Protocol
1A3d: CO_2, N_2O, and CH_4 from Inland shipping

IPCC Category:	1A3d
NFR Code:	1A3d
NOSE Code:	202.03
NACE Code 2008	50

Foreword
Under the Kyoto Protocol, the Netherlands is required to set up and maintain a national system to monitor its greenhouse gas emissions. One of the elements of this system is a transparent and verifiable description of the methods and processes used in this monitoring system. These methods must meet international guideline criteria, which have been defined by the United Nations (UN) and the European Union (EU).

The Netherlands meets the aforementioned requirement, for example, by defining a series of Monitoring Protocols, which describe the methods and work processes used to determine greenhouse gas emissions and the amounts of carbon sinks available. Protocols have been written for about 40 greenhouse gas sources or sinks. This document describes the protocol for one of these sources or sinks.

The protocols have been compiled in close collaboration with experts from various sectors of society in the Netherlands, particularly experts from the Emissions Registration (ER). The ER is a collaborative group that includes institutions such as CBS, WUR, RIVM and PBL. Until 31 December 2009 this was coordinated by PBL (Planbureau for the Leefomgeving, or the Netherlands Environmental Assessment Agency), but on 1 January 2010 this coordination task was taken over by RIVM (the Netherlands institute for public health and the environment). Other institutions that have contributed to the protocols include NL Agency; Ministry of Agriculture, Nature and Food Quality; and the Ministry of VROM (Housing, Spatial Planning and the Environment).

1 Scope and significance of emission sources/activities

1.1 Scope and definition
This protocol describes the methodology of calculating CO_2, N_2O, and CH_4 emissions from inland shipping in the Netherlands, i.e. inland shipping with departure and destination within the Netherlands (IPCC-category: 1A3d; SBI-code: 50). It comprises both cargo and passenger transport, respectively professional inland shipping and passenger ships and ferries.

Not included are the following emission sources:
- Commercial fishing: the emissions from ships, which are used in commercial fishing, are separately reported in the IPCC-category ‘Agriculture / Forestry / Fishing’ (1A4c).
- Seagoing ships: emissions coming from fuel sales to seagoing ships (marine bunkers) are separately reported in the IPCC-category 1C1b ‘marine bunkers’, part of category ‘international Bunker fuels’ (1C1).
- Recreational boat traffic; The fuel supplies to leisure boats are not seperately distinguished in the national fuel sales statistics, and therefore have been accounted for in the supplies to road traffic through petrol stations (IPCC-category 1A3b). No

emissions for recreational boat traffic are calculated; these are included in the emission totals for road traffic (1A3b).

The present Tier 2 methodology level complies with the IPCC Good Practice Guidance (IPCC, 2001).

1.2 Significance and influences

1.2.1 Contribution to total national emissions

CO_2-emissions by inland shipping contribute less than 0.5% to the Netherlands annual greenhouse gas emissions. The emissions of CH_4 and N_2O by inland shipping both contribute less than 0.1% to the Netherlands annual greenhouse gas emissions.

1.2.2 Major developments that infuence emissions

There are no substantial developments affecting the emissions.

2 Method, emission factors and activity data

2.1 Calculation method

The emissions by inland shipping are calculated by multiplying the fuel consumption by emission factors.

Emission (kg) = fuel consumption (kg) * emission factor (grams/kg) * 10^{-3}

The background figures used to calculate CO_2, N_2O and CH_4 emissions from domestic/inland shipping are published annually and updated in a *set of tables* that accompany the methodology report for calculating the emissions from mobile sources in the Netherlands [Klein et al.]. Each table in the set states which source is used for the figures. The methodology report itself contains a detailed description of the way in which emission factors and emissions are calculated.

Tabel 2.1 of the *set of tables* indicates the annual fuel consumption for the inland/domestic shipping sector. Table 2.6 shows which IPCC emission factors are used for calculating CO_2, N_2O and CH_4 emissions.

2.2 Emission factors

The tables below show the used emission factors and fuel conversion factors.

CO_2-emission factors IPCC

	Specific heat *(MJ/kg)*	**CO2 EF** *(gram/MJ)*	**CO2 EF** *(gram/kg)*
Diesel fuel	42,7	74,3	3173

Source**:** Vreuls, 2006

IPCC Default factors N_2O en CH_4

	N_2O EF *(gram/MJ)*	**N_2O EF** *(gram/kg)*	**CH_4 EF** *(gram/MJ)*	**CH_4 EF** *(gram/kg)*
Inland shipping	0,0006	0,02562	0,005	0,2135

Source: Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories; Reference Manual p 1.35 and p. 1.36 (IPCC, 1997)

2.3 Activity data

Professional inland shipping
It is not possible to use fuel sales figures, because there are no reliable data available on the distribution of these sales between national and international shipping. Therefore, the fuel consumption figures of national cargo transport have been calculated within the EMS-project [EMS, 2003], based on the ship movements.

According to the IPCC protocol, the greenhouse gas emissions of inland navigation must be calculated based on the fuel supplied for vessel movements which have their points of departure and arrival within the Netherlands. Because it is impossible to distinguish between fuel deliveries for national and international use, the fuel consumption for national vessel movements are calculated using the EMS system. This amount is then multiplied with the same factors that are used to determine the actual emissions. To be able to do this a CBS database is used which contains the number of vessel kilometres on the Dutch waterways per vessel size class with a distinction between national and international journeys.

Passenger boats and ferries
The IPCC emissions have been set equal to the actual emissions. Here as well, it is impossible to split off the fuel deliveries to this category of vessels from total fuel deliveries.The fuel consumption figures on passenger transport are based on a discontinued CBS survey on energy consumption [CBS, 1994].

3 Working processes

Process for estimating (t-1)
The ER produces annual preliminary emission figures for the previous year (T-1). These preliminary data are calculated by extrapolating the figures from the previous year, based on the development prognoses for the most important activity data (derived from CBS and other statistics).

Process for final determination of (t-2)
The final emission figures (as described in this protocol) are calculated using the following process.

INPUT	PROCESS STEP	OUTPUT	BY WHOM
EMS-figures[1)] on fuel consumption by national cargo transport [2)]. **(A)** CBS-estimation of fuel consumption by national passenger transport. **(B)** Emission factors **(C)** [3)]	**(A+B) x (C_{CO2})** **(A+B) x (C_{N2O})** **(A+B) x (C_{CH4})**	CO_2, N_2O, and CH_4 emissions by inland shipping **(D)** Final data Work package leader (t-2)	Statistics Netherlands (CBS)
Final data Work package leader (t-2)	Include (t-2) data in ER database	ER-db with (t-2) data	Work package leader

ER-db with (t-2) data	Check, and trend analysis of air emissions: explain deviations or modify figures	Final defined emission figures (t-2)	Task forces and PBL experts

[1)] EMS = Emission Registration and Monitoring of Shipping [EMS, 2003].
[2)] The EMS-figures include the emissions of the international cargotransport on Dutch territory. Therefore figures from the "CBS Publicatiebestand (scheepvaart)" are used to calculate the emissions of inland shipping with departure and destination within the Netherlands
[3)] IPCC-factors.

4 Uncertainty and quality

4.1 Estimating uncertainties

A Tier-1 uncertainty analysis is implemented every year before the NIR is submitted by the ER, based on the greenhouse gas inventory and in compliance with IPCC guidelines. The assumptions used and the results thereof are described in a background report to the NIR. In addition to this, where included in the QA/QC programme for the relevant period, extra analyses are implemented regularly in specific situations, which include any updating of the Tier-2 uncertainty analyses. The Tier-2 uncertainty assessment was last updated in 2006. This assessment showed that a Tier-1 uncertainty assessment is sufficiently reliable and that Tier-2 uncertainty assessments need only be implemented at periodic intervals of around 5 years, unless a major change in an important source is sufficient to require earlier reassessment.

- Source-specific uncertainty

The uncertainty estimate-totaal concerns the root of the sum of uncertainty in the data sources used (AD_{onz}) in the square and the uncertainty of the emission factor (EF_{onz}) in the square. The extent of the total uncertainty is here primarily determined by the greatest AD or EF uncertainty.

$$\text{Uncertainty estimate}_{\text{total}} = \sqrt{EF_{onz.}^{2} + AD_{onz.}^{2}}$$

The uncertainty estimates concerning the data sources (AD) and emission factors (EF) used, and the total uncertainty estimate, are listed in the following table.

IPCC	Category	Gas	$AD_{onz.}$	$EF_{onz.}$	Uncertainty estimates $_{tot}$
1A3	Mobile combustion: waterborne navigation	CO_2	20	0.2	20
1A3	Mobile combustion: other (non-road)	CH_4	50	100	112
1A3	Mobile combustion: other (non-road)	N_2O	50	100	112

Activity data (AD) and emission factors (EF)

The uncertainty in fuel used by 'Navigation' was estimated to be about 20%. For the uncertainty in the CO_2 emission factor for navigation, the same value was chosen as that for diesel in road transport, that is 0,2%. With regard to CH_4 and N_2O data activity the uncertainty was estimated a 50%. The uncertainty in the CH_4 and N_2O emission factor was estimated at 100% [Olivier et al, 2009].

Annual emissions

The uncertainty in CO_2 emissions from navigation was estimated to be about 20% in emissions from annual shipping emissions. The uncertainty in CH_4 and N_2O emissions from

non-road transport (c.q. inland shipping) was estimated to be about 100% in annual emissions. Data on the share of CH_4 in total VOC were based on information in Veldt and Van der Most (1993) and have not been validated since [Olivier et al, 2009].

4.2 Quality assurance and quality control (QA/QC)

The ER work package leaders check that:

1. the basic data are well documented and adopted (check for typing errors, use of the correct unit sizes and correct conversion);
2. the calculations have been implemented correctly;
3. assumptions are consistent, also whether specific parameters (e.g. activity data) are used consistently;
4. complete and consistent data sets have been supplied.

Any actions that result from these checks are noted on an 'action list'. Before defining the data, supervisors check whether the relevant actions on this list, plus the QC checks, have all been completed. Defining the data is carried out by the WEM (working group on emissions monitoring), and confirmed in writing via an e-mail from the institute representatives to the ER project leader at PBL.

The work package leaders fill out a new documentation sheet when adding new data. For reasons of efficiency a minimum level has been set for obligatory documentation, i.e. 5% changes at target group level, and 0.5% at levels concerning the national total. These documentation sheets form part of the trend analysis, as well as the eventual definition of the data set.

The ER work package leaders communicate by e-mail regarding these QC checks, results and actions. They send a printed copy to the ER secretary, who keeps a logbook and compiles these e-mails into an 'action list'. This shows explicitly that the required checks and corrections have been carried out.

4.3 Verification

In order to check the quality of the emission figures for the sources in this protocol, general QA/QC procedures have been followed that are in line with the IPCC guidelines. These are described further in the QAQC programme used by the National System, and the annual working plans published by the ER.

- Sector-specific QC

No additional specific verification procedures are implemented for the sources defined in this protocol.

4.4 Possibilities for improvement compared to the current calculation method

4.4.1 History

In 2003 the Transport Research Centre (AVV) and several other contractors finished off the EMS-project (EMS = Emission Registration and Monitoring of Shipping). This project has been carried out under authority of the Ministry of Transport, Public Works and Water Management. The final report of the EMS includes a number of protocols, among which a protocol for the determination of the emissions due to combustion by inland shipping. The report can be downloaded from the internet site of AVV [EMS, 2003). The EMS-protocol has been used to calculate a complete time series from 1990 onwards.

4.4.2 Future
Not applicable

5 Remaining aspects

5.1 Point source criteria
Not applicable

5.2 Component profiles
Not applicable

5.3 Regionalisation
Not applicable

5.4 Time-based variations in source strength
Not applicable

6 References and additional information

6.1 References

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6.2 Additional information
Not applicable