Danish Ministry
of the Environment
Environmental
Protection Agency

United Nations Economic Commission for Europe
Environment Division
Director Marco Keiner
CC: UNECE Secretariat, EMEP Steering Body and Implementation Committee (CLRTAP)

Danish EPA Environmental Technology
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Dear Mr. Marco Keiner

As notified to the UNECE in December 2013 Denmark would like to make use of the adjustment procedure as described in Decision 2012/3 in accordance with the guidance in the annex of Decision 2012/12 regarding the 2010 ammonia ceiling in the current Gothenburg Protocol, based on Decision 2012/4.

According to the emission inventory for 2010 reported by Denmark in February 2014, the Danish emissions of NH3 in 2010 was 78,68 Gg as listed below. The obligation of Denmark according to the 1999 Gothenburg Protocol is 69 Gg from 2010.

		Main Pollutants (from 1980)			
		NOx (as NO_2)	NMVOC	SOx (as SO_2)	NH_3
Year		**Gg NO_2**	**Gg**	**Gg SO_2**	**Gg**
1999	National total for the entire territory	**219,24**	**142,17**	**58,03**	**98,67**
2010	National total for the entire territory	132,32	88,63	14,93	78,68
2012	National total for the entire territory	116,07	79,11	12,51	76,20

Denmark regrets this exceedance, since Denmark for many years has had a special focus to reduce its ammonia emissions. Many initiatives and national legislation has been implemented regarding Danish agriculture achieving a 20 % reduction in the period 1999 to 2010 which is among the highest reductions among parties to the Gothenburg Protocol.

However, continued improvements in the emission inventories have caused Denmark to be in non-compliance.

As the non-compliance situation is due to improved knowledge and not related to a missing effort Denmark intend to use the possibility to adjust the emission inventory.

Environmental Protection Agency • Strandgade 29 • DK-1401 Copenhagen K Denmark
Tel +45 72 54 40 00 • CVR 25798376 • EAN (drift)5798000863002 (tilskud)5798000863019 • mst@mst.dk • www.mst.dk

Ammonia emissions from Denmark

The adjustment of the ammonia emission inventory consists of two elements. One related to the updated emission factors (EFs) for synthetic fertilizer and one related to NH_3 emissions from growing crops.

The total ammonia emissions will after the adjustments be reduced to 67,500 tonnes in 2012 and 69,340 tonnes in 2010, which brings Denmark in compliance in 2012.

2010 emission without adjustment	78,68	Gg
Adjustment in emission in 4 D 1 a, synthethic N-fertilizers	-3,67	Gg
Adjustment in emission in 4 G, agriculture other	-5,64	Gg
2010 emissions with adjustment	**69,37**	Gg

2012 emission without adjustment	76,20	Gg
Adjustment in emission in 4 D 1 a, synthethic N-fertilizers	-3,30	Gg
Adjustment in emission in 4 G, agriculture other	-5,40	Gg
2012 emissions with adjustment	**67,50**	Gg

National projections

In 2012 Denmark published a national projection that was used as the basis for the final negotiations of the revised Gothenburg Protocol. This projection showed that Denmark would be in compliance with the national emissions 2010-ceiling for ammonia in 2015 without applying any adjustments. In 2013 a new national projection has been published where the new emission factor for N-fertilizer has been used and where some key assumptions for investments and number of animal units the agriculture sector have changed significantly.

The new projection therefore shows that Denmark will not be in compliance with the 2010-ceiling without adjustment until 2023. Because of the significant changes in the key assumption the new projection is now being reviewed again including a sensitivity analysis.

Description of the two adjustments

Please find the detailed information about the separate adjustment in annex I enclosed to this letter. The annex has been produced by Aarhus University /Danish Centre for Environment and Energy who is responsible for reporting emissions to LRTAP on behalf of the Danish Ministry of the Environment.

Regarding ammonia emissions from growing crops this source was not part of the basis when the emissions ceilings were set in 1999 (Decision 2012/3 para 6 (a)).

The EMEP/EEA Guidebook acknowledge that there might be emission from this source but has not set any default emission factor since the uncertainties are too large. The source is mentioned for the first time in the Guidebook in 2002.Text from EMEP/Corinair Guidebook 2002:

"3 GENERAL
3.1 Description
3.1.1 Ammonia
The best information on NH3 emissions from cultures with fertilizers concerns the direct emissions following fertilizer-N application. The evidence for direct emissions from, and uptake by, plant foliage is also good (Schjørring and Mattsson, 2001), though estimates of net emissions are much more uncertain. Although estimates of the component emissions from crop foliage have been made (Denmead et al., 1983; Nemitz et al., 2000), it is often difficult to separate the direct fertilizer and plant emissions in practice, since both are a function of fertilizer-N supply, and in many experiments total emissions were measured. General reviews and estimates of NH3 from these sources have been provided by Asman (1992), ECETOC (1994), Sutton et al. (1995b) and Schjørring and Mattsson (2001)."

The text was revised in 2013 but still without any emission factor being defined. Text from the EMEP/EEA Guidebook 2013:

"2.2 Emissions
2.2.1 Ammonia
Crop emissions appear to be rather small on an area basis; for example Schjørring and Mattsson, (2001) found emissions of 1–2 kg ha-1 N early in the season. This means that it is difficult to obtain accurate estimates of crop emissions and the data are currently considered too uncertain to establish separate default EFs for this source. In the Tier 1 and 2 methodologies described here, the EFs used include direct emission from the fertiliser and the emission from foliage that occurs immediately following application. The only exception is the emission from cultivated legumes; here, a separate, tentative default EF is provided. A further emission may occur from cereal crops during grain-filling or if the crop becomes diseased (Schjørring and Mattsson, 2001). However, there are currently insufficient data to justify establishing a default EF. If users have sufficient information to estimate emissions from crops, this would be considered a Tier 3 approach. In which case, users would also need to amend the EFs for fertilisers, otherwise there will be an element of double-counting."

It is our understanding that ammonia emissions from growing crops only is reported by relative few countries due to the missing emission factor.

Regarding N-fertilizer the annex I explain the significant change of the emission factor that has resulted from the latest update of the guidebook. This change has clearly occurred after the reduction commitment was set in 1999 and increases the total national ammonia emission by almost 5 %. Denmark thus believes this to be significant change in an emission factor in accordance with Decision 2012/3 para 6(b) both due the sheer size of the change and due to the fact that it causes Denmark to be in non-compliance.

Following the guidance set out in Decision 2012/12 Denmark hope that we have documented two adjustments to be applied to the national ammonia emissions in accordance with Decision 2012/3.

Denmark would also like to stress the fact that using the adjustment procedure not in any way means that the continued effort to reduce ammonia emissions in Denmark will have lower priority.

If any question in relation to this letter arises please contact Stine Sandermann Justesen for further information.

Yours sincerely

Carsten Møberg Larsen

ANNEX I

Reporting of adjustments for Denmark

Denmark has notified the UNECE Secretariat of the intention to apply an adjustment for ammonia (NH_3). The overall adjustment is related to two separate adjustments. One is related to the updated emission factors (EFs) for synthetic fertilizer in the 2013 edition of the EMEP/EEA Guidebook. The other is related to NH_3 emissions from growing crops.

In the reporting on February 15 2014, Denmark exceeded the emission ceiling for NH_3 in 2010. Denmark reported an emission of 78.68 kt, while the ceiling is 69 kt. In 2012, the emission has been reduced to 76.20 kt.

The latest official projection (Nielsen et al., 2013) shows that the emission ceiling of 69 kt will not be achieved until 2023. For more information regarding the emission projection, please refer to Nielsen et al. (2013).

The proposed adjustments for Denmark will bring Denmark in compliance reducing the emissions in 2012 to 67.50 kt.

NH_3 emissions from synthetic fertilizer

The 2013 EMEP/EEA Guidebook contained updated EFs for NH_3 from the use of synthetic fertilizer. These EFs are unlike the EFs in the previous version of the EMEP/EEA Guidebook not temperature dependent. This means that the current EFs are significantly different compared to the previous EFs. The current and previous EFs and the associated emissions are shown in Table 1 below.

Table 1: Activity data, EFs and emission for synthetic fertiliser

2010					
Fertiliser type	Amount of N	EF old	EF new	Emi old	Emi new
	mio. kg N	kg NH_3 per kg N	kg NH_3 per kg N	Tonnes NH_3-N	Tonnes NH_3-N
Ammonium nitrate	8.4	0.86	3.7	72.1	310.0
Anhydrous ammonia	5.8	1.99	1.1	114.4	63.3
Ammonium phosphates	5.9	1.43	11.3	85.0	671.4
Ammonium sulphate	6.1	1.43	1.3	86.7	78.8
Calcium ammonium nitrate	94.1	0.86	2.2	809.3	2 070.2
Ammonium solutions	18.9	6.3	3.7	1 190.8	699.4
Urea	0.5	12.77	24.3	66.3	126.1
Other NK and NPK	50.3	0.86	3.7	432.6	1 861.1
Total, mio. kg N	190.0				
Total, Gg NH_3				**3.47**	**7.14**

2012					
Fertiliser type	Amount of N	EF old	EF new	Emi old	Emi new

	mio. kg N	kg NH_3 per kg N	kg NH_3 per kg N	Tonnes NH_3-N	Tonnes NH_3-N
Ammonium nitrate	8.1	0.86	3.7	69.5	299.0
Anhydrous ammonia	7.8	1.99	1.1	155.1	85.7
Ammonium phosphates	5.7	1.43	11.3	81.9	647.2
Ammonium sulphate	5.9	1.43	1.3	83.8	76.1
Calcium ammonium nitrate	90.8	0.86	2.2	780.7	1 997.1
Ammonium solutions	22.8	6.3	3.7	1 439.5	845.4
Urea	0.8	12.77	24.3	103.6	197.1
Other NK and NPK	45.1	0.86	3.7	388.1	1 669.7
Total, mio. kg N	187.0				
Total, Gg NH_3				**3.77**	**7.06**

As stated both the previous and current EFs refer to EMEP/EEA Guidebook and the change in emission is caused by this new agreed methodology. The new EFs were not known at the time of setting the reduction commitments and hence the EFs in the 2009 edition of the EMEP/EEA Guidebook were used to establish the reduction commitment.

NH_3 emissions from growing crops

NH_3 emissions from growing crops are acknowledged in the EMEP/EEA Guidebook, but no default EF is provided. Denmark uses a country specific EF to estimate emissions from growing crops as documented in the Informative Inventory Report submitted together with this report.

The NH_3 emission from growing crops is estimated to be 5.64 kt in 2010 and 5.40 kt in 2012.

This source was not included in the consideration when establishing the emission ceiling neither is it included in the GAINS model.

References

Nielsen, O.-K., Plejdrup, M., Hjelgaard, K., Nielsen, M., Winther, M., Mikkelsen, M.H., Albrektsen, R., Fauser, P., Hoffmann, L. & Gyldenkærne, S. 2013. Projection of SO_2, NO_x , NMVOC, NH_3 and particle emissions - 2012-2035. Aarhus University, DCE – Danish Centre for Environment and Energy, 151 pp. Technical Report from DCE – Danish Centre for Environment and Energy No. 81. http://www.dce2.au.dk/pub/SR81.pdf

Reporting of adjustments

NFR Source category	Long name	Year	Activity data	Adjusted activity data	Difference in %	EF	Adjusted EF	Difference in %	Emissions	Adjusted emissions	Difference in ktonnes
4 D 1 a	4 D 1 a Synthetic N-fertilizers	2010	**190**	**190**	**0**	[2]	[2]		**7.14**	**3.47**	3.67
4 G	4 G Agriculture other[1]	2010							**5.71**	**0.06**	5.64
4 D 1 a	4 D 1 a Synthetic N-fertilizers	2012	**187**	**187**	**0**	[2]	[2]		**7.06**	**3.77**	3.30
4 G	4 G Agriculture other[1]	2012							**5.46**	**0.06**	5.40

[1] Please note that the emissions reported in NFR 4G, also contain a contribution from sludge applied to soils. This subcategory is not affected by the proposed adjustment.

[2] See Table 1