Measures and scenarios for the implementation of the reduction targets set by the NEC directive (2016/2284/EU) for agriculture

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Abstract

Measures and scenarios for the implementation of the reduction targets for certain air pollutants with the focus on ammonia (NH_3) set by the NEC directive (2016/2284/EU) are presented. According to the NEC directive Germany is obliged to reduce its ammonia (NH_3) emissions by 5% in 2020 and by 29% in 2030 compared to 2005. The mitigation effects of individual measures on all stages of the agricultural production process and a combination of measures ("scenarios") on the overall emissions in 2020, 2025 and 2030 are calculated. No individual measure is sufficient to achieve the reduction targets set for NH_3 in 2030. Various scenarios with the focus on slurry acidification, organic manure incorporation or building integrated techniques are sufficient to achieve the reduction targets for NH_3 in 2030.

Keywords: Agriculture; NEC directive; Germany; ammonia emissions; mitigation measures; air pollutants

1. Introduction

According to the NEC directive and the Gothenburg protocol to abate acidification, eutrophication and ground level ozone Germany is obliged to reduce the emissions of certain air pollutants by given percentages in 2020 and 2030 compared with the emission levels in 2005.

According to the NEC directive NH_3 emissions must be reduced by 5% and 29% in 2020 and 2030, respectively, which corresponds to a maximum of 594 kt NH_3 in 2020 and 444 kt NH_3 in 2030. In contrast to other air pollutants, reduction targets for NH_3 are of outstanding importance for agriculture, since 95% of the NH_3 emissions in Germany originate from agriculture.

The calculations of the mitigation effects of the measures and scenarios are based on the methodology of National Emission Inventory for agriculture as described by Haenel et al. (2018). The emission reductions achieved by the individual measures and scenarios were compared to the projected emissions in 2020, 2025 and 2030. In addition, emission reductions achieved by scenarios were compared to emission levels in 2005.

Mitigation measures for NH_3 emission are available along the whole process chain of agricultural production beginning from livestock feeding, followed by housing, farmyard manure (FYM) storage to fertiliser application.

2. Results

The most promising individual mitigation measures for NH_3 emission are settled at manure application, with the highest reduction potential achievable by implementation of slurry injection into grassland or slurry acidification. The overall NH_3 emission mitigation potential of this measure is -14.4% in 2020 and -8.3% in 2025 and 2030, respectively.

Other mitigation measures for manure application range between -2.3% and -8%. Reducing NH_3 emissions from fertiliser application without reducing the total quantity of nitrogen in the system, would result in an increase of potentially leachable nitrogen. In the case of mitigation measures for manure application between 0.7 and 2.3% in 2030.

NH_3 emission reductions achievable with measures for manure storage range from 0.8% to 2.1%, mainly depending on the share of covered FYM. These measures lead to a slight increase in NO_x emissions (0.1 to 0.8%) and to a change in potentially leachable nitrogen (-0.1 to 0.5%).

NH_3 emission reductions achievable by air scrubbers range from -2.4 to -6.7%, mainly depending on the share of animal places eqipped with air scrubbers. These measures also substantially reduce dust emissions (PM_{10}, $PM_{2,5}$ and TSP) substantially by up to -18, -10 and -25% in 2030, respectively.

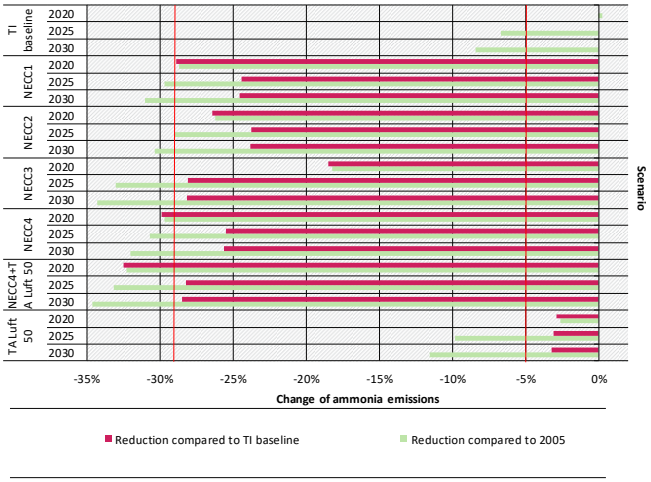
Other mitigation measures reduce NH_3 emissions between -0.5% and -8.5%, which means no single measure suffices to fullfill the NH_3 emission reduction targets set for 2030 individually. This goal is only achievable by a combination of measures ("scenarios").

Various scenarios have been developed with different main emphasises. The first scenario is the Thünen basline scenario which projects the current development of emissions into the years 2020, 2025 and 2025 based on current climate and clean air policies and already passed laws and regulations. This reduces NH_3 emissions by -8.3% by 2030 compared to 2005. Therefore, another 21.7% have to be reduced with additional measures. These additional measures were combined to four so called "NEC commitment" scenarios (NECC1 to NECC4) with various main emphasis for each. Addtionally, two scenarios have been developed of which the first one estimates the effect of the draft of the Technical Instructions on Air Quality Control (TA Luft) as of July 16, 2018 on NH_3 emissions assuming an implementation rate of the measures in this scenario of 50% in 2030 ("TA Luft 50") and the second one combines this scenario with NECC4.

All NECC scenarios focus on manure application and include the replacement of urea and urea ammonium nitrate solution with calcium ammonium nitrate. NECC1, NECC2 and NECC4 include to a certain extent slurry acidification, whereas NECC3 does not. NECC3 emphases in addition to manure application to manure storage. NECC4 is based on NECC1 but additonally includes N surplus reductions by reducing mineral fertiliser application at 20 kg N/ha UAA. TA Luft 50 mainly emphasis on livestock feeding and measures in barns like air scrubbers in big livestock facilities, which fall under the Federal pollution control act and the EU industrial emissions directive (directive 2010/75/EU).

NH_3 emission reduction targets for 2020, 2025 and 2030 are achievable with all four NEC commitment scenarios. However, NECC1, NECC2 and NECC3 lead to a remarkable increase of potentially leachable nitrogen of around 17%, as well as to a slight increase of particulate matter (PM_{10}, $PM_{2,5}$ and TSP) emissions of around 2% and NO_x emissions by around 1.7%. NECC4 increases potentially leachable nitrogen by around 5%, but decreaes NO_x emissions slightly. Combining NECC4 with TA Luft 50 leads to lower particulate matter, NMVOC and NO_x emissions, in addition to much lower NH_3 emissions and slightly increased potentially leachable nitrogen.

Figure 1: Change of NH_3 emissions in 2020, 2025 and 2030 achievable with different scenarios in relation to Thünen baseline scenario and NH_3 emissions in 2005.



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