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**Report for the Stage 3 in-depth review of emission
inventories submitted under the UNECE LRTAP
Convention and EU National Emissions Ceilings
Directive for:**

LIECHTENSTEIN

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INTRODUCTION

1. The mandate and overall objectives for the emission inventory review process under the LRTAP Convention is given by the UNECE document '*Methods and Procedures for the Technical Review of Air Pollutant Emission Inventories reported under the Convention and its Protocols*' ⁽¹⁾ – hereafter referred to as the 'Methods and Procedures' document.
2. This annual review has concentrated on SO₂, NO_x, NMVOC, NH₃, plus PM₁₀ & PM_{2.5} and POPs for the time series years 1990 – 2010 reflecting current priorities from the EMEP Steering Body and the Task Force on Emission Inventories and Projections (TFEIP). HMs have been reviewed where possible.
3. This report covers the stage 3 centralised reviews of the UNECE LRTAP Convention and EU NEC Directive inventories of Liechtenstein coordinated by the EMEP emission centre CEIP acting as review secretariat. The review took place from 25th June 2012 to 29th June 2012 in Copenhagen, Denmark, and was hosted by the European Environment Agency (EEA). The following team of nominated experts from the roster of experts performed the review: Generalist – Pieter Lodewijks (EU/VITO), Energy – Ricardo Fernandez (EU/EEA), Transport – Helen Heintalu (Estonia), Industry - Julien Jabot (France), Solvents – David Kuntze (Germany), Agriculture + Nature – Hakam Al-Hanbali (Sweden), Waste – Intars Cakaras (Latvia).
4. Anne Misra was the lead reviewer. The review was coordinated by Katarina Marečková, (EMEP Centre on Emission Inventories and Projections - CEIP).

¹ Methods and Procedures for the Technical Review of Air Pollutant Emission Inventories reported under the Convention and its Protocols. Note from the Task Force on Emission Inventories and Projections. ECE/EB.AIR/GE.1/2007/16 <http://www.unece.org/env/documents/2007/eb/ge1/ece.eb.air.ge.1.2007.16.e.pdf>

PART A: KEY REVIEW FINDINGS

5. This is Liechtenstein's first Informative Inventory Report (IIR) submitted under the Convention. The ERT is pleased to see the progress and the effort that has gone into the submission of the IIR.
6. The ERT is highly in favour of the streamlined approach of involving the same people working on the IIR and the NIR simultaneously.

INVENTORY SUBMISSION

7. The inventory is partly in line with the EMEP EEA inventory guidebook and UNECE Reporting Guidelines.
8. The ERT highly recommends that the Party reports emissions in NFR09 categories, not NFR02.
9. Liechtenstein submitted emissions for the years 1985 to 2010.
10. The Party reports emissions for the pollutants NO_x, CO, NMVOC, SO_x, NH₃ and PM₁₀.

Further improvements identified during this review are presented in part B of this report.

KEY CATEGORIES

11. Liechtenstein's IIR contains a level Key Category Analysis (KCA) and a Trend Assessment consistent with the EMEP/EEA Guidebook for the pollutants NO_x, CO, NMVOC, SO_x, NH₃ and PM₁₀. The ERT encourages Liechtenstein to present the key sources also for the other pollutants.
12. The ERT recommends that the NFR categories should not be aggregated to perform the Key Category Analysis and the Trend Assessment.
13. The ERT would like to point out that Tier 2 or 3 methodologies should be applied to all sources identified as key categories. While higher tier methodologies are already used for some of the key sources, these methodologies should also be adopted for NFR codes 3A and 3C.

QUALITY

Transparency

14. The ERT recognises the level of effort undertaken by Liechtenstein to provide an inventory with a significant level of detail to allow a thorough review. The IIR is well presented and contains all required chapters.

15. The ERT encourages the Party to provide more information on assumptions, activity data trends, data sources, emission drivers and the level of methods (tier) used for all sectors in the IIR to improve transparency further.

16. The ERT recommends that the Party uses the latest 2009 EMEP/EEA air pollutant emission inventory guidebook.

17. The transparency of the IIR can be improved by ensuring that the graphs and the text in chapter 2: 'Explanation of Key Trends' are consistent, e.g. in figure 2.1-2 CO emissions from sector 1A4b are increasing while in the text the Party mentions that they are decreasing (see also figure 2.1-12 and figure 2.1-15). In the general section on page 21 the Party states that emissions from waste incineration are allocated to the electricity sector, while in Chapter 8.3 on page 30 it is stated that there are no waste incineration plants in Liechtenstein.

Completeness

18. In the 2012 CLRTAP submission, Liechtenstein provided an inventory for NO_x, CO, NMVOC, SO_x, NH₃, PM (TSP, PM₁₀, PM_{2.5}), dioxins and POPs listed in Annex III in NFR02 categories for the time series from 1985 to 2010.

19. Since Liechtenstein has ratified the Aarhus Protocol on Heavy Metals and on Persistent Organic Pollutants, the ERT encourages the Party to report emissions of heavy metals and POPs listed in Annex I and II in the future for the complete time series.

20. The IIR lists all sources that are not estimated (chapter 1.8) by pollutant category and by using the correct 'notation keys'. Although the ERT acknowledges that the emissions will be small, no information is provided as to whether Liechtenstein plans to report emissions from sources that are 'not available' (NA) in the future.

Consistency, including recalculations and time series

21. As this is the first IIR Liechtenstein has submitted, there is no information on recalculations included. The ERT encourages Liechtenstein to provide detailed information on recalculations in the next IIR submission by pollutant, NFR code and year.

Comparability

22. The inventory of Liechtenstein is in general comparable with those of other reporting parties. The allocation of source categories follows that of the EMEP/EEA Reporting Guidelines but use of the NFR09 categories is highly recommended.

CLRTAP/NECD comparability

23. Liechtenstein, as a non-EU country, does not report emissions under the NEC Directive. Liechtenstein reports the indirect greenhouse gases compiled under the UNFCCC to the CLRTAP. However, these are calculated in line with the UNFCCC Guidelines to comply with the reporting requirements under the UNFCCC. The data

on SO_x, NO_x, NMVOC and CO are consistent between the UNFCCC and the CLRTAP, yet aviation is treated differently in LRTAP and UNFCCC reporting. The ERT encourages Liechtenstein to state if it only includes emissions from national and international landings and take-offs in the national total.

Accuracy and uncertainties

24. Liechtenstein does not currently perform an uncertainty analysis. The ERT encourages the Party to provide quantitative uncertainty estimates of emissions in its next CLRTAP submission, especially for key sources.

Verification and quality assurance/quality control approaches

25. Liechtenstein's IIR lists the institutional arrangements, the inventory preparation process and the QA/QC processes. The Party stated that the QA/QC Plan had been set out for the UNFCCC GHG emissions inventory, but that the main part had also been applied to air pollutants. The ERT encourages Liechtenstein to describe in more detail the QA/QC applicable for air pollutants in the IIR. Furthermore the ERT encourages the Party to provide information on sector-specific information on QA/QC procedures in future submissions.

FOLLOW-UP TO PREVIOUS REVIEWS

26. The current stage 3 centralised review has used outputs from the stage 1 and stage 2 review processes. The ERT encourages Liechtenstein to refer to these previous reviews when examining this review report, and when updating its improvement plans.

AREAS FOR IMPROVEMENTS IDENTIFIED BY LIECHTENSTEIN

27. Liechtenstein does not list any planned improvements in the IIR, but it is stated that future improvements will be discussed on the basis of this review.

28. The ERT recognises the level of effort undertaken by Liechtenstein in providing an inventory to perform a stage 3 review. Any questions issued by the ERT to the Party were addressed promptly and descriptive responses were provided, enabling good communication prior and during the review process.

PART B: RECOMMENDATIONS FOR IMPROVEMENTS TO THE PARTY

CROSS-CUTTING IMPROVEMENTS IDENTIFIED BY THE ERT

29. The ERT recommends that Liechtenstein reports all pollutants under CLRTAP including HMs and all POPs.
30. The ERT highly recommends that the Party updates the categories from NFR02 to NFR09.
31. The ERT would like to point out that Tier 2 or 3 methodologies should be applied to all sources identified as key categories. While higher tier methodologies are already used for some of the key sources, these methodologies should also be adopted for NFR code 3A and 3C.
32. The ERT encourages Liechtenstein to provide uncertainty assessment.
33. The ERT recommends that Liechtenstein provides, for each sector, more information on assumptions, activity data time series, data sources, emission drivers and levels of methods (tiers) used.
34. The ERT recommends that improvements relating to specific source categories are presented in the relevant NFR sector chapters in the IIR.
35. The ERT encourages Liechtenstein to include an improvement plan in the next IIR, and to highlight how the identified improvements are prioritised, taking into account issues with important impacts on the national emission inventory. The improvement plan should also cover information on missing sources and whether there are any plans to include these in the inventory.

SECTOR SPECIFIC RECOMMENDATIONS FOR IMPROVEMENTS IDENTIFIED BY ERT

ENERGY

Review Scope

Pollutants Reviewed		NO _x , CO, NMVOC, SO _x , NH ₃ , TSP, PM ₁₀ , PM _{2.5} , Pb, Cd, Hg, PAHs and dioxin		
Years		1990-2010		
NFR Code	CRF_NFR Name	Reviewed	Not Reviewed	Recommendation Provided
1.A.1.a	public electricity and heat production	X		
1.A.1.b	petroleum refining	NO		
1.A.1.c	Manufacture of solid fuels and other energy industries	NO		
1.A.2.a	iron and steel	NO		
1.A.2.b	non-ferrous metals	NO		
1.A.2.c	chemicals	NO		
1.A.2.d	pulp, paper and print	NO		
1.A.2.e	food processing, beverages and tobacco	X		
1.A.2.f.i	Stationary Combustion in Manufacturing Industries and Construction: Other (Please specify in your IIR)	X		
1.A.2.f.ii	Mobile Combustion in Manufacturing Industries and Construction: (Please specify in your IIR)		X	
1 A 3 e	Pipeline compressors		X	
1.A.4.a.i	commercial / institutional: stationary	X		X
1.A.4.a.ii	commercial / institutional: mobile		X	
1.A.4.b.i	residential plants	X		X
1.A.4.b.ii	household and gardening (mobile)		X	
1.A.4.c.i	Agriculture/forestry/fishing, stationary	X		
1.A.4.c.ii	off-road vehicles and other machinery		X	
1.A.4.c.iii	national fishing	NO		
1.A.5.a	other, stationary (including military)	NO		
1.A.5.b	other, mobile (including military, land-based and recreational boats)		X	
1.B.1.a	coal mining and handling	NO		
1.B.1.b	solid fuel transformation	NO		
1.B.1.c	other fugitive emissions from solid fuels)	NO		
1 B 2 a i	Exploration, production, transport	NO		
1 B 2 a iv	Refining / storage	NO		
1 B 2 a v	Distribution of oil products	X		
1 B 2 b	Natural gas	X		X
1 B 2 c	Venting and flaring	NO		
1 B 3	Other fugitive emissions from geothermal energy production , peat and other energy extraction not included in 1 B 2	NO		

Note: Sectors 1.A.2.f.ii, 1.A.4.a.ii, 1.A.4.b.ii, 1.A.4.c.ii, 1.A.5.b have not been reviewed under Energy as they are Transport sources

General recommendations on cross-cutting issues.

Transparency:

36. The ERT notes that there is a close connection between the preparation of the LRTAP inventory and the preparation of the GHG inventory submitted to the UNFCCC. During the review, the Party confirmed that the same activity data for stationary combustion has been used for reporting under both Conventions. The ERT commends Liechtenstein for this coordinated effort, which ensures consistency between air pollutants reported under LRTAP and GHG emissions reported under UNFCCC.

37. The ERT finds that the transparency of Liechtenstein's IIR regarding stationary combustion could be improved. There is almost no description of the methods, activity data and emission factors used in the calculation of stationary-combustion emissions (pages 22-25 of the 2012 IIR). The ERT notes, however, that the descriptions in the NIR submitted to UNFCCC are detailed and transparent (pages 57-91 of the 2012 NIR). Because of the high degree of consistency in Liechtenstein's reporting under both UN Conventions, the ERT strongly recommends that Liechtenstein improves the descriptions in the IIR, particularly regarding the use of activity data, in line with the descriptions used in the NIR.

Completeness:

38. Liechtenstein's submission is generally complete, with emissions reported for all main pollutants (NO_x, CO, NMVOC, SO_x and NH₃), particulate matter (TSP, PM₁₀ and PM_{2.5}), priority heavy metals (Pb, Cd and Hg), polycyclic aromatic hydrocarbons (PAHs), and dioxin. Data are reported for the years 1985 to 2010. Whereas the reporting of emissions is complete, the Party has not reported underpinning activity data, neither in the NFR nor the IIR. During the review, Liechtenstein confirmed and agreed with the ERT that it would use the CRF submitted to UNFCCC 13/04/12 as the basis for activity data in stationary combustion under LRTAP. This helped the ERT greatly during the review week. However, the ERT recommends that the Party reports underpinning activity data, alongside with the NFR emissions, in its next inventory submission.

Consistency including recalculation and time series:

39. Despite the lack of a transparent description in the IIR, the ERT believes that Liechtenstein's inventory submission for stationary combustion is internally consistent, with the same methodologies used for all years. The ERT recommends that the Party improves its description in the IIR of how it ensures consistent emission estimates for all years of the time series. The ERT notes that Liechtenstein's inventory submission is also consistent with other international reporting obligations, notably to UNFCCC. As stated in the IIR, no recalculations have been done as this is the first submission by the Party.

Comparability:

40. Despite the lack of transparent description in the IIR, the ERT believes that Liechtenstein's inventory estimates for stationary combustion have been calculated in a manner consistent with the methodologies described in the EMEP/EEA Guidebook. The ERT recommends that the Party improves its description in the IIR of how it ensures that its emission estimates are comparable with those of other Parties and follows the Guidelines for Reporting Emissions Data under CLRTAP.

Accuracy and uncertainties:

41. Liechtenstein has not carried out an uncertainty analysis in its 2012 inventory submission. In addition, the ERT notes that no improvements are planned. The ERT recommends that the Party quantifies the uncertainties in its emission estimates for stationary combustion using the most appropriate methodologies available, while taking into consideration the guidance notes provided in the Guidebook, to help prioritise inventory improvements.

Improvement:

42. The ERT commends Liechtenstein for its first inventory submission under LRTAP and for the high degree of consistency in the activity data reported to both LRTAP and UNFCCC.

Sub-sector Specific Recommendations.**Category issue 1: 1.A.4.a (commercial) and 1.A.4.b (residential): Methods, activity data and emission factors**

43. There are two key emission sources from stationary combustion in Liechtenstein. Emissions of CO (trend), NO_x (trend), PM₁₀ (level and trend) and SO_x (level and trend) from the combustion of gaseous and liquid fuels in the commercial and residential sectors are key source categories. However, there is limited information in the IIR regarding the methods, activity data and the source of emission factors used in the estimation of these emissions. It appears that Liechtenstein uses a Tier 2 method to estimate emissions from these key sources. During the review, the ERT asked Liechtenstein to provide the source/s of the EFs used for the estimation of all its stationary combustion emissions, and particularly for its key sources (residential and commercial). The Party responded that their main sources for emission factors are the EMEP/EEA inventory guidebook and emission factors published by the Swiss Department of the Environment, Transport, Energy and Communications (FOEN). The ERT recommends that Liechtenstein improves the description of the methods, activity data and emission factors overall, and particularly of its key sources in its next inventory submission.

Category issue 2: 1.B.2 – activity data and emissions

44. Liechtenstein provides no information on fugitive emissions in the IIR. Most sub-categories are reported as NO in the NFR tables. In addition, fugitives from

distribution of natural gas are reported as NA, even though such distribution exists and activity data and emissions are reported in the CRFs to UNFCCC. The ERT asked Liechtenstein to clarify this apparent inconsistency and to check whether emissions from NMVOCs, or other fugitives, should perhaps be reported under LRTAP. The Party responded that they would examine the possibility to report these emissions in the next submission. The ERT recommends that Liechtenstein improves its description of the estimation of fugitive emissions in the IIR, while also estimating emissions from non-estimated sources and improving the consistency of its reporting with UNFCCC reporting on fugitive emissions from oil and natural gas in its next inventory submission.

Category issue 3: 1.A.2.a-1A2d – emissions

45. There are no combustion emissions from iron and steel, non-ferrous metals, chemicals, and pulp and paper in Liechtenstein. The Party states in its IIR that there is no production from any of these industries. In the NFR table, however, the notation key NA has been used. The ERT recommends that Liechtenstein uses the correct notation keys in the NFR (in this case 'NO') and ensures consistency of the information reported in its IIR and NFR in its next inventory submission.

TRANSPORT

Review Scope

Pollutants Reviewed		NO _x , NMVOC, SO _x , NH ₃ , PM _{2.5} , PM ₁₀ , TSP, CO, dioxin, PAHs		
Years		1985 – 2010		
NFR Code	CRF_NFR Name	Reviewed	Not Reviewed	Recommendation Provided
1.A.2.f.ii	Mobile Combustion in manufacturing industries and construction: (Please specify in your IIR)		X	X
1.A.3.a.i.(i)	international aviation (LTO)	NO		
1.A.3.a.i.(ii)	international aviation (cruise)	NO		
1.A.3.a.ii.(i)	civil aviation (domestic, LTO)	IE		
1.A.3.a.ii.(ii)	civil aviation (domestic, cruise)	X		X
1.A.3.b.i	road transport, passenger cars	X		X
1.A.3.b.ii	road transport, light duty vehicles	X		X
1.A.3.b.iii	road transport, heavy duty vehicles	X		X
1.A.3.b.iv	road transport, mopeds & motorcycles	X		X
1.A.3.b.v	road transport, gasoline evaporation	X		
1.A.3.b.vi	road transport, automobile tyre and brake wear	X		X
1.A.3.b.vii	road transport, automobile road abrasion	X		
1.A.3.c	Railways	NA		
1.A.3.d.i (ii)	international inland navigation	NO		
1.A.3.d.ii	national navigation	NO		
1.A.4.a.ii	commercial/institutional (mobile)		X	X
1.A.4.b.ii	household and gardening (mobile)	NA		X
1.A.4.c	agriculture / forestry / fishing	X		X
1.A.4.c.ii	off-road vehicles and other machinery	X		X
1.A.4.c.iii	national fishing	NO		
1.A.5.b	other, mobile (including military, land-based and recreational boats)	X		X
1 A 3 d i (i)	International maritime navigation	NO		
1 A 3	Transport (fuel used)			

Note: NFR codes 1.A.2.f.ii and 1.A.4.a.ii were not included in LI's NFR tables and could not be reviewed

General recommendations on cross-cutting issues.

Transparency:

46. Liechtenstein has provided a detailed and generally transparent emissions inventory for the transport sector including a brief IIR and reporting templates with emissions data for the period 1985 to 2010. Estimates are not provided for all sub-sectors, however. The reasons for this are explained in the IIR. Only limited information on the emission factors and activity data has been provided in the IIR. The ERT encourages the Party to include more information on emission factors and/or activity data used for compiling the inventory and also to make efforts to calculate emissions from all sub-sectors separately, e.g. household and gardening etc.

Completeness:

The ERT considers the transport sector to be complete for most of the main pollutants (NO_x, NMVOC, SO_x, NH₃), particulate matter, dioxins and PAHs. However, heavy metals and other POPs are not reported.

Consistency including recalculation and time series:

47. Trends in emissions are generally described and a comparison with 1990 is provided in the IIR (for 1A3b, 1A5b). The ERT recommends that the Party includes more detailed descriptions in the IIR including descriptions of trends in other transport sectors as well.

48. This is the first IIR for Liechtenstein. Therefore there are no recalculations included in the inventory. However, emissions have been recalculated for 1A3bi-iv sectors in this submission compared to the emissions data provided in the last year's submission (see also Sub-sector Specific Recommendations: Category issue 5 below). The ERT encourages the Party to provide detailed and complete information on recalculations in the next IIR submissions.

Comparability:

49. Liechtenstein has provided very general information on the methods and the EFs used, but no activity data. The ERT recommends that the Party provides supplementary information on the methods, EFs and activity data used.

50. The emission factors used e.g. for 1A4cii and 1A5b are consistent with an older version of the Guidebook (EMEP/CORINAIR Guidebook 2007). Based on the Tier 1 emission factors provided in the older version of the Guidebook, emissions appear to be overestimated for 1A4cii and 1A5b. The ERT recommends that Liechtenstein uses the latest available Guidebook (EMEP/EEA Guidebook 2009).

Accuracy and uncertainties:

51. Liechtenstein has not provided any uncertainty estimates. The ERT encourages the Party to undertake an uncertainty analysis to help inform the improvement process and to provide an indication of the reliability of the inventory data.

52. Liechtenstein has performed QA/QC activities, which are presented in the NIR. Nevertheless, the ERT encourages the Party to provide QA/QC activities in the IIR as well and include sector-specific information on QA/QC procedures.

Improvement:

53. Liechtenstein has stated in its IIR that there are no improvements planned at this point. However, future improvement plans for the transport sector will be made on the basis of the findings/results of this review. The ERT welcomes this plan.

Sub-sector Specific Recommendations.

Category issue 1: All Sectors – Heavy Metals (HM) and POPs

54. The ERT has noted that Liechtenstein does not estimate emissions for heavy metals. During the review, the Party replied that heavy metal emissions had already been calculated and would be reported in the next submission. Due to an error in

data handling it was not possible to include HMs in this year's submission. The ERT encourages Liechtenstein to include HM emissions in the next submission to improve its national inventory. The ERT would like to point out that emissions of other POPs should also be taken into account when compiling the inventory.

Category issue 2: 1.A.3.a.ii.(i), 1.A.3.a.ii.(ii) – All Pollutants

55. During the review, the ERT wished to clarify whether the Party had a plan to improve its calculations for the aviation sector and to make separate calculations for each sub-sector. The Party stated that the very small quantities of emissions accounted for by the aviation sector do not justify an expensive and time consuming effort for any further improvements, which would not lead to more accurate data. Therefore no improvements are planned for this sector. The ERT acknowledges the Party's answer.

Category issue 3: 1.A.3.b: Road transport – All Pollutants

56. Liechtenstein states in its IIR that emission calculations for the road transport sector are based on the emission factors adopted from Switzerland [HBEFA] which reflect a realistic situation in Liechtenstein. The ERT encourages the Party to include more information on the methodology, emission factors and activity data used for compiling the inventory.

Category issue 4: 1.A.3.b.ii: Road transport: Light Duty Vehicles – DIOX, PAHs

57. The ERT noted that dioxins and PAHs emissions from 1A3bii sector are marked as IE and included in 1A3bi sector. During the review the Party stated that separate estimations would be discussed for the next submission. The ERT acknowledges this response and encourages the Party to make efforts for reporting these emissions separately in future submissions.

Category issue 5: 1.A.3.b.i-iv: Road transport: NO_x, NMVOC, NH₃, CO, TSP

58. The Stage 2 review identified that emissions from sector 1A3b had some sudden jumps and dips in 2010 compared to 2009. During the review, Liechtenstein clarified this issue and stated that an error occurred when uploading NFR tables to CDR. According to the Party's statement, the correct NFR tables are the tables which were uploaded to CDR in February and not the tables uploaded in April. The ERT encourages the Party to provide detailed and complete information on recalculations in the next IIR submissions.

Category issue 6: 1.A.2.f.ii, 1.A.4.a.ii, 1.A.4.b.ii – All Pollutants

59. The ERT noted that emissions from these sectors have not been calculated. Although these sectors might have minor importance, the ERT recommends that the Party calculates these emissions separately for each sub-sector. Liechtenstein stated that this issue will be discussed and checked further for the next submission.

Category issue 7: 1.A.4.c.ii, 1.A.5.b – SO_x

60. The ERT discovered a sudden decline in SO_x emissions in 2004 compared to 2003 (1A3b sector). Presumably there should be a similar decline for sectors 1A4cii

and 1A5b. However, this kind of reduction was not seen in SO_x emissions for these sectors. During the review the Party stated that this issue would be checked for the next submission. The ERT welcomes this plan and encourages the Party to check the sulphur contents of fuel which are used in the calculations.

Category issue 8: 1.A.4.c.ii, 1.A.5.b – All pollutants

61. The ERT noted that EFs used for 1A4cii and 1A5b are consistent with an older version of the Guidebook (EMEP/CORINAIR Guidebook 2007). Based on the Tier 1 emission factors provided in the older version of the Guidebook, emissions seem to be an overestimated for 1A4cii and 1A5b. The ERT recommends that Liechtenstein uses the latest Guidebook available (EMEP/EEA Guidebook 2009). During the review the Party stated that this issue would be checked within the next submission.

INDUSTRIAL PROCESSES

Review Scope

Pollutants Reviewed		SO ₂ , NO _x , NMVOC, NH ₃ , PM ₁₀ & PM _{2.5} , HM, POP		
Years		1985 – 2010		
NFR Code	CRF_NFR Name	Reviewed	Not Reviewed	Recommendation Provided
2.A.1	cement production	NO		
2.A.2	lime production	NO		
2.A.3	limestone and dolomite use	NO		
2.A.4	soda ash production and use	NO		
2.A.5	asphalt roofing	NO		
2.A.6	road paving with asphalt	X		
2.A.7.a	Quarrying and mining of minerals other than coal	NO		
2.A.7.b	Construction and demolition	X		X
2.A.7.c	Storage, handling and transport of mineral products	NO		
2.A.7.d	Other Mineral products (Please specify the sources included/excluded in the notes column to the right)	NO		
2.B.1	ammonia production	NO		
2.B.2	nitric acid production	NO		
2.B.3	adipic acid production	NO		
2.B.4	carbide production	NO		
2.B.5.a	Other chemical industry (Please specify the sources included/excluded in the notes column to the right)	NO		
2.B.5.b	Storage, handling and transport of chemical products (Please specify the sources included/excluded in the notes column to the right)	NO		
2.C.1	iron and steel production	NO		
2.C.2	ferroalloys production	NO		
2.C.3	aluminium production	NO		
2.C.5.a	Copper Production	NO		
2.C.5.b	Lead Production	NO		
2.C.5.c	Nickel Production	NO		
2.C.5.d	Zinc Production	NO		
2.C.5.e	Other metal production (Please specify the sources included/excluded in the notes column to the right)	NO		
2.C.5.f	Storage, handling and transport of metal products (Please specify the sources included/excluded in the notes column to the right)	NO		
2.D.1	pulp and paper	NO		
2.D.2	food and drink	NO		
2.D.3	Wood processing	NO		
2.E	production of POPs	NO		
2.F	consumption of HM and POPs (e.g. electrical and scientific equipment)	NO		
2.G	Other production, consumption, storage, transportation or handling of bulk products (Please specify the sources included/excluded in the notes column to the right)	NO		
Note: Where a sector has been partially reviewed (e.g. some of the NFR codes) please indicate which codes have been reviewed and which have not in the respective columns.				

General recommendations on cross-cutting issues

62. Only very few industrial process sector categories occur in Liechtenstein. Industrial processes 2B, 2C, 2D, 2E, and 2G do not occur. No key source appears in NFR 2.

Transparency:

63. Emissions are only reported for NFR 2A6 (road paving with asphalt). But the methodology used to estimate these emissions is not described in the IIR. This lack of transparency has been compensated by data provided by Liechtenstein to the ERT during the review week. Indeed Liechtenstein provided the ERT with emission factors and methodology details necessary to understand and review this sector.

Completeness:

64. The IIR mentions that only emissions for NFR code 2A6 occur in Liechtenstein. This information was confirmed by Liechtenstein during the review week. But the ERT considers that activities from NFR 2A7b (construction and demolition) should also occur and thus be reported. Hence, the ERT recommends that Liechtenstein estimates emissions from this activity and describes the methodology used for this activity in the IIR.

Consistency including recalculation and time series:

65. Emission trends are not described in the IIR. The ERT encourages Liechtenstein to describe emission trends for industrial activities.

Comparability:

66. Emission factors used to estimate emissions of NFR code 2A6 come from the EMEP/EEA Guidebook version 2007. These emissions factors have been updated in the new version of the Guidebook (2009). The ERT encourages Liechtenstein to use the latest version of the EMEP/EEA Guidebook to estimate emissions of NFR code 2A6.

Accuracy and uncertainties:

67. Liechtenstein does not currently perform an uncertainty analysis for the industry sector.

Improvement:

68. Liechtenstein does not mention any planned improvements in the IIR.

Sub-sector Specific Recommendations.

Category issue 1:2A6 – Road paving with asphalt – all pollutants

69. The ERT encourages Liechtenstein to apply emission factors as given in the latest version of the EMEP/EEA Guidebook.

Category issue 1:2A7b – Construction and demolition – all pollutants

70. In its latest submission, Liechtenstein has not estimated emissions from construction and demolition activities (NFR2A7b). The ERT recommends that Liechtenstein considers this activity for its next submission.

SOLVENTS

Review Scope

Pollutants Reviewed		NMVOC		
Years		1985-2010		
NFR Code	CRF_NFR Name	Reviewed	Not Reviewed	Recommendation Provided
3.A.1	Decorative coating application	X		x
3.A.2	Industrial coating application	X		x
3.A.3	Other coating application (Please specify the sources included/excluded in the notes column to the right)	X		x
3.B.1	Degreasing	X		
3.B.2	Dry cleaning	X		
3.C	Chemical products,	X		
3.D.1	Printing	X		x
3.D.2	Domestic solvent use including fungicides	X		x
3.D.3	Other product use	X		x

Note: Where a sector has been partially reviewed (e.g. some of the NFR codes) please indicate which codes have been reviewed and which have not in the respective columns.

General recommendations on cross-cutting issues

Transparency:

71. The ERT acknowledges that Liechtenstein has provided an IIR for the first time. The Party has provided a generally transparent emissions inventory. Liechtenstein's methodology and emission factors in the IIR are considered to be transparent and well described for the solvents sector. The ERT encourages Liechtenstein to include more detailed information on subcategories in the IIR. The ERT encourages Liechtenstein to report emissions in the different subcategories 3A1, 3A2, 3A3, 3B1, 3B2, 3C, 3D1, 3D2 and 3D3 according to the NFR09 format and to report disaggregated emissions in the NRF tables.

72. The ERT encourages Liechtenstein to use the appropriate notation keys and to replace NO by NA for other pollutants when in the same category NMVOC emissions are reported.

73. For more transparency, the ERT encourages Liechtenstein also to report activity data in the IIR and in the NFR tables for all subcategories.

Completeness:

74. Emissions are reported based on a Tier 1 method. EFs in kg/capita derived for 3A-C are based on the EMEP Guidebook and EFs for 3D are derived from emissions from Switzerland. The ERT considers the solvents sector to be complete. But since the Tier 1 method is used, the ERT considers the level of uncertainty for the emissions to be higher.

Consistency including recalculation and time series:

75. No recalculations have been performed. Because of the use of population data for the time series the data are consistent over time.

Comparability:

76. Liechtenstein is reporting emissions based on a Tier 1 method for all categories. But 3A and 3D are a key category. According to the CLRTAP stage 2 key category analyses, 3B is also a key category. The ERT encourages the Party to use a Tier 2 or 3 methodology for 3A, 3B and 3D.

Accuracy and uncertainties:

77. So far no uncertainty analysis has been provided for the solvents sector. The ERT encourages Liechtenstein to undertake an uncertainty analysis for the solvents sector in order to help inform the improvement process and to provide an indication of the reliability of the inventory data.

78. The ERT encourages Liechtenstein to implement sector-specific QA/QC procedures for the solvents sector.

Improvement:

79. The quality of the solvent sector in the IIR is very good. The ERT recommends two improvements. The ERT encourages Liechtenstein to include new information, specifically activity data, in the IIR and in the NFR tables. The ERT encourages Liechtenstein to report emissions in the NFR09 format and to report the different sub-sectors (3A1, 3A2, 3A3, 3B1, 3B2, 3C, 3D1, 3D2 and 3D3). The ERT also recommends reporting the key categories using a higher tier level, Tier 2 or 3. Liechtenstein reported in the review that no improvements had been planned for key categories so far. The ERT strongly encourages Liechtenstein to reconsider this and to develop Tier 2 or 3 methods for the key categories.

Sub-sector Specific Recommendations.

Category issue 1: 3B - NMVOC

80. 3B is not considered a key category in the key category analysis of Liechtenstein. In the key category analyses of the CLRTAP (stage 2), however, it is a key category. The ERT suggests that Liechtenstein checks this.

Category issue 2: 3C - NMVOC

81. Liechtenstein reports in the IIR that 3C is a key category. During the review Liechtenstein informed the ERT that this was a mistake. The ERT recommends correcting the IIR text.

AGRICULTURE

Review Scope

Pollutants Reviewed		NO _x , NMVOC, NH ₃ , PM ₁₀ & PM _{2.5}		
Years		1985–2010		
NFR Code	CRF_NFR Name	Reviewed	Not Reviewed	Recommendation Provided
4 B 1 a	Cattle dairy	X		X
4 B 1 b	Cattle non-dairy	X		X
4 B 2	Buffalo	X		X
4 B 3	Sheep	X		X
4 B 4	Goats	X		X
4 B 6	Horses	X		X
4 B 7	Mules and asses	X		X
4 B 8	Swine	X		X
4 B 9 a	Laying hens	X		X
4 B 9 b	Broilers	X		X
4 B 9 c	Turkeys	X		X
4 B 9 d	Other poultry	X		X
4 B 13	4 B 13 Other	X		X
4 D 1 a	Synthetic N-fertilisers	X		X
4 D 2 a	Farm-level agricultural operations including storage, handling and transport of agricultural products			
4 D 2 a	Off-farm storage, handling and transport of bulk agricultural products			
4 D 2 c	N excretion on pasture range and paddock unspecified (Please specify the sources included/excluded in the notes column to the right)			
4 F	Field burning of agricultural wastes			
4 G	Agriculture other(c)	X		X
11 A	(11 08 Volcanoes)			
11 B	Forest fires			

Note: Where a sector has been partially reviewed (e.g. some of the NFR codes) please indicate which codes have been reviewed and which have not in the respective columns.

(a) reviewed main pollutants, PM₁₀ and PM_{2.5}

(b) not reviewed POPs, dioxins, furans, HM

General recommendations on cross-cutting issues

82. Liechtenstein has used the Guidebook (EMEP/CORINAIR Guidebook 2007) to calculate NH₃ emission from different manure storage systems. Emission of particles from manure management is reported as a sum under 4.G Other. Emission of NMVOC from 4.B (manure management) is not reported. Emission trends of these pollutants are not given in the IIR report. The ERT recommends that the Party estimates MNVOC emissions from the agriculture sector and describes emission trends of NH₃ and other pollutants in the future submissions. The ERT also recommends that the Party uses the latest 2009 EMEP/EEA air pollutant emission inventory guidebook. Specific recommendations are given in the sector sections.

Transparency:

83. Liechtenstein reports in the IIR that NH₃, particulates and NMVOC emissions from animal manure have been calculated. However, the ERT recognised that only NH₃ emissions are reported. During the review process Liechtenstein confirmed that that sentence in the IIR was not correct. The ERT recommends that the Party makes the necessary correction in the next IIR submission.

84. Liechtenstein uses zero-values in a number of areas (4.B manure management) in the reporting templates. The ERT recommends that Liechtenstein uses appropriate notation keys (e.g. NO where emissions are “Not Occurring”, NE where emissions are “Not Estimated” and IE where emissions are “Included Elsewhere”) where estimates are not available or not shown.

Completeness:

85. The CLRTAP submission includes emissions from 1985 to 2010. Liechtenstein provides in its IIR a short chapter on the agriculture sector with some general information on pollutants and methodologies. The Tier 1 default approach was applied for all the categories. No activity data for 4.B (manure management) or 4.D (synthetic N fertilisers) is provided in the IIR or in the NFR templates. The ERT recommends that the Party includes the activity data used in the calculation of the pollutants in the next submission

Consistency including recalculation and time series:

86. The ERT encourages the Party to provide recalculations of its inventory emissions in the future submissions.

87. The IIR does not include key trends by pollutant over the reported time series. The ERT recommends that Liechtenstein provides information on trends in its future IIR.

Comparability:

88. Liechtenstein uses the EMEP/EEA 2007 Guidebook for estimating emissions and uses the detailed NFR codes for reporting its emissions. The ERT recommends that the Party uses the latest 2009 EMEP/EEA air pollutant emission inventory guidebook in the next submission.

Accuracy and uncertainties:

89. Liechtenstein did not perform an uncertainty analysis for its agriculture inventory. The ERT encourages the Party to provide quantitative uncertainty estimates of emissions in its next CLRTAP submission.

Improvement:

90. There are no planned improvements mentioned in the IIR. The ERT encourages Liechtenstein to consider the recommendations mentioned in the section below and to provide additional information on activity data, and to include documentation of planned and expected improvements in the IIR.

Sub-sector Specific Recommendations.

91. The ERT has noted that Liechtenstein does not provide estimates of PM and MNVOC emissions from manure management although stated in the IIR that emission of these pollutants are calculated using the methodologies described in the Guidebook. The ERT recommends that the Party estimates emissions of PM and MNVOC from 4.B in the future submissions.

92. The ERT asked the Party during the review week to clarify the reason for the dip of approximately 19 % in NH₃ emissions between 2009 and 2010. The Party responded that "large variations from year to year had already been identified in previous years. For example from 1991 to 1992, 1999 to 2000 and 2000 to 2001. Such changes are due to the smallness of the country. Changes in the livestock numbers of a few farmers can already lead to significant changes in emissions". The ERT recommends that Liechtenstein includes this information and any other important information in the next submission.

93. Liechtenstein is encouraged by the ERT to provide more detailed information on data used in the calculation of emissions and to provide activity data (e.g., number of animals) to improve the transparency further.

94. The ERT questioned Liechtenstein why particle emissions from animal housing systems are reported as a total in 4.G and not in 4.B. According to the EMEP/EEA emission inventory guidebook 2009 "*All emissions that cannot be placed under one of the three other chapters (4.B, 4.D and 4.F) will be put in this source category (4.G)*" and "*particle emissions from animal husbandry should be placed in 4.B Animal husbandry and manure management*". The ERT recommends that the Party follows this good practice and includes particle estimates in 4.B in the next submission.

4.D.1 Agricultural Soils:

95. The ERT encourages Liechtenstein to provide detailed information on the breakdown of national fertiliser consumption into the relevant compounds in use, which are accounted for in emission estimates under 4.D1 direct soil emissions.

WASTE

Review Scope:

Pollutants Reviewed		All		
Years		1990 – 2010		
NFR Code	CRF_NFR Name	Reviewed	Not Reviewed	Recommendation Provided
6.A	solid waste disposal on land		x	x
6.B	waste-water handling		x	x
6 C a	6 C a Clinical waste incineration (d)	x		x
6 C b	Industrial waste incineration (d)	x		x
6 C c	Municipal waste incineration (d)	x		x
6 C d	Cremation	x		x
6 C e	Small scale waste burning	x		x
6.D	other waste (e)		x	x
Note: Where a sector has been partially reviewed (e.g. some of the NFR codes) please indicate which codes have been reviewed and which have not in the respective columns.				

General recommendations on cross-cutting issues.

96. Liechtenstein reports emissions only for sector 6C. There are no disaggregated emissions reported under 6C (6Ca, 6Cb, 6Cc, 6Cd, 6Ce). Emissions should be reported for each sub-sector. The NFR tables do not contain activity data. This part should be added to the NFR tables as part of the next submission. The NFR tables also contain a lot of blank cells. If no emissions have been calculated for these sectors, notation keys should be used (NO, NE or NA).

Transparency:

97. The IIR does not provide clear explanations of the kind of emissions factors used to calculate emissions from 6C. The ERT encourages the Party to explain calculation methods and factors in more detail. Emissions should be divided into sub-sectors. According to the IIR, explanations about burning activities and emissions should be added to sector 6Ce "Small scale burning".

Completeness:

98. Liechtenstein reports emissions in 1 (out of 8) waste sub-sectors. The methodology described in the IIR is very short and does not provide all necessary information to fully understand the emission calculations. Activity data are not provided in the NFR table. The ERT encourages the Party to add the necessary information to the IIR and NFR. The ERT recommends that the Party includes more sub-sector calculations. According to information in the UNFCCC NIR 2012, Liechtenstein calculates GHG emissions from waste water handling and from solid waste disposal.

Consistency, including recalculation and time series:

99. The time series for sector 6C is consistent for the years 1990 to 2010. No recalculations are mentioned in the IIR. NH₃ emissions are reported for sector 6D from 1990 to 2003. There are no explanations in the IIR as to what methodologies

have been used for these calculations and why the times series stopped in 2003. The ERT encourages the Party to provide an explanation in the IIR.

Comparability:

100. There are no explanations as to what emissions factors are used in sector 6C. The calculations provided are difficult to compare with other country results. Liechtenstein emissions are of small scale compared to other countries. The method is not comparable, because no explanations about calculations are giving.

Accuracy and uncertainties:

101. No specific QA/QC procedures for CLARTAP calculations are made in Liechtenstein. The Party makes reference to its UNFCCC QA/QC plan. This plan is acceptable for some calculations in the waste sector. The ERT encourages the Party to explain in more detail what kind of QA/QC procedures are to be introduced for the waste sector.

Improvement:

102. Liechtenstein mentions, in its IIR 2012, that it does not intended to perform any improvements. The ERT encourages the Party to consider improvements according to sub-sector recommendations.

Sub-sector Specific Recommendations.

6A - solid waste disposal on land

103. In the UNFCCC NIR report the Party calculates CH₄ emissions from solid waste disposal. The EMEP/EEA emission inventory guidebook 2009 provides a methodology to calculate NMVOC emissions from solid waste disposal. The ERT encourages Liechtenstein to do that.

6B- Waste-water handling

104. Liechtenstein does not report emissions in this sector. According to Liechtenstein's NIR, waste water treatment plants are operated in the country. If it is possible to estimate yearly amounts of waste water, the ERT encourages the Party to calculate NMVOC emissions for sector 6B. Gas collection from sludge does not exclude emissions of NMVOC.

6Ca, 6Cb, 6Cc – Waste incineration (clinical, industrial, municipal)

105. Liechtenstein does not report emissions in these sub-sectors. In the NFR tables these sub-sectors should be added and the notation key "NO" should be used.

6Cd Cremation

106. Liechtenstein does not report emissions in this sub-sector. In the NFR tables this sub-sector should be added and the notation key "NO" should be used.

6Ce Small scale waste burning

107. Based on explanations provided in Liechtenstein's 2012 IIR, emissions from sector 6C should be transferred to 6Ce. Activity data and emissions factors should be explained in the IIR. Activity data should be added to the NFR tables.

6D Other wastes

108. Liechtenstein does not report emissions in this sub-sector. The ERT recommends replacing blank cells with the notation key "NO" in the NFR tables. During the stage 3 review the Party explained the break in the times series for NH₃ in 2004. The ERT recommends that the Party adds this information in the next IIR.

LIST OF ADDITIONAL MATERIALS PROVIDED BY THE COUNTRY DURING THE REVIEW

Response to questions raised during the review:

General

Energy

Liechtenstein-stationarycombustion-27-06-12-Q1_Final 2.doc

Liechtenstein-stationarycombustion-210612-Q1_Final.doc

Liechtenstein-stationarycombustion-260612-Q2_Final.doc

Transport

LIECHTENSTEIN-Transport-13-06-2012-Q1.doc

LIECHTENSTEIN-Transport-19-06-2012-Q2_Final.doc

Industrial processes

LIECHTENSTEIN-Industry-27-06-12-Q2_Final.docx

LIECHTENSTEIN-Industry-12062012-Q1_Final.docx

LIECHTENSTEIN-Industry-12062012-Q2.docx

Agriculture

LI_Initial questions_Agriculture and Nature.docx

Solvents

Liechtenstein-Solvent use-27-06-12--Q10_Final_2.doc

Liechtenstein-Solvent use-20012-06-19-Q10_Final.doc

Waste

Liechtenstein-Wastes-27-06-12-Q1_Final.doc