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| **Title:**  **Draft Ammonia Strategy** | **Regulatory Impact Assessment (RIA)** |
| **Date: 28 October 2022** |
| **Type of measure:** Strategy |
| **Lead department or agency:**  **DAERA** | **Stage:** **Consultation** |
| **Source of intervention:** Domestic NI |
| **Other departments or agencies:**  **N/A** | **Contact details:** Kate Semple |
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| Tel 02890 524516 |

**Summary Intervention and Options**

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| **What is the problem under consideration? Why is government intervention necessary?** (7 lines maximum)  Northern Ireland’s agricultural ammonia emissions are too high and need to be reduced. Government intervention is necessary to meet legislative emissions reduction commitments and nature protection requirements, and to deliver ‘Sustainability for the Future – DAERA’s Plan to 2050’. Northern Ireland currently has 6% of the UK land area and 3% of the population and is responsible for 12% of UK ammonia emissions. Between 2009 and 2019 ammonia emissions from agriculture in Northern Ireland increased by almost 19%. Excess ammonia levels and associated nitrogen deposition damage sensitive species and habitats. Ammonia also impacts public health through its contribution to the formation of particulate matter. | |
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| **What are the policy objectives and the intended effects?** (7 lines maximum)  The policy objectives are to meet 2030 targets of a reduction in total NI agricultural ammonia emissions by at least 30%, from the 2020 baseline of 31.2 kt; and to reduce ammonia levels at internationally designated sites by 40% from the 2020 baseline, or to below the site’s Critical Level.  The intended effects of meeting these policy objectives are that Northern Ireland achieves its fair share of the UK’s international ammonia reduction target under the Gothenburg Protocol, and better outcomes are achieved for agricultural sustainability, nitrogen sensitive species and habitats, public health, and air quality in NI. | |
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| **What policy options have been considered, including any alternatives to regulation? Please justify preferred option (further details in Evidence Base)** (10 lines maximum)  Option 1: Do nothing, do not develop or implement an Ammonia Strategy. This is the baseline option.  Option 2: Develop and implement an Ammonia Strategy with lower cost measures only (21% ammonia reduction).  Option 3: Develop and implement an Ammonia Strategy including the full range of feasible ammonia reduction measures (25 to 28% ammonia reduction).  Option 3 is deemed the most appropriate option as the pressing need identified for sustained and tangible ammonia reduction means that the more ambitious options modelled should be preferred in the draft strategy for consultation. The current draft strategy proposes a wide range of feasible ammonia reduction measures, including legislation in relation to low emission slurry spreading, chemical fertiliser and mandatory standards for new livestock housing. It also seeks views on whether permitting should be extended to cattle farms in Northern Ireland. | |
| **Will the policy be reviewed?**  The Ammonia Strategy will be delivered through an initial five-year policy cycle, with a stocktake at the end of year 2 and a full review after year 5. The stocktake will enable account to be taken of ammonia reductions and potential room for sustainable development. | **If applicable, set review date:**  Year 2 stocktake by end of 2025.  Year 5 review by end of 2028. |

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| **Cost of Preferred (or more likely) Option** | | |
| **Total outlay cost for business** £m | **Total net cost to business per year** £m | **Annual cost for implementation by Regulator** £m |
|  | **£43.65 m** | **TBC** |

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| **Does Implementation go beyond minimum EU requirements?** | | | **YES** | **NO** |
| **Is this measure likely to impact on trade and investment?** | | | **YES** | **NO** |
| Are any of these organisations in scope? | **Micro**  Yes  No | **Small**  Yes  No | **Medium**  Yes  No | **Large**  Yes  No |

**The final RIA supporting legislation must be attached to the Explanatory Memorandum and published with it.**

Approved by:       Date:

Summary: Analysis and Evidence Policy Option 1

Description: Do Nothing, do not develop or implement an Ammonia Strategy. This is the baseline option.

**ECONOMIC ASSESSMENT (Option 1)**

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| **Costs (£m)** | **Total Transitional (Policy)** | | **Average Annual (recurring)** | **Total Cost** |
|  | (constant price) | Years | (excl. transitional) (constant price) | (Present Value) |
| **Low** | **£13 m** | **5** | **£0.6m** | **£7.14 m** |
| **High** | **£15.1 m** | **£0.6 m** | **£8.32 m** |
| **Best Estimate** | **£14.05 m** | **£0.6 m** | **£7.73 m** |
| **Description and scale of key monetised costs by ‘main affected groups’** Maximum 5 lines  If the Ammonia Strategy is not implemented, there will be no additional costs beyond the legal commitments already made through the Nutrients Action Programme (NAP) to reduce ammonia emissions. Figures above are from the NAP RIA and are associated with LESSE and covering new above ground slurry stores.  However, the target of 30% ammonia reduction from current levels in line with the Gothenburg Protocol is highly unlikely to be achieved as the low emissions slurry spreading equipment (LESSE) in NAP are estimated to reduce ammonia emissions by 5.9%. Therefore, the benefits of a 21-28% reduction in ammonia will not occur. As outlined in option 2 below, there are significant “damage costs” associated with ammonia emission levels and therefore there is a cost associated with failure to achieve the relevant reductions. | | | | |
| **Other key non-monetised costs by ‘main affected groups’** Maximum 5 lines  If significant reductions in ammonia emissions are not achieved, as well as a failure to achieve better environmental and public health outcomes, the reputation of Northern Ireland agri-food sector may be impacted as current levels of ammonia emissions cannot be considered sustainable.  Non-monetised costs from Option 1 are the same as those for the NAP: an EU approved derogation would be available to farmers, and changes relating to fertilisation plans and nitrogen excretion rates for dairy cows simplify administrative requirements for farmers. | | | | |
| **Benefits (£m)** | **Total Transitional (Policy)** | | **Average Annual (recurring)** | **Total Benefit** |
| **(Calculated in terms of improved air quality)** | (constant price) | Years | (excl. transitional) (constant price) | (Present Value) |
| **Low** |  |  | **£2.84 m** |  |
| **High** |  | **£45.75 m** |  |
| **Best Estimate** |  | **£14.82 m** |  |
| **Description and scale of key monetised benefits by ‘main affected groups’** Maximum 5 lines  The “benefits” of this option are that specific investment to reduce ammonia emissions beyond the measures committed to under NAP may not be initially required. However, the legal imperative to reduce ammonia emissions will mean that an alternative approach will be required which will have other economic implications, including potential impacts on livestock numbers and the overall value of the agri-food sector to the economy.  Benefits will accrue across NI society of achieving an ammonia reduction target of 5.9% through the NAP measures (ie 1.87 kt of ammonia reduction annually). At UK level, the damage cost of ammonia emissions is assessed at between £1,521 and £24,467 per tonne with a central damage cost of £7,923[[1]](#footnote-1). While the public health element of this figure is based on PM2.5 levels across the UK, benefits from ammonia reduction will accrue in Northern Ireland. However, these benefits are not maximised due to the selection of NAP measures only.  Calculations are shown in Annex A. | | | | |
| **Other key non-monetised benefits by ‘main affected groups’** Maximum 5 lines  There will be no initial additional regulatory or administrative requirements if an Ammonia Strategy is not implemented. | | | | |
| **Key Assumptions, Sensitivities, Risks** Maximum 5 lines  The risk of this approach is that insufficient progress is made in reducing ammonia emissions, that the benefits of improved nutrient efficiency and better biodiversity and public health outcomes are not realised. The key assumption within this option is that if sufficient action is not taken to address the legal imperative now, more damage will occur and it will prove more costly and disruptive to take the appropriate action at a later date, from potentially higher emission levels. | | | | |

**BUSINESS ASSESSMENT (Option** 1**)**

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| **Direct Impact on business (Equivalent Annual) £m** | | |  |
| **Costs: £7.73 m** | **Benefits: £4.91 m** | **Net: £2.82 m** |

**Cross Border Issues (Option** 1**)**

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| **How does this option compare to other UK regions and to other EU Member States (particularly Republic of Ireland)** Maximum 3 lines  Under this approach, Northern Ireland would be an outlier in its failure to address the pressing need to reduce ammonia emissions, despite a clearly identified environmental and public health need to do so. This option would leave Northern Ireland out of step with other UK regions and EU member states with high ammonia levels as all of these are contemplating some degree of regulation to reduce emissions. |

Summary: Analysis and Evidence Policy Option 2

Description: Option 2: Develop and implement an Ammonia Strategy with lower cost measures only (21% ammonia reduction).

**ECONOMIC ASSESSMENT (Option 2)**

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| --- | --- | --- | --- | --- |
| **Costs (£m)** | **Total Transitional (Policy)** | | **Average Annual (recurring)** | **Total Cost** |
|  | (constant price) | Years | (excl. transitional) (constant price) | (Present Value) |
| **Low** |  | **5 - 10** | **Optional** | **Optional** |
| **High** |  | **Optional** | **Optional** |
| **Best Estimate** |  | **£6.63 m** |  |
| **Description and scale of key monetised costs by1111 ‘main affected groups’** Maximum 5 lines  The monetised costs highlighted above come from the AFBI economic analysis of the cost of ammonia reduction for NI agriculture based on implementing only measures assessed to be lower cost (ie extending grazing, lower crude protein diet, genetic improvement and low emission slurry spreading. The economic analysis in Table 3 shows that this scenario would deliver ammonia reductions of 6.5 kt at the costs above. These scenarios would achieve a 21% reduction in ammonia emissions. | | | | |
| **Other key non-monetised costs by ‘main affected groups’** Maximum 5 lines  While some of the measures proposed are likely to be more cost-effective at farm level (longer grazing seasons, stabilised urea, lower crude protein, genetic improvement and low emission slurry spreading), there will be costs incurred in establishing systems to verify their uptake and transactional costs for farmers relating to changes in daily management practices and decisions on the farm. There will also be costs associated with the conservation actions required on designated sites and in relation to the proposed Operational Protocol. | | | | |
| **Benefits (£m)** **(Calculated in terms of improved air quality)** | **Total Transitional (Policy)** | | **Average Annual (recurring)** | **Total Benefit** |
|  | (constant price) | Years | (excl. transitional) (constant price) | (Present Value) |
| **Low** |  |  | **£9.89 m** |  |
| **High** |  | **£159.04 m** |  |
| **Best Estimate** |  | **£51.50 m** |  |
| **Description and scale of key monetised benefits by ‘main affected groups’** Maximum 5 lines  Benefits to agriculture sector:  Benefits will accrue across NI society of achieving an ammonia reduction target of 21% through the lower cost measures only (ie 6.5 kt of ammonia reduction annually). At UK level, the damage cost of ammonia emissions is assessed at between £1,521 and £24,467 per tonne with a central damage cost of £7,923. While the public health element of this figure is based on PM2.5 levels across the UK, benefits from ammonia reduction will accrue in Northern Ireland. However, these benefits are not maximised due to the selection of lower cost measures only.  Calculations are shown in Annex A. | | | | |
| **Other key non-monetised benefits by ‘main affected groups’** Maximum 5 lines  There is a legal imperative on Northern Ireland to reduce ammonia emissions and protect and restore habitats. If the options highlighted in the draft ammonia strategy are not successfully implemented to meet these legal obligations, alternative approaches may impose greater costs on the agri-food sector and the public purse. There are wider environmental benefits from some ammonia mitigation measures, such as improved water quality. | | | | |
| **Key Assumptions, Sensitivities, Risks** Maximum 5 lines  The economic analysis conducted by AFBI assumes static livestock numbers. Increases or decreases in livestock numbers will have corresponding impacts on ammonia emissions. There is a significant variation in the low and high damage costs of ammonia. These costs have been calculated at the UK level. Levels of PM2.5, an air quality pollutant for which ammonia is a contributory factor, vary across the UK. There is a risk that if systems to ensure uptake of measures are not sufficient, the targets in the draft ammonia strategy will not be achieved. | | | | |

**BUSINESS ASSESSMENT (Option 2)**

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| --- | --- | --- | --- | --- |
| **Direct Impact on business (Equivalent Annual) £** | | |  |  |
| **Costs:** | **Benefits:** | **Net:** |  | A significant portion of the cost of ammonia reduction either now or in the future is likely to fall on businesses. These specific costs will be identified as regulation is proposed. |

**Cross Border Issues (Option** **2)**

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| **How does this option compare to other UK regions and to other EU Member States (particularly Republic of Ireland)** Maximum 3 lines  Each UK region is obliged to contribute to the overall UK ammonia reduction of 16% from 2005 levels by 2030. Defra have outlined their plans to reduce ammonia through requirements on urea fertiliser, low emission slurry spreading, slurry store covers and extension of environmental permitting. ROI analysis suggests similar measures will be taken to those proposed in NI[[2]](#footnote-2). |

Summary: Analysis and Evidence Policy Option 3

Description: Develop and implement an Ammonia Strategy including the full range of feasible ammonia reduction measures (25 to 28% ammonia reduction)

**ECONOMIC ASSESSMENT (Option 3)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Costs (£m)** | **Total Transitional (Policy)** | | **Average Annual (recurring)** | **Total Cost** |
|  | (constant price) | Years | (excl. transitional) (constant price) | (Present Value) |
| **Low** |  | **5 – 10 yrs** | **£31.24 m** |  |
| **High** |  | **£43.65 m** |  |
| **Best Estimate** |  | Dependent on uptake rates |  |
| **Description and scale of key monetised costs by ‘main affected groups’** Maximum 5 lines  The monetised costs highlighted above come from the AFBI economic analysis of the cost of ammonia reduction for NI agriculture based on the MACC1 and MACC3 scenarios which modelled the ammonia reduction impact of a wide range of feasible ammonia reduction measures (with some variation in the precise type of measures between the scenarios). This option has a potential of an ammonia reduction of between 25% and 28% at the specified uptake rates. These uptake rates are the key determinant of the efficacy of the Option 3 approach and lack the certainty delivered by a mandatory approach. | | | | |
| **Other key non-monetised costs by ‘main affected groups’** Maximum 5 lines  The uptake of ammonia reduction measures required to achieve a 25% to 28% will represent a transformational change in farming practice across Northern Ireland. There will be an administrative burden in participating in schemes which will implement the various measures. There is also likely to be a requirement for training in the new technologies to be adopted. Some measures may increase uncertainty within the farming system, for example in relation to weather for extending grazing seasons and availability of supply for measures such as stabilised urea and technologies, including low emission slurry spreading. | | | | |
| **Benefits (£m)**  **(Calculated in terms of improved air quality)** | **Average Annual (recurring)**  **25% reduction** | | **Average Annual (recurring)**  **28% reduction** | **Total Benefit** |
|  | (excl. transitional) (constant price) |  | (excl. transitional) (constant price) | (Present Value) |
| **Low** | **£12.17 m** |  | **£13.54 m** |  |
| **High** | **£195.74 m** | **£217.76 m** |  |
| **Best Estimate** | **£63.38 m** | **£70.51 m** |  |
| **Description and scale of key monetised benefits by ‘main affected groups’** Maximum 5 lines  Benefits will accrue across NI society of achieving reductions in ammonia emission levels of 25-28% (a reduction of 7.88 kt to 8.88 kt from baseline levels of ammonia). At UK level, the damage cost of ammonia emissions is assessed at between £1,521 and £24,467 per tonne with a central damage cost of £7,923. Although the public health element of the figure is based on PM2.5 levels across the UK, benefits from ammonia reduction will accrue in Northern Ireland.  Calculations are shown in Annex A. | | | | |
| **Other key non-monetised benefits by ‘main affected groups’** Maximum 5 lines  There is a legal imperative on Northern Ireland to reduce ammonia emissions and protect and restore habitats. If the options highlighted in the draft ammonia strategy are not successfully implemented, alternative approaches may impose greater costs on the agri-food sector and the public purse. The risk that alternative approaches will be required will increase if the ammonia strategy is not appropriately ambitious. There are wider environmental benefits from some ammonia mitigation measures, such as improved water quality. | | | | |
| **Key Assumptions, Sensitivities, Risks** Maximum 5 lines  The economic analysis conducted by AFBI assumes static livestock numbers. Increases or decreases in livestock numbers will have corresponding impacts on ammonia emissions. There is a significant variation in the low and high damage costs of ammonia. These costs have been calculated at the UK level. Levels of PM2.5, an air quality pollutant for which ammonia is a contributory factor, vary across the UK. There is a risk that if systems to ensure uptake of measures are not sufficient, the targets in the draft ammonia strategy will not be achieved. Under this more ambitious option, that risk is increased. | | | | |

**BUSINESS ASSESSMENT (**Option 3)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Direct Impact on business (Equivalent Annual) £** | | |  | A significant portion of the cost of ammonia reduction either now or in the future is likely to fall on businesses. These specific costs will be identified as regulation is proposed. |
| **Costs:** | **Benefits:** | **Net:** |  |  |

**Cross Border Issues (Option** **3)**

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| --- |
| **How does this option compare to other UK regions and to other EU Member States (particularly Republic of Ireland)** Maximum 3 lines  Each UK region is obliged to contribute to the overall UK ammonia reduction of 16% from 2005 levels by 2030. Defra have outlined their plans to reduce ammonia through requirements on urea fertiliser, low emission slurry spreading, slurry store covers and extension of environmental permitting. ROI analysis suggests similar measures will be taken to those proposed in NI. |

**Evidence Base**

* **Problem under consideration**

The UK has international commitments to reduce ammonia emissions by 16% by 2030, based on 2005 levels. Northern Ireland is expected to contribute to the required reductions but is currently producing a disproportionately large amount of total UK ammonia emissions due to the predominance of livestock production in the agriculture industry. Northern Ireland has 6% of the UK land area and 3% of the population and is responsible for 12% of UK ammonia emissions.

Agricultural activities associated with livestock manure management and fertiliser spreading are the main source of ammonia levels in Northern Ireland, shown in Table 1 for 2005 and 2019. Ammonia emissions from agriculture in Northern Ireland increased from 2005 to 2019.

Table 1. Sources of Ammonia in Northern Ireland in 2005 and 2020.[[3]](#footnote-3)

|  |  |  |
| --- | --- | --- |
| **Sources of Ammonia in NI** | **2005 (kt)** | **2020 (kt)** |
| **Agriculture** | **29.2** | **31.2** |
| **Other sources** | **1.3** | **0.97** |
| **Total** | **30.5** | **32.1** |

Excessive ammonia in the environment is currently negatively impacting the majority of high nature value sites designated for protection and impacting on DAERA’s ability to meet legislative obligations to protect designated sites and to enhance and promote biodiversity.

Excess ammonia levels and associated nitrogen deposition damage sensitive species and habitats.

Sensitive habitats types such as peat bogs have specific critical levels for atmospheric ammonia and critical loads for nitrogen deposition to protect them from significant harmful effects.

Legislative protection of habitats and species in Northern Ireland is provided through successor legislation to the Habitats Directive in Northern Ireland following EU Exit and The Environment Order 2002. DAERA is responsible for compliance with this legislation and ensuring that steps are taken to avoid deterioration of habitats and species of community importance. DAERA has further responsibility for habitat protection in its roles as the Statutory Nature Conservation Body under the Planning (General Development Procedure) Order 2015, and as competent authority in the decision making process in granting permits, licences or consents. And in ensuring compliance with air quality legislation including the National Emissions Ceiling Regulations and the Air Quality Standards Regulations.

Current levels of exceedance of these key thresholds at designated habitats shown in Table 2 are extremely high and challenging to DAERA’s delivery of the existing legislative requirements listed as well as future cross cutting DAERA key policy proposals including the Green Growth Strategy.

Table 2. The extent of exceedance of critical loads and critical levels at Northern Ireland’s designated sites.[[4]](#footnote-4)

|  |  |  |
| --- | --- | --- |
| Site designation | % sites with exceedance of critical level of 1 µg ammonia | % sites with exceedance of critical load of nitrogen |
| Special Areas of Conservation (SACs) | 100 | 98 |
| Special Protection Areas (SPAs) | 100 | 83.3 |
| Areas of Special Scientific Interest (ASSIs) | 99.7 | 95.7 |

Atmospheric ammonia is also a precursor for fine particulate matter, PM2.5, which has adverse effects on human health. PM2.5) is cited in the Clean Air Strategy for NI – Public Discussion Document as one of the air pollutants of concern in NI. The Discussion Document highlighted that a report published by Public Health England in 2014 estimated that in 2010, 553 deaths in over-25s in Northern Ireland were attributable to exposure to anthropogenic air pollution (PM2.5).

* **Rationale for intervention**

Sustained and tangible reductions in ammonia emissions are required to meet Northern Ireland’s legal obligations, to protect nature, and to ensure a sustainable agri-food sector.

Action is needed to tackle increases in agricultural ammonia emissions in Northern Ireland of 15% from 2010 (27.9 kt) to the most recent 2020 (32.1 kt) Air Pollutant Inventory. This marked rise in emissions was due to a trend of increasing livestock numbers and greater use of indoor housing systems without a corresponding widespread uptake of ammonia reduction measures.

* **Policy objectives**

The policy objectives are to meet the following targets by 2030:

1. To reduce NI agricultural ammonia emissions by at least 30%.

2. To reduce ammonia levels at internationally designated sites by 40% or to below the site’s Critical Load.

* **Description of options considered (including do nothing), with reference to the evidence base to support the option selection**

Option 1: Do nothing, do not develop or implement an Ammonia Strategy. This is the baseline option.

Option 2: Develop and implement an Ammonia Strategy with lower cost measures only (21% ammonia reduction)

Option 3: Develop and implement an Ammonia Strategy including the full range of feasible ammonia reduction measures (25 to 28% ammonia reduction)

***Option 1: Do nothing, do not develop or implement an ammonia strategy. This is the baseline option***

No specific action is taken to reduce ammonia emissions. Livestock numbers will determine changes in ammonia emissions. Some additional ammonia reduction will be achieved through phasing in of a requirement for use of low emission slurry spreading on some, but not all, farms under the Nutrients Action Programme. Northern Ireland will likely fail to meet its legal obligations to protect habitats and improve air quality and will not derive any of the benefits of ammonia reduction.

Current levels of exceedance of these key thresholds at designated habitats shown in Table 2 are extremely high and challenging to DAERA’s delivery of the existing legislative requirements listed as well as future cross cutting DAERA key policy proposals including the Green Growth Strategy.

***Option 2: Develop and implement an Ammonia Strategy*** ***with lower cost measures only (21% ammonia reduction)***

This option would see Northern Ireland take some steps to meet its legal obligations to protect habitats and air quality. There will be significant environmental and health benefits to achieving a 21% reduction in ammonia emissions, the monetary value of which can be estimated using figures in the Defra Air Quality damage cost update 2020[[5]](#footnote-5).

The lower cost measures modelled by AFBI as achieving a 21% reduction in ammonia emissions were:

* Require all slurry to be spread using low emission slurry spreading equipment
* Introduce legislation to reduce ammonia emissions from fertiliser
* Longer Grazing Seasons
* Reducing Crude Protein in Livestock Diets
* Improving Feed Efficiency Through Genetic Improvement

Table 3 shows the results of modelling work on the extent of ammonia reductions feasible through implementation of comparatively equivalent mitigation measures at specified uptake rates. The marginal abatement method used in the modelling means that reductions are not additive and must be considered in sequence but results clearly illustrate the difference in both costs and potential ammonia reduction resulting from the ‘All Measures’ option and the ‘Low Cost measures Only’ approaches. While this option has significantly reduced costs to farm businesses compared to Option 3 (£6.63m per annum compared to at least £31.24m per annum), it does not maximum the current technical potential for ammonia reduction and therefore fails to maximise the potential for economic benefits to the environmental and public health through the implementation of ammonia reduction measures.

***Option 3: Develop and implement an Ammonia Strategy including the full range of feasible ammonia reduction measures (25 to 28% ammonia reduction)***

The option would involve implementation of the Option 2 ammonia reduction measures, as well as a series of additional measures to increase the ammonia of the ammonia strategy. The measure to be implemented are as follows:

* Require all slurry to be spread using low emission slurry spreading equipment
* Introduce legislation to reduce ammonia emissions from fertiliser
* Longer grazing seasons
* Reducing crude protein in livestock diets
* Improving feed efficiency through genetic improvement

This is the preferred option as it provides the greatest amount of ammonia reduction of the options examined and therefore the greatest improvements to sensitive species and habitats and to public health. The benefits of the reduction in emissions are greater than the costs given the economic level of emission reduction.

* **Monetised and non-monetised costs and benefits of each option (including administrative burden)**

*Option 1: Do nothing, do not develop or implement an Ammonia Strategy. This is the baseline option.*

Option 1 would have no additional costs to the farming sector as it maintains the status quo and takes no additional action to reduce ammonia. It does however mean that the key objectives of the Ammonia Strategy would not be met. Northern Ireland would not achieve its fair share of the UK’s international ammonia reduction target under the Gothenburg Protocol, and there would be no benefits via improvement in outcomes for nitrogen sensitive species and habitats, public health, and air quality in NI.

Option 1 would prove challenging to DAERA’s delivery of the existing legislative requirements listed as well as future cross cutting DAERA key policy proposals including the Green Growth Strategy.

A Ricardo PLC report for Defra on the damage costs of air quality at UK level estimated costs occurring due to the impact of ammonia emissions on public health and the environment, including Particulate Matter exposure. The central damage cost estimate for ammonia was £7,923 per tonne of ammonia, with a low – high damage cost sensitivity range of £1,521 per tonne to £24,467. Adopting option 1 rather than options 2 or 3 will mean that a reduction in ammonia emissions of between 21 and 28% will not occur and the economic benefits of ammonia reduction will not occur.

*Option 2: Develop and implement an Ammonia Strategy with lower cost measures only (21% ammonia reduction)*

Option 2 will have costs to farmers equivalent to those set out in Table 3 under the ‘Low Cost Measures Only’ column, in relation to the specific measures implemented and the rate of uptake and would achieve a significant benefit to Northern Ireland in terms of ammonia reduction. However, since it does not include a range of feasible ammonia reduction measures, option 2 will not fully deliver either of the objectives of the Ammonia Strategy and therefore Northern Ireland is at significant risk of not achieving its fair share of the UK’s international ammonia reduction target under the Gothenburg Protocol. There would also be significantly reduced benefits in outcomes for nitrogen sensitive species and habitats, public health, and air quality in NI.

The economic benefits of Option 2 have been assessed by multiplying the assumed ammonia reduction of 21% (6.53kT) by the damage costs of ammonia, as per the Ricardo report described above.

*Option 3: Develop and implement an Ammonia Strategy including the full range of feasible ammonia reduction measures (25 to 28% ammonia reduction)*

Option 3 will have costs equivalent to those set out in Table 3 under MACC 1 or MACC 3, in relation to the specific measures implemented and the rate of uptake. The combination of available technical measures will provide an ambition in the level of ammonia reduction not provided by the other options.

Option 3 has the highest cost to the farming sector but is the only option capable of delivering the scale of ammonia reduction required to enable Northern Ireland to achieve its fair share of the UK’s international ammonia reduction target under the Gothenburg Protocol and deliver the benefits of improvement in outcomes for nitrogen sensitive species and habitats, public health, and air quality in NI. Its economic benefits to the environment and to public health are greater than its costs.

Option 3 will support DAERA’s delivery of the existing legislative requirements listed as well as future cross cutting DAERA key policy proposals including the Green Growth Strategy.

The economic benefits of Option 3 have been assessed by multiplying the ammonia reduction achieved by MACC 3 (7.88kt) by the low ammonia damage cost (£1,521 cost per tonne of ammonia. The highest economic benefit is assessed £217m per annum using MACC 1 and the high ammonia damage cost (8.88kT reduction at £24,1467 cost per tonne of ammonia). The best estimate of an economic benefit of £66.4m is derived using a midpoint between the ammonia reduction achieved by MACC 1 and MACC 3 (8.38kT) and multiplying by the central ammonia damage cost of £7,923 cost per tonne of ammonia.

* **Rationale and evidence that justify the level of analysis used in the RIA (proportionality approach)**

To inform policy on ammonia emissions, DAERA commissioned a multi-year research programme on ammonia, led by the Agri Food and Biosciences Institute and incorporating the UK Centre for Ecology and Hydrology (UKCEH) and Rothamsted Research as partners, and informed by the recommendations of the Expert Working Group in ‘Making Ammonia Visible’ report[[6]](#footnote-6).

***Ammonia research programme evidence outputs to date:***

* Clear evidence of direct damage to sensitive species and habitats due to excess ammonia levels and associated nitrogen deposition.
* Provision of increased granularity in the NI Ammonia Inventory on cattle housing periods; pig housing systems; free range poultry systems; broiler heating systems; and slurry application.
* Verification of ammonia modelling systems through establishment of a UK leading ammonia monitoring network.
* Modelled outputs of the impact of suites of ammonia reduction measures at differing implementation rates on farms across NI.
* Modelled outputs of the impact of implementing specific suites of ammonia reduction measures on farms in targeted zones around designated sites.

***Key policy messages arising from the research evidence base:***

* A long-term strategic approach is needed to address ammonia emissions and their impact.
* The first steps in this strategy are to set specific targets for reduction of Northern Ireland ammonia emissions and ammonia concentration levels at designated sites and implement an ambitious programme of measures to reduce emissions.
* Measures selected should take account of cost effectiveness.
* Targeting measures around selected designated sites provides greater benefit to protected habitats and will be required to deliver more urgent action to address exceedance and support development.
* Conservation management programmes will be required to restore habitats impacted by excess ammonia levels and associated nitrogen deposition.
* Development of new ‘next generation’ ammonia solutions should be included in future iterations of ammonia reduction strategies.

The analysis above has informed both the development of the draft NI Ammonia Strategy and also this Regulatory Impact Assessment and is considered a comprehensive and proportionate evidence base which will be added to as the draft strategy undergoes public consultation.

**Risks and Assumptions**

Modelling work completed in the ammonia research programme used the Marginal Abatement Cost Curve Method (MACC) to quantify the amount of ammonia mitigation that can be achieved at a given cost. Results are shown in Table 3. The MACC approach takes into account the net additional, or marginal, abatement and associated cost of combining several measures together (ie the measures are not simply additive). The NH3 emissions and mitigation scenarios were based on activity data and emission factors from the 2019 UK NH3 inventory submission.

The costs of measures in the MACC typically include two elements: capital investment and annual running costs. In calculating the total costs to the farmer, these two elements were combined by adding the annualised cost (annual charge) of the capital element to the estimated annual running costs.

Table 3. MACC results for use of all mitigation measures (MACC 1 & MACC 3) compared with use of low-cost measures only (MACC 2).



Table 3 MACC results illustrate the relationship between cumulative reductions in ammonia levels achievable and the cumulative cost per annum. Mitigation measures requiring engineering solutions such as housing modifications greatly increase the costs of ammonia reduction and achieve reductions close to the Ammonia Strategy target of 30%. Conversely the use of low-cost measures only gives overall ammonia reductions well below the target.

The ‘low-cost measures only’ (MACC 2) option in Table 3 offers the most applicable modelled illustration of RIA Option 2 (Develop and implement an Ammonia Strategy with low-cost measures only). Results demonstrate that under this option the 30% reduction target, at these specified uptake rates, is not achievable.

Under the Option 3 approach (Develop and implement an Ammonia Strategy including the full range of feasible ammonia reduction measures () the potential ammonia reduction rises to between 25 and 28%, at the specified uptake rates. If the uptake rates mandated under the MACC3 approach in Table 3 are increased there is potential for the total ammonia reduction to be greater than the modelled 28.1%.

Each of the three MACC scenarios modelled are described and detailed below:

**MACC 1**

The scenario developed for this MACC includes all mitigation measures with the exception of washing of hard standings with increased frequency of scraping. Assumptions were made regarding uptake rates based on what could potentially be achieved in a 5 to 10 year period within Northern Ireland using the NARSES model that was modelled in 2018. Details of the mitigation measures implemented in MACC 1, their implementation rate, and the upfront capital outlay required are shown in Table X. The reductions in ammonia achieved by MACC 1 are shown in Table X.

Table X Summary of MACC 1 ammonia reductions and cost.

Graphical user interface

Description automatically generated

Table 4. MACC1 details.

|  |  |  |
| --- | --- | --- |
| MACC 1 | Mitigation measures implemented | Implementation rate |
| 1 | Extended grazing | 100% implemented for all cattle; 2 weeks additional grazing |
| 2 | Lower CP diets for livestock | 75% of dairy, beef, pig and poultry associated with low CP diets |
| 3 | Genetic improvement for cattle, pigs and poultry | 50% of cattle, 75% of pigs and poultry; 5% reduction in N excretion |
| 4 | Stabilised urea | 100% of urea |
| 5 | Low emission slurry application | 45% trailing hose, 45% trailing shoe, 10% shallow injection |
| 6 | In-field slurry application | 10% slurry applied with in-field acidification |
| 7 | Pig and poultry housing - acid scrubbers | 75% of pig and poultry housed; replace existing measures as necessary |
| 8 | In-house slurry acidification | 5% dairy cattle and 5% finishing pigs |
| 9 | Comfort slat mats - dairy cattle | 30% of dairy cattle |
| 10 | Fixed slurry store covers | 30% of above-ground slurry |
| 11 | Comfort slat mats - beef cattle | 30% of beef cattle slurry |

**MACC 2**

The scenario developed for this MACC focused only on the five lowest cost ammonia mitigation measures. Results of the Ammonia MACC 2 model reveal a total achievable reduction in ammonia emissions of 6.5kt NH3, costing £6.6M per annum to implement and reducing ammonia emissions by 21% compared to business as usual. However, while the MACC 2 scenario achieved a 21% reduction in emissions with just 5 measures, it is important to note that there may be more complexities involved in monitoring compliance of uptake of these low-cost measures. Uptake rates assumed for the following mitigation measures are shown in Table X.

Table X Summary of MACC 2 ammonia reductions and cost.

Graphical user interface, chart

Description automatically generated

Table 5 MACC 2 details.

|  |  |  |
| --- | --- | --- |
| MACC2 | Mitigation measures implemented | Implementation rate |
| 1 | Extended grazing | 100% implemented for all cattle; 2 weeks additional grazing |
| 2 | Lower CP diets for livestock | 75% of dairy, beef, pig and poultry associated with low CP diets |
| 3 | Genetic improvement for cattle, pigs and poultry | 50% of cattle, 75% of pigs and poultry; 5% reduction in N excretion |
| 4 | Stabilised urea | 100% of urea |
| 5 | Low emission slurry application | 75% trailing hose, 25% trailing shoe |

**MACC 3**

Following further discussion mitigation measures identified in MACC 1 were further re-examined with their associated uptake rates. Therefore, the scenario developed for MACC 3 focused on ammonia mitigation measures in MACC 1 with the exception of shallow injection. The scenario also included washing of collecting yards for dairy cows and separated out low emission housing using acid scrubbers for pigs, layers and broilers (i.e. these were combined as one measure in MACC 1). These gave a total of 14 measures for analysis. Furthermore, scenarios in MACC 3 revised uptake rates for low emission spreading techniques, and acid scrubbers for pigs and poultry housing.

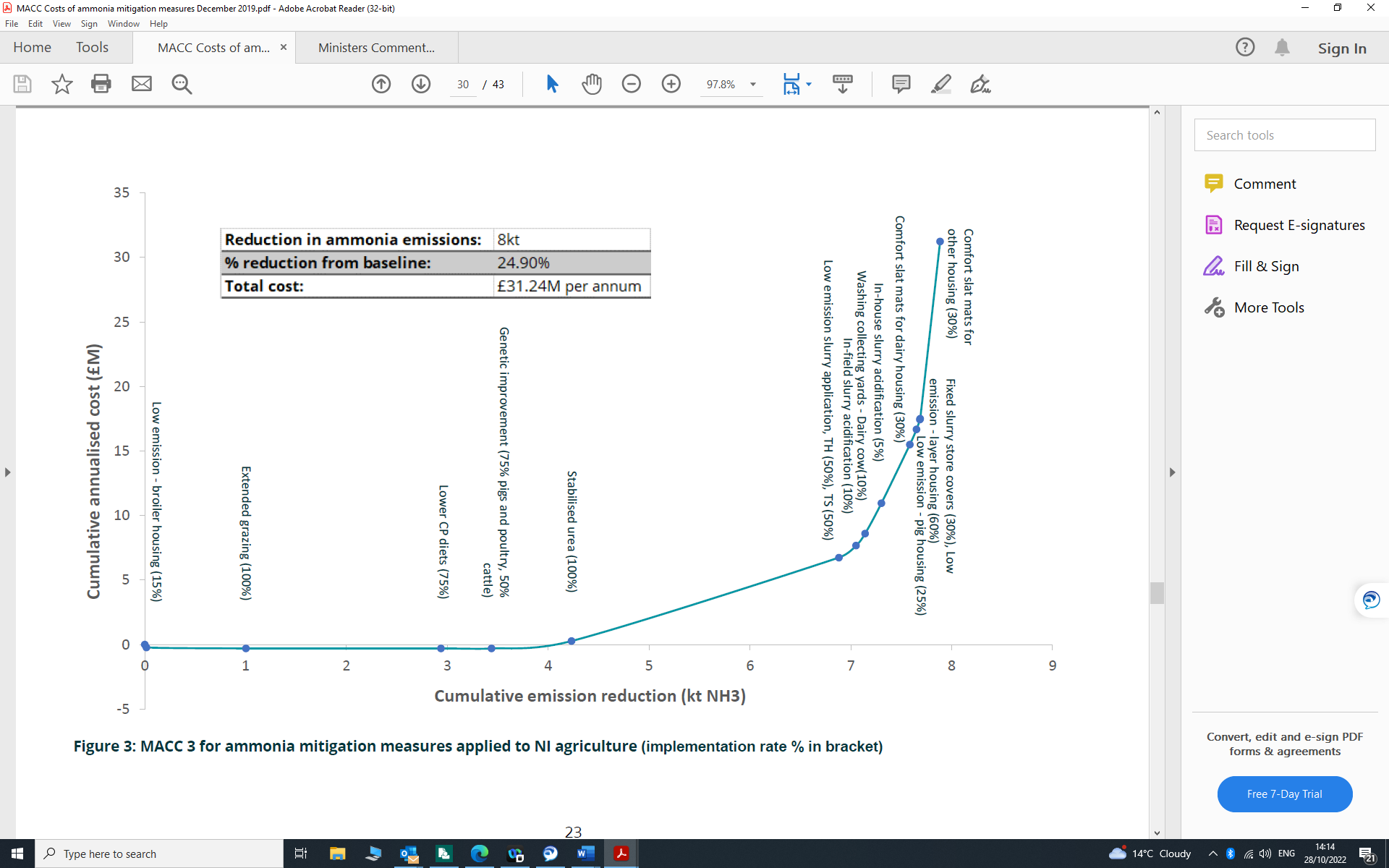
Table X Summary of MACC 3 ammonia reductions and cost.

Table 6 MACC 3 details.

|  |  |  |
| --- | --- | --- |
| MACC 3 | Mitigation measures implemented | Implementation rate |
| 1 | Low emission broiler housing | 15% uptake of litter acidification with alum |
| 2 | Extended grazing | 100% implemented for all cattle; 2 weeks additional grazing |
| 3 | Lower CP diets for livestock | 75% of dairy, beef, pig and poultry associated with low CP diets |
| 4 | Genetic improvement for cattle, pigs and poultry | 50% of cattle, 75% of pigs and poultry; 5% reduction in N excretion |
| 5 | Stabilised urea | 100% of urea |
| 6 | Low emission slurry application | 50% trailing hose, 50% trailing shoe |
| 7 | In-field slurry acidification | 10% slurry applied with in-field acidification |
| 8 | Washing of collecting yards - dairy cows | 15% (assume washing down) |
| 9 | In-house slurry acidification | 5% dairy cattle and 5% finishing pigs |
| 10 | Comfort slat mats - dairy cattle | 30% of dairy cattle |
| 11 | Low emission pig housing - acid scrubbers | 25% uptake |
| 12 | Fixed slurry store covers | 30% of above-ground slurry |
| 13 | Low emission poultry housing | 60% acid scrubbers for layers |
| 14 | Comfort slat mats - beef cattle | 30% of beef cattle slurry |

Uptake rates for ammonia mitigation measures are the key risk factor and determinant of total ammonia reduction. Changes in economic analysis of cost effectiveness of ammonia reduction measures due to external factors such as the rise in cost of fertiliser and other key agricultural inputs is a significant risk.

It is assumed that if livestock numbers increase, additional effort will be required to reach the targets highlighted in the strategy. Similarly, if livestock numbers fall, then reductions in emissions will be achieved and the effort required in relation to ammonia reduction measures may not be as high.

* **Direct costs and benefits to business**

The Ammonia Strategy is a plan for addressing the challenge of ammonia emissions in Northern Ireland. While the above information provides a summary analysis of the likely costs and benefits of the various ammonia measures, DAERA recognises that regulation to implement specific ammonia reduction measures will require bespoke analysis to identify the direct costs and benefits to business of each measure. This RIA will be updated in advance of finalisation of the Ammonia Strategy to take into account the specific suit of measures agreed following consultation.

**Annex A**

Calculation of the benefits of Options using the damage costs avoided approach.[[7]](#footnote-7)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **ammonia reduction kt (%)** | **1.87 (5.9)** | **6.5 (21)** | **8 (24.9)** | **8.9 (28)** |
| **Ricardo paper: damage costs of air quality at UK level** | **£/tonne i.e. ammonia damage costs avoided** | **Option 1 benefits (£m)** | **Option 2 benefits (£m)** | **Option 3 benefits (£m)** | **Option 3 benefits (£m)** |
| **low** | **1,521** | **2.84** | **9.89** | **12.17** | **13.54** |
| **med** | **7,923** | **14.82** | **51.50** | **63.38** | **70.51** |
| **high** | **24,467** | **45.75** | **159.04** | **195.74** | **217.76** |

1. <https://uk-air.defra.gov.uk/assets/documents/reports/cat09/2007031424_Damage_cost_update_2020_FINAL.pdf> [↑](#footnote-ref-1)
2. <https://www.teagasc.ie/media/website/publications/2020/NH3-Ammonia-MACC.pdf> [↑](#footnote-ref-2)
3. Air Pollutant Inventories for England, Scotland, Wales, and Northern Ireland: 2005-2019 NB Figures may not add up exactly due to rounding. [↑](#footnote-ref-3)
4. https://uk-air.defra.gov.uk/assets/documents/reports/cat09/2208301034\_Trends\_Report\_2022.pdf [↑](#footnote-ref-4)
5. https://uk-air.defra.gov.uk/assets/documents/reports/cat09/2007031424\_Damage\_cost\_update\_2020\_FINAL.pdf [↑](#footnote-ref-5)
6. <https://www.daera-ni.gov.uk/articles/ammonia-emissions-northern-ireland> [↑](#footnote-ref-6)
7. <https://uk-air.defra.gov.uk/assets/documents/reports/cat09/2007031424_Damage_cost_update_2020_FINAL.pdf> [↑](#footnote-ref-7)