Protocol
1A2f and 1A4c: CO_2 N_2O and CH_4 mobile equipment

IPCC Category:	1A2f and 1A4c
NFR Code:	n.a.
NOSE Code:	n.a.
NACE Code 2008	01; 02 and 41, 42 and 43

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 method used to calculate CO2, N2O and CH4 emissions from mobile equipment, otherwise known as mobile machines. The category for mobile equipment includes all machines with a combustion engine that are not primarily meant for transport over the public roads, and that are not immobile equipment with a fixed connection to a stationary unit. These include, for example, diggers, fork-lift trucks, agricultural tractors, and lawnmowers. Mobile equipment is primarily used in the Netherlands in the sectors: construction and industry, households, maintaining green areas, and agriculture.

The CO2, N2O and CH4 emissions from mobile equipment are caused by the combustion of fossil fuels and biofuels in the combustion engines of the machines. The majority of these mobile machines run on gasoil (red diesel), with the use of petrol and LPG being minimal. The sales of petrol and LPG for mobile equipment cannot be separated in the national

statistics for fuel turnover. Due to the small percentage made up by mobile equipment in the total sales of petrol and LPG in the Netherlands, the entire sales of petrol and LPG in the Netherlands, and the consequential emissions of CO2, N2O and CH4 are fully allocated to road traffic.

The greenhouse gas emissions produced by mobile equipment in the agricultural sector are reported under the category 1A4c 'Agriculture', while the emissions from the construction sector and industry, households, and maintenance of green areas are reported under the category 1A2f 'Other'. Both categories include emission from other sources, in addition to emissions from mobile equipment.

1.2 Significance and influences

1.2.1 Contribution to total national emissions

The contribution made by mobile equipment to greenhouse gas emissions in the Netherlands amounts to around 1%. This particularly concerns the CO2 emissions from mobile equipment, while the contribution made by the CH4 and N20 emissions to the national greenhouse gas emissions is very small (<0.1%).

1.2.2 Important developments that infuence emissions

No measures known.

2 Methods, emission factors and activity data

2.1 Calculation method

The combustion emissions of other mobile sources are estimated by multiplying the fuel consumption by emission factors per kg of fuel used. The national emission factor is applied when calculating the combustion emissions of CO_2, tier 2 (Olivier 2004), and the IPCC default values are used (tier 1, IPCC 1997) for N_2O and CH_4 emissions.

CO_2 emission (g)	=	fuel consumption	*	emission factor (g/GJ)
N_2O emission (g)	=	fuel consumption	*	emission factor (g/GJ)
CH_4 emission (g)	=	fuel consumption	*	emission factor (g/GJ)

The background figures used to calculate CO_2, N_2O and CH_4 emissions from mobile equipment are published annually and updated in a *set of tables* that accompany the methodology report for mobile sources [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.

Table 7.1 of the set of tables that accompany the methodology report for the calculation of emissions from mobile sources in the Netherlands [Klein et al.] shows the fuel consumption for mobile equipment. Table 7.2 shows the emission factors with respect to mobile equipment.

2.2 Emission factors

The national emission factor is used for combustion emissions of CO_2 (Olivier 2004), and the IPCC default values (IPCC 1997) are used for N_2O and CH_4.

2.3 Activity data

The fuel consumption by mobile equipment in the agricultural sector is calculated using the EMMA-model (Hulskotte, 2009). This model is based on sales information of mobile equipment and data concerning the use and fuel consumption of the various types of equipment.

The fuel consumed by mobile equipment in the Netherlands is derived from the fuel sales statistics published by CBS.

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
Energiebalans CBS (Netherlands Energy Management); LEI/CBS (Agriculture); CBS (Construction) **(A)** CO_2 emission factors (g/GJ); ditto N_2O and CH_4 factors **(B)**	**(A) x (B)**	**(C)**	Field work supervisor ER
(C)	Control values	Values validated by task force (t-2)	Task force
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

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 $_{tot}$
1A4c	Stationary combustion : Other Sectors, Agriculture/Forestry/Fisheries, gases	CO_2	10	1	10
1A4c	Stationary combustion : Other Sectors, Agriculture/Forestry/Fisheries, liquids	CO_2	20	2	20
1A2	Stationary combustion : Manufacturing Industries and Construction, liquids	CO_2	1	5	5
1A2	Stationary combustion : Manufacturing Industries and Construction, solids	CO_2	2	10	10
1A2	Stationary combustion : Manufacturing Industries and Construction, gases	CO_2	2	1	2

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

The year 2005 saw the first reports for categories 1A2f and 1A4c. Previously these figures were only reported under transport, other (1A3e).

4.4.2 Future developments

Not applicable

5 Remaining aspects

5.1 Point source criteria

Not applicable

5.2 Substance profiles

Not applicable

5.3 Regions

Not applicable

5.4 Time-based variations in source strength

Not applicable

6 References and additional information

6.1 References

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- Hulskotte J.H.J., Verbeek R., 2009 Emissiemodel Mobiele Machines gebaseerd op machineverkopen in combinatie met brandstofafzet (EMMA), TNO-034-UT-2009-01782_RPTML, november 2009

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- Klein, J.A.P. e.a. (CBS, PBL, RWS-Waterdienst/Deltares, RWS-DVS, TNO-M&L, TNO-EST), Methods for calculating the emissions of transport in the Netherlands. The report, including the tables in the Excelfile, can be found on: http://www.cbs.nl; choose: Thema's / Natuur en Milieu / Methoden / Onderzoeksbeschrijvingen / Aanvullende onderzoeksbeschrijvingen. The Methodoly Report and the tables in the Excelfile are being updated once a year.
- Klein Goldewijk, K., J.G.J. Olivier, J.A.H.W. Peters, P.W.H.G. Coenen en H.H.J. Vreuls, Greenhouse Gas Emissions in the Netherlands 1990-2003, National Inventory Report 2005, RIVM report 773201009, 2005
- LEI (various years), Reports by the Landbouw Economisch Instituut.
- Olivier, J.G.H., 2004: Note on Netherlands' CO2 emission factors for petrol, diesel and LPG. Version 2, December 2004, RIVM document no. M/773201/01/NI.
- Olivier J.G.J., L.J. Brandes and R.A.B. te Molder, 2009 (in print) Uncertainty in the Netherlands' greenhouse gas emissions inventory: Estimate of annual and trend uncertainty for Dutch sources of greenhouse gas emissions using the IPCC Tier 1 approach, PBL-Report 500080013, Bilthoven
- www.CBS.nl

6.2 Additional information

Not applicable