

FEDERAL OFFICE FOR THE ENVIRONMENT FOEN

CLIMATE REPORTING SWITZERLAND VERIFICATION OF SWISS IMPLIED EMISSION FACTORS

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The logo for INFRAS, featuring the word "INFRAS" in white lowercase letters on a black rectangular background, which is adjacent to a yellow rectangular background.

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1. INTRODUCTION

According to its obligations under the UN Climate Convention (UNFCCC/KP), Switzerland submits the Greenhouse Gas Inventory (GHG CRF) and the National Inventory Report (NIR) on an annual basis. Therein activity data, emission factors and respective emissions from all emitting sectors in Switzerland are summarised and sorted by climate relevant gases. Verification of this information is utmost relevant in order to ensure integrity of the CRF and subsequently of the NIR. Therefore the Federal Office for the Environment (FOEN) has decided to strengthen its verification process, focussing on Implied Emission Factors (IEF). EF for the conversion of activity data into emissions, play a critical role in the reporting process. Since some are difficult to obtain, a plausibility check of EF is essential. Consequently this report describes the additional activities conducted for Submission 2012 to put the Swiss EF into the international context. This will give indications for areas where further investigations are required to corroborate Swiss EFs.

This report first describes how the approach is conceptualised. Subsequently the general results from the study are presented. In a separate discussion in the NIR, the analysis of the comparison is conducted by the sectoral experts and subsequently described in the corresponding subchapters “source-specific QA/QC and verification”.

2. CONCEPT AND METHODS

The objective for this verification is to deliver a comprehensive reference for the IEF used in the Swiss Greenhouse Gas Inventory. It provides a comparison of Swiss EF with those used in other countries and with the default values proposed by the IPCC und UNFCCC for consideration by the sectoral experts in charge at FOEN and to the reviewers of the UNFCCC. Therefore the ultimate aim is to identify categories in which Switzerland’s IEF differ significantly from other countries IEF or the IPCC default value. These differences will be addressed and explained in the NIR. Where the difference cannot be derived from country-specific circumstances, further scrutiny will be applied and the IEF will potentially be adapted. In order to develop a comparison scheme, the following approach is chosen:

- › selection of relevant categories and subcategories of the inventory,
- › search and compilation of data from all countries and IPCC Guidelines for selected categories,
- › comparison of IEFs and detection of divergences of Swiss IEF.

Selection of relevant sectors and subsectors is required since overall there are large numbers of source and sink categories. Accordingly the Core Group of the GHG Inventory decided that only key categories will be considered, thus 95% of total Swiss emissions are encompassed in this analysis. Some of the key categories can be further disaggregated into subcategories. Particularly in the sector 5 LULUCF such subcategories exist in abundance. Therefore relevant subcategories are selected by expert judgement, according to their contribution to total emissions within the respective sector. From this selection process, a list of 82 categories resulted.

Data on IEF for all relevant categories and gases from other countries is accessible through the data base of the UNFCCC¹. Furthermore the revised 1996 and 2006 IPCC Guidelines (IPCC 1997, 2006) for National Greenhouse Gas Inventories were screened for proposed EF default values. However not for all categories an equivalent IPCC default value exists. Often the default values of the guidelines are more disaggregated and very detailed (especially in IPCC 2006), thus they are not helpful for an overall comparison of aggregated implied emission factors. Data is compiled in a single Excel sheet and sorted according to the categories chosen. For each category the following information is available:

- › Concise definition of the category, process and gas to be compared,
- › IEF of all countries and respective mean, median, standard deviation and variation coefficient,
- › histogram highlighting the placement of Switzerland's IEF among other countries,
- › IPCC default values (if available),
- › deviation of Swiss IEFs from mean value.

3. RESULTS

The results for the sectoral experts are summarised in the Excel sheet “20120113 Auswertung IEF NIR CH 2011.xlsx” and for LULUCF “20111014 Auswertung IEF NIR CH 2011 LULUCF.xlsx”. In total, 82 Key Categories are deemed relevant for this analysis. The majority stems from the energy sector, but there are also numerous categories from the agriculture and LULUCF sector. In more than half of all cases the IEFs are related to CO₂. Additional relevant

¹ <http://unfccc.int/di/FlexibleQueries.do>

gases are CH₄ and N₂O. Finally Table 1 depicts the results from the comparison of IEFs and Table 2 lists the IEF in Switzerland that diverge more than 10% from the mean value.

COMPARISON OF IEF								
Source Category		Direct GHG	IPCC default	CH	Mean	IEF dev. CH/mean %	Std Dev	V.K.
1A1	Gaseous Fuels	CO ₂		55.00	55.34	-1%	3.9	7%
1A1	Liquid Fuels	CO ₂		65.90	71.61	-8%	4.1	6%
1A1	Other Fuels	CO ₂		44.35	51.56	-14%	16.8	33%
1A1	Other Fuels	N ₂ O	1.4-4	6.48	4.79	35%	2.8	59%
1A2	Biomass	N ₂ O	4.0	2.77	3.39	-18%	0.9	27%
1A2	Gaseous Fuels	CO ₂		55.00	54.85	0%	1.9	3%
1A2	Liquid Fuels	CO ₂		74.65	72.11	4%	3.5	5%
1A2	Other Fuels	CO ₂		79.08	77.38	2%	41.1	53%
1A2	Other Fuels	N ₂ O	1.4-4	14.12	3.17	346%	2.7	85%
1A2	Solid Fuels	CO ₂		96.52	90.91	6%	15.0	16%
1A3a	Civil Aviation	CO ₂		73.20	67.92	8%	15.9	23%
1A3b	Diesel	CO ₂		73.60	73.04	1%	1.5	2%
1A3b	Gasoline	CH ₄	20.0	8.32	10.99	-24%	5.4	50%
1A3b	Gasoline	CO ₂		73.90	70.49	5%	2.1	3%
1A3b	Gasoline	N ₂ O	0.6	1.14	3.81	-70%	4.1	107%
1A4a	Gaseous Fuels	CO ₂		55.00	55.25	0%	1.9	3%
1A4a	Liquid Fuels	CO ₂		73.50	71.87	2%	3.7	5%
1A4b	Biomass	CH ₄	300.0	96.83	277.40	-65%	96.8	35%
1A4b	Gaseous Fuels	CO ₂		55.00	55.48	-1%	2.1	4%
1A4b	Liquid Fuels	CO ₂		73.50	69.13	6%	4.6	7%
1A4b	Liquid Fuels	N ₂ O	0.6	0.60	0.91	-34%	0.8	90%
1A4c	Liquid Fuels	CO ₂		73.63	72.74	1%	1.5	2%
1A4c	Liquid Fuels	N ₂ O	0.6-4	2.39	7.44	-68%	10.0	134%
1A5	vergleich siehe 1A3	CO ₂						
1B2	Oil and Natural Gas	CH ₄	300-5000	1041.67	3032.80	-66%	8171.4	269%
1B2	Oil and Natural Gas	CH ₄	72000-133000	370.26	145999.93	-100%	534609.1	366%
1B2	Oil and Natural Gas	CH ₄	1000-3000	81.02	989.88	-92%	2398.9	242%
2A1	Cement Production-CO ₂	CO ₂	0.5	0.53	0.53	0%	0.01	3%
2A2	Lime Production-CO ₂	CO ₂	0.79-0.91	C	0.72		0.1	13%
2A3	Limestone and Dolomite Use-CO ₂	CO ₂	0.4	0.08	0.41	-81%	0.1	30%
2B2	Chemical Industry	N ₂ O	0.005-0.009	C	0.00		0.0	62%
2C1	Metal Production: Steel Production	CO ₂	1.6-3.6	0.14	0.31	-55%	0.3	88%
2F1	Consumption of Halocarbons and SF ₆ ; Refrig. & AC Eq.	HFC-125	verschiedene Prozesse, siehe Backgroundsheet					
2F1	Consumption of Halocarbons and SF ₆ ; Refrig. & AC Eq.	HFC-134a	verschiedene Prozesse, siehe Backgroundsheet					
2F1	Consumption of Halocarbons and SF ₆ ; Refrig. & AC Eq.	HFC-143a	verschiedene Prozesse, siehe Backgroundsheet					
2F1	Consumption of Halocarbons and SF ₆ ; Refrig. & AC Eq.	SF ₆	Keine Daten					
3A	Solvent and Other Product Use, Paint Application	CO ₂		0.06	1.62	-96%	1.1	65%
3B	Solvent and Other Product Use, Degreasing Dry Cleaning	CO ₂		NA	1.87		1.1	61%
3C	Solvent and Other Product Use, Chemical Product	CO ₂		NA	1.69		1.3	80%
3B	Solvent and Other Product Use	N ₂ O	no default					
4A	Enteric Fermentation Dairy Cattle	CH ₄	100.0	121.00	110.85	9%	15.5	14%
4A	Enteric Fermentation Non-Dairy Cattle	CH ₄		48.0	81.00	44%	11.1	20%
4A	Enteric Fermentation Sheep	CH ₄		8.0	10.70	28%	1.9	22%
4A	Enteric Fermentation Swine	CH ₄		1.5	1.40	1%	0.2	14%
4B	Manure Management Dairy Cattle			14.0	25.66	30%	17.1	86%
4B	Manure Management Non-Dairy Cattle			6.0	13.30	56%	5.3	81%
4B	Manure Management Sheep			0.2	1.20	32%	0.4	110%
4B	Manure Management Swine			3.0	5.43	43%	6.0	76%
4D	Nex Dairy Cattle			100.0	110.00	10%	18.9	19%
4D	Nex Non-Dairy Cattle			70.0	80.00	52%	11.9	23%
4D	Nex Sheep			20.0	8.00	12%	4.7	39%
4D	Nex Swine			20.0	9.00	27%	4.2	34%
4D	Nex Poultry			0.6	0.50	0%	0.2	28%
4D	FracGRAZ			no default	0.19	0.28	32%	67%
4D	FracGASM			0.2	0.33	0%	0.1	43%
4D	FracIASF			0.1	0.04	0%	0.04	51%
4D	FracEACH			0.3	0.20	0%	0.1	40%
4D	FracNCRBF			0.0	0.02	0%	0.01	52%
4D	FracNCRO			0.0	0.02	0%	0.1	344%
4D	FracR			0.5	0.70	0%	0.2	50%
5A1	Forest Land Net Carbon Stock Change Living Biomass	CO ₂		0.10	1.11	-91%	2.4	214%
5A1	Forest Land Net Carbon Stock Change DOM	CO ₂		0.15	0.09	71%	0.1	91%
5A1	Forest Land Wildfires	CO ₂		27.28	96.83	26%	52.5	143%
5A2	Forest Land Net Carbon Stock Change Living Biomass	CO ₂		0.20	1.72	-88%	1.7	99%
5A2	Forest Land Net Carbon Stock Change DOM	CO ₂		0.10	0.30	66%	0.3	91%
5B1	Crop Land Net Carbon Stock Change Organic Soils	CO ₂		-9.52	-6.09	56%	3.8	-62%
5C1	Grass Land Net Carbon Stock Change Living Biomass	CO ₂		0.00	0.07	96%	0.2	225%
5C1	Grass Land Net Carbon Stock Change Mineral Soils	CO ₂		0.00	0.03	81%	0.1	428%
5C1	Grass Land Net Carbon Stock Change Organic Soils	CO ₂		-8.41	-2.48	239%	2.5	-99%
5C2	Grass Land Net Carbon Stock Change Living Biomass	CO ₂		-0.93	-2.17	57%	6.4	-298%
5C2	Grass Land Net Carbon Stock Change DOM	CO ₂		-0.41	-0.36	17%	-0.03	66%
5C2	Grass Land Net Carbon Stock Change Mineral Soils	CO ₂		0.63	2.45	74%	5.5	225%
5C2	Grass Land Net Carbon Stock Change Organic Soils	CO ₂		-8.32	-2.20	278%	2.2	-101%
5E2	Settlements Net Carbon Stock Change Living Biomass	CO ₂		-0.01	0.38	-103%	0.9	230%
5E2	Settlements Net Carbon Stock Change Soils	CO ₂		-0.02	-0.14	86%	0.2	-155%
5F2	Other Land Net Carbon Stock Change Living Biomass	CO ₂		-1.49	-5.71	74%	16.2	-285%
5F2	Other Land Net Carbon Stock Change Living Biomass	CO ₂		-0.36	-2.41	85%	7.0	-288%
5F2	Other Land Net Carbon Stock Change Living Biomass	CO ₂		-2.47	-7.57	67%	19.0	-251%
6A1	Solid Waste Disposal on Land	CH ₄		NA				
6B21	Wastewater Handling	N ₂ O		NA				
6B22	Wastewater Handling	N ₂ O		0.01	0.01	9%	0.002	18%
6D	Other	CH ₄	no default					
7	Other	CO ₂	no default					

Table 1: Comparison of IEF in Key Categories: IPCC default values, Swiss IEF and divergence from mean value.

DEVIATION OF SWISS IEF FROM MEAN

Source Category		Direct GHG	IEF					
			IPCC default	CH	Mean	dev. CH/mean %	Std Dev	V.K.
5E2	Settlements Net Carbon Stock Change Living Biomass	CO2		-0.01	0.38	<div><div></div></div> -103%	0.9	230%
1B2	Oil and Natural Gas	CH4	72'000-133'000	370.26	145999.93	<div><div></div></div> -100%	534609.1	366%
3A	Solvent and Other Product Use, Paint Application	CO2		0.06	1.62	<div><div></div></div> -96%	1.1	65%
5C1	Grass Land Net Carbon Stock Change Living Biomass	CO2		0.00	0.07	<div><div></div></div> -96%	0.2	225%
1B2	Oil and Natural Gas	CH4	1'000-3'000	81.02	989.88	<div><div></div></div> -92%	2398.9	242%
5A1	Forest Land Net Carbon Stock Change Living Biomass	CO2		0.10	1.11	<div><div></div></div> -91%	2.4	214%
5A2	Forest Land Net Carbon Stock Change Living Biomass	CO2		0.20	1.72	<div><div></div></div> -88%	1.7	99%
5E2	Settlements Net Carbon Stock Change Soils	CO2		-0.02	-0.14	<div><div></div></div> -86%	0.2	-155%
5F2	Other Land Net Carbon Stock Change Living Biomass	CO2		-0.36	-2.41	<div><div></div></div> -85%	7.0	-288%
2A3	Limestone and Dolomite Use-CO2	CO2	0.4	0.08	0.41	<div><div></div></div> -81%	0.1	30%
5C1	Grass Land Net Carbon Stock Change Mineral Soils	CO2		0.00	0.03	<div><div></div></div> -81%	0.1	428%
4B	Manure Management Non-Dairy Cattle		6.0	13.30	56.08	<div><div></div></div> -76%	5.3	81%
5C2	Grass Land Net Carbon Stock Change Mineral Soils	CO2		0.63	2.46	<div><div></div></div> -74%	5.5	225%
5F2	Other Land Net Carbon Stock Change Living Biomass	CO2		-1.49	-5.71	<div><div></div></div> -74%	16.2	-285%
1A3b	Gasoline	N2O	0.6	1.14	3.81	<div><div></div></div> -70%	4.1	107%
1A4c	Liquid Fuels	N2O	0.6-4	2.39	7.44	<div><div></div></div> -68%	10.0	134%
5F2	Other Land Net Carbon Stock Change Living Biomass	CO2		-2.47	-7.57	<div><div></div></div> -67%	19.0	-251%
5A2	Forest Land Net Carbon Stock Change DOM	CO2		0.10	0.30	<div><div></div></div> -66%	0.3	91%
1B2	Oil and Natural Gas	CH4	300-5000	1041.67	3032.80	<div><div></div></div> -66%	8171.4	269%
1A4b	Biomass	CH4	300.0	96.83	277.40	<div><div></div></div> -65%	96.8	35%
4D	FracNCRO		0.0	0.02	0.04	<div><div></div></div> -63%	0.1	344%
5C2	Grass Land Net Carbon Stock Change Living Biomass	CO2		-0.93	-2.17	<div><div></div></div> -57%	6.4	-298%
2C1	Metal Production: Steel Production	CO2	1.6-3.6	0.14	0.31	<div><div></div></div> -45%	0.3	88%
4D	FracGASF		0.1	0.04	0.07	<div><div></div></div> -45%	0.04	51%
1A4b	Liquid Fuels	N2O	0.6	0.60	0.91	<div><div></div></div> -34%	0.8	90%
4D	Nex Sheep		20.0	8.00	12.07	<div><div></div></div> -34%	4.7	39%
4B	Manure Management Swine		3.0	5.43	7.98	<div><div></div></div> -32%	6.0	76%
4D	FracGRAZ		no default	0.19	0.28	<div><div></div></div> -32%	0.2	67%
4D	Nex Swine		20.0	9.00	12.32	<div><div></div></div> -27%	4.2	34%
5A1	Forest Land Wildfires	CO2		27.28	36.83	<div><div></div></div> -26%	52.5	143%
1A3b	Gasoline	CH4	20.0	8.32	10.99	<div><div></div></div> -24%	5.4	50%
4D	FracNCRBF		0.0	0.02	0.03	<div><div></div></div> -21%	0.01	52%
1A2	Biomass	N2O	4.0	2.77	3.39	<div><div></div></div> -18%	0.9	27%
4D	FracLEACH		0.3	0.20	0.24	<div><div></div></div> -15%	0.1	40%
1A1	Other Fuels	CO2		44.35	51.56	<div><div></div></div> -14%	16.8	33%
4D	Nex Poultry		0.6	0.50	0.56	<div><div></div></div> -10%	0.2	28%
5C2	Grass Land Net Carbon Stock Change DOM	CO2		-0.41	-0.36	<div><div></div></div> 17%	-0.03	66%
4A	Enteric Fermentation Sheep	CO2	8.0	10.70	8.38	<div><div></div></div> 28%	1.9	22%
4B	Manure Management Dairy Cattle		14.0	25.66	19.80	<div><div></div></div> 30%	17.1	86%
1A1	Other Fuels	N2O	1.4-4	6.48	4.79	<div><div></div></div> 35%	2.8	59%
4A	Enteric Fermentation Non-Dairy Cattle	N2O	48.0	81.00	56.08	<div><div></div></div> 44%	11.1	20%
4D	FracR		0.5	0.70	0.47	<div><div></div></div> 48%	0.2	50%
4D	Nex Non-Dairy Cattle		70.0	80.00	52.90	<div><div></div></div> 51%	11.9	23%
5B1	Crop Land Net Carbon Stock Change Organic Soils	CO2		-9.52	-6.09	<div><div></div></div> 56%	3.8	-62%
4D	FracGASM		0.2	0.33	0.19	<div><div></div></div> 71%	0.1	43%
5A1	Forest Land Net Carbon Stock Change DOM	CO2		0.15	0.09	<div><div></div></div> 71%	0.1	91%
5C1	Grass Land Net Carbon Stock Change Organic Soils	CO2		-8.41	-2.48	<div><div></div></div> 239%	2.5	-99%
4B	Manure Management Sheep		0.2	1.20	0.33	<div><div></div></div> 268%	0.4	110%
5C2	Grass Land Net Carbon Stock Change Organic Soils	CO2		-8.32	-2.20	<div><div></div></div> 278%	2.2	-101%
1A2	Other Fuels	N2O	1.4-4	14.12	3.17	<div><div></div></div> 346%	2.7	85%

Table 2: List of Swiss IEFs that deviate more than $\pm 10\%$ from the mean value.

LITERATURE

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