

UNITED
NATIONS

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**Economic and Social
Council**

Distr.

GENERAL

CEIP/S3.RR/2008/NOR

17/02/2008

ENGLISH ONLY

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

NORWAY

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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} for the time series years 1990 – 2006 reflecting current priorities from EMEP Steering Body and the Task Force on Emission Inventories and Projections (TFEIP).
3. This report covers the stage 3 centralised review of the UNECE LRTPA Convention and EU NEC Directive inventories of Norway, coordinated by the EMEP emission centre CEIP acting as review secretariat. The review took place from 6th to 10th October 2008 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 – Justin Goodwin (EC), Energy - Stephan Poupa (Austria) and Ole Kenneth Nielsen (Denmark), Industry - Helena Hnilicová (Czech r.), Solvents - Patrik Fauser (Denmark), Agriculture plus Nature - Bernard Hyde (Ireland), Waste - Celine Gueguen (France).
4. No review findings have been included in this report for Industrial processes as there were difficulties in completing a review of the industrial process sector due to the time demanding task and language difficulties experienced by the industrial processes expert.
5. Justin Goodwin 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 by 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>

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PART A: KEY REVIEW FINDINGS

INVENTORY SUBMISSION

6. Norway has reported emissions for its Protocol base years and a full timeseries from 1989 to 2006 (the latest year) for its protocol pollutants in the NFR. In addition Norway has also provided, in NFR, a full 1989 - 2006 timeseries for CO, a 1990 - 2006 timeseries for PM₁₀ and PM_{2.5} and estimates for 1987 for the pollutants reviewed (SO₂, NOx, NMVOC, NH₃, plus PM₁₀ and PM_{2.5}). In its previous submission Norway reported gridded SO₂ emissions for years 2000 and 2005 and gridded NOx, NH₃ and NMVOC 2005 data. Norway did not provide an IIR in its formal submission. However, during the review, Norway presented their IIR for their 2007 submission in response to requests from the ERT.
7. The CLRTAP inventory submitted by Norway appears to be of good quality and is in general well documented in the informative inventory report (IIR). However ERT recommends to improve transparency for number of categories in the next submission.

KEY CATEGORIES

8. Norway has not presented a Key Source Category Analysis. The ERT encourages Norway to undertake level and trend Key Category analysis as defined in the EMEP/EEA Guidebook for all sectors.

QUALITY

Transparency

9. The ERT recognises the level of effort undertaken by Norway in providing an inventory of with a significant level of detail to undertake a review. The ERT noted that Norway did not provide an informative Inventory Report with their submission. a number of areas where more transparent descriptions could be provided in the IIR and notation keys used more consistently. The ERT encourages Norway to improve transparency by including in its IIR references for emission factors and descriptions of country specific values, activity data timeseries for Energy, Solvents (including more detail for the sectors 3A – 3D) and Waste. The ERT also encourages Norway to provide sub-sector activity data and calculation tables for sector 4B Manure Management and 4D1 Direct Soil and further details on recalculations for solvent use and waste.

Completeness

10. The ERT acknowledges the effort to which Norway has gone to provide estimates of emissions for all sub-sectors and all pollutants.
11. Norway's inventory for the pollutants reviewed is generally complete. However, there are missing sources indicated in the agriculture 4F Field Burning of Agricultural Wastes, Energy (Emissions from coal mining 1B1a) and PM emissions from clutch wear, use of unpaved roads, sand strewing) and waste (sludge spreading, compost

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production and sludge incineration) sectors. The ERT encourages Norway to make estimates of these sources in future submissions and to provide more detailed documentation of the sources not included in the inventory.

Consistency, including recalculations and time-series

12. The ERT noted recalculations and a good level of documentation for energy and agriculture in the IIR and supporting documents. The ERT encourages Norway to provide similar information in relation to any future recalculations in its IIR submissions.
13. The ERT encourages Norway to provide, in future submissions, statements and details of any recalculations. The ERT also encourages Norway to follow up on the questions raised by the ERT concerning emission timeseries changes for 6C and NFR 6D.

Accuracy and uncertainties

14. The ERT noted that Norway have compiled uncertainty estimates for the Energy, Solvents, Waste and Agriculture sectors.

Verification and quality assurance/quality control approaches

15. The ERT notes that Norway undertakes general and sector specific QA/QC and verification procedures and encourage the party to continue to undertake such procedures in future submissions.

FOLLOW-UP TO PREVIOUS REVIEWS

16. Norway did not provide a response to the Stage 2 S&A report. The ERT encourages Norway to provide information in response to its Stage 2 S&A report in future years.

AREAS FOR IMPROVEMENTS IDENTIFIED BY NORWAY

17. Norway has indicated a number of areas for improvement in their IIR including:
 - a. Update of many of the emission factors
 - b. Update to the road transport model for NO_x, CO, Particulates and NMVOC
 - c. Fuel wood emission factors and consumption data
 - d. The energy inventory
 - e. a new updated model for estimating solvent emissions in 2009.
 - f. Improved methods for agricultural soils.

PART B: RECOMMENDATIONS FOR IMPROVEMENTS TO THE PARTY

CROSS CUTTING IMPROVEMENTS IDENTIFIED BY THE ERT

1. The ERT identifies the following cross-cutting issues for improvement:
 - a. Improved description of activity data, emission factors especially for key categories in future IIRs.
 - b. Keeps the IIR up-to-date and submitted with the data submitted and to avoid inconsistencies between the IIR and the submitted data tables.
 - c. Inclusion of discussions on the emission time-series and recalculations in future IIRs.
 - d. Documentation of completeness in future IIRs.
 - g. To complete a key category analysis.
 - e. Review and where necessary improve NO_x emission factors for energy emissions especially road transport and shipping.
 - f. To review and where necessary bring up-to-date emission factors for other categories.
 - g. Include estimates for sources that are not estimates but which have methods presented in the Guidebook (including 1B1a).
 - h. Review estimates for residential combustion for PM₁₀ wood.
 - i. Recommended improvements relating to specific source categories are presented in the relevant sector sections of this report.

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SECTOR SPECIFIC RECOMMENDATIONS FOR IMPROVEMENTS IDENTIFIED BY THE ERT

ENERGY AND TRANSPORT

Review Scope:

Pollutants Reviewed		SO ₂ , NO _x , NMVOC, NH ₃ , PM ₁₀ & PM _{2.5}		
Years		1990 – 2006 + (Protocol Years)		
NFRCode	CRF_NFRName	Reviewed	Not Reviewed	Recommendation Provided
1.A.1	Energy industries	x		x
1.A.2	Manufacturing industries and construction	x		x
1.A.3	Transport	x		x
1.A.4	Commercial, Residential, Agriculture & Forestry	x		x
1.A.5	Other	x		
1.B.1	Fugitive emissions from solid fuels	x		x
1.B.2	Fugitive emissions from oil and natural gas	x		
Note: Where a sector has been partially reviewed (e.g. some of the NFR codes please indicate which have and which have not in the respective columns.				

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General recommendations on cross cutting issues.

18. The ERT notes that Norway did not provide a key category analysis for the Energy sector. The ERT encourages Norway to provide key category analysis in its future submissions.
19. The ERT noted that the documentation for the methodology and emission factors could be improved. The ERT recommends that Norway includes better description of activity data and emission factors, and that the emission time-series is discussed in the IIR. Norway indicated in their response that the documentation would be improved in future submissions.

Sector Specific Recommendations.

Combustion: – NO_x

20. The ERT noted that many of the emission factors provided in the IIR reference to relatively old studies (e.g. NO_x EFs from stationary combustion relate to a study from 1987 and their country specific road transport model has not been updated with EFs since 1999). Norway indicated that there were no fixed plans to review or update these emission factors but that a number of areas should be updated including the road transport model. Norway indicates it will try to find resources to look at the EFs. The ERT recommends that Norway priorities to update emission factors at least for key sources. The ERT recommends to compare the transport model output with the output of other models like TREMOV and describe such a comparison in the future IIR.

1B1a Coal Mining and Handling – NMVOC

21. Emissions from sector 1B1a (fugitive emissions from coal mining) are reported as not estimated. The ERT recommends that emissions from this source are estimated for future submissions as a methodology is available from the Guidebook.

1A: Combustion: – Wood Fuel

22. In the IIR a project on fuel wood consumption in the residential sector is mentioned under future improvements. During the review Norway informed the ERT that the new research on wood fuel consumption had been included in the inventory. However, no description of this research had been provided in the IIR. The ERT encourages Norway to include a description of these studies in future reports.

1A4b Residential Combustion PM₁₀

23. The ERT noted that the PM emissions from residential fuel wood combustion (small stoves) were high. $EF(\text{particle}) = 27.92 \text{ kg/t fuel wood} = 27.92 \text{ kg} / 16.8 \text{ GJ} = 1662 \text{ g/GJ}$. Norway indicated that they plan to improve estimates from fuel wood combustion in future estimates. The ERT recommends for Norway to use the CORINAIR default EFs until these country specific factors have been verified and to take steps to implement their planned review and update of emission factors.

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1A2 & 2: cement, lime and iron and steel

24. The ERT noted a lack of clarity in the distinction between energy related emissions and process emissions. The IIR table B1 states that SO₂ EF's are derived from Sulphur contents. However, it is not clear how (and if) double counting with process emissions is avoided. The ERT encourages Norway to describe the methodology of how estimates for cement, lime and iron and steel are split into combustion and process emissions more clearly. The ERT encourages the party to include further details on completeness and where emissions are included.

1.A.2.a & 2.C.1 Iron and Steel - CO

25. The ERT noted that the CO emissions from Iron and steel could be underestimated. 1.A.2.a and 2.C emissions appear low (0.02 Gg CO for the year 2006). The ERT recommends that Norway review the methods and data used for estimating CO from iron and Steel processes and to engage with the industry to identify the most appropriate data for the national estimates.

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INDUSTRIAL PROCESSES

26. No review findings have been included for Industrial Processes as there were difficulties in completing a review of the Industrial Process sector due to the time demanding task and language difficulties experienced by the Industrial Processes Expert.

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SOLVENTS

Review Scope:

Pollutants Reviewed		SO ₂ , NO _x , NMVOC, NH ₃ , PM ₁₀ & PM _{2.5}		
Years		1990 – 2006 + (Protocol Years)		
NFRCode	CRF_NFRName	Reviewed	Not Reviewed	Recommendation Provided
3.A.1	Decorative coating application	3A		X (general)
3.A.2	Industrial coating application			
3.A.3	Other coating application (Please specify the sources included/excluded in the notes column to the right)			
3.B.1	Degreasing	3B		X (general)
3.B.2	Dry cleaning			
3C	Chemical Products, Manufacture & Processing			
3.D.1	Printing	3D		X (general)
3.D.2	Domestic solvent use including fungicides			
3.D.3	Other product use			
<i>Note: Where a sector has been partially reviewed (e.g. some of the NFR codes please indicate which have and which have not in the respective columns.</i>				

General recommendations on cross cutting issues

27. In general the ERT noted that the method description and data presentation need to be expanded to improve the transparency of the inventory estimates. However, the fact that Norway have included categories that are not commonly reported indicates that a good level of effort has been put into compiling the inventory estimates. The ERT encourages Norway to reflect this effort in the IIR with fuller descriptions of data sources, methods and assumptions.
28. The ERT notes that Norway did not provide a key category analysis for the Solvents sector. The ERT encourages Norway to provide key category analysis in its future submissions.
29. The ERT noted the lack detailed in the IIR on the methods, data and assumptions used for the solvent sector (particularly for paint application and industrial and domestic use of solvents). This lack of detail made it difficult to assess completeness and review the inventory. Norway presents emissions for 3A – 3D but

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does not provide a subsector breakdown (reporting these subcategories as NE in the tables) and providing limited further details in the IIR. The ERT encourages Norway to include further breakdown of emissions estimates in future reports and to describe the methods, data sources and assumptions more fully. When there is information on specific chemicals and a user product group it is recommended that it is presented in IIR and an explanation is given on how this information is used in the inventory.

30. The emission from solvent use pr. Capita is the highest reported. However, an assessment of this relative high contribution is not provided in the IIR. The ERT encourages the Norway to include further descriptions of these estimates in future IIRs.

Sector Specific Recommendations

3.A to 3.D Solvent use Statistics:

31. The ERT noted that data on raw materials used in industrial processes are gathered by Statistics Norway (Manufacturing Statistics) at roughly five-year intervals. The ERT encourages Norway to update these statistics more frequently and reduce the uncertainty in the related emission figures.

3.A to 3.D Solvent use Emission Factors:

32. The emission factors for solvent use are provided by the Norwegian Pollution Control Authority. In a number of cases these data are not the most up-to-date data available. The ERT encourages Norway to make use of the most up-to-date data available from industry in their emissions estimates.

3.A to 3.D and sub-categories: - NMVOC

33. The ERT encourages Norway to present EFs and activity data on product function level for categories 3A to 3D and sub-categories on SNAP level, when available so that estimates are transparent. This applies both for the industrial activities and consumer use of products.
34. The ERT encourages Norway to include, in its future IIRs, a list of the most important NMVOCs (contributing with > 95% of the NMVOC emission from solvent use). And, if available, a list of the most important product use categories.
35. The ERT encourages Norway to include activity data and emission factors for the solvent sub-categories on SNAP level for those solvent categories contributing > 95 % of the emissions from solvent use.

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AGRICULTURE

Review Scope:

Pollutants Reviewed		SO ₂ , NO _x , NMVOC, NH ₃ , PM ₁₀ & PM _{2.5}		
Years		1990 – 2006 + (Protocol Years)		
NFRCode	CRF_NFRName	Reviewed	Not Reviewed	Recommendation Provided
4.B	Manure Management	NH ₃		
4.D1	Direct Soil Emissions	NH ₃		
4.F	Field Burning of Agricultural Wastes	NO _x , CO, PM ₁₀ , PM _{2.5}		
4.G	Other	NH ₃ , PM ₁₀ , PM _{2.5}		
Note: Where a sector has been partially reviewed (e.g. some of the NFR codes please indicate which have and which have not in the respective columns).				

General recommendations on cross cutting issues

36. The ERT notes that Norway did not provide a key category analysis for the Agriculture sector. The ERT encourages Norway to provide key category analysis in its future submissions.
37. The ERT notes that Norway has sector specific systems in place within the national system, which govern sector specific QA/QC roles. The ERT encourages Norway to continue to utilise these procedures in future submissions.
38. The ERT notes that Norway has carried out a large body of development work with respect to a national emissions model for NH₃. However the ERT notes that the description of the methodology may benefit from a clearer presentation of methodological calculations, in particular those for sector 4B Manure Management (4B1-4B13) and 4D1 Direct Soil Emissions and to review the allocation of emissions of NH₃ from livestock between these two NFR source categories.
39. The ERT recognises the effort undertaken by Norway to develop a country specific model of NH₃ emissions from agricultural sources. However the ERT notes the incorrect use of notation keys for sectors 4B1 to 4B9. The party states that NH₃ emissions from these sources (usually key sources within the majority of reporting parties) are not estimated; however during review the party stated that all emissions of NH₃ for 4B are reported under 4B13. The ERT also notes that there are sub-sectoral allocation issues with regard to the allocation of livestock emissions to sector 4B Manure Management and sector 4D1 Direct Soil Emissions. The ERT encourages Norway either to use the correct notation keys for the sectors identified or to report

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emissions of NH₃ at the level of aggregation provided for in NFR tables and to follow the UNECE reporting guidance and the EMEP/CORINAR Guidebook.

40. The ERT notes that Norway utilises emission factors developed by other reporting party's in the estimation of NH₃ from agricultural sources. The ERT encourages Norway to undertake a review of the applicability of these emission factors to national circumstances.
41. The ERT notes that Norway has undertaken a revision of animal population statistics with respect to the population of reindeer for the years 2004 and 2005 and that a rationale for the recalculation is provided. The ERT encourages Norway to provide similar information in relation to any future recalculations in its IIR submissions.

Sector specific recommendations

4.B Manure management:- NH₃ & PM

42. The ERT encourages Norway to review the methods to calculate NH₃ for 4B Manure Management and to report emission estimates at the level of aggregation provided in the NFR Table where activity data and methodological choice allows.
43. The ERT encourages Norway to provide sub-sector activity data and calculation tables for sector 4B Manure Management to allow future ERT's to transparently review the country specific methodologies employed.

4.D.1 Agricultural soils:- NH₃ & PM

44. The ERT encourages Norway to review the methods to calculate NH₃ for 4D1 Direct Soil Emissions and to report emission estimates at the level of aggregation provided in the NFR Table where activity data and methodological choice allows.
45. The ERT encourages Norway to provide sub-sector activity data and calculation tables for sector 4D1 Direct Soil Emissions to allow future ERT's to transparently review the country specific methodologies employed.

4.F Field Burning of Agricultural Wastes

46. The ERT notes that Norway in its IIR states that the estimation of emissions from 4F Field Burning of Agricultural Wastes may not be "entirely complete since the statistics are not of particularly high quality or completeness". The ERT encourages Norway to review the applicability of the activity data in regard to providing transparent emission estimates from this source category.

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WASTE

Review Scope:

Pollutants Reviewed		SO ₂ , NO _x , NMVOC, NH ₃ , PM ₁₀ & PM _{2.5}		
Years		1990 – 2006 + (Protocol Years)		
NFRCode	CRF_NFRName	Reviewed	Not Reviewed	Recommendation Provided
6.A	solid waste disposal on land	NA		
6.B	waste-water handling	NA		
6.C	waste incineration	yes		yes
6.D	other waste (e)	yes		yes
Note: Where a sector has been partially reviewed (e.g. some of the NFR codes please indicate which have and which have not in the respective columns.				

General recommendations on cross cutting issues.

47. The ERT notes that Norway did not provide a key category analysis for the Waste sector. The ERT encourages Norway to provide key category analysis in its future submissions.
48. Although Norway have provided some concise methodological descriptions and EF values in the IIR report. The ERT found that some of these descriptions did not reflect what is currently in the model (incineration of hospital waste, waste trade). The ERT encourages Norway to keep the IIR up-to-date with activity time series and the EFs data used in its models.
49. The IIR contains a dedicated chapter concerning recalculations. The ERT noted that recalculations have been applied to NFR 6C and that these recalculations have had a significant impact on NO_x emissions. However, the explanation for the recalculations are limited in the IIR. The ERT encourages Norway elaborate on the reasons for and the impacts of the recalculations for NRF 6C in its IIR.
50. The ERT encourages Norway to improve the completeness of the inventory by taking including emissions from other pollutants for sources already in the inventory (e.g. NMVOC for landfills, NH₃ for latrines) and by adding new sources for which data may be obtained and methodologies are specified in the EMEP/CORINAIR Guidelines (e.g. sludge spreading, compost production and sludge incineration).

Sector Specific Recommendations

NFR 6C Waste Incineration: – CO, NMVOC, NH₃

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51. Stage 2 of the review identified inconsistencies concerning CO emissions from the NFR 6C (especially jumps in 1997 and 2000). Similar inconsistencies have been identified by the ERT concerning NMVOC and NH₃ (1997). Norway responded that the main source for CO emissions is natural gas flared in the production of methanol and that activity data are reported to Statistics Norway by the plants. But activity data were not provided to the ERT within the time affected to the review. The ERT encourages Norway to investigate further activity and emissions times series for the NFR 6C sectors and to provide information in the next submission.

NFR 6C Waste Incineration: – TSP, PM

52. The ERT have identified a problem with the TSP and PM emissions time series: values over the period 1990-1994 (0.9 Gg) are extremely high comparing to other years (0.002 Gg). Norway responded that this is an error and that the values are 900 t to high for the 1990-1994 period. The ERT recommends that Norway correct the mistake in the next submission and include descriptions regarding the recalculation in the IIR.
53. The ERT have identified a problem with TSP and PM₁₀ emission values for 2006 : emission of PM₁₀ (0.0026 Gg) is higher than TSP emission (0.0021 Gg). The ERT recommends that Norway address this issue for their next submission and develop future QA/QC activities that check for these differences in the future.

NFR 6C Waste Incineration: – all

54. The ERT notes that the EF for incineration are mostly based on measurements performed in the 1980ies combined with data from EPA (1970ies). The ERT encourages Norway to review these emission factors with a view to updating them for later inventory years to take into consideration the possible implementation of abatement techniques.
55. The ERT have identified a problem with activity data concerning hospital waste and MSW that may lead to double counting. Norway agreed that this issue required investigation. The ERT encourages Norway review the activity data for hospital waste and the share between the quantity incinerated in MSW incinerators and in specific incinerators in order to avoid double counting.

NFR 6D: – all

56. The ERT noted that the NH₃ time series presents a dip in 2006, and NMVOC, NO_x and TSP time series present dips in 1995, 1999 and 2005. Norway responded that NH₃ values are reported by one plant for 2002 and 2006 but was unable to provide more detailed activity data for the ERT to review. The ERT encourages Norway to investigate further activity and emissions times series for the NFR 6D sectors (checking declared values with plants and justifying assumptions) and to provide information in the next submission.
57. Norway have reported emissions from the use of tobacco under NFR 6D. The ERT noted that it is common practice in a number of Parties to report emissions from

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this source under NFR 3D (Solvent and other product use / other solvent and product use) and encourages the Party to consider reporting the use of tobacco under NFR 3D in the future to further improve the comparability of reporting between Parties.

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LIST OF ADDITIONAL MATERIALS PROVIDED BY THE COUNTRY DURING THE REVIEW

1. G.I.Gundersen, O.Rognstad; Lagring og bruk av husdyrjodsel (Manure storage and spreading practices); Statistics Norway, 2001/39
http://www.ssb.no/emner/10/04/10/rapp_200139/rapp_200139.pdf
2. Brita Hoem (ed); The Norwegian Emission inventory 2006, Documentation of methodologies for estimating emission of green-house gases and long-range Transboundary air pollutants, Statistics Norway 2006/30
3. The Norwegian emission inventory 2008, Statistics Norway, Reports (RAPP 2008/48) http://www.ssb.no/emner/01/04/10/rapp_emissions/
4. Excel file, NO 2005 -difference between 2008 and 2007 reporting
5. Party response to preliminary questions and questions during the review week