UNITED
NATIONS

UNFCCC Framework Convention on Climate Change

Distr.
GENERAL

FCCC/ARR/2006/ISL
4 April 2008

ENGLISH ONLY

Report of the individual review of the greenhouse gas inventory of Iceland submitted in 2006*

* In the symbol for this document, 2006 refers to the year in which the inventory was submitted, and not to the year of publication.

CONTENTS

I. Overview

A. Introduction

1. This report covers the in-country review of the 2006 greenhouse gas (GHG) inventory submission of Iceland, coordinated by the United Nations Framework Convention on Climate Change (UNFCCC) secretariat, in accordance with decision 19/CP.8. The review took place from 18 to 23 June 2007 in Reykjavik, Iceland, and was conducted by the following team of nominated experts from the roster of experts: generalist – Mr. Vlad Trusca (Romania); energy – Ms. Sumana Bhattacharya (India); industrial processes – Ms. Kristine Zommere (Latvia); agriculture – Mr. Paul Duffy (Ireland); land use, land-use change and forestry (LULUCF) – Mr. Zoltan Somogyi (Hungary); waste – Ms. Medea Inashvili (Georgia). Ms. Sumana Bhattacharya and Mr. Paul Duffy were the lead reviewers. The review was coordinated by Ms. Keryn Oude-Egberink (UNFCCC secretariat).

2. In accordance with the "UNFCCC guidelines for the technical review of greenhouse gas inventories from Parties included in Annex I to the Convention", (hereinafter referred to as UNFCCC review guidelines), a draft version of this report was communicated to the Government of Iceland, which stated it had no comments on the draft report.

B. Inventory submission and other sources of information

3. In its 2006 submission, Iceland submitted a complete set of common reporting format (CRF) tables for the years 1990–2004 and a national inventory report (NIR). Iceland officially submitted a revised GHG inventory on 11 September 2007 in response to questions raised by the expert review team (ERT) during the course of the in country review.

4. Where necessary the ERT also used the previous year's submission, additional information provided during the review and other information. The full list of materials used during the review is provided in the annex to this report.

C. Emission profiles and trends

5. In 2004, the most important GHG in Iceland was carbon dioxide (CO_2), contributing 77.1 per cent to total[1] national GHG emissions expressed in CO_2 equivalent (eq.), followed by nitrous oxide (N_2O) 8.9 per cent and methane (CH_4,) 11.2 per cent. Hydrofluorocarbons (HFCs) contributed 1.6 per cent, perfluorocarbons (PFCs) 1.0 per cent, and sulphur hexafluoride (SF_6) 0.1 per cent. Taken together the total HFCs contributed 2.8 per cent to total national GHG emissions. The energy sector accounted for 56.0 per cent of the total GHG emissions, followed by industrial processes 25.5 per cent, solvent and other product use 0.3 per cent, agriculture 13.5 per cent, and waste, 4.6 per cent. The total GHG emissions in 2004 were 3716.84 Gg CO_2 eq., an increase of 10.4 per cent with respect to the base year (1990).

6. Tables 1 and 2 show the GHG emissions by gas and by sector, respectively.

[1] In this report, the term total emissions refers to the aggregated national GHG emissions expressed in terms of CO_2 eq. excluding LULUCF, unless otherwise specified.

Table 1. Greenhouse gas emissions by gas, 1990–2004[a]

GHG emissions	Gg CO_2 eq.								Change
	Base year (Convention)	1990	1995	2000	2001	2002	2003	2004	BY–2004 (%)
CO_2 (with LULUCF)	3789.29	3789.29	3876.64	4237.71	4225.12	4296.36	4192.37	4252.33	12.2
CO_2 (without LULUCF)	2158.64	2158.64	2308.45	2755.45	2759.22	2850.63	2770.33	2865.33	32.8
CH_4	463.09	463.09	456.67	473.81	477.88	480.67	466.45	465.67	0.6
N_2O	785.78	785.78	764.24	774.06	767.61	733.99	726.66	747.72	–4.8
HFCs	NA,NE,NO	NA,NE,NO	25.01	32.28	53.78	35.16	69.35	58.40	NA
PFCs	419.63	419.63	58.84	127.16	91.66	72.54	59.78	38.58	–90.8
SF_6	5.38	5.38	5.38	5.38	5.38	5.38	5.38	5.38	0.0

Note: BY = Base year; LULUCF = Land use, land-use change and forestry; NA = not applicable; NE = not estimated; NO = not occurring.

[a] Iceland submitted revised estimates for 1990–2004 in the course of the review on 11 September 2007.These estimates differ from Iceland's GHG inventory submitted in 2006.

Table 2. Greenhouse gas emissions by sector, 1990–2004[a]

Sectors	Gg CO_2 eq.								Change
	Base year (Convention)	1990	1995	2000	2001	2002	2003	2004	BY–2004 (%)
Energy	1770.58	1770.58	1901.78	2036.10	1999.14	2075.45	1999.18	2081.27	17.5
Industrial processes	866.64	866.64	559.12	949.96	971.41	936.31	959.77	949.33	9.5
Solvent and other product use	13.94	13.94	14.09	14.89	16.69	12.95	10.05	10.32	–25.9
Agriculture	575.75	575.75	527.04	532.96	529.50	506.38	492.23	503.55	–12.5
LULUCF	2095.19	2095.19	2032.73	1946.80	1930.44	1910.26	1886.58	1851.24	–11.6
Waste	141.06	141.06	152.02	169.71	174.25	182.75	172.18	172.38	22.2
Other	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total (including LULUCF)	5463.16	5463.16	5186.78	5650.41	5621.43	5624.10	5519.99	5568.08	1.9
Total (excluding LULUCF)	3367.97	3367.97	3154.05	3703.61	3609.99	3713.84	3633.41	3716.84	10.4

Note: BY = Base year; LULUCF = Land use, land-use change and forestry, NA = not applicable.

[a] Iceland submitted revised estimates for 1990–2004 in the course of the review on 11 September 2007. These estimates differ from Iceland's GHG inventory submitted in 2006.

D. Key categories

7. Iceland reported a key category tier 1 analysis, both level and trend, for the first time as a part of its 2006 inventory submission. The key category analysis performed by Iceland and the secretariat[2] produced similar results. Differences between the results of these analyses are because Iceland did not include the LULUCF sector in its key category analysis. In addition Iceland's classification for its key category analysis compared to that of the secretariat was more disaggregated.

8. As the results of the key category analysis are a driving factor for the preparation of the inventory, in particular the prioritization of resources and methodological complexity, the ERT recommends that Iceland incorporate the LULUCF sector in the key category analysis, provide a 1990 analysis and develop a tier 2 key category analysis in its next submission.

E. Main findings

9. Iceland's inventory is to a large extent complete and consistent with the "UNFCCC Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories" (hereinafter referred to as the UNFCCC reporting guidelines). The ERT noted however, that further improvement is required, for example the need to progress the development of an energy balance, and comprehensive inclusion of detailed descriptions of the methodologies and emission factors (EFs) for the different categories in the NIR.

10. In response to previous ERT findings and the in-country review of the 2006 GHG inventory submission, Iceland provided the ERT with information on procedures in place to strengthen its current institutional arrangements, for example, the establishment of formal procedures for review and approval of its national inventory. In addition Iceland provided a quality assurance/quality control (QA/QC) plan and identified the roles and responsibilities for the management of its QA/QC programme. Iceland, in response to the recommendation of the previous (2005) review, also included in the CRF tables industrial process CO_2 emissions which may fall under decision 14/CP.7, such as CO_2 emissions from plants in the ferroalloy and aluminium industries.

F. Cross-cutting topics

1. Completeness

11. The 2006 GHG inventory submission covers all years from 1990 to 2004. It is complete in terms of geographical coverage, years and sectors, and is generally complete in terms of categories and gases. With regard to fluorinated gases, actual emissions of PFCs (perfluoromethane (CF_4) and perfluoroethane (C_2F_6)) are reported, SF_6 emissions are held constant over the time series, and the importation of HFCs (e.g. HFC-125, HFC-134a and HFC-143a), as reflected by the inventory, only commenced in 1992. The ERT commends Iceland for submitting LULUCF tables in accordance with decision 13/CP.9.

12. In its 2006 inventory, CRF table summary 3, recalculation table 8(b) and the completeness CRF table 9 are incomplete.

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[2] The secretariat identified, for each Party, those source categories that are key categories in terms of their absolute level of emissions, applying the tier 1 level assessment as described in the IPCC *Good Practice Guidance for Land Use, Land-use Change and Forestry* (hereinafter referred to as the IPCC good practice guidance for LULUCF). Key categories according to the tier 1 trend assessment were also identified for those Parties that provided a full set of CRF tables for the base year. Where the Party performed a key category analysis, the key categories presented in this report follow the Party's analysis. However, they are presented at the level of aggregation corresponding to a tier 1 key category assessment conducted by the secretariat

13. During the in-country review visit Iceland, in response to the ERT recommendations, provided estimates for "not estimated" ("NE") categories in the sectors of energy, solvent and other product use, and agriculture. The ERT recommends that Iceland in its next inventory submission provide documentation on its choice of activity data (AD), EFs and methodologies used to estimate these categories in the relevant chapters of the NIR.

2. Transparency

14. The NIR and CRF tables provide sufficient transparency for the ERT to assess the data used and methodologies applied. However, the ERT noted that the transparency of the inventory can be improved by including in the NIR documentation on QA/QC and verification activities; more complete information on AD, EFs and the rationale for methodological choice; and documentation of expert judgment and references to literature sources. The transparency of the inventory can also be significantly improved by reporting in the relevant CRF table explanations for recalculations, the use of notation keys, methods and EFs.

3. Recalculations and time series consistency

15. The ERT concludes that Iceland's inventory is broadly consistent with the UNFCCC reporting guidelines and the Intergovernmental Panel on Climate Change (IPCC) *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (hereinafter referred to as the IPCC good practice guidance). The institutional arrangements ensure that recalculations of previously submitted estimates of GHG emissions by sources and removals by sinks are prepared in accordance with the IPCC good practice guidance. Recalculations are due to improvements in methodologies, revisions of AD and EFs, inclusion of new categories and correction of calculations. Iceland has provided recalculated estimates for the years 1990 to 2003 in CRF table 8(a), but explanatory information in CRF table 8(b) is limited. The effect of the recalculations has been an increase in the estimates of total GHG emissions for 1990 by 2.2 per cent, and of 18.3 per cent for 2003. The ERT recommends that Iceland document the major changes and the rationale for recalculations in chapter 10 of the NIR, and improve explanations for recalculations in CRF table 8(b) in its next inventory submission.

16. Subject to the availability of data and resources, further improvements are required to ensure greater consistency with the IPCC good practice guidance, for example, the use of more advanced tier methods to estimate the key categories, and the provision of quantitative uncertainty estimates. The ERT also noted that the LULUCF sector time series is not completely consistent.

4. Uncertainties

17. The ERT acknowledges that Iceland, in response to a recommendation from the 2005 review, provided for the first time a quantitative tier 1 uncertainty analysis for the national inventory as a whole, as well as at a category level (except for the LULUCF sector). The overall uncertainty of the inventory is estimated at 7.4 per cent, and the uncertainty of the LULUCF sector is presently qualitative.

18. The ERT noted that the uncertainty analysis generally follows the IPCC good practice guidance, however, it is mostly based on expert judgments. The ERT recommends that the uncertainty analysis be improved by including all source/sink categories and documenting in the NIR the data and assumptions used; and ensuring that improvements in the inventory are prioritized based on this analysis. In addition, the ERT also encourages Iceland to develop a tier 2 uncertainty analysis for key categories in line with the IPCC good practice guidance, subject to the availability of data and resources.

5. Verification and quality assurance/quality control approaches

19. In response to the 2006 in-country review, Iceland developed a QA/QC plan. Iceland has performed standard tier 1 QC procedures for several key categories, but no formal QA by independent

experts has been undertaken due to a lack of resources. Furthermore, Iceland has not applied standard QC checks to the CRF tables generated by the CRF Reporter software.

20. The ERT recommends that Iceland implement the newly-developed QA/QC plan before its next submission in 2008 and that this QA/QC plan be further developed so that it is consistent with the IPCC good practice guidance. In particular, the plan should include information on the roles and responsibilities for the management of QA/QC procedures, and details of QC procedures.

21. The ERT also recommends that Iceland include descriptions of the QA/QC procedures in each sector in the NIR in accordance with the UNFCCC reporting guidelines. The Party is also recommended to develop and implement source-specific tier 2 QC procedures with a primary focus on key categories and/or categories which have been through a significant methodological and/or data revision.

G. Follow-up to previous reviews

22. The ERT acknowledges the improvements implemented by Iceland in particular: the recent establishment of strengthened institutional arrangements and procedures for the preparation, planning and management of the national inventory; the development of a QA/QC plan; the inclusion of information on industrial process emissions required under 14/CP.7; implementation of a quantitative tier 1 uncertainty analysis (except LULUCF); and the use of LULUCF tables in accordance with decision 13/CP.9.

23. Iceland is also addressing the issue of completeness in its reporting of "NE" categories, for example, CO_2 emissions from solvent and other product use, and CH_4 and N_2O from agriculture.

H. Areas for further improvement

1. Identified by the Party

24. Iceland has identified the following areas for improvement: the QA/QC programme; preparation of the national energy balance; improving completeness of reporting and quality of AD; further implementation of IPCC good practice guidance; improving the transparency and consistency of the NIR; estimating actual emissions of HFCs and SF_6; developing a system to identify land areas under LULUCF; improving estimates of forest land area, carbon stock changes and revegetation.

25. Additional improvements under consideration by Iceland include: development of improved methodologies to estimate emissions from road transportation; development of country-specific EFs for enteric fermentation; revision of country-specific nitrogen (N) excretion factors; and revision of LULUCF emission/removal factors, emphasizing key categories; and investigating the use of the application of higher-tier methodologies.

2. Identified by the ERT

26. The ERT identifies the following cross-cutting issues for improvement:

(a) Allocate sufficient resources towards strengthening the institutional arrangements, for example the planning, management and preparation of the inventory, in particular implementing a QA/QC plan consistent with the IPCC good practice guidance, which should be submitted for expert review in Iceland's next inventory submission. Iceland, in accordance with the UNFCCC reporting guidelines, should also include in the NIR descriptions of QA/QC procedures and activities for each sector;

(b) Improve transparency and documentation by including detailed information in the next NIR on procedural and institutional arrangements, that is, the roles and responsibilities of organizations involved in inventory planning, preparation, management and approval; and providing, in particular for key categories, complete documentation on AD, recalculations, EFs, and selected methods. Iceland should also improve the documentation of expert judgments and references to literature sources;

(c) Improve the inventory by: including the LULUCF sector in the key category analysis; ensuring time series consistency (e.g. LULUCF); and developing and implementing higher-tier methods;

(d) Improve completeness by addressing the calculation of categories currently reported as "NE" by estimating the missing emissions when AD or methodologies are available, and by ensuring complete transfer of data to the CRF Reporter software;

(e) Improve accuracy in future inventory submissions through the use of higher-tier methods for the estimation of key categories in line with the recommendations of the IPCC good practice guidance, subject to the availability of data and resources;

(f) Improve uncertainty analysis through providing more details on the rationale for the selection of uncertainty levels, and the documentation of expert judgment in its next submission. In addition, Iceland is also encouraged to use a tier 2 method uncertainty analysis in its future submissions.

27. Recommended improvements relating to specific source/sink categories are presented in the relevant sector sections of this report.

II. Energy

A. Sector overview

28. In 2004, the energy sector in Iceland accounted for 56.0 per cent (2081.27 Gg CO_2 eq.) of total national GHG emissions. Liquid fuels used in fishing under other sectors (1.A.4.c) and road transportation (1.A.3.b) were the largest categories, contributing, 34.6 and 32.0 per cent, respectively to the total GHG emissions from the energy sector. CO_2 emissions from geothermal extraction contributed 6.0 per cent and increased by 86.2 per cent between 1990 and 2004. Emissions from energy industries were a minor source because of Iceland's high share of renewable energy sources.

29. The reporting of the energy sector in the NIR is generally complete, accurate, comparable and consistent throughout the time series. The Environment and Food Agency (EFA) prepares the emissions inventory for the energy sector based on AD on fuel use by sector, and emissions from geothermal power provided by the National Energy Authority (NEA). The ERT, however, noted completeness issues in the CRF tables. Some of the cells in the CRF tables are not filled in, for example 1.A(a). The ERT, however, acknowledges the efforts being made by Iceland to generate AD in the form of a national energy balance in its future submissions, and recommends that Iceland strengthen the progress being made in this area.

30. The ERT noted that estimates of CO_2, CH_4 and N_2O from food processing, beverages and tobacco – biomass (1.A.2.e), and CO_2 and CH_4 emissions from the distribution of oil products (1.B.2.a.v) are reported as "NE" from 1990–2004. During the in-country review the ERT recommended that Iceland estimate these categories. Iceland informed the ERT that according to the Icelandic Association of Fishmeal Manufacturers there was minor usage of fish oil in the fishmeal industry during the period 1991–2003. For transparency it is recommended that Iceland provide further explanations in this category in its next NIR. Iceland also informed the ERT that emissions from distribution of oil products would be estimated in the future. The ERT encourages Iceland to provide estimates in its next inventory submission for all categories in the energy sector where emissions occur in the country, even if they are minor, by using simple but reasonable approaches, utilizing expert judgment as necessary. If this is not possible, then the Party must use the appropriate notation key and explain the use of the notation key in CRF table 9(a).

31. The ERT also recommends that Iceland improve the transparency of the energy sector by improving the documentation on methodologies, AD and EFs, particularly for the key categories in both the NIR and CRF tables, for example, CO_2 emissions from the extraction of geothermal energy, international bunker fuels (fuel allocation), road transporation (the allocation of vehicle type by fuel type, i.e., diesel and gasoline), liquid fuels (iron and steel), and allocation of fuel (liquid) between the energy industries sector and the residential sector.

32. The ERT acknowledges the improvements made by Iceland as a result of the recommendations arising from the previous reviews, such as inclusion of estimates of N_2O and CH_4 emissions from fuel combustion, and that the Party is planning to improve its methodologies for estimating emissions from road transportation. However, the ERT recommends that Iceland provide AD in the form of a national energy balance in its future submissions and that it develop and implement a QA/QC plan for the key categories in the energy sector.

B. Reference and sectoral approaches

1. Comparison of the reference approach with the sectoral approach and international statistics

33. Apparent fuel consumption in Iceland's reference approach for 2004 corresponds to the International Energy Agency (IEA) data. For all years except 1990 and 1996 the difference is within 3 per cent in apparent fuel consumption between the reference approach and the IEA data, and specifically 2 per cent for 2004.

34. Iceland has calculated CO_2 emissions from fuel combustion using the IPCC reference approach and the sectoral approach for all years of the time series. For 2004, there is a difference of 0.16 per cent in the CO_2 emissions estimates from fuel consumption between the reference approach and the sectoral approach, which is within the threshold defined by the *Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (hereinafter referred to as the Revised 1996 IPCC Guidelines). The ERT noted that in the absence of an energy balance, the difference in the two approaches could not be verified. The ERT reiterates the recommendation from the previous (2005) review and recommends that Iceland continue to progress the work of preparing the energy balance.

2. International bunker fuels

35. Fuel consumption in international aviation and international marine bunkers corresponds to the IEA data for most years. However, for international aviation, jet kerosene quantities reported in the CRF for both 1991and 1995 are 10 per cent higher with respect to the corresponding data reported by the IEA. For international marine bunkers, the quantity of gas/diesel oil reported in the CRF tables by Iceland in 2003 is 16 per cent lower than that reported by the IEA. The ERT reiterates the previous (2005) review recommendation that the split in fuel consumption data between domestic and international bunkers for

both marine and aviation purposes needs to be documented in the NIR. This allocation should be compiled using the definitions given in the Revised 1996 IPCC Guidelines and the IPCC good practice guidance.

3. Feedstocks and non-energy use of fuels

36. As identified in the previous (2005) review the ERT considers that the methodologies for estimating the quantity of fuel used and the CO_2 emissions from feedstocks in the 2006 inventory submission are still not transparent. The ERT recommends that Iceland improve documentation of the methods used for estimating CO_2 emissions from feedstocks in the NIR.

C. Key categories

1. Manufacturing industries and construction − solid fuels – CO_2

37. The trend of CO_2 emissions due to coal combustion in the cement industry makes it a key category, therefore the determination of the national calorific value (NCV) used for coal is a critical factor. Iceland, in its 2006 submission, has used an EF for CO_2 of 2.6 t CO_2/t coking coal for the entire time series, which corresponds to an NCV of 28.05 TJ/kt of coking coal. The IPCC good practice guidance recommends an NCV of 29.01 TJ/kt for Iceland. The ERT reiterates the recommendation of the previous (2005) review, that Iceland in its next submission identify the source of coal used in the cement plant and give details of the NCV of that coal to justify the CO_2 implied emission factor (IEF).

2. Manufacturing industries and construction – liquid fuels – CO_2

38. The ERT could not assess from the NIR whether Iceland has considered the types and characteristics of construction equipment under other (1.A.2.f), including the EFs used, based on the allocation between road and off-road construction machinery. The ERT recommends that Iceland make this assessment and document it in its next inventory submission.

3. Other – liquid fuels – CO_2

39. CO_2 emissions from combustion of liquid fuels – other (1.A.5) increased by 13,106.7 per cent from 1990–2004. The ERT acknowledged that the significant increase in GHG emissions from the category other (1.A.5), is likely to be the result of inaccurate reporting from the oil companies or the lack of a national energy balance. The ERT encourages Iceland to make efforts for the appropriate allocation of liquid oil consumption to the categories energy industries, manufacturing industries and construction, transport, other sectors, and other, and to reflect this in its next inventory submission.

4. Transport – liquid fuels – CO_2 and N_2O

40. The assumptions used by Iceland on the distribution of gasoline consumption across the different types of vehicles are not clearly explained in the NIR, including the assumption that the number of diesel-driven vehicles remains constant between 1990 and 2004. The ERT recommends that Iceland clearly document the assumptions made for distributing the vehicle fleet under the different categories, taking into account the number/category/age of vehicles, type and quantity of fuel consumed and engine technologies.

D. Non-key categories

1. Manufacturing industries and construction – liquid fuels – CO_2

41. The ERT notes that the consumption of liquid fuel used in the manufacturing of iron and steel is not reported for the years 1990 and 1991 and that notation keys have not been used. In the previous

review (2005) the ERT recommended that Iceland use notation keys as appropriate. The ERT reiterates this recommendation. In addition, the ERT recommends, for completeness, that the quantity of biomass (wood) used as a reducing agent for manufacturing ferrosilicon should be reported in worksheet 1A(b) of the CRF tables.

2. Energy industries – other, biomass – CO_2

42. CO_2 emissions from waste incineration and from energy recovered from waste are reported in 1.A.1.a of the CRF. The CO_2 EF is applied to the total quantity of waste, which may also contain biomass. The ERT recommends that the Party detail the composition of the waste in its next NIR so that a distinction can be made between biogenic and non-biogenic waste.

3. Navigation – liquid fuels – CO_2, CH_4 and N_2O

43. The ERT notes that in the 2006 inventory submission there is no distinction between refueling of fishing vessels in and outside the national territory. Any refueling outside the national territory should be reported separately under marine bunkers. As identified in the previous (2005) review, the ERT encourages Iceland to address such reporting, while developing a QA/QC plan, and to improve reporting on navigation fuel use when a national energy balance becomes available.

44. The IEA reports a 80TJ consumption of residual oil (residual fuel oil) in navigation in Iceland in 2003, although this is not reported in the corresponding CRF (category 1A.3.d in table 1.A(a)). The ERT recommends that Iceland investigate the reasons for not providing data corresponding to this category.

4. Fugitive emissions from oil, natural gas and other sources – oil – CO_2 and CH_4

45. The ERT noted that AD, IEFs and CO_2 and CH_4 emissions from the distribution of oil products are reported as "NE". While this is not likely to be a significant source, the ERT encourages Iceland to estimate these emissions.

46. CO_2 emissions, from geothermal energy extraction have increased by 86.2 per cent from 66.6 Gg in 1990 to 124.1 Gg in 2004 and are a key category, as indicated in the trend assessment for 1990 and 2004 . As CO_2 emissions from geothermal extraction are fugitive in nature, during the in-country review the ERT recommended that Iceland reallocate CO_2 emissions from geothermal extraction from sector 7 – other, to sector 1 – fugitive emissions from oil, natural gas and other sources – other (1.B.2.d). Following the review and in response to the ERT recommendations Iceland reallocated CO_2 emissions from geothermal energy extraction to the category fugitive emissions from oil, natural gas and other sources – other.

47. The ERT recommends that in its next submission Iceland include more details in the NIR about CO_2 emissions from geothermal energy, such as the number of and location and production capacity of geothermal power plants, parameters influencing CO_2 emission, CO_2 flux measurement details such as methodology, trends of diurnal, seasonal and annual flux, and the methodology for estimating CO_2 emission on an annual scale.

III. Industrial processes and solvent and other product use

A. Sector overview

48. In 2004, the industrial processes sector amounted to 949.33 Gg CO_2 eq. The contribution of industrial processes to national GHG emissions was 25.5 per cent and solvent and other product use accounted for 0.3 per cent. Between 1990 and 2004, emissions from the sector have increased by 9.5 per cent. The main category within the industrial processes sector is metal production, accounting for

87.9 per cent of the sector's emissions. CO_2 emissions from metal production (the production of aluminium, and ferroalloys) accounted for 42.9 per cent and 40.8 per cent respectively of the total GHG emissions for the industrial processes sector in 2004, while PFCs from metal production contributed 4.1 per cent to the sector total. Due to improved technology and process control total PFC emissions decreased by 90.8 per cent during the period 1990–2004.

49. No actual emissions estimates of HFCs and SF_6 were provided by Iceland. Estimates of potential SF_6 emissions are held constant over the whole time series. Iceland indicates that insufficient data are available to estimate actual emissions of SF_6. Potential emissions of HFCs are estimated based on imports. The ERT encourages Iceland to estimate actual emissions of SF_6 and halocarbons for its next inventory submission and/or to prepare a plan for data collection.

50. The transparency of the inventory compared to previous submissions has improved, although transparency is still not sufficient. The ERT recommends that Iceland include in the NIR thorough and complete information about key categories, including information on the methodologies used in estimating process emissions. Iceland is also encouraged to provide information on non-key categories.

51. In the 2006 GHG inventory submission, CO_2 emissions from the sector solvent and other product use (3.A–D) are reported as "NE". During the in-country review the ERT recommended that Iceland estimate CO_2 emissions from this sector in the same manner as non-methane volatile organic compounds (NMVOC) emissions are estimated. In response, Iceland provided estimates for CO_2 emissions of 6.91Gg CO_2 eq.

52. In response to the previous (2005) review recommendations, Iceland has reported industrial process emissions that may fall under decision 14/CP.7. The ERT commends Iceland for the inclusion of these emissions. The ERT recommends that Iceland continue to report emissions that may fall under decision 14/CP.7 in its annual inventory, including detailing the emission factors, total process emissions from these projects, and an estimate of the emission savings resulting from the use of renewable energy in these projects in their annual inventory submissions.

53. Iceland has reported NMVOC emissions from solvent and other product use, however CO_2 emissions are reported as "NE". During the in-country review the ERT recommended that Iceland estimate CO_2 emissions from the following categories: CO_2 from paint application (3.A); degreasing and dry cleaning (3.B); chemical products, manufacture and processing (3.C); and other (3.D). In response to this recommendation, Iceland submitted to the ERT revised estimates for CO_2 emissions from solvent and other product use. The result of this revision of estimates increased total sectoral emissions in 2004 from 3.41 Gg CO_2 eq. to 10.32 Gg CO_2 eq. The ERT recommends that Iceland report on these categories in its future inventory submissions.

B. Key categories

1. Aluminium production – CO_2

54. Iceland estimates CO_2 emissions using the IPCC tier 1 method based on the quantity of electrodes used in the process and EFs from the Revised 1996 IPCC Guidelines. Iceland collects data on consumption of carbon cathode electrodes directly from industry. The ERT recommends that Iceland use a higher-tier method in line with the IPCC good practice guidance. It also recommends that the Party provide in its next inventory submission more transparent and complete information by including a description of processes and all relevant information used in the emission calculation.

2. Aluminium production – PFCs

55. EFs are calculated according to the tier 2 slope method. The default coefficients are taken from the IPCC good practice guidance using the Centre Worked Prebaked Technology (CWPB); 0.14 for CF_4 and 0.018 for C_2F_6. To improve transparency Iceland is encouraged to provide more information on the aluminium production process in its next inventory by including the AD and anode effect data.

3. Ferroalloys production – CO_2

56. CO_2 emissions from ferroalloys production (2.C.2) are calculated according to the IPCC tier 1 method, which is based on the consumption of reducing agents, such as coal, coke and carbon electrodes. CO_2 EFs are based on the carbon content of the reducing agents and electrodes. EFs are taken from the Revised 1996 IPCC Guidelines and values for NCV are provided by the NEA. The EFA directly collects data on the consumption of coal and coke as reducing agents, and carbon electrodes from the single operating ferroalloy production plant. The ERT recommends that Iceland introduce a tier 2 approach and provide more details on ferroalloys production in its next inventory submission.

57. During the in-country visit the ERT was provided with the information that Iceland uses charcoal in the production of ferroalloys but this was not reported in the CRF tables. The ERT recommends that Iceland report emissions from charcoal used in the production of ferroalloys under the energy sector in its next inventory submission.

4. Cement production – CO_2

58. Iceland uses a tier 2 method. AD are plant-specific data and are collected on clinker production, the calcium oxide (CaO) content of clinker (63 per cent) and cement kiln dust (7.5 per cent) are obtained from the cement production plant. The corrected EF for CO_2 from clinker production is 0.495 instead of the previously used EF 0.4402 t CO_2 per tonne of cement. Data on clinker production is only available for the years 2003 and 2004. Historical clinker production data is calculated as 85 per cent of cement production, according to the IPCC good practice guidance. The ERT recommends that more transparent and complete information be provided in the NIR, including a methodological description and all relevant information used in the calculation of the process emissions.

IV. Agriculture

A. Sector overview

59. In 2004, emissions from the agriculture sector accounted for 13.5 per cent of total national GHG emissions, or 503.55 Gg of CO_2 eq. In 2004, excluding GHG emissions from LULUCF, CH_4 emissions from agriculture accounted for 59.9 per cent of total national CH_4 emissions and N_2O emissions for 76.5 per cent of total national N_2O emissions. Between 1990 and 2004, emissions from the sector decreased by 12.5 per cent reflecting falling dairy cattle and sheep populations and reductions in synthetic fertilizer use in this period. Between 2003 and 2004, estimated emissions from agriculture increased by 2.3 per cent due to increased emissions of N_2O from synthetic fertilizer use in agricultural soils.

60. Iceland's agricultural inventory is generally complete, however, during the in-country review the ERT recommended that Iceland submit revised estimates for previously "NE" categories, including: CH_4 from enteric fermentation – other – fur animals (4.A.10); CH_4 and N_2O from manure management – other – livestock – fur animals (4.B.10); and N_2O emissions arising from animal manures under agricultural soils (4.D.1.2, 4.D.3.1 and 4.D.3.2). During the course of the review, Iceland provided revised estimates for these categories. The result of this revision of estimates increased total sector emissions in 2004 from

500.40 Gg of CO_2 eq. to 503.55 Gg of CO_2 eq., an increase of 0.63 per cent. The ERT recommends that Iceland report on these categories in its future inventory submissions.

61. To improve transparency the ERT recommends that Iceland include a livestock and crop characterization in its next submission. Improvements in documentation in the NIR in the agriculture sector are welcomed by the ERT, in particular for manure management. However, the ERT encourages Iceland in its next submission to provide more information on methodological choices for enteric fermentation, manure management and agricultural soils.

62. Iceland has identified three key categories from agriculture: CH_4 from enteric fermentation, N_2O from direct agricultural soils and N_2O from indirect agricultural soils. The ERT notes that Iceland includes N_2O emissions from pasture, range and paddock under the category 4.D.1 in its key category analysis. The ERT recommends that Iceland further disaggregate the categories of direct soil emissions (4.D.1) and pasture range and paddock (4.D.2) in its future key category analyses**.**

B. Key categories

1. Enteric fermentation – CH_4

63. Iceland estimates CH_4 emissions from this key category using an IPCC tier 1 method and Western European default EFs. The ERT notes that Iceland plans to develop a tier 2 method. The ERT reiterates the recommendation from the previous review (2005) that Iceland develop a tier 2 method for key species, in particular dairy cattle and sheep, for future submissions, and to assess the applicability of Western European default EFs for native Icelandic livestock species. During the in-country review Iceland provided estimates for the previously "NE" category, CH_4 from enteric fermentation – other – fur animals (4.A.10). The ERT recommends that Iceland report on these categories in its next inventory submission.

2. Direct emissions from agricultural soils – N_2O

64. Iceland uses a tier 1b methodology and IPCC default emission factors to estimate emissions from this key category. The ERT recommends that Iceland include synthetic fertilizer data in future submissions and elaborate on the choice of methodology used. The ERT encourages Iceland to improve on the transparency of reporting by providing the appropriate IPCC good practice guidance equations used and providing an N balance in its next NIR.

65. The ERT recommends that Iceland assess the appropriateness of the default fraction of synthetic N fertilizer applied to soils that volatilizes as NH_3 and NO_X ($Frac_{GASF}$) used in its emissions estimates, and develop a country-specific value based on the type of synthetic fertilizer used in Iceland. In addition the ERT requests Iceland to provide AD in CRF table 4.D for N inputs for crop residues (category 4.D1.4) and to elaborate on the methodology used in its next NIR.

66. During the in-country review Iceland provided estimates of previously "NE" categories for agricultural soils – direct emissions – animal manure applied to soils (4.D.1.2). The ERT recommends that Iceland report on this category in its next submission.

3. Indirect emissions from agricultural soils – N_2O

67. Iceland uses a tier 1 method with IPCC default EFs and volatilization rates to estimate emissions from the following indirect sources: atmospheric deposition, leaching and run-off. The ERT recommends that Iceland provide an N balance to show inputs from volatilized N sources and the choice of equations used from the IPCC good practice guidance in future submissions to improve transparency.

68. During the in-country review Iceland provided estimates for previously "NE" categories for agricultural soils – indirect emissions – atmospheric deposition (4.D.3.1) and agricultural soils – indirect emissions – N leaching (4.D.3.2). The ERT recommends that Iceland report on these categories in its next submission.

C. Non-key categories

Manure management – CH_4 and N_2O

69. Iceland estimates emissions of CH_4 from manure management using an IPCC tier 1 method and emissions factors from the IPCC Guidelines for the Western European cool climate region. Iceland reports in its NIR that these factors may be overstated for native Icelandic livestock, in particular, sheep and horses. The ERT recommends that Iceland further assess the appropriateness of these factors in future submissions by undertaking national research in this area, subject to the availability of resources. The ERT recommends that Iceland report percentages of allocations of manure in CRF table 4.B in its next inventory submission.

70. During the in-country review Iceland provided estimates for previously "NE" categories including CH_4 emissions and N_2O emissions from manure management, the estimation of CH_4 emissions – other livestock (4.B.10) – fur animals; and N_2O from manure management – other livestock (4.B.10) – fur animals. The ERT recommends that Iceland report on these categories in its next inventory submission.

V. Land use, land-use change and forestry

A. Sector overview

71. In 2004, the LULUCF sector was the second largest source of emissions in Iceland (1,851.24 Gg CO_2 eq.). Net CO_2 eq. emissions decreased by 11.6 per cent between 1990 and 2004. The most significant source of emissions is from grasslands (1,815.00 Gg CO_2), which contributed 98.0 per cent to net emissions from the LULUCF sector. Iceland also reported emissions and removals from land under revegetation. While the reporting of such information is acknowledged by the ERT, it is not necessary under the UNFCCC reporting guidelines.

72. The ERT acknowledges that Iceland for the first time has reported the LULUCF sector using the revised CRF tables, as agreed in decision 13/CP.9. Recalculations have been performed for all years (1990–2003). In addition to forest land, emissions estimates for the categories cropland (5.B), grassland (5.C), wetland (5.D) and other (5.G) are reported.

73. The 2006 GHG inventory is generally transparent, however data for the complete time series are only available for forest land (5.A), therefore an assessment by the ERT of the sectoral trends was not possible. The ERT recommends that Iceland improve time series consistency in the estimation of GHG emissions from the LULUCF sector by providing a full time series for the categories cropland (5.B), grassland, (5.C), wetland (5.D) and other lands (5.F) in its next inventory submission.

74. Iceland has not, however, included the LULUCF sector in the key category assessment for the whole inventory. There are neither QA/QC procedures nor a quantitative uncertainty estimation for the sector (only a qualitative assessment of the possible uncertainties). The ERT encourages Iceland to move from a tier 1 to a tier 2 methodology for the key categories and to develop country-specific EFs.

75. Uncertainties (i.e. qualitative) appear high. A contributing factor to such levels of uncertainty is that land use and land-use change categories have not yet been defined, reported and documented according to the *IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry*

(hereinafter referred to as the IPCC good practice guidance for LULUCF). During the in-country review the ERT recommended that Iceland define all LULUCF categories considering relevant sections of the IPCC good practice guidance for LULUCF to ensure accurate and consistent identification of land areas. In addition to land cover characteristics the definition should also include country-specific information on the length of time land remains in a converted land-use category.

76. During the in-country review Iceland informed the ERT that the development of a countrywide land use and land-use change database to map land uses and define land-use changes is under way. The ERT recommends that Iceland develop country-specific EFs for the key category grassland. The ERT also recommends that in future submissions Iceland include relevant details of land-use statistics, forest and land management activities, and forest inventory information such as area, volume and harvest statistics in an annex to its NIR or on a public website.

B. Key categories

1. Forest land – CO_2

77. Iceland reports that afforestation has taken place since 1990. However, neither AD nor the applied removal factors are sufficiently transparent to assess their quality and associated uncertainties. For example, Iceland applies a country-average CO_2 removal factor, however, tree growth is highly dependent on species, site and age. The ERT noted that that the new forest inventory under preparation by Iceland is expected to provide verified country-specific CO_2 removal factors, and also information on any harvesting activities, wildfires or biomass burning. The ERT recommends that Iceland provide more detailed and transparent information on the AD, that is, changes to forest land, (5.A.2) and develop country-specific removal factors to be used for estimating emissions and removals from afforestation and reforestation activities.

2. Grassland remaining grassland – CO_2

78. Emissions from drained peatland are included under this grassland sub-category. However, as these areas are peatland, the ERT recommends that emissions from this activity be reported under the category wetlands (5.D).

79. CO_2 emissions from drained peatland are the highest single source of emissions in the LULUCF sector in Iceland, therefore the accurate estimation of CO_2 emissions from this source is a key issue. With regard to AD, the ERT recommends that a detailed description of how land is categorised as drained peatland and how data is obtained should be provided by Iceland in its next inventory submission.

80. The EF used by Iceland for drained peatland is the IPCC default value from the IPCC good practice guidance for LULUCF. The ERT considers the application of this EF to be justifiable. Iceland is encouraged to develop country-specific EFs, preferably addressing any within-country variation, which could affect CO_2 emissions estimates from this key category. This also applies to the non-CO_2 emissions estimated for organic soils, a sub-category.

3. Wetlands remaining wetlands – CO_2

81. CO_2 emissions from wetlands (5.D) are only estimated for reservoirs. CO_2 emissions are estimated according to the tier 1 method using default EFs. As emissions of CO_2 from reservoirs are identified by the secretariat as a key category by level assessment in LULUCF the ERT recommends using a tier 2 methodology, that is, that Iceland develop and apply country-specific EFs.

VI. Waste

A. Sector overview

82. In 2004, GHG emissions from the waste sector accounted for 4.6 per cent of Iceland's total GHG emissions, or 172.38 CO_2 eq. Between 1990 and 2004 sectoral emissions increased by 22.2 per cent, which is primarily due to the growth in CH_4 emissions from solid waste disposal on land (6.A). CH_4 emissions from solid waste disposal on land are the largest source of emissions in this sector, accounting for 91.1 per cent of total waste emissions in 2004.

83. Most of the AD for the waste sector are collected by the EFA. Secondary sources include municipalities and large waste companies in Iceland. The ERT acknowledges that Iceland, as recommend in the previous (2005) review, has applied a tier 2 method (i.e. first-order decay (FOD)) in estimating CH_4 emission from solid waste disposal on land. Recalculations have been performed due to the use of this new tier 2 method for estimating CH_4 emissions from solid waste disposal on land. The impact on 2003 was a decrease of 28.1 per cent.

84. Reporting in the waste sector is generally complete and accurate, and the time series is consistent. Iceland does not, however, report emissions from industrial wastewater handling (6.B.1). The ERT recommends that Iceland compile AD and provide estimates of emissions for this category from industrial facilities in its future submissions.

85. The transparency of estimates from the waste sector has improved because of the inclusion of descriptions of methods, assumptions and data sources on this sector in the NIR. For its next submission the ERT recommends that Iceland provide in the NIR more detailed references and descriptions for the FOD method and gross domestic product (GDP) driver-based method, as well as management practices used for CH_4 emissions from solid waste disposal on land.

86. QA/QC procedures have not been performed for the waste sector. Iceland is recommended to elaborate and implement QA/QC procedures in its next submission.

87. The ERT notes that Iceland has provided an uncertainty estimate for waste for the first time using a tier 1 approach. The ERT recommends that Iceland discuss the uncertainty estimates for EFs and AD in the table (Annex II in the NIR) and provide references and/or expert judgement for justification of these estimates.

B. Key categories

Solid waste disposal on land – CH_4

88. The ERT welcomes the improvements Iceland has made by moving to a tier 2 method (IPCC FOD method) as recommended in the previous (2005) review and providing different default parameters according to the composition and management practices for solid waste disposal on land (SWDL). Iceland provides detailed data for generated municipal and industrial landfill waste and its composition for 1999–2004, although no description of SWDL management practices are available in Iceland. The ERT encourages Iceland to use country-specific EFs (which rely on expert judgement), rather than using IPCC default EFs. The country-specific EFs should reflect national conditions (temperature, humidity, dry/wet waste, management practice) and should be comparable to other countries with similar conditions.

89. Iceland has recalculated AD for the whole time series using actual data from 1995 to 2004, and interpolated data for 1950 to 1994 using a GDP-based method. The ERT recommends that Iceland compare the interpolated data with corresponding data from different data sources such as statistical services in the country, international databases and other countries with similar GDPs and conditions.

90. Due to the use of the new tier 2 method the CH_4 emissions estimates from this key category were recalculated. The NIR provides data on the emissions before and after recalculations and the differences between them. The recalculations lowered CH_4 emissions estimates across the whole time series. The ERT noted large interannual fluctuations in the CH_4 IEF and encourages Iceland to check these recalculations and the CH_4 recovery rates in its next submission.

C. Non-key categories

1. Waste incineration – CO_2

91. The trend of CO_2 emissions from waste incineration shows a considerable decrease (– 87.0 per cent) from 1990 to 2004. Iceland identifies this decrease in waste incineration as being caused by intensified waste recycling with energy recovery. CO_2 emissions are estimated using the IPCC method with default EF values, with actual amounts of incinerated waste provided from the only existing incineration plant in Iceland. The assessment of this category requires improvement. The ERT reiterates the recommendation of the previous (2005) review, that Iceland derive its own EFs rather than using the IPCC default values in its estimation of incineration-related CO_2 emissions.

92. A suggested approach could be to identify the percentage of solid waste composition per capita. This approach could also be used for identification of the amount of biogenic and non-biogenic waste incinerated. The ERT recommends that Iceland attempt to derive country-specific EFs, taking into consideration the moisture content of the incinerated waste, and note all additional information in the CRF documentation box.

2. Wastewater handling – CH4, N_2O

93. The ERT welcomes the estimates made by Iceland for the first time with regard to wastewater handling (6.B). CH_4 emissions are estimated from domestic and commercial wastewater (6.B.2). The estimates of CH_4 emissions do not show significant changes throughout the time series as CH_4 emissions are estimated using the IPCC "check" method. The EFs are IPCC default and AD are based on the population connected to the wastewater collection system. CH_4 emissions calculated by this method may, however, be overestimated for all years, as the parameter (FTA[3]) considers the presence of sludge in wastewater. Sludge, however, is considered to be landfill and estimated in solid waste disposal on land (6.A).

94. The ERT recommends that Iceland improve the assessment of this category by collecting AD from wastewater treatment facilities and municipalities and using the IPCC method with the country-specific data according to the decision trees, as recommended by the IPCC good practice guidance, to estimate CH_4 emissions (for example figures 5.2 and 5.3, IPCC good practice guidance).

95. Iceland estimates N_2O for human sewage using the IPCC default EFs and a country-specific protein intake value. The ERT recommends that Iceland provide supporting references for country-specific data on protein intake.

VII. Conclusions and recommendations

96. Iceland's 2006 GHG inventory is complete in terms of years and geographical coverage, and is fairly complete in terms of the coverage of categories and gases. With respect to the UNFCCC reporting guidelines, the inventory is generally accurate and transparent and broadly consistent with the Revised 1996 IPCC Guidelines and the IPCC good practice guidance.

[3] FTA: the fraction of biochemical oxygen demand in sludge which degrades anaerobically.

97. Iceland has made improvements since last year's inventory submission (2005), in particular the inclusion of CO_2 emissions that may fall under decision 14/CP.7, such as emissions from plants in the ferroalloy and aluminium industries, under the industrial processes sector. Iceland is also strengthening its institutional and procedural arrangements for the preparation and national review and approval of its inventory, including developing its QA/QC programme.

98. During the course of the review, the ERT formulated a number of recommendations relating to the accuracy, transparency and completeness of Iceland's 2006 GHG inventory submission. Many of these recommendations were implemented during the course of the review. The key recommendations[4] are that Iceland should:

(a) Implement the QA/QC plan and procedures, and further develop the plan in accordance with the IPCC good practice guidance. The ERT recommends that this plan be submitted in its next inventory submission for expert review. Furthermore, Iceland should include descriptions of QA/QC procedures and activities in each sector section of the NIR in accordance with the UNFCCC reporting guidelines;

(b) Provide in its next NIR detailed information on the institutional arrangements underpinning the planning, preparation and management of the inventory, including descriptions of the specific roles and responsibilities of the relevant organizations. Iceland should also provide information on the coordinating team in its next inventory submission, including agency representation and the mandate of the coordinating team; and any other improvements implemented as a result of this review report;

(c) Allocate sufficient resources to inventory planning and preparation , including expertise to develop and implement higher-tier methods for the general improvement and QC of the inventory;

(d) Archive all key information for the preparation, planning and management of the national inventory at a single location and nominate an archive manager who has exclusive access and administrative rights. In addition, it should prepare a procedural manual for the management and maintenance of the archiving system. Information on the archiving system should be included in its next submission;

(e) Improve completeness by addressing the categories currently reported as "NE" by estimating the missing emissions when AD or methodologies are available;

(f) Improve the transparency of estimates by providing more precise descriptions and documentation of methods and more detailed information about AD and EF recalculations, particularly for all key categories, in its next NIR. In addition, the ERT also recommends that Iceland improve the documentation of expert judgements and references to literature sources;

(g) Improve the inventory by: including LULUCF in the key category analysis; ensuring time series consistency (e.g. in the LULUCF sector); enhancing transparency (methods and EFs) and completeness of the inventory; and improving uncertainty analysis in its next submission.

[4] For a complete list of recommendations the relevant sections of this report should be consulted.

Annex

Documents and information used during the review

A. Reference documents

IPCC. Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, 2000. Available at: <http://www.ipcc-nggip.iges.or.jp/public/gp/english/>.

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B. Additional information provided by the Party

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Iceland's response to the ERT on the Draft Initial Review Report-Report of the review of the initial

report of Iceland. Version 16 November for comments by Party, 13 December 2007.

Iceland's QA/QC plan, December 2007.

International Energy Agency, IEA statistics, <http://www.iea.org/Textbase/stats/index.asp>.

Mandate of the coordinating team, 2007 (in English).

Ministry for the Environment, Office of Sustainable Development and International Affairs Skuggasund, Reykjavik, Iceland, 3 August 2007. Iceland's response to "Potential problems and further questions" from the ERT formulated in the course of the 2007 in-country review of Iceland's initial report under the Kyoto Protocol and 2006 inventory Submission.

The Farmers' Association of Iceland in cooperation with the Agricultural Genetic Resources Committee and the Nordic Gene Bank for Domestic Animals, Reykjavik 2004. Icelandic Livestock Breeds.

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