

Switzerland's Greenhouse Gas Inventory 1990–2003

Quality Control and Quality Assurance
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1. Introduction

1.1 Switzerland's GHG Inventory

In 1993, Switzerland ratified the United Nations Framework Convention on Climate Change (UNFCCC). Since the 1996 submission, its national greenhouse gas inventory has been reported based on IPCC guidelines. From 1998 on, the inventories were submitted in the Common Reporting Format (CRF). In 2004, Switzerland submitted its first National Inventory Report to the UNFCCC secretariat.

In 2003, Switzerland ratified the Kyoto Protocol to the UNFCCC. The national inventory system according to Article 5.1 of the Kyoto Protocol is presently under implementation.

1.2 Definitions

The following terms are essential for the paper on hand (all definitions are taken literally from UNFCCC 2002):

- A **national system** includes all institutional, legal and procedural arrangements made within a Party included in Annex I for estimating anthropogenic emissions by sources and removals by sinks of all greenhouse gases not controlled by the Montreal Protocol, and for reporting and archiving inventory information.
- **Quality control (QC)** is a system of routine technical activities to measure and control the quality of the inventory as it is being developed. The QC system is designed to:
 - Provide routine and consistent checks to ensure data integrity, correctness and completeness;
 - Identify and address errors and omissions;
 - Document and archive inventory material and record all QC activities.
- **Quality control activities** include general methods such as accuracy checks on data acquisition and calculations and the use of approved standardized procedures for emission calculations, measurements, estimating uncertainties, archiving information and reporting. Higher tier QC activities also include technical reviews of source categories, activity and emission factor data and methods.
- **Quality assurance (QA)** activities include a planned system of review procedures conducted by personnel not directly involved in the inventory compilation development process, to verify that data quality objectives were met, ensure that the inventory represents the best possible estimate of emissions and sinks given the current state of scientific knowledge and data available, and support the effectiveness of the QC programme.

Further explanations and specifications for QA/QC are given in chapter 8 of IPCC Good Practice Guidance (IPCC 2000).

1.3 Purpose

This paper documents the actual state (February 2005) of quality control activities for the Swiss GHG inventory (chapter 2) and describes planned improvements (chapter 3). It will be periodically updated as the QA/QC system develops and improves.

2. Actual Swiss QA/QC System

2.1 The Swiss National Inventory System

The Swiss national inventory system (NIS) is presently under implementation. It is part of a comprehensive project to ensure full compliance with the reporting requirements under the UNFCCC and its Kyoto Protocol. The implementation of the NIS includes several sub-projects

- Responsibilities: Organisational structure, legal compliance, arrangements with involved institutions and organisations.
- Coordination and communication: Publication of inventory data, submissions to the UNFCCC secretariat, alignment with Swiss federal CO₂ law etc.
- Inventory Development Plan.
- Quality control system: QA/QC plan, documentation of status quo and planned improvements, training of involved persons, archiving, access to data.
- Institutional framework: Evaluation of resources, consolidation of "single national entity".

The quality control system as described in this paper may be considered as a sub-system of the Swiss NIS. The National System itself is described in SAEFL 2005.

2.2 Institutions, roles and responsibilities

Figure 1 gives a schematic overview of the institutional setting of the process of inventory preparation within the NIS.

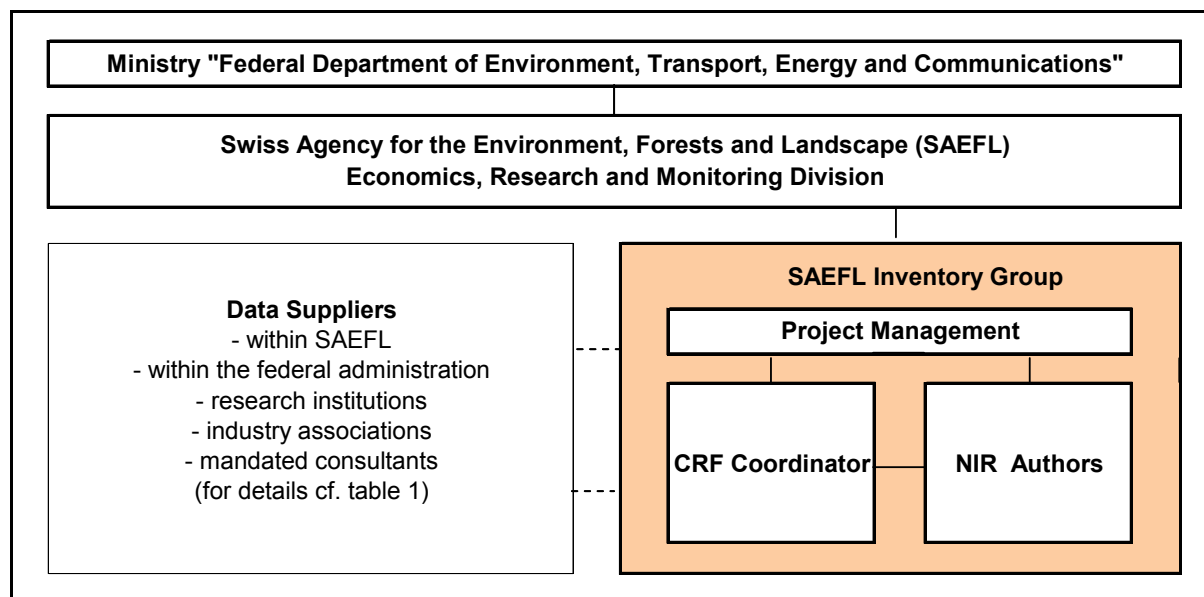


Figure 1 Institutional framework of inventory preparation.

The Swiss National Inventory System (NIS) is developed and managed under the auspices of the Ministry of Environment, Transport, Energy and Communications. It is hosted by the Ministry's Agency for the Environment, Forests and Landscape (SAEFL) which constitutes the national entity with overall responsibility for the national GHG inventory.

The roles and responsibilities of the various actors in inventory related activities are defined as follows:

SAEFL – Economics, Research, and Monitoring Division

- Inventory planning: Definition of roles and responsibilities and conclusion of agreements with contributors to the inventory; establishment of processes for the official consideration, approval and submission of inventory information.
- Inventory preparation: Supervision of the respect of relevant decisions, guidelines and other guidance; supervision of the implementation of inventory development and QA/QC plans; approval of recalculations; arrangement of independent evaluations of the inventory planning and preparation process and its outcome.
- Inventory management: Supervision of review procedures, in particular of the consideration of issues raised by the inventory review process.

SAEFL Inventory Group

- Inventory planning: Definition and allocation of specific responsibilities in the inventory development process; elaboration of an inventory development and a QA/QC plan; definition of schedules, deadlines and quality objectives.
- Inventory preparation: Supervision of compilation, revision and editing of CRF and NIR; implementation and updating of inventory development and QA/QC plans, periodic internal evaluations of the inventory preparation process.
- Inventory Management: Archiving of information on inventory planning and preparation; provision of review teams with access to information.

Data suppliers

- Select appropriate methods for calculation of emission.
- Collect activity data, determine appropriate emission factors and calculate emissions.
- Apply QC procedures.
- Implement relevant tasks of inventory development plan.

The most important suppliers are mentioned in the following table.

Institution	Subject	Data supplied for source category...										References in NIR 2005				
		1A1	1A2	1A3	1A4	1A5	1B	R.A.	2	3	4		5	6		
Data suppliers (annual updates)																
1	SAEFL, Air Pollution Control	EMIS 95 database	x	x		x	x	x			x	x	x		x	SAEFL 1995b
2	SAEFL, Air Pollution Control	Off-road database			x		x									SAEFL 1996a, 2000b
3	SAEFL, Waste Management	Waste Statistics	x	x											x	SAEFL 2003a
4	SAEFL, Hazardous Substances	Import Statistics F-gases									x					SAEFL 2004e
5	SAEFL, Forest Agency	Forest Statistics												x		SFSO 2003
6	SFOE	Global Energy Statistics	x	x	x	x		x	x							SFOE 2003
7	FOCA/BAZL	Air traffic			x											FOCA 2004
8	BABLW	Military Aviation			x											BABLW 2003
9	SFSO	Agric. + Land use data										x	x	x		SFSO 2003, 2004, 2004a
10	FAL	Agric. + Land use change										x	x			SBV 2004; SFSO 2003, 2004
11	WSL	National Forest Inventory												x		SFSO 2004a
12	Cepe/Basics	Energy Consumption		x		x										Cepe 2004, Basics 2004
13	Ind. suppliers: SGCI, Swissmem, VSAI etc.	Synthetic gases									x					Carbotech 2005
14	Swiss Petroleum Ass. (Erdölvereinigung)	Oil Statistics							x							EV 2004
15	Cemsuisse	Cement, clinker prod.		x							x					cemsuisse 2004
Data suppliers (episodic updates)																
16	SVGW	Gas distribution losses							x							GWA 2004
17	EMPA	Various emission factors	x	x	x	x										NIR 2005, Annex 2.1
18	INFRAS	On-road Emission Model			x											SAEFL 2004a
19	Electrowatt	Off-road activity data			x	x	x									SAEFL 1996a, 2000b
20	TTM Meier	Off-road emission factors			x	x	x									SAEFL 1996a, 2000b
21	INFRAS	Off-road emission model			x	x	x									SAEFL 1996a, 2000b
22	Sigmaplan (based on SFSO area statistics)	Land use change												x		SAEFL 2005c

Table 1 Internal (no. 1-5) and external (no. 6-22) data suppliers.
The IPCC nomenclature is used for the source categories (1A1 = Energy Industries, 1A2 = Manufacturing Industries and Construction etc.). R.A. = Reference Approach. For further abbreviations see the glossary in the annex.

CRF coordinator

- Compilation of emission data; generation of Internal GHG Files.
- Transfer of inventory data into the CRF tables.
- Carrying out of recalculations.
- Ensuring completeness and consistency of inventories.
- Implementation of tasks of the inventory development plan concerning CRF tables.
- Documentation of inventory information; archiving of the GHG inventory.

NIR authors

- Carrying out key source analysis.
- Carrying out uncertainty analysis.
- Documentation of the inventory, including QA/QC activities.
- Implementation of tasks of the inventory development plan concerning NIR.
- Editing of NIR, including checking of consistency between CRF and NIR.

2.3 Responsibilities for Quality Control

Data suppliers: Up to the present, QC standards have been defined by data suppliers themselves. They carry the responsibility for the quality of their sectoral data.

SAEFL: Beyond the quality of data collected and calculated in-house, SAEFL is responsible for the completeness and consistency of information compiled in its Internal GHG Files and

in the CRF tables. SAEFL is responsible as well for correctness, completeness, transparency and quality of the NIR.

2.4 Actual Situation of QA/QC

2.4.1 QC Activities

Activities and procedures to be carried out are summarised in Table 8.1 of the Good Practice Guidance (IPCC 2000). Most of these are already applied but are not documented systematically.

The data suppliers

- select appropriate methods, activity data and emission factors,
- check for correct emission modelling and consistency of time series, compare with previous estimates,
- document their results.

The CRF coordinator checks for the

- correct transcription of data delivered by suppliers into the SAEFL Internal GHG Files,
- consistent use of emission factors,
- correctness of emissions aggregation,
- integrity of data structures in the GHG inventory,
- completeness of the GHG inventory,
- consistency of the time series,
- correct transcription of data from Internal GHG Files into CRF,
- correctness of recalculations,
- complete and correct archiving of GHG data.

The NIR authors

- compare the methods used with IPCC Good Practice Guidance,
- check the correct description of the methods in the NIR,
- check the correct transcription of data from CRF into NIR tables and figures,
- check for consistency between data tables and text in the NIR,
- check for completeness of references in the NIR,

The Project Management

- supervises the GHG emission modelling, monitors the key source analysis and the uncertainty analysis,
- reviews the NIR, checks it for correctness, completeness, transparency and quality,

- checks the implementation of improvements defined in the inventory development plan,
- checks for the implementation of QA/QC activities,
- checks for the completeness of the inventory submission documents.

2.4.2 QA Activities

No external review in the formal sense of QA has been carried out so far. However, SAEFL has mandated external consultants to assist in the preparation of the NIR 2004 and 2005. Part of the consultants work consisted in the assessment of the correspondence of emission calculations with the recommendations of the IPCC Good Practice Guidance.

Additionally, the first in-country review of the Swiss GHG inventory took place in September 2004. The SAEFL Inventory Group analysed the findings of the expert review team in the light of quality improvements. The expert recommendations (UNFCCC 2004) were used to establish a first version of the Inventory Development Plan (see Annex 4 of NIR, SAEFL 2005a).

3. Planned Improvements of the QA/QC System

3.1 Establishment of the National Inventory System

An overview of the Swiss NIS is presented in sections 2.1 and 2.2 above. Implementation activities presently focus on the following activities:

- Agreements/memoranda/contracts with data suppliers,
- Initiation of yearly kick-off meetings with all individuals involved in inventory preparation,
- Detailed QA/QC plan including activities and schedule,
- Centralised database for data and documentation of all QA/QC activities.

The first kick-off meeting will take place in spring 2005. The implementation plan for the NIS and the present status of inventory activities will be presented. In particular, quality standards, QC activities, procedures and tools (checklists) will be discussed and agreed. Thus, this meeting will have great bearing on quality management in inventory preparation.

3.2 Planned QC Activities and Procedures

For future submissions, QC activities and procedures are planned in line with IPCC Good Practice Guidance, particularly as summarised in Table 8.1 of IPCC GPG (IPCC 2000). Many of the activities mentioned there have already been accomplished for the previous and the actual submission, but have not been documented systematically. Therefore, two main improvements are going to be realised

1. A standardized and formalized way of QC activities will be implemented using checklists.
2. The systematic documentation of all inventory preparation activities will be introduced.

The QC activities with the checklists will serve as the starting point for the systematic documentation. Five checklists are planned:

- checklist for suppliers of activity data (e.g. fuel statistics, industrial production, agricultural data, forest area, biomass stocks, waste fluxes).
- checklist for suppliers of emission factors and emissions (e.g. energy, solvents, synthetic gases).
- checklist for the CRF coordinator.
- checklist for the NIR authors.
- checklist for the SAEFL Inventory Group

Prototypes of the checklists are shown in the annex below.

After checklists are filled in they are controlled by the SAEFL Inventory Group. Follow-up actions are defined and controlled as well. Thus, the quality system is designed according to a Plan-Do-Check-Act-Cycle (PDCA-cycle) as shown in figure 2. This approach is in accordance with procedures described in decision 20/CP.7 and in the IPCC Good Practice Guidance (chapter 8, Quality Assurance and Quality Control).

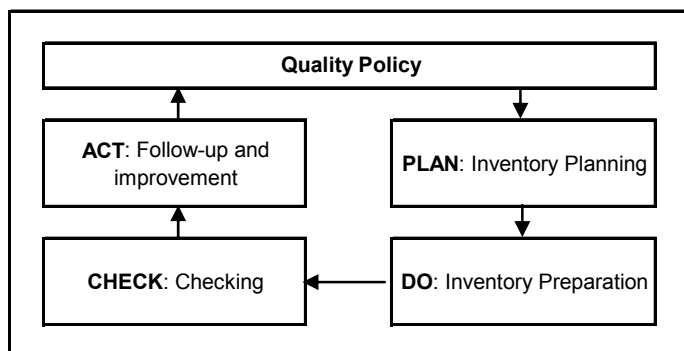


Figure 2 PDCA-cycle

3.3 Planned QA Activities and Procedures

Two approaches are selected to carry out QA activities:

- 1) Episodic domestic in-depth reviews of the complete inventory carried out by independent national experts:
 - QA procedures will be introduced sector by sector with the aim to cover the complete inventory by end of 2007.
 - The most important source category “1 Energy” will undergo a QA process beginning in late 2005.
 - These QA activities will be carried out on an *ex post* basis and cover the complete time-series since 1990.

- 2) Yearly review of the inventory by the SAEFL Inventory Group before submission:
 - Within the SAEFL Inventory Group, a responsible expert and a reviewer will be defined for each sector.
 - Before submission, the reviewer has to check the sector and to give a feedback to the responsible expert.

The yearly cycle of inventory preparation is shown in Table 2.

What	Mai	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
Inventory Management												
Yearly kick-off meeting	■											
Supervision of emission calculation		■				■	■	■				
Supervision of editing of NIR						■	■	■				
Archiving												■
QC		■	■	■	■	■	■	■				
Review report UNFCCC						■	■	■				
QA									■	■	■	
Submission												■
Emissions/GHG inventory												
Data collection		■	■	■	■	■	■	■	■	■	■	■
Emission calculation			■	■	■	■	■	■				
CRF tables						■	■	■				
Key Source Analysis									■	■	■	
Uncertainty analysis						■	■	■	■	■	■	■

Table 2 Time schedule inventory preparation

Annex Checklists

A1. Checklist for Suppliers of Activity Data

Qualitätskontrollsystem für Klimareporting Schweiz (Verpflichtung Kyoto-Protokoll) Submission 2006 Checkliste für Lieferanten von Aktivitätsdaten bis und mit 2004 (Brenn-/Treibstoffverbrauch, Produktionsraten, Tierzahlen, Forststatistiken, Abfallzahlen) Datelieferant (Amt, Firma): Kontaktperson: Telefon, e-mail:			
Kontrollaktivität Prüfung auf....	Prozedur was wurde konkret geprüft?	Datum	Visum
korrekte Übertragung Inputdaten			
korrekte Berechnung der Resultate			
Richtigkeit Konversionsfaktoren			
Integrität der Datenstrukturen			
Datenkonsistenz, Homogenität Datenreihen			
korrekte Aggregation von Daten			
korrekte Abschätzung der Unsicherheiten			
Richtigkeit+Vollständigkeit der Dokumentation			
Vergleich mit früheren Resultaten			
Vergleich mit anderen Ländern			

bis zurücksenden an BUWAL, P. Filliger, Sektion Ökonomie und Klima

Follow-up Aktivitäten
ist zu definieren durch SAEFL Inventory Group

Kontrollaktivität Prüfung auf....	Prozedur was wurde konkret geprüft?	Datum	Visum

A2. Checklist for Suppliers of Emission Factors and Emissions

Qualitätskontrollsystem für Klimareporting Schweiz (Verpflichtung Kyoto-Protokoll)			
Submission 2006			
Checkliste für Lieferanten von Emissionsfaktoren und Emissionen bis und mit 2004			
Datelieferant (Amt, Firma):			
Kontaktperson:			
Telefon, e-mail:			
Kontrollaktivität	Prozedur	Datum	Visum
Prüfung auf....	was wurde konkret geprüft?		
1. Emissionsfaktoren (EF)			
korrekte Übertragung Inputdaten			
korrekte Messung von EF (ISO 10012 o.ä.)			
korrekte Berechnung der EF			
Richtigkeit Konversionsfaktoren			
Integrität der Datenstrukturen			
Datenkonsistenz, Homogenität Datenreihen			
korrekte Aggregierung von Daten			
korrekte Abschätzung der Unsicherheiten			
Vergleich mit früheren Resultaten			
Vergleich mit IPCC default EF (Erklärung von Diskrepanzen)			
Vergleich mit anderen Ländern			
2. Aktivitätsdaten (AD)			
korrekte Übertragung Inputdaten			
korrekte Berechnung der Resultate			
Richtigkeit Konversionsfaktoren			
Integrität der Datenstrukturen			
Datenkonsistenz, Homogenität Datenreihen			
korrekte Aggregierung von Daten			
korrekte Abschätzung der Unsicherheiten			
Vergleich mit früheren Resultaten			
Vergleich mit anderen Ländern			
3. Emissionen			
korrekte Übertragung EF-, AD-Daten			
Begründung Methodenwahl			
korrekte Berechnung der Emissionen			
Vollständigkeit der Emissionen			
Konsistenz (jährl. Änderungen etc.)			
Vergleich mit früheren Resultaten			
Vergleich mit anderen Ländern			
4. Unsicherheiten			
Methodenwahl			
Plausibilität der Inputs (expert judgment, Literaturhinw.)			
korrekte Berechnung der Unsicherheiten			
korrekte Aggregierung der Unsicherheiten			
5. Dokumentation			
Richtigkeit+Vollständigkeit der Dokumentation			

bis zurücksenden an BUWAL, P. Filliger, Sektion Ökonomie und Klima

Follow-up Aktivitäten

ist zu definieren durch SAEFL Inventory Group

Kontrollaktivität	Prozedur	Datum	Visum
Prüfung auf....	was wurde konkret geprüft?		

A3. Checklist for the CRF Coordinator

Qualitätskontrollsystem für Klimareporting Schweiz (Verpflichtung Kyoto-Protokoll)			
Submission 2006			
Checkliste für CRF Koordinator (BUWAL)			
Kontaktperson:			
Telefon, e-mail:			
Kontrollaktivität Prüfung auf....	Prozedur was wurde konkret geprüft?	Datum	Visum
1. Cross-cutting QC			
korrekte Übertragung der Inputs Datenlieferanten			
Übertragung der Quellenangaben, Rückführbarkeit			
Konsistenz mehrfach verwendeter Inputs (z.B. EF CO2, Tierzahlen,...)			
korrekte Einheiten und Konversionsfaktoren			
Integrität der Datenstrukturen (Verknüpfungen)			
korrekte Aggregation der Emissionsdaten			
Vollständigkeit resp. Identifikation der Datenlücken			
korrekte Übertragung in CRF			
Vergleich mit früheren Resultaten			
Verifikation der Resultate (wo möglich)			
2. Recalculations			
Identifikation und korrekte Berechnungen			
Dokumentation der recalculations			
3. Dokumentation und Archivierung			
Vollständigkeit der Dokumente (Daten, KSA, uncertainty., QC-Doks)			
Archivierung elektron. und Papierdokumente (einmalige Files, unmissverständl. Nomenklatur)			

bis zurücksenden an BUWAL, P. Filliger, Sektion Ökonomie und Klima

Follow-up Aktivitäten

ist zu definieren durch SAEFL Inventory Group

Kontrollaktivität Prüfung auf....	Prozedur was wurde konkret geprüft?	Datum	Visum

A4. Checklist for NIR Authors

Qualitätskontrollsystem für Klimareporting Schweiz (Verpflichtung Kyoto-Protokoll)			
Submission 2006			
Checkliste für NIR-Autoren			
Kontaktperson:			
Telefon, e-mail:			
Kontrollaktivität	Prozedur	Datum	Visum
Prüfung auf....	was wurde konkret geprüft?		
korrekte Berechnung der key sources			
konsistente, korrekte Aggregation Unsicherheiten			
korrekte Übertragung der Methoden -> NIR			
korrekte Übertragung EF-, AD-, Em.daten CRF in NIR			
Konsistenz zwischen Text und Zahlen			
vollständige, korrekte Referenzen			
Vollständigkeit der Berichterstattung			
Transparenz (Reviews!)			

bis zurücksenden an BUWAL, P. Filliger, Sektion Ökonomie und Klima

Follow-up Aktivitäten

ist zu definieren durch SAEFL Inventory Group

Kontrollaktivität	Prozedur	Datum	Visum
Prüfung auf....	was wurde konkret geprüft?		

A5. Checklist for the Project Management

Qualitätskontrollsystem für Klimareporting Schweiz (Verpflichtung Kyoto-Protokoll) Submission 2006 Checkliste für SAEFL Inventory Group Kontaktperson: Telefon, e-mail:			
Kontrollaktivität Prüfung auf....	Prozedur was wurde konkret geprüft?	Datum	Visum
Monitoring GHG Inventar-Berechnungen			
Monitoring Key Source Analysis			
Monitoring Uncertainty Analysis			
Einhaltung QA/QC Aktivitäten			
Vollständigkeit der Submissionsdokumente			
Prüfung Archivierung			

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Follow-up Aktivitäten
 ist zu definieren durch Leiter SAEFL Inventory Group

Kontrollaktivität Prüfung auf....	Prozedur was wurde konkret geprüft?	Datum	Visum

Glossary and Abbreviations

English term	German term
Federal institutions	
SAEFL, Economics, Research and Monitoring	BUWAL, Ökonomie, Forschung und Umweltbeobachtung
SAEFL, Air Pollution Control	BUWAL, Luftreinhaltung und NIS
SAEFL, Waste Management	BUWAL, Abfall und Rohstoffe
SAEFL, Biocides and Plant Protection Prod.	BUWAL, Stoffe, Boden, Biotechnologie
SAEFL, Forest Agency	BUWAL, Forstdirektion
SFOE, Swiss Federal Office of Energy	BFE Bundesamt für Energie
FOCA, Federal Office of Civil Aviation	BAZL, Bundesamt für Zivilluftfahrt
FOAG, Swiss Federal Office for Agriculture	BLW, Bundesamt für Landwirtschaft
SFSO, Swiss Federal Statistical Office	BFS, Bundesamt für Statistik
BABLW, Federal Office of the Air Force	BABLW, Bundesamt für Betriebe der Luftwaffe
FAL, Swiss Federal Research Station for Agroecology and Agriculture	FAL, Agroscope, Eidgenössische Forschungsanstalt für Agrarökologie und Landbau
WSL, Swiss Federal Institute for Forest, Snow and Landscape Research	WSL, Eidg. Forschungsanstalt für Wald, Schnee und Landschaft
Empa Swiss Federal Laboratories for Materials Testing and Research	EMPA, Eidgenössische Materialprüfungs- und Forschungsanstalt
Swiss Petroleum Association	Erdölvereinigung
UVEK, Federal Department of Environment, Transport, Energy and Communications	UVEK, Eidg. Departement für Umwelt, Verkehr und Kommunikation
Further abbreviations	
IPCC, Intergovernmental Panel on Climate Change	
CRF, Common Reporting Format	
UNFCCC, United Nations Framework Convention on Climate Change	UNFCCC, Klimakonvention der Vereinten Nationen
QA Quality Assurance	QC Qualitätssicherung
QC Quality Control	QC Qualitätskontrolle
GHG, Green house gas	GHG, Treibhausgas (klimawirksames Gas)
CO ₂ , carbon dioxide	CO ₂ , Kohlendioxid
NIR, National Inventory Report	NIR, nationaler Bericht zum Treibhausgasinventar
PDCA cycle, Plan-Do-Check-Act cycle	PDCA cycle, PDCA- oder Deming Zyklus

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- SAEFL 1995b:** Vom Menschen verursachte Luftschadstoffemissionen in der Schweiz von 1900 bis 2010, Bundesamt für Umwelt, Wald und Landschaft (BUWAL), Schriftenreihe Umwelt Nr. 256, Bern (Available in German only).
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- SAEFL 2000b:** Schadstoffemissionen und Treibstoffverbrauch des Off-road Sektors (Überarbeitung), Entwurf vom Oktober 2000, Bundesamt für Umwelt, Wald und Landschaft (BUWAL), unveröffentlicht, Bern
- SAEFL 2003a:** Abfallstatistik der Schweiz, Bundesamt für Umwelt, Wald und Landschaft (BUWAL), Bern
- SAEFL 2004e:** Importe 2003 ozonschichtabbauender Stoffe gemäss StoV, Erhebung BUWAL 2003, Stand 08.11.2004 (SAEFL internal import statistics of synthetic gases; , contact Mr. A. Liechti),
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