

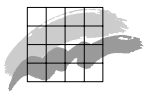


**National Environmental Research Institute**  
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# **Emissions of greenhouse gases and long-range transboundary air pollutants in the Faroe Islands 1990-2001**

*NERI Technical Report, No. 477*

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# **Emissions of greenhouse gases and long-range transboundary air pollutants in the Faroe Islands 1990-2001**

*NERI Technical Report, No. 477*  
**2003**

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Ministry of Petroleum  
The Faroese Food-, Veterinary- and Environmental Agency

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National Environmental Research Institute

## Data sheet

Title: Emissions of greenhouse gases and long-range transboundary air pollutants in the Faroe Islands 1990-2001.

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Abstract: This report explains the first detailed inventory of emissions of greenhouse gases and long-range transboundary pollutants for the Faroe Islands. Emission estimates are carried out according to the IPCC Guidelines for National Greenhouse Gas Inventories. Special efforts have been made to collect and validate the data used in the inventory. Also it has been prioritised to develop an inventory model suitable for future emission inventories. Activity data come from different Faroese institutions and oil companies, while NERI mainly provides emission factors. From 1990 to 1993 there was a fuel use and emission decline on the Faroe Islands due to the economic crises. After that the energy use (and emissions of most components) have increased up to 2001. In 2001 the largest source for CO<sub>2</sub> (32%) and NO<sub>x</sub> (71%) is fishery, for CH<sub>4</sub> (94%) and N<sub>2</sub>O (65%) agriculture, for CO (64%) and NMVOC (47%) road transport and for SO<sub>2</sub> (54%) power plants. The report points out areas in which the inventories are to be improved. These are reporting of fuel sale from the oil companies according to the IPCC guidelines, evaluation of emission coefficients for the fishery sector according to gear and motor type, more accurate traffic data for road transport and navigation and specific Faroese emission factors.

Keywords: CO<sub>2</sub>, N<sub>2</sub>O, CH<sub>4</sub>, SO<sub>2</sub>, NO<sub>x</sub>, CO, NMVOC, activity data, emission factors, emission inventory

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## Preface

Each year the Faroe Islands have the obligation to report their emission of greenhouse gases according to the requirements of the United Nations Framework Convention on Climate Change (UNFCCC). The Faroese emission figures are a part of the emission total for the Kingdom of Denmark, and emission data are subsequently submitted to the UNFCCC. Until 1998 this final submission of emission information was in the hands of the Danish Energy Authority, after which the task was taken over by the National Environmental Research Institute (NERI).

Until recently the emission inventories have been made using an average method based upon the total use of fossil fuels in the Faroe Islands and consequently the inventories have only included total estimates of CO<sub>2</sub> emissions. The weakest part of the inventories at this stage is that no distinction is given between sectors and the fact that the inventories exclude estimates for the greenhouse gases CH<sub>4</sub> and N<sub>2</sub>O and other emission components of relevance.

The present project is carried out by the Faroese Food-, Veterinary and Environmental Agency (Heilsufrøðiliga Starvsstovan) funded by the Faroese Government. NERI has provided the consultancy services in the project.

The project aim is to establish a detailed emission inventory system both in terms of sectors and emission components. After the finalisation of the project the basic idea is that the Faroe Islands will be able to make the emission inventories in the future.

## Summary

This report explains the first detailed inventory of emissions of greenhouse gases and long-range transboundary pollutants for the Faroe Islands. Emission estimates are carried out according to the IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 1997a & b). Special efforts have been made to collect and validate the data used in the inventory. Also it has been prioritised to develop a inventory model to be used in future emission inventories.

The emission inventory (1990-2001) can in the future be used for different purposes:

- ◆ Reporting to international protocols
- ◆ As input to air quality models for estimation and projection of local air pollution and evaluation of reduction methods
- ◆ As a basis for government evaluation of technical regulation and taxes
- ◆ As a basis for emission projections

## Activity data

### Fuel combustion

The total consumption of fossil fuels from 1990-2001 is presented in Figure 2.1. The energy use has risen from 8.7 PJ in 1990 to 9.6 PJ in 2001 corresponding to an increase of 10%. From 1990-1993 the energy use decreased with 24%, caused by the economic crisis in the Faroe Islands during that time period. The energy use has after this increased with 45% until today (from 6.6 PJ in 1993 to 9.6 PJ in 2001).

Figure 2.2 shows the proportion of fuel use per fuel type for the time period 1990-2001 compared with the use of fuel in 1990. The figure shows that the use of heavy fuel in 2001 has increased by 33% compared with 1990 and the use of gas-diesel fuel has increased by 9%. The use of gasoline fuel has decreased by 24% compared with 1990.



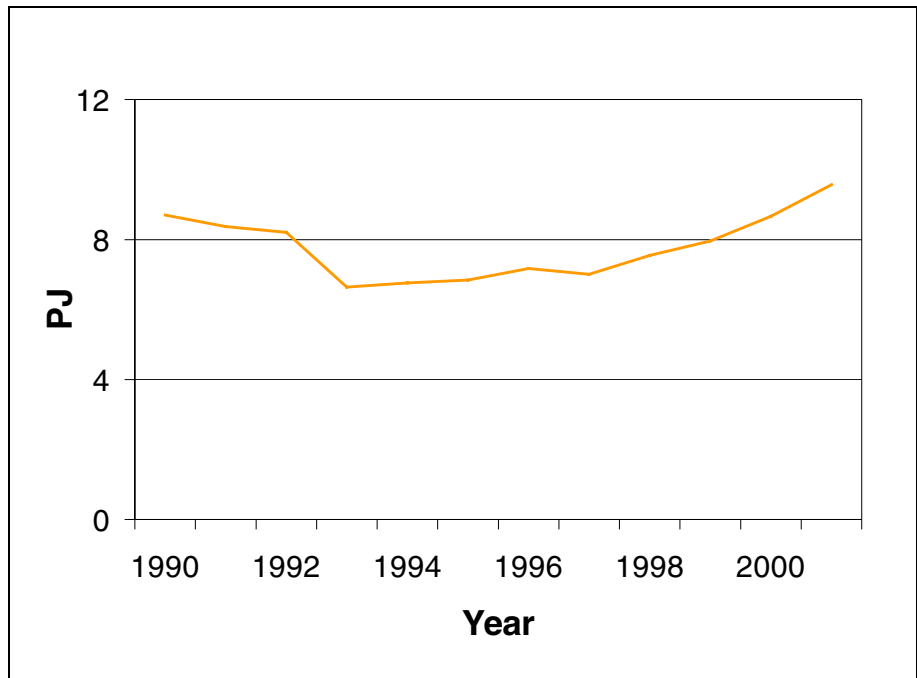


Figure 2.1 The total energy use from fossil fuels in the Faroe Islands from 1990 to 2001. Source: Statistics Faroe Islands; Statoil; Shell.

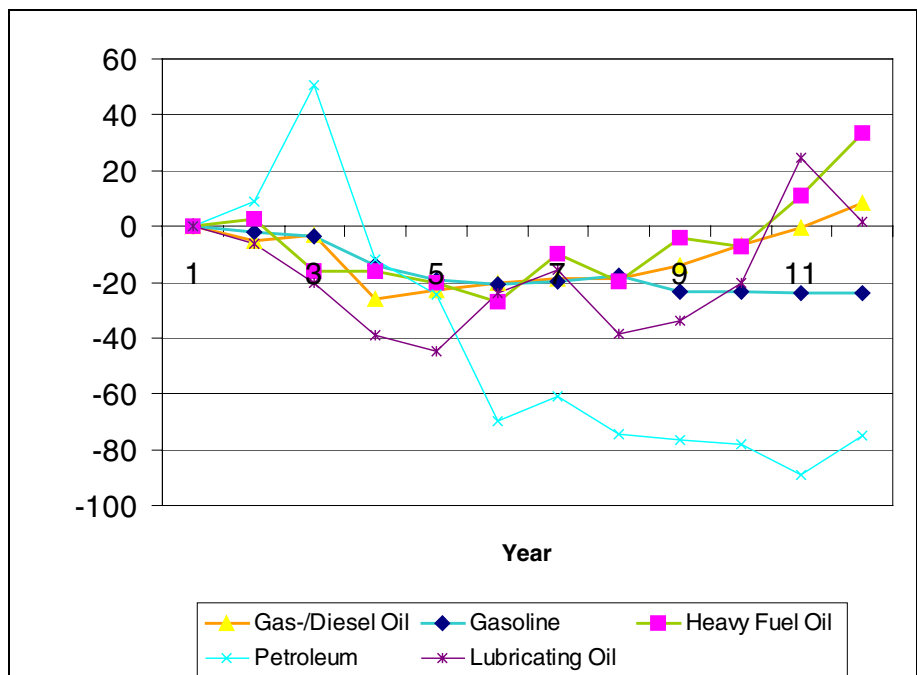


Figure 2.2 The 1990-2001 fuel use development per fuel type compared with 1990 values.

### Waste incineration

The total amount of energy produced by waste incineration increased by 99% from 1990 to 2001 and is explained by an increasing import of goods to the Faroe Islands in the same period (Figure 2.4).

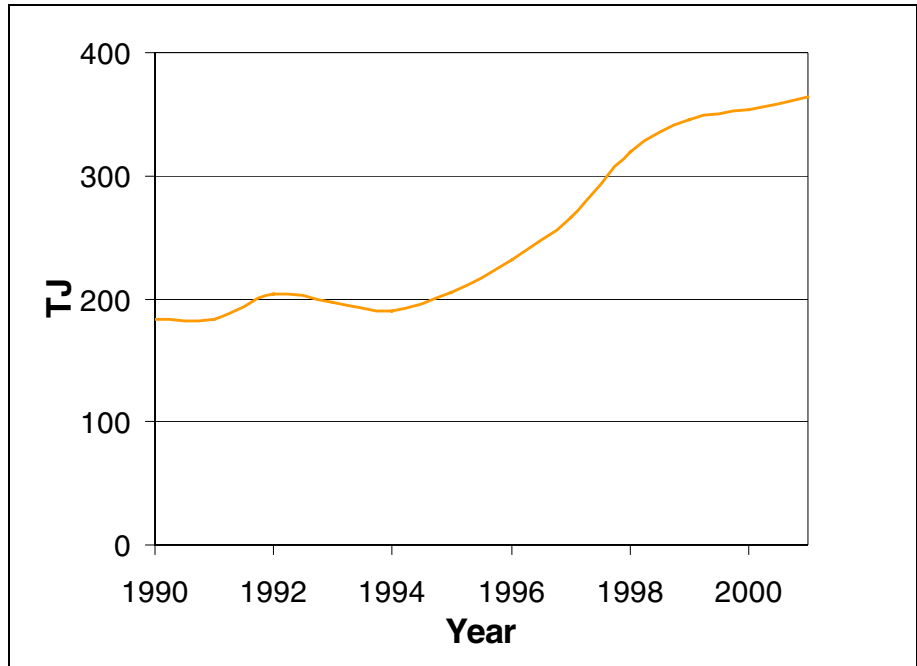


Figure 2.3 Total amount of energy produced by waste incineration in the Faroe Islands 1990-2001. Source: Kommunalá Brennistöðin (KOB); Interkommunalá Renovation Felagið (IRF).

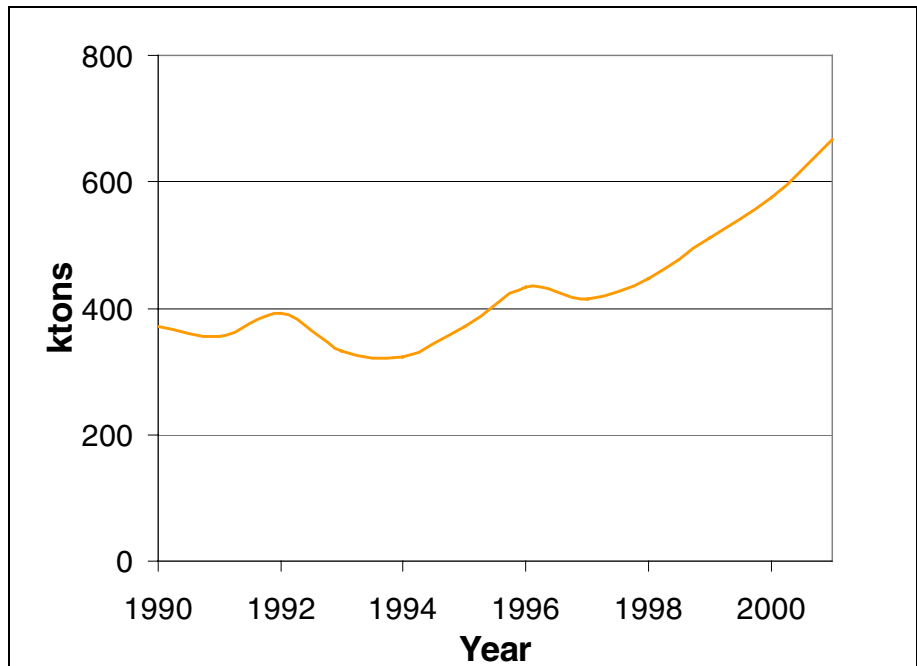


Figure 2.4 Import of goods to the Faroe Islands from 1990-2001. Source: Statistics Faroe Islands.

## Agriculture

Sheep and cattle are the two major animal species present in the agriculture in the Faroe Islands. The number of sheep is assumed to be constant at 78940 in the period 1990-2001, while the number of cattle has increased from 1582 in 1990 to 2332 in 2001 (Figure 2.5).

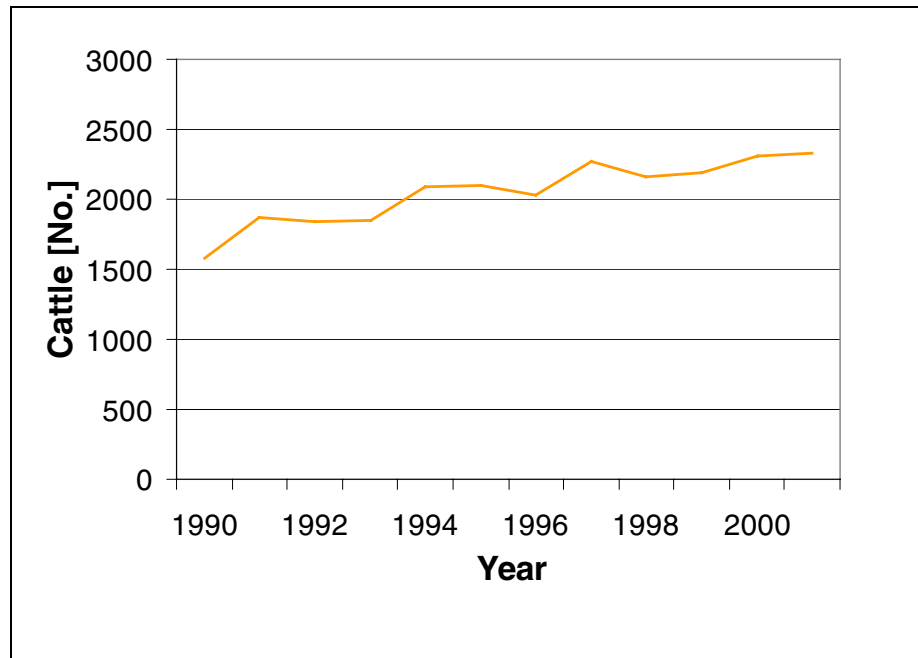


Figure 2.5 Number of cattle in the Faroe Islands from 1990-2001. Source: The Agricultural Institute in the Faroe Islands.

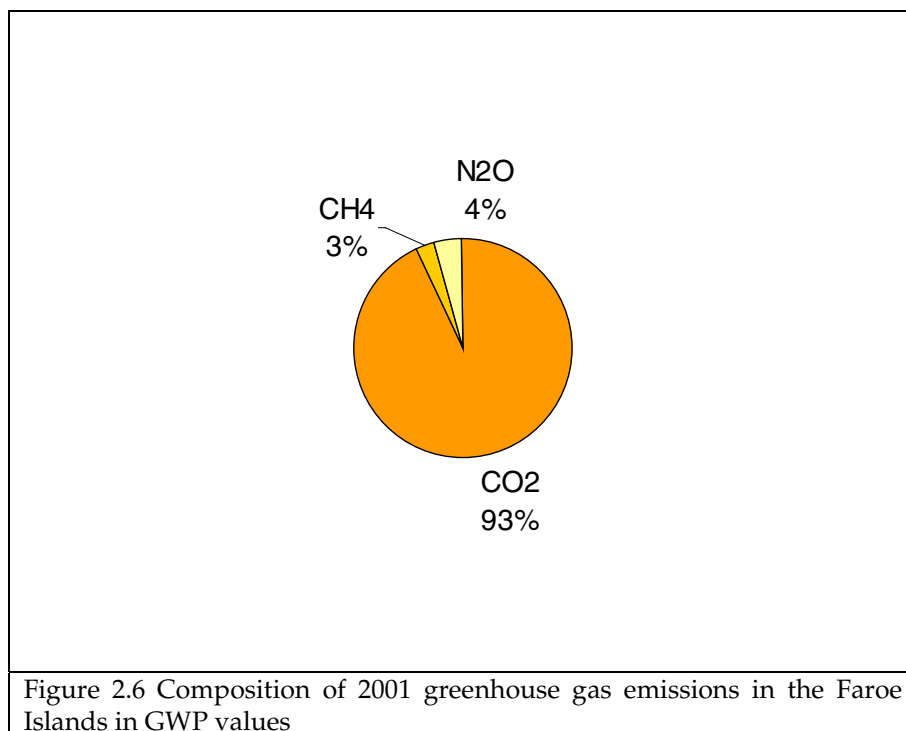
## Emission factors

Emission factors connected to fuel combustion have been selected in co-operation with NERI. For road transport the emission factors have been calculated using results from the Danish emission inventory modified for Faroese traffic conditions. Emission factors for waste incineration are based on Danish waste composition. The emission factors for agriculture have been chosen based on information on Faroese animal stocks and have been evaluated using the NP model in Denmark (Andersen, 1999).

## Emission results

### Greenhouse gases

The composition of greenhouse gases (in CO<sub>2</sub> equivalents) in the Faroe Islands in 2001 is shown in Figure 2.6. The CO<sub>2</sub> emissions constitute 93% of the total emission of greenhouse gases; the N<sub>2</sub>O and CH<sub>4</sub> emission shares are 4% and 3%, respectively.



The emissions of greenhouse gases have increased by 12% from 1990 to 2001 (Figure 2.7). From 1990-1993 a decrease of 22% is observed, explained by the economical crises in the Faroe Islands in this time period. After 1993 the emissions have increased by 44 % until today (from 543 ktonnes in 1993 to 782 ktonnes in 2001).

For CO<sub>2</sub> alone the emissions from 1990 to 2001 follow the pattern observed for CO<sub>2</sub> equivalents, since CO<sub>2</sub> constitutes 93% of the total greenhouse gas emissions each year in the observed time period. In 2001 32% of the CO<sub>2</sub> emissions originated from fishery, 18% from public electricity, 18% from the residential sector, 12% from manufacturing industry and 10% from road transportation.

The total emissions of CH<sub>4</sub> have increased by 14% from 1990 to 2001. The increase is due to a larger number of cattle in the Faroe Islands. In the same time period the emissions of N<sub>2</sub>O have shown a 37% increase, mainly due to an emission increase from agricultural soils.

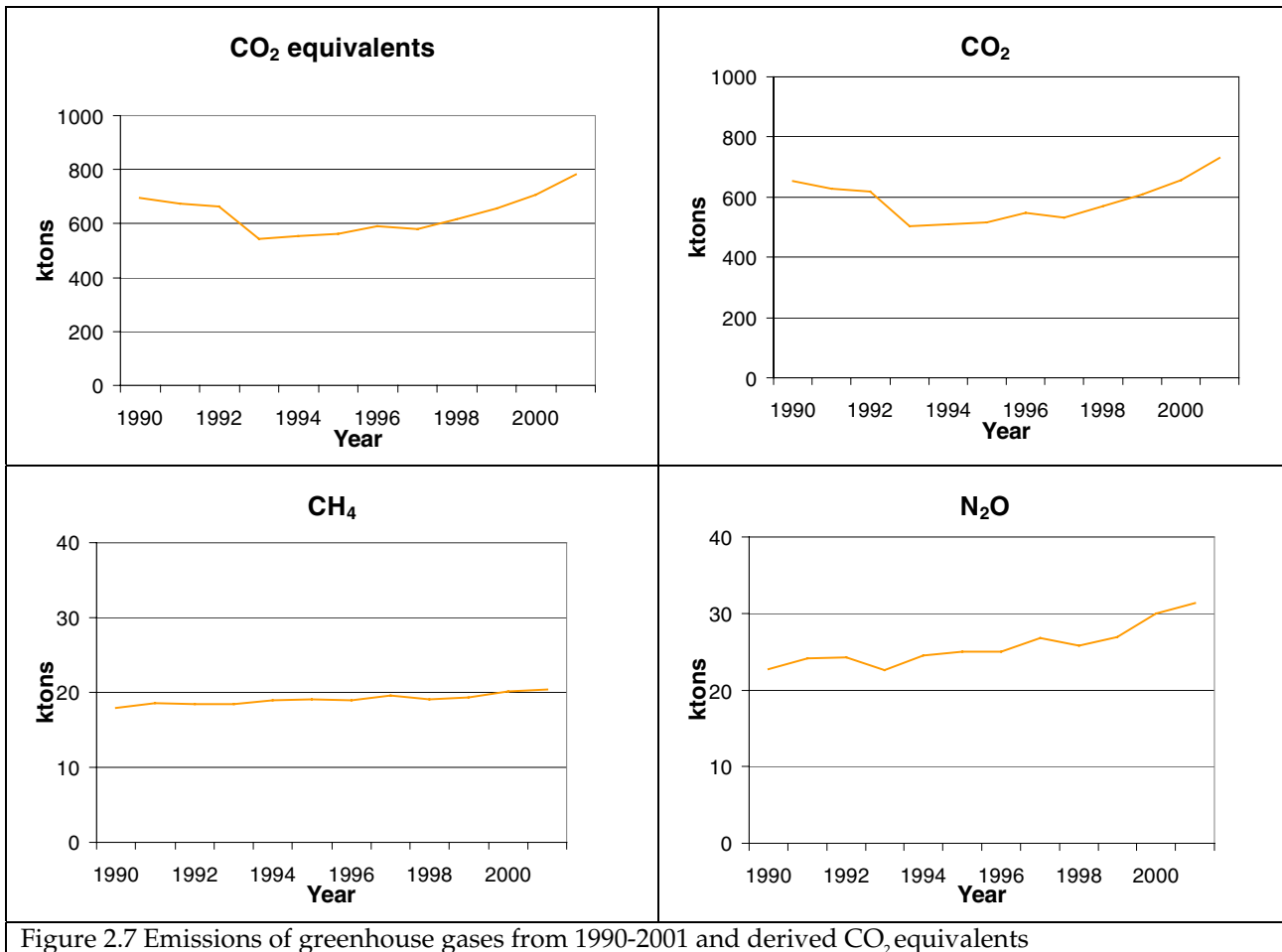


Figure 2.7 Emissions of greenhouse gases from 1990-2001 and derived CO<sub>2</sub> equivalents

### Long-range transboundary pollutants

The emissions of NO<sub>x</sub> have increased by 7% from 1990-2001 (Figure 2.8). A minimum in the emissions is observed in 1993 (4.0 ktonnes) explained by the economic crises in this time period in the Faroe Islands. Since 1993 the emissions have increased by 46% due to an increase in fuel use in fishery, and test drills (manufacturing industry) in 2001. In 2001, 71% of the NO<sub>x</sub> emissions originated from fishery, 8% from navigation, 7% road transportation, 6% from manufacturing industry and 6% from public electricity.

The emissions of CO and NMVOC decreased with 44% and 41%, respectively in the time period 1990-2001 (Figure 2.8). For both emission species the decrease is mainly due to the introduction of gasoline catalyst in private cars.

From 2000 to 2001 a CO emission increase of 6% is observed, which is mainly due to fuel use by test drills. For NMVOC an emission increase of 12% is observed from 1999 to 2001, explained by an increase in fuel use by the manufacturing industries (test drills), navigation and fishery.

In 2001 64% of the CO emissions originated from road transportation, 19% from fishery, 8% from navigation and 4% from manufacturing industry. In the same year 47% of the NMVOC emissions originated from road transportation, 26% from fishery, 17% from navigation and 7% from manufacturing industry.

In the time period 1990-2001 the emissions of SO<sub>2</sub> increased with 18% (Figure 2.8). The increase is mainly due to increasing use of heavy fuel oil in the public industry and manufacturing industry sectors. In 2001, 54% of the SO<sub>2</sub> emissions originated from public industry, 26% from fishery and 15% from manufacturing industry.

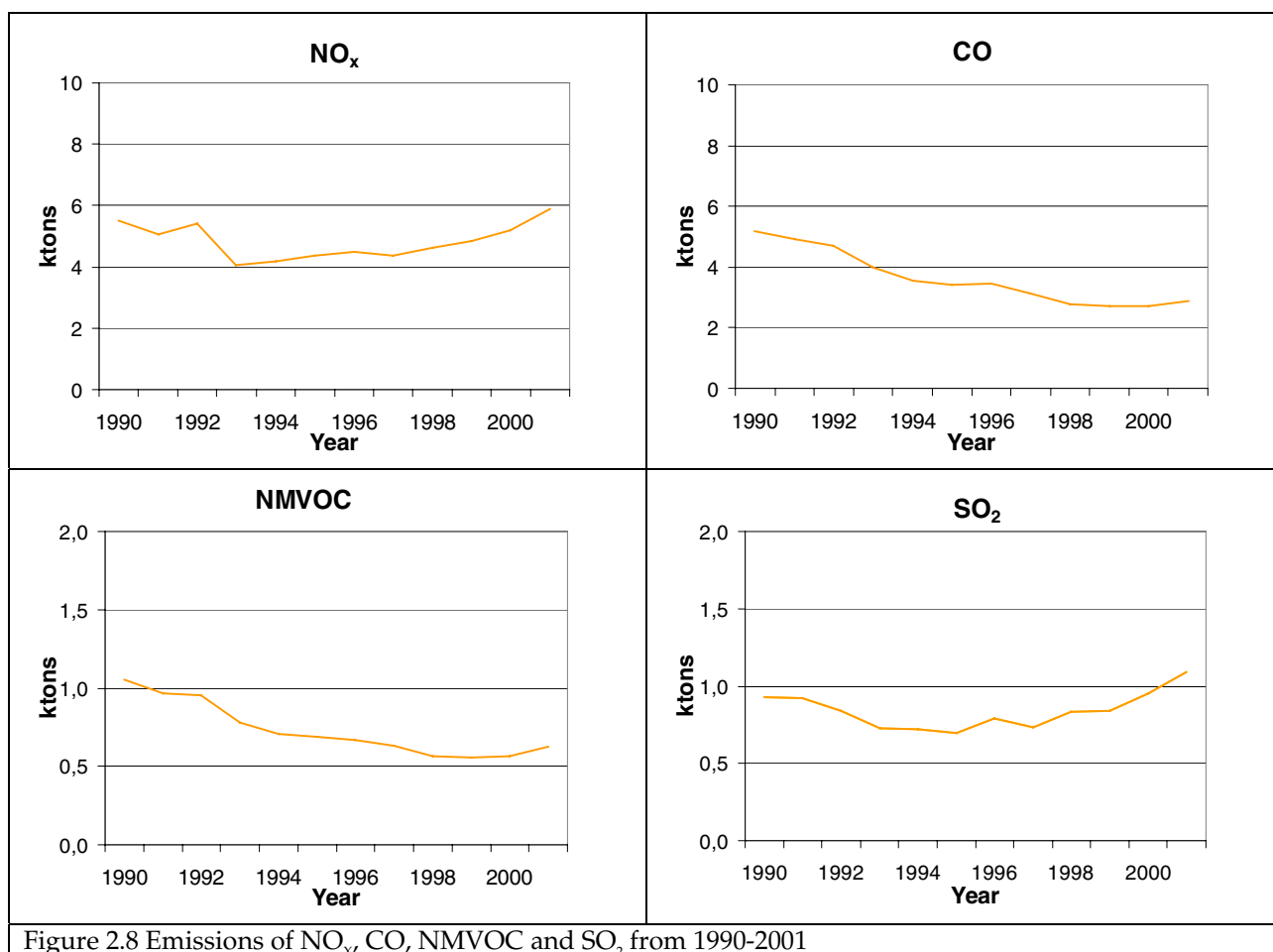


Figure 2.8 Emissions of NO<sub>x</sub>, CO, NMVOC and SO<sub>2</sub> from 1990-2001

## Conclusions

In the present project emission inventories were established for the 1990-2001 according to the guidelines of the UNFCCC convention. The inventory comprises estimates of the greenhouse gases CO<sub>2</sub>, N<sub>2</sub>O and CH<sub>4</sub> and the long-range transboundary air pollutants SO<sub>2</sub>, NO<sub>x</sub>, CO and NMVOC.

Suggestions for improvements of background data are made in the following areas in order to make the future annual inventories more precise:

The fuel data used in the emission inventory are presently not grouped according to IPCC categories, and moreover the reporting formats of the two oil companies differ. It is therefore suggested to evaluate a new common format.

The new format should include more detailed information on fuel sold to fishing ships (according to gear). Moreover, the fuel sold to Faroese ships bunkering outside Faroese waters and fuel sold to foreign ships, must be classified as either fishery or other vessels and furthermore be divided into sub-totals for other vessels according to destination. For the industrial sector it is necessary to make a fuel split into sub-groups according to the UNFCCC reporting format.

In terms of transport more detailed Faroese vehicle fleet and mileage figures must be obtained for road transportation vehicles. For aviation and sea transport, specific data (aircraft/vessel type and destination airport/seaport) must be gathered in order to classify the emissions as being either domestic or international.

The emission factors used for the emission inventory presented in this report have mainly been provided by NERI. It is recommended that the Faroe Islands in the future adjust the present emission factors on the basis on more detailed information of fuel types used in the Faroe Islands. This relates also to detailed emission information for sea vessels.

Resources must be set aside to continue the emission inventory work in the future. This implies continuous efforts to ensure a timely, consistent and accurate provision of activity data by relevant companies and institutions. Lastly it must be legally clarified where in the Faroe Islands the responsibility should be placed for preparing the final report of the Faroese air emission results in the future.

# Sammendrag

Denne rapport dokumenterer den første detaljerede emissionsopgørelse af drivhusgasser og langtransporteret luftforurening for Færøerne. Emissionerne er opgjort efter IPCC's retningslinjer for drivhusgasopgørelser (IPCC 1997a. b). Der er i arbejdet lagt særlig vægt på indsamle og kvalitetssikre de data der bruges i opgørelsen. Som en del af projektet har det også været vigtigt at udvikle opgørelsesmetoden, så den kan bruges til fremtidige emissionsopgørelser. Den færøske emissionsopgørelse 1990-2001 kan bruges til forskellige formål såsom:

- ◆ Rapportering til internationale konventioner
- ◆ Som input til luftkvalitetsmodeller (estimation og fremskrivning af lokal luftforurening og evaluering af reduktionstiltag)
- ◆ Som fundament for politisk vurdering af tekniske tiltag og afgifter
- ◆ Som fundament for emissionsfremskrivninger

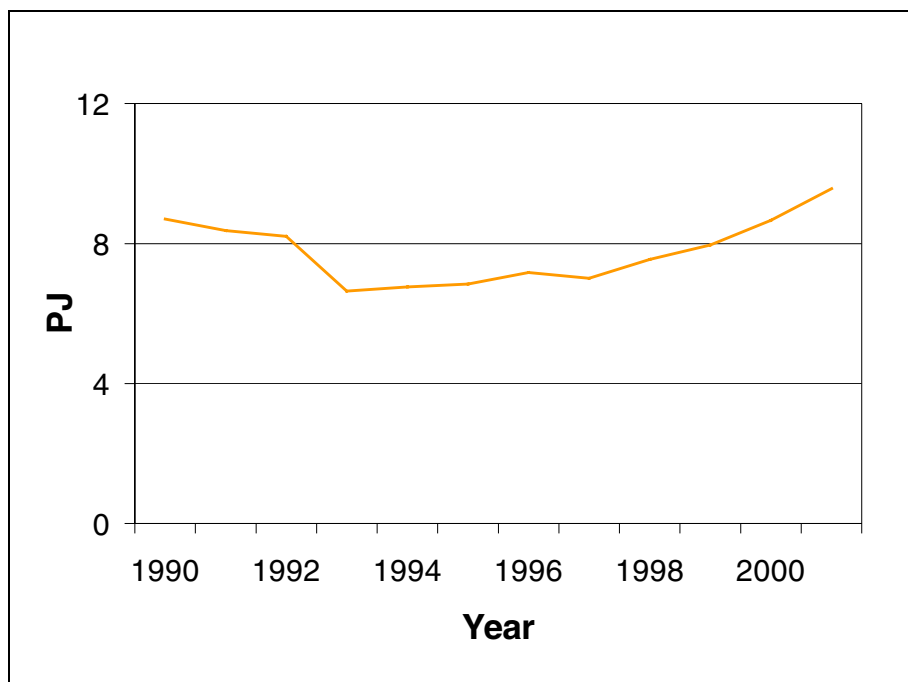
## Aktivitetsdata

### Fossilt brændstofforbrug

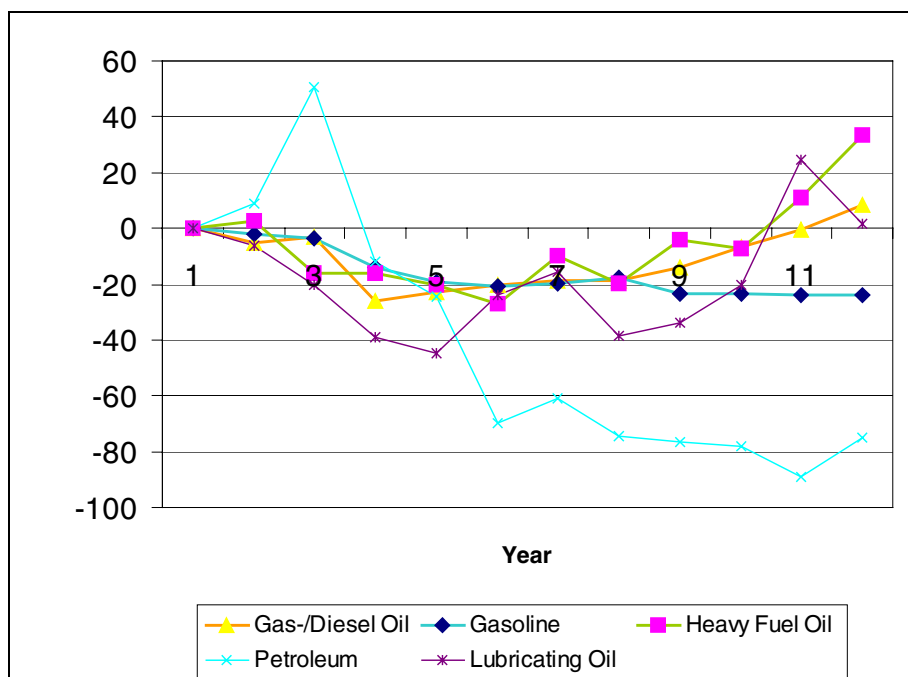
Det totale forbrug af fossile brændsler fra 1990 til 2001 er vist i figur 2.1. Energiforbruget er steget fra 8,7 PJ i 1990 til 9,6 PJ i 2001, hvilket svarer til en procentvis stigning på 10%. Fra 1990 til 1993 er energiforbruget faldet med 24% pga. Færøernes økonomiske nedgang i denne periode. Efter 1993 er energiforbruget steget med 45% frem til 2001 (fra 6,6 PJ i 1993 til 9,6 PJ i 2001).

Figur 2.2 viser den relative udvikling i energiforbruget pr. brændselstype i perioden fra 1990 til 2001, med 1990 som udgangspunkt. Figuren viser, at forbruget af tung olie og gas-diesellole er steget med hhv. 33 og 9% fra 1990 til 2001, hvorimod benzinforbruget er faldet med 24% i samme periode.





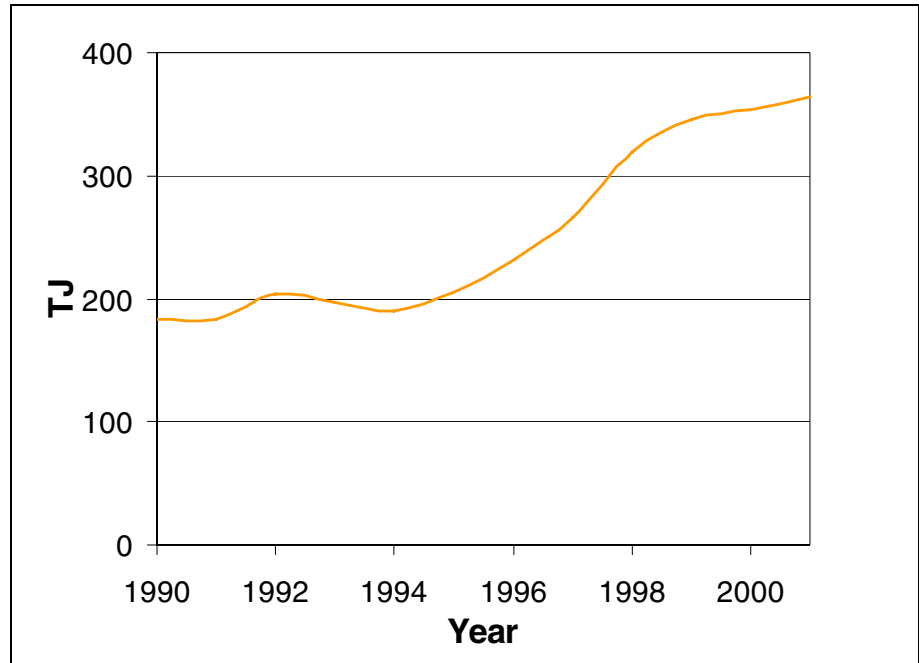
Figur 2.1 Det totale energiforbrug af fossile brændsler på Færøernes fra 1990 til 2001. Kilde: Statistics Faroe Islands; Statoil; Shell.



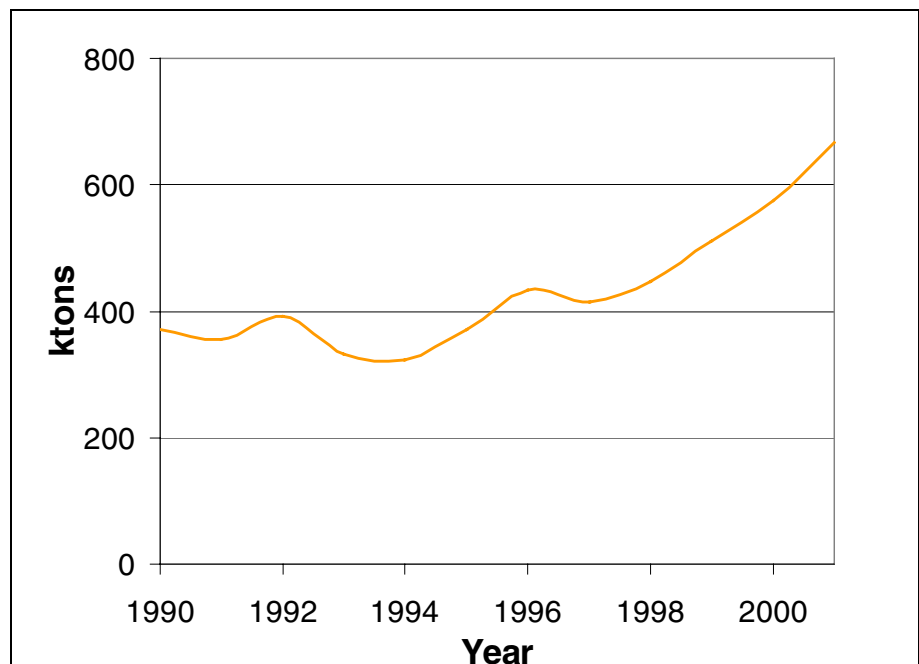
Figur 2.2 Energiforbrugsudviklingen fra 1990 til 2001 fordelt på brændselstyper.

### Affaldsforbrænding

Den totale mængde energi produceret ved affaldsforbrænding er steget med 99% fra 1990 til 2001, hvilket skyldes en stigende vareimport til Færøerne i den samme periode (figur 2.4).



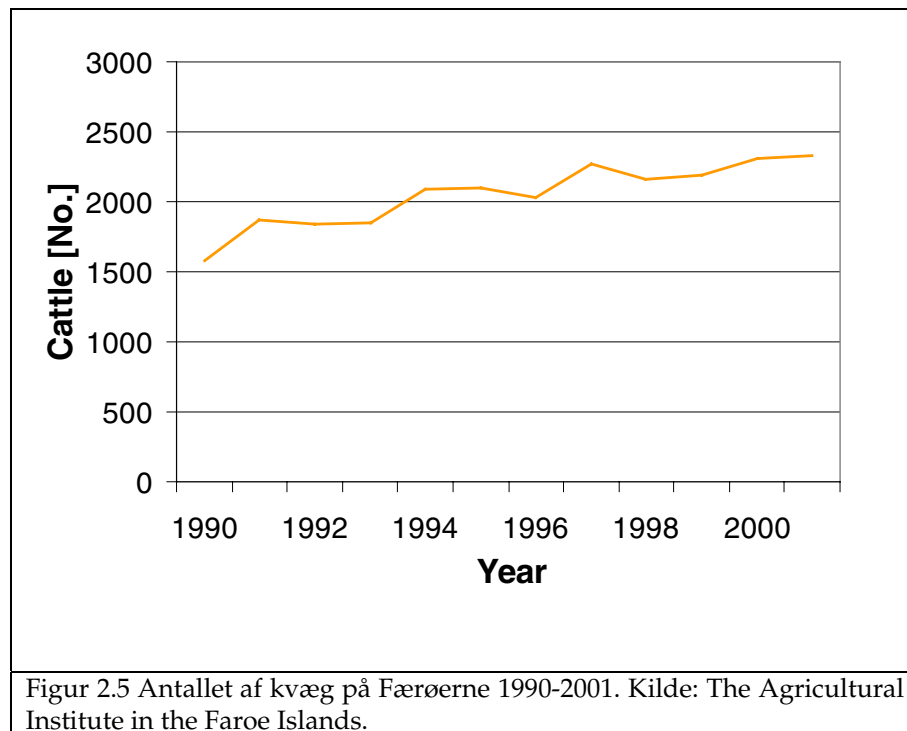
Figur 2.3 Total energimængde produceret ved affaldsforbrænding på Færøerne fra 1990 til 2001. Kilde: Kommunala Brennistøðin (KOB); Interkommunala Renovation Felagið (IRF).



Figur 2.4 Import af varer til Færøerne fra 1990 til 2001. Kilde: Statistics Faroe Islands.

## Landbrug

Får og kvæg er de to mest almindelige typer af dyrehold på Færøerne. Antallet af får antages at være konstant (78940) fra 1990 til 2001, mens antallet af køer er steget fra 1582 til 2332 i den samme periode.



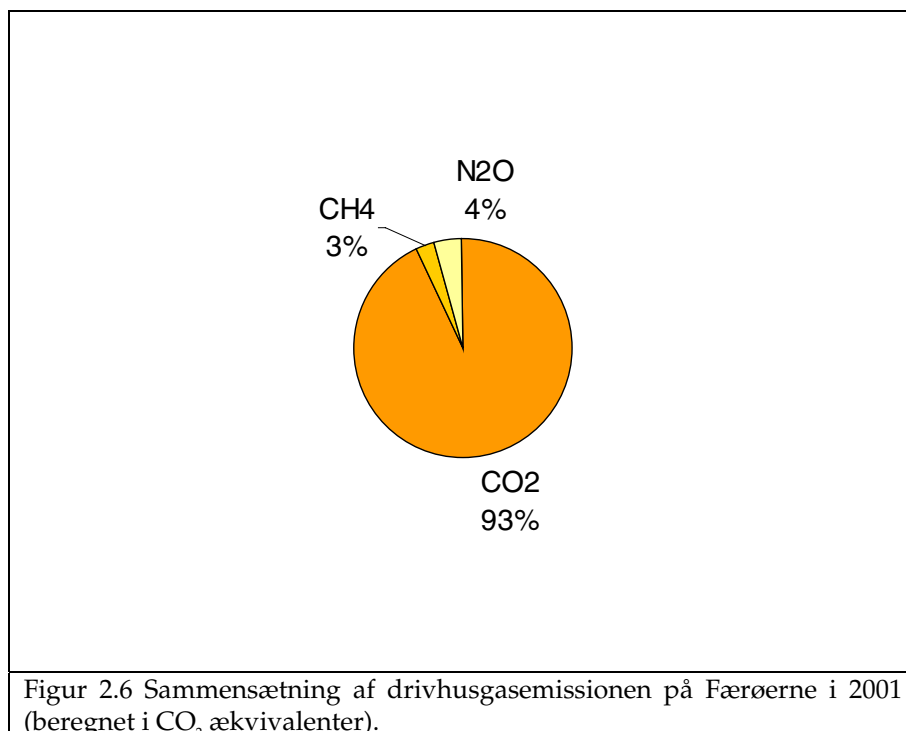
## Emissionsfaktorer

Emissionsfaktorer for forbrænding er valgt i samarbejde med DMU. For vejtrafik er faktorerne beregnet ud fra de danske emissionsopgørelser justeret efter færøske trafikbetingelser. For affaldsforbrænding er emissionsfaktorerne fastlagt ud fra sammensætningen af affald i Danmark. Landbrugsemissionsfaktorerne er valgt ud fra sammensætningen i den færøske dyrebestand og en evaluering med den danske NP model (Andersen, 1999).

## Resultater

### Drivhusgasser

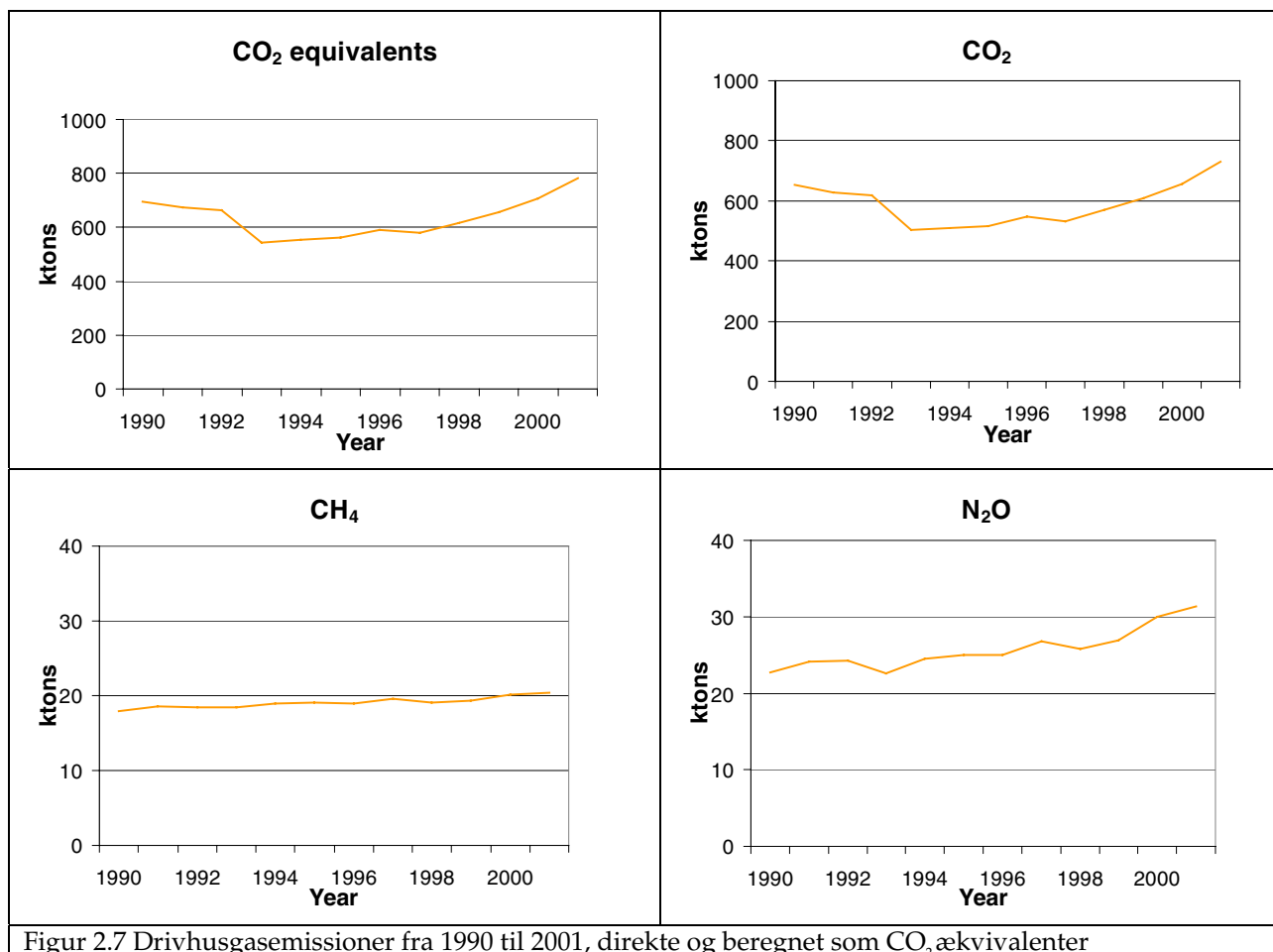
Sammensætningen af drivhusgasemissionen (i CO<sub>2</sub> ækvivalenter) på Færøerne i 2001 er vist i figur 2.6. CO<sub>2</sub> emissionen udgør 93% af den totale drivhusgasemission, mens de respektive emissionsandele for N<sub>2</sub>O og CH<sub>4</sub> er på 4 og 3%.



Emissionen af drivhusgasser (beregnet i CO<sub>2</sub> ækvivalenter) er steget med 12% fra 1990 til 2001 (figur 2.7). Fra 1990 til 1993 ses et fald på 22% pga. den økonomiske nedgang på Færøerne i denne periode. Fra 1993 og frem til 2001 er drivhusgasemissionen steget med 44% (fra 543 ktors i 1993 til 782 ktors i 2001).

Udslippet for CO<sub>2</sub> alene følger udviklingen i det samlede drivhusgasudslip, da bidraget fra CO<sub>2</sub> udgør 93% af den samlede CO<sub>2</sub> ækvivalent-total i hvert af årene 1990-2001. I 2001 var de største kilder til CO<sub>2</sub> emissionen fiskeri, kraftværker, beboelse/institutioner, industri og vejtrafik, med hhv. 32, 18, 18, 12 og 10% af den samlede CO<sub>2</sub> emission.

Stigningen i CH<sub>4</sub> udslippet var på 14% fra 1990 til 2001. Emissionsforøgelsen skyldes et gradvist større antal køer på Færøerne i dette tidsrum. For N<sub>2</sub>O steg emissionen med 37% i samme periode, hovedsageligt pga. en emissionsstigning fra landbrugsjorde.



Figur 2.7 Drivhusgasemissioner fra 1990 til 2001, direkte og beregnet som CO<sub>2</sub>-ækvivalenter

### Langtransporteret luftforurening

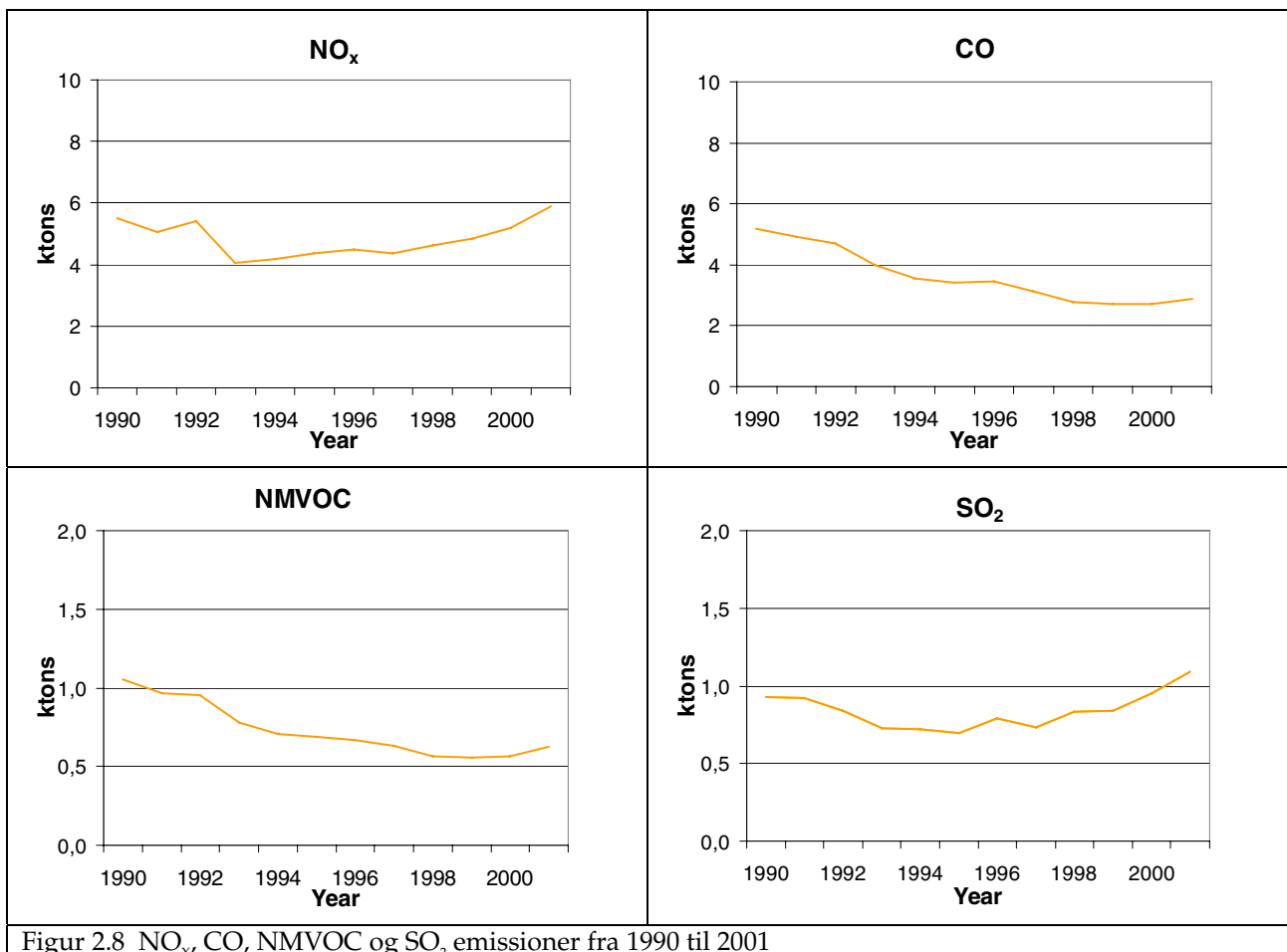
NO<sub>x</sub> emissionen er steget med 7% fra 1990 til 2001 (figur 2.8). Et minimum i emissionen ses i 1993 (4,0 ktons), hvilket skyldes den økonomiske nedgang på Færøerne. Efter 1993 er emissionen steget med 46% frem til 2001 pga. et stigende energiforbrug til fiskeri og prøveboringer (2001). De største kilder til NO<sub>x</sub> udslippet i 2001 er fiskeri, søtransport, vejtransport, industri og kraftværker med procentandele på hhv. 71, 8, 7, 6 og 6% af det samlede NO<sub>x</sub>-udslip.

CO og NMVOC emissionen er faldet med hhv. 44 og 41% fra 1990 til 2001 (figur 2.8). For begge emissionskomponenter skyldes de store emissionsfald indførelsen af benzinpersonbiler med katalysator. Fra 2000 til 2001 ses en stigning i CO emissionen på 6%, pga. et vist energiforbrug til prøveboringer i 2001. For NMVOC stiger emissionen med 12% fra 1999 til 2001. Stigningen skyldes tildels et større energiforbrug til national søtransport og fiskeri og tildels energiforbruget til prøveboringer (2001).

I 2001 var de største kilder til CO udslippet vejtransport, fiskeri, søtransport og industri med procentandele på hhv. 64, 19, 8 og 4% af

det samlede CO udslip. For NMVOC var procentandelene af det samlede udslip på 47, 26, 17 og 7% for hhv. vejtransport, fiskeri, søtransport og industri.

SO<sub>2</sub> emissionen er steget med 18% fra 1990 til 2001 (Figur 2.8). Stigningen skyldes hovedsageligt et større forbrug af tung olie for kraftværker og industri. I 2001 var de største kilder til SO<sub>2</sub> emissionen kraftværker, fiskeri og industri med procentandele på hhv. 54, 26 og 15% af den samlede SO<sub>2</sub> emission.



Figur 2.8 NO<sub>x</sub>, CO, NMVOC og SO<sub>2</sub> emissioner fra 1990 til 2001

## Konklusioner

I nærværende projekt er emissionsopgørelser beregnet for Færøerne for årene 1990-2001 iht. retningslinjerne for FN's klimakonvention. Opgørelserne omfatter drivhusgasserne CO<sub>2</sub>, N<sub>2</sub>O og CH<sub>4</sub> samt stofferne SO<sub>2</sub>, NO<sub>x</sub>, CO and NMVOC (benævnt som langtransporteret luftforurening). En forbedring af baggrundsdata foreslås på følgende områder med et sigte på at forbedre de årlige opgørelser i fremtiden.

Brændstofdata der benyttes i emissionsopgørelsen er ikke fordelt iht. IPCC's gruppering, og derudover er de to olieselskabers rapporteringsformater forskellige. Det foreslås derfor at udvikle et nyt fælles format, der tilgodeser formatet for FN's klimakonvention.

Det nye format skal også indeholde mere detaljeret information om brændstoffet solgt til fiskeskibe (efter redskabs- og motor type). Derudover skal brændstof til færøske skibe der bunkrer udenfor Færøsk havområde, og al brændstof solgt til fremmede skibe klassificeres som solgt til enten fiskeri eller andre skibe. For den sidste skibstype skal forbruget derudover opdeles efter indenrigs/udenrigs destination. For industrisektoren er det nødvendigt at lave en brændstofopdeling i undergrupper som foreskrevet i formatet for FN's klimakonvention.

Hvad transporten angår skal mere detaljerede færøske bestands- og årskørselsdata indhentes for vejtrafikkens køretøjer. For flytrafik og søtransport skal specifikke oplysninger om flytype/skibstype og destination fremskaffes for at klassificere emissionerne mere præcist som nationale eller internationale.

Emissionsfaktorerne der bruges i denne emissionsopgørelse er hovedsageligt leveret af DMU. Det anbefales at Færøerne justerer disse emissionsfaktorer i fremtiden på basis af mere detaljerede oplysninger om de benyttede brændsler på Færøerne. Dette vedrører også mere detaljeret emissionsviden for skibstyper.

Ressourcer skal tildeles arbejdet med emissionsopgørelser i fremtiden. Arbejdet omfatter ikke mindst bestræbelserne på at sikre konsistente og præcise aktivitetsdata leveret indenfor tidsfristen af relevante virksomheder og institutioner. Samtidigt skal det formelt afklares, hvor på Færøerne ansvaret ligger for at lave de færøske emissionsopgørelser.

# 1 Introduction

The Kingdom of Denmark (which includes Denmark, Greenland and the Faroe Islands as geographical areas) has signed the United Nations Climate Change Convention (UNFCCC). Emission information from the Faroe Islands must each year be submitted to Denmark. Until today the National Environmental Research Institute (NERI) in Denmark has calculated the emissions from the Faroe Islands as total CO<sub>2</sub> emissions based on total fuel sales information.

The aim of the present project is to construct an emission inventory for the Faroe Islands for 2001 according to the guidelines of the UNFCCC convention. The inventory should comprise estimates of the greenhouse gas emissions of CO<sub>2</sub>, N<sub>2</sub>O and CH<sub>4</sub> and the long-range transboundary pollutants of SO<sub>2</sub>, NO<sub>x</sub>, CO and NMVOC.

Another aim is to make inventories for the Faroe Islands as a consistent time series from 1990 to 2000 using the 2001 inventory methodology. The project also includes the evaluation of a reporting model aimed at reporting the emissions.

Emissions of the greenhouse gases HFC, PFC and SF<sub>6</sub> have been omitted in the present inventory, but is suggested to be included in future emission inventories.

This present report documents the activity data and emission factors used to estimate the emissions, and presents the emission results of greenhouse gases and long-range transboundary pollutants covering the years 1990-2001. The report also serves as a basis for future inventories.

The work in this project has been carried out in co-operation between the Faroese Food-, Veterinary- and Environmental Agency in the Faroe Islands and NERI in Denmark who has provided council and information of emission factors for the years 1990-2001.



## 2 Activity data

### 2.1 Fuel combustion

Statistics Faroe Islands provides the information of fuel sales divided into eight main groups (fishing vessels, other ships, transportation, industry, trading and service, residential and communities, institutions and public power) as total fuel sale numbers (Statistics Faroe Islands, 2002). The fuel data originate from several sources. The main data sources are the two oil companies in the Faroe Islands. Fuel data not included in sales information from the companies are provided directly by the industry.

To evaluate the emissions it was necessary to get information on fuel sale according to IPCC categories and by fuel type. Therefore fuel sales information was provided directly from the two oil companies in the Faroe Islands: Føroya Shell and Statoil Føroya. From one of the oil companies information of fuel sales were available for all the years covering the time period 1990-2001 while information covering the years 1990 and 1991 were missing from the other oil company. For these years the missing information was estimated by using fuel data from 1992 and the fuel sale proportion between the two companies, together with information of total fuel sales in 1990 and 1991.

Fuel consumption for the sector "Manufacturing Industries and Construction" is calculated as a total fuel use for the sector, as data on disaggregated levels were not available. Fuel amounts for foreign ships and bunkering by fishing ships operating abroad Faroese waters are included under the sectors "International Bunkers". Fuel use covering the years 1990-2001 are shown in Appendix A and heating values for different fuel types are shown in Table 1.

Table 3.1 Heating values for different fuel types

Fuel type	Heating value GJ/ton
Gasoline	43.80
Gas-/Diesel Oil	42.70
Jet Fuel	43.50
Fuel Oil	40.65
Petroleum	43.50
Lubricants	41.90

Figure 3.1 shows that the consumption of gas-diesel oil and heavy fuel oil has increased from 1993 to 2001, and gasoline from 1997 and onwards. The consumption of other fuel types has been constant in the same time period. The fuel consumption increased from 8.7 PJ in

1990 to 9.6 PJ in 2001, which corresponds with an increase by 10%. The gas-diesel oil share was 74% of the total fuel consumption, while the heavy fuel oil consumption accounted for 19% of the total fuel consumption in 2001 (Figure 3.2).

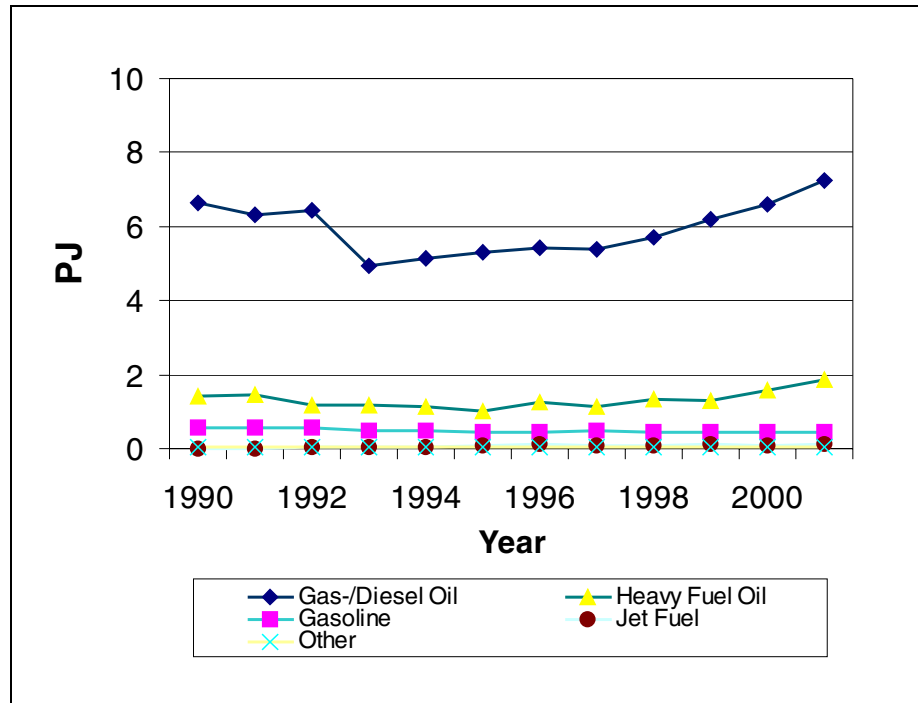


Figure 3.1 Fuel use by fuel type in the Faroe Islands 1990-2001. Source: Statistics Faroe Islands.

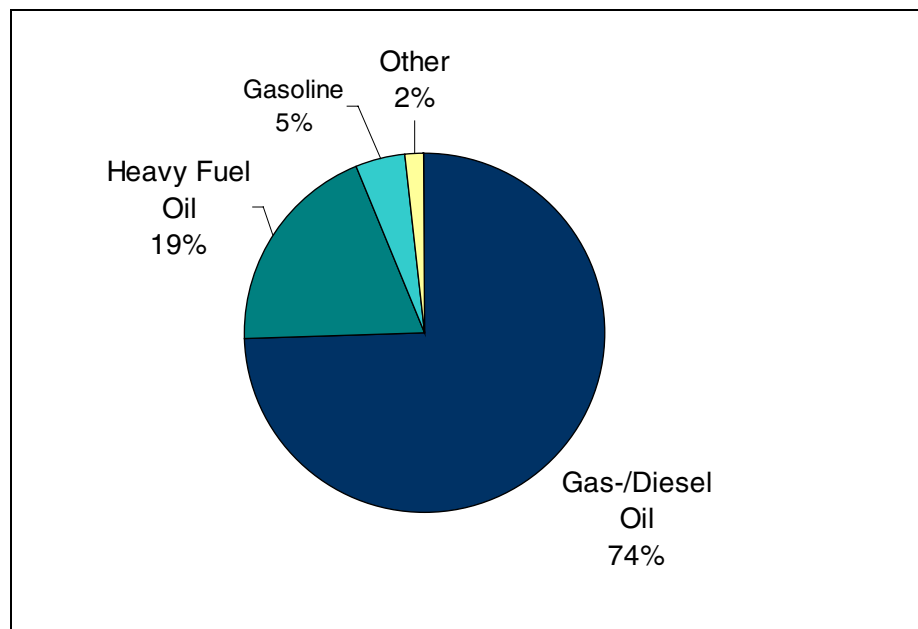


Figure 3.2 Composition of fuel types in the Faroe Islands. 2001. Source: Statistics Faroe Islands; Statoil; Shell.

The increase in the consumption of gas-diesel oil from 1993 is mainly due to the increasing fuel use in the fishery and road transport sectors as a result of an increase in fishery activity and new vehicle sales. The increase in the heavy fuel oil consumption is mainly due to an increased fuel use in the public electricity and manufacturing industry sectors. This is a result of an increase in the use of electrical power (Figure 3.5) and an increase in the heavy fuel use in the fishing industry.

In 2001 the fishery sector accounted for 31% of the energy use, residential 18%, public power 18%, manufacturing industry 12% and road transportation 11% (Figure 3.3).

From 1990-2001 the fuel consumption in the fishery sector increased by 4%. A minimum is observed in 1993 (in connection with the economical recession in the Faroe Islands at that time) and the fuel use has since that year increased by 44% (from 2157 TJ in 1993 to 3108 TJ in 2001; see Figure 3.4).

The fuel consumption in the residential sector decreased by 13% from 1990-2001. A minimum is observed in 1993 (due to the economic crisis in the Faroe Islands at that time) and has since that year increased by 13% (from 1517 TJ in 1993 to 1715 TJ in 2001). The energy use in the residential sector is closely linked to seasonal temperature variations and is relatively high because of the fairly low temperatures in the Faroe Islands.

The fuel consumption (mostly heavy fuel) in the public power sector has increased by 46 % from 1990-2001. A minimum is observed in 1995 (connected to the economic crises in the Faroe Islands at that time) and has since that year increased by 85% (from 920 TJ in 1995 to 1702 TJ in 2001). The increase in heavy fuel use is correlated with the increase in power use/capita (Figure 3.5).

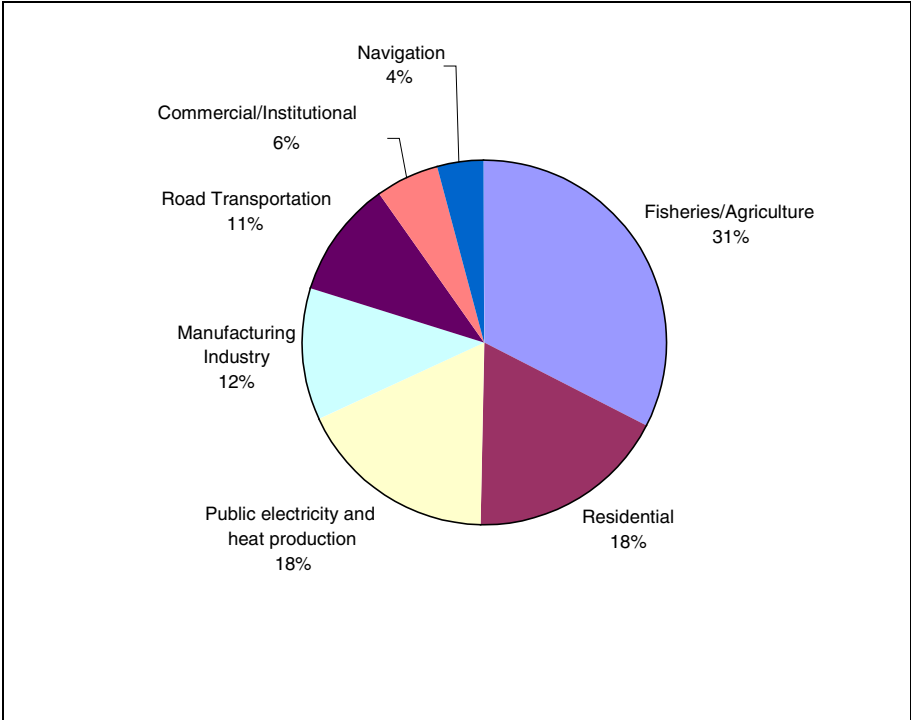


Figure 3.3 Composition of Energy use by consumer group in 2001. Source: Statistics Faroe Islands; Statoil; Shell.

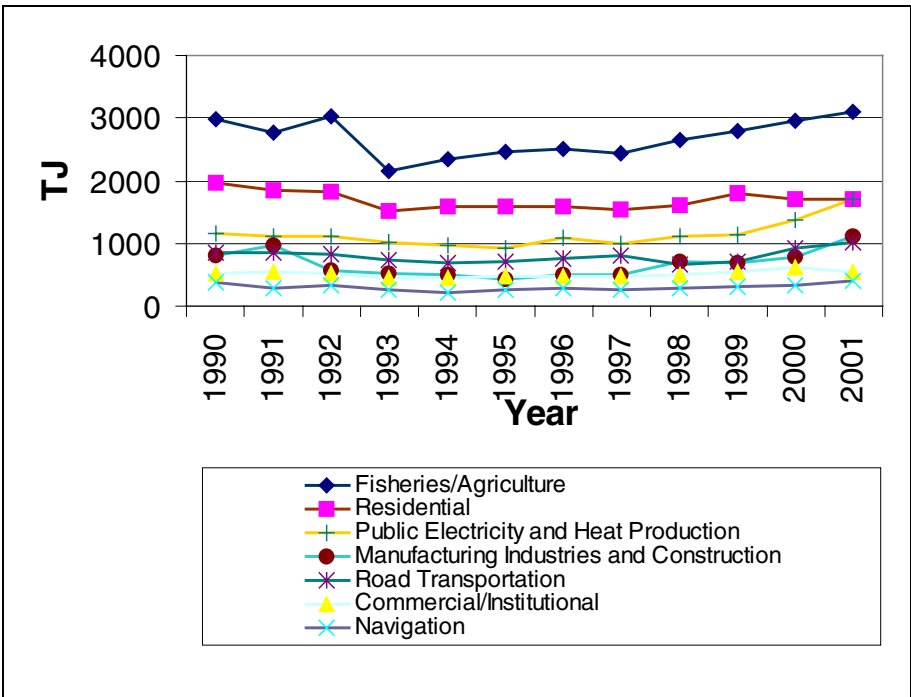
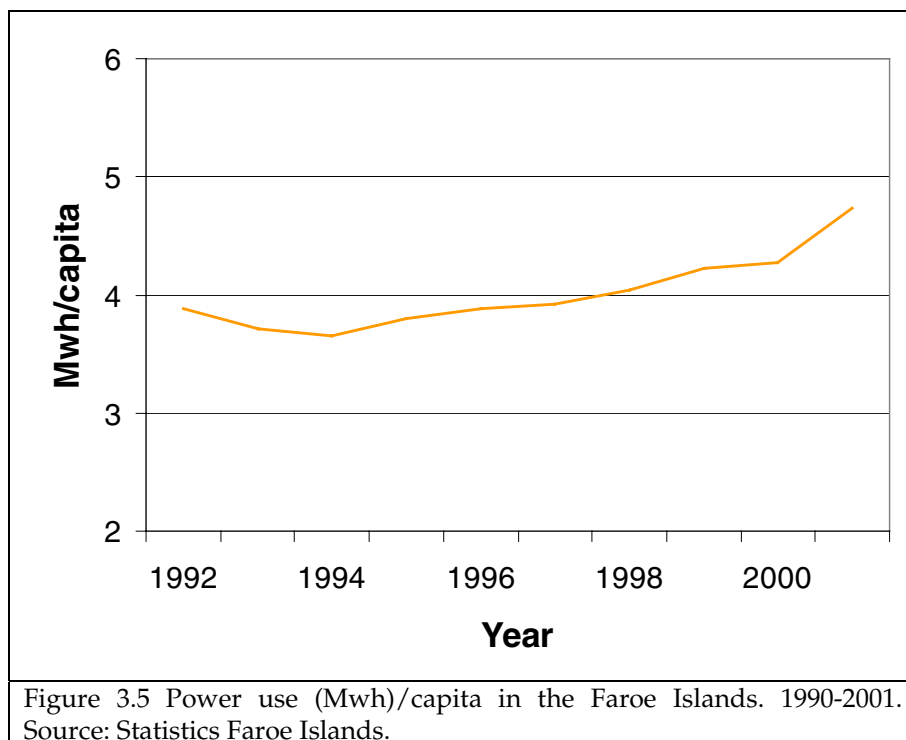


Figure 3.4 Energy use by consumer group in the Faroe Islands 1990-2001. Source: Statistics Faroe Islands; Statoil; Shell.



The fuel consumption for manufacturing industries has increased by 37% from 1990-2001. A minimum is observed in 1995 (due to the economic crises in the Faroe Islands at that time) and has since that year increased by 165% (from 422 TJ in 1995 to 1118 TJ in 2001). The fuel used by test drillings in 2001 and an increase in the use of heavy fuel in the fishing industry cause the pronounced increase.

The fuel consumption by road transport has increased by 17% from 1990 to 2001. A minimum is observed in 1998 and the fuel consumption has since that increased with 52% (from 665 TJ in 1998 to 1008 TJ in 2001). The reasons for the increase are an increasing number of new diesel private cars in the Faroe Islands and an increase in mileage driven for all vehicle types in general (Faroese Vehicle Inspection (FVI), 2002).

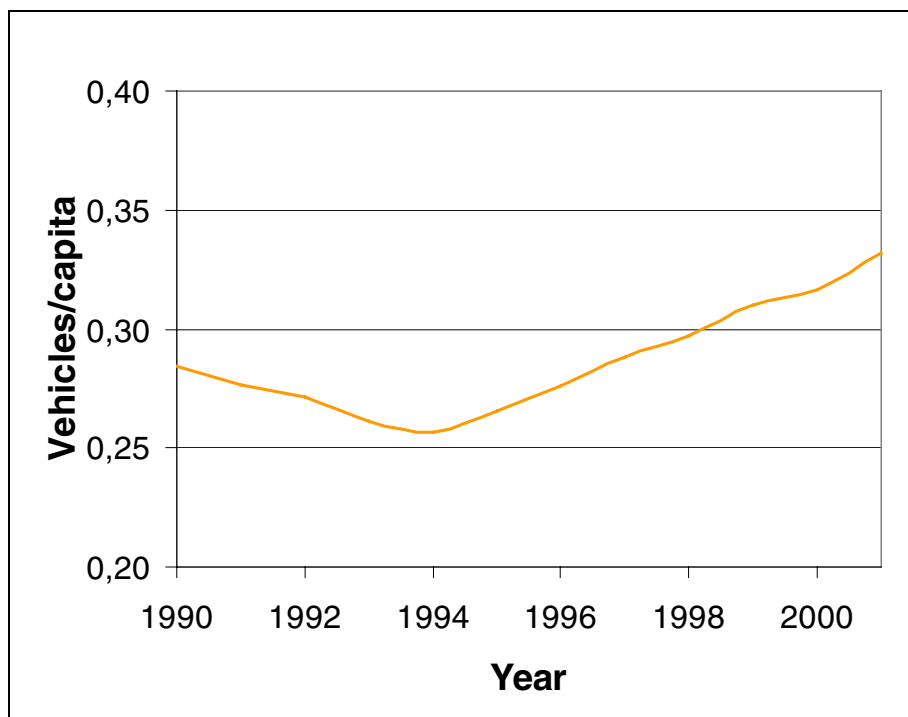


Figure 3.6 Number of private cars/capita in the Faroe Islands from 1990-2001. Source: The Faroese Vehicle Inspection (FVI)

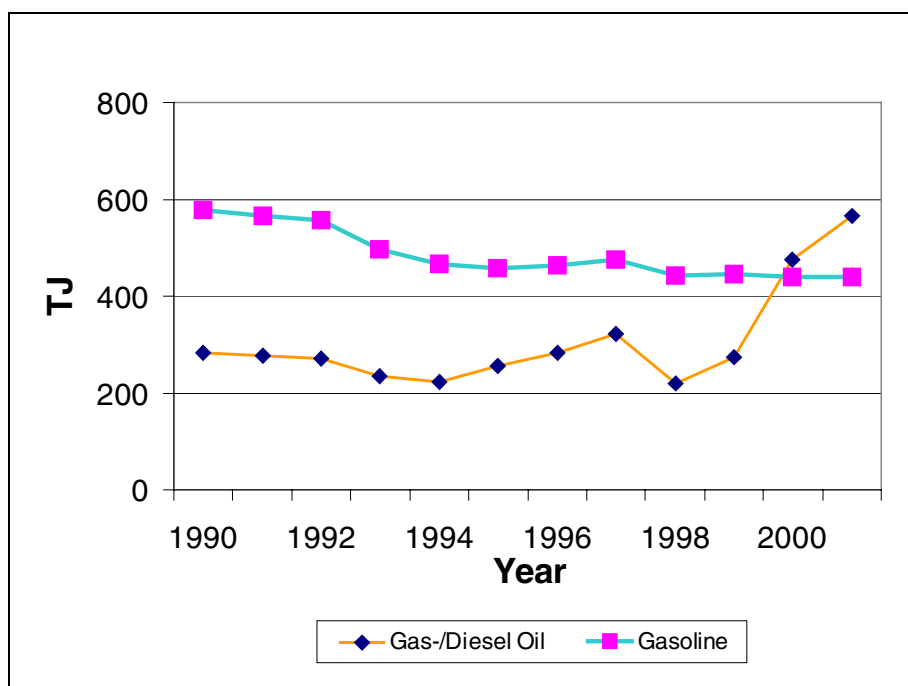


Figure 3.7 Fuel consumption by fuel type for road transportation from 1990-2001. Source: Statistics Faroe Islands.

Information on aviation fuel sales is provided by Statistics Faroe Islands for the time period 1992-2001. Information of fuel sold per destination country is not available today and efforts should be made to get more detailed information in the future. This will make it possible

to separate aviation fuel use into domestic and international figures and to make the subsequent emission calculations. As the Faroe Islands have accepted the United Nations Climate Convention as a part of the Kingdom of Denmark, aviation between Denmark and the Faroe Islands is to be reported as domestic aviation. Since almost all aviation in the Faroe Islands is between Denmark and the Faroe Islands the fuel used by aviation is added to the domestic fuel total.

Figure 3.8 shows the fuel use for aviation. The fuel use has increased by 174% from 1992 to 2001.

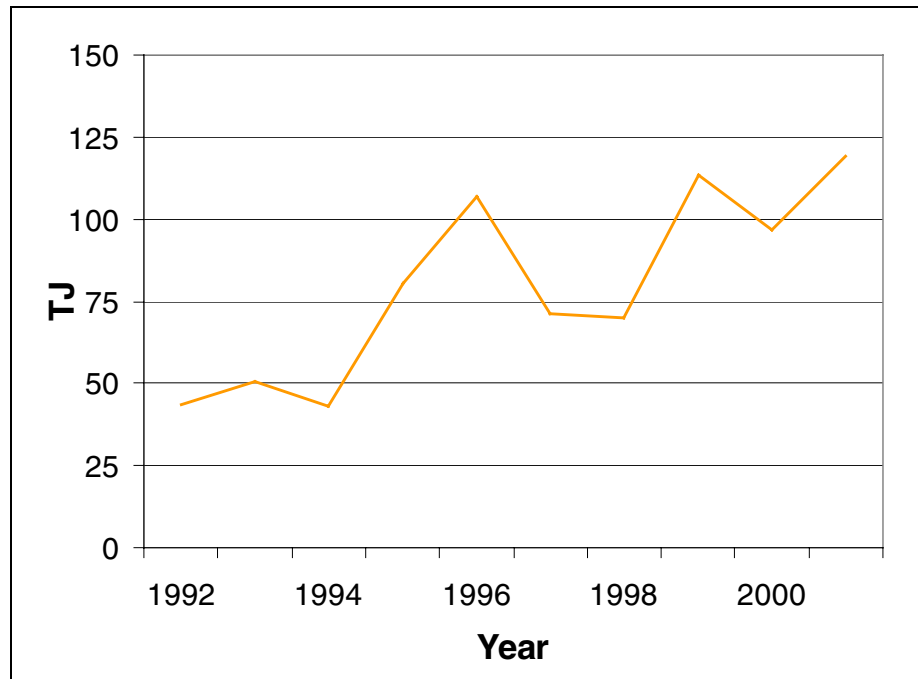


Figure 3.8 Energy use connected to fuel consumption from aviation in the Faroe Islands from 1992-2001. Source: Statistics Faroe Islands.

Four marine fuel sale totals are provided by the oil companies in the Faroe Islands 1990-2001:

- ◆ Fuel sales to Faroese fishing ships bunkering in Faroese ports.
- ◆ Fuel sales to other Faroese ships bunkering in Faroese ports.
- ◆ Fuel sales to Faroese ships bunkering outside Faroese waters (fuel data are lacking for 1990-1991).
- ◆ Fuel sales to foreign ships bunkering in Faroese ports or outside Faroese waters (fuel data are lacking for 1990-1991).

#### **Fuel sales to Faroese fishing ships bunkering in Faroese ports**

In harmony with the UNFCCC convention format the fuel use by Faroese fishing ships is classified fishery (Figure 3.4).

### **Fuel sale to other Faroese ships bunkering in Faroese ports**

To satisfy the UNFCCC rules the fuel total for other Faroese ships should be disaggregated into fuel sold to ships with destinations inside and outside the Kingdom of Denmark, as the Faroe Islands have accepted the United Nations Climate Convention as a part of the Kingdom Of Denmark. Destination information for other Faroese ships is not available for this inventory, but it is assumed that almost all of the fuel use is used for destinations inside the Kingdom of Denmark. Consequently the fuel use and emissions for other Faroese ships are classified as domestic navigation.

### **Fuel sale to Faroese ships bunkering outside Faroese waters**

No distinction is given for fuel sale to fishing vessels and other Faroese ships outside Faroese waters. A rough assumption is to place this fuel figure within the class: "International Bunkers". In the future efforts must be made to distinguish between fuel sold to fishing vessels (added to the fishery fuel use category) and other Faroese ships outside Faroese waters. A sub-division of the latter fuel amount should also be made according to fuel used by ships with destination inside or outside the Kingdom of Denmark, the fuel amount being classified as domestic and international, respectively.

### **Fuel sales to foreign ships bunkering in Faroese ports or outside Faroese waters**

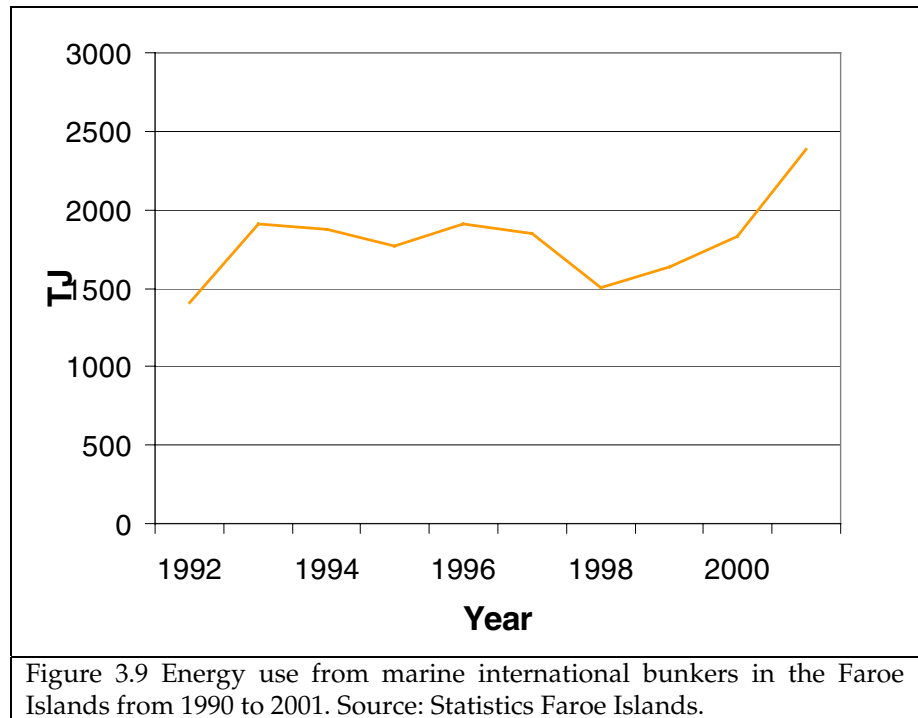
The fuel use figure for foreign ships is given only as a total number. At present the assumption is that all fuel is being used for international destination, and as a consequence the fuel total in question is classified as "International bunkers".

In the future and for UNFCCC consistency reasons the fuel sales to foreign ships should be divided into sales figures for fishing vessels and other ships. The classification should then be made as described in the previous paragraph for Faroese ships bunkering outside Faroese waters.

Figure 3.9 shows the total fuel sale connected to the sector International Bunkers (Marine).

The fuel use has increased by 77% from 1992 to 2001.





## 2.2 Waste incineration

Waste amount data and heating values covering the time period 1990-2001 are provided by Interkommunala Renovation Felagið (IRF, 2002) and Kommunala Brennistøðin (KOB, 2002), see Table 3.1. The information on waste is provided by the incineration plants in the Faroe Islands. Figure 3.10 shows the waste amounts for incineration in the time period 1990-2001. The figure shows that the energy produced by waste incineration has increased significantly, from 183 TJ in 1990 to 364 TJ in 2001 corresponding to an increase by 99%. The increase of waste amounts is correlated with the fluctuations in goods import to the Faroe Islands (Figure 3.11).

Table 3.1 Waste amounts and heating values for waste incineration 1990-2001

Year	Waste amount [tons]	Heating value [GJ/tons]
1990	22369	8.20
1991	22392	8.20
1992	22668	9.00
1993	21030	9.40
1994	20287	9.40
1995	20526	10.00
1996	22090	10.50
1997	25374	10.50
1998	30755	10.40
1999	32974	10.50
2000	33715	10.50
2001	34681	10.50

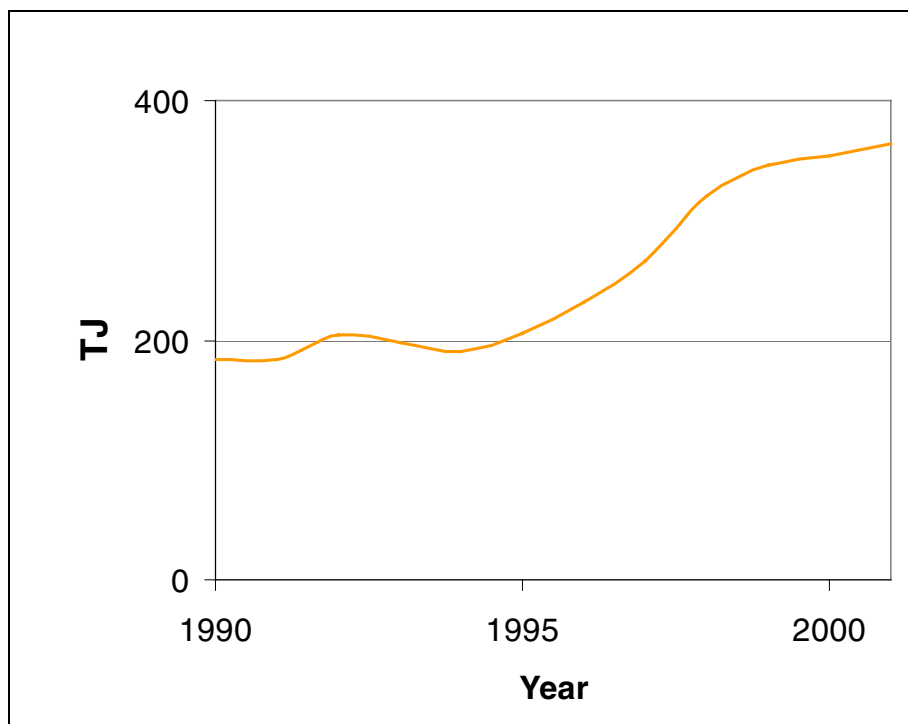


Figure 3.10 Energy produced by waste incineration in the Faroe Islands from 1990 to 2001. Source: IRF and KOB.

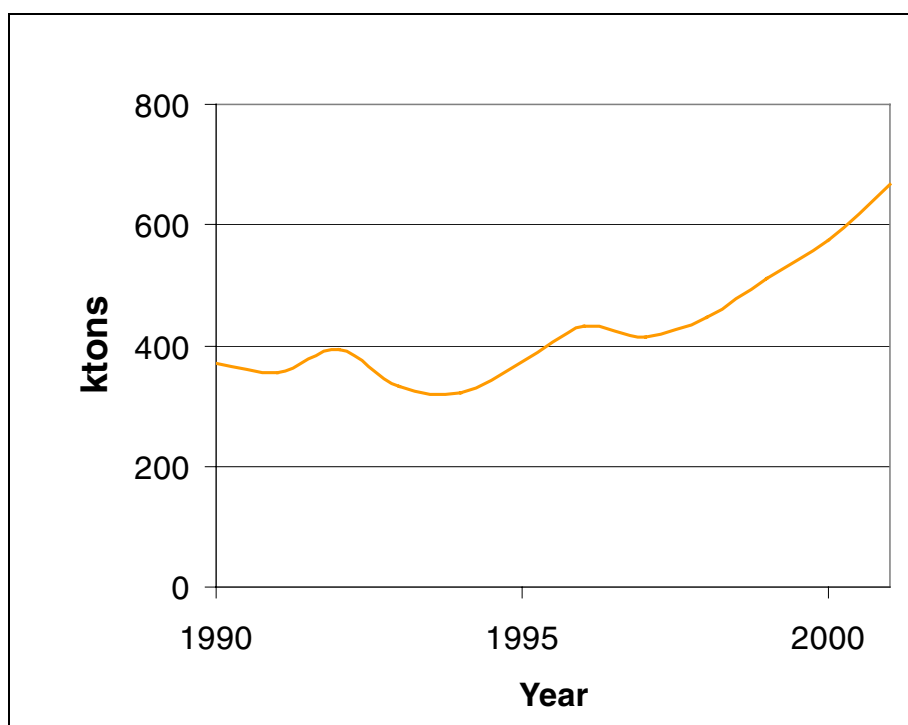


Figure 3.11 Total import of goods to the Faroe Islands from 1990-2001. Source: Statistics Faroe Islands

## 2.3 Agriculture

The activity data used to estimate the emissions of CH<sub>4</sub> from enteric fermentation and the N<sub>2</sub>O emissions from manure management and agricultural soils are delivered by the Agricultural Institute in the Faroe Islands (2002). The data are shown in Table 3.2. The number of dairy cattle has increased by 66% from 1990-2001 while the number of non-dairy cows has decreased by 49% in the same time period. The number of sheep is assumed to be constant for the time period 1990-2001.

Table 3.2 Number of animals in the Faroe Islands from 1990 to 2001

Year	Dairy cattle [Number]	Non-dairy cattle [Number]	Sheep [Number]
1990	1322	260	78940
1991	1567	308	78940
1992	1541	303	78940
1993	1544	303	78940
1994	1786	300	78940
1995	1797	302	78940
1996	1736	292	78940
1997	1981	290	78940
1998	1757	400	78940
1999	1843	349	78940
2000	2135	171	78940
2001	2200	132	78940

## **3 Emission factors**

### **3.1 Fuel combustion**

Emissions from fuel combustion come from two main sources: stationary and mobile combustion. By stationary combustion is meant fuel combustion related to industrial processes, house heating and test drills. Mobile combustion includes the combustion in engines used for propulsion in the various modes of transport such as road transport, marine activities and aviation.

Emissions are calculated by multiplying fuel consumption data with an emission factor (e.g. in tonnes emission per GJ fuel). The emission factors used are mainly provided by NERI, or selected from the IPCC Guidelines (IPCC, 1997a).

The emission factors for road traffic are calculated by NERI using background results from the Danish 1990-2001 emission inventories made with the European COPERT model (Ntziachristos et al., 2000). The Danish results are modified for Faroese traffic conditions such as other gross vehicle weights for heavy-duty vehicles and no highway driving conditions. For aviation aggregation of emission factors for all flights leaving Vagar airport in 2001 was made by NERI. The overall calculation principle is explained in Winther (2001). Due to lack of flight statistics the latter factors have been used for the years 1990-2000, but must be recalculated when better flight statistics become available.

The emission factors used to calculate emission of greenhouse gases and other gases from fuel combustion are listed in Appendix B.

### **3.2 Waste Incineration**

Emission factors concerning emissions of CO<sub>2</sub>, N<sub>2</sub>O and CH<sub>4</sub> from waste incineration in 1990-2001 are listed in Table 4.1. Emission factors for CH<sub>4</sub> and N<sub>2</sub>O are selected from the IPCC Guidelines (IPCC, 1997a). CO<sub>2</sub> emission factors are provided by NERI and are based on an estimate of 6.4 w/w% of plastic in the municipality waste (Illerup et al., 2000).

Table 4.1 Emission factors from waste incineration 1990-2001

Year	CO <sub>2</sub> [kg/GJ]	CH <sub>4</sub> [g/GJ]	N <sub>2</sub> O [g/GJ]
1990	24.44	6.00	4.00
1991	24.44	6.00	4.00
1992	22.27	6.00	4.00
1993	21.32	6.00	4.00
1994	21.32	6.00	4.00
1995	20.04	6.00	4.00
1996	19.09	6.00	4.00
1997	19.09	6.00	4.00
1998	19.41	6.00	4.00
1999	19.20	6.00	4.00
2000	19.20	6.00	4.00
2001	19.20	6.00	4.00

### 3.3 Agriculture

The emission factors for enteric fermentation are assumed constant for the time period 1990-2001. The emission factors are selected from IPCC Guidelines for sheep and for cows the emission factors are provided by Andersen (1999).

N<sub>2</sub>O emission factors for manure management and agricultural soils are delivered by NERI and are assumed constant during the time period 1990-2001.

Table 4.2 Emission factors for agriculture in the Faroe Islands 1990-2001

	Enteric fermentation CH <sub>4</sub> [kg/animal/yr]	Manure management N <sub>2</sub> O [kg/animal/yr]	Agricultural soils N <sub>2</sub> O [kg/animal/yr]
Dairy cows	104	21.8	0.233
Non-dairy cows	37	1.6	0.285
Sheep	8		0.192

The emission factors for all three sources should be recalculated in next year's inventories, according to more detailed information on animals in the Faroe Islands.

## 4 Emissions of gases

In Table 5.1 the total emissions of CO<sub>2</sub>, N<sub>2</sub>O, CH<sub>4</sub>, SO<sub>2</sub>, NO<sub>x</sub>, NMVOC and CO are shown for the Faroe Islands in the time period from 1990 to 2001. More detailed emission data are listed in Appendix C.

Table 5.1 Total emissions of CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, NO<sub>x</sub>, NMVOC, CO and SO<sub>2</sub> in the Faroe Islands 1990-2001.

Year	CO <sub>2</sub> [ktons]	CH <sub>4</sub> [tons]	N <sub>2</sub> O [tons]	NO <sub>x</sub> [tons]	NMVOC [tons]	CO [tons]	SO <sub>2</sub> [tons]
1990	654.074	853	73	5497	1054	5174	925
1991	629.726	885	78	5068	966	4911	920
1992	618.997	881	78	5426	954	4696	838
1993	502.216	875	73	4040	781	4009	726
1994	510.170	906	79	4179	706	3539	721
1995	517.102	909	81	4371	690	3432	693
1996	546.756	904	81	4490	670	3464	793
1997	532.433	935	86	4361	629	3137	731
1998	572.097	908	83	4614	565	2778	835
1999	607.912	920	87	4839	559	2728	838
2000	658.089	959	97	5203	566	2706	952
2001	730.049	972	101	5884	626	2874	1092

### 4.1 Emissions of greenhouse gases

Figure 5.1 shows the composition of greenhouse gas emissions (CO<sub>2</sub>, N<sub>2</sub>O and CH<sub>4</sub>) in 2001, calculated in GWP values. The GWP values used are 1 for CO<sub>2</sub>, 21 for CH<sub>4</sub> and 310 for N<sub>2</sub>O. CO<sub>2</sub> accounted for 94% of the total greenhouse gas emissions in 2001, while the N<sub>2</sub>O and CH<sub>4</sub> emissions contributed 4 and 3%, respectively.

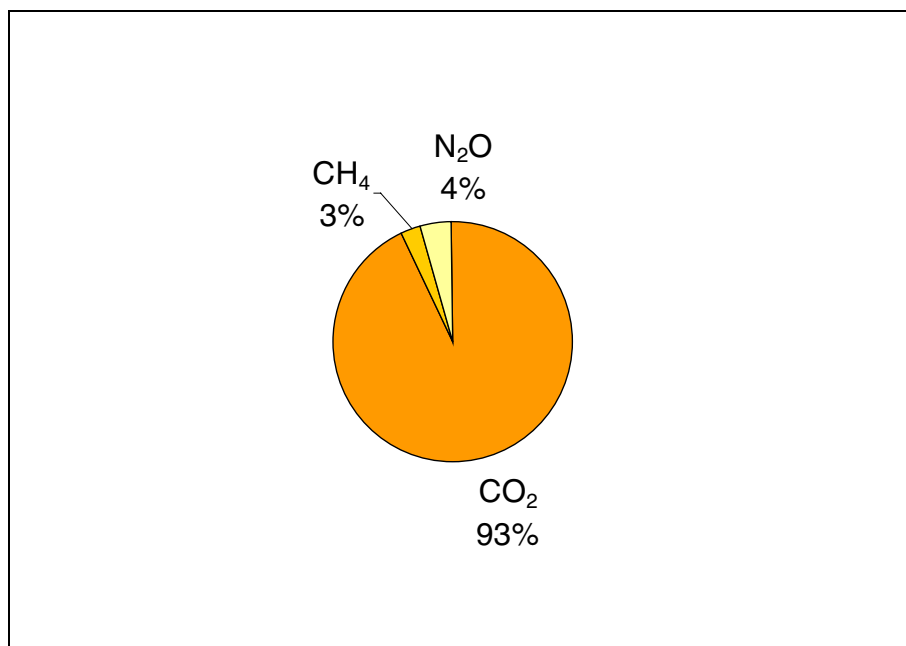


Figure 5.1 The share of greenhouse gases CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O weighted by GWP values in 2001

Figure 5.2 shows the total emissions of greenhouse gases (in CO<sub>2</sub> equivalents) in the time period 1990-2001. The total emission has increased by 12% from 1990-2001. From 1990 to 1993 a decrease of 22% is observed, due to the economic crises in the Faroe Islands.. After 1993 the emissions have increased by 44% (from 543 ktonnes CO<sub>2</sub> in 1993 to 782 ktonnes CO<sub>2</sub> in 2001).

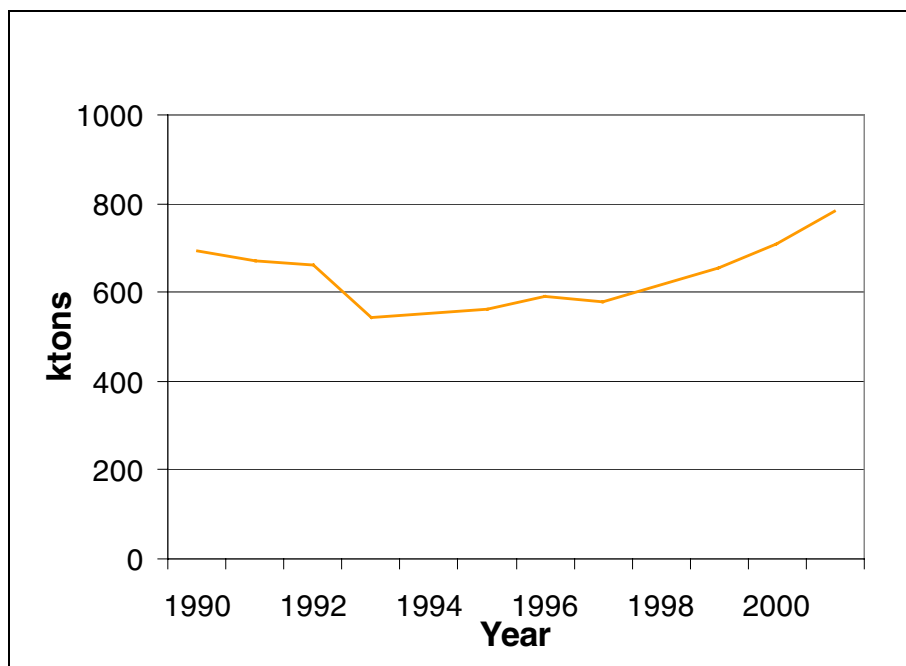
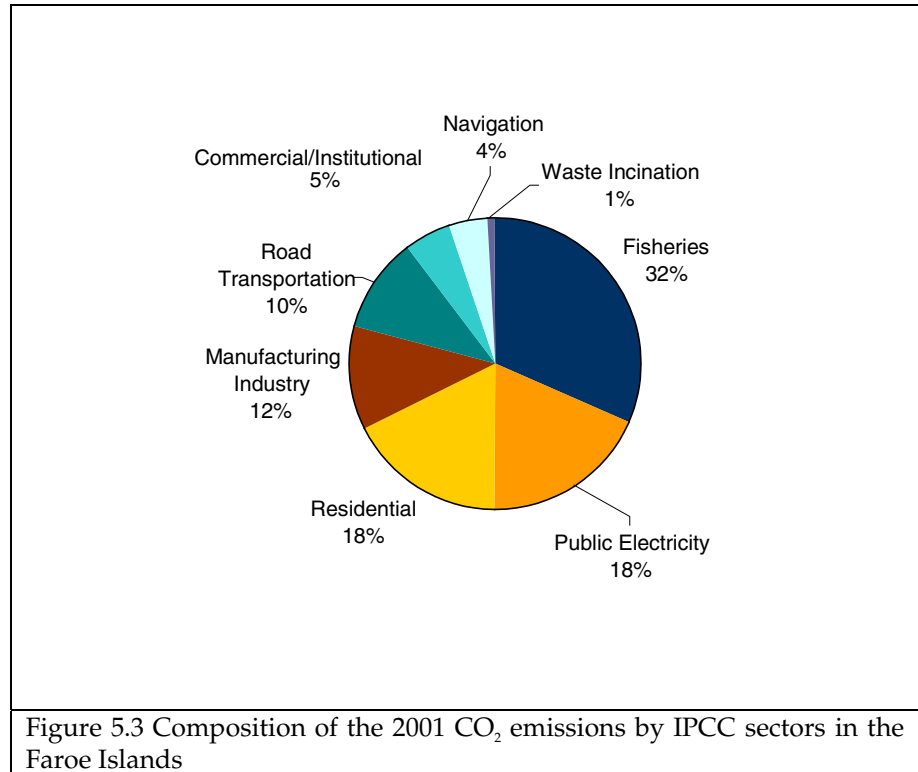


Figure 5.2 Emissions of greenhouse gases in CO<sub>2</sub> equivalents from 1990 to 2001

#### 4.1.1 Carbon dioxide (CO<sub>2</sub>)

In 2001, 32% of the CO<sub>2</sub> emissions originated from fisheries, while 18% from public electricity, 18% from residential, 12% from manufacturing industry and 10% road transportation (Figure 5.3).



From 1990 to 2001 a total CO<sub>2</sub> emission increase of 12% is observed (Table 5.1). The emissions from fisheries have increased by 44% from 1993-2001, and in the same period the emissions from residential have increased by 13% (Figure 5.4).

The emissions from manufacturing industry increased by 164% from 1995-2001, partly due to an increasing use of heavy fuel oil in the fishery industry and the use of fuel oil in connection with test drillings in 2001. Test drillings accounted for 21% of the total CO<sub>2</sub> emissions in manufacturing industries.

The emissions from public industry increased by 85% during the time period 1995-2001 (Figure 5.4). The increase is due to an increasing use of heavy fuel to meet the power demand for all user groups in the Faroe Islands.



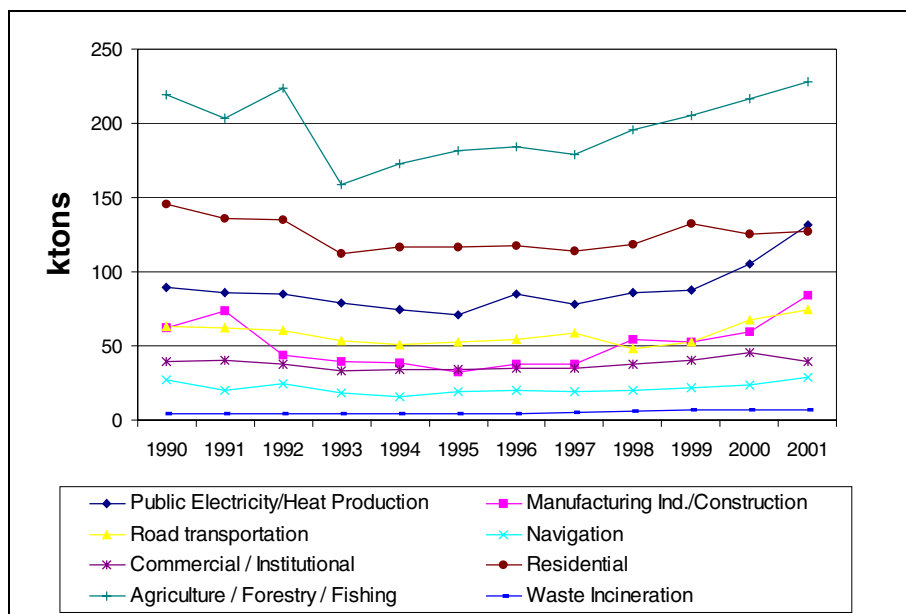


Figure 5.4 Emissions of CO<sub>2</sub> by IPCC sectors in the Faroe Islands 1990-2001.

#### 4.1.2 Methane (CH<sub>4</sub>)

In 2001, 94% of the total CH<sub>4</sub> emissions originated from agriculture (enteric fermentation) and the remaining 6% from other sources (Figure 5.5). From 1990 to 2001 a total emission increase of 14% is observed (Table 5.1), mainly caused by the development in agricultural emissions (Figure 5.6). The increase is due to a rise in the number of cows during the time period 1990-2001 (Table 3.2).

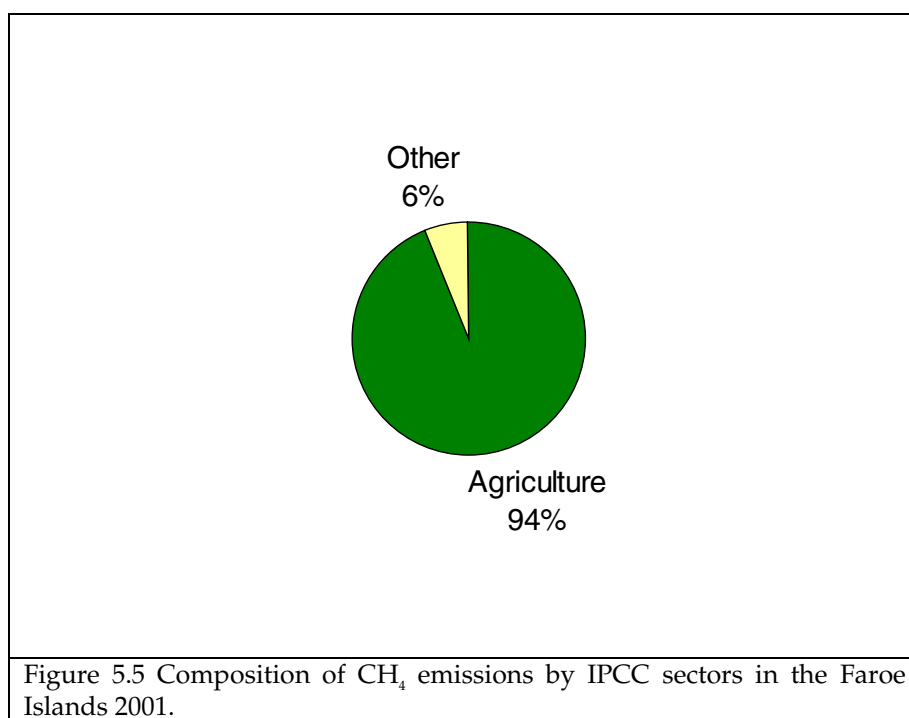
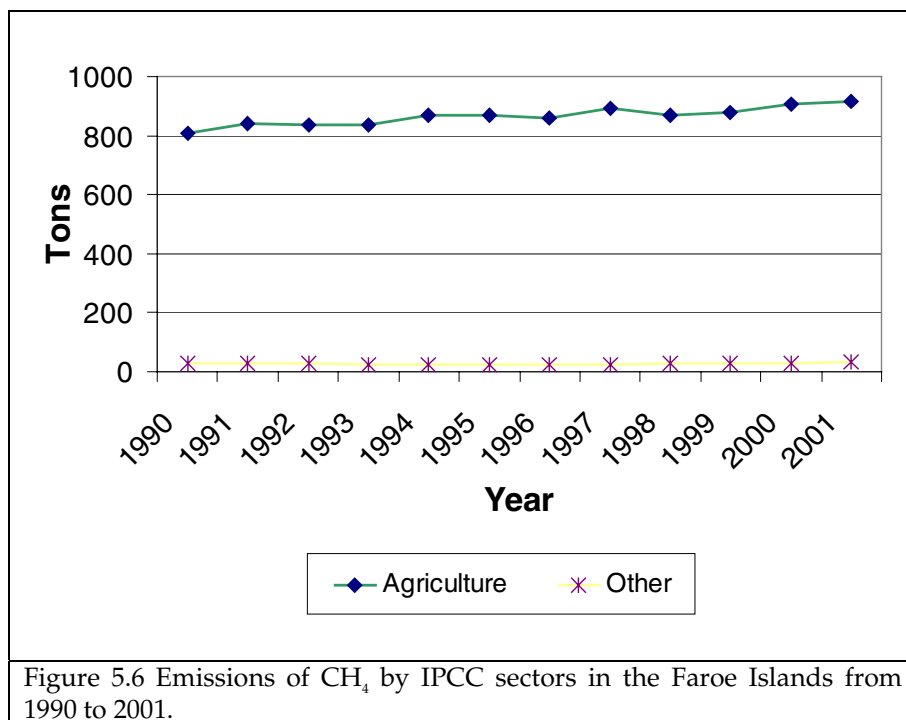


Figure 5.5 Composition of CH<sub>4</sub> emissions by IPCC sectors in the Faroe Islands 2001.



#### 4.1.3 Nitrous oxide (N<sub>2</sub>O)

The emission shares of N<sub>2</sub>O in 2001 were 65% for agriculture (Manure Management and Agriculture Soils), 15% for Fisheries and 9% for Transportation (Figure 5.7). From 1990 to 2001 a total emission increase of 38% is observed (Table 5.1). The emissions from agriculture increased by 43%, while the emission increase for fisheries was 4% (Figure 5.8). The emissions from road transportation increased by 163% from 1990-2001, mainly due to the introduction of gasoline private cars equipped with catalytic converters in the beginning of the 1990s.

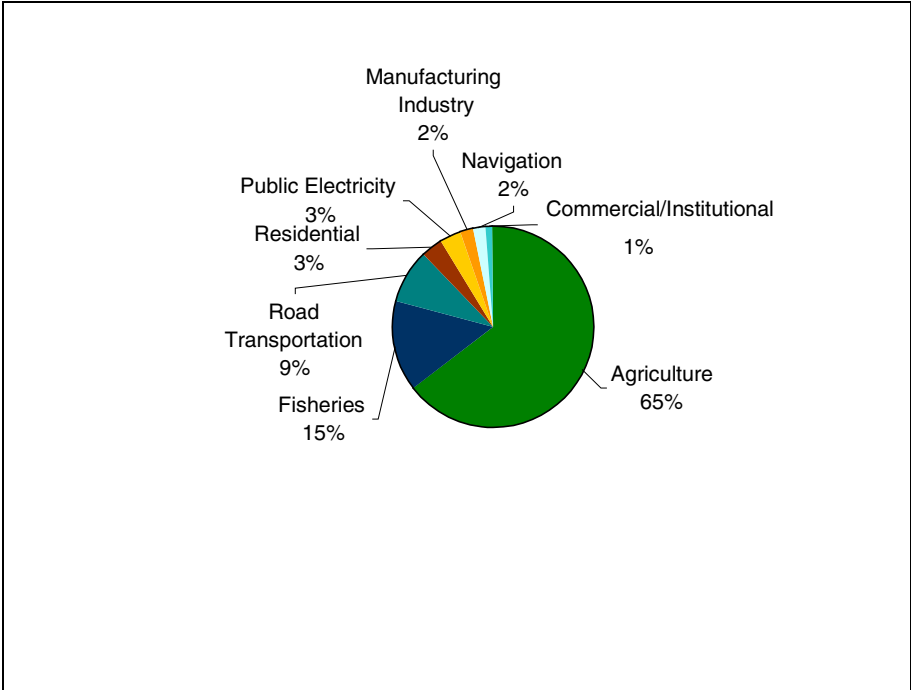


Figure 5.7 Composition of N<sub>2</sub>O emissions by IPCC sectors in the Faroe Islands. 2001.

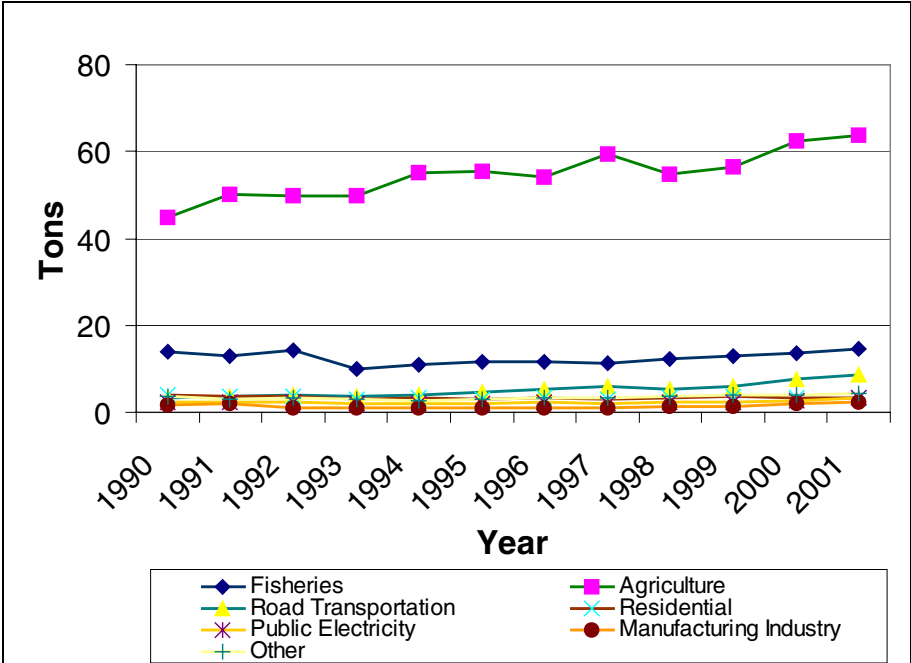


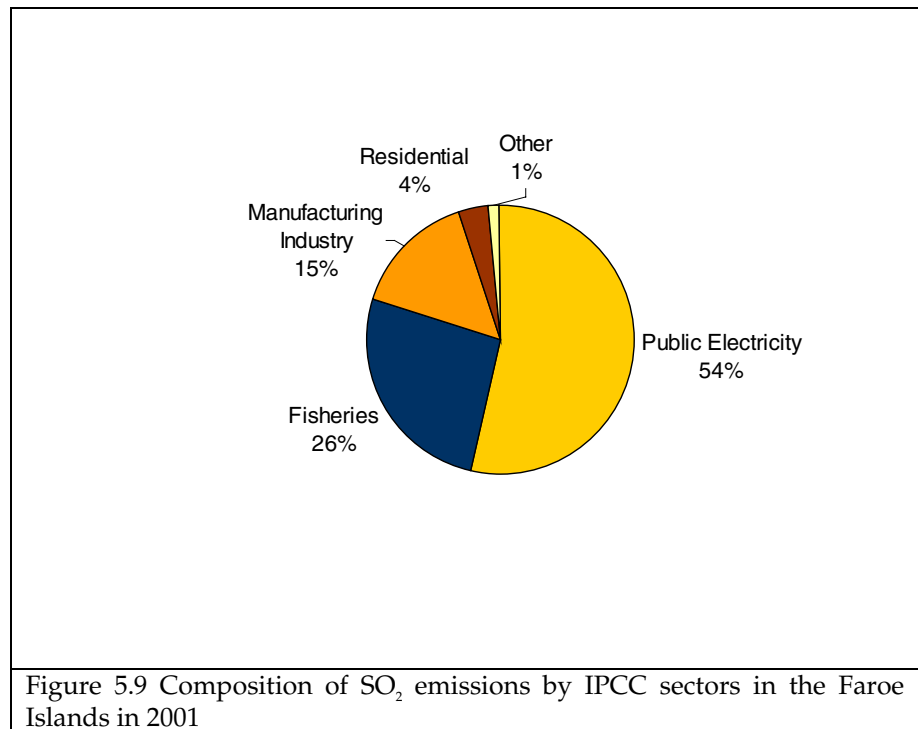
Figure 5.8 Emissions of N<sub>2</sub>O by IPCC sectors in the Faroe Islands from 1990 to 2001.

## 4.2 Emissions of other gases

### 4.2.1 Sulphur dioxide (SO<sub>2</sub>)

The total emissions of SO<sub>2</sub> have increased by 18% from 1990-2001 (Table 5.1).

In 2001, 54% of the SO<sub>2</sub> emissions originated from public electricity, 26% from fisheries, 15% from manufacturing industry and 4% from residential (Figure 5.9).



The emissions from public electricity have increased by 79% from 1995-2001, mainly due to an increase in the use of heavy fuel oil (Figure 5.10). The emissions from fisheries have increased by 44% from 1993 to 2001, while the emissions from manufacturing industry have increased by 103% from 1995-2001. The latter increase is partly due to an increase in heavier fuel oil use in the fishery industry and the use of fuel oil for test drillings in 2001.

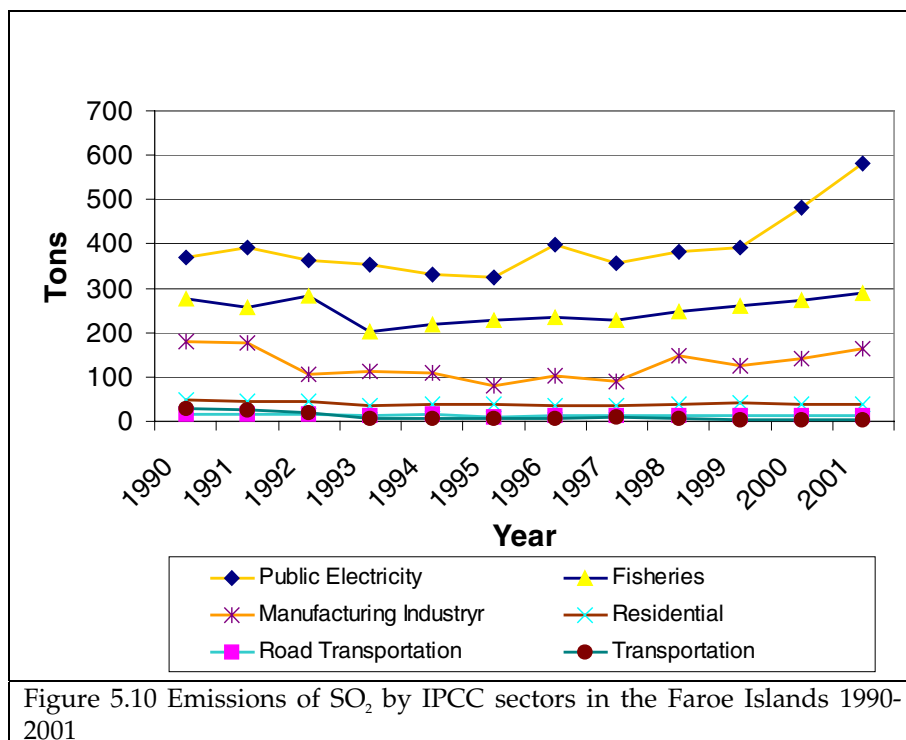


Figure 5.10 Emissions of SO<sub>2</sub> by IPCC sectors in the Faroe Islands 1990-2001

#### 4.2.2 Nitrogen oxides (NO<sub>x</sub>)

The total emissions of NO<sub>x</sub> increased by 7% from 1990-2001 (Table 5.1).

In 2001, 71% of the emissions originated from fisheries, 8% from navigation and 7% from transportation (Figure 5.11). The emissions from fisheries have increased by 44% from 1993-2001. The opposite is seen in the emissions from road transportation, which decreased by 48% from 1990 to 1999 (Figure 5.12), due to the stepwise strengthening of NO<sub>x</sub> emission standards for all vehicle types. From 1999 and onwards the emissions have increased by 28% (1999-2001) caused by a rising number of vehicles and an increase in traffic. The emissions from navigation increased by 87% from 1994 to 2001.

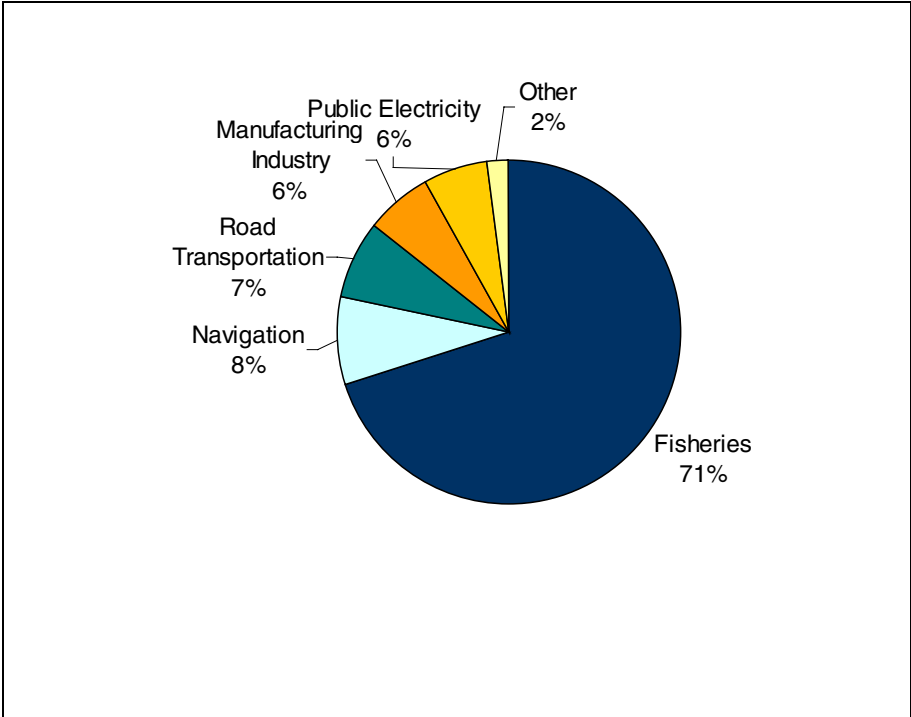


Figure 5.11 Composition of NO<sub>x</sub> emissions by IPCC sectors in the Faroe Islands. 2001.

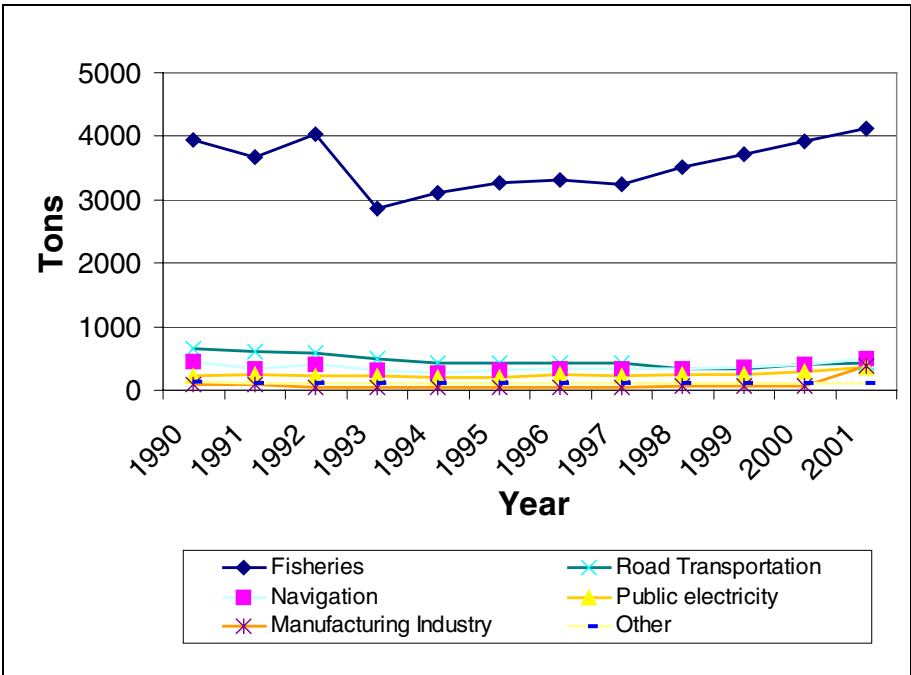


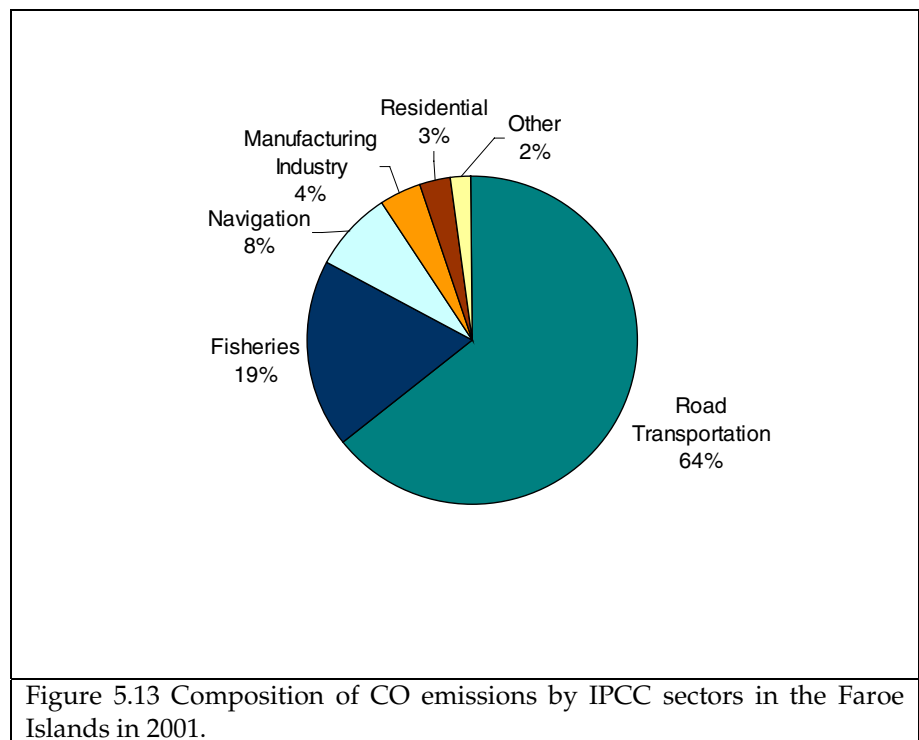
Figure 5.12 Emissions of NO<sub>x</sub> by IPCC sectors in the Faroe Islands from 1990 to 2001.

### 4.2.3 Carbon monoxide (CO)

The total emissions of CO have decreased by 44% from 1990 to 2001 (Table 5.1).

In 2001, 64% of the CO emissions originated from transportation, 19% from fisheries and 8% from navigation (Figure 5.13).

The total emission from transportation has decreased by 57% from 1990 to 2001 (Figure 5.18), and is mainly due to use of catalytic converters for gasoline private cars. The emissions from fisheries have increased by 34% from 1993 to 2001, while the emissions from navigation have increased by 86% from 1994-2001 (Figure 5.14).



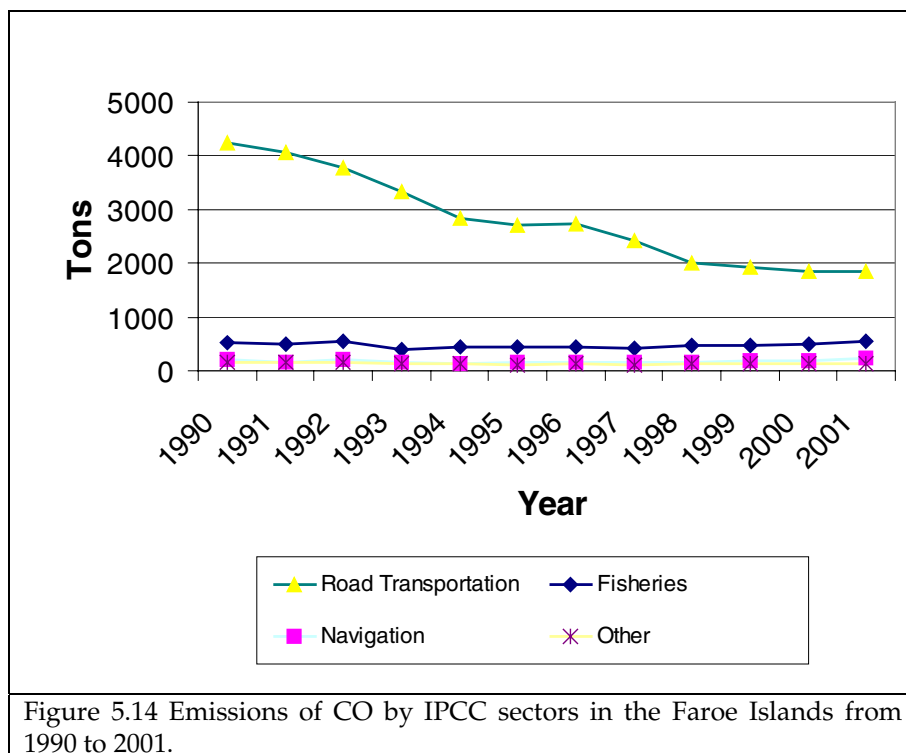


Figure 5.14 Emissions of CO by IPCC sectors in the Faroe Islands from 1990 to 2001.

#### 4.2.4 Non-methane volatile organic compounds (NMVOC)

The total emissions of NMVOC decreased by 41% from 1990-2001 (Table 5.1).

In 2001, the NMVOC emission share from road transportation was 47% from fisheries 27%, from navigation 17% and from manufacturing industry 7% (Figure 5.15). The emissions from transportation have decreased by 61% from 1990-2001 (Figure 5.16). The emissions from fisheries have increased by 27% from 1993 to 2001, while the emissions from navigation have increased by 87% from 1994-2001 (Figure 5.16).



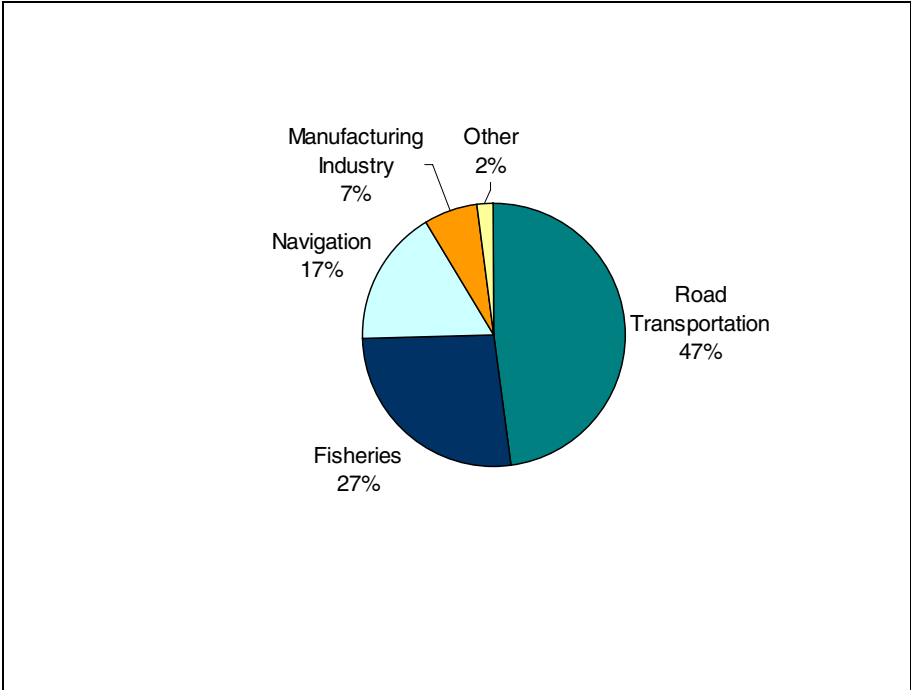


Figure 5.15 Composition of NMVOC emissions by IPCC sectors in the Faroe Islands in 2001.

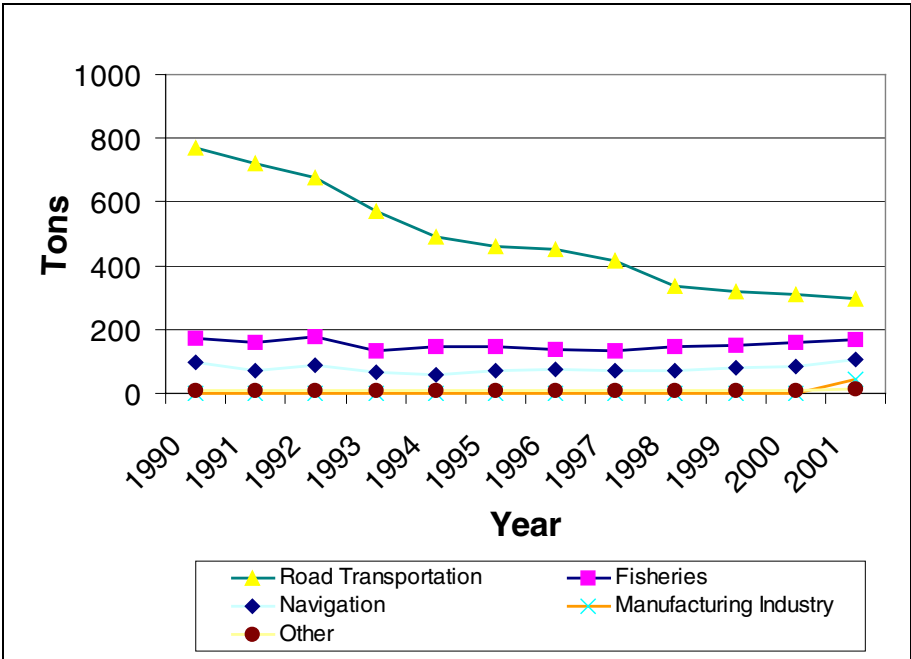


Figure 5.16 Emissions of NMVOC by IPCC sectors in the Faroe Islands from 1990 to 2001.

## 5 Conclusions

In the present project an emission inventory was constructed for the Faroe Islands for 2001 according to the guidelines of the UNFCCC convention. The inventory comprises estimates of the greenhouse gas emissions of CO<sub>2</sub>, N<sub>2</sub>O and CH<sub>4</sub> and the long-range transboundary air pollutants of SO<sub>2</sub>, NO<sub>x</sub>, CO and NMVOC.

Inventories were also made for the Faroe Islands in a consistent time series from 1990 to 2000 using the 2001 inventory methodology. The inventory format is feasible to be used in terms of 1) input of activity data and emission factors, 2) the subsequent emission calculations and 3) the further reporting of total emission results.

Suggestions for improvements in the following areas in order to make the future annual inventories more precise are:

- ◆ The fuel data used in the estimations of the emissions are presently not available grouped by IPCC categories. It is therefore necessary to change the reporting of data from the oil companies. As the reporting format from the two oil companies differs it is suggested to develop a new common format.
- ◆ The new format should also include more detailed information on fuel sold to fishing ships (according to gear). Moreover, the fuel sold to Faroese ships bunkering outside Faroese waters and fuel sold to all foreign ships, must be classified as either fishery or other vessels and furthermore must be divided into sub-totals for other vessels according to destination. For the industry it is necessary to make a fuel split into sub-groups according to the UNFCCC reporting format.
- ◆ Related to transport more detailed Faroese vehicle fleet and mileage figures must be obtained for road transportation vehicles. For aviation and sea transport, specific data (aircraft/sea vessel type and destination airport/seaport) must be gathered in order to classify the emissions as domestic or international.
- ◆ NERI has mainly provided the emission factors used for the emission inventory and presented in the report. It is recommended that the Faroe Islands in the future adjust the emission factors on the basis of more detailed information on fuel types in the Faroe Islands. This relates also to detailed emission information for sea vessels.
- ◆ Resources must be set aside to continue the emission inventory work in the future. This implies continuous efforts to ensure a timely, consistent and accurate provision of activity data by relevant companies and institutions. Finally it must be legally clarified where in the Faroe Islands the responsibility for making the final report of the Faroese emission results should be placed.

## References

Andersen, M.A. 1999: Estimering af emission af metan og lattergas fra landbruget (baseret på IPCC's estimeringsmetoder). Samfund og Miljø. Integrerede Miljøinformationssystemer (IMIS). Danmarks Miljøundersøgelser. 47 s. Arbejdsrapport fra DMU nr. 116.

FVI, 2002. (Unpublished).

Føroya Shell, 2002. (Unpublished).

Illerup, B.J., Lyck, E., Winther, M. and Rasmussen, E. 2000: Denmark's National Inventory Report Submitted under the United Nations Framework Convention on Climate Change.

IPCC 1997a: Greenhouse Gas Inventory. Workbook. IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, London: Intergovernmental Panel on Climate Change.

IPCC 1997b: Greenhouse Gas Inventory. Reference Manual. Revised 1996. IPCC Guidelines for National Greenhouse Gas Inventories, Volume 3, London: Intergovernmental Panel on Climate Change.

IRF, 2002. (Unpublished).

KOB, 2002. (Unpublished).

Ntziachristos, L. and Samaras, Z. 2000: COPERT III Computer Programme to Calculate Emissions from Road Transport - Methodology and Emission Factors (Version 2.1). Technical report No 49. European Environment Agency, November 2000, Copenhagen.

Statistics Faroe Islands, 2002. (Unpublished).

Statoil Føroya, 2002. (Unpublished).

The Agricultural Institute in the Faroe Islands, 2002. (Unpublished).

Winther, M. 2001: 1998 Fuel Use and Emissions for Danish IFR Flights. Environmental Project no. 628, 2001. 112 p. Danish EPA. Prepared by the National Environmental Research Institute, Denmark. Electronic report at homepage of Danish EPA <http://www.mst.dk/udgiv/Publications/2001/87-7944-661-2/html/>.

# Appendix A – Fuel use (tonnes) in the Faroe Islands 1990 - 2001

Table A0. Fuel sources. 1990-2001.

IPCC code	Sector	Fuel source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
			tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes
1.A.1	Public electricity and heat production	Gas/Diesel	6066	3495	4958	3426	3498	2786	2603	2947	4066	3928	4247	6370
		Heavy Fuel Oil	22261	23715	21902	21362	20076	19716	24172	21562	23170	23689	29099	35192
		Lubricating Oil			1	3	2	2	1	2	1	1	1	1
1.A.2	Manufacturing Industries and construction	Gas/Diesel	7342	11467	6705	4848	4625	4637	5056	5875	7126	8286	9482	15736
		Heavy Fuel Oil	12284	11740	7033	7612	7541	5478	6971	6081	9996	8375	9324	10906
		Petroleum	3	3	2	2	3	2	1	2	2	2	2	57
		Lubricating Oil	80	126	68	27	23	31	36	41	49	59	59	3
1.A.3.a	Civil Aviation	Jet Fuel			1000	1161	991	1848	2460	1639	1607	2606	2228	2743
1.A.3.b	Road transportation	Gas/Diesel	6613	6485	6373	5470	5242	6014	6594	7504	5144	6381	11119	13227
		Gasoline	13177	12922	12698	11332	10639	10450	10564	10837	10089	10136	10010	10023
		Petroleum	16	17	25	15	16	10	10	19	11	10	4	2
		Lubricating Oil	64	62	61	47	49	62	70	80	69	40	87	92
1.A.3.d	Navigation	Gas/Diesel	8426	6242	7611	5730	4867	6098	6414	6191	6327	6855	7420	9105
		Petroleum	144	171	212	66	10	22	16	17	26	26	26	26
		Lubricating Oil	121	143	179	128	30	32	42	58	51	130	162	84
1.A.4.a	Commercial/Institutional	Gas/Diesel	12130	12460	11795	10274	10583	10796	11043	11207	11872	12750	14390	12503
		Petroleum	193	198	187	157	174	15	114	12	10	10	6	9
		Lubricating Oil	25	26	25	20	18	15	21	16	28	33	56	66
1.A.4.b	Residential	Gas/Diesel	45978	42988	42552	35426	36824	36817	37097	35946	37543	41853	39767	40136
		Gasoline			2		2	2	1	1	1	1	1	1
		Petroleum	2	2	116	78	70	58		42	34	30	28	22
		Lubricating Oil	125	117	18	14	15	9	8	9	9	9	10	8
1.A.4.c	Fisheries/Agriculture	Gas/Diesel	69338	64364	70822	50274	54657	57313	58218	56724	61814	65077	68581	72288
		Gasoline	24	23	25	33	42	29						
		Petroleum	3	2	2			2	1	1	1	1		1
		Lubricating Oil	324	218	239	213	270	413	445	248	282	318	546	496
<b>Total</b>		<b>Gas/Diesel</b>	<b>155893</b>	<b>147501</b>	<b>150816</b>	<b>115448</b>	<b>120296</b>	<b>124461</b>	<b>127025</b>	<b>126394</b>	<b>133892</b>	<b>145130</b>	<b>155006</b>	<b>169365</b>
		<b>Gasoline</b>	<b>13201</b>	<b>12945</b>	<b>12725</b>	<b>11365</b>	<b>10683</b>	<b>10481</b>	<b>10565</b>	<b>10838</b>	<b>10090</b>	<b>10137</b>	<b>10011</b>	<b>10023</b>
		<b>Heavy Fuel Oil</b>	<b>34545</b>	<b>35455</b>	<b>28935</b>	<b>28974</b>	<b>27617</b>	<b>25194</b>	<b>31143</b>	<b>27643</b>	<b>33166</b>	<b>32064</b>	<b>38423</b>	<b>46098</b>
		<b>Petroleum</b>	<b>361</b>	<b>393</b>	<b>544</b>	<b>318</b>	<b>273</b>	<b>109</b>	<b>142</b>	<b>93</b>	<b>84</b>	<b>79</b>	<b>40</b>	<b>91</b>
		<b>Lubricating Oil</b>	<b>739</b>	<b>692</b>	<b>591</b>	<b>452</b>	<b>407</b>	<b>564</b>	<b>623</b>	<b>454</b>	<b>489</b>	<b>590</b>	<b>921</b>	<b>750</b>
		<b>Jet Fuel</b>			<b>1000</b>	<b>1161</b>	<b>991</b>	<b>1848</b>	<b>2460</b>	<b>1639</b>	<b>1607</b>	<b>2606</b>	<b>2228</b>	<b>2743</b>
International bunkers : Marine		Gas/Diesel			26085	38172	37755	36659	40812	37628	31507	36313	41927	55791
		Heavy Fuel Oil			7187	6932	6532	4969	4121	6013	3943	2081	980	0

# Appendix B - Fuel use (TJ) in the Faroe Islands 1990-2001

Table B0. Energy use 1990-2001.

IPCC code	Sector	Fuel source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
			TJ	TJ	TJ	TJ	TJ	TJ	TJ	TJ	TJ	TJ	TJ	TJ
1.A.1	Public electricity and heat production	Gas/Diesel	259	149	212	146	149	119	111	126	174	168	181	272
		Heavy Fuel Oil	905	964	890	868	816	801	983	876	942	963	1183	1431
		Lubricating Oil			0	0	0	0	0	0	0	0	0	0
1.A.2	Manufacturing Industries and construction	Gas/Diesel	314	490	286	207	197	198	216	251	304	354	405	672
		Heavy Fuel Oil	499	477	286	309	307	223	283	247	406	340	379	443
		Petroleum	0	0	0	0	0	0	0	0	0	0	0	2
		Lubricating Oil	3	5	3	1	1	1	2	2	2	2	2	0
1.A.3.a	Civil Aviation			44	51	43	80	107	71	70	113	97	119	
1.A.3.b	Road transportation	Gas/Diesel	282	277	272	234	224	257	282	320	220	272	475	565
		Gasoline	577	566	556	496	466	458	463	475	442	444	438	439
		Petroleum	1	1	1	1	1	0	0	1	0	0	0	0
		Lubricating Oil	3	3	3	2	2	3	3	3	3	3	2	4
1.A.3.d	Navigation	Gas/Diesel	360	267	325	245	208	260	274	264	270	293	317	389
		Petroleum	6	7	9	3	0	1	1	1	1	1	0	0
		Lubricating Oil	5	6	8	5	1	1	2	2	2	5	7	4
1.A.4.a	Commercial/Institutional	Gas/Diesel	518	532	504	439	452	461	472	479	507	544	614	534
		Petroleum	8	9	8	7	8	1	5	1	0	0	0	0
		Lubricating Oil	1	1	1	1	1	1	1	1	1	1	2	3
1.A.4.b	Residential	Gas/Diesel	1963	1836	1817	1513	1572	1572	1584	1535	1603	1787	1698	1714
		Gasoline	0	0	0	0	0	0	0	0	0	0	0	0
		Petroleum	0	0	5	3	3	3	0	2	1	1	1	1
		Lubricating Oil	5	5	1	1	1	0	0	0	0	0	0	0
1.A.4.c	Fisheries/Agriculture	Gas/Diesel	2961	2748	3024	2147	2334	2447	2486	2422	2639	2779	2928	3087
		Gasoline	1	1	1	1	2	1	0	0	0	0	0	0
		Petroleum	0	0	0	0	0	0	0	0	0	0	0	0
		Lubricating Oil	14	9	10	9	11	17	19	10	12	13	23	21
<b>Total</b>		<b>Gas/Diesel</b>	<b>6657</b>	<b>6298</b>	<b>6440</b>	<b>4930</b>	<b>5137</b>	<b>5314</b>	<b>5424</b>	<b>5397</b>	<b>5717</b>	<b>6197</b>	<b>6619</b>	<b>7232</b>
		<b>Gasoline</b>	<b>578</b>	<b>567</b>	<b>557</b>	<b>498</b>	<b>468</b>	<b>459</b>	<b>463</b>	<b>475</b>	<b>442</b>	<b>444</b>	<b>438</b>	<b>439</b>
		<b>Heavy Fuel Oil</b>	<b>1404</b>	<b>1441</b>	<b>1176</b>	<b>1178</b>	<b>1123</b>	<b>1024</b>	<b>1266</b>	<b>1124</b>	<b>1348</b>	<b>1303</b>	<b>1562</b>	<b>1874</b>
		<b>Petroleum</b>	<b>16</b>	<b>17</b>	<b>24</b>	<b>14</b>	<b>12</b>	<b>5</b>	<b>6</b>	<b>4</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>4</b>
		<b>Lubricating Oil</b>	<b>31</b>	<b>29</b>	<b>25</b>	<b>19</b>	<b>17</b>	<b>24</b>	<b>26</b>	<b>19</b>	<b>21</b>	<b>25</b>	<b>39</b>	<b>31</b>
		<b>Jet Fuel</b>			<b>44</b>	<b>51</b>	<b>43</b>	<b>80</b>	<b>107</b>	<b>71</b>	<b>70</b>	<b>113</b>	<b>97</b>	<b>119</b>
International bunkers : Marine		Gas/Diesel			1114	1630	1612	1565	1743	1607	1345	1551	1790	2382
		Heavy Fuel Oil			292	282	266	202	168	244	160	85	40	0

## Appendix C - Emission factors 1990-2001 for the Faroe Islands

Table C.1 Emission factors for CO<sub>2</sub> 1990-2001

IPCC code	Sector	Year	Gas	Gasoline	Heavy fuel oil	Petroleum	Jet fuel
			/Diesel oil				
			kg/GJ	kg/GJ	kg/GJ	kg/GJ	kg/GJ
1.A.1	Public electricity and heat production	1990-2001	74		78		
1.A.2	Manufacturing Industries and construction	1990-2001	74		78	72	
1.A.3.b	Road transportation	Tab. B.9	74	73			
1.A.3.d	Navigation	1990-2001	74		78	72	
1.A.4.a	Commercial/Institutional	1990-2001	74			72	
1.A.4.b	Residential	1990-2001	74			72	
1.A.4.c	Fisheries/Agriculture	1990-2001	74	73			
International bunkers: Aviation				73			72
International bunkers: Marine			74		78		

Table C.2 Emission factors for CH<sub>4</sub> 1990-2001

IPCC code	Sector	Year	Gas	Gasoline	Heavy fuel oil	Petroleum	Jet fuel
			/Diesel oil				
			kg/GJ	kg/GJ	kg/GJ	kg/GJ	kg/GJ
1.A.1	Public electricity and heat production	1990-2001	1.50		3.00		
1.A.2	Manufacturing Industries and construction	1990-2001	1.50		3.00	1.50	
1.A.3.b	Road transportation	Tab. B.9					
1.A.3.d	Navigation	1990-2001	1.69			1.50	
1.A.4.a	Commercial/Institutional	1990-2001	7.00			1.50	
1.A.4.b	Residential	1990-2001	7.00			1.50	
1.A.4.c	Fisheries/Agriculture	1990-2001	1.69	108.10		1.50	
International bunkers: Aviation			21.90				0.65
International bunkers: Marine			1.69		1.76		

Table C.3 Emission factors for N<sub>2</sub>O 1990-2001

IPCC code	Sector	Year	Gas	Gasoline	Heavy fuel oil	Petroleum	Jet fuel
			/Diesel oil				
			kg/GJ	kg/GJ	kg/GJ	kg/GJ	kg/GJ
1.A.1	Public electricity and heat production	1990-2001	2.00		2.00		
1.A.2	Manufacturing Industries and construction	1990-2001	2.00		2.00	3.00	
1.A.3.b	Road transportation	Tab. B.9					
1.A.3.d	Navigation	1990-2001	4.70			3.00	
1.A.4.a	Commercial/Institutional	1990-2001	2.00			3.00	
1.A.4.b	Residential	1990-2001	2.00			3.00	
1.A.4.c	Fisheries/Agriculture	1990-2001	4.70	0.52		3.00	
International bunkers: Aviation			2.00				2.68
International bunkers: Marine			4.70		4.90		

Table C.4 Emission factors for SO<sub>2</sub> 1990-2001

IPCC code	Sector	Year	Gas	Gasoline	Heavy fuel oil	Petroleum	Jet fuel
			/Diesel oil				
			kg/GJ	kg/GJ	kg/GJ	kg/GJ	kg/GJ
1.A.1	Public electricity and heat production	1990-2001	23.00		403.00		
1.A.2	Manufacturing Industries and construction	1990-2001	23.00		344.00	573.00	
1.A.3.b	Road transportation	Tab. B.9					
1.A.3.d	Navigation	1990-2001	93.68			573.00	
1.A.4.a	Commercial/Institutional	1990-2001	23.00			573.00	
1.A.4.b	Residential	1990-2001	23.00			573.00	
1.A.4.c	Fisheries/Agriculture	1990-2001	93.68	4.60		573.00	
International bunkers: Aviation			4.59				2.30
International bunkers: Marine			468.38		1641.94		

Table C.5 Emission factors for NO<sub>x</sub> 1990-2001

IPCC code	Sector	Year	Gas	Gasoline	Heavy fuel oil	Petroleum	Jet fuel
			/Diesel oil				
			kg/GJ	kg/GJ	kg/GJ	kg/GJ	kg/GJ
1.A.1	Public electricity and heat production	1990-2001	52.00		142.00		
1.A.2	Manufacturing Industries and construction	1990-2001	52.00		142.00	105.00	
1.A.3.b	Road transportation	Tab. B.9					
1.A.3.d	Navigation	1990-2001	1334.90			105.00	
1.A.4.a	Commercial/Institutional	1990-2001	52.00			105.00	
1.A.4.b	Residential	1990-2001	52.00			105.00	
1.A.4.c	Fisheries/Agriculture	1990-2001	1334.90	64.34		105.00	
International bunkers: Aviation			859.00				205.14
International bunkers: Marine			2037.50		2127.10		

Table C.6 Emission factors for NMVOC 1990-2001

IPCC code	Sector	Year	Gas	Gasoline	Heavy fuel oil	Petroleum	Jet fuel
			/Diesel oil				
			kg/GJ	kg/GJ	kg/GJ	kg/GJ	kg/GJ
1.A.1	Public electricity and heat production	1990-2001	1.50		3.00		
1.A.2	Manufacturing Industries and construction	1990-2001	1.50		3.00	1.50	
1.A.3.b	Road transportation	Tab. B.9					
1.A.3.d	Navigation	1990-2001	54.50			1.50	
1.A.4.a	Commercial/Institutional	1990-2001	3.00			1.50	
1.A.4.b	Residential	1990-2001	3.00			1.50	
1.A.4.c	Fisheries/Agriculture	1990-2001	54.50	10809.6 <sub>0</sub>		1.50	
International bunkers: Aviation			1242.60				6.14
International bunkers: Marine			54.50		56.90		

Table C.7 Emission factors for CO 1990-2001

IPCC code	Sector	Year	Gas	Gasoline	Heavy	Petroleum	Jet fuel
			/Diesel oil		fuel oil		
			kg/GJ	kg/GJ	kg/GJ	kg/GJ	kg/GJ
1.A.1	Public electricity and heat production	1990-2001	47.00		15.00		
1.A.2	Manufacturing Industries and construction	1990-2001	47.00		15.00	1000	
1.A.3.b	Road transportation	Tab. B.9					
1.A.3.d	Navigation	1990-2001	173.3			1000	
1.A.4.a	Commercial/Institutional	1990-2001	47.00			1000	
1.A.4.b	Residential	1990-2001	47.00			1000	
1.A.4.c	Fisheries/Agriculture	1990-2001	173.30	18485.1 0		1000	
International bunkers: Aviation			173.30				49.76
International bunkers: Marine			6972.00		180.9		

Table C.8 Emission factors for road traffic 1990-2001

	CO <sub>2</sub>		CH <sub>4</sub>		N <sub>2</sub> O		SO <sub>2</sub>		NO <sub>x</sub>		NMVOC		CO	
	kg/GJ	kg/GJ	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ
	Diesel	Gasoline	Diesel	Gasoline	Diesel	Gasoline	Diesel	Gasoline	Diesel	Gasoline	Diesel	Gasoline	Diesel	Gasoline
1990	74.00	73.00	9.25	36.69	7.13	2.20	93.68	2.28	609.69	817.41	226.62	1225.80	529.72	7090.55
1991	74.00	73.00	9.26	38.59	7.20	2.95	93.68	2.28	607.58	776.65	230.81	1160.92	534.50	6933.91
1992	74.00	73.00	9.20	39.26	7.18	3.65	60.89	2.28	607.64	743.63	227.92	1107.62	529.93	6546.09
1993	74.00	73.00	9.40	41.97	7.14	4.31	23.42	2.28	609.94	708.41	227.09	1043.76	529.48	6447.99
1994	74.00	73.00	8.76	42.74	7.22	5.37	23.42	2.28	588.40	657.76	220.33	951.25	507.51	5843.64
1995	74.00	73.00	8.59	45.22	7.18	6.14	23.42	2.28	577.52	617.32	212.05	890.96	481.02	5625.73
1996	74.00	73.00	8.48	49.26	7.20	6.78	23.43	2.28	565.09	580.91	210.06	842.94	464.91	5624.61
1997	74.00	73.00	8.23	46.01	7.24	7.84	23.42	2.28	544.18	530.44	203.59	739.04	440.51	4816.18
1998	74.00	73.00	8.05	42.93	7.30	8.45	23.42	2.28	526.51	489.69	198.93	664.70	418.76	4350.56
1999	74.00	73.00	7.78	42.11	7.39	9.04	12.88	2.28	505.38	440.66	191.89	596.47	396.85	4069.99
2000	74.00	73.00	7.43	40.85	7.45	9.55	2.34	2.28	485.52	403.62	181.85	505.62	372.99	3812.17
2001	74.00	73.00	7.24	40.89	7.49	10.03	2.34	2.28	470.69	364.90	176.19	452.63	354.53	3746.72



# Appendix D – Emissions values 1990-2001 for the Faroe Islands

Table D.1 Emissions of CO<sub>2</sub> 1990-2001

IPCC code	Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
		ktonnes	ktonnes	ktonnes	ktonnes	ktonnes	ktonnes	ktonnes	ktonnes	ktonnes	ktonnes	ktonnes	ktonnes
1.A.1	Public electricity and heat production	89.750	86.237	85.111	78.558	74.708	71.317	84.867	77.679	86.313	87.522	105.684	131.711
1.A.2	Manufacturing Industries and construction	62.162	73.470	43.495	39.463	38.538	32.030	38.083	37.854	54.220	52.746	59.534	84.555
1.A.3.a	Civil aviation	3.132 *	3.132 *	3.132	3.636	3.104	5.788	7.705	5.133	5.033	8.162	6.978	8.591
1.A.3.b	Road transportation	63.071	61.850	60.779	53.536	50.607	52.512	54.753	58.565	48.552	52.710	67.669	74.543
1.A.3.d	Navigation	27.264	20.481	24.989	18.402	15.424	19.365	20.337	19.639	20.106	21.775	23.446	28.770
1.A.4.a	Commercial/Institutional	39.185	40.250	38.100	33.160	34.212	34.180	35.399	35.465	37.558	40.332	45.496	39.547
1.A.4.b	Residential	145.843	136.360	134.977	112.285	116.674	116.598	117.223	113.772	118.783	132.384	125.784	126.920
1.A.4.c	Fisheries/Agriculture	219.183	203.459	223.871	158.960	172.838	181.198	183.962	179.241	195.324	205.635	216.702	228.420
6.C	Waste incineration	4.483	4.488	4.543	4.215	4.066	4.113	4.428	5.086	6.208	6.648	6.797	6.992
	<b>Total</b>	<b>654.074</b>	<b>629.725</b>	<b>618.998</b>	<b>502.215</b>	<b>510.171</b>	<b>517.102</b>	<b>546.756</b>	<b>532.434</b>	<b>572.097</b>	<b>607.912</b>	<b>658.089</b>	<b>730.048</b>
	International bunkers : Marine			105.211	142.595	140.009	131.590	142.024	137.962	112.058	121.340	135.588	176.288

The emissions listed for civil aviation in 1990 and 1991 are set equal to the values in 1992 while data were missing for these years.

Table D.2 Emissions of CH<sub>4</sub> 1990-2001

IPCC code	Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
		tonnes	tonnes	tonnes	tonnes	tonnes	Tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes
1.A.1	Public electricity and heat production	3.10	3.12	2.99	2.82	2.67	2.58	3.11	2.82	3.09	3.14	3.82	4.70
1.A.2	Manufacturing Industries and construction	1.97	2.17	1.29	1.24	1.22	0.97	1.17	1.12	1.68	1.55	1.74	3.05
1.A.3.a	Civil Aviation	0.03 *	0.03 *	0.03 *	0.03 *	0.03 *	0.05 *	0.07 *	0.05 *	0.05 '	0.07 *	0.06 *	0.08 *
1.A.3.b	Road transportation	15.83	16.07	15.95	14.61	13.79	15.75	18.05	18.93	13.14	15.14	23.07	26.79
1.A.3.d	Navigation	0.62	0.46	0.56	0.42	0.35	0.44	0.46	0.45	0.46	0.50	0.54	0.66
1.A.4.a	Commercial/Institutional	3.64	3.74	3.54	3.08	3.17	3.23	3.31	3.35	3.55	3.81	4.30	3.74
1.A.4.b	Residential	13.76	12.87	12.74	10.59	11.28	11.02	11.09	10.75	11.23	12.52	11.89	12.00
1.A.4.c	Fisheries/Agriculture	5.12	4.76	5.23	3.79	4.15	4.28	4.20	4.09	4.46	4.70	4.95	5.22
4.A	Enteric Fermentation	778.63	805.88	803.00	803.31	828.36	829.58	822.87	848.27	829.05	836.11	859.89	865.20
4.B	Manure Management	29.30	34.73	34.16	34.22	39.50	39.75	38.40	43.75	39.04	40.83	46.91	48.27
6.C	Waste Incineration	1.10	1.10	1.22	1.19	1.14	1.23	1.39	1.60	1.92	2.08	2.12	2.18
	<b>Total</b>	<b>853.10</b>	<b>884.93</b>	<b>880.71</b>	<b>875.30</b>	<b>905.66</b>	<b>908.88</b>	<b>904.12</b>	<b>935.18</b>	<b>907.67</b>	<b>920.45</b>	<b>959.29</b>	<b>971.89</b>
	International bunkers : Marine			2.40	3.25	3.19	3.00	3.24	3.15	2.56	2.77	3.10	4.03

The emissions listed for civil aviation in 1990 and 1991 are set equal to the values in 1992 while data were missing for these years

Table D.3 Emissions of N<sub>2</sub>O 1990-2001

IPCC code	Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
		tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes
1.A.1	Public electricity and heat production	2.33	2.23	2.20	2.03	1.93	1.84	2.19	2.00	2.23	2.26	2.73	3.41
1.A.2	Manufacturing Industries and construction	1.63	1.93	1.14	1.03	1.01	0.84	1.00	1.00	1.42	1.39	2.03	2.24
1.A.3.a	Civil Aviation	0.12 *	0.12 *	0.12	0.14	0.12	0.22	0.29	0.19	0.19	0.31	0.26	0.32
1.A.3.b	Road transportation	3.28	3.69	4.01	3.81	4.12	4.66	5.16	6.04	5.34	6.03	7.72	8.63
1.A.3.d	Navigation	1.71	1.27	1.56	1.16	0.98	1.23	1.29	1.24	1.27	1.38	1.49	1.83
1.A.4.a	Commercial/Institutional	1.06	1.09	1.03	0.90	0.93	0.92	0.96	0.96	1.02	1.09	1.23	1.07
1.A.4.b	Residential	3.94	3.69	3.65	3.04	3.15	3.15	3.17	3.08	3.21	3.58	3.40	3.43
1.A.4.c	Fisheries/Agriculture	13.92	12.92	14.21	10.09	10.97	11.50	11.68	11.38	12.41	13.06	13.76	14.51
4.D	Agricultural Soils	44.77	50.26	49.68	49.75	55.07	55.32	53.96	59.35	54.62	56.42	62.52	63.88
6.C	Waste Incineration	0.73	0.73	0.82	0.79	0.76	0.82	0.93	1.07	1.28	1.38	1.42	1.46
	<b>Total</b>	<b>73.49</b>	<b>77.93</b>	<b>78.42</b>	<b>72.74</b>	<b>79.04</b>	<b>80.50</b>	<b>80.63</b>	<b>86.31</b>	<b>82.99</b>	<b>86.90</b>	<b>96.56</b>	<b>100.78</b>
	International bunkers : Marine			6.67	9.04	8.88	8.35	9.01	8.75	7.11	7.70	8.61	11.20

The emissions listed for civil aviation in 1990 and 1991 are set equal to the values in 1992 while data were missing for these years.

Table D.4 Emissions of SO<sub>2</sub> 1990-2001

IPCC code	Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
		tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes
1.A.1	Public electricity and heat production	370.64	391.93	363.67	353.32	332.32	325.72	398.54	356.12	383.56	391.93	480.87	582.77
1.A.2	Manufacturing Industries and construction	179.06	175.50	104.98	111.25	110.07	81.21	102.47	90.85	146.83	125.30	139.75	164.48
1.A.3.a	Civil Aviation	0.10 *	0.10 *	0.10	0.12	0.10	0.19	0.25	0.17	0.16	0.26	0.22	0.28
1.A.3.b	Road transportation	27.77	27.24	17.84	6.60	6.30	7.05	7.64	8.58	6.15	4.53	2.09	2.30
1.A.3.d	Navigation	5.10	5.68	7.03	2.53	0.78	1.26	1.11	1.12	1.40	1.45	0.74	0.91
1.A.4.a	Commercial/Institutional	16.72	17.17	16.24	14.00	14.73	10.98	13.69	11.31	11.91	12.77	14.28	12.50
1.A.4.b	Residential	48.27	45.14	44.68	36.74	37.91	37.61	36.43	36.35	37.72	41.85	39.75	39.97
1.A.4.c	Fisheries/Agriculture	277.46	257.53	283.36	201.11	218.64	229.32	232.91	226.93	247.29	260.35	274.33	289.19
	<b>Total</b>	<b>925.12</b>	<b>920.29</b>	<b>837.90</b>	<b>725.67</b>	<b>720.85</b>	<b>693.34</b>	<b>793.04</b>	<b>731.43</b>	<b>835.02</b>	<b>838.44</b>	<b>952.03</b>	<b>1092.40</b>
	International bunkers : Marine			1001.39	1226.11	1191.07	1064.83	1091.29	1153.89	893.31	865.15	903.94	1115.81

The emissions listed for civil aviation in 1990 and 1991 are set equal to the values in 1992 while data were missing for these years.

Table D.5 Emissions of NO<sub>x</sub> 1990-2001

IPCC code	Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
		tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes
1.A.1	Public electricity and heat production	234.01	241.06	227.44	217.92	205.57	200.08	243.05	218.54	237.33	242.01	295.68	361.01
1.A.2	Manufacturing Industries and construction	87.24	93.25	55.50	54.72	53.82	41.93	51.47	48.16	73.54	66.76	74.89	373.71
1.A.3.a	Civil Aviation	8.98 *	8.98 *	8.98	10.42	8.90	16.59	22.09	14.72	14.43	23.40	20.01	24.63
1.A.3.b	Road transportation	643.93	607.85	578.91	494.06	438.23	430.85	427.90	426.13	332.04	333.36	407.46	426.05
1.A.3.d	Navigation	449.53	332.99	406.03	305.68	259.65	325.28	342.14	330.29	337.50	365.67	395.83	485.71
1.A.4.a	Commercial/Institutional	27.35	28.10	26.60	23.15	23.88	24.00	24.77	24.91	26.38	28.33	31.96	27.78
1.A.4.b	Residential	102.37	95.71	94.74	78.83	81.92	81.88	82.37	79.91	83.44	93.00	88.36	89.17
1.A.4.c	Fisheries/Agriculture	3952.36	3668.83	4036.95	2865.72	3115.58	3266.94	3318.44	3233.28	3523.41	3709.41	3909.13	4120.43
	<b>Total</b>	<b>5505.77</b>	<b>5076.77</b>	<b>5435.15</b>	<b>4050.50</b>	<b>4187.55</b>	<b>4387.55</b>	<b>4512.23</b>	<b>4375.94</b>	<b>4628.07</b>	<b>4861.94</b>	<b>5223.32</b>	<b>6113.18</b>
	International bunkers : Marine			2890.86	3920.40	3849.53	3619.03	3907.02	3793.61	3082.09	3339.21	3732.44	5908.49

The emissions listed for civil aviation in 1990 and 1991 are set equal to the values in 1992 while data were missing for these years.

Table D.6 Emissions of NMVOC 1990-2001

IPCC code		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
		tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes
1.A.1	Public electricity and heat production	3.10	3.12	2.99	2.82	2.67	2.58	3.11	2.82	3.09	3.14	3.82	4.70
1.A.2	Manufacturing Industries and construction	1.97	2.17	1.29	1.24	1.22	0.97	1.17	1.12	1.68	1.55	1.74	42.96
1.A.3.a	Civil Aviation	0.27 *	0.27 *	0.27	0.31	0.27	0.50	0.66	0.44	0.43	0.70	0.60	0.74
1.A.3.b	Road transportation	771.46	720.96	678.03	571.12	492.61	462.26	449.17	416.01	337.42	317.11	308.04	298.22
1.A.3.d	Navigation	97.19	72.00	87.79	66.57	56.14	70.33	73.97	71.41	72.97	79.06	85.58	105.01
1.A.4.a	Commercial/Institutional	1.57	1.61	1.52	1.33	1.37	1.38	1.42	1.44	1.52	1.63	1.84	1.60
1.A.4.b	Residential	5.95	5.57	5.52	4.54	4.78	4.78	4.78	4.64	4.84	5.39	5.12	5.14
1.A.4.c	Fisheries/Agriculture	172.98	160.92	176.92	132.98	147.53	147.42	135.48	132.01	143.85	151.44	159.60	168.23
	<b>Total</b>	<b>1054.49</b>	<b>966.62</b>	<b>954.33</b>	<b>780.91</b>	<b>706.59</b>	<b>690.22</b>	<b>669.76</b>	<b>629.89</b>	<b>565.80</b>	<b>560.02</b>	<b>566.34</b>	<b>626.60</b>
	International bunkers : Marine			77.33	104.87	102.97	96.80	104.51	101.47	82.44	89.32	99.84	129.83

The emissions listed for civil aviation in 1990 and 1991 are set equal to the values in 1992 while data were missing for these years.

Table D.7 Emissions of CO 1990-2001

IPCC code	Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
		tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes
1.A.1	Public electricity and heat production	25.75	21.47	23.30	19.90	19.26	17.61	19.96	19.06	22.29	22.33	26.27	34.24
1.A.2	Manufacturing Industries and construction	22.26	30.21	17.77	14.40	13.92	12.67	14.41	15.52	20.42	21.76	24.74	121.47
1.A.3.a	Civil Aviation	2.18 *	2.18 *	2.18	2.53	2.16	4.03	5.36	3.57	3.50	5.68	4.86	5.98
1.A.3.b	Road transportation	4241.93	4072.54	3784.90	3324.09	2836.64	2698.46	2733.42	2427.21	2014.25	1915.02	1848.51	1845.11
1.A.3.d	Navigation	220.42	166.07	202.65	149.33	124.14	155.93	163.70	158.09	161.92	175.34	188.58	231.40
1.A.4.a	Commercial/Institutional	32.74	33.62	31.81	27.45	28.81	22.32	27.12	23.01	24.26	26.02	29.14	25.48
1.A.4.b	Residential	98.05	91.70	90.78	74.49	77.28	76.75	74.62	74.13	76.99	85.47	81.19	81.51
1.A.4.c	Fisheries/Agriculture	533.10	495.42	544.87	399.35	439.24	448.21	430.85	419.80	457.46	481.61	507.49	534.97
	<b>Total</b>	<b>5176.43</b>	<b>4913.21</b>	<b>4698.26</b>	<b>4011.54</b>	<b>3541.45</b>	<b>3435.98</b>	<b>3469.44</b>	<b>3140.39</b>	<b>2781.09</b>	<b>2733.23</b>	<b>2710.78</b>	<b>2880.16</b>
	International bunkers : Marine			7818.47	11414.95	11287.86	10950.09	12180.22	11246.24	9408.77	10825.84	12489.06	16609.23

The emissions listed for civil aviation in 1990 and 1991 are set equal to the values in 1992 while data were missing for these years.

# Appendix E - Glossary

## Abbreviations

### Pollutants

CH <sub>4</sub>	Methane
CO	Carbon monoxide
CO <sub>2</sub>	Carbon dioxide
N <sub>2</sub> O	Nitrous oxide
NMVOC	Non-methane volatile organic compound
NO <sub>x</sub>	Nitrogen oxides
SO <sub>2</sub>	Sulphur dioxide

### Other

GWP	Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
LTO	Landing and take off
UNFCCC	United Nations Framework Convention on Climate Change

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# National Environmental Research Institute

The National Environmental Research Institute, NERI, is a research institute of the Ministry of the Environment. In Danish, NERI is called *Danmarks Miljøundersøgelser (DMU)*.

NERI's tasks are primarily to conduct research, collect data, and give advice on problems related to the environment and nature.

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## Publications:

NERI publishes professional reports, technical instructions, and the annual report. A R&D projects' catalogue is available in an electronic version on the World Wide Web.

Included in the annual report is a list of the publications from the current year.

# NERI Technical Reports

## 2002

- Nr. 426: Statistisk optimering af monitoringsprogrammer på miljøområdet. Eksempler fra NOVA-2003. Af Larsen, S.E., Jensen, C. & Carstensen, J. 195 s. (elektronisk)
- Nr. 427: Air Quality Monitoring Programme. Annual Summary for 2001. By Kemp, K. & Palmgren, F. 32 pp. (electronic)

## 2003

- Nr. 428: Vildtbestande, jagt og jagttider i Danmark 2002. En biologisk vurdering af jagtens bæredygtighed som grundlag for jagttidsrevisionen 2003. Af Bregnballe, T. et al. 227 s. (elektronisk)
- Nr. 429: Movements of Seals from Rødsand Seal Sanctuary Monitored by Satellite Telemetry. Relative Importance of the Nysted Offshore Wind Farm Area to the Seals. By Dietz, R. et al. 44 pp. (electronic)
- Nr. 430: Undersøgelse af miljøfremmede stoffer i gylle. Af Schwærter, R.C. & Grant, R. 60 s. (elektronisk)
- Nr. 432: Metoder til miljøkonsekvensvurdering af økonomisk politik. Af Møller, F. 65 s. (elektronisk)
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