2	23.0	22.9	52.8
National sea	Gas oil	1993	6285474	93.7	1123.1	51.3	1.6	169.1	74.0	4.7	0.0	23.2	23.0	22.9	52.8
National sea	Gas oil	1994	6238037	93.7	1129.9	51.4	1.6	169.5	74.0	4.7	0.0	23.2	23.0	22.9	53.0
National sea	Gas oil	1995	6654768	93.7	1151.7	51.8	1.6	171.0	74.0	4.7	0.0	23.2	23.0	22.9	53.4
National sea	Gas oil	1996	8146737	93.7	1197.6	51.6	1.6	163.7	74.0	4.7	0.0	23.2	23.0	22.9	53.2
National sea	Gas oil	1997	8532482	93.7	1124.0	49.4	1.5	142.1	74.0	4.7	0.0	23.2	23.0	22.9	50.9
National sea	Gas oil	1998	6904369	93.7	1143.7	49.2	1.5	137.6	74.0	4.7	0.0	23.2	23.0	22.9	50.7
National sea	Gas oil	1999	5419166	93.7	1147.6	48.4	1.5	129.0	74.0	4.7	0.0	23.2	23.0	22.9	49.9
National sea	Gas oil	2000	4371006	93.7	1227.4	48.6	1.5	126.6	74.0	4.7	0.0	23.2	23.0	22.9	50.1
National sea	Gas oil	2001	4172824	93.7	1257.0	49.3	1.5	131.2	74.0	4.7	0.0	23.2	23.0	22.9	50.8
National sea	Gas oil	2002	4082724	93.7	1322.6	50.4	1.6	138.5	74.0	4.7	0.0	23.2	23.0	22.9	51.9
National sea	Gas oil	2003	4081473	93.7	1284.1	50.0	1.5	135.8	74.0	4.7	0.0	23.2	23.0	22.9	51.5
National sea	Gas oil	2004	4182126	93.7	1266.8	49.8	1.5	134.1	74.0	4.7	0.0	23.2	23.0	22.9	51.3
National sea	Gas oil	2005	4135076	93.7	1270.0	49.9	1.5	134.4	74.0	4.7	0.0	23.2	23.0	22.9	51.4
National sea	Gas oil	2006	4131029	93.7	1276.5	50.0	1.5	134.9	74.0	4.7	0.0	23.2	23.0	22.9	51.6
National sea	Gas oil	2007	4131029	93.7	1280.0	50.1	1.5	135.2	74.0	4.7	0.0	23.2	23.0	22.9	51.7
National sea	Gas oil	2008	4131029	46.8	1283.3	50.2	1.6	135.5	74.0	4.7	0.0	21.5	21.3	21.2	51.8
National sea	Gas oil	2009	4131029	46.8	1286.4	50.3	1.6	135.8	74.0	4.7	0.0	21.5	21.3	21.2	51.9
National sea	Gas oil	2010	4131029	46.8	1289.2	50.4	1.6	136.1	74.0	4.7	0.0	21.5	21.3	21.2	52.0
National sea	Gas oil	2011	4131029	46.8	1291.8	50.5	1.6	136.4	74.0	4.7	0.0	21.5	21.3	21.2	52.0
National sea	Gas oil	2012	4124350	46.8	1297.8	50.6	1.6	136.9	74.0	4.7	0.0	21.5	21.3	21.2	52.2
National sea	Gas oil	2013	4124350	46.8	1299.8	50.7	1.6	137.1	74.0	4.7	0.0	21.5	21.3	21.2	52.3
National sea	Gas oil	2014	4117189	46.8	1305.2	50.9	1.6	137.6	74.0	4.7	0.0	21.5	21.3	21.2	52.4

National sea	Gas oil	2015	4117189	46.8	1306.6	50.9	1.6	137.8	74.0	4.7	0.0	21.5	21.3	21.2	52.5
National sea	Gas oil	2016	4117189	46.8	1307.5	51.0	1.6	138.0	74.0	4.7	0.0	21.5	21.3	21.2	52.6
National sea	Gas oil	2017	4117189	46.8	1308.1	51.0	1.6	138.1	74.0	4.7	0.0	21.5	21.3	21.2	52.6
National sea	Gas oil	2018	4117189	46.8	1308.3	51.1	1.6	138.3	74.0	4.7	0.0	21.5	21.3	21.2	52.7
National sea	Gas oil	2019	4117189	46.8	1308.1	51.1	1.6	138.4	74.0	4.7	0.0	21.5	21.3	21.2	52.7
National sea	Gas oil	2020	4117189	46.8	1308.5	51.1	1.6	138.4	74.0	4.7	0.0	21.5	21.3	21.2	52.7
National sea	Gas oil	2021	4117189	46.8	1308.7	51.2	1.6	138.5	74.0	4.7	0.0	21.5	21.3	21.2	52.7
National sea	Gas oil	2022	4117189	46.8	1308.9	51.2	1.6	138.6	74.0	4.7	0.0	21.5	21.3	21.2	52.8
National sea	Gas oil	2023	4117189	46.8	1309.0	51.2	1.6	138.7	74.0	4.7	0.0	21.5	21.3	21.2	52.8
National sea	Gas oil	2024	4117189	46.8	1309.0	51.2	1.6	138.7	74.0	4.7	0.0	21.5	21.3	21.2	52.8
National sea	Gas oil	2025	4117189	46.8	1308.9	51.2	1.6	138.8	74.0	4.7	0.0	21.5	21.3	21.2	52.8
National sea	Gas oil	2026	4074118	46.8	1247.5	51.8	1.6	140.3	74.0	4.7	0.0	21.5	21.3	21.2	53.4
National sea	Gas oil	2027	4074118	46.8	1247.2	51.8	1.6	140.3	74.0	4.7	0.0	21.5	21.3	21.2	53.4
National sea	Gas oil	2028	4053439	46.8	1231.2	52.1	1.6	141.0	74.0	4.7	0.0	21.5	21.3	21.2	53.7
National sea	Gas oil	2029	4053439	46.8	1230.7	52.1	1.6	141.0	74.0	4.7	0.0	21.5	21.3	21.2	53.7
National sea	Gas oil	2030	4053439	46.8	1230.7	52.1	1.6	141.0	74.0	4.7	0.0	21.5	21.3	21.2	53.7
National sea	Kerosene	1990	452	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
National sea	Kerosene	1991	2018	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
National sea	Kerosene	1992	905	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
National sea	Kerosene	1993	835	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
National sea	Kerosene	1994	1044	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
National sea	Kerosene	1995	766	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
National sea	Kerosene	1996	592	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
National sea	Kerosene	1997	278	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
National sea	Kerosene	1998	1148	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
National sea	Kerosene	1999	383	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
National sea	Kerosene	2000	626	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
National sea	Kerosene	2001	522	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
National sea	Kerosene	2002	696	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
National sea	Kerosene	2003	1079	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
National sea	Kerosene	2004	940	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
National sea	Kerosene	2005	696	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
National sea	LPG	1990	1794	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
National sea	LPG	1991	1702	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
National sea	LPG	1992	3128	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
National sea	LPG	1993	15732	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
National sea	LPG	1994	1426	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2

National sea	LPG	1995	2300	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
National sea	LPG	1996	1150	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
National sea	LPG	1997	1518	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
National sea	LPG	1998	2714	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
National sea	LPG	1999	782	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
National sea	LPG	2000	138	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
National sea	LPG	2003	230	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
National sea	LPG	2004	46	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
National sea	LPG	2005	92	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	Gas oil	1990	7919928	93.7	1052.1	49.1	1.5	162.1	74.0	4.7	0.0	23.2	23.0	22.9	50.6
Fisheries	Gas oil	1991	8169757	93.7	1070.9	49.5	1.5	163.2	74.0	4.7	0.0	23.2	23.0	22.9	51.0
Fisheries	Gas oil	1992	7481823	93.7	1090.7	49.8	1.5	164.4	74.0	4.7	0.0	23.2	23.0	22.9	51.4
Fisheries	Gas oil	1993	7074539	93.7	1111.3	50.2	1.6	165.6	74.0	4.7	0.0	23.2	23.0	22.9	51.8
Fisheries	Gas oil	1994	7097389	93.7	1133.0	50.6	1.6	166.9	74.0	4.7	0.0	23.2	23.0	22.9	52.2
Fisheries	Gas oil	1995	7133947	93.7	1155.7	51.0	1.6	168.3	74.0	4.7	0.0	23.2	23.0	22.9	52.6
Fisheries	Gas oil	1996	6786716	93.7	1179.3	51.5	1.6	169.8	74.0	4.7	0.0	23.2	23.0	22.9	53.1
Fisheries	Gas oil	1997	5487245	93.7	1203.9	51.9	1.6	171.4	74.0	4.7	0.0	23.2	23.0	22.9	53.5
Fisheries	Gas oil	1998	5719371	93.7	1229.6	52.4	1.6	173.0	74.0	4.7	0.0	23.2	23.0	22.9	54.1
Fisheries	Gas oil	1999	6546047	93.7	1256.3	53.0	1.6	174.8	74.0	4.7	0.0	23.2	23.0	22.9	54.6
Fisheries	Gas oil	2000	7565922	93.7	1275.4	53.5	1.7	176.7	74.0	4.7	0.0	23.2	23.0	22.9	55.2
Fisheries	Gas oil	2001	7144690	93.7	1293.0	54.1	1.7	178.5	74.0	4.7	0.0	23.2	23.0	22.9	55.8
Fisheries	Gas oil	2002	7699138	93.7	1309.1	54.6	1.7	180.2	74.0	4.7	0.0	23.2	23.0	22.9	56.3
Fisheries	Gas oil	2003	7230276	93.7	1323.5	55.1	1.7	181.8	74.0	4.7	0.0	23.2	23.0	22.9	56.8
Fisheries	Gas oil	2004	5616370	93.7	1336.1	55.6	1.7	183.3	74.0	4.7	0.0	23.2	23.0	22.9	57.3
Fisheries	Gas oil	2005	6561340	93.7	1346.8	56.0	1.7	184.7	74.0	4.7	0.0	23.2	23.0	22.9	57.7
Fisheries	Gas oil	2006	7114575	93.7	1355.4	56.4	1.7	185.9	74.0	4.7	0.0	23.2	23.0	22.9	58.1
Fisheries	Gas oil	2007	7048753	93.7	1361.8	56.7	1.8	187.0	74.0	4.7	0.0	23.2	23.0	22.9	58.4
Fisheries	Gas oil	2008	6960601	46.8	1366.0	57.0	1.8	188.0	74.0	4.7	0.0	21.5	21.3	21.2	58.7
Fisheries	Gas oil	2009	6849576	46.8	1367.7	57.2	1.8	188.8	74.0	4.7	0.0	21.5	21.3	21.2	59.0
Fisheries	Gas oil	2010	6705315	46.8	1373.1	57.4	1.8	189.4	74.0	4.7	0.0	21.5	21.3	21.2	59.2
Fisheries	Gas oil	2011	6704926	46.8	1377.8	57.6	1.8	189.9	74.0	4.7	0.0	21.5	21.3	21.2	59.3
Fisheries	Gas oil	2012	6711523	46.8	1381.7	57.7	1.8	190.4	74.0	4.7	0.0	21.5	21.3	21.2	59.5
Fisheries	Gas oil	2013	6712353	46.8	1384.8	57.9	1.8	190.9	74.0	4.7	0.0	21.5	21.3	21.2	59.7
Fisheries	Gas oil	2014	6719186	46.8	1387.1	58.0	1.8	191.3	74.0	4.7	0.0	21.5	21.3	21.2	59.8
Fisheries	Gas oil	2015	6719200	46.8	1388.4	58.1	1.8	191.6	74.0	4.7	0.0	21.5	21.3	21.2	59.9
Fisheries	Gas oil	2016	6718613	46.8	1388.8	58.2	1.8	191.9	74.0	4.7	0.0	21.5	21.3	21.2	60.0
Fisheries	Gas oil	2017	6719276	46.8	1388.3	58.2	1.8	192.2	74.0	4.7	0.0	21.5	21.3	21.2	60.0

Fisheries	Gas oil	2018	6718649	46.8	1386.8	58.3	1.8	192.3	74.0	4.7	0.0	21.5	21.3	21.2	60.1
Fisheries	Gas oil	2019	6717823	46.8	1384.3	58.3	1.8	192.4	74.0	4.7	0.0	21.5	21.3	21.2	60.1
Fisheries	Gas oil	2020	6718414	46.8	1384.3	58.3	1.8	192.4	74.0	4.7	0.0	21.5	21.3	21.2	60.1
Fisheries	Gas oil	2021	6718374	46.8	1384.3	58.3	1.8	192.4	74.0	4.7	0.0	21.5	21.3	21.2	60.1
Fisheries	Gas oil	2022	6717970	46.8	1384.3	58.3	1.8	192.4	74.0	4.7	0.0	21.5	21.3	21.2	60.1
Fisheries	Gas oil	2023	6718284	46.8	1384.3	58.3	1.8	192.4	74.0	4.7	0.0	21.5	21.3	21.2	60.1
Fisheries	Gas oil	2024	6716491	46.8	1384.3	58.3	1.8	192.4	74.0	4.7	0.0	21.5	21.3	21.2	60.1
Fisheries	Gas oil	2025	6717254	46.8	1384.3	58.3	1.8	192.4	74.0	4.7	0.0	21.5	21.3	21.2	60.1
Fisheries	Gas oil	2026	6759485	46.8	1384.3	58.3	1.8	192.4	74.0	4.7	0.0	21.5	21.3	21.2	60.1
Fisheries	Gas oil	2027	6758523	46.8	1384.3	58.3	1.8	192.4	74.0	4.7	0.0	21.5	21.3	21.2	60.1
Fisheries	Gas oil	2028	6779159	46.8	1384.3	58.3	1.8	192.4	74.0	4.7	0.0	21.5	21.3	21.2	60.1
Fisheries	Gas oil	2029	6777845	46.8	1384.3	58.3	1.8	192.4	74.0	4.7	0.0	21.5	21.3	21.2	60.1
Fisheries	Gas oil	2030	6777524	46.8	1384.3	58.3	1.8	192.4	74.0	4.7	0.0	21.5	21.3	21.2	60.1
Fisheries	Kerosene	1990	25787	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	1991	8735	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	1992	5429	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	1993	4037	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	1994	3445	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	1995	3619	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	1996	3410	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	1997	2993	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	1998	1984	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	1999	487	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	2000	24708	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	2001	1496	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	2002	592	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	2003	731	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	2004	974	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	2005	592	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	2006	5603	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	2007	5603	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	2008	5603	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	2009	5603	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	2010	5603	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	2011	5603	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	2012	5603	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	2013	5603	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0

Fisheries	Kerosene	2014	5603	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	2015	5603	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	2016	5603	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	2017	5603	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	2018	5603	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	2019	5603	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	2020	5603	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	2021	5603	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	2022	5603	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	2023	5603	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	2024	5603	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	2025	5603	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	2026	5603	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	2027	5603	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	2028	5603	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	2029	5603	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	Kerosene	2030	5603	2.3	50.0	3.0	7.0	20.0	72.0	0.0	0.0	5.0	5.0	5.0	10.0
Fisheries	LPG	1990	42320	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	1991	33856	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	1992	29762	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	1993	11684	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	1994	17664	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	1995	15686	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	1996	36064	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	1997	5106	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	1998	1196	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	1999	16054	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	2000	12742	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	2001	19182	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	2002	20976	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	2003	20332	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	2004	18400	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	2005	20378	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	2006	17857	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	2007	17857	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	2008	17857	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	2009	17857	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2

Fisheries	LPG	2010	17857	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	2011	17857	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	2012	17857	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	2013	17857	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	2014	17857	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	2015	17857	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	2016	17857	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	2017	17857	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	2018	17857	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	2019	17857	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	2020	17857	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	2021	17857	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	2022	17857	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	2023	17857	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	2024	17857	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	2025	17857	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	2026	17857	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	2027	17857	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	2028	17857	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	2029	17857	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Fisheries	LPG	2030	17857	0.0	1249.0	384.9	20.3	443.0	65.0	0.0	0.0	0.2	0.2	0.2	405.2
Internat. sea	Heavy fuel	1990	28543368	1447.4	1689.6	54.0	1.7	178.1	78.0	4.9	0.0	189.4	187.5	186.6	55.7
Internat. sea	Heavy fuel	1991	23470461	1413.2	1715.9	54.3	1.7	179.1	78.0	4.9	0.0	179.8	178.0	177.1	56.0
Internat. sea	Heavy fuel	1992	20997536	1408.3	1742.3	54.6	1.7	180.1	78.0	4.9	0.0	178.5	176.7	175.8	56.3
Internat. sea	Heavy fuel	1993	36987856	1564.8	1768.5	54.9	1.7	181.2	78.0	4.9	0.0	226.5	224.2	223.1	56.6
Internat. sea	Heavy fuel	1994	39024461	1481.7	1794.8	55.3	1.7	182.4	78.0	4.9	0.0	199.6	197.6	196.6	57.0
Internat. sea	Heavy fuel	1995	39508736	1613.7	1821.2	55.6	1.7	183.6	78.0	4.9	0.0	244.0	241.6	240.4	57.4
Internat. sea	Heavy fuel	1996	35739077	1672.4	1847.6	56.0	1.7	184.9	78.0	4.9	0.0	266.9	264.2	262.9	57.8
Internat. sea	Heavy fuel	1997	32426790	1687.0	1874.1	56.4	1.7	186.2	78.0	4.9	0.0	272.9	270.2	268.8	58.2
Internat. sea	Heavy fuel	1998	26951844	1672.4	1900.9	56.9	1.8	187.7	78.0	4.9	0.0	266.9	264.2	262.9	58.6
Internat. sea	Heavy fuel	1999	28526097	1687.0	1927.8	57.3	1.8	189.2	78.0	4.9	0.0	272.9	270.2	268.8	59.1
Internat. sea	Heavy fuel	2000	33165319	1643.0	1947.0	57.8	1.8	190.8	78.0	4.9	0.0	255.2	252.6	251.4	59.6
Internat. sea	Heavy fuel	2001	25923684	1672.4	1965.8	58.3	1.8	192.4	78.0	4.9	0.0	266.9	264.2	262.9	60.1
Internat. sea	Heavy fuel	2002	17546654	1682.2	1984.3	58.8	1.8	194.0	78.0	4.9	0.0	270.9	268.2	266.8	60.6
Internat. sea	Heavy fuel	2003	20461869	1520.8	2002.3	59.3	1.8	195.6	78.0	4.9	0.0	211.8	209.7	208.6	61.1
Internat. sea	Heavy fuel	2004	17298079	1564.8	2019.9	59.8	1.8	197.2	78.0	4.9	0.0	226.5	224.2	223.1	61.6
Internat. sea	Heavy fuel	2005	20590607	1711.5	2037.1	60.3	1.9	198.8	78.0	4.9	0.0	283.2	280.4	279.0	62.1

Internat. sea	Heavy fuel	2006	20565822	1711.5	2053.7	60.7	1.9	200.3	78.0	4.9	0.0	283.2	280.4	279.0	62.6
Internat. sea	Heavy fuel	2007	20565822	733.5	2069.8	61.2	1.9	201.9	78.0	4.9	0.0	63.8	63.2	62.9	63.1
Internat. sea	Heavy fuel	2008	20565822	733.5	2085.3	61.7	1.9	203.4	78.0	4.9	0.0	63.8	63.2	62.9	63.6
Internat. sea	Heavy fuel	2009	20565822	733.5	2100.2	62.1	1.9	205.0	78.0	4.9	0.0	63.8	63.2	62.9	64.1
Internat. sea	Heavy fuel	2010	20565822	733.5	2114.4	62.6	1.9	206.5	78.0	4.9	0.0	63.8	63.2	62.9	64.5
Internat. sea	Heavy fuel	2011	20565822	733.5	2127.9	63.0	1.9	207.9	78.0	4.9	0.0	63.8	63.2	62.9	65.0
Internat. sea	Heavy fuel	2012	20565822	733.5	2140.6	63.5	2.0	209.4	78.0	4.9	0.0	63.8	63.2	62.9	65.4
Internat. sea	Heavy fuel	2013	20565822	733.5	2151.5	63.9	2.0	210.8	78.0	4.9	0.0	63.8	63.2	62.9	65.9
Internat. sea	Heavy fuel	2014	20565822	733.5	2160.4	64.3	2.0	212.1	78.0	4.9	0.0	63.8	63.2	62.9	66.3
Internat. sea	Heavy fuel	2015	20565822	733.5	2167.4	64.7	2.0	213.4	78.0	4.9	0.0	63.8	63.2	62.9	66.7
Internat. sea	Heavy fuel	2016	20565822	733.5	2172.3	65.1	2.0	214.7	78.0	4.9	0.0	63.8	63.2	62.9	67.1
Internat. sea	Heavy fuel	2017	20565822	733.5	2174.9	65.4	2.0	215.9	78.0	4.9	0.0	63.8	63.2	62.9	67.5
Internat. sea	Heavy fuel	2018	20565822	733.5	2175.9	65.8	2.0	217.1	78.0	4.9	0.0	63.8	63.2	62.9	67.8
Internat. sea	Heavy fuel	2019	20565822	733.5	2175.0	66.1	2.0	218.1	78.0	4.9	0.0	63.8	63.2	62.9	68.2
Internat. sea	Heavy fuel	2020	20565822	733.5	2172.3	66.4	2.1	219.2	78.0	4.9	0.0	63.8	63.2	62.9	68.5
Internat. sea	Heavy fuel	2021	20565822	733.5	2167.7	66.7	2.1	220.1	78.0	4.9	0.0	63.8	63.2	62.9	68.8
Internat. sea	Heavy fuel	2022	20565822	733.5	2162.7	67.0	2.1	220.9	78.0	4.9	0.0	63.8	63.2	62.9	69.0
Internat. sea	Heavy fuel	2023	20565822	733.5	2157.2	67.2	2.1	221.7	78.0	4.9	0.0	63.8	63.2	62.9	69.3
Internat. sea	Heavy fuel	2024	20565822	733.5	2151.2	67.4	2.1	222.4	78.0	4.9	0.0	63.8	63.2	62.9	69.5
Internat. sea	Heavy fuel	2025	20565822	733.5	2144.8	67.6	2.1	223.0	78.0	4.9	0.0	63.8	63.2	62.9	69.7
Internat. sea	Heavy fuel	2026	20565822	733.5	2137.8	67.7	2.1	223.4	78.0	4.9	0.0	63.8	63.2	62.9	69.8
Internat. sea	Heavy fuel	2027	20565822	733.5	2130.2	67.8	2.1	223.8	78.0	4.9	0.0	63.8	63.2	62.9	69.9
Internat. sea	Heavy fuel	2028	20565822	733.5	2122.0	67.9	2.1	224.1	78.0	4.9	0.0	63.8	63.2	62.9	70.0
Internat. sea	Heavy fuel	2029	20565822	733.5	2113.1	68.0	2.1	224.2	78.0	4.9	0.0	63.8	63.2	62.9	70.1
Internat. sea	Heavy fuel	2030	20565822	733.5	2113.1	68.0	2.1	224.2	78.0	4.9	0.0	63.8	63.2	62.9	70.1
Internat. sea	Gas oil	1990	11632674	93.7	1208.6	49.5	1.5	163.2	74.0	4.7	0.0	23.2	23.0	22.9	51.0
Internat. sea	Gas oil	1991	12589668	93.7	1227.7	49.7	1.5	164.0	74.0	4.7	0.0	23.2	23.0	22.9	51.3
Internat. sea	Gas oil	1992	16880521	93.7	1247.2	50.0	1.5	164.9	74.0	4.7	0.0	23.2	23.0	22.9	51.5
Internat. sea	Gas oil	1993	19114201	93.7	1267.0	50.3	1.6	165.9	74.0	4.7	0.0	23.2	23.0	22.9	51.8
Internat. sea	Gas oil	1994	24122772	93.7	1287.2	50.6	1.6	166.9	74.0	4.7	0.0	23.2	23.0	22.9	52.2
Internat. sea	Gas oil	1995	26742607	93.7	1307.9	50.9	1.6	168.0	74.0	4.7	0.0	23.2	23.0	22.9	52.5
Internat. sea	Gas oil	1996	27230627	93.7	1329.0	51.3	1.6	169.1	74.0	4.7	0.0	23.2	23.0	22.9	52.8
Internat. sea	Gas oil	1997	25324852	93.7	1350.7	51.6	1.6	170.3	74.0	4.7	0.0	23.2	23.0	22.9	53.2
Internat. sea	Gas oil	1998	31243359	93.7	1372.9	52.0	1.6	171.5	74.0	4.7	0.0	23.2	23.0	22.9	53.6
Internat. sea	Gas oil	1999	26085290	93.7	1395.7	52.4	1.6	172.9	74.0	4.7	0.0	23.2	23.0	22.9	54.0
Internat. sea	Gas oil	2000	22872342	93.7	1413.9	52.8	1.6	174.3	74.0	4.7	0.0	23.2	23.0	22.9	54.5
Internat. sea	Gas oil	2001	21388985	93.7	1431.8	53.2	1.6	175.7	74.0	4.7	0.0	23.2	23.0	22.9	54.9

Internat. sea	Gas oil	2002	21579480	93.7	1449.4	53.7	1.7	177.1	74.0	4.7	0.0	23.2	23.0	22.9	55.3
Internat. sea	Gas oil	2003	20729767	93.7	1466.7	54.1	1.7	178.4	74.0	4.7	0.0	23.2	23.0	22.9	55.8
Internat. sea	Gas oil	2004	16152078	93.7	1483.7	54.5	1.7	179.8	74.0	4.7	0.0	23.2	23.0	22.9	56.2
Internat. sea	Gas oil	2005	13917430	93.7	1500.3	54.9	1.7	181.2	74.0	4.7	0.0	23.2	23.0	22.9	56.6
Internat. sea	Gas oil	2006	20729767	93.7	1516.6	55.3	1.7	182.6	74.0	4.7	0.0	23.2	23.0	22.9	57.1
Internat. sea	Gas oil	2007	20729767	93.7	1532.4	55.8	1.7	183.9	74.0	4.7	0.0	23.2	23.0	22.9	57.5
Internat. sea	Gas oil	2008	20729767	46.8	1547.7	56.2	1.7	185.3	74.0	4.7	0.0	21.5	21.3	21.2	57.9
Internat. sea	Gas oil	2009	20729767	46.8	1562.6	56.6	1.7	186.6	74.0	4.7	0.0	21.5	21.3	21.2	58.3
Internat. sea	Gas oil	2010	20729767	46.8	1577.0	56.9	1.8	187.9	74.0	4.7	0.0	21.5	21.3	21.2	58.7
Internat. sea	Gas oil	2011	20729767	46.8	1590.8	57.3	1.8	189.1	74.0	4.7	0.0	21.5	21.3	21.2	59.1
Internat. sea	Gas oil	2012	20729767	46.8	1604.0	57.7	1.8	190.4	74.0	4.7	0.0	21.5	21.3	21.2	59.5
Internat. sea	Gas oil	2013	20729767	46.8	1616.2	58.1	1.8	191.6	74.0	4.7	0.0	21.5	21.3	21.2	59.9
Internat. sea	Gas oil	2014	20729767	46.8	1627.4	58.4	1.8	192.7	74.0	4.7	0.0	21.5	21.3	21.2	60.2
Internat. sea	Gas oil	2015	20729767	46.8	1637.6	58.8	1.8	193.9	74.0	4.7	0.0	21.5	21.3	21.2	60.6
Internat. sea	Gas oil	2016	20729767	46.8	1646.6	59.1	1.8	195.0	74.0	4.7	0.0	21.5	21.3	21.2	60.9
Internat. sea	Gas oil	2017	20729767	46.8	1654.3	59.4	1.8	196.0	74.0	4.7	0.0	21.5	21.3	21.2	61.3
Internat. sea	Gas oil	2018	20729767	46.8	1660.8	59.7	1.8	197.0	74.0	4.7	0.0	21.5	21.3	21.2	61.6
Internat. sea	Gas oil	2019	20729767	46.8	1666.1	60.0	1.9	197.9	74.0	4.7	0.0	21.5	21.3	21.2	61.9
Internat. sea	Gas oil	2020	20729767	46.8	1670.2	60.3	1.9	198.8	74.0	4.7	0.0	21.5	21.3	21.2	62.1
Internat. sea	Gas oil	2021	20729767	46.8	1672.9	60.5	1.9	199.6	74.0	4.7	0.0	21.5	21.3	21.2	62.4
Internat. sea	Gas oil	2022	20729767	46.8	1674.8	60.7	1.9	200.3	74.0	4.7	0.0	21.5	21.3	21.2	62.6
Internat. sea	Gas oil	2023	20729767	46.8	1675.8	60.9	1.9	201.0	74.0	4.7	0.0	21.5	21.3	21.2	62.8
Internat. sea	Gas oil	2024	20729767	46.8	1675.9	61.1	1.9	201.6	74.0	4.7	0.0	21.5	21.3	21.2	63.0
Internat. sea	Gas oil	2025	20729767	46.8	1675.0	61.3	1.9	202.1	74.0	4.7	0.0	21.5	21.3	21.2	63.2
Internat. sea	Gas oil	2026	20729767	46.8	1673.2	61.4	1.9	202.5	74.0	4.7	0.0	21.5	21.3	21.2	63.3
Internat. sea	Gas oil	2027	20729767	46.8	1670.3	61.5	1.9	202.8	74.0	4.7	0.0	21.5	21.3	21.2	63.4
Internat. sea	Gas oil	2028	20729767	46.8	1666.3	61.5	1.9	203.0	74.0	4.7	0.0	21.5	21.3	21.2	63.4
Internat. sea	Gas oil	2029	20729767	46.8	1661.2	61.6	1.9	203.1	74.0	4.7	0.0	21.5	21.3	21.2	63.5
Internat. sea	Gas oil	2030	20729767	46.8	1661.2	61.6	1.9	203.1	74.0	4.7	0.0	21.5	21.3	21.2	63.5

Annex 3

A.3.1 1990-2005 fuel use and emission results for the most important Danish ferry routes

Pollutant	Ferry service	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
CH_4 (tons)	Halsskov-Knudshoved	2.4	2.4	2.6	2.7	2.8	2.9	3.1	3.1	1.3							
CH_4 (tons)	Hundested-Grenaa	0.7	0.7	0.7	0.7	0.5	0.6	0.1									
CH_4 (tons)	Kalundborg-Juelsminde		0.2	0.3	0.3	0.3	0.3	0.1									
CH_4 (tons)	Kalundborg-Samsø	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
CH_4 (tons)	Kalundborg-Århus	2.3	1.9	2.0	1.8	1.9	2.3	3.7	4.0	4.3	1.4	1.7	1.6	1.8	1.6	1.5	1.5
CH_4 (tons)	Korsør-Nyborg, DSB	3.4	3.4	3.4	3.4	3.3	3.4	3.3	1.3								
CH_4 (tons)	Korsør-Nyborg, Vognmandsruten	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.3							
CH_4 (tons)	København-Rønne	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.5	0.5	0.5	0.3	
CH_4 (tons)	Køge-Rønne															0.2	0.6
CH_4 (tons)	Sjællands Odde-Ebeltoft	1.6	1.6	1.6	1.6	1.7	1.8	2.5	3.1	3.0	3.0	1.5	1.3	1.1	1.0	0.9	0.9
CH_4 (tons)	Sjællands Odde-Århus										1.8	1.4	1.4	1.4	1.7	2.0	1.9
CH_4 (tons)	Tårs-Spodsbjerg	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
CO (tons)	Halsskov-Knudshoved	259.0	258.0	282.5	283.2	299.9	312.8	326.5	327.9	141.6							
CO (tons)	Hundested-Grenaa	73.0	72.9	73.4	73.3	49.0	58.7	6.5									
CO (tons)	Kalundborg-Juelsminde		23.8	31.1	27.7	27.6	27.0	15.4									
CO (tons)	Kalundborg-Samsø	18.7	18.7	13.0	13.0	12.2	11.9	12.0	12.1	12.2	14.6	14.2	14.0	14.3	14.3	14.5	14.9
CO (tons)	Kalundborg-Århus	241.3	204.4	209.0	192.4	200.7	245.9	399.5	426.0	454.8	150.7	178.9	172.6	188.8	166.8	162.2	159.9
CO (tons)	Korsør-Nyborg, DSB	365.9	366.8	363.4	362.6	356.2	358.5	354.7	136.6								
CO (tons)	Korsør-Nyborg, Vognmandsruten	57.9	56.8	57.6	57.8	57.8	60.3	61.0	64.0	27.6							
CO (tons)	København-Rønne	67.9	66.3	58.9	50.1	51.9	51.8	53.1	56.6	55.7	61.5	59.7	52.3	50.2	48.3	35.6	
CO (tons)	Køge-Rønne															16.9	61.0
CO (tons)	Sjællands Odde-Ebeltoft	167.4	170.4	171.7	170.8	185.3	195.7	209.9	155.9	150.1	147.9	14.5	12.8	10.9	9.7	8.8	8.8
CO (tons)	Sjællands Odde-Århus										194.2	153.0	154.5	152.3	162.4	174.0	169.8
CO (tons)	Tårs-Spodsbjerg	24.6	28.2	30.5	30.5	29.9	27.3	28.6	29.2	22.7	21.4	21.5	21.6	21.5	21.6	21.6	21.6
CO_2 (ktons)	Halsskov-Knudshoved	114.1	113.6	124.4	124.5	132.0	137.7	143.9	144.4	62.3							
CO_2 (ktons)	Hundested-Grenaa	33.1	33.1	33.3	33.3	22.0	23.8	2.6									
CO_2 (ktons)	Kalundborg-Juelsminde		10.3	13.5	12.0	12.0	11.8	6.7									
CO_2 (ktons)	Kalundborg-Samsø	8.8	8.8	5.8	5.8	5.4	5.3	5.3	5.4	5.4	5.6	5.5	5.4	5.5	5.5	5.6	5.7
CO_2 (ktons)	Kalundborg-Århus	103.4	87.5	88.5	81.8	85.0	103.3	165.5	174.5	186.2	63.1	63.6	61.3	67.1	59.3	57.6	56.8
CO_2 (ktons)	Korsør-Nyborg, DSB	159.3	159.5	158.2	157.7	155.1	156.0	154.3	59.4								
CO_2 (ktons)	Korsør-Nyborg, Vognmandsruten	25.2	24.7	25.0	25.1	25.1	26.2	26.5	27.8	12.0							
CO_2 (ktons)	København-Rønne	31.5	30.7	27.3	23.2	24.1	24.0	24.6	26.2	25.8	28.5	27.7	24.3	23.3	22.4	16.5	
CO_2 (ktons)	Køge-Rønne															7.9	24.9

CO_2 (ktons)	Sjællands Odde-Ebeltoft	76.8	78.1	78.7	78.3	85.0	89.8	122.3	180.5	173.8	171.0	109.8	97.2	82.7	73.4	66.8	66.4
CO_2 (ktons)	Sjællands Odde-Århus										78.6	61.9	62.6	62.7	79.7	95.8	93.5
CO_2 (ktons)	Tårs-Spodsbjerg	10.7	12.3	13.3	13.3	13.1	11.9	12.5	12.8	9.9	9.3	9.4	9.4	9.4	9.4	9.4	9.4
N_2O (tons)	Halsskov-Knudshoved	7.2	7.2	7.8	7.9	8.3	8.7	9.1	9.1	3.9							
N_2O (tons)	Hundested-Grenaa	2.1	2.1	2.1	2.1	1.4	1.5	0.2									
N_2O (tons)	Kalundborg-Juelsminde		0.7	0.9	0.8	0.8	0.7	0.4									
N_2O (tons)	Kalundborg-Samsø	0.5	0.5	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.3	0.4	0.4
N_2O (tons)	Kalundborg-Århus	6.5	5.5	5.6	5.2	5.4	6.5	10.5	11.0	11.8	4.0	4.0	3.9	4.2	3.8	3.6	3.6
N_2O (tons)	Korsør-Nyborg, DSB	10.1	10.1	10.0	10.0	9.8	9.9	9.8	3.8								
N_2O (tons)	Korsør-Nyborg, Vognmandsruten	1.6	1.6	1.6	1.6	1.6	1.7	1.7	1.8	0.8							
N_2O (tons)	København-Rønne	2.0	1.9	1.7	1.5	1.5	1.5	1.5	1.6	1.6	1.8	1.7	1.5	1.5	1.4	1.0	
N_2O (tons)	Køge-Rønne															0.5	1.6
N_2O (tons)	Sjællands Odde-Ebeltoft	4.8	4.9	4.9	4.9	5.3	5.6	7.7	11.4	11.0	10.8	7.0	6.2	5.2	4.6	4.2	4.2
N_2O (tons)	Sjællands Odde-Århus										5.0	3.9	4.0	4.0	5.0	6.1	5.9
N_2O (tons)	Tårs-Spodsbjerg	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
NH_3 (tons)	Halsskov-Knudshoved	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0							
NH_3 (tons)	Hundested-Grenaa	0.0	0.0	0.0	0.0	0.0	0.0	0.0									
NH_3 (tons)	Kalundborg-Juelsminde		0.0	0.0	0.0	0.0	0.0	0.0									
NH_3 (tons)	Kalundborg-Samsø	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NH_3 (tons)	Kalundborg-Århus	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NH_3 (tons)	Korsør-Nyborg, DSB	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0								
NH_3 (tons)	Korsør-Nyborg, Vognmandsruten	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0							
NH_3 (tons)	København-Rønne	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
NH_3 (tons)	Køge-Rønne															0.0	0.0
NH_3 (tons)	Sjællands Odde-Ebeltoft	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NH_3 (tons)	Sjællands Odde-Århus										0.0	0.0	0.0	0.0	0.0	0.0	0.0
NH_3 (tons)	Tårs-Spodsbjerg	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NMVOC (tons)	Halsskov-Knudshoved	78.5	78.2	85.6	85.9	90.9	94.8	99.0	99.4	42.9							
NMVOC (tons)	Hundested-Grenaa	22.1	22.1	22.2	22.2	14.9	17.8	2.0									
NMVOC (tons)	Kalundborg-Juelsminde		7.2	9.4	8.4	8.4	8.2	4.7									
NMVOC (tons)	Kalundborg-Samsø	5.7	5.7	3.9	3.9	3.7	3.6	3.6	3.7	3.7	4.4	4.3	4.3	4.3	4.3	4.4	4.5
NMVOC (tons)	Kalundborg-Århus	73.1	62.0	63.4	58.3	60.8	74.5	121.1	129.1	137.9	45.7	54.2	52.3	57.2	50.6	49.2	48.5
NMVOC (tons)	Korsør-Nyborg, DSB	110.9	111.2	110.2	109.9	108.0	108.7	107.5	41.4								
NMVOC (tons)	Korsør-Nyborg, Vognmandsruten	17.6	17.2	17.5	17.5	17.5	18.3	18.5	19.4	8.4							
NMVOC (tons)	København-Rønne	20.6	20.1	17.8	15.2	15.7	15.7	16.1	17.1	16.9	18.7	18.1	15.9	15.2	14.6	10.8	
NMVOC (tons)	Køge-Rønne															5.1	18.5
NMVOC (tons)	Sjællands Odde-Ebeltoft	50.7	51.7	52.0	51.8	56.2	59.3	79.7	100.8	97.0	95.5	49.2	43.5	37.0	32.9	29.9	29.7

NMVOC (tons)	Sjællands Odde-Århus										58.9	46.4	46.8	46.6	55.2	63.7	62.1
NMVOC (tons)	Tårs-Spodsbjerg	7.5	8.5	9.3	9.3	9.1	8.3	8.7	8.8	6.9	6.5	6.5	6.5	6.5	6.6	6.5	6.5
NO_X (tons)	Halsskov-Knudshoved	1912.5	1900.7	2118.9	2148.2	2258.5	2388.3	2471.7	2444.5	1012.6							
NO_X (tons)	Hundested-Grenaa	451.5	451.1	454.2	453.3	377.3	418.3	46.6									
NO_X (tons)	Kalundborg-Juelsminde		157.7	206.1	183.4	183.2	179.3	101.8									
NO_X (tons)	Kalundborg-Samsø	169.4	169.4	78.0	75.1	70.4	69.1	69.3	70.1	72.3	107.7	104.9	103.5	105.5	105.3	106.5	109.8
NO_X (tons)	Kalundborg-Århus	2774.6	1943.8	1407.4	1323.2	1351.7	1673.8	2783.0	2993.6	3247.2	1053.9	2131.2	2056.0	2249.0	1987.3	1932.1	1904.5
NO_X (tons)	Korsør-Nyborg, DSB	2517.4	2519.8	2498.2	2473.1	2419.2	2435.6	2409.6	918.7								
NO_X (tons)	Korsør-Nyborg, Vognmandsruten	382.3	374.7	380.1	381.5	381.8	398.4	402.9	422.5	182.0							
NO_X (tons)	København-Rønne	441.1	430.8	382.6	325.7	337.5	336.8	345.4	367.6	362.0	400.0	388.1	339.9	326.5	313.8	231.6	
NO_X (tons)	Køge-Rønne															110.2	435.7
NO_X (tons)	Sjællands Odde-Ebeltoft	1046.2	1065.0	1073.0	1067.7	1157.9	1223.2	2092.1	2343.5	2256.7	2222.7	579.2	512.6	436.3	387.1	352.5	350.4
NO_X (tons)	Sjællands Odde-Århus										1430.6	1127.0	1138.2	1126.4	1259.8	1396.7	1363.5
NO_X (tons)	Tårs-Spodsbjerg	164.4	188.6	203.3	203.3	198.7	181.7	189.9	191.8	149.2	141.3	142.1	142.6	141.9	143.0	142.6	142.5
PM_{10} (tons)	Halsskov-Knudshoved	88.0	74.2	67.3	93.3	110.3	150.4	120.8	123.2	30.2							
PM_{10} (tons)	Hundested-Grenaa	10.3	10.3	10.4	10.3	22.9	7.4	0.8									
PM_{10} (tons)	Kalundborg-Juelsminde		3.2	4.2	3.7	3.7	3.6	2.1									
PM_{10} (tons)	Kalundborg-Samsø	16.6	13.4	2.1	1.8	1.7	1.6	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.8
PM_{10} (tons)	Kalundborg-Århus	195.9	93.8	27.5	32.5	26.4	32.1	54.7	54.2	57.8	19.6	19.7	19.1	20.8	18.4	17.9	17.6
PM_{10} (tons)	Korsør-Nyborg, DSB	75.5	68.1	60.4	65.0	66.5	72.7	64.8	23.4								
PM_{10} (tons)	Korsør-Nyborg, Vognmandsruten	7.8	7.7	7.8	7.8	7.8	8.1	8.2	8.6	3.7							
PM_{10} (tons)	København-Rønne	59.6	46.9	27.7	36.5	44.9	57.3	44.3	53.5	29.7	32.8	28.3	22.8	19.0	19.8	19.1	
PM_{10} (tons)	Køge-Rønne															9.1	29.3
PM_{10} (tons)	Sjællands Odde-Ebeltoft	145.4	119.3	79.8	123.2	158.6	214.2	104.7	56.1	54.0	53.1	34.1	30.2	25.7	22.8	20.8	20.6
PM_{10} (tons)	Sjællands Odde-Århus										24.4	19.2	19.4	19.5	24.7	29.7	29.0
PM_{10} (tons)	Tårs-Spodsbjerg	3.3	3.8	4.1	4.1	4.1	3.7	3.9	4.0	3.1	2.9	2.9	2.9	2.9	2.9	2.9	2.9
$PM_{2,5}$ (tons)	Halsskov-Knudshoved	87.6	73.8	67.0	92.8	109.8	149.6	120.2	122.6	30.0							
$PM_{2,5}$ (tons)	Hundested-Grenaa	10.2	10.2	10.3	10.3	22.8	7.3	0.8									
PM2,5 (tons)	Kalundborg-Juelsminde		3.2	4.2	3.7	3.7	3.6	2.1									
$PM_{2,5}$ (tons)	Kalundborg-Samsø	16.5	13.3	2.1	1.8	1.7	1.6	1.6	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.8
$PM_{2,5}$ (tons)	Kalundborg-Århus	194.9	93.4	27.4	32.4	26.3	31.9	54.5	53.9	57.5	19.5	19.6	19.0	20.7	18.3	17.8	17.6
$PM_{2,5}$ (tons)	Korsør-Nyborg, DSB	75.1	67.7	60.1	64.7	66.1	72.3	64.5	23.2								
$PM_{2,5}$ (tons)	Korsør-Nyborg, Vognmandsruten	7.8	7.6	7.7	7.8	7.8	8.1	8.2	8.6	3.7							
$PM_{2,5}$ (tons)	København-Rønne	59.3	46.7	27.5	36.4	44.7	57.0	44.1	53.2	29.6	32.6	28.1	22.7	18.9	19.7	19.0	
$PM_{2,5}$ (tons)	Køge-Rønne															9.1	29.1
$PM_{2,5}$ (tons)	Sjællands Odde-Ebeltoft	144.7	118.7	79.4	122.6	157.8	213.1	104.2	55.8	53.7	52.8	33.9	30.0	25.6	22.7	20.6	20.5
$PM_{2,5}$ (tons)	Sjællands Odde-Århus										24.3	19.1	19.3	19.4	24.6	29.6	28.9

$PM_{2.5}$ (tons)	Tårs-Spodsbjerg	3.3	3.8	4.1	4.1	4.0	3.7	3.9	3.9	3.1	2.9	2.9	2.9	2.9	2.9	2.9	2.9
SO_2 (tons)	Halsskov-Knudshoved	652.1	574.9	566.4	751.5	842.8	1067.4	942.2	903.6	222.1							
SO_2 (tons)	Hundested-Grenaa	42.0	41.9	42.2	42.1	184.8	30.1	3.4									
SO_2 (tons)	Kalundborg-Juelsminde		13.1	17.1	15.2	15.2	14.9	8.4									
SO_2 (tons)	Kalundborg-Samsø	144.9	129.0	11.6	7.3	6.8	6.7	6.7	6.8	6.8	7.1	6.9	6.8	7.0	7.0	7.0	7.3
SO_2 (tons)	Kalundborg-Århus	1711.8	849.2	112.1	181.0	107.7	130.8	242.8	220.8	235.7	79.9	80.5	77.7	84.9	75.1	73.0	71.9
SO_2 (tons)	Korsør-Nyborg, DSB	452.9	407.0	360.2	373.9	374.7	398.8	364.0	120.4								
SO_2 (tons)	Korsør-Nyborg, Vognmandsruten	31.9	31.2	31.7	31.8	31.8	33.2	33.6	35.2	15.2							
SO_2 (tons)	København-Rønne	520.8	452.8	308.0	348.1	395.5	444.3	397.1	450.5	319.0	352.4	314.2	258.5	220.5	227.4	205.1	
SO_2 (tons)	Køge-Rønne															97.6	312.3
SO_2 (tons)	Sjællands Odde-Ebeltoft	1270.6	1151.3	888.5	1173.8	1395.5	1659.9	821.1	228.5	220.0	216.5	139.0	123.0	104.7	92.9	84.6	84.1
SO_2 (tons)	Sjællands Odde-Århus										99.5	78.4	79.2	79.4	100.9	121.2	118.4
SO_2 (tons)	Tårs-Spodsbjerg	13.6	15.6	16.9	16.9	16.6	15.0	15.8	16.2	12.6	11.8	11.9	11.9	11.9	11.9	11.9	11.9
TSP (tons)	Halsskov-Knudshoved	88.9	74.9	68.0	94.2	111.5	151.9	122.1	124.5	30.5							
TSP (tons)	Hundested-Grenaa	10.4	10.4	10.5	10.4	23.2	7.5	0.8									
TSP (tons)	Kalundborg-Juelsminde		3.2	4.2	3.8	3.8	3.7	2.1									
TSP (tons)	Kalundborg-Samsø	16.8	13.5	2.1	1.8	1.7	1.7	1.7	1.7	1.7	1.8	1.7	1.7	1.7	1.7	1.7	1.8
TSP (tons)	Kalundborg-Århus	197.9	94.8	27.8	32.9	26.7	32.4	55.3	54.7	58.4	19.8	19.9	19.2	21.0	18.6	18.1	17.8
TSP (tons)	Korsør-Nyborg, DSB	76.3	68.7	61.0	65.7	67.1	73.4	65.5	23.6								
TSP (tons)	Korsør-Nyborg, Vognmandsruten	7.9	7.7	7.8	7.9	7.9	8.2	8.3	8.7	3.8							
TSP (tons)	København-Rønne	60.2	47.4	27.9	36.9	45.4	57.9	44.8	54.1	30.0	33.1	28.5	23.0	19.2	20.0	19.3	
TSP (tons)	Køge-Rønne															9.2	29.6
TSP (tons)	Sjællands Odde-Ebeltoft	146.9	120.5	80.6	124.4	160.2	216.4	105.8	56.6	54.5	53.7	34.4	30.5	25.9	23.0	21.0	20.8
TSP (tons)	Sjællands Odde-Århus										24.7	19.4	19.6	19.7	25.0	30.0	29.3
TSP (tons)	Tårs-Spodsbjerg	3.4	3.9	4.2	4.2	4.1	3.7	3.9	4.0	3.1	2.9	2.9	3.0	2.9	3.0	3.0	3.0
VOC (tons)	Halsskov-Knudshoved	80.9	80.6	88.3	88.5	93.7	97.7	102.0	102.5	44.3							
VOC (tons)	Hundested-Grenaa	22.8	22.8	22.9	22.9	15.3	18.4	2.0									
VOC (tons)	Kalundborg-Juelsminde		7.4	9.7	8.6	8.6	8.5	4.8									
VOC (tons)	Kalundborg-Samsø	5.8	5.8	4.0	4.1	3.8	3.7	3.7	3.8	3.8	4.6	4.4	4.4	4.5	4.5	4.5	4.7
VOC (tons)	Kalundborg-Århus	75.4	63.9	65.3	60.1	62.7	76.8	124.8	133.1	142.1	47.1	55.9	53.9	59.0	52.1	50.7	50.0
VOC (tons)	Korsør-Nyborg, DSB	114.3	114.6	113.6	113.3	111.3	112.0	110.8	42.7								
VOC (tons)	Korsør-Nyborg, Vognmandsruten	18.1	17.7	18.0	18.1	18.1	18.9	19.1	20.0	8.6							
VOC (tons)	København-Rønne	21.2	20.7	18.4	15.7	16.2	16.2	16.6	17.7	17.4	19.2	18.7	16.3	15.7	15.1	11.1	
VOC (tons)	Køge-Rønne															5.3	19.0
VOC (tons)	Sjællands Odde-Ebeltoft	52.3	53.2	53.7	53.4	57.9	61.2	82.2	103.9	100.0	98.5	50.7	44.9	38.2	33.9	30.8	30.7
VOC (tons)	Sjællands Odde-Århus										60.7	47.8	48.3	48.1	56.9	65.6	64.1
VOC (tons)	Tårs-Spodsbjerg	7.7	8.8	9.5	9.5	9.4	8.5	8.9	9.1	7.1	6.7	6.7	6.7	6.7	6.8	6.7	6.7

FC (PJ)	Halsskov-Knudshoved	1.5	1.5	1.7	1.7	1.8	1.8	1.9	1.9	0.8							
FC (PJ)	Hundested-Grenaa	0.4	0.4	0.5	0.4	0.3	0.3	0.0									
FC (PJ)	Kalundborg-Juelsminde		0.1	0.2	0.2	0.2	0.2	0.1									
FC (PJ)	Kalundborg-Samsø	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
FC (PJ)	Kalundborg-Århus	1.3	1.1	1.2	1.1	1.1	1.4	2.2	2.4	2.5	0.9	0.9	0.8	0.9	0.8	0.8	0.8
FC (PJ)	Korsør-Nyborg, DSB	2.1	2.1	2.1	2.1	2.1	2.1	2.1	0.8								
FC (PJ)	Korsør-Nyborg, Vognmandsruten	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.2							
FC (PJ)	København-Rønne	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.3	0.3	0.3	0.2	
FC (PJ)	Køge-Rønne															0.1	0.3
FC (PJ)	Sjællands Odde-Ebeltoft	1.0	1.0	1.0	1.0	1.1	1.2	1.6	2.4	2.3	2.3	1.5	1.3	1.1	1.0	0.9	0.9
FC (PJ)	Sjællands Odde-Århus										1.1	0.8	0.8	0.8	1.1	1.3	1.3
FC (PJ)	Tårs-Spodsbjerg	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
FC (tons)	Halsskov-Knudshoved	36017	35857	39244	39263	41654	43421	45374	45551	19691							
FC (tons)	Hundested-Grenaa	10490	10480	10551	10531	6917	7527	838									
FC (tons)	Kalundborg-Juelsminde		3270	4274	3803	3800	3719	2111									
FC (tons)	Kalundborg-Samsø	2745	2745	1827	1824	1710	1679	1684	1704	1699	1781	1735	1712	1746	1741	1762	1817
FC (tons)	Kalundborg-Århus	32421	27514	28019	25874	26915	32694	52356	55210	58927	19968	20124	19414	21236	18766	18244	17984
FC (tons)	Korsør-Nyborg, DSB	50357	50438	50031	49869	49043	49329	48812	18778								
FC (tons)	Korsør-Nyborg, Vognmandsruten	7963	7805	7916	7946	7952	8298	8392	8800	3791							
FC (tons)	København-Rønne	9864	9635	8556	7283	7549	7531	7725	8220	8097	8945	8680	7602	7301	7018	5180	
FC (tons)	Køge-Rønne															2464	7808
FC (tons)	Sjællands Odde-Ebeltoft	24064	24495	24680	24556	26631	28134	38557	57128	55011	54128	34751	30756	26178	23223	21149	21025
FC (tons)	Sjællands Odde-Århus										24884	19602	19799	19848	25219	30312	29593
FC (tons)	Tårs-Spodsbjerg	3392	3891	4217	4221	4138	3762	3953	4044	3143	2951	2967	2977	2964	2986	2978	2977

A.3.2 1990-2005 fuel use and emission results for ferries, ferryboats and other national sea transport

Pollutant	SNAPCode	Category	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
SO_2 (tons)	080402	Regional ferries	4840.6	3666.0	2354.6	2941.6	3371.5	3801.1	2835.2	1982.1	1031.4	767.3	630.9	557.1	508.4	515.1	600.5	605.9
SO_2 (tons)	080402	Ferryboats	49.3	50.1	50.6	49.7	56.4	58.2	50.9	55.0	55.7	56.3	56.2	55.7	58.0	58.1	57.4	57.2
SO_2 (tons)	080402	Other nat. sea	494.0	1853.0	1367.4	823.8	0.0	0.0	0.0	344.0	838.7	1029.8	1021.2	999.4	1314.8	1296.0	1347.5	1217.6
NO_X (tons)	080402	Regional ferries	9859.6	9201.6	8801.7	8634.3	8736.2	9304.4	10912.3	9752.4	7282.2	5356.2	4472.5	4292.8	4385.6	4196.3	4272.2	4306.5
NO_X (tons)	080402	Ferryboats	533.0	551.0	566.7	565.9	653.7	687.8	612.4	674.7	697.0	718.4	729.2	734.1	775.6	786.7	788.7	795.6
NO_X (tons)	080402	Other nat. sea	648.9	2769.2	2710.7	1266.4	1.8	2.9	1.5	483.1	1658.4	2061.9	2246.6	2363.4	3638.1	3443.7	2811.3	3336.4
NMVOC (tons)	080402	Regional ferries	386.6	383.8	391.3	382.3	385.2	409.2	460.8	419.8	313.6	229.6	178.7	169.3	166.9	164.2	169.6	169.9
NMVOC (tons)	080402	Ferryboats	25.5	26.1	26.5	26.2	29.9	31.1	27.4	29.9	30.5	31.1	31.4	31.4	33.0	33.3	33.2	33.4
NMVOC (tons)	080402	Other nat. sea	21.4	88.2	86.0	44.8	0.6	0.9	0.4	15.1	50.6	61.6	66.8	70.1	108.8	103.5	83.2	105.2
CH_4 (tons)	080402	Regional ferries	12.0	11.9	12.1	11.8	11.9	12.7	14.3	13.0	9.7	7.1	5.5	5.2	5.2	5.1	5.2	5.3
CH_4 (tons)	080402	Ferryboats	0.8	0.8	0.8	0.8	0.9	1.0	0.8	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0
CH_4 (tons)	080402	Other nat. sea	0.7	2.8	2.7	1.5	0.0	0.1	0.0	0.5	1.6	1.9	2.1	2.2	3.4	3.2	2.6	3.3
CO (tons)	080402	Regional ferries	1275.5	1266.2	1291.0	1261.3	1270.6	1350.0	1467.2	1208.3	864.7	590.4	441.8	427.8	437.9	423.1	433.6	435.9
CO (tons)	080402	Ferryboats	84.0	85.9	87.4	86.4	98.7	102.7	90.5	98.6	100.7	102.6	103.5	103.6	108.8	109.9	109.6	110.1
CO (tons)	080402	Other nat. sea	69.0	289.6	281.2	134.7	0.7	1.0	0.5	48.5	164.6	202.6	220.2	231.3	358.8	341.3	274.5	346.9
CO_2 (ktons)	080402	Regional ferries	562.8	558.6	568.2	555.1	558.8	589.7	664.2	630.9	475.5	356.2	277.9	260.2	250.7	249.7	259.6	256.8
CO_2 (ktons)	080402	Ferryboats	38.9	39.6	40.0	39.2	44.5	46.0	40.2	43.4	44.0	44.4	44.4	44.0	45.8	45.9	45.4	45.2
CO_2 (ktons)	080402	Other nat. sea	30.0	126.0	121.4	56.1	0.2	0.2	0.1	20.1	68.2	83.5	90.1	93.8	144.6	136.5	108.6	138.0
N_2O (tons)	080402	Regional ferries	35.5	35.2	35.9	35.0	35.3	37.2	42.0	39.9	30.1	22.5	17.6	16.5	15.9	15.8	16.4	16.2
N_2O (tons)	080402	Ferryboats	2.5	2.5	2.5	2.5	2.8	2.9	2.5	2.7	2.8	2.8	2.8	2.8	2.9	2.9	2.9	2.9
N_2O (tons)	080402	Other nat. sea	1.9	7.9	7.6	3.4	0.0	0.0	0.0	1.3	4.3	5.2	5.6	5.9	9.1	8.6	6.8	8.7
NH_3 (tons)	080402	Regional ferries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NH_3 (tons)	080402	Ferryboats	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NH_3 (tons)	080402	Other nat. sea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TSP (tons)	080402	Regional ferries	608.6	445.0	294.1	382.2	451.4	556.8	410.2	327.9	182.0	135.9	107.0	97.0	90.5	91.3	102.3	102.3
TSP (tons)	080402	Ferryboats	12.2	12.4	12.5	12.3	14.0	14.4	12.6	13.6	13.8	13.9	13.9	13.8	14.4	14.4	14.2	14.2
TSP (tons)	080402	Other nat. sea	57.1	193.9	124.0	87.3	0.0	0.0	0.0	41.3	78.9	96.9	92.8	89.1	115.8	116.2	127.0	124.1
PM_{10} (tons)	080402	Regional ferries	602.5	440.6	291.1	378.3	446.9	551.2	406.1	324.6	180.2	134.6	106.0	96.1	89.6	90.4	101.3	101.3
PM_{10} (tons)	080402	Ferryboats	12.1	12.3	12.4	12.2	13.8	14.3	12.5	13.5	13.7	13.8	13.8	13.7	14.2	14.2	14.1	14.0
PM_{10} (tons)	080402	Other nat. sea	56.5	192.0	122.8	86.5	0.0	0.0	0.0	40.9	78.1	95.9	91.9	88.2	114.7	115.1	125.8	122.9
$PM_{2,5}$ (tons)	080402	Regional ferries	599.5	438.4	289.7	376.4	444.7	548.4	404.0	323.0	179.3	133.9	105.4	95.6	89.2	90.0	100.8	100.8

$PM_{2,5}$ (tons)	080402	Ferryboats	12.0	12.2	12.4	12.1	13.8	14.2	12.4	13.4	13.6	13.7	13.7	13.6	14.2	14.2	14.0	14.0
$PM_{2,5}$ (tons)	080402	Other nat. sea	56.3	191.0	122.2	86.0	0.0	0.0	0.0	40.7	77.7	95.4	91.4	87.7	114.1	114.5	125.1	122.3
FC (PJ)	080402	Regional ferries	7.4	7.4	7.6	7.4	7.4	7.8	8.9	8.5	6.4	4.8	3.7	3.5	3.4	3.4	3.5	3.5
FC (PJ)	080402	Ferryboats	0.5	0.5	0.5	0.5	0.6	0.6	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
FC (PJ)	080402	Other nat. sea	0.4	1.6	1.6	0.7	0.0	0.0	0.0	0.3	0.9	1.1	1.2	1.2	1.9	1.8	1.4	1.8
VOC (tons)	080402	Regional ferries	398.6	395.7	403.4	394.2	397.1	421.9	475.1	432.7	323.3	236.7	184.2	174.5	172.1	169.2	174.8	175.1
VOC (tons)	080402	Ferryboats	26.3	26.9	27.3	27.0	30.8	32.1	28.3	30.8	31.5	32.1	32.3	32.4	34.0	34.3	34.3	34.4
VOC (tons)	080402	Other nat. sea	22.0	90.9	88.7	46.3	0.6	0.9	0.5	15.6	52.2	63.5	68.9	72.3	112.1	106.7	85.8	108.4

A.3.3 1990-2005 fuel use and emission results for fisheries

Pollutant	SNAPCode	Category	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
SO_2 (tons)	080403	Fishing vessels	742.0	765.3	700.9	662.7	664.9	668.3	635.8	514.0	535.8	613.2	708.8	669.3	721.2	677.3	526.1	614.6
NO_X (tons)	080403	Fishing vessels	8386.9	8792.1	8197.6	7876.9	8063.4	8264.4	8048.8	6612.7	7033.9	8244.1	9666.7	9262.2	10104.9	9594.4	7527.0	8862.4
NMVOC (tons)	080403	Fishing vessels	405.5	417.2	384.2	359.6	365.9	370.0	363.2	287.0	300.4	353.0	410.1	393.9	428.6	406.2	319.1	375.1
CH_4 (tons)	080403	Fishing vessels	13.1	13.2	12.2	11.2	11.5	11.6	11.6	8.9	9.3	11.1	13.0	12.4	13.4	12.7	10.0	11.8
CO (tons)	080403	Fishing vessels	1302.9	1348.4	1243.0	1176.8	1192.6	1207.7	1168.3	942.6	990.1	1151.2	1342.7	1283.5	1396.4	1323.4	1037.6	1220.7
CO_2 (ktons)	080403	Fishing vessels	590.7	607.4	556.0	524.6	526.6	529.2	504.8	406.6	423.5	485.5	562.5	530.1	571.1	536.4	416.9	486.9
N_2O (tons)	080403	Fishing vessels	37.1	38.3	35.0	33.1	33.2	33.4	31.8	25.7	26.8	30.7	35.4	33.5	36.1	33.9	26.3	30.7
NH_3 (tons)	080403	Fishing vessels	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TSP (tons)	080403	Fishing vessels	184.0	189.7	173.7	164.2	164.8	165.6	157.6	127.4	132.8	152.0	175.8	165.9	178.7	167.8	130.4	152.3
PM_{10} (tons)	080403	Fishing vessels	182.1	187.8	172.0	162.6	163.1	164.0	156.0	126.1	131.4	150.4	174.0	164.2	176.9	166.2	129.1	150.8
$PM_{2,5}$ (tons)	080403	Fishing vessels	181.2	186.9	171.1	161.8	162.3	163.1	155.2	125.5	130.8	149.7	173.1	163.4	176.0	165.3	128.4	150.0
FC (PJ)	080403	Fishing vessels	8.0	8.2	7.5	7.1	7.1	7.2	6.8	5.5	5.7	6.6	7.6	7.2	7.7	7.3	5.6	6.6
VOC (tons)	080403	Fishing vessels	418.5	430.4	396.4	370.9	377.4	381.6	374.7	295.9	309.7	364.0	423.1	406.2	442.0	419.0	329.2	386.9

A.3.4 1990-2005 fuel use and emission results for international sea transport

Pollutant	Heavy fuel type	SNAPCode	Category	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
SO_2 (tons)	Gas oil	080404	Internat. sea	1089,7	1179,4	1581,3	1790,6	2259,7	2505,2	2550,9	2372,4	2926,8	2443,6	2142,6	2003,7	2021,5	1941,9	1513,1	1303,7
SO_2 (tons)	Heavy fuel	080404	Internat. sea	41314,6	33168,5	29571,1	57878,3	57821,1	63754,9	59769,0	54705,3	45073,5	48124,7	54491,7	43354,0	29516,1	31118,0	27067,9	35240,6
NO_X (tons)	Gas oil	080404	Internat. sea	14059,3	15456,7	21053,2	24217,9	31051,7	34976,4	36190,0	34205,3	42892,9	36406,6	32338,3	30624,3	31277,5	30405,0	23965,1	20880,8
NO_X (tons)	Heavy fuel	080404	Internat. sea	48225,9	40274,1	36583,2	65414,5	70042,1	71951,5	66030,5	60771,9	51231,7	54993,7	64572,8	50961,2	34817,2	40971,0	34940,7	41944,3
NMVOC (tons)	Gas oil	080404	Internat. sea	575,4	626,0	844,0	961,2	1220,4	1361,6	1395,7	1307,1	1624,5	1366,8	1208,1	1138,9	1158,2	1121,3	880,5	764,5
NMVOC (tons)	Heavy fuel	080404	Internat. sea	1540,9	1274,0	1146,4	2031,7	2157,2	2198,5	2002,7	1830,4	1533,1	1635,8	1918,0	1511,8	1031,8	1213,2	1034,0	1240,7
CH_4 (tons)	Gas oil	080404	Internat. sea	17,8	19,4	26,1	29,7	37,7	42,1	43,2	40,4	50,2	42,3	37,4	35,2	35,8	34,7	27,2	23,6
CH_4 (tons)	Heavy fuel	080404	Internat. sea	47,7	39,4	35,5	62,8	66,7	68,0	61,9	56,6	47,4	50,6	59,3	46,8	31,9	37,5	32,0	38,4
CO (tons)	Gas oil	080404	Internat. sea	1898,1	2065,1	2784,2	3170,9	4026,2	4491,9	4604,4	4312,2	5359,1	4508,9	3985,6	3757,1	3820,7	3699,1	2904,6	2521,9
CO (tons)	Heavy fuel	080404	Internat. sea	5083,3	4203,0	3781,9	6702,4	7116,5	7252,8	6606,7	6038,5	5057,6	5396,4	6327,4	4987,5	3404,0	4002,3	3411,0	4092,9
CO_2 (ktons)	Gas oil	080404	Internat. sea	860,8	931,6	1249,2	1414,5	1785,1	1979,0	2015,1	1874,0	2312,0	1930,3	1692,6	1582,8	1596,9	1534,0	1195,3	1029,9
CO_2 (ktons)	Heavy fuel	080404	Internat. sea	2226,4	1830,7	1637,8	2885,1	3043,9	3081,7	2787,6	2529,3	2102,2	2225,0	2586,9	2022,0	1368,6	1596,0	1349,3	1606,1
N_2O (tons)	Gas oil	080404	Internat. sea	54,5	59,0	79,1	89,5	113,0	125,3	127,5	118,6	146,3	122,2	107,1	100,2	101,1	97,1	75,7	65,2
N_2O (tons)	Heavy fuel	080404	Internat. sea	139,6	114,8	102,7	180,9	190,8	193,2	174,8	158,6	131,8	139,5	162,2	126,8	85,8	100,1	84,6	100,7
NH_3 (tons)	Gas oil	080404	Internat. sea	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
NH_3 (tons)	Heavy fuel	080404	Internat. sea	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
TSP (tons)	Gas oil	080404	Internat. sea	270,0	292,2	391,9	443,7	560,0	620,8	632,1	587,9	725,3	605,5	530,9	496,5	500,9	481,2	374,9	323,1
TSP (tons)	Heavy fuel	080404	Internat. sea	5406,9	4220,0	3747,4	8378,2	7788,0	9641,4	9537,1	8848,8	7192,2	7784,3	8463,4	6917,8	4752,7	4334,3	3918,2	5832,1
PM_{10} (tons)	Gas oil	080404	Internat. sea	267,3	289,3	387,9	439,3	554,4	614,6	625,8	582,0	718,0	599,5	525,6	491,5	495,9	476,4	371,2	319,8
PM_{10} (tons)	Heavy fuel	080404	Internat. sea	5352,8	4177,8	3709,9	8294,4	7710,1	9545,0	9441,7	8760,3	7120,3	7706,5	8378,8	6848,7	4705,2	4291,0	3879,1	5773,8
$PM_{2,5}$ (tons)	Gas oil	080404	Internat. sea	266,0	287,9	386,0	437,1	551,6	611,5	622,6	579,1	714,4	596,4	523,0	489,1	493,4	474,0	369,3	318,2
$PM_{2,5}$ (tons)	Heavy fuel	080404	Internat. sea	5325,8	4156,7	3691,1	8252,5	7671,2	9496,8	9394,1	8716,1	7084,3	7667,6	8336,4	6814,1	4681,4	4269,3	3859,5	5744,6
FC (PJ)	Gas oil	080404	Internat. sea	11,6	12,6	16,9	19,1	24,1	26,7	27,2	25,3	31,2	26,1	22,9	21,4	21,6	20,7	16,2	13,9
FC (PJ)	Heavy fuel	080404	Internat. sea	28,5	23,5	21,0	37,0	39,0	39,5	35,7	32,4	27,0	28,5	33,2	25,9	17,5	20,5	17,3	20,6
VOC (tons)	Gas oil			593,1	645,3	870,1	990,9	1258,2	1403,7	1438,9	1347,6	1674,7	1409,0	1245,5	1174,1	1194,0	1156,0	907,7	788,1
VOC (tons)	Heavy fuel			1588,5	1313,4	1181,9	2094,5	2223,9	2266,5	2064,6	1887,0	1580,5	1686,4	1977,3	1558,6	1063,7	1250,7	1065,9	1279,0

A.3.5 2006-2030 fuel use and emission results for ferries, ferryboats and other national sea transport

Pollutant	SNAPCode	Category	2006	2007	2008	2009	2010	2015	2020	2025	2030
SO_2 (tons)	080402	Regional ferries	605.5	488.4	341.8	327.5	327.5	326.8	326.8	326.8	323.8
SO_2 (tons)	080402	Local ferries	57.2	57.2	28.6	28.6	28.6	28.6	28.6	28.6	28.6
SO_2 (tons)	080402	Other national sea	388.6	256.6	238.3	238.3	238.3	238.3	238.3	238.3	238.3
NO_X (tons)	080402	Regional ferries	4312.7	4312.7	4312.7	4334.2	4334.2	4347.1	4347.1	4347.1	3952.1
NO_X (tons)	080402	Local ferries	804.7	813.1	820.8	827.7	833.8	850.8	845.9	845.9	845.9
NO_X (tons)	080402	Other national sea	1330.8	1342.7	1354.3	1365.5	1376.2	1418.9	1433.4	1425.4	1408.6
NMVOC (tons)	080402	Regional ferries	169.9	169.9	169.9	169.9	169.9	169.9	169.9	169.9	169.9
NMVOC (tons)	080402	Local ferries	33.6	33.9	34.1	34.4	34.6	35.4	35.6	35.6	35.6
NMVOC (tons)	080402	Other national sea	43.4	43.8	44.1	44.4	44.7	46.2	47.4	48.2	48.5
CH_4 (tons)	080402	Regional ferries	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3	5.3
CH_4 (tons)	080402	Local ferries	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1
CH_4 (tons)	080402	Other national sea	1.3	1.4	1.4	1.4	1.4	1.4	1.5	1.5	1.5
CO (tons)	080402	Regional ferries	435.9	435.9	435.9	435.9	435.9	435.9	435.9	435.9	435.9
CO (tons)	080402	Local ferries	111.0	111.8	112.6	113.3	114.0	116.7	117.6	117.6	117.6
CO (tons)	080402	Other national sea	143.3	144.4	145.5	146.5	147.6	152.4	156.4	159.1	159.9
CO_2 (ktons)	080402	Regional ferries	256.5	256.5	256.5	254.7	254.7	253.7	253.7	253.7	249.0
CO_2 (ktons)	080402	Local ferries	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2	45.2
CO_2 (ktons)	080402	Other national sea	56.9	56.9	56.9	56.9	56.9	56.9	56.9	56.9	56.9
N_2O (tons)	080402	Regional ferries	16.2	16.2	16.2	16.1	16.1	16.0	16.0	16.0	15.7
N_2O (tons)	080402	Local ferries	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9	2.9
N_2O (tons)	080402	Other national sea	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6	3.6
NH_3 (tons)	080402	Regional ferries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NH_3 (tons)	080402	Local ferries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NH_3 (tons)	080402	Other national sea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TSP (tons)	080402	Regional ferries	102.2	89.6	84.4	83.1	83.1	82.8	82.8	82.8	81.4
TSP (tons)	080402	Local ferries	14.2	14.2	13.2	13.2	13.2	13.2	13.2	13.2	13.2
TSP (tons)	080402	Other national sea	42.4	28.1	27.5	27.5	27.5	27.5	27.5	27.5	27.5
PM_{10} (tons)	080402	Regional ferries	101.2	88.7	83.5	82.3	82.3	82.0	82.0	82.0	80.6
PM_{10} (tons)	080402	Local ferries	14.0	14.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
PM_{10} (tons)	080402	Other national sea	42.0	27.8	27.2	27.2	27.2	27.2	27.2	27.2	27.2
$PM_{2,5}$ (tons)	080402	Regional ferries	100.7	88.2	83.1	81.9	81.9	81.6	81.6	81.6	80.2
$PM_{2,5}$ (tons)	080402	Local ferries	14.0	14.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
$PM_{2,5}$ (tons)	080402	Other national sea	41.8	27.7	27.1	27.1	27.1	27.1	27.1	27.1	27.1
FC (PJ)	080402	Regional ferries	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.3
FC (PJ)	080402	Local ferries	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6

FC (PJ)	080402	Other national sea	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
VOC (tons)	080402	Regional ferries	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1	175.1
VOC (tons)	080402	Local ferries	34.7	34.9	35.2	35.4	35.6	36.5	36.7	36.7	36.7
VOC (tons)	080402	Other national sea	44.8	45.1	45.5	45.8	46.1	47.6	48.9	49.7	50.0

A.3.6 2006-2030 fuel use and emission results for fisheries

Pollutant	SNAPCode	Category	2006	2007	2008	2009	2010	2015	2020	2025	2030
SO_2 (tons)	080403	Fishing vessels	666.5	660.3	326.0	320.8	314.1	314.7	314.7	314.6	317.5
NO_X (tons)	080403	Fishing vessels	9665.9	9621.9	9530.5	9390.7	9229.9	9351.5	9322.7	9321.1	9404.5
NMVOC (tons)	080403	Fishing vessels	407.9	406.5	403.5	398.8	391.8	397.2	398.7	398.6	402.1
CH_4 (tons)	080403	Fishing vessels	12.8	12.8	12.7	12.5	12.3	12.5	12.5	12.5	12.6
CO (tons)	080403	Fishing vessels	1330.8	1326.3	1316.4	1300.9	1277.7	1295.7	1300.5	1300.3	1311.9
CO_2 (ktons)	080403	Fishing vessels	528.0	523.2	516.6	508.4	497.8	498.8	498.7	498.6	503.1
N_2O (tons)	080403	Fishing vessels	33.3	33.0	32.6	32.1	31.4	31.5	31.5	31.5	31.7
NH_3 (tons)	080403	Fishing vessels	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TSP (tons)	080403	Fishing vessels	165.2	163.7	150.0	147.6	144.5	144.8	144.8	144.8	146.1
PM_{10} (tons)	080403	Fishing vessels	163.5	162.0	148.5	146.1	143.1	143.4	143.3	143.3	144.6
$PM_{2,5}$ (tons)	080403	Fishing vessels	162.7	161.2	147.8	145.4	142.3	142.6	142.6	142.6	143.9
FC (PJ)	080403	Fishing vessels	7.1	7.1	7.0	6.9	6.7	6.7	6.7	6.7	6.8
VOC (tons)	080403	Fishing vessels	420.7	419.3	416.2	411.3	404.1	409.7	411.2	411.1	414.7

A.3.7 2006-2030 fuel use and emission results for international sea transport

Pollutant	Heavy fuel type	SNAPCode	Category	2006	2007	2008	2009	2010	2015	2020	2025	2030
SO_2 (tons)	Gas oil	080404	Internat. sea	1941.9	1941.9	970.9	970.9	970.9	970.9	970.9	970.9	970.9
SO_2 (tons)	Heavy fuel	080404	Internat. sea	30169.9	15085.0	15085.0	15085.0	15085.0	15085.0	15085.0	15085.0	15085.0
NO_X (tons)	Gas oil	080404	Internat. sea	31438.0	31765.7	32084.1	32392.4	32689.9	33947.8	34621.8	34723.2	34437.2
NO_X (tons)	Heavy fuel	080404	Internat. sea	42236.0	42566.9	42885.9	43191.9	43484.2	44574.5	44674.9	44109.1	43457.6
NMVOC (tons)	Gas oil	080404	Internat. sea	1147.2	1155.7	1164.1	1172.3	1180.5	1218.3	1249.2	1269.8	1276.4
NMVOC (tons)	Heavy fuel	080404	Internat. sea	1249.0	1258.7	1268.3	1277.8	1287.1	1330.5	1366.2	1390.0	1397.6
CH_4 (tons)	Gas oil	080404	Internat. sea	35.5	35.7	36.0	36.3	36.5	37.7	38.6	39.3	39.5
CH_4 (tons)	Heavy fuel	080404	Internat. sea	38.6	38.9	39.2	39.5	39.8	41.2	42.3	43.0	43.2
CO (tons)	Gas oil	080404	Internat. sea	3784.6	3812.6	3840.3	3867.5	3894.3	4019.0	4121.1	4189.1	4210.6
CO (tons)	Heavy fuel	080404	Internat. sea	4120.3	4152.4	4184.0	4215.3	4246.0	4389.4	4507.0	4585.6	4610.5
CO_2 (ktons)	Gas oil	080404	Internat. sea	1534.0	1534.0	1534.0	1534.0	1534.0	1534.0	1534.0	1534.0	1534.0
CO_2 (ktons)	Heavy fuel	080404	Internat. sea	1604.1	1604.1	1604.1	1604.1	1604.1	1604.1	1604.1	1604.1	1604.1
N_2O (tons)	Gas oil	080404	Internat. sea	97.1	97.1	97.1	97.1	97.1	97.1	97.1	97.1	97.1
N_2O (tons)	Heavy fuel	080404	Internat. sea	100.6	100.6	100.6	100.6	100.6	100.6	100.6	100.6	100.6
NH_3 (tons)	Gas oil	080404	Internat. sea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NH_3 (tons)	Heavy fuel	080404	Internat. sea	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TSP (tons)	Gas oil	080404	Internat. sea	481.2	481.2	446.7	446.7	446.7	446.7	446.7	446.7	446.7
TSP (tons)	Heavy fuel	080404	Internat. sea	5825.1	1312.8	1312.8	1312.8	1312.8	1312.8	1312.8	1312.8	1312.8
PM_{10} (tons)	Gas oil	080404	Internat. sea	476.4	476.4	442.2	442.2	442.2	442.2	442.2	442.2	442.2
PM_{10} (tons)	Heavy fuel	080404	Internat. sea	5766.9	1299.7	1299.7	1299.7	1299.7	1299.7	1299.7	1299.7	1299.7
$PM_{2,5}$ (tons)	Gas oil	080404	Internat. sea	474.0	474.0	440.0	440.0	440.0	440.0	440.0	440.0	440.0
$PM_{2,5}$ (tons)	Heavy fuel	080404	Internat. sea	5737.7	1293.1	1293.1	1293.1	1293.1	1293.1	1293.1	1293.1	1293.1
FC (PJ)	Gas oil	080404	Internat. sea	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7	20.7
FC (PJ)	Heavy fuel	080404	Internat. sea	20.6	20.6	20.6	20.6	20.6	20.6	20.6	20.6	20.6
VOC (tons)	Gas oil			1182.7	1191.4	1200.1	1208.6	1217.0	1256.0	1287.8	1309.1	1315.8
VOC (tons)	Heavy fuel			1287.6	1297.6	1307.5	1317.3	1326.9	1371.7	1408.4	1433.0	1440.8

A.3.8 1990-2030 fuel use and emission results per fuel type for total national sea transport, fisheries and international sea transport

Category	SNAPcode	Fuel type	Year	Fuel use (PJ)	SO_2 (tons)	NO_X (tons)	NMVOC (tons)	CH_4 (tons)	CO (tons)	CO_2 (ktons)	N_2O (tons)	NH_3 (tons)	TSP (tons)	PM_{10} (tons)	$PM_{2,5}$ (tons)	VOC (tons)
Nat. sea transport	080402	Gas oil	1990	4.9	463.0	5438.0	250.4	7.7	826.2	365.7	23.1	0.0	114.7	113.6	113.0	258.2
Nat. sea transport	080402	Gas oil	1991	5.6	522.2	6200.1	284.1	8.8	937.2	412.5	26.1	0.0	129.4	128.1	127.5	292.9
Nat. sea transport	080402	Gas oil	1992	6.5	606.3	7244.9	331.4	10.3	1093.4	479.0	30.3	0.0	150.2	148.7	148.0	341.7
Nat. sea transport	080402	Gas oil	1993	6.3	588.8	7059.3	322.2	10.0	1062.9	465.1	29.4	0.0	145.9	144.4	143.7	332.1
Nat. sea transport	080402	Gas oil	1994	6.2	584.4	7048.6	320.4	9.9	1057.1	461.6	29.2	0.0	144.8	143.4	142.6	330.3
Nat. sea transport	080402	Gas oil	1995	6.7	623.4	7664.2	344.9	10.7	1137.9	492.5	31.2	0.0	154.5	152.9	152.2	355.6
Nat. sea transport	080402	Gas oil	1996	8.1	763.2	9756.2	420.4	13.0	1334.0	602.9	38.2	0.0	189.1	187.2	186.3	433.4
Nat. sea transport	080402	Gas oil	1997	8.5	799.3	9590.8	421.2	13.0	1212.9	631.4	40.0	0.0	198.1	196.1	195.1	434.2
Nat. sea transport	080402	Gas oil	1998	6.9	646.8	7896.8	339.6	10.5	950.2	510.9	32.3	0.0	160.3	158.7	157.9	350.1
Nat. sea transport	080402	Gas oil	1999	5.4	507.7	6218.9	262.5	8.1	698.9	401.0	25.4	0.0	125.8	124.5	123.9	270.6
Nat. sea transport	080402	Gas oil	2000	4.4	409.5	5364.9	212.6	6.6	553.5	323.5	20.5	0.0	101.5	100.5	99.9	219.1
Nat. sea transport	080402	Gas oil	2001	4.2	390.9	5245.4	205.6	6.4	547.6	308.8	19.5	0.0	96.9	95.9	95.4	212.0
Nat. sea transport	080402	Gas oil	2002	4.1	382.5	5400.0	205.6	6.4	565.6	302.1	19.1	0.0	94.8	93.8	93.4	212.0
Nat. sea transport	080402	Gas oil	2003	4.1	382.3	5241.2	203.9	6.3	554.3	302.0	19.1	0.0	94.7	93.8	93.3	210.2
Nat. sea transport	080402	Gas oil	2004	4.2	391.8	5297.7	208.1	6.4	560.7	309.5	19.6	0.0	97.1	96.1	95.6	214.6
Nat. sea transport	080402	Gas oil	2005	4.1	387.4	5251.5	206.2	6.4	555.7	306.0	19.4	0.0	96.0	95.0	94.5	212.6
Nat. sea transport	080402	Gas oil	2006	4.1	387.0	5273.2	206.6	6.4	557.1	305.7	19.3	0.0	95.9	94.9	94.5	213.0
Nat. sea transport	080402	Gas oil	2007	4.1	387.0	5287.7	207.0	6.4	558.4	305.7	19.3	0.0	95.9	94.9	94.5	213.4
Nat. sea transport	080402	Gas oil	2008	4.1	193.5	5301.4	207.4	6.4	559.8	305.7	19.3	0.0	89.0	88.1	87.7	213.8
Nat. sea transport	080402	Gas oil	2009	4.1	193.5	5314.1	207.8	6.4	561.0	305.7	19.3	0.0	89.0	88.1	87.7	214.2
Nat. sea transport	080402	Gas oil	2010	4.1	193.5	5325.8	208.2	6.4	562.2	305.7	19.3	0.0	89.0	88.1	87.7	214.6
Nat. sea transport	080402	Gas oil	2011	4.1	193.5	5336.5	208.5	6.4	563.4	305.7	19.3	0.0	89.0	88.1	87.7	215.0
Nat. sea transport	080402	Gas oil	2012	4.1	193.2	5352.8	208.8	6.5	564.5	305.2	19.3	0.0	88.9	88.0	87.5	215.3
Nat. sea transport	080402	Gas oil	2013	4.1	193.2	5361.0	209.2	6.5	565.5	305.2	19.3	0.0	88.9	88.0	87.5	215.6
Nat. sea transport	080402	Gas oil	2014	4.1	192.8	5374.0	209.4	6.5	566.4	304.7	19.3	0.0	88.7	87.8	87.4	215.9
Nat. sea transport	080402	Gas oil	2015	4.1	192.8	5379.4	209.7	6.5	567.2	304.7	19.3	0.0	88.7	87.8	87.4	216.2
Nat. sea transport	080402	Gas oil	2016	4.1	192.8	5383.3	209.9	6.5	568.0	304.7	19.3	0.0	88.7	87.8	87.4	216.4
Nat. sea transport	080402	Gas oil	2017	4.1	192.8	5385.6	210.1	6.5	568.7	304.7	19.3	0.0	88.7	87.8	87.4	216.6
Nat. sea transport	080402	Gas oil	2018	4.1	192.8	5386.4	210.3	6.5	569.2	304.7	19.3	0.0	88.7	87.8	87.4	216.8
Nat. sea transport	080402	Gas oil	2019	4.1	192.8	5385.6	210.4	6.5	569.7	304.7	19.3	0.0	88.7	87.8	87.4	216.9
Nat. sea transport	080402	Gas oil	2020	4.1	192.8	5387.2	210.5	6.5	570.0	304.7	19.3	0.0	88.7	87.8	87.4	217.0
Nat. sea transport	080402	Gas oil	2021	4.1	192.8	5388.3	210.6	6.5	570.3	304.7	19.3	0.0	88.7	87.8	87.4	217.1
Nat. sea transport	080402	Gas oil	2022	4.1	192.8	5389.0	210.7	6.5	570.6	304.7	19.3	0.0	88.7	87.8	87.4	217.2
Nat. sea transport	080402	Gas oil	2023	4.1	192.8	5389.4	210.8	6.5	570.9	304.7	19.3	0.0	88.7	87.8	87.4	217.3

Nat. sea transport	080402	Gas oil	2024	4.1	192.8	5389.4	210.9	6.5	571.1	304.7	19.3	0.0	88.7	87.8	87.4	217.4
Nat. sea transport	080402	Gas oil	2025	4.1	192.8	5389.1	210.9	6.5	571.3	304.7	19.3	0.0	88.7	87.8	87.4	217.4
Nat. sea transport	080402	Gas oil	2026	4.1	190.8	5082.4	211.0	6.5	571.4	301.5	19.1	0.0	87.8	86.9	86.5	217.5
Nat. sea transport	080402	Gas oil	2027	4.1	190.8	5081.3	211.0	6.5	571.6	301.5	19.1	0.0	87.8	86.9	86.5	217.5
Nat. sea transport	080402	Gas oil	2028	4.1	189.9	4990.7	211.0	6.5	571.6	300.0	19.0	0.0	87.3	86.5	86.0	217.6
Nat. sea transport	080402	Gas oil	2029	4.1	189.9	4988.7	211.0	6.5	571.7	300.0	19.0	0.0	87.3	86.5	86.0	217.6
Nat. sea transport	080402	Gas oil	2030	4.1	189.9	4988.7	211.0	6.5	571.7	300.0	19.0	0.0	87.3	86.5	86.0	217.6
Nat. sea transport	080402	Heavy fuel	1990	3.8	4960.5	6152.5	204.9	6.3	676.1	299.7	18.8	0.0	573.5	567.8	564.9	211.3
Nat. sea transport	080402	Heavy fuel	1991	3.2	3673.7	4769.3	169.3	5.2	558.4	249.4	15.6	0.0	384.4	380.6	378.7	174.5
Nat. sea transport	080402	Heavy fuel	1992	2.5	2176.5	3359.2	130.1	4.0	429.3	192.9	12.1	0.0	197.4	195.4	194.4	134.2
Nat. sea transport	080402	Heavy fuel	1993	2.5	2889.7	3395.8	130.4	4.0	430.0	192.9	12.1	0.0	306.3	303.3	301.7	134.4
Nat. sea transport	080402	Heavy fuel	1994	2.6	3373.4	3615.5	138.9	4.3	458.3	205.4	12.9	0.0	387.2	383.3	381.4	143.2
Nat. sea transport	080402	Heavy fuel	1995	2.7	3827.2	3621.7	140.0	4.3	461.9	206.9	13.0	0.0	498.8	493.8	491.4	144.3
Nat. sea transport	080402	Heavy fuel	1996	2.1	2635.7	3050.2	111.5	3.4	367.9	163.6	10.3	0.0	297.1	294.1	292.6	115.0
Nat. sea transport	080402	Heavy fuel	1997	1.3	1773.4	2103.8	71.3	2.2	235.2	103.2	6.5	0.0	212.8	210.7	209.6	73.5
Nat. sea transport	080402	Heavy fuel	1998	0.9	830.1	1336.3	46.6	1.4	153.6	67.2	4.2	0.0	78.1	77.3	76.9	48.0
Nat. sea transport	080402	Heavy fuel	1999	0.7	699.2	1094.0	39.3	1.2	129.6	56.6	3.5	0.0	65.8	65.1	64.8	40.5
Nat. sea transport	080402	Heavy fuel	2000	0.7	632.8	1089.1	38.9	1.2	128.4	55.8	3.5	0.0	57.5	56.9	56.6	40.1
Nat. sea transport	080402	Heavy fuel	2001	0.7	557.7	1047.6	36.8	1.1	121.6	52.3	3.3	0.0	49.7	49.2	49.0	38.0
Nat. sea transport	080402	Heavy fuel	2002	0.7	486.3	1040.8	36.4	1.1	120.1	51.4	3.2	0.0	42.4	41.9	41.7	37.5
Nat. sea transport	080402	Heavy fuel	2003	0.6	512.6	1034.7	36.0	1.1	118.7	50.5	3.2	0.0	45.2	44.7	44.5	37.1
Nat. sea transport	080402	Heavy fuel	2004	0.7	651.2	1069.0	37.5	1.2	123.6	52.5	3.3	0.0	61.4	60.8	60.5	38.6
Nat. sea transport	080402	Heavy fuel	2005	0.7	664.4	1169.0	40.2	1.2	132.5	53.0	3.3	0.0	62.9	62.3	62.0	41.4
Nat. sea transport	080402	Heavy fuel	2006	0.7	664.4	1175.0	40.3	1.2	133.1	53.0	3.3	0.0	62.9	62.3	62.0	41.6
Nat. sea transport	080402	Heavy fuel	2007	0.7	415.2	1180.8	40.5	1.3	133.6	53.0	3.3	0.0	36.0	35.6	35.5	41.8
Nat. sea transport	080402	Heavy fuel	2008	0.7	415.2	1186.4	40.7	1.3	134.2	53.0	3.3	0.0	36.0	35.6	35.5	41.9
Nat. sea transport	080402	Heavy fuel	2009	0.7	400.9	1213.2	40.8	1.3	134.7	51.2	3.2	0.0	34.8	34.4	34.2	42.1
Nat. sea transport	080402	Heavy fuel	2010	0.7	400.9	1218.3	41.0	1.3	135.3	51.2	3.2	0.0	34.8	34.4	34.2	42.3
Nat. sea transport	080402	Heavy fuel	2011	0.7	400.9	1223.2	41.2	1.3	135.8	51.2	3.2	0.0	34.8	34.4	34.2	42.4
Nat. sea transport	080402	Heavy fuel	2012	0.7	400.9	1227.8	41.3	1.3	136.3	51.2	3.2	0.0	34.8	34.4	34.2	42.6
Nat. sea transport	080402	Heavy fuel	2013	0.7	400.9	1231.7	41.5	1.3	136.8	51.2	3.2	0.0	34.8	34.4	34.2	42.8
Nat. sea transport	080402	Heavy fuel	2014	0.7	400.9	1234.9	41.6	1.3	137.3	51.2	3.2	0.0	34.8	34.4	34.2	42.9
Nat. sea transport	080402	Heavy fuel	2015	0.7	400.9	1237.4	41.8	1.3	137.8	51.2	3.2	0.0	34.8	34.4	34.2	43.1
Nat. sea transport	080402	Heavy fuel	2016	0.7	400.9	1239.2	41.9	1.3	138.2	51.2	3.2	0.0	34.8	34.4	34.2	43.2
Nat. sea transport	080402	Heavy fuel	2017	0.7	400.9	1240.1	42.0	1.3	138.7	51.2	3.2	0.0	34.8	34.4	34.2	43.3
Nat. sea transport	080402	Heavy fuel	2018	0.7	400.9	1240.5	42.2	1.3	139.1	51.2	3.2	0.0	34.8	34.4	34.2	43.5
Nat. sea transport	080402	Heavy fuel	2019	0.7	400.9	1240.2	42.3	1.3	139.5	51.2	3.2	0.0	34.8	34.4	34.2	43.6

Nat. sea transport	080402	Heavy fuel	2020	0.7	400.9	1239.2	42.4	1.3	139.8	51.2	3.2	0.0	34.8	34.4	34.2	43.7
Nat. sea transport	080402	Heavy fuel	2021	0.7	400.9	1237.5	42.5	1.3	140.2	51.2	3.2	0.0	34.8	34.4	34.2	43.8
Nat. sea transport	080402	Heavy fuel	2022	0.7	400.9	1235.7	42.6	1.3	140.5	51.2	3.2	0.0	34.8	34.4	34.2	43.9
Nat. sea transport	080402	Heavy fuel	2023	0.7	400.9	1233.7	42.7	1.3	140.8	51.2	3.2	0.0	34.8	34.4	34.2	44.0
Nat. sea transport	080402	Heavy fuel	2024	0.7	400.9	1231.6	42.7	1.3	141.0	51.2	3.2	0.0	34.8	34.4	34.2	44.1
Nat. sea transport	080402	Heavy fuel	2025	0.7	400.9	1229.3	42.8	1.3	141.2	51.2	3.2	0.0	34.8	34.4	34.2	44.1
Nat. sea transport	080402	Heavy fuel	2026	0.7	400.9	1226.8	42.9	1.3	141.4	51.2	3.2	0.0	34.8	34.4	34.2	44.2
Nat. sea transport	080402	Heavy fuel	2027	0.7	400.9	1224.0	42.9	1.3	141.5	51.2	3.2	0.0	34.8	34.4	34.2	44.2
Nat. sea transport	080402	Heavy fuel	2028	0.7	400.9	1221.1	42.9	1.3	141.6	51.2	3.2	0.0	34.8	34.4	34.2	44.3
Nat. sea transport	080402	Heavy fuel	2029	0.7	400.9	1217.9	42.9	1.3	141.7	51.2	3.2	0.0	34.8	34.4	34.2	44.3
Nat. sea transport	080402	Heavy fuel	2030	0.7	400.9	1217.9	42.9	1.3	141.7	51.2	3.2	0.0	34.8	34.4	34.2	44.3
Nat. sea transport	080402	Kerosene	1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nat. sea transport	080402	Kerosene	1991	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Nat. sea transport	080402	Kerosene	1992	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Nat. sea transport	080402	Kerosene	1993	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Nat. sea transport	080402	Kerosene	1994	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Nat. sea transport	080402	Kerosene	1995	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Nat. sea transport	080402	Kerosene	1996	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nat. sea transport	080402	Kerosene	1997	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nat. sea transport	080402	Kerosene	1998	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Nat. sea transport	080402	Kerosene	1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nat. sea transport	080402	Kerosene	2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nat. sea transport	080402	Kerosene	2001	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nat. sea transport	080402	Kerosene	2002	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Nat. sea transport	080402	Kerosene	2003	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Nat. sea transport	080402	Kerosene	2004	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Nat. sea transport	080402	Kerosene	2005	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Nat. sea transport	080402	LPG	1990	0.0	0.0	2.2	0.7	0.0	0.8	0.1	0.0	0.0	0.0	0.0	0.0	0.7
Nat. sea transport	080402	LPG	1991	0.0	0.0	2.1	0.7	0.0	0.8	0.1	0.0	0.0	0.0	0.0	0.0	0.7
Nat. sea transport	080402	LPG	1992	0.0	0.0	3.9	1.2	0.1	1.4	0.2	0.0	0.0	0.0	0.0	0.0	1.3
Nat. sea transport	080402	LPG	1993	0.0	0.0	19.6	6.1	0.3	7.0	1.0	0.0	0.0	0.0	0.0	0.0	6.4
Nat. sea transport	080402	LPG	1994	0.0	0.0	1.8	0.5	0.0	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.6
Nat. sea transport	080402	LPG	1995	0.0	0.0	2.9	0.9	0.0	1.0	0.1	0.0	0.0	0.0	0.0	0.0	0.9
Nat. sea transport	080402	LPG	1996	0.0	0.0	1.4	0.4	0.0	0.5	0.1	0.0	0.0	0.0	0.0	0.0	0.5
Nat. sea transport	080402	LPG	1997	0.0	0.0	1.9	0.6	0.0	0.7	0.1	0.0	0.0	0.0	0.0	0.0	0.6
Nat. sea transport	080402	LPG	1998	0.0	0.0	3.4	1.0	0.1	1.2	0.2	0.0	0.0	0.0	0.0	0.0	1.1
Nat. sea transport	080402	LPG	1999	0.0	0.0	1.0	0.3	0.0	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.3

Nat. sea transport	080402	LPG	2000	0.0	0.0	0.2	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Nat. sea transport	080402	LPG	2003	0.0	0.0	0.3	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Nat. sea transport	080402	LPG	2004	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nat. sea transport	080402	LPG	2005	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fisheries	080403	Gas oil	1990	7.9	741.9	8332.7	389.1	12.0	1283.6	586.1	37.1	0.0	183.8	182.0	181.1	401.1
Fisheries	080403	Gas oil	1991	8.2	765.3	8749.4	404.1	12.5	1333.2	604.6	38.3	0.0	189.6	187.8	186.8	416.6
Fisheries	080403	Gas oil	1992	7.5	700.9	8160.1	372.8	11.5	1229.7	553.7	35.0	0.0	173.7	171.9	171.1	384.3
Fisheries	080403	Gas oil	1993	7.1	662.7	7862.1	355.1	11.0	1171.6	523.5	33.1	0.0	164.2	162.6	161.8	366.1
Fisheries	080403	Gas oil	1994	7.1	664.9	8041.2	359.1	11.1	1184.7	525.2	33.2	0.0	164.8	163.1	162.3	370.2
Fisheries	080403	Gas oil	1995	7.1	668.3	8244.6	364.0	11.3	1200.7	527.9	33.4	0.0	165.6	163.9	163.1	375.2
Fisheries	080403	Gas oil	1996	6.8	635.8	8003.6	349.3	10.8	1152.3	502.2	31.8	0.0	157.5	156.0	155.2	360.1
Fisheries	080403	Gas oil	1997	5.5	514.0	6606.1	285.0	8.8	940.2	406.1	25.7	0.0	127.4	126.1	125.5	293.8
Fisheries	080403	Gas oil	1998	5.7	535.8	7032.3	299.9	9.3	989.5	423.2	26.8	0.0	132.8	131.4	130.8	309.2
Fisheries	080403	Gas oil	1999	6.5	613.2	8224.1	346.8	10.7	1144.1	484.4	30.7	0.0	152.0	150.4	149.7	357.5
Fisheries	080403	Gas oil	2000	7.6	708.8	9649.5	405.1	12.5	1336.5	559.9	35.4	0.0	175.6	173.9	173.0	417.7
Fisheries	080403	Gas oil	2001	7.1	669.3	9238.1	386.5	12.0	1275.0	528.7	33.5	0.0	165.9	164.2	163.4	398.4
Fisheries	080403	Gas oil	2002	7.7	721.2	10078.7	420.5	13.0	1387.1	569.7	36.1	0.0	178.7	176.9	176.0	433.5
Fisheries	080403	Gas oil	2003	7.2	677.3	9569.0	398.4	12.3	1314.3	535.0	33.9	0.0	167.8	166.2	165.3	410.7
Fisheries	080403	Gas oil	2004	5.6	526.1	7503.9	312.0	9.7	1029.4	415.6	26.3	0.0	130.4	129.1	128.4	321.7
Fisheries	080403	Gas oil	2005	6.6	614.6	8836.9	367.3	11.4	1211.7	485.5	30.7	0.0	152.3	150.8	150.0	378.7
Fisheries	080403	Gas oil	2006	7.1	666.5	9643.3	401.0	12.4	1322.8	526.5	33.3	0.0	165.2	163.5	162.7	413.4
Fisheries	080403	Gas oil	2007	7.0	660.3	9599.3	399.6	12.4	1318.3	521.6	33.0	0.0	163.6	162.0	161.2	412.0
Fisheries	080403	Gas oil	2008	7.0	326.0	9507.9	396.6	12.3	1308.4	515.1	32.6	0.0	150.0	148.5	147.7	408.9
Fisheries	080403	Gas oil	2009	6.8	320.8	9368.1	391.9	12.1	1292.9	506.9	32.1	0.0	147.6	146.1	145.4	404.0
Fisheries	080403	Gas oil	2010	6.7	314.1	9207.3	384.9	11.9	1269.7	496.2	31.4	0.0	144.5	143.0	142.3	396.8
Fisheries	080403	Gas oil	2011	6.7	314.0	9238.3	386.0	11.9	1273.4	496.2	31.4	0.0	144.5	143.0	142.3	397.9
Fisheries	080403	Gas oil	2012	6.7	314.4	9273.6	387.4	12.0	1278.1	496.7	31.4	0.0	144.6	143.2	142.4	399.4
Fisheries	080403	Gas oil	2013	6.7	314.4	9295.5	388.4	12.0	1281.3	496.7	31.4	0.0	144.6	143.2	142.5	400.4
Fisheries	080403	Gas oil	2014	6.7	314.7	9319.9	389.6	12.1	1285.4	497.2	31.5	0.0	144.8	143.3	142.6	401.7
Fisheries	080403	Gas oil	2015	6.7	314.7	9328.9	390.3	12.1	1287.7	497.2	31.5	0.0	144.8	143.3	142.6	402.4
Fisheries	080403	Gas oil	2016	6.7	314.7	9330.9	390.9	12.1	1289.5	497.2	31.5	0.0	144.8	143.3	142.6	403.0
Fisheries	080403	Gas oil	2017	6.7	314.7	9328.2	391.4	12.1	1291.1	497.2	31.5	0.0	144.8	143.3	142.6	403.5
Fisheries	080403	Gas oil	2018	6.7	314.7	9317.2	391.6	12.1	1292.0	497.2	31.5	0.0	144.8	143.3	142.6	403.8
Fisheries	080403	Gas oil	2019	6.7	314.7	9299.3	391.7	12.1	1292.4	497.1	31.5	0.0	144.7	143.3	142.6	403.9
Fisheries	080403	Gas oil	2020	6.7	314.7	9300.1	391.8	12.1	1292.5	497.2	31.5	0.0	144.8	143.3	142.6	403.9
Fisheries	080403	Gas oil	2021	6.7	314.7	9300.0	391.8	12.1	1292.5	497.2	31.5	0.0	144.8	143.3	142.6	403.9
Fisheries	080403	Gas oil	2022	6.7	314.7	9299.5	391.8	12.1	1292.4	497.1	31.5	0.0	144.8	143.3	142.6	403.9

Fisheries	080403	Gas oil	2023	6.7	314.7	9299.9	391.8	12.1	1292.5	497.2	31.5	0.0	144.8	143.3	142.6	403.9
Fisheries	080403	Gas oil	2024	6.7	314.6	9297.4	391.7	12.1	1292.1	497.0	31.5	0.0	144.7	143.3	142.5	403.8
Fisheries	080403	Gas oil	2025	6.7	314.6	9298.5	391.7	12.1	1292.3	497.1	31.5	0.0	144.7	143.3	142.6	403.8
Fisheries	080403	Gas oil	2026	6.8	316.6	9356.9	394.2	12.2	1300.4	500.2	31.7	0.0	145.6	144.2	143.5	406.4
Fisheries	080403	Gas oil	2027	6.8	316.6	9355.6	394.1	12.2	1300.2	500.1	31.7	0.0	145.6	144.2	143.4	406.3
Fisheries	080403	Gas oil	2028	6.8	317.5	9384.2	395.3	12.2	1304.2	501.7	31.8	0.0	146.1	144.6	143.9	407.6
Fisheries	080403	Gas oil	2029	6.8	317.5	9382.3	395.2	12.2	1303.9	501.6	31.7	0.0	146.0	144.6	143.9	407.5
Fisheries	080403	Gas oil	2030	6.8	317.4	9381.9	395.2	12.2	1303.9	501.5	31.7	0.0	146.0	144.6	143.8	407.5
Fisheries	080403	Kerosene	1990	0.0	0.1	1.3	0.1	0.2	0.5	1.9	0.0	0.0	0.1	0.1	0.1	0.3
Fisheries	080403	Kerosene	1991	0.0	0.0	0.4	0.0	0.1	0.2	0.6	0.0	0.0	0.0	0.0	0.0	0.1
Fisheries	080403	Kerosene	1992	0.0	0.0	0.3	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.1
Fisheries	080403	Kerosene	1993	0.0	0.0	0.2	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
Fisheries	080403	Kerosene	1994	0.0	0.0	0.2	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Fisheries	080403	Kerosene	1995	0.0	0.0	0.2	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0
Fisheries	080403	Kerosene	1996	0.0	0.0	0.2	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Fisheries	080403	Kerosene	1997	0.0	0.0	0.1	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Fisheries	080403	Kerosene	1998	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Fisheries	080403	Kerosene	1999	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fisheries	080403	Kerosene	2000	0.0	0.1	1.2	0.1	0.2	0.5	1.8	0.0	0.0	0.1	0.1	0.1	0.2
Fisheries	080403	Kerosene	2001	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Fisheries	080403	Kerosene	2002	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fisheries	080403	Kerosene	2003	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Fisheries	080403	Kerosene	2004	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Fisheries	080403	Kerosene	2005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Fisheries	080403	Kerosene	2006	0.0	0.0	0.3	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.1
Fisheries	080403	Kerosene	2007	0.0	0.0	0.3	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.1
Fisheries	080403	Kerosene	2008	0.0	0.0	0.3	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.1
Fisheries	080403	Kerosene	2009	0.0	0.0	0.3	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.1
Fisheries	080403	Kerosene	2010	0.0	0.0	0.3	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.1
Fisheries	080403	Kerosene	2011	0.0	0.0	0.3	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.1
Fisheries	080403	Kerosene	2012	0.0	0.0	0.3	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.1
Fisheries	080403	Kerosene	2013	0.0	0.0	0.3	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.1
Fisheries	080403	Kerosene	2014	0.0	0.0	0.3	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.1
Fisheries	080403	Kerosene	2015	0.0	0.0	0.3	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.1
Fisheries	080403	Kerosene	2016	0.0	0.0	0.3	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.1
Fisheries	080403	Kerosene	2017	0.0	0.0	0.3	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.1
Fisheries	080403	Kerosene	2018	0.0	0.0	0.3	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.1

Fisheries	080403	Kerosene	2019	0.0	0.0	0.3	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.1
Fisheries	080403	Kerosene	2020	0.0	0.0	0.3	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.1
Fisheries	080403	Kerosene	2021	0.0	0.0	0.3	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.1
Fisheries	080403	Kerosene	2022	0.0	0.0	0.3	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.1
Fisheries	080403	Kerosene	2023	0.0	0.0	0.3	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.1
Fisheries	080403	Kerosene	2024	0.0	0.0	0.3	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.1
Fisheries	080403	Kerosene	2025	0.0	0.0	0.3	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.1
Fisheries	080403	Kerosene	2026	0.0	0.0	0.3	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.1
Fisheries	080403	Kerosene	2027	0.0	0.0	0.3	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.1
Fisheries	080403	Kerosene	2028	0.0	0.0	0.3	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.1
Fisheries	080403	Kerosene	2029	0.0	0.0	0.3	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.1
Fisheries	080403	Kerosene	2030	0.0	0.0	0.3	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.0	0.1
Fisheries	080403	LPG	1990	0.0	0.0	52.9	16.3	0.9	18.7	2.8	0.0	0.0	0.0	0.0	0.0	17.1
Fisheries	080403	LPG	1991	0.0	0.0	42.3	13.0	0.7	15.0	2.2	0.0	0.0	0.0	0.0	0.0	13.7
Fisheries	080403	LPG	1992	0.0	0.0	37.2	11.5	0.6	13.2	1.9	0.0	0.0	0.0	0.0	0.0	12.1
Fisheries	080403	LPG	1993	0.0	0.0	14.6	4.5	0.2	5.2	0.8	0.0	0.0	0.0	0.0	0.0	4.7
Fisheries	080403	LPG	1994	0.0	0.0	22.1	6.8	0.4	7.8	1.1	0.0	0.0	0.0	0.0	0.0	7.2
Fisheries	080403	LPG	1995	0.0	0.0	19.6	6.0	0.3	6.9	1.0	0.0	0.0	0.0	0.0	0.0	6.4
Fisheries	080403	LPG	1996	0.0	0.0	45.0	13.9	0.7	16.0	2.3	0.0	0.0	0.0	0.0	0.0	14.6
Fisheries	080403	LPG	1997	0.0	0.0	6.4	2.0	0.1	2.3	0.3	0.0	0.0	0.0	0.0	0.0	2.1
Fisheries	080403	LPG	1998	0.0	0.0	1.5	0.5	0.0	0.5	0.1	0.0	0.0	0.0	0.0	0.0	0.5
Fisheries	080403	LPG	1999	0.0	0.0	20.1	6.2	0.3	7.1	1.0	0.0	0.0	0.0	0.0	0.0	6.5
Fisheries	080403	LPG	2000	0.0	0.0	15.9	4.9	0.3	5.6	0.8	0.0	0.0	0.0	0.0	0.0	5.2
Fisheries	080403	LPG	2001	0.0	0.0	24.0	7.4	0.4	8.5	1.2	0.0	0.0	0.0	0.0	0.0	7.8
Fisheries	080403	LPG	2002	0.0	0.0	26.2	8.1	0.4	9.3	1.4	0.0	0.0	0.0	0.0	0.0	8.5
Fisheries	080403	LPG	2003	0.0	0.0	25.4	7.8	0.4	9.0	1.3	0.0	0.0	0.0	0.0	0.0	8.2
Fisheries	080403	LPG	2004	0.0	0.0	23.0	7.1	0.4	8.2	1.2	0.0	0.0	0.0	0.0	0.0	7.5
Fisheries	080403	LPG	2005	0.0	0.0	25.5	7.8	0.4	9.0	1.3	0.0	0.0	0.0	0.0	0.0	8.3
Fisheries	080403	LPG	2006	0.0	0.0	22.3	6.9	0.4	7.9	1.2	0.0	0.0	0.0	0.0	0.0	7.2
Fisheries	080403	LPG	2007	0.0	0.0	22.3	6.9	0.4	7.9	1.2	0.0	0.0	0.0	0.0	0.0	7.2
Fisheries	080403	LPG	2008	0.0	0.0	22.3	6.9	0.4	7.9	1.2	0.0	0.0	0.0	0.0	0.0	7.2
Fisheries	080403	LPG	2009	0.0	0.0	22.3	6.9	0.4	7.9	1.2	0.0	0.0	0.0	0.0	0.0	7.2
Fisheries	080403	LPG	2010	0.0	0.0	22.3	6.9	0.4	7.9	1.2	0.0	0.0	0.0	0.0	0.0	7.2
Fisheries	080403	LPG	2011	0.0	0.0	22.3	6.9	0.4	7.9	1.2	0.0	0.0	0.0	0.0	0.0	7.2
Fisheries	080403	LPG	2012	0.0	0.0	22.3	6.9	0.4	7.9	1.2	0.0	0.0	0.0	0.0	0.0	7.2
Fisheries	080403	LPG	2013	0.0	0.0	22.3	6.9	0.4	7.9	1.2	0.0	0.0	0.0	0.0	0.0	7.2
Fisheries	080403	LPG	2014	0.0	0.0	22.3	6.9	0.4	7.9	1.2	0.0	0.0	0.0	0.0	0.0	7.2

Fisheries	080403	LPG	2015	0.0	0.0	22.3	6.9	0.4	7.9	1.2	0.0	0.0	0.0	0.0	0.0	7.2
Fisheries	080403	LPG	2016	0.0	0.0	22.3	6.9	0.4	7.9	1.2	0.0	0.0	0.0	0.0	0.0	7.2
Fisheries	080403	LPG	2017	0.0	0.0	22.3	6.9	0.4	7.9	1.2	0.0	0.0	0.0	0.0	0.0	7.2
Fisheries	080403	LPG	2018	0.0	0.0	22.3	6.9	0.4	7.9	1.2	0.0	0.0	0.0	0.0	0.0	7.2
Fisheries	080403	LPG	2019	0.0	0.0	22.3	6.9	0.4	7.9	1.2	0.0	0.0	0.0	0.0	0.0	7.2
Fisheries	080403	LPG	2020	0.0	0.0	22.3	6.9	0.4	7.9	1.2	0.0	0.0	0.0	0.0	0.0	7.2
Fisheries	080403	LPG	2021	0.0	0.0	22.3	6.9	0.4	7.9	1.2	0.0	0.0	0.0	0.0	0.0	7.2
Fisheries	080403	LPG	2022	0.0	0.0	22.3	6.9	0.4	7.9	1.2	0.0	0.0	0.0	0.0	0.0	7.2
Fisheries	080403	LPG	2023	0.0	0.0	22.3	6.9	0.4	7.9	1.2	0.0	0.0	0.0	0.0	0.0	7.2
Fisheries	080403	LPG	2024	0.0	0.0	22.3	6.9	0.4	7.9	1.2	0.0	0.0	0.0	0.0	0.0	7.2
Fisheries	080403	LPG	2025	0.0	0.0	22.3	6.9	0.4	7.9	1.2	0.0	0.0	0.0	0.0	0.0	7.2
Fisheries	080403	LPG	2026	0.0	0.0	22.3	6.9	0.4	7.9	1.2	0.0	0.0	0.0	0.0	0.0	7.2
Fisheries	080403	LPG	2027	0.0	0.0	22.3	6.9	0.4	7.9	1.2	0.0	0.0	0.0	0.0	0.0	7.2
Fisheries	080403	LPG	2028	0.0	0.0	22.3	6.9	0.4	7.9	1.2	0.0	0.0	0.0	0.0	0.0	7.2
Fisheries	080403	LPG	2029	0.0	0.0	22.3	6.9	0.4	7.9	1.2	0.0	0.0	0.0	0.0	0.0	7.2
Fisheries	080403	LPG	2030	0.0	0.0	22.3	6.9	0.4	7.9	1.2	0.0	0.0	0.0	0.0	0.0	7.2
Int. sea transport	080404	Gas oil	1990	11.6	1089.7	14059.3	575.4	17.8	1898.1	860.8	54.5	0.0	270.0	267.3	266.0	593.1
Int. sea transport	080404	Gas oil	1991	12.6	1179.4	15456.7	626.0	19.4	2065.1	931.6	59.0	0.0	292.2	289.3	287.9	645.3
Int. sea transport	080404	Gas oil	1992	16.9	1581.3	21053.2	844.0	26.1	2784.2	1249.2	79.1	0.0	391.9	387.9	386.0	870.1
Int. sea transport	080404	Gas oil	1993	19.1	1790.6	24217.9	961.2	29.7	3170.9	1414.5	89.5	0.0	443.7	439.3	437.1	990.9
Int. sea transport	080404	Gas oil	1994	24.1	2259.7	31051.7	1220.4	37.7	4026.2	1785.1	113.0	0.0	560.0	554.4	551.6	1258.2
Int. sea transport	080404	Gas oil	1995	26.7	2505.2	34976.4	1361.6	42.1	4491.9	1979.0	125.3	0.0	620.8	614.6	611.5	1403.7
Int. sea transport	080404	Gas oil	1996	27.2	2550.9	36190.0	1395.7	43.2	4604.4	2015.1	127.5	0.0	632.1	625.8	622.6	1438.9
Int. sea transport	080404	Gas oil	1997	25.3	2372.4	34205.3	1307.1	40.4	4312.2	1874.0	118.6	0.0	587.9	582.0	579.1	1347.6
Int. sea transport	080404	Gas oil	1998	31.2	2926.8	42892.9	1624.5	50.2	5359.1	2312.0	146.3	0.0	725.3	718.0	714.4	1674.7
Int. sea transport	080404	Gas oil	1999	26.1	2443.6	36406.6	1366.8	42.3	4508.9	1930.3	122.2	0.0	605.5	599.5	596.4	1409.0
Int. sea transport	080404	Gas oil	2000	22.9	2142.6	32338.3	1208.1	37.4	3985.6	1692.6	107.1	0.0	530.9	525.6	523.0	1245.5
Int. sea transport	080404	Gas oil	2001	21.4	2003.7	30624.3	1138.9	35.2	3757.1	1582.8	100.2	0.0	496.5	491.5	489.1	1174.1
Int. sea transport	080404	Gas oil	2002	21.6	2021.5	31277.5	1158.2	35.8	3820.7	1596.9	101.1	0.0	500.9	495.9	493.4	1194.0
Int. sea transport	080404	Gas oil	2003	20.7	1941.9	30405.0	1121.3	34.7	3699.1	1534.0	97.1	0.0	481.2	476.4	474.0	1156.0
Int. sea transport	080404	Gas oil	2004	16.2	1513.1	23965.1	880.5	27.2	2904.6	1195.3	75.7	0.0	374.9	371.2	369.3	907.7
Int. sea transport	080404	Gas oil	2005	13.9	1303.7	20880.8	764.5	23.6	2521.9	1029.9	65.2	0.0	323.1	319.8	318.2	788.1
Int. sea transport	080404	Gas oil	2006	20.7	1941.9	31438.0	1147.2	35.5	3784.6	1534.0	97.1	0.0	481.2	476.4	474.0	1182.7
Int. sea transport	080404	Gas oil	2007	20.7	1941.9	31765.7	1155.7	35.7	3812.6	1534.0	97.1	0.0	481.2	476.4	474.0	1191.4
Int. sea transport	080404	Gas oil	2008	20.7	970.9	32084.1	1164.1	36.0	3840.3	1534.0	97.1	0.0	446.7	442.2	440.0	1200.1
Int. sea transport	080404	Gas oil	2009	20.7	970.9	32392.4	1172.3	36.3	3867.5	1534.0	97.1	0.0	446.7	442.2	440.0	1208.6
Int. sea transport	080404	Gas oil	2010	20.7	970.9	32689.9	1180.5	36.5	3894.3	1534.0	97.1	0.0	446.7	442.2	440.0	1217.0

Int. sea transport	080404	Gas oil	2011	20.7	970.9	32975.9	1188.4	36.8	3920.6	1534.0	97.1	0.0	446.7	442.2	440.0	1225.2
Int. sea transport	080404	Gas oil	2012	20.7	970.9	33249.7	1196.2	37.0	3946.3	1534.0	97.1	0.0	446.7	442.2	440.0	1233.2
Int. sea transport	080404	Gas oil	2013	20.7	970.9	33503.6	1203.8	37.2	3971.3	1534.0	97.1	0.0	446.7	442.2	440.0	1241.0
Int. sea transport	080404	Gas oil	2014	20.7	970.9	33736.6	1211.2	37.5	3995.6	1534.0	97.1	0.0	446.7	442.2	440.0	1248.6
Int. sea transport	080404	Gas oil	2015	20.7	970.9	33947.8	1218.3	37.7	4019.0	1534.0	97.1	0.0	446.7	442.2	440.0	1256.0
Int. sea transport	080404	Gas oil	2016	20.7	970.9	34133.5	1225.1	37.9	4041.6	1534.0	97.1	0.0	446.7	442.2	440.0	1263.0
Int. sea transport	080404	Gas oil	2017	20.7	970.9	34292.6	1231.7	38.1	4063.2	1534.0	97.1	0.0	446.7	442.2	440.0	1269.7
Int. sea transport	080404	Gas oil	2018	20.7	970.9	34427.7	1237.9	38.3	4083.7	1534.0	97.1	0.0	446.7	442.2	440.0	1276.2
Int. sea transport	080404	Gas oil	2019	20.7	970.9	34537.8	1243.7	38.5	4103.0	1534.0	97.1	0.0	446.7	442.2	440.0	1282.2
Int. sea transport	080404	Gas oil	2020	20.7	970.9	34621.8	1249.2	38.6	4121.1	1534.0	97.1	0.0	446.7	442.2	440.0	1287.8
Int. sea transport	080404	Gas oil	2021	20.7	970.9	34678.9	1254.3	38.8	4137.8	1534.0	97.1	0.0	446.7	442.2	440.0	1293.1
Int. sea transport	080404	Gas oil	2022	20.7	970.9	34718.4	1258.9	38.9	4153.1	1534.0	97.1	0.0	446.7	442.2	440.0	1297.8
Int. sea transport	080404	Gas oil	2023	20.7	970.9	34739.4	1263.1	39.1	4166.8	1534.0	97.1	0.0	446.7	442.2	440.0	1302.1
Int. sea transport	080404	Gas oil	2024	20.7	970.9	34741.3	1266.7	39.2	4178.8	1534.0	97.1	0.0	446.7	442.2	440.0	1305.9
Int. sea transport	080404	Gas oil	2025	20.7	970.9	34723.2	1269.8	39.3	4189.1	1534.0	97.1	0.0	446.7	442.2	440.0	1309.1
Int. sea transport	080404	Gas oil	2026	20.7	970.9	34684.4	1272.4	39.4	4197.5	1534.0	97.1	0.0	446.7	442.2	440.0	1311.7
Int. sea transport	080404	Gas oil	2027	20.7	970.9	34624.3	1274.3	39.4	4204.0	1534.0	97.1	0.0	446.7	442.2	440.0	1313.8
Int. sea transport	080404	Gas oil	2028	20.7	970.9	34542.1	1275.7	39.5	4208.4	1534.0	97.1	0.0	446.7	442.2	440.0	1315.1
Int. sea transport	080404	Gas oil	2029	20.7	970.9	34437.2	1276.4	39.5	4210.6	1534.0	97.1	0.0	446.7	442.2	440.0	1315.8
Int. sea transport	080404	Gas oil	2030	20.7	970.9	34437.2	1276.4	39.5	4210.6	1534.0	97.1	0.0	446.7	442.2	440.0	1315.8
Int. sea transport	080404	Heavy fuel	1990	28.5	41314.6	48225.9	1540.9	47.7	5083.3	2226.4	139.6	0.0	5406.9	5352.8	5325.8	1588.5
Int. sea transport	080404	Heavy fuel	1991	23.5	33168.5	40274.1	1274.0	39.4	4203.0	1830.7	114.8	0.0	4220.0	4177.8	4156.7	1313.4
Int. sea transport	080404	Heavy fuel	1992	21.0	29571.1	36583.2	1146.4	35.5	3781.9	1637.8	102.7	0.0	3747.4	3709.9	3691.1	1181.9
Int. sea transport	080404	Heavy fuel	1993	37.0	57878.3	65414.5	2031.7	62.8	6702.4	2885.1	180.9	0.0	8378.2	8294.4	8252.5	2094.5
Int. sea transport	080404	Heavy fuel	1994	39.0	57821.1	70042.1	2157.2	66.7	7116.5	3043.9	190.8	0.0	7788.0	7710.1	7671.2	2223.9
Int. sea transport	080404	Heavy fuel	1995	39.5	63754.9	71951.5	2198.5	68.0	7252.8	3081.7	193.2	0.0	9641.4	9545.0	9496.8	2266.5
Int. sea transport	080404	Heavy fuel	1996	35.7	59769.0	66030.5	2002.7	61.9	6606.7	2787.6	174.8	0.0	9537.1	9441.7	9394.1	2064.6
Int. sea transport	080404	Heavy fuel	1997	32.4	54705.3	60771.9	1830.4	56.6	6038.5	2529.3	158.6	0.0	8848.8	8760.3	8716.1	1887.0
Int. sea transport	080404	Heavy fuel	1998	27.0	45073.5	51231.7	1533.1	47.4	5057.6	2102.2	131.8	0.0	7192.2	7120.3	7084.3	1580.5
Int. sea transport	080404	Heavy fuel	1999	28.5	48124.7	54993.7	1635.8	50.6	5396.4	2225.0	139.5	0.0	7784.3	7706.5	7667.6	1686.4
Int. sea transport	080404	Heavy fuel	2000	33.2	54491.7	64572.8	1918.0	59.3	6327.4	2586.9	162.2	0.0	8463.4	8378.8	8336.4	1977.3
Int. sea transport	080404	Heavy fuel	2001	25.9	43354.0	50961.2	1511.8	46.8	4987.5	2022.0	126.8	0.0	6917.8	6848.7	6814.1	1558.6
Int. sea transport	080404	Heavy fuel	2002	17.5	29516.1	34817.2	1031.8	31.9	3404.0	1368.6	85.8	0.0	4752.7	4705.2	4681.4	1063.7
Int. sea transport	080404	Heavy fuel	2003	20.5	31118.0	40971.0	1213.2	37.5	4002.3	1596.0	100.1	0.0	4334.3	4291.0	4269.3	1250.7
Int. sea transport	080404	Heavy fuel	2004	17.3	27067.9	34940.7	1034.0	32.0	3411.0	1349.3	84.6	0.0	3918.2	3879.1	3859.5	1065.9
Int. sea transport	080404	Heavy fuel	2005	20.6	35240.6	41944.3	1240.7	38.4	4092.9	1606.1	100.7	0.0	5832.1	5773.8	5744.6	1279.0
Int. sea transport	080404	Heavy fuel	2006	20.6	35198.2	42236.0	1249.0	38.6	4120.3	1604.1	100.6	0.0	5825.1	5766.9	5737.7	1287.6

Int. sea transport	080404	Heavy fuel	2007	20.6	15085.0	42566.9	1258.7	38.9	4152.4	1604.1	100.6	0.0	1312.8	1299.7	1293.1	1297.6
Int. sea transport	080404	Heavy fuel	2008	20.6	15085.0	42885.9	1268.3	39.2	4184.0	1604.1	100.6	0.0	1312.8	1299.7	1293.1	1307.5
Int. sea transport	080404	Heavy fuel	2009	20.6	15085.0	43191.9	1277.8	39.5	4215.3	1604.1	100.6	0.0	1312.8	1299.7	1293.1	1317.3
Int. sea transport	080404	Heavy fuel	2010	20.6	15085.0	43484.2	1287.1	39.8	4246.0	1604.1	100.6	0.0	1312.8	1299.7	1293.1	1326.9
Int. sea transport	080404	Heavy fuel	2011	20.6	15085.0	43761.7	1296.2	40.1	4276.2	1604.1	100.6	0.0	1312.8	1299.7	1293.1	1336.3
Int. sea transport	080404	Heavy fuel	2012	20.6	15085.0	44023.5	1305.2	40.4	4305.7	1604.1	100.6	0.0	1312.8	1299.7	1293.1	1345.5
Int. sea transport	080404	Heavy fuel	2013	20.6	15085.0	44247.2	1313.9	40.6	4334.4	1604.1	100.6	0.0	1312.8	1299.7	1293.1	1354.5
Int. sea transport	080404	Heavy fuel	2014	20.6	15085.0	44431.4	1322.3	40.9	4362.4	1604.1	100.6	0.0	1312.8	1299.7	1293.1	1363.2
Int. sea transport	080404	Heavy fuel	2015	20.6	15085.0	44574.5	1330.5	41.2	4389.4	1604.1	100.6	0.0	1312.8	1299.7	1293.1	1371.7
Int. sea transport	080404	Heavy fuel	2016	20.6	15085.0	44674.2	1338.4	41.4	4415.4	1604.1	100.6	0.0	1312.8	1299.7	1293.1	1379.8
Int. sea transport	080404	Heavy fuel	2017	20.6	15085.0	44729.0	1345.9	41.6	4440.2	1604.1	100.6	0.0	1312.8	1299.7	1293.1	1387.6
Int. sea transport	080404	Heavy fuel	2018	20.6	15085.0	44748.2	1353.1	41.8	4463.9	1604.1	100.6	0.0	1312.8	1299.7	1293.1	1395.0
Int. sea transport	080404	Heavy fuel	2019	20.6	15085.0	44730.6	1359.9	42.1	4486.2	1604.1	100.6	0.0	1312.8	1299.7	1293.1	1401.9
Int. sea transport	080404	Heavy fuel	2020	20.6	15085.0	44674.9	1366.2	42.3	4507.0	1604.1	100.6	0.0	1312.8	1299.7	1293.1	1408.4
Int. sea transport	080404	Heavy fuel	2021	20.6	15085.0	44580.0	1372.0	42.4	4526.3	1604.1	100.6	0.0	1312.8	1299.7	1293.1	1414.5
Int. sea transport	080404	Heavy fuel	2022	20.6	15085.0	44476.8	1377.4	42.6	4544.0	1604.1	100.6	0.0	1312.8	1299.7	1293.1	1420.0
Int. sea transport	080404	Heavy fuel	2023	20.6	15085.0	44364.3	1382.2	42.7	4559.8	1604.1	100.6	0.0	1312.8	1299.7	1293.1	1424.9
Int. sea transport	080404	Heavy fuel	2024	20.6	15085.0	44242.0	1386.4	42.9	4573.7	1604.1	100.6	0.0	1312.8	1299.7	1293.1	1429.3
Int. sea transport	080404	Heavy fuel	2025	20.6	15085.0	44109.1	1390.0	43.0	4585.6	1604.1	100.6	0.0	1312.8	1299.7	1293.1	1433.0
Int. sea transport	080404	Heavy fuel	2026	20.6	15085.0	43965.0	1393.0	43.1	4595.4	1604.1	100.6	0.0	1312.8	1299.7	1293.1	1436.1
Int. sea transport	080404	Heavy fuel	2027	20.6	15085.0	43808.8	1395.2	43.2	4602.8	1604.1	100.6	0.0	1312.8	1299.7	1293.1	1438.4
Int. sea transport	080404	Heavy fuel	2028	20.6	15085.0	43639.9	1396.8	43.2	4607.9	1604.1	100.6	0.0	1312.8	1299.7	1293.1	1440.0
Int. sea transport	080404	Heavy fuel	2029	20.6	15085.0	43457.6	1397.6	43.2	4610.5	1604.1	100.6	0.0	1312.8	1299.7	1293.1	1440.8
Int. sea transport	080404	Heavy fuel	2030	20.6	15085.0	43457.6	1397.6	43.2	4610.5	1604.1	100.6	0.0	1312.8	1299.7	1293.1	1440.8

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