

Sectors and Solutions:

Opportunities and challenges to reduce air pollution from agriculture

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Key Conclusions

[headline conclusions agreed in plenary]

- **While voluntary and economic approaches are popular, they will need to be complemented by further regulation in order to meet the NECD and GP goals for NH₃ (e.g. low-emission manure spreading, covered manure storage) (⇒ Governments).**
- **Joined up approaches across the nitrogen cycle are needed to achieve air, climate, water and economic co-benefits. (⇒ Air Convention, Climate Convention, European Commission, UN Environment, INMS).**
- **Reduction in meat and dairy intake in the UNECE region will be necessary to meet the suite of air and other environment and development goals for 2030 and offers opportunity for health co-benefits. This includes a goal to include environment into national and international dietary guidance (⇒ Education, Health Agencies & Governments, WHO).**
- **A new “30% Club” would offer an opportunity to share best practices in meeting ammonia goals, where leading countries commit to a few priority measures with at least 30% mitigation efficiency (⇒ Governments)**
- **Reform of EU Common Agricultural Policy (CAP) offers a major opportunity to integrate air pollution solutions into agricultural financing schemes (⇒ EU Council, EU Commission)**
- **There is an opportunity to include large cattle farms under Industrial Emissions legislation (such as the IE Directive in the EU) alongside the pig and poultry sector, especially given the ongoing upscaling to larger cattle farms, where use of Best Available Techniques would be appropriate.**
- **There is a need to explore how to link agricultural subsidies to emission reduction obligations and healthy food production (⇒ EU-Com, Parties Air Convention, UNFCCC).**
- **There is a need to established guidance how to reduce emissions from agricultural residue burning (⇒ Parties Air Convention, TFRN in cooperation with TTFEI).**

1. Overall Approach

The group addressed the challenges in two ways: Firstly, what would be needed to meet the national ceilings for ammonia emissions from agriculture under the Gothenburg Protocol and National Emissions Ceilings Directive for 2020 and 2030. Secondly, the group considered what would be

needed to meet the full suite of air and other environmental goals for 2030 (including avoidance of damaging air pollution to human health and ecosystems, to water quality, to avoiding greenhouse gas emissions and to meeting the Sustainable Development Goals).

The group took an approach that asked: will voluntary action be sufficient to achieve goals within the specified time frames, and if not what can economic approaches achieve (including subsidies, taxes etc)? It was then asked to what extent regulation would be necessary if these first two approaches would be insufficient to meet the goals.

The group first discussed options for improved agricultural management to reduce emissions, including proposals for the most-favoured approaches and then considered the relationship to dietary choice in the UNECE area, considering to what extent there is a need to optimize human diets by reducing meat and dairy consumption to meet environmental and health goals. For each of the topics, target groups were identified as receivers of the key messages.

Additional discussion across the “Sectors and Solutions” groups identified the importance of developing UNECE guidance for practices to reduce air pollution emissions from **agricultural residue burning**. The summary conclusions were agreed in cooperation with the wider ‘Sectors and Solutions’ group and then in plenary.

2. Voluntary, Economic and Regulatory Approaches

It was recognized that there were a range of benefits and limitations of different voluntary, economic and regulatory approaches. For example:

- Voluntary approaches are often preferred by farming organisations as compared with regulations. However, the results of such voluntary approaches can often be difficult to see. There can also be a significant transaction cost to assess the extent to which measures have been adopted and to which measures have contributed to emission reductions.
- A heavy focus on regulatory approaches can have a negative outcome in promoting antagonism between farming organisations and environmental regulators. In order to foster acceptability, farmers want to be convinced of the advantages of regulation (e.g., market protection, common standards etc).
- There remain different views on whether and when it is better to focus on voluntary actions that require a higher level of reporting, as compared with a focus on simple regulatory benchmarks that all should meet, with simply defined exemptions.
- The only countries to achieve major emissions reductions of ammonia by around 50% (e.g. Netherlands and Denmark) had achieved it by a regulatory approach.

It was noted that in many cases ammonia emissions are *currently increasing* rather than decreasing. Based on the published official data for the UNECE region (2013-2015, WebDab database of the Centre for Emissions Inventories and Projections), ammonia emissions are increasing in 24 out of the 31 countries committed to reduce emissions, as listed in Table 4 of the revised Gothenburg Protocol. Based on current trends, several countries are on track to exceed National Emissions Ceilings for 2020, with the EU as a whole currently on track to be having ammonia emissions 10% above the committed level.

In most countries of the UNECE there are currently few or no national regulations in place to meet the ammonia emission targets for 2020. The following points were noted:

- Voluntary approaches were widely welcomed, but it was recognized that this may result in very slow change, so that emission ceilings are not achieved by a certain date. This had been highlighted by a recent report for the Nordic Council of Ministers comparing experiences across Nordic countries (Hellsten et al. 2017, Nordic Nitrogen and Agriculture, TemaNord 217/547).
- There is opportunity for increased use of economic levers to promote ammonia emission reduction, with examples shared of how the EU Rural Development Programmes could be used to stimulate ammonia emission control, as well as of nitrogen levies or taxation or other national grant schemes to support capital investment in ammonia emission control. However, at present the scale of funds allocated is rather modest, and larger investment would be needed in many cases to meet national emissions ceilings.
- While a nitrogen tax had operated successfully in Sweden for many years, the extent of environmental improvement resulting remained debated, with the suggestion made that the tax (at 20% of fertilizer price) was too small to mobilize change. Conversely, a temporary doubling of fertilizer prices in 2007-2008 had been found to mobilize change for better manure management in several European countries.

Considering these points and the timescales involved, it was concluded that additional regulation will be necessary to meet the ammonia emissions ceilings for 2020, since a solely voluntary and economic approach cannot be expected to deliver the scale of necessary change within the timescale.

It was also concluded that reform of EU Common Agricultural Policy (CAP) offers a major opportunity to integrate air pollution solutions into agricultural financing schemes.

It was considered that there is a need to explore how to link agricultural subsidies to emission reduction obligations and healthy food production.

3. Key techniques to reduce ammonia emissions

A comprehensive listing of techniques to reduce ammonia emissions is listed in the 'UNECE Ammonia Guidance Document' (Bittman et al., 2014, *Options for ammonia mitigation: Guidance from the UNECE Task Force on Reactive Nitrogen*, ECE.EB/AIR/120), which are also summarized in the 'UNECE Ammonia Framework Code' (*United Nations Economic Commission for Europe Framework Code for Good Agricultural Practice for Reducing Ammonia Emissions*, 2015). In evaluating options for revision of the Gothenburg Protocol Annex IX, the UNECE Task Force on Reactive Nitrogen had identified a short-list of the main ways to reduce ammonia emissions (UNECE, AIR/WG.5/2011/16):

1. Low emission techniques for land spreading of cattle/pig/poultry manures and mineral fertilizers
2. Animal feeding strategies, inc phase feeding
3. Covers on new slurry stores
4. Farm N balance on demonstration farms
5. Low emission new pig & poultry housing

Of these techniques, it was noted by the Task Force that low-emission spreading of liquid manure offered the largest potential to reduce ammonia emissions. This also offers opportunities for cost-savings by farmers by allowing them to reduce inputs of mineral fertilizer nitrogen considering the

nitrogen saved by the measure. Together with covered manure storage, this makes a coherent package allowing farmers to reduce emissions substantially.

When done well, such techniques can be seen as farm investments with a pay-back period after which they could be profitable. However, further provision of tools would help confidence building, while availability of capital grants would help mobilize change, especially considering the many competing calls faced by farmers when considering capital investments.

It was noted that experience from a shipping scheme considering NO_x emissions offered the opportunity for a positive approach to nitrogen taxation, one of the major risks of which is that farmers do not benefit directly if the revenues raised are transferred to general treasury funds. Under this approach, it would be proposed that there is an *exemption from taxation*, if an equivalent (or reduced amount) is deposited in a specific nitrogen fund that can then be used to mobilize technology development and investment in low emission approaches (e.g., capital grants).

4. Coordination and International Leadership

It was recognized that there is a need to promote and communicate existing techniques to those who have yet to adopt them. For those that are already in the process of implementing these techniques, there is also the opportunity to go beyond this and provide landscape-specific and region-specific solutions.

4.1. A new “30% club” for ammonia

Given the slow progress in achieving ammonia emission reductions reported by many countries, as well as the wide availability of measures to reduce emissions, it was noted that there is an opportunity for countries to coordinate more effectively and offer international leadership on meeting this challenge. In particular, it was noted that:

- a) Many of the measures listed in Annex IX of the Gothenburg Protocol refer to a benchmark of 30% emission reduction compared with a standard reference method.
- b) That the most cost-effective measures noted by the TFRN (AIR/WG.5/2011/16) concern low emission manure and fertilizer application, where several technical measures are available to reduce emissions by 30% or more,
- c) That the revised EU National Emissions Ceilings Directive will require Member States to submit National Air Pollution Reduction Plans (NAPRPs) in meeting the committed ceilings, but that these are focused on *individual* action by Member States,
- d) That there is an opportunity for an informal approach where countries take leadership in *sharing technologies and committing to a package of measures that meet a basic standard.*

In this context, it was noted that a new “30% club” would offer an opportunity for member countries to share best practices in meeting the ammonia goals. Under this approach leading countries could commit to a few priority measures with at least 30% mitigation efficiency.

Such an approach would provide the opportunity for countries to demonstrate leadership in championing the opportunities for improving nitrogen resource efficiency on farms, while reducing air pollution impacts on human health and ecosystems. At the same time, it would provide a significant step to meeting the goals of Annex IX of the Gothenburg Protocol, while promoting more effective coordination and technology sharing.

For example, as part of such a “30% club” a country might commit to high efficiency / low emission application of liquid manures and chemical fertilizer (that achieve at least 30% emission reduction compared with the reference defined in Annex IX of the Gothenburg Protocol), when used on medium and large size farms. It is for leading countries to take the initiative.

4.2. Emission control regulations for large pig, poultry and cattle installations

The group recognized that farming is extremely diverse, ranging from small-holder family businesses to large “industrial scale” operations. The strategies to respond optimally to such different farming types are therefore expected to vary.

It was also recognized that significant point source emissions result from the largest farms, especially large pig, poultry and cattle farms. This is particularly relevant, as there is a major ongoing transition towards fewer larger farms in order to maintain profitability in farming.

In the European Union it was recognized that the largest pig farms (>2000 places for fatteners, > 750 places for sows) and poultry farms (>40000 places for birds) are required to be permitted under the Industrial Emissions Directive (IE Directive, ref), where they must apply Best Available Techniques (BAT) to reduce emissions, with guidance provided by published BAT Reference (BREF) documentation. However, there is a gap at present, as large cattle farms are not included in this legislation. This means that there is increasingly large number of very industrial-scale cattle farm installations, none of which are required to follow BAT.

It is understood that similar issues may apply in other parts of the world, where large cattle farms (e.g., feedlots and dairies) will in many cases operate with little environmental regulation.

This highlights an opportunity to include large cattle farms under Industrial Emissions legislation (such as the IE Directive in the EU) alongside the pig and poultry sector, especially given the ongoing upscaling to larger cattle farms, where use of Best Available Techniques would be appropriate. Further work would be needed to consider appropriate farm-size thresholds considering both environmental and business perspectives.

4.3. Next steps towards sustainability

A few countries such as the Netherlands and Denmark have already taken substantial action to reduce ammonia emissions from agriculture. Where such countries already had ambitious technical measures in place (e.g. having already halved emissions), it was noted that innovative approaches would be needed if further emission reductions should be achieved. This raised the following points:

- *Technical measures may be complemented by landscape optimization, where additional actions are taken within local context, in order to maximize the environmental benefits. Such additional local policies can work to support nature and water protection in ‘hot spot’ areas, by providing buffer zones and promoting ‘nature based solutions’ for nitrogen recapture and utilization (e.g., re-capturing ammonia in growing biomass).*
- *While such landscape solutions offer significant benefits for the local environment, they typically offer a smaller contribution to total emissions reductions, which are needed to reduce impacts of secondary air pollution, such as the health impacts of particulate matter.*
- *It is vital to support new investment in technological innovation in emission reduction. For example, earlier versions of the UNECE Ammonia Guidance Document considered that slurry acidification was not a recommended method, but this has since been revised following*

demonstration of operational success across Denmark as an alternative to high ambition emission reduction by slurry injection. Such ongoing investment is needed to develop the next generation of more-efficient measures.

- *There is opportunity to develop more holistic approaches* to pollution mitigation and increased resource efficiency. Here an approach that covers the full nitrogen cycle, may help bring together issues to help overcome barriers (see below).
- *It is expected that societal changes in consumption patterns will also be necessary* to meet the 2030 goals for environmental quality and sustainability, including the Sustainable Development Goals (see below).

5. Strategic approach across the nitrogen cycle

It was recognized that current policies and regulatory approaches were often fragmented between environmental problems, leading both to complexity and concerns of incoherency between solutions. An example, concerns the emission of nitric oxide (NO) from agricultural soils, which alongside with biogenic volatile organic compounds (BVOCs) is excluded from the calculation of ceilings in the revised EU National Emissions Ceilings Directive and the revised Gothenburg Protocol as being a natural source. Yet as NO_x emissions from combustion sources reduce in Europe and North America, soil NO emissions contribute an increasing share of regional NO emissions.

The fact that ammonia emissions from agriculture are considered a pollutant as part of the Gothenburg Protocol, while nitric oxide emission is excluded, demonstrates the lack of coherency in current policy. This perspective can be widened, when it is considered that policies to reduce nitrous oxide (N₂O) from agriculture are typically considered separately from those for ammonia, while policies to reduce nitrate and other forms of nitrogen leaching from agriculture are typically considered separately ('Nitrogen Input in the Biosphere', German Ministry of Environment, 2017).

While each of these policies focus on reducing pollution, this is only one side of the coin. Based on the European Nitrogen Assessment, it is estimated that nitrogen pollution represents a major loss of resource, worth about €14 billion annually. This is equivalent to losing around 25% of Europe's Common Agricultural Policy. This means that a strategic approach across the nitrogen cycle can become a positive approach, by focusing on improving resource use efficiency, reducing nitrogen waste, and reducing multiple forms of environmental pollution all at the same time. Such holistic approaches also offer the opportunity to incorporate reduction of methane emission from agriculture (e.g., Hellstedt et al., 2014, 'Nordic initiatives to abate methane emissions' ANP 2014: 741).

A particular concern was noted in the discussion: Would Europe lose competitiveness in a global market if it changed its food production systems to be more environmentally conscious? It was concluded that a nitrogen cycle perspective offers the opportunity for the opposite, where reduced pollution and increased resource efficiency go together in making the transition to a circular economy.

It is noted that technical work on these challenges is being addressed under the UNECE through the Task Force on Reactive Nitrogen, and in partnership with UN Environment under the International Nitrogen Management System (INMS). These activities are developing the foundation for approaches that could see a stronger cooperation between conventions and strategies for air pollution, climate, water, biodiversity and stratospheric ozone depletion.

It was noted that at present the European Union has no overarching nitrogen policy, while there is similarly no Nitrogen Coordination Mechanism currently within the UN system.

It is concluded that joined-up approaches across the nitrogen cycle are needed to achieve air, climate, water and economic co-benefits. (⇒ Air Convention, Climate Convention, European Commission, UN Environment, INMS).

6. Air pollution, agriculture and food choice

The group discussed the linkages between air pollution, agriculture and food choice, noting that several recent reports had shown that reduced meat and dairy consumption in Europe would be associated with substantially reduced air pollution emissions from European agriculture, alongside several other benefits (reduced greenhouse gas emissions, reduced nitrate leaching, reduced dependence on soybean imports, reduced land requirements for EU agriculture, land opportunities for increased bioenergy production).

Example reports noted include: 'Nitrogen on the Table' (Westhoek et al. 2015, Task Force on Reactive Nitrogen), 'Future Nordic Diets' (Karlsson et al., 2017, Nordic Council of Ministers, TemaNord 2017/566) and 'What is on our plate?' (Ocké et al., 2017, National Institute of Public Health and the Environment, The Netherlands). For example, the Nitrogen on the Table report found that a demitarian scenario that halved European meat and dairy intake would reduce ammonia emissions by around 40%. This did not include any technical measures to reduce emissions from agricultural sources, so it is obvious that a combined strategy of food choice optimization, agricultural emission reductions and efficiency improvement, plus food waste reduction could achieve much larger reductions.

The group noted that there is substantial food trade across Europe, with the relationships varying across regions and countries. For example, it was noted that the Netherlands has simultaneously reduced its meat consumption but increased its livestock farming with a growth in exports. It was therefore acknowledged that there was not a direct relationship between eating less meat and dairy and reducing environmental impacts, as the level of exports also needed to be considered. Conversely, it was noted that high meat and dairy consumption in developed countries fostered an aspiration to increase their consumption in other parts of the world. Therefore further interactions could be expected. For example, if Europe really did choose to halve its meat and dairy intake this would be anticipated to have consequent interactions with the aspirations of citizens elsewhere in the world.

Overall, it was noted that the current commitments achieved through international agreements in the revised Gothenburg Protocol and the revised National Emissions Ceilings Directive, make a contribution to reducing the environmental and health impacts of agricultural air pollution, but do not remove these problems entirely.

It was noted that targeting health issues when encouraging reduced meat consumption could provide incentives to optimize meat and dairy consumption, such as by demitarian and other dietary choices. It was agreed that one way to address this would be to ensure that environmental considerations are incorporated into dietary guidelines in future.

It was concluded that reduction in meat and dairy intake in the UNECE region will be necessary to meet the suite of air and other environment and development goals for 2030 and offers

opportunity for health co-benefits. This includes a goal to include environment into national and international dietary guidance (⇒ Education, Health Agencies & Governments, WHO).

7. Final Messages

The discussion closed with several members of the group offering suggestions of what might be the most effective actions needed to reduce emissions and adverse effects of air pollution from agriculture. The following list illustrates the diversity of views, with a note given in each case of the actors suggested to be best placed to take action.

- Optimising the implementation of specific techniques ⇒ farmers
- Regulation on low emission practices ⇒ national authorities
- Ammonia emissions regulations ⇒ ministries
- Use of low emission slurry storage, low-tech options ⇒ farmers
- Working on air quality programmes, link a range of sectors and players ⇒ Environmental agencies
- Progress the public/farmer consultation ⇒ farmers unions
- Development of regulatory measures ⇒ environment protection agencies & ministries
- Establishing a cap on methane emissions ⇒ European council, air convention
- Establish “cross compliance” between agricultural payments to farmers and the EU National Emissions Ceilings Directive ⇒ European Commission, farmers
- More ambitious ammonia targets ⇒ European Commission
- Implement a ban on broad spreading liquid manure and focus on technical measures ⇒ European Commission
- New Common Agricultural Policy is being drafted, should use opportunity to achieve goals set out for air pollution ⇒ European Commission
- Important to pick low hanging fruits through use of the most cost-effective measures ⇒ farmers, farmer associations and ministry level
- Closer working relationship with UN Air Convention and Climate Convention, low carbon and low nitrogen strategies ⇒ Parties, UNECE and UNFCCC