



Department  
for Environment  
Food & Rural Affairs

# Consultation on reducing ammonia emissions from solid urea fertilisers

**November 2020**



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# Introduction

The government is determined to improve our air quality and natural environment. In the Clean Air Strategy<sup>1</sup>, we outline our plans to tackle air pollution from several sources such as industrial processes, domestic heating and, via a range of measures, from agriculture. Our commitment to restore 75% (by area) of protected habitats to favourable condition, among other environmental commitments, is outlined in the 25 Year Environment Plan<sup>2</sup>. This consultation seeks views on proposals designed to reduce ammonia emissions from agriculture and, more specifically, from the use of solid urea fertilisers. Agriculture contributes 87% of the UK's ammonia emissions<sup>3</sup>. Most agricultural ammonia emissions come from livestock manures in animal housing and stores, and when manures and inorganic fertilisers are applied to land. Around 18% of agriculture-derived ammonia emissions are from inorganic fertiliser application<sup>4</sup> and solid urea fertilisers release greater ammonia emissions than any other inorganic fertilisers, contributing 8% of the UK's ammonia emissions<sup>5</sup>.

Ammonia (NH<sub>3</sub>) is a gaseous air pollutant that impacts negatively on human health and ecosystems. **Figure 1** is a simplified diagram of some of the sources of ammonia and its effects on the environment. In relation to human health, ammonia reacts with other pollutants such as nitrogen oxides and sulphur dioxide to form particulate matter (PM) that is inhaled and affects cardiovascular and respiratory health. Ammonia emissions are harmful to the environment because it is toxic to some plant species and results in deposition of nitrogen-containing compounds onto vegetation and soils. Nitrogen deposition can lead to the acidification of soil and promotes growth of nitrogen-loving plant species. These impacts result in a loss of biodiversity in sensitive terrestrial and aquatic habitats. When ammonia is deposited on land through atmospheric deposition it leads to emissions of nitrous oxide (a greenhouse gas) and nitrate leaching (drainage from the soil) and run-off, which pollute water courses. There is a risk that inadequate action to reduce nitrogen deposition will mean that the target set out in the 25 Year Environment Plan cannot be reached. Between 2014 and 2016 more than 86% of designated sites in

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<sup>1</sup> <https://www.gov.uk/government/publications/clean-air-strategy-2019>

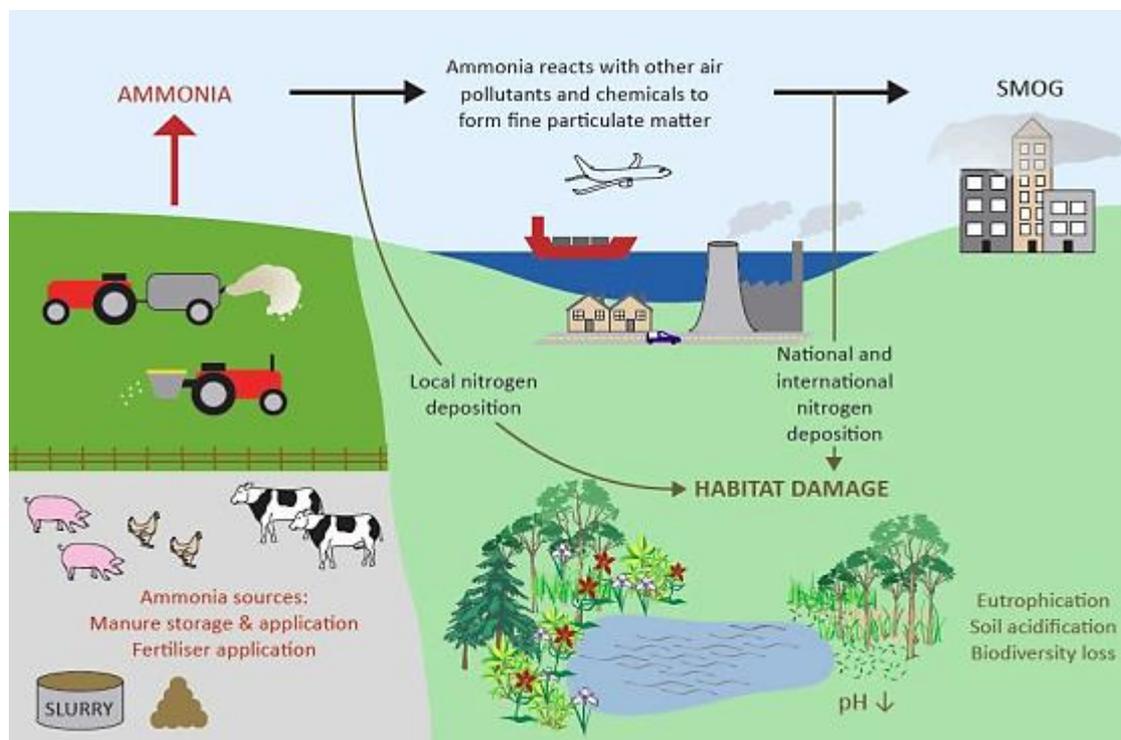
<sup>2</sup> <https://www.gov.uk/government/publications/25-year-environment-plan#history>

<sup>3</sup> Emissions of air pollutants in the UK, 1970 to 2018 – Ammonia (NH<sub>3</sub>), <https://www.gov.uk/government/publications/emissions-of-air-pollutants/emissions-of-air-pollutants-in-the-uk-1970-to-2018-ammonia-nh3>

<sup>4</sup> [https://uk-air.defra.gov.uk/assets/documents/reports/cat09/1903141332\\_UK\\_Agriculture\\_Ammonia\\_Emission\\_Report\\_1990-2017.pdf](https://uk-air.defra.gov.uk/assets/documents/reports/cat09/1903141332_UK_Agriculture_Ammonia_Emission_Report_1990-2017.pdf)

<sup>5</sup> See Impact Assessment: Proposed regulation to reduce ammonia emissions from solid urea fertilisers in England. This Impact Assessment accompanies the consultation on Citizen Space: <https://consult.defra.gov.uk/air-quality-and-industrial-emissions/reducing-ammonia-emissions-from-urea-fertilisers>

England received more nitrogen than they could tolerate<sup>6</sup>. In addition, the government is determined to reduce ammonia emissions levels (from the base year 2005) by 8% (31 kilotons) by 2020, and 16% (51kt) by 2030<sup>7</sup>, via the National Emission Ceilings Regulations 2018.



**Figure 1: Environmental impacts of ammonia pollution<sup>8</sup>.**

This consultation presents proposals implementing the first of several regulatory measures (outlined in the Clean Air Strategy) to be applied to the agriculture sector. The following are the three main options that reduce ammonia emissions from urea fertilisers in a cost-effective way:

1. A ban on solid urea fertilisers ("**Ban**"). Preferred option: provides the most ammonia emission reductions (abatement) of the three options.
2. A requirement to stabilise solid urea fertilisers with the addition of a urease inhibitor ("**Urease Inhibitor**"). Achieves less ammonia reductions than Option 1.

<sup>6</sup> [https://uk-air.defra.gov.uk/assets/documents/reports/cat09/1908280952\\_Trends\\_Report\\_2019.pdf](https://uk-air.defra.gov.uk/assets/documents/reports/cat09/1908280952_Trends_Report_2019.pdf)

<sup>7</sup> National Emission Ceilings Regulations 2018, <http://www.legislation.gov.uk/ukxi/2018/129/schedule/3/made>

<sup>8</sup> <https://www.gov.uk/government/publications/code-of-good-agricultural-practice-for-reducing-ammonia-emissions/code-of-good-agricultural-practice-cogap-for-reducing-ammonia-emissions>

3. A requirement to restrict the spreading of solid urea fertilisers, allowable only from 15 January to 31 March (“**Restricted Period**”)<sup>9</sup>. Achieves less ammonia reductions than Options 1 and 2.

As part of the process of changing the law, or introducing new regulations, the government is committed to consulting those likely to be affected by the change. This approach ensures that we take into account their views and the impacts the policy change will have.

## Stakeholder engagement

In the development of our proposals, government has consulted directly with the fertilisers and agriculture industries and with a wider stakeholder group including environmental organisations and members of the public through the Clean Air Strategy consultation<sup>10</sup>.

## Devolved Administrations

The National Emissions Ceilings Regulations 2018 requires UK-wide emissions reductions. However, environmental and agricultural policies are devolved. Therefore Defra is consulting on these proposals on an England-only basis but will consider joint legislation if other administrations choose to adopt the same implementation approach. The Northern Irish government is considering measures on how to reduce ammonia emissions from urea fertilisers and the Welsh Government will be consulting on urea fertilisers shortly. It is worth noting that solid urea fertilisers are used much more in England than anywhere else (149kt of solid urea nitrogen in England compared with the next biggest use in Scotland, of 21kt, in 2017).

## Structure of the document

This document will proceed to provide additional background information and describe each of the three policy options with a range of questions listed at the end of each proposal. A list of all of the consultation questions are included in the annexes at the end of this document.

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<sup>9</sup> For more information on the other policy options considered, please refer to the accompanying Impact Assessment: <https://consult.defra.gov.uk/air-quality-and-industrial-emissions/reducing-ammonia-emissions-from-urea-fertilisers>

<sup>10</sup>

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/770714/draft-clean-air-strategy-consult-sum-resp.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/770714/draft-clean-air-strategy-consult-sum-resp.pdf)

The Impact Assessment published with this consultation provides an analysis of the estimated costs and benefits of the proposals and it is recommended that it is read in conjunction with this document.

# Background: N fertilisers and other measures to reduce ammonia emissions

## Nitrogen fertilisers

Nitrogen (N) is one of four key plant nutrients that are required in relatively large amounts for crops to achieve their optimal growth, yield and quality potential. The others are phosphorus, potassium and sulphur. While the vast majority (98%) of natural nitrogen is locked away in the lithosphere (earth's crust and upper mantle) and around 2% is in the atmosphere, in order for plants to take up the atmospheric N it has to be converted (or "fixed") to a more usable form. Most agricultural soils in the UK contain little plant-available nitrogen (0.2%) and hence the need for supplementary nitrogen fertilisers.

Supplementary nitrogen fertiliser supply comes in organic (slurry, manure) or inorganic (urea, ammonium nitrate) form. Urea fertiliser is converted to ammonium and nitrate, both of which is then taken up by plants. Ammonium nitrate fertiliser is more soluble in water than urea and so the ammonium and nitrate is more quickly available to plants. The fundamental drawback with the application of supplementary nitrogen is that not all of the nitrogen is taken up by plants; large amounts (up to 50%) is lost to the environment as a pollutant through evaporation (or volatilisation), bacterial chemical conversion processes in the soil (known as nitrification and denitrification) or through run-off or leaching.

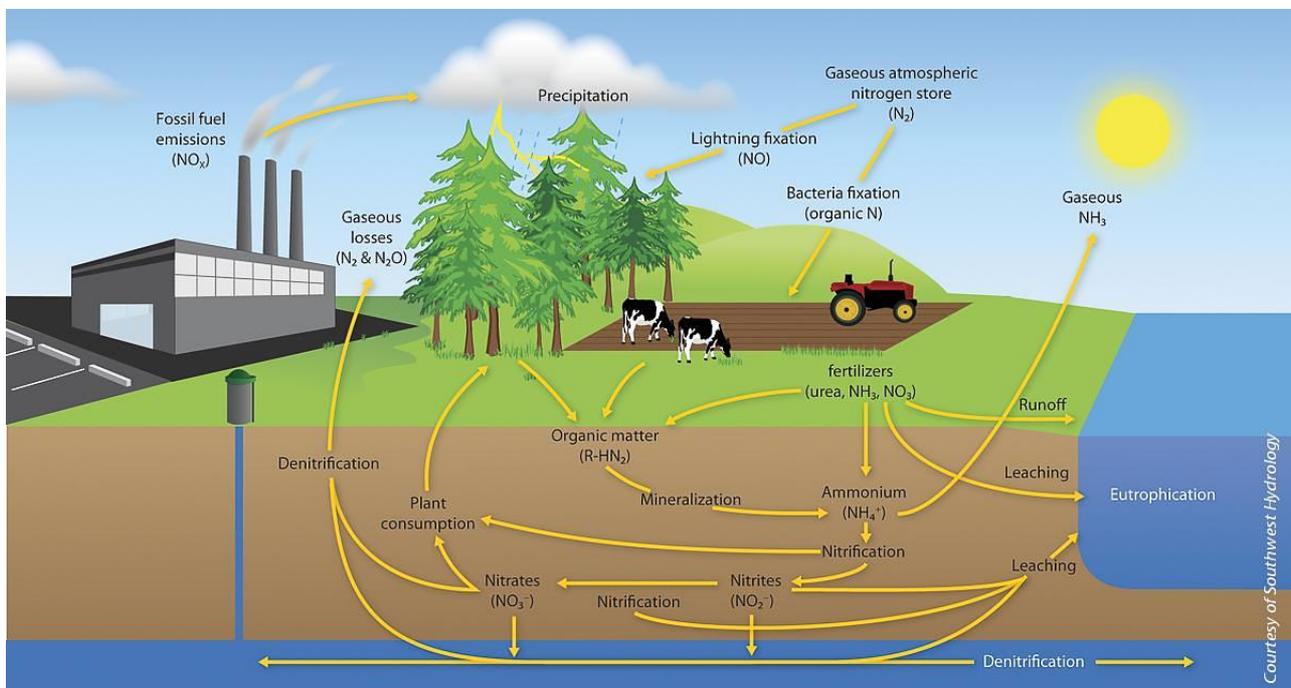


Figure 2: Nitrogen cycle incorporating the three ways nitrogen is fixed: biologically via

**bacteria and organic matter, through lightening and precipitation, and industrially (via fertilisers)<sup>11</sup>.**

This reactive nitrogen is lost predominantly to air (as ammonia – NH<sub>3</sub>, nitrous oxide – N<sub>2</sub>O) and water (as nitrite – NO<sub>2</sub><sup>-</sup>, nitrate – NO<sub>3</sub><sup>-</sup> or ammonium – NH<sub>4</sub><sup>+</sup>) impacting our air quality, water quality and contributing to climate change (**Figure 2**). In general, solid urea will lose more nitrogen as a pollutant than ammonium nitrate but with differences in the form of loss. Solid urea will predominantly lose nitrogen in the form of ammonia and ammonium nitrate will lose less nitrogen but in the forms of nitrous oxide and nitrate.

Agriculture accounts for 10% (45 megatons) of UK greenhouse gas (GHG) emissions, and around 70% (14.3mt) of these are in the form of nitrous oxide emissions<sup>12</sup>. Agriculture also accounts for around 70% of nitrate pollution in both surface and ground waters, which can harm aquatic biodiversity and has to be removed before water can be safely supplied to consumers<sup>13</sup>. There is, then, a real need for an integrated approach to reducing reactive nitrogen loss and increasing nitrogen use efficiency across all agricultural practices<sup>14</sup>. It is not always possible for any single measure to deliver improvements across air, water and climate, but as a whole the measures that will need to be taken by the agriculture sector will together improve air quality, water quality and tackle climate change.

In the Clean Air Strategy, Defra committed to regulate to minimise pollution from fertiliser use, seeking advice from an Expert Group on the optimal policy approach. The Nutrient Management Expert Group has now been appointed, and will run over the next 16 months. The Expert Group will independently review and analyse existing policy, alongside up-to-date technical and scientific evidence on fertilisers and nutrient management. It will consider the multiple challenges surrounding nutrient management (reaching Net Zero by 2050, enhancing soil health, improving water and air quality, protecting natural biodiversity and managing resources sustainably) and develop recommendations on the optimal policy approaches to minimise nitrogen-based and other pollution and greenhouse gas emissions from fertiliser use. The Group will engage with sector sounding boards, including industry representatives and other key stakeholders, to ensure its recommendations have practical merit.

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<sup>11</sup> University of California. Accessed 15/06/2020: <http://calag.ucanr.edu/Archive/?article=ca.E.v067n01p68>

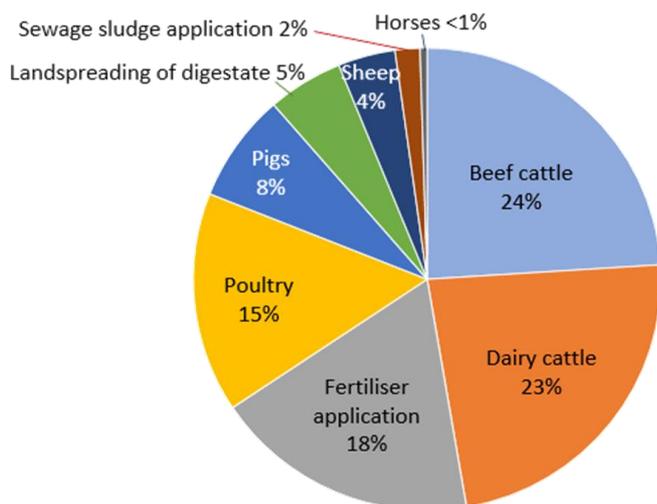
<sup>12</sup> National Atmospheric Emissions Inventory 2018 factsheet: [https://naei.beis.gov.uk/resources/Sector\\_Summary\\_Factsheet\\_2020-v2.html](https://naei.beis.gov.uk/resources/Sector_Summary_Factsheet_2020-v2.html)

<sup>13</sup> [https://consult.environment-agency.gov.uk/++preview++/environment-and-business/challenges-and-choices/user\\_uploads/nitrates-pressure-rbmp-2021.pdf](https://consult.environment-agency.gov.uk/++preview++/environment-and-business/challenges-and-choices/user_uploads/nitrates-pressure-rbmp-2021.pdf)

<sup>14</sup> UNECE, 2018, Options for ammonia mitigation: guidance from the UNECE Task Forces on Reactive Nitrogen. Available at <http://www.inms.international/options-ammonia-mitigation-guidance-unece-task-force-reactive-nitrogen>

## Clean Air Strategy proposals for agriculture

The Clean Air Strategy 2019 sets out an ambitious package of legislation and support that will be required to meet the 2030 ammonia reduction target. As mentioned, agriculture accounted for 87% of the UK's ammonia emissions in 2017 (which remained the same for 2018) and **Figure 3** shows the different sources of ammonia and other reactive nitrogen emissions from agriculture.



**Figure 3: 2017 Sources of UK emissions of ammonia from agriculture (Defra analysis)**

Within the Clean Air Strategy, as well as setting out our intention to consult on how we may reduce ammonia emissions from urea fertilisers, we stated that we would:

- Require use of low emission spreading techniques (for slurry and digestate) by 2025
- Extend environmental permitting to the dairy and beef sectors by 2025
- Require slurry and digestate stores to be covered by 2027
- Incorporate manures into bare soil within 12 hours of spreading
- Introduce standards for new livestock housing (intensive pigs, poultry, dairy and beef)
- Introduce further regulation to reduce emissions from organic and inorganic fertilisers

The action needed to achieve the ammonia emissions reductions the UK has committed to will involve substantial changes in farming practice and major investment in farm infrastructure and equipment.

Our initial analysis suggests that out of all the actions set out in the CAS, action on solid urea fertilisers has the potential to deliver the greatest ammonia emission reductions in a cost-effective way. **Option 1**, a ban on the use or sale<sup>15</sup> of solid urea, has been selected as the preferred policy option because our analysis suggests this would form part of the most cost-effective package of policies to reduce ammonia emissions in line with 2030 UK commitments. If one of the options that offers lower ammonia emissions reductions was selected, more farms may be required to adopt one or more of the policies described above. Furthermore, additional, more costly measures to reduce ammonia emissions from agriculture, may be required, for example, through environmental permitting or standards for new livestock housing.

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<sup>15</sup> A ban on the sale of solid urea fertilisers will be subject to the developing proposals that will be finalised under the UK Internal Market Act (<https://www.gov.uk/government/publications/uk-internal-market/uk-internal-market>).

# Policy options for reducing ammonia emissions from solid urea fertilisers

## Introduction

Urea is a mineral (or “synthetic” or “inorganic”) fertiliser that is produced in a chemical process by reacting ammonia with carbon dioxide, and is the predominant source of nutrient nitrogen in agriculture globally. “Straight” urea typically contains 46% ureic nitrogen (as carbamide,  $\text{CO}(\text{NH}_2)_2$ ) and can be manufactured in solid (as granules or prills) or liquid (urea ammonium nitrate, UAN) form.

In the UK the most common forms of urea are:

- Urea
- Urea ammonium nitrate, UAN (a liquid mix of ammonium nitrate and urea)
- Urea ammonium sulphate, UAS (a solid mixture of urea and ammonium sulphate)

Nitrogen use in the UK has been on a downward trend since the maximum usage that was seen in the 1980s, primarily due to a decrease in use on grassland<sup>16</sup>. The most dominant form of nitrogen fertiliser in the UK is ammonium nitrate although urea use is increasing and currently accounts for 20% of all inorganic nitrogen fertiliser use<sup>17</sup>. Around 40% of ammonium nitrate used is produced in the UK with around 57% imported from the EU and around 3% imported from outside the EU, on average from 2015 to 2018<sup>18</sup>. Urea is not produced at all in the UK and is mostly imported from Egypt, Germany, Russia and the Netherlands – these countries accounted for around 71% of the total imports averaged between 2015 and 2018<sup>19</sup>. All of the policy options proposed for England presented below relate solely to the restriction on the use or sale of solid urea fertilisers. Furthermore, considering the experience of the German government around the percentage of carbamide content (see the section below on International Examples of Action on Urea Fertilisers), due consideration will need to be given on the scope of the policies. We are

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<sup>16</sup> 2018 British Survey of Fertiliser Practice (BSFP) accessed here:

<https://www.gov.uk/government/statistics/british-survey-of-fertiliser-practice-2018>

<sup>17</sup> UK Informative Inventory Report (IIR) for the National Atmospheric Emissions Inventory (NAEI): [https://uk-air.defra.gov.uk/assets/documents/reports/cat09/1904121008\\_GB\\_IIR\\_2019\\_v2.0.pdf](https://uk-air.defra.gov.uk/assets/documents/reports/cat09/1904121008_GB_IIR_2019_v2.0.pdf)

<sup>18</sup> UK trade information comes from HM Revenue and Customs. You can build your own table of products from here: <https://www.uktradeinfo.com/Statistics/BuildYourOwnTables/Pages/Home.aspx>.

<sup>19</sup> Ibid.

proposing that a solid fertiliser is to be considered in-scope if it contains more than 1% carbamide nitrogen. This means that any solid compound fertilisers (as well as straight urea) that contain more than 1% of ureic nitrogen will be considered as in-scope for the presented policy options.

Options to restrict the use of liquid fertiliser products containing urea, such as urea ammonium nitrate (UAN), were considered during policy development but these have now been exempt from the policy options in this consultation. Liquid urea fertiliser is particularly important for specific crops such as high-protein milling wheat, where the liquid fertiliser is applied as a foliar application late in the growing season for the crop to reach the protein level required by milling/baking industries<sup>20</sup>. It is understood that there is no viable replacement for UAN for these products. It has also been estimated that a switch from liquid to solid fertilisers would cost in the range of £20K to £30K per farm<sup>21</sup>. A switch from a solid to a liquid-based system would also involve additional costs due to the equipment and additional storage required. Therefore we do not anticipate that farmers are likely to change their fertiliser application methods to enable the use of liquid urea. With respect to Option 2, inhibitors may degrade in aqueous solution and it is understood that they are not available in pre-mixed solutions. Addition of urease inhibitors with liquid fertilisers containing urea would therefore require mixing with the fertiliser immediately before it is applied which would increase the length of the spreading operation. This option would therefore result in practical difficulties for farmers and compliance would be difficult to enforce.

The Impact Assessment associated with all the policy options is available on Citizen Space, where you can also see information on a range of other policy options considered (to reduce ammonia emissions) that are not brought forward in this consultation. There are a number of reasons why these policy options are not brought forward ranging from low cost-effectiveness (as in the case of restricting UAN or introducing dual nitrification and urease inhibitors) to inadequate effectiveness in reducing ammonia emissions (as in the case of a voluntary approach).

**Table 1** summarises the three main policy options considered for this consultation by comparing their ammonia emission reduction (abatement) potential, cost and benefits.

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<sup>20</sup> Impact Assessment on Urea Fertilisers on Citizen Space: <https://consult.defra.gov.uk/air-quality-and-industrial-emissions/reducing-ammonia-emissions-from-urea-fertilisers>

<sup>21</sup> Ibid.

**Table 1: Comparative emission abatement, costs and benefits of the three options**

		Abatement	Present	Present	Present	Benefit cost ratio
		(kt) 2022 / 2030	value benefits (£m) 2022-2030	value costs (£m) 2022-2030	value net benefits (£m) 2022- 2030	
<i>Options, England only</i>						
<b>Option 1 (preferred): Ban of solid urea</b>	Low	<b>15.9 / 15.7</b>	196.0	150.6	45.3	1.3
	<b>Central</b>		<b>1093.6</b>	<b>125.5</b>	<b>968.1</b>	<b>8.7</b>
	High		3450.5	100.4	3350.0	34.4
<b>Option 2: Urea + urease inhibitor</b>	Low	<b>12.8 / 12.7</b>	191.0	78.9	112.1	2.4
	<b>Central</b>		<b>950.2</b>	<b>65.8</b>	<b>884.5</b>	<b>14.5</b>
	High		2891.0	52.6	2838.4	54.9
<b>Option 3: Restricted application period</b>	Low	<b>11.8 / 11.7</b>	104.5	104.6	0.0	1.0
	<b>Central</b>		<b>824.3</b>	<b>87.1</b>	<b>737.1</b>	<b>9.5</b>
	High		2587.4	69.7	2517.5	37.1

Source: Defra estimates

## International examples of action on urea fertilisers

### 1. Germany

Germany is the only country that has regulations in place specifically controlling the use of urea fertilisers. The German Fertilisers Act in §6(2), specifies that;

*“From 1 February 2020, urea can only be applied as a fertiliser if a urease inhibitor is added, or if it is incorporated without delay or within four hours from its application”.*<sup>22</sup>

However, it is now understood that the definition of urea (with 44% carbamide nitrogen content) has proven to be problematic to enforce. Farmers have found this definition to be a loophole where they continue to use urea fertilisers with less than 44% carbamide nitrogen content. As a result, the policy is currently under review.

The Impact Assessment<sup>23</sup> accompanying this consultation has an annex on the experience of Germany’s revision of the German Fertilisers Act.

<sup>22</sup> [Working translation to English](#) of the "Düngeverordnung vom 26. Mai 2017 (BGBl. I S. 1305)"

<sup>23</sup> Impact Assessment is available here: <https://consult.defra.gov.uk/air-quality-and-industrial-emissions/reducing-ammonia-emissions-from-urea-fertilisers>

## 2. Action in other countries

Use of urea fertilisers is very low in Denmark and the Netherlands. They have taken substantial action to control ammonia emissions, leading to emissions reductions of 40% and 64%, respectively. Specific action to control use of urea fertilisers has not been taken, however both countries have imposed controls on the use of nitrogen fertilisers in general by applying plans and limits<sup>24</sup>

The Republic of Ireland published a consultation in November 2019 (“Ag-Climate”<sup>25</sup>) outlining a range of actions to help the country reduce its greenhouse gas emissions by 2030 from the agriculture sector. Action 2 (Promote the use of protected nitrogen products) aims to replace 50% of calcium ammonium nitrate with protected (i.e. urease inhibited) urea by 2022 and to prohibit the use of (uninhibited) urea by 2025.

### Questions: general urea fertilisers policy

*Q1a: Should the use of liquid fertilisers (such as UAN) containing urea remain unrestricted? Yes/No/No view.*

*Q1b: If No, why?*

*Q2a: Should the policy applied relate to solid compound fertilisers (as well as solid straight urea fertilisers)? Yes/No/Don't know.*

*Q2b: If No, what solid compound fertilisers should/should not be restricted and why?*

*Q2c: If you agree should the policy applied relate to all compound fertilisers containing greater than 1% carbamide (ureic) nitrogen? Yes/No/Don't know.*

*Q2d: If you disagree what should be the threshold of carbamide nitrogen content in order for the policy to reduce ammonia emissions to be effective?*

*Q3a: Do you agree or disagree with the Impact Assessment results for each of the policy options presented? Agree/Disagree/Don't know.*

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<sup>24</sup> Taken from the Clean Air Strategy 2019: <https://www.gov.uk/government/publications/clean-air-strategy-2019>.

<sup>25</sup>

<https://www.agriculture.gov.ie/media/migration/ruralenvironment/climatechange/bioenergy/ClimateandAirRoadmapfortheAgriculturalSector141119.pdf>. Ireland release additional guidance on UI here: <https://www.teagasc.ie/media/website/environment/climate-change/Andy-Boland--Patrick-Forrestal-Protected-Urea-April-2019-resized.pdf>.

Q3b: If you disagree please specify which of the results you disagree with and provide additional evidence to support your response.

Q4a: Would these policy options (on an England only basis) have a significant impact on the UK internal market and ensure a level playing field for users? Yes/No.

Q4b: If Yes, please indicate how.

## Option 1 (preferred approach): Ban on the use or sale of solid urea fertilisers

### Introduction

This policy option would ban the use or sale of all solid urea fertilisers in England. There are a range of alternative ways to support plant growth and generate nitrogen inputs, including the use of green manures, herbal leys and biostimulants among others. Under this option we would expect farmers to mostly use ammonium nitrate in place of solid urea fertiliser. Of all the policies analysed, a ban would lead to the greatest reduction in ammonia emissions, which is estimated to be 15.9kt by 2022. A ban on the use or sale of solid urea is the preferred policy option because it would result in a greater amount of ammonia emissions reduction than the other policy options analysed and put forward in this document.

### Impacts

#### A. Economic

Costs (from 2022 to 2030) to industry (including farmers and fertiliser manufacturers) is estimated to be £125.5m with net benefits of £968.1m. Ammonium nitrate is already the most used inorganic fertiliser in the UK. It is anticipated that this option would increase demand for ammonium nitrate and that we may need a supply of an additional 388,000 tonnes by 2022<sup>26</sup>. Import/export data for fertilisers show that the UK exported over 160,000t and imported over 320,000t<sup>27</sup> indicating that we may need to import an additional 227,000t per year. Therefore a substantial additional volume of imported ammonium nitrate is likely to be required under this policy. Other important considerations are that

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<sup>26</sup> Impact Assessment available here: <https://consult.defra.gov.uk/air-quality-and-industrial-emissions/reducing-ammonia-emissions-from-urea-fertilisers>

<sup>27</sup> UK trade information comes from HM Revenue and Customs. You can build your own table of products from here: <https://www.uktradeinfo.com/Statistics/BuildYourOwnTables/Pages/Home.aspx>.

additional secure storage capacity may be required on farms and in ports where the imported ammonium nitrate lands. In terms of crop yield, a Defra study found that solid urea fertilisers were commonly a less efficient nitrogen source than ammonium nitrate. Around 20% higher N rates were needed for urea fertilisers in order to achieve the same cereal crop yield and grain N/protein concentration compared to use of ammonium nitrate<sup>28</sup>.

## B. Environmental

Ammonium nitrate fertiliser loses much less nitrogen in the form of ammonia than urea when it is spread to land, it is retained in the soil longer and taken up by the crop more efficiently<sup>29</sup>. However, as ammonium nitrate is more susceptible to nitrogen loss via nitrate leaching and nitrous oxide emissions, this policy option could have a negative impact on water quality and greenhouse gas emissions, through increased use of ammonium nitrate. Effective nutrient management following current guidelines, and a focus on increasing nitrogen use efficiency (choosing appropriate products to apply to appropriate crops in appropriate conditions), could help mitigate these impacts<sup>30</sup>. This policy is complementary with Nitrate Vulnerable Zones<sup>31</sup> and Farming Rules for Water<sup>32</sup> regulations, both of which regulate the application of fertilisers in the specific interests of sensitive habitats and water courses, respectively.

### i. Water quality

An assessment of water quality in England found that 86% of river water bodies had not reached good ecological status with agriculture being one of the major reasons. Only 47% of ground waters protected for drinking water achieved good chemical status under the Water Framework Directive and nitrates (80% of which from agriculture) accounted for

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<sup>28</sup> Defra NT2605: The behaviour of some different fertiliser-N materials – Main experiments. The report referenced is WP1a Crop Responses:

[http://sciencesearch.defra.gov.uk/Document.aspx?Document=NT2605\\_4061\\_FRP.doc](http://sciencesearch.defra.gov.uk/Document.aspx?Document=NT2605_4061_FRP.doc).

<sup>29</sup> Information on the comparative nitrogen use efficiency between mineral fertiliser products can be found in a major study conducted in the UK (as part of the NT26 programme:

<http://sciencesearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=11983>) and in Ireland (as part of Teagasc's project):

<https://www.agriculture.gov.ie/media/migration/research/rsfallfundedprojects/11S138FinalReport%20210817.pdf>).

<sup>30</sup> AHDB Nutrient Management Guide: <https://ahdb.org.uk/nutrient-management-guide-rb209>

<sup>31</sup> <https://www.gov.uk/guidance/using-nitrogen-fertilisers-in-nitrate-vulnerable-zones#when-you-cant-spread-manufactured-nitrogen-fertilisers-closed-periods>

<sup>32</sup> <https://www.gov.uk/guidance/rules-for-farmers-and-land-managers-to-prevent-water-pollution#applying-fertiliser>

65% of the reasons for failure<sup>33</sup>. High concentrations of nitrate in ground waters have been shown to impact human health if threshold limits are exceeded. Nitrate in surface water can lead to excessive growth of algae and plants which then decompose resulting in oxygen depletion that can be harmful to fish.

An increase in ammonium nitrate use could lead to a small (up to 5%) increase in nitrate leaching to surface and ground waters<sup>34</sup> as ammonium nitrate is more soluble in water than solid urea. However, the amount of nitrate leached will depend on the quantity in the soil when the soil reaches field capacity<sup>35</sup> (i.e. the amount of water content in the soil after excess water drainage). This means that effective nutrient application management, as mentioned above, could mitigate this risk.

## ii. Greenhouse gas emissions

Nitrous oxide (N<sub>2</sub>O) is a powerful greenhouse gas and is one of the three forms of diffuse pollution from fertilisers (the others are ammonia and nitrate leaching). In general, more nitrous oxide is emitted from the use of ammonium nitrate fertilisers than urea fertilisers. Ammonium nitrate undergoes both nitrification (the conversion of ammonium to nitrate) and denitrification (the reduction of nitrate to gaseous nitrogen oxide products). Although these chemical conversion processes, driven by soil bacteria, make nutrients more quickly available for plant uptake, they also emit nitrous oxide. A ban on the use of urea is expected to increase nitrous oxide emissions if ammonium nitrate use is increased. This may result in an increase of GHG emissions of around 80kt carbon dioxide equivalent per year (around 0.2% of total UK agricultural emissions, 0.02% of total UK emissions). In addition it is also the option that is likely to have the highest embedded GHG emissions. This is because ammonium nitrate production is generally associated with higher GHG emissions than urea although the extent of emissions is influenced heavily by the source of origin and whether the production uses the best available technique<sup>36</sup>. Early discussion with industry indicates the UK is currently at production capacity for ammonium nitrate and

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[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/709493/State\\_of\\_the\\_environment\\_water\\_quality\\_report.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/709493/State_of_the_environment_water_quality_report.pdf)

<sup>34</sup> Defra User Guide, 2011: An Inventory of Mitigation Methods and Guide to their Effects on Diffuse Water Pollution, Greenhouse Gas Emissions and Ammonia Emissions from Agriculture. Available at [http://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiXtLLVvOjpAhU9RxUIHRb2CkEQFjAAegQIAxAB&url=http%3A%2F%2Frandd.defra.gov.uk%2FDocument.aspx%3FDocument%3DMitigationMethods-UserGuideDecember2011FINAL.pdf&usq=AOvVaw0zd\\_BYx5W6va69TZy9Ypco](http://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiXtLLVvOjpAhU9RxUIHRb2CkEQFjAAegQIAxAB&url=http%3A%2F%2Frandd.defra.gov.uk%2FDocument.aspx%3FDocument%3DMitigationMethods-UserGuideDecember2011FINAL.pdf&usq=AOvVaw0zd_BYx5W6va69TZy9Ypco).

<sup>35</sup> AHDB, 2020, Nutrient Management Guide (RB209) available here: <https://ahdb.org.uk/knowledge-library/rb209-section-1-principles-of-nutrient-management-and-fertiliser-use>

<sup>36</sup> <https://www.farmcarbontoolkit.org.uk/toolkit/fertiliser-production>

therefore will have to import additional ammonium nitrate to meet increased demand under the proposed policy.

Again, effective nutrient management, will help to mitigate the increase in nitrous oxide emissions. We will be seeking advice from the Nutrient Management Expert Group on the optimal policy approach to minimise pollution emissions considering government targets of reaching Net Zero by 2050, enhancing soil health, improving water and air quality, protecting natural biodiversity and managing resources sustainably.

## **Regulatory options**

A ban on the use or sale of solid urea fertilisers can be implemented via existing regulatory powers<sup>37</sup>. The policy will be enforced by either Local Authorities (Trading Standards Officers) or the Environment Agency, depending on the powers used. Discussions with fertiliser industry representatives have indicated that fertiliser distributors would not market fertilisers in areas where use has been prohibited.

## **Record keeping and Inspections**

Should the implemented policy be a ban on the use of solid urea fertilisers, enforcement may be via simple inspections of fertiliser stocks and/or invoices/receipts, likely to be carried out by the Environment Agency as part of their existing farm inspections regime. A ban on the sale of the fertiliser would be easier to implement at the point of sale as it is expected that retailers would comply with the ban without any significantly increased demands being placed on enforcement resources of Trading Standards Officers in local authorities. However, a ban on the sale of solid urea fertilisers would likely require Scotland and Wales to follow suit so that the banned fertiliser in England cannot be bought across the border.

## **Storage and security for ammonium nitrate**

The storage of Ammonium Nitrate (AN) in Great Britain is subject to a robust regulatory framework<sup>38</sup>, which considers the hazards posed by storage, product safety and measures to deal with emergencies.

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<sup>37</sup> We have powers to make secondary legislation to implement a ban on sale or use under the Agriculture Act 1970 (<http://www.legislation.gov.uk/ukpga/1970/40/contents>) or a ban on use only via the Environment Act 1995 (<http://www.legislation.gov.uk/ukpga/1995/25/section/87>).

<sup>38</sup> <https://www.legislation.gov.uk/uksi/2003/1082/made>, <https://www.hse.gov.uk/explosives/ammonium/comah.htm>, <https://www.hse.gov.uk/agriculture/namos.htm>, <https://www.hse.gov.uk/landuseplanning/hazardoussubstances.htm>

Under the provisions of the Dangerous Substances (Notification and Marking of Sites) Regulations 1990 (NAMOS) anyone storing quantities of AN must notify the relevant regulatory authorities and the emergency services;

- For storage of 25 tonnes or more the Health and Safety Executive (HSE) or the Local Authority, and the Fire and Rescue Service (FRS) must be notified;
- For storage of 150 tonnes or more of AN or the storage of certain AN mixtures, an additional notification to their local Fire and Rescue Service (FRS) is required to allow emergency services to prepare their response to incidents on such sites.

Local Authorities have to give permission, known as Hazardous Substance Consent (HSC) to anyone intending to store in excess of 1250 tonnes of AN. When an application is made HSE advises the Local Authority on whether a site is suitable to be granted HSC taking into account risks to local people. The Local Authority is also required to take account of any increased risk to people off-site created by developments, such as new housing, which takes place around these sites.

The storage of larger quantities of AN is subject to the provisions of the Control of Major Accident Hazard Regulations 2015 (COMAH). The threshold quantity for lower and upper tier sites depends on the type of AN that is being stored.

Quantities of AN subject to the COMAH Regulations:

	Lower tier (tonnes)	Upper tier (tonnes)
Ammonium nitrate, fertilisers capable of self-sustaining decomposition	5000	10000
Ammonium nitrate, fertiliser grade	1250	5000
Ammonium nitrate, technical grade	350	2500
Ammonium nitrate, 'off spec' materials and fertilisers not satisfying the detonation resistance test	10	50

There is a risk that an increase in AN imports from Option 1 (and Option 3 "Restricted Period" to a lesser extent) could lead to multiple AN storage sites that are below the lower tier threshold (1250t) to trigger the HSE and COMAH requirements. Careful monitoring of AN imports and subsequent storage sites may be required to further evaluate this risk.

The COMAH Regulations require operators to have considered the nature and consequences of their major hazard risks and the means of controlling those risks. They must also prepare emergency plans for mitigating the consequences of incidents. HSE and the environmental authorities inspect these high hazard sites and have the power to prohibit the operation of a site if there is evidence that measures taken for prevention and mitigation of major accidents are seriously deficient.

Under the provisions of the Ammonium Nitrate Materials (High Nitrogen Content) Safety Regulations 2003 all high nitrogen content AN fertilisers have to pass a specified resistance to detonation test (DRT). If the AN does not pass the test it is considered 'off-spec'. Once AN is known to be 'off spec' then the person responsible for the AN must notify HSE and the Local Authority and take remedial action.

Industry, with the support of government, has set up the Fertiliser Industry Assurance Scheme (FIAS<sup>39</sup>) for the fertiliser supply chain. It provides an assurance framework for the manufacturers, merchants, hauliers and storekeepers to meet security, traceability and safety requirements. The scheme is administered by the fertiliser industry and companies are audited annually against FIAS Standards by an independent audit team that are specialists in the area. In addition FIAS and the Agricultural Industries Confederation (AIC) produce free guidance on fertiliser safety, traceability and security, including a ten point check list.

## Questions: Ban

*Q5a: The Impact Assessment suggests that this option provides the greatest reduction of ammonia emissions. Do you agree or disagree with this being the preferred option? Agree/Disagree/No view.*

*Q5b: If you disagree please explain why and what your preferred policy option would be.*

*Q6a: Do you agree or disagree with the assumption that there will be a shift to the use of ammonium nitrate as a result of a ban? Agree/Disagree/No view.*

*Q6b: If you disagree, what alternatives might be used?*

*Q7a: Would storage and transportation of ammonium nitrate be a challenge to farmers and/or industry? Yes/No. Please delete appropriately: I am a farmer / an industry representative / Other (please specify).*

*Q7b: If Yes, how? Please list the potential challenges and ways these might be mitigated.*

*Q7c: If you have suggested ways to mitigate potential challenges, what do you estimate the financial costs of these would be?*

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<sup>39</sup> <https://www.aictradeassurance.org.uk/fias/documents/fias-standards/>

Q8: *If a ban is the agreed approach, how quickly following confirmation of this do you think this option could be introduced without impacting on the availability of suitable alternative fertilisers?*

- a. *0 to 6 months*
- b. *7 to 12 months*
- c. *1 to 2 years*
- d. *More than 2 years*

Q9a: *Would this policy option impact any other specific sectors such as horticulture or other small-scale end-users? Yes/No/Don't know.*

Q9b: *If yes, please indicate who.*

Q9c: *If yes, please provide further details including whether alternatives can be used.*

Q10a: *If it is necessary to ban the use rather than the sale (and use) of solid urea fertilisers, do you agree or disagree that farmers should be required to hold and present records of fertilisers purchased, such as receipts or invoices, when required? Agree/Disagree/Don't know.*

Q10b: *If you Disagree, what other enforcement options would you suggest? Please specify.*

Q11a: *Do you agree or disagree with the analysis of the environmental impacts of this measure? Agree/Disagree/No view.*

Q11b: *Do you have evidence of environmental impacts which have not been considered? Yes/No. If yes please provide links or references.*

## **Option 2: Requirement to stabilise solid urea fertilisers with the addition of a urease inhibitor**

### **Introduction**

This policy would require all solid urea fertilisers to be stabilised with the addition of a urease inhibitor (UI) either in the melt of the fertiliser product or as a coating. Urease inhibitors are chemicals that inhibit the action of enzymes in naturally-occurring soil bacteria that convert urea to ammonium, allowing more time for rain to disperse the urea into the soil. There are three different types of urease inhibitor that are available in the

UK<sup>40</sup>. The use of one of these inhibitors (NBPT- marketed as Agrotain) has been tested by independent scientists as part of the Defra NT26 project which observed average emissions reductions (across a range of soils and temperatures) of 61% to 80%, depending on concentration of the UI<sup>41</sup>. Recent trials in the Republic of Ireland indicated that the use of Agrotain reduced ammonia emissions by 78%<sup>42</sup>. Of all of the policy options analysed, this option results in the second highest reduction in ammonia emissions, which is 12.8kt of reduction by 2022, assuming a central estimate of ammonia emission reduction of 70%. Our current analysis suggests, however, that it is unlikely that we will achieve the 2030 ammonia emissions reduction commitment through cost-effective action if we adopt this approach, and will need to consider other, less cost-effective measures. The efficacy of urease inhibitors in solid urea is another consideration and is dependent on three main factors: active ingredient concentrations, storage and whether blended with other materials.

Efficacy of urease inhibitors in solid urea will depend on the active ingredient concentration, which is currently not stipulated in existing domestic fertiliser legislation nor adequately represented in EU fertiliser Regulation (EC 2003/2003)<sup>43</sup>. Industry have indicated different recommended concentrations for each of the three UI products in the UK market while some studies recommend concentrations of NBPT to not be less than 500mg per kg of ureic nitrogen<sup>44</sup>. Efficacy of the UI may also be dependent on its duration and ambient temperature of its storage, age, and formulation. One study found that the efficacy and shelf life of the UI are better when blended with urea in the melt before granulation (rather than coated on to the granules) and the optimum ambient temperature for storage to be around 4°C (rather than equal to and above 25°C)<sup>45</sup>. Finally, efficacy of the UI is also impacted when combined with certain other chemicals and minerals. For instance, adding UI *and* nitrification inhibitors (to reduce nitrous oxide emissions) to urea proved to increase ammonia emissions compared to urea treated solely with UI<sup>46</sup>. There is also a report that sulphur is a mineral that, if added to UI-treated urea, would rapidly

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<sup>40</sup> Agrotain (N-butyl thiophosphoric triamide, NBPT), Alzon Neo-N (N-(2-nitrophenyl) phosphoric triamide)), and Limus (N-butyl thiosphosphoric triamide and N-butyl propylthiosphosphoric acid triamide).

<sup>41</sup> [http://sciencesearch.defra.gov.uk/Document.aspx?Document=NT2605\\_4063\\_FRP.doc](http://sciencesearch.defra.gov.uk/Document.aspx?Document=NT2605_4063_FRP.doc)

<sup>42</sup> <https://www.teagasc.ie/media/website/environment/climate-change/Andy-Boland--Patrick-Forrestal-Protected-Urea-April-2019-resized.pdf>

<sup>43</sup> <http://www.legislation.gov.uk/eur/2003/2003/contents>

<sup>44</sup> Defra Project NT2605, 2005, WP3 Optimum use of nBTPT (Agrotain) urease inhibitor, available at <http://sciencesearch.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=11983>. Heitor Cantarella et. al., 2018, Agronomic efficiency of NBPT as a urease inhibitor: A review, available at <https://www.sciencedirect.com/science/article/pii/S2090123218300638?via%3Dihub>.

<sup>45</sup> Cantarella et al., 2018.

<sup>46</sup> Ibid.

degrade the UI thus rendering the UI ineffective<sup>47</sup>. We propose to work with industry to evaluate the evidence and ascertain whether it is appropriate to reflect some of these points within the secondary legislation or in additional guidance.

## Impacts

### A. Economic

Costs (from 2022 to 2030) to industry (including farmers and fertiliser manufacturers) is estimated to be £65.8m with net benefits of £884.5m. Our economic analysis suggests that urease-inhibited urea currently costs 10% more than uninhibited urea and we have assumed that farmers would therefore use inhibited urea rather than switch to the more expensive ammonium nitrate. It has been found that UI-treated urea can increase crop yield (by 1-10%) compared to untreated urea<sup>48</sup>, which is to be expected as less nitrogen is lost as ammonia to air. However, as there is some uncertainty with this, we have not assumed yield increases in the analysis of this option in the Impact Assessment.

### B. Environmental

Our analysis has assumed that UI-treated solid urea will be used instead of uninhibited urea and that the scale and pattern of urea use is unchanged. If there was an increase in the use of inhibited solid urea as a substitute for ammonium nitrate, there may still be an increase in ammonia emissions as inhibited urea loses more ammonia to air (6-7%) than ammonium nitrate (2-3%)<sup>49</sup>.

The Clean Air Strategy consultation responses<sup>50</sup> highlighted some concerns about the environmental safety of urease inhibitors. The most common type of inhibitor, Agrotain/NBPT, has successfully passed extensive toxicological and environmental tests and is registered under and complies with the European Chemicals Agency's (ECHA) REACH regulation (Registration, Evaluation Authorisation and Restriction of Chemicals)<sup>51</sup>. In terms of UI concentrations in fertilisers, these have been given a minimum and maximum threshold in the EU fertiliser Regulation 2003/2003 and according to industry, the manufacturers' recommended concentrations are below the maximum concentrations

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<sup>47</sup> This has been advised by the fertiliser industry, for example <https://www.yara.co.uk/crop-nutrition/take-control-of-nitrogen-and-sulphur/>

<sup>48</sup> Cantarella et al., 2018.

<sup>49</sup> <http://www.cpm-magazine.co.uk/2019/12/23/fertiliser-urea-on-a-knife-edge/>

<sup>50</sup>

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/770714/draft-clean-air-strategy-consult-sum-resp.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/770714/draft-clean-air-strategy-consult-sum-resp.pdf)

<sup>51</sup> <https://echa.europa.eu/information-on-chemicals/registered-substances/-/disreg/substance/100.103.392>

permissible under the Regulation. Fertiliser industry stakeholders have expressed concern about potential negative impacts of urease inhibitors on soils due to a lack of long-term studies. If, following consultation, stabilisation with urease inhibitors is selected as the favoured approach to tackling ammonia emissions from inorganic fertilisers, we will further consider whether it is necessary to carry out a study.

#### i. Water quality

Similar to Option 1 (“Ban”), there is a risk that this policy option could lead to a small increase in ammonium and nitrite leaching to surface and ground waters as the UI ensures the urea-nitrogen stays in-situ for longer than uninhibited urea. As mentioned for Option 1, effective nutrient application management (adjusting the application of UI-treated urea to account for its increased nitrogen use efficiency), could help to mitigate this risk.

#### ii. Greenhouse gas emissions

It is estimated that a requirement to use urease inhibitors would lead to a small decrease in nitrous oxide emissions by around 49kt per year. This is primarily because the UI effectively limits the nitrogen re-deposition that occurs from ammonia emissions from uninhibited urea, thus avoiding nitrous oxide emissions from the re-deposition. As mentioned above this analysis assumes for this policy option that there will not be an increase in ammonium nitrate use as farmers will use urease inhibited urea. If some farmers choose to use ammonium nitrate instead of urease inhibited urea the ammonia emissions are expected to be lower and the GHG emissions would reduce by less or may increase.

### **Regulatory options**

As with Option 1, ban on the use or sale of uninhibited solid urea fertilisers can be implemented via existing regulatory powers<sup>52</sup>. The policy will be enforced by either Local Authorities (Trading Standards Officers) or the Environment Agency, depending on the powers used. Discussions with fertiliser industry representatives have indicated that fertiliser distributors would not market fertilisers in areas where use has been prohibited.

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<sup>52</sup> We have powers to make secondary legislation to implement a ban on sale or use under the Agriculture Act 1970 (<http://www.legislation.gov.uk/ukpga/1970/40/contents>) or a ban on use only via the Environment Act 1995 (<http://www.legislation.gov.uk/ukpga/1995/25/section/87>).

## Record keeping and inspections

As with Option 1, should the implemented policy be a ban on the use of uninhibited solid urea fertilisers, enforcement may be via inspections of fertiliser stocks and/or invoices/receipts, likely to be carried out by the Environment Agency as part of their existing farm inspections regime. A ban on the sale of uninhibited solid urea fertilisers would be easier to implement at the point of sale as it is expected that retailers would comply with the ban without any significantly increased demands being placed on the enforcement resources of Trading Standards Officers in local authorities. However, a ban on the sale of solid urea fertilisers would likely require Scotland and Wales to follow suit so that the banned fertiliser in England cannot be bought across the border.

## Questions: Urease Inhibitors

*Q12a: Would farmers use solid urea stabilised with UI? Yes/No/No view.*

*Q12b: If not, why? What alternatives might farmers use?*

*Q13: At what concentrations should UI be applied to solid urea in order for there to be good efficacy? Please support your answer with evidence.*

*Q14a: With regards to the efficacy of UI in solid urea when blended/coated with other minerals (e.g. sulphur), do you have further evidence that might support this consideration? Yes/No.*

*Q14b: If Yes, please submit your further evidence.*

*Q15a: As a supplier, when would sufficient volumes of treated urea be available to the UK market if there was a requirement to include UI in the melt?*

*a. 0 to 6 months*

*b. 7 to 12 months*

*c. 1 to 2 years*

*d. More than 2 years*

*Q15b: Would a requirement to include UI in the melt (as opposed to a coating) increase the price of UI treated urea? Yes/No/No view.*

*Q15c: If Yes, by how much?*

*Q16a: Would this policy option impact any other specific sectors such as horticulture or other small-scale end-users? Yes/No/Don't know.*

Q16b: *If yes, please indicate what sectors/which users.*

Q16c: *If yes, please provide further details including whether alternatives can be used.*

Q17a: *If it is necessary to ban use rather than sale (and use) of uninhibited solid urea fertilisers, should farmers be required to hold and present when required, records of fertilisers purchased, such as receipts or invoices? Yes/No/No view.*

Q17b: *Can invoices/receipts contain details of the name of the specific fertiliser product bought? Yes/No/Don't know.*

Q17c: *What other option(s) might be more effective for monitoring and enforcing the measure?*

Q18a: *Do you agree or disagree that UI-treated solid urea would be a better option to use than ammonium nitrate, should this policy option be chosen? Agree/Disagree.*

Q18b: *If you Disagree, why?*

Q19a: *Are you aware of any evidence of negative health or other environmental impacts from use of UIs that are licensed for use in the EU or UK? Yes/No.*

Q19b: *If Yes, please provide evidence/references.*

## **Option 3: Requirement to restrict the spreading of solid urea fertilisers, allowable only from 15 January to 31 March**

### **Introduction**

This policy would restrict the application period for solid urea, enabling its use only between 15 January and 31 March when conditions are cool and moist and ammonia emissions from the spreading of solid urea fertilisers are lower. In assessing the likely impacts of this option, we have assumed that farmers would use the same amount of urea as they use currently from January to the end of March and that during the period when urea spreading is prohibited farmers will use ammonium nitrate in place of urea.

Our analysis indicates that this policy would achieve ammonia emissions reductions of 11.8kt, the lowest of the options presented. The main benefit of this approach for farmers is that it retains untreated urea, which is a globally-traded commodity, in the English fertiliser market and therefore constrains the price of other fertiliser products. However, there are several drawbacks with this policy option.

A changing climate (in temperature and precipitation) could present farmers with uncertainty on the conditions that are optimal for spreading solid urea. The cool and moist conditions (i.e. in the winter) for solid urea application, followed quickly by heavy rainfall (or irrigation) to move surface-applied urea into the soil, will ensure the fertiliser does not volatilise (into ammonia) so quickly. Warm and drying conditions will maximise the potential for rapid volatilisation<sup>53</sup>. Therefore, the success (in terms of ammonia emissions mitigation) of a restricted period policy for the spreading of solid urea will largely depend on the prevalence of cold and moist conditions followed by heavy rainfall, which is not always guaranteed in a changing climate. Applying solid urea to already waterlogged soil increases the potential for nitrite and ammonium leaching in to surface and ground waters.

A Restricted Period for solid urea would add another layer of complexity to an already complex set of regulations relating to nutrient management for farmers especially when considered in the context of Nitrate Vulnerable Zones (NVZ) and Farming Rules for Water. For instance, disallowing the spreading of solid urea between 1 April and 15 January adds an additional requirement to the rule that already exists within NVZ regulations to not spread manufactured nitrogen fertilisers (including urea) from 15 September to 15 January on grassland and from 1 September to 15 January on tillage land, in NVZs. Under Farming Rules for Water, manufactured fertilisers are not to be spread if the soil is waterlogged, flooded or snow covered or if the soil has been frozen for more than 12 hours in the previous 24 hours. These conditions are more likely to occur during the period proposed for the spreading of solid urea (from 15 January to 31 March) under this policy option.

Enforcement is another major challenge for this policy option. Farmers would have access to urea products throughout the year and as there is no obvious difference between spreading of urea and other inorganic fertilisers enforcement would rely heavily on checking of records that farmers would be required to keep.

## Regulatory options

Under this option it is possible to restrict the *use* (rather than sale) of solid urea (during a restricted period) using powers in either the Agriculture Act 1970 or the Environment Act 1995. Due to the relatively higher risk of non-compliance with this policy (compared to the other policy options), we propose that its effectiveness would need to be evaluated after 2 years through assessing fertiliser usage figures from the BSFP and import figures for urea fertilisers and Environment Agency compliance reporting.

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<sup>53</sup> Defra 2005, NT2605 WPb1a Ammonia emissions and crop N use efficiency. Available at [http://sciencesearch.defra.gov.uk/Document.aspx?Document=NT2605\\_4060\\_FRP.doc](http://sciencesearch.defra.gov.uk/Document.aspx?Document=NT2605_4060_FRP.doc)

## Record keeping and inspections

Under this option farmers would be required to keep accurate records of purchases of all fertilisers used and the timings of application of urea fertiliser, which can be difficult to validate. These record-keeping requirements would be additional to the current requirements of the nitrate regulations and Farming Rules for Water. Additionally, the Rural Payments Agency have indicated that the proportion of record keeping breaches under the nitrates regulations compared to overall number of inspections is high. The costs to enforce this policy would be considerably more than the other policy options as inspections would be needed throughout the year (both inside and outside of the Restricted Period).

## Impacts

### A. Economic

Cost (from 2022 to 2030) to industry (including farmers and fertiliser manufacturers) is estimated to be £87.1m with net benefits of £737.1m. This assumes that the use of solid urea in the closed period (from 1 April to 15 January) will be replaced by ammonium nitrate requiring an additional supply of 246,000t of ammonium nitrate per year<sup>54</sup>. Import/export data for fertilisers show that the UK exported over 160,000t and imported over 320,000t<sup>55</sup> indicating that an additional 86,000t per year may need to be imported. Sufficient secure storage capacity would be required on farms and at ports where the imported ammonium nitrate lands.

### B. Environmental

#### i. Water quality

Similar to Option 1 (“Ban”), a potential increase in ammonium nitrate use in the closed period (between 1 April and 15 January), could lead to a small increase (by up to 5%) in nitrate leaching to surface and ground waters<sup>56</sup> especially after heavy rainfall, as more

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<sup>54</sup> Impact Assessment: <https://consult.defra.gov.uk/air-quality-and-industrial-emissions/reducing-ammonia-emissions-from-urea-fertilisers>

<sup>55</sup> UK trade information comes from HM Revenue and Customs. You can build your own table of products from here: <https://www.uktradeinfo.com/Statistics/BuildYourOwnTables/Pages/Home.aspx>.

<sup>56</sup> Defra User Guide, 2011: An Inventory of Mitigation Methods and Guide to their Effects on Diffuse Water Pollution, Greenhouse Gas Emissions and Ammonia Emissions from Agriculture. Available at [http://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiXtLLVvOjpAhU9RxUIHRb2CkEQFjAAegQIAxAB&url=http%3A%2F%2Frandd.defra.gov.uk%2FDocument.aspx%3FDocument%3DMitigationMethods-UserGuideDecember2011FINAL.pdf&usq=AOvVaw0zd\\_BYx5W6va69TZy9Ypco](http://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiXtLLVvOjpAhU9RxUIHRb2CkEQFjAAegQIAxAB&url=http%3A%2F%2Frandd.defra.gov.uk%2FDocument.aspx%3FDocument%3DMitigationMethods-UserGuideDecember2011FINAL.pdf&usq=AOvVaw0zd_BYx5W6va69TZy9Ypco).

mineral nitrogen is retained in the soil through reduced ammonia emissions to air. There could be an increase in nitrite and ammonium leaching in the open period (15 January to 31 March) if farmers decide to apply more of their total nitrogen fertiliser in the form of solid urea during these months. There is also additional risk of leaching and surface run-off in these generally wetter months. Again, the amount of leaching will depend on the quantity in the soil when the soil reaches field capacity<sup>57</sup>, meaning effective nutrient application management, as mentioned under **Option 1, Impacts**, above, could go some way to mitigating this risk.

## ii. Greenhouse gas emissions

Similar to a Ban, a Restricted Period is estimated to increase carbon dioxide-equivalent emissions because there is an assumption there could be an increase in use of ammonium nitrate. This is because a greater proportion of the nitrogen will remain in the soil after ammonium nitrate fertiliser application than after application of solid urea, which loses more nitrogen through ammonia volatilisation. This option may result in an increase of GHG emissions of around 44kt per year (around 0.1% of total UK agricultural emissions, 0.01% of total UK emissions). As discussed under Option 1, ammonium nitrate production is also generally associated with higher GHG emissions than urea although the extent of emissions is influenced heavily by the source of origin and whether the production uses the best available technique<sup>58</sup>.

Again as with Option 1, effective nutrient management, will help to mitigate the increase in nitrous oxide emissions. We will be seeking advice from the Nutrient Management Expert Group on the optimal policy approach to minimise nitrogen-based and other pollution and greenhouse gas emissions from fertiliser use.

## **Questions: Restricted Period**

*Q20: In your opinion, are farmers likely to apply more solid urea than needed during the open application window? Yes/No/No view.*

*Q21a: Do you think this policy aligns with Farming Rules for Water and the Code of Good Agricultural Practise in terms of nutrient management? Yes/No/Don't know.*

*Q21b: If No, please explain why and note any potential conflicts.*

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<sup>57</sup> AHDB, 2020, Nutrient Management Guide (RB209) available here: <https://ahdb.org.uk/knowledge-library/rb209-section-1-principles-of-nutrient-management-and-fertiliser-use>

<sup>58</sup> <https://www.farmcarbontoolkit.org.uk/toolkit/fertiliser-production>

*Q22: (To farmers currently using solid urea between April and December) What fertiliser(s) might you use to substitute solid urea from April to December under this option?*

*Q23: (To fertiliser suppliers) What fertiliser(s) might be in more demand to substitute solid urea from April to December under this option?*

*Q24a: Do you have suggestions for more effective or less burdensome approaches to enforce this requirement? Please provide details here.*

*Q24b: If Yes, please provide details here.*

*Q25: Are there any other suggestions you would like to make that are not covered in this consultation document, or not covered by the previous questions?*

# Timing and duration of the consultation

The consultation will be published for a period of 12 weeks from the publication date at:

<https://consult.defra.gov.uk/air-quality-and-industrial-emissions/reducing-ammonia-emissions-from-urea-fertilisers>

Responses should be received by 23:59 on 26 January 2021

You can respond using the online survey at the above link. If you would prefer not to respond online, you can respond:

By email: [consultation.coordinator@defra.gov.uk](mailto:consultation.coordinator@defra.gov.uk)

Or by writing to:

Consultation Coordinator  
2nd Floor,  
Foss House,  
Kings Pool,  
1-2 Peasholme Green,  
YORK  
YO1 7PX

Your response will be most useful if it is framed in direct response to the questions posed, though further comments and evidence are also welcome.

# Annex A: Questions about you

1. What is your name?
2. What is your email address?
3. What is your profession or organisation?
  - Academic
  - Farm advisor
  - Farm contractor
  - Farmer (arable)
  - Farmer (livestock)
  - Fertiliser distributor or retailer
  - Fertiliser manufacturer
  - Industry body
  - General public
  - Local authority
  - NGO – Industry
  - NGO – Environment
  - Other – please specify
4. Would you like your response to be confidential?
  - Yes
  - No
5. What is your location?

Please enter the county in which you or your organisation is based.

## Annex B – Consultation questions

<b>General urea fertilisers policy questions</b>	
<b>Q1a</b>	<b><i>Should the use of liquid fertilisers (such as UAN) containing urea remain unrestricted? Yes/No/No view.</i></b>
<b>Q1b</b>	<b><i>If No, why?</i></b>
<b>Q2a</b>	<b><i>Should the policy applied relate to solid compound fertilisers (as well as solid straight urea fertilisers)? Yes/No/Don't know.</i></b>
<b>Q2b</b>	<b><i>If No, what solid compound fertilisers should/should not be restricted and why?</i></b>
<b>Q2c</b>	<b><i>If you agree should the policy applied relate to all compound fertilisers containing greater than 1% carbamide (ureic) nitrogen? Yes/No/Don't know.</i></b>
<b>Q2d</b>	<b><i>If you disagree what should be the threshold of carbamide nitrogen content in order for the policy to reduce ammonia emissions to be effective?</i></b>
<b>Q3a</b>	<b><i>Do you agree or disagree with the Impact Assessment results for each of the policy options presented? Agree/Disagree/Don't know.</i></b>
<b>Q3b</b>	<b><i>If you disagree please specify which of the results you disagree with and provide additional evidence to support your response.</i></b>
<b>Q4a</b>	<b><i>Would these policy options (on an England only basis) have a significant impact on the UK internal market and ensure a level playing field for users? Yes/No.</i></b>
<b>Q4b</b>	<b><i>If yes, please indicate how.</i></b>
<b>Option 1 Ban questions</b>	
<b>Q5a</b>	<b><i>The Impact Assessment suggests that this option provides the greatest reduction of ammonia emissions. Do you agree or disagree with this being the preferred option? Agree/Disagree/No view.</i></b>
<b>Q5b</b>	<b><i>If you disagree please state why and what your preferred policy option would be.</i></b>
<b>Q6a</b>	<b><i>Do you agree or disagree with the assumption that there will be a shift to the use of ammonium nitrate as a result of a ban? Agree/Disagree</i></b>

Q6b	<i>If you disagree, what alternatives might be used?</i>
Q7a	<i>Would storage and transportation of ammonium nitrate be a challenge to farmers and/or industry? Yes/No. Please delete appropriately: I am <u>a farmer / an industry representative / Other (please specify)</u>.</i>
Q7b	<i>If Yes, how? Please list the potential challenges and ways these might be mitigated.</i>
Q7c	<i>If you have suggested ways to mitigate potential challenges, what do you estimate the financial costs of these would be?</i>
Q8	<i>If a ban is the agreed approach, how quickly following confirmation of this do you think this option could be introduced without impacting on the availability of suitable alternative fertilisers?</i> <i>a. 0 to 6 months</i> <i>b. 7 to 12 months</i> <i>c. 1 to 2 years</i> <i>d. More than 2 years</i>
Q9a	<i>Would this policy option impact any other specific sectors such as horticulture or other small-scale end-users? Yes/No/Don't know.</i>
Q9b	<i>If yes, please indicate who.</i>
Q9c	<i>If yes, please provide further details including whether alternatives can be used.</i>
Q10a	<i>If it is necessary to ban the use rather than the sale (and use) of solid urea fertilisers, do you agree or disagree that farmers should be required to hold and present records of fertilisers purchased, such as receipts or invoices, when required? Agree/Disagree/Don't know.</i>
Q10b	<i>If you Disagree, what other enforcement options would you suggest? Please specify.</i>
Q11a	<i>Do you agree or disagree with the analysis of the environmental impacts of this measure? Agree/Disagree/No view.</i>
Q11b	<i>Do you have evidence of environmental impacts which have not been considered? Yes/No. If yes please provide links or references.</i>
<b>Option 2 Urease Inhibitors (UI) questions</b>	
Q12a	<i>Would farmers use solid urea stabilised with UI? Yes/No/No view.</i>
Q12b	<i>If not, why? What alternatives might farmers use?</i>

<b>Q13</b>	<b><i>At what concentrations should UI be applied to solid urea in order for there to be good efficacy? Please support your answer with evidence.</i></b>
<b>Q14a</b>	<b><i>With regards to the efficacy of UI in solid urea when blended/coated with other minerals (e.g. sulphur), do you have further evidence that might support this consideration? Yes/No.</i></b>
<b>Q14b</b>	<b><i>If Yes, please submit your further evidence.</i></b>
<b>Q15a</b>	<b><i>As a supplier, when would sufficient volumes of treated urea be available to the UK market if there was a requirement to include UI in the melt?</i></b> <b><i>a. 0 to 6 months</i></b> <b><i>b. 7 to 12 months</i></b> <b><i>c. 1 to 2 years</i></b> <b><i>d. More than 2 years</i></b>
<b>Q15b</b>	<b><i>Would a requirement to include UI in the melt (as opposed to a coating) increase the price of UI treated urea? Yes/No/No view.</i></b>
<b>Q15c</b>	<b><i>If Yes, by how much?</i></b>
<b>Q16a</b>	<b><i>Would this policy option impact any other specific sectors such as horticulture or other small-scale end-users? Yes/No/Don't know.</i></b>
<b>Q16b</b>	<b><i>If yes, please indicate what sectors/which users.</i></b>
<b>Q16c</b>	<b><i>If yes, please provide further details including whether alternatives can be used.</i></b>
<b>Q17a</b>	<b><i>If it is necessary to ban use rather than sale (and use) of uninhibited solid urea fertilisers, should farmers be required to hold and present when required, records of fertilisers purchased, such as receipts or invoices? Yes/No/No view.</i></b>
<b>Q17b</b>	<b><i>Can invoices/receipts contain details of the name of the specific fertiliser product bought? Yes/No/Don't know.</i></b>
<b>Q17c</b>	<b><i>What other option(s) might be more effective for monitoring and enforcing the measure?</i></b>
<b>Q18a</b>	<b><i>Do you agree or disagree that UI-treated solid urea would be a better option to use than ammonium nitrate, should this policy option be chosen? Agree/Disagree.</i></b>
<b>Q18b</b>	<b><i>If you Disagree, why?</i></b>

<b>Q19a</b>	<b><i>Are you aware of any evidence of negative health or other environmental impacts from use of UIs that are licensed for use in the EU or UK? Yes/No.</i></b>
<b>Q19b</b>	<b><i>If Yes, please provide evidence/references.</i></b>
<b>Option 3 Restricted Period questions</b>	
<b>Q20</b>	<b><i>In your opinion, are farmers likely to apply more solid urea than needed during the open application window? Yes/No/No view.</i></b>
<b>Q21a</b>	<b><i>Do you think this policy aligns with Farming Rules for Water and the Code of Good Agricultural Practise in terms of nutrient management? Yes/No/Don't know.</i></b>
<b>Q21b</b>	<b><i>If No, please explain why and note any potential conflicts.</i></b>
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