**Your Details**

Forename: Mark

Surname: Tucker

Country: Ireland

How would you best describe yourself?

Other

Please specify here:

I am the Business Development Lead and Head of Agronomy at Yara UK Ltd and Yara Ireland, which are part of Yara International.

**About Yara International**

Yara International (which is headquartered in Norway) is a global manufacturer of fertilisers, and a supplier of digital and precision farming tools and a provider of agronomy advice to farmers and others concerned with crop nutrition and the sustainable production of food. Yara's vision is: ***A world without hunger and a planet respected***. We support climate-friendly crop nutrition and zero-emission energy solutions. Alone or through partnerships, Yara is investing in innovative solutions that actively contribute to the EU objective of climate neutrality. We take our responsibility for the climate footprint of our manufacturing processes and commercial operations very seriously and have made significant inroads into reducing these.

Yara is one of Europe's largest manufacturers of fertilisers from 12 production centres. In Ireland, Yara supplies high quality nitrogen and complex compound fertilisers (CCF) through our Ireland Team which comprises 10 direct employees and authorised distributors operating from four terminals located at Belfast and Moira in Northern Ireland and Ringaskiddy, Co. Cork, Roscrea, Co. Tipperary in the Republic of Ireland.

Please indicate if you are submitting your proposal on behalf of:

An organisation.

Name of Organisation:

Yara Ireland, which is part of Yara International.

Please choose from options below to indicate whether you wish to have your name published on the Departments website alongside your submission:

My name can be published.

**Questions**

***Q1. Do you have any observations on the conclusions in the Environmental Report and Natura Impact Assessment?***

Yara supports the Sustainable Farming Systems (SFSs) approach set out in the draft Agri-Food Strategy 2030 ('the Strategy 2030') and its objectives to address the economic, social and environmental sustainability of the agri-food sector in Ireland.

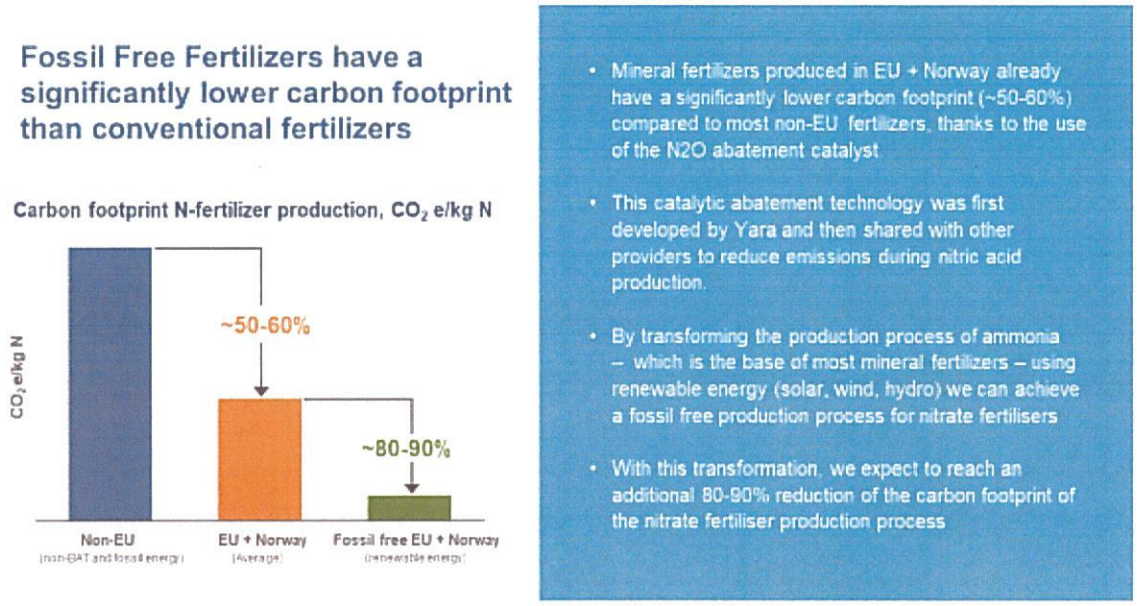
The Strategic Environmental Assessment and the Appropriate Assessment processes conducted on behalf of the Department of Agriculture and Food are broadly comprehensive. The Strategy itself acknowledges the need to consider the food system and the overall impacts of supply and value chains within farming and food production in Ireland. However, this consideration does not appear to extend to developments in the sustainability of key inputs in crop nutrition, such as mineral fertilisers.

**Reducing the Carbon Footprint of Nitrogen Fertilisers**

Nitrate-based fertilizers are central to crop nutrition for grassland and tillage. The processes used in their manufacture releases nitrous oxide ($N_2O$) and carbon ($CO_2$). This has been the focus of Yara's sustainability agenda. Yara has developed high-performing catalytic abatement technologies in the manufacture of its nitrate-based fertilizers which have resulted in some of the lowest carbon footprints from fertiliser manufacturing anywhere in the world and reductions in $N_2O$ emissions by 90%.

Yara has shared this technology, which is now defined as one of the "best available techniques" (BAT) for fertilizer production by the European Union, with other manufacturers which is contributing to further significant reductions in the carbon footprint of fertilizer production in Europe, and also of the carbon footprint of the whole lifecycle of crops and grassland grown using fertilisers that deploy these technologies in their manufacture.

Since 2005, Yara has also reduced its direct GHG emissions in Europe by 55% (baseline year 2019). Our objective is to reduce emissions by a further 30% by 2030 (baseline year 2019) which will bring the total reductions in GHG emissions to around 60% versus 2005.




However, in striving towards our 2050 objectives, Yara is piloting the production of mineral fertilisers using renewable energy which will lead to further lowering of the carbon footprint of nitrogen fertilizer production by 80% to 90%.

By choosing the right mineral fertilizer and the right nitrogen form, such as Calcium Ammonium Nitrate and other nitrate-based products, farmers can contribute to reducing gaseous emissions to the air. Compared to other widely used nitrogen forms based on urea, CAN hardly generates any ammonia emissions in use.

The opportunity to completely replace fossil fuels with renewables in nitrogen fertiliser manufacture with the production of ***Green Ammonia is only available in the manufacture of nitrate-based nitrogen fertilisers (such as CAN), and not in the manufacture of Urea which requires CO2 from fossil fuels in its production***. Furthermore, much of the urea-based nitrogen fertilisers used by Irish farmers are imported into the European Union and are manufactured using processes with higher associated carbon footprints.

*The SEA and AA do not appear to have adequately considered the impacts of current 'embedded' carbon in key inputs, such as nitrogen fertilisers, in the whole crop and grassland nutrition and food production lifecycles.*

**Chemical Inhibitors**

Current agronomy advice to Irish farmers advocates the use of nitrogen fertilisers that incorporate urease inhibitors which have been shown to reduce nitrous oxide losses to the atmosphere when applied on grassland. This 'chemically protected urea' will potentially introduce an extra 1,208,025 litres of chemical in the form of a urease inhibitor, such as NBPT which is applied at 3 litre/tonne of fertiliser.

It should be noted that the active ingredients that 'chemically protect' urea fertilisers degrade with time and more quickly in the presence of other nutrients (most notably sulphur and phosphorous). Furthermore, scientific literature suggests that up to 30% of the soil microbiome produces urease as part of their natural biochemical processes. If these biological processes are impacted, as a consequence of the addition of 'chemical inhibitors', it could prove detrimental to vital balances in soil microbiology. If 'chemically protected urea' does not work as described, ammonia emissions will increase.

Current EU Fertiliser Regulations (2003) require 'chemical inhibitors' to demonstrate effectiveness in reducing ammonia emissions. Revised Fertiliser Regulations (2019) come into force from July 2022 and will set a higher standard for the effectiveness of such 'chemical inhibitors' to reduce emissions of ammonia by at least 20% as measured over the 14 days immediately follow application to the crop or grassland. Given the reliance that is currently being placed on the effectiveness of 'chemical inhibitors' in the advice being given to farmers on the use of urea fertilisers, it is important that measures are implemented that provide assurances as to their effectiveness in limiting emissions and meeting the new standards required by the new Fertilisers Regulations.

Urea nitrogen fertiliser also contains CO2 at a rate of 1.56 kg CO2/1 kg of urea which is released immediately following its application as hydrolysis starts. This differs from nitrogen applied as CAN fertiliser which has no embedded CO2.

*The SEA and AA do not appear to have adequately considered the additional impacts of 'chemical inhibitors' on ammonia emissions or soil health because of their impacts on the soil microbiome.*

*The SEA and AA also do not consider how measures can be implemented which will provide assurances around the effectiveness of 'chemical inhibitors' in limited ammonia emissions and meeting the new standards that will be required by the EU Fertiliser Regulations (2019)*

**Origin Green**

Goal 7 of Mission 1 (A Climate Smart, Environmentally Sustainable Agri-Food Sector) seeks to: Strengthen Origin Green and Sustainable Supports to Reflect the Higher Level of Ambition (of Origin Green and of the Agri-Food Strategy 2030).

Developed by Bord Bia, Origin Green is the premier quality assurance and traceability programme for Irish food. The 2030 Strategy envisages a further development of Origin Green's role in assessing the sustainability performance of primary producers and the rest of the food and drink supply chain. Teagasc and Bord Bia have developed a Carbon Navigator as part of the Origin Green programme which has been applied in conducting approximately 212,000 carbon assessments on farms.

The Origin Green programme is concerned with the traceability of Irish food and the sustainability of farming and production activities – across a wide range of on-farm and production parameters - that go into producing Irish food. Carbon leakage is a key concern in global climate action plans as the carbon impacts of activities can move or leak across borders as products or activities move. Such leakage in the production of Irish food can arise with key inputs including livestock feed and fertilisers. We have referred earlier to the progress that Yara has made in reducing the carbon footprint of its fertiliser manufacturing processes. We also referred to future innovations in this area, particularly around green ammonia, which has the potential to reduce the carbon footprint of nitrate-based nitrogen fertilisers by up to 90% by replacing fossil fuels with renewables as the primary energy source in the manufacturing process – ***a future innovation that will not be available in the manufacture of Urea fertilisers.***

*We do not believe that the Origin Green programme adequately reflects the whole lifecycle sustainability of farming and food production by not taking account of embedded carbon in certain imported nitrogen fertilisers (mainly non-European manufactured Urea fertilisers).*

*Furthermore, we do not think that the 2030 Strategy, nor its SEA, has adequately considered this issue or advised on further mitigation to address it.*

***Q2. Having reviewed the Environmental Report, please provide comments on individual sections in more detail. Please ensure to state clearly the section of the Environmental Report and page number (if relevant) that your comment or submission relates to.***

The SEA and AA consider the impacts of the four Missions (Climate Smart Agri-Food sector, Viable and Resilient Primary producers, Nutritious and Safe Food and an Innovative, Competitive and Resilient sector) and their associated Goals and Actions on a range of environmental and social parameters. Key actions that feature within several the Goals, but primarily in Mission 1: A Climate Smart, Environmentally Sustainable Agri-Food Sector, Goal

1 and Goal 3 include reductions in mineral nitrogen fertilisers to reduce nutrient losses, mainly to water.

Mineral fertilisers play an important role in crop nutrition of both grassland and tillage crops. The objective in applying mineral fertilisers is to achieve the optimal balance in the supply of nutrients to growing crops so that applied nutrients are removed in harvested crops or grass grazed by livestock or remain in the soil to enhance its health and fertility to support the growing of future crops. Losses of applied nutrients to water or the atmosphere are a loss to the crop, to farm profitability and can damage the environment.

**Nutrient Use Efficiency**

The 2030 Strategy places the emphasis for reducing nutrient losses on limiting mineral fertiliser usage rather than improving the efficiency of nutrient use in the growing system.

While the two approaches are not mutually exclusive – in fact improvements in nutrient use efficiencies will inevitably lead to reductions in mineral fertiliser usage - it is not advisable to focus solely on reducing mineral fertiliser use without considering how farmers can improve their overall nutrient use efficiencies through their grassland management and crop husbandry.

Livestock farming and the production of milk and meat from grassland is our dominant farming activity in Ireland. Yara supports the development of grassland management and husbandry skills towards the greater incorporation of clover and multi-species swards which will play an important role in increasing nitrogen supply from natural atmospheric fixation.

Better nutrient use efficiency also equips farmers to more effectively incorporate nutrients contained in animal slurries and other organic sources (some of which may be imported onto their farms) via nutrient management planning. This will also provide a range of other benefits including higher yields, better crop quality and greater profitability.

***Nitrogen Use Efficiency (NUE)*** - The concept of Nitrogen Use Efficiency (NUE) describes the relationship between nitrogen supply to grassland and tillage crops and nitrogen removal from the field in milk, liveweight gain, conserved fodder and harvested arable crops. NUE can be described as the nitrogen contained in the crop (kg) as a percentage of the nitrogen applied (kg). The nitrogen applied is essentially composed of mineral and organic fertilisation, biological nitrogen fixation, the nitrogen deposition and nitrogen residues from cultivation in the previous year. It is important to optimize the ratio between crop yield and nitrogen supply in reducing losses of nitrogen. Less is not always more. A rate of nitrogen fertilisation that produces a high yield can be just as efficient and have limited losses compared with a low amount of nitrogen with a low yield.

**Technology Applications**

We can support grassland and arable farmers in improving nitrogen use efficiency with knowledge transfer, agronomy advice and other digital services such as technology applications which can already today assist farmers in achieving greater precision in their nutrient management planning and application of nutrients (including the timing, amounts and location in-field).

***Precision Agriculture*** refers to the use of new technology, such as in-field sensors and satellites, to inform the preferred action that can be taken in-field, improving both fertiliser efficiency at farm level and the impact on the environment by reducing nutrient losses and GHG emissions.

In addition, as the climate is already changing which is leading to more dynamic weather conditions, the need for farmers to adapt fertilisation plans during the season, especially for nitrogen, will increase.

Yara has developed and today provides several technology solutions to assist arable farmers in nutrient management. However, these and other technology tools will become available in the near future to support grassland farmers.

- **AtFarm** is an affordable digital tool for farmers to monitor crop growth and create variable-rate application maps based on satellite images. In this way different zones in a field can be fertilised differently according to the yield potential and crop need. Currently, AtFarm covers key crops for the different EU Member States and helps farmers identify areas of their fields that are behaving in an unexpected way. This powerful tool can be combined with existing farm equipment to empower variable rate fertilisation. It helps to reduce nutrient losses by giving crops what they require at the different stages of the season in different areas of the field.

- **Yara N-Tester BT ('Bluetooth')** - Applying "usual" nitrogen rates from one season to the other can lead to sub-optimal Nitrogen Use Efficiency including potential nutrient losses, additional costs, and lower crop yields. The N-Tester BT helps farmers remove the guesswork in meeting crops nitrogen requirements. The N-Tester BT is a handheld device that determines nitrogen requirements in real-time by measuring the chlorophyll content of the leaf, supporting farmers' nutrient planning.

- **Yara N-Sensor** was developed by Yara in 2000 following many years of field trials and it is the technology behind the AtFarm application. The **Yara N-Sensor** is mounted on the tractor roof and is directly connected to the fertiliser spreader; it adjusts fertilisation rates instantaneously as nitrogen needs vary significantly across an individual field. Measuring actual crop needs in real-time and adapting fertilisation rates accordingly during spreading is the most advanced form of precision farming available today. The Yara N-Sensor is an optical device. It measures light reflectance from the crop canopy in different spectral ranges with built-in light sources.

*The SEA and AA do not adequately examine the potential for improved Nitrogen Use Efficiency and the wide application of technologies, including Precision Farming, in reducing nutrient losses from farming systems.*

*The narrow focus on reductions in mineral fertiliser usage to address nutrient losses does not adequately consider the implications for meeting crop nutrition requirements and maintaining soil health and fertility levels, with consequential impacts for yields and farmer profitability (which is also an objective of Mission 2: Viable and Resilient Primary Producers with Enhanced Wellbeing).*

*The Agri-Food Strategy 2030 does look at knowledge exchange and AKIS, however, the role of advances in Precision Farming and other information and technology supports and services that are becoming available now, and how these will contribute to achieving the goals of the Agri-Food Strategy, merits additional examination.*

***Q3. Having reviewed the Natura Impact Assessment, please provide comments on individual sections in more detail. Please ensure to state clearly the section of the Natura Impact Assessment and page number (if relevant) that your comment or submission relates to.***

*We repeat our observations in response to Question 2 above on the focus of the Strategy on reductions in mineral fertiliser usage to reduce nutrient losses and how the wider implications of such a narrow focus on the optimal balance of nutrients for crop nutrition, and the wider implications for profitability and the viability of primary producers, have not been adequately considered. We also repeat our observations on the lack of consideration of the impacts of 'embedded' carbon in agricultural inputs, and particularly in imported nitrogen fertilisers and Urea, and the limitations of this product for further reducing the carbon footprint of fertilisers in the manufacturing process.*

***Q4. Is there any additional information which in your view should be considered in the Environmental Report and/or the Natura Impact Assessment? Please specify.***

*We repeat our observations in response to Question 2 and Question 3 above on the focus of the Strategy on reductions in chemical fertiliser usage to reduce nutrient losses and how the wider implications of such a narrow focus on the optimal balance of nutrients for crop nutrition, and the wider implications for profitability and the viability of primary producers, have not been adequately considered. We also repeat our observations on the lack of consideration of the impacts of 'embedded' carbon in agricultural inputs, and particularly in imported nitrogen fertilisers and Urea, and the limitations of this product for further reducing the carbon footprint of fertilisers in the manufacturing process.*

***Q5. Are there additional mitigation/monitoring measures that you would like to propose?***

*We propose that embedded carbon in fertiliser inputs arising from their manufacturing processes, particularly in nitrogen fertilisers, should be considered and taken account of in Mission 1, Goal 1, Goal 3 and Goal 7 of the Strategy and assessed as part of the SEA and AA for the Strategy 2030. The capacity for future reductions in the carbon footprint of fertilisers should also be considered in the 2030 Strategy and its SEA and AA.*

***Q6. If you wish to make comments on the draft 2030 Agri-Food strategy, please ensure to state clearly the section of the draft Strategy and page number (if relevant) that your comment or submission relates to.***

Yara wishes to make the following observations on the draft 2030 Agri-Food Strategy:

1. ***Focus on reductions in mineral fertiliser usage to reduce nutrient losses***

   Mission 1, Goal 1 on Developing a Climate Neutral Food System by 2050 and Improving Air Quality, Goal 2 on Restoring and Enhancing Biodiversity and Goal 3 on Protecting High Status Sites and Contribute to Achieving Good Water Quality include actions which seek to limit nitrogen fertiliser usage to 325,000 tonnes and reduce nitrous oxide (N2O) emissions by 50% by 2030. Yara suggests that greater emphasis should be applied to supporting farmers in achieving improved nitrogen use efficiency to limit nutrient losses. A direct consequence of improvements in NUE is likely to be reductions in mineral fertiliser usage but while supporting output and the profitability of primary producers, and adapting to local conditions and soil characteristics.

2. ***Lack of recognition of lower carbon footprint of European fertiliser manufacturing***

European fertiliser manufacturers, including Yara International, have invested significantly in reducing the carbon footprint of their manufacturing processes including the deployment of catalytic abatement technologies developed by Yara. This has seen reductions in N2O emissions by 90% and total GHG emissions by 50-60%. Nitrate-based fertilisers manufactured in Europe have lower carbon footprint than non-European manufactured product, and particularly Urea.

Sustainability should be considered from a whole lifecycle perspective in assessing the carbon performance of farming and food production. The Draft Agri-Food Strategy 2030, nor the Ag Climatise document, take account of the embedded carbon in fertiliser imports. This should be reflected in the final Strategy.

3. ***Green Ammonia***

Yara is pioneering the production of Green Ammonia – the starting point in nitrogen fertiliser manufacture – by replacing fossil fuels as an energy source with renewables. This low-carbon fertiliser opportunity is only available for nitrate-based fertilisers such as CAN. Urea is produced by combining Ammonia (NH3) with CO2 derived from fossil fuel energy sources.

The Strategy should take account of future innovations in fertiliser manufacture that will reduce the embedded carbon in nitrogen fertilisers used on Irish farms.

4. ***Improving Nitrogen Use Efficiency***

The focus on reductions in chemical fertiliser usage to reduce nutrient losses to water and emissions of nitrous oxide should be balanced with improvements in nitrogen use efficiency (NUE). Improvements in NUE will help ensure optimal yields and primary producer profitability while also – as a consequence – reduce mineral fertiliser usage.

Farmers should be supported in achieving greater NUE through AKIS and the emerging technology solutions.

5. ***Origin Green***

The Origin Green programme should better reflect the sustainability and carbon footprint of agricultural inputs – particularly nitrogen fertilisers – in its carbon assessment methodologies employed to assess farms.

**Additional Supporting Information**

We have included two documents in support of our submission on the AgriFood Strategy 2030 Strategic Environmental Assessment and Appropriate Assessment reports. These are:

- Yara Ireland's response to the 'Ag Climatise' Public Consultation (January 10, 2020)
- Yara's roadmap for putting Europe's Farm to Fork Strategy into action; Reducing nutrient losses, increasing crop yields and producing healthier crops (Yara International, June 1, 2021)

Knowledge grows

# Yara's roadmap for putting Europe's Farm to Fork Strategy into action

## Reducing nutrient losses, increasing yields and producing healthier crops

# Nutrient losses in Europe: what is at stake?

*The Farm to Fork* (F2F) *Strategy puts the European Union as a front-runner in the transformation of the global food industry by setting several aspirational goals to make food systems fair, healthy, and environmentally friendly. Reducing nutrient losses from agriculture by 50 % and increasing the share of EU farmland under organic farming to 25 % by 2030 are just two examples of the goals brought forward by the European Union. EU farmers and the agri-food industry are in the spotlight of this transformation.*

*We need to strengthen current efforts that move us away from inefficient farming practices, which lead to the excessive use of nutrients. Yara supports European farmers in addressing this challenge. Our core competence lies in empowering farmers to select and manage nutrients in the most sustainable and efficient way by using digital tools and precision farming to ensure profitability at the farm level. Reducing nutrient losses also means closing nutrient cycles, which requires collaboration throughout the entire food value chain. That's why Yara is also actively engaged in projects that contribute to a more circular economy as another route for reducing nutrient losses to the environment.*

*Yara backs the EU ambition of transforming the food system in Europe to the benefit of all. This transformation will greatly benefit from best practices that are already available today and from the innovative, scientific solutions that are in the pipeline. One year after the launch of the Farm to Fork Strategy, it is time to put it into action. Here is our roadmap for how to get there.*

***Collaborative approach needed to improve the environment***

Fertilizers provide crops with the nutrients they need to grow so we can responsibly feed a growing global population. However, if weather conditions are not considered when fertilizers are applied, if the nutrient content of manure is not well known by the farmers or if nutrients are applied when crops don't need them, fertilization may lead to excess nutrients that can be released to the wider environment, for instance by runoff into surface water or by leaching into groundwater. Pollution from nutrients (especially nitrogen and phosphorus) has a negative impact on biodiversity in rivers, lakes, wetlands, and seas, as the EU Commission points out in its Farm to Fork Strategy. Thanks to farmers' efforts, nitrogen losses to the environment on agricultural land have decreased in the EU[i]. The efficiency of the nitrogen used (expressed by the Nitrogen Use Efficiency indicator) in EU-28 has increased from 56% in 2000, to over 60% in 2005 and 65% in 2014[ii]. The crop nutrition industry, the farming community, policymakers, the scientific community, and society at large, must all collaborate to rise to the challenge created by the F2F target of halving nutrient losses by 2030 while ensuring long-term soil fertility. Upscaling best nutrient management practices and decision-support tools at farm level can contribute to reaching the last mile towards the Farm to Fork ambition.

## How we can help

***Yara Europe has a broad toolkit of proven solutions already in place that farmers can use today to contribute to reaching the target of halving nutrient losses by 2030. The best way forward is to take a holistic approach using a menu of different solutions, including following the principles of balanced plant nutrition, using the right fertilizer, and improving nutrient use efficiency.***

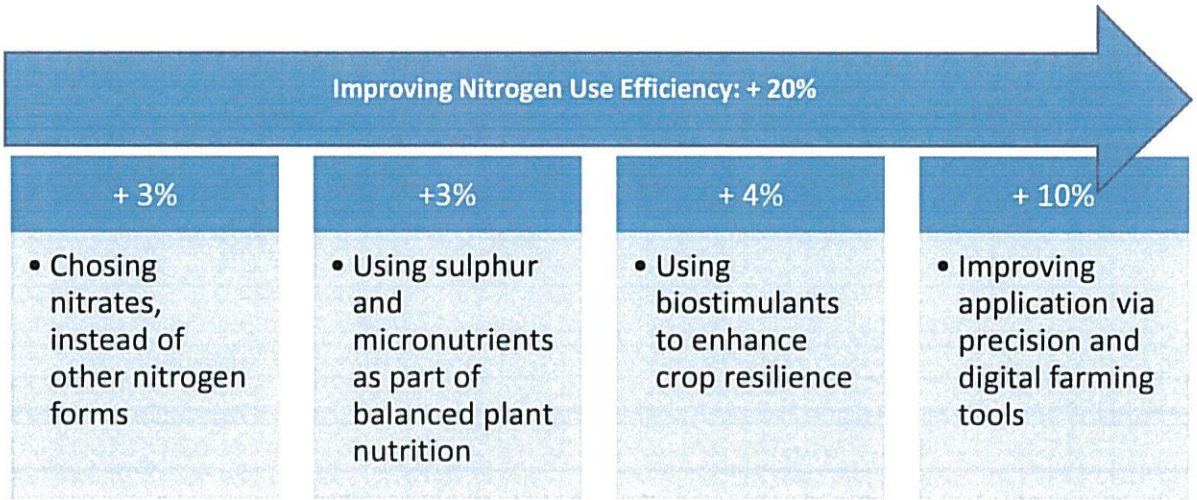



*Figure 1: Nutrient losses can be significantly reduced, and the efficiency of nutrients, and especially nitrogen, can be improved by 20% thanks a broad toolkit of solutions that are already available.*[iii]

***Yara's sustainable agricultural solutions enable both farmers and food companies to take an active part in the ongoing transformation of the food system. Thanks to the concerted efforts of these players in the food value chain, consumers have access to safe, affordable, and sustainable food choices every day. By using best practices and solutions that exist today, European farmers[iv] can already improve nutrient use efficiency by 20 %, increase yields and incomes by 5-7 %, and reduce their carbon footprint related to mineral fertilization up to 20 %[v].***

## Fast track solution 1: using the right mineral fertilizer

By choosing the right mineral fertilizer and the right nitrogen form, such as ammonium nitrate (AN) and ammonium nitrate-based products, farmers can contribute to reducing nutrient losses to the air. Compared to other widely used nitrogen forms based on urea, ammonium nitrate hardly generates any ammonia emissions [see figure 2].

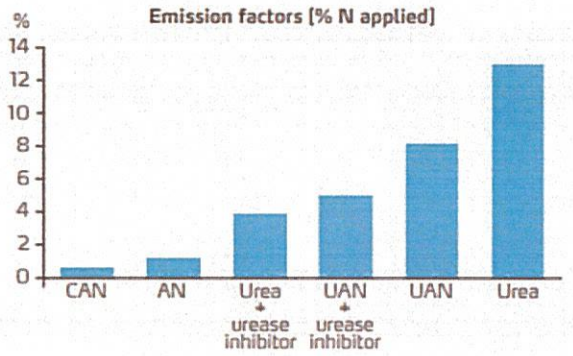



*Figure 2: Ammonia emission factors for different nitrogen fertilizers applied to normal soils in Europe (pH≤ 7)* [vi]

Therefore, the increase in urea use and imports into the EU (+ 76 % in the last 10 years[vii]) is a worrying development, colliding with EU efforts to improve the air we breathe and reduce greenhouse gas emissions. However, ammonia emissions from the use of mineral nitrogen fertilizers, which can significantly deteriorate air quality, can be reduced from the outset if farmers choose a different nitrogen form. Replacing all urea-based fertilizers with ammonium nitrate could prevent 63 % of overall ammonia losses from fertilizer application in Europe. That would not only contribute to reducing nutrient losses (in the form of ammonia), but also contribute to cleaner air in Europe. Switching from urea-based to nitrate-based fertilizers also has major benefits for climate mitigation. Less nitrogen needs to be fixated, transported and applied to produce the same amount of food, which has an immediate positive impact on the climate footprint. This is why both the Gothenburg protocol[viii] and the National Emissions Ceiling Directive[ix] encourage farmers to switch from using urea-based to using ammonium nitrate based fertilizers.

# Fast track solution 2: using fertilizers with the lowest carbon footprint

***Taking responsibility for the emissions we release***

Nitrate-based fertilizers, such as ammonium nitrate (AN), are the most common source of nitrogen in Europe. Production of AN releases nitrous oxide ($N_2O$) and carbon ($CO_2$). However, Yara's nitrate-based fertilizers have one of the lowest carbon footprints, enabling European farmers to harvest quality crops with the lowest possible impact on our climate. Using the best performing catalysts during the production process can reduce $N_2O$ emissions from fertilizer production by as much as 90 %. This technology, developed by Yara, is defined as one of the "best available techniques" for fertilizer production by the European Union and contributes to reducing the carbon footprint of fertilizer production and thus of the whole lifecycle of a crop. Yara's plants are equipped with this catalyst technology and are rated amongst the most energy efficient fertilizer plants in the world. Yara International has reduced its direct GHG emissions (scope 1 reductions) in Europe (baseline year 2019) by 55 % since 2005. We aim to reduce global emissions[x] by a further 30 % by 2030 (compared to 2019), bringing the total reduction to around 60 % versus 2005 (see figure 4). However, Yara doesn't stop there since the transformation towards a fossil-free food chain starts in the field. Crop nutrition, which is essential to ensuring yield and quality, will play a key role in the transition to a more climate-friendly food production. Yara is now piloting the production of mineral fertilizer using renewable energy and could lead to lowering the carbon footprint of nitrogen fertilizer production by 80 to 90 %.

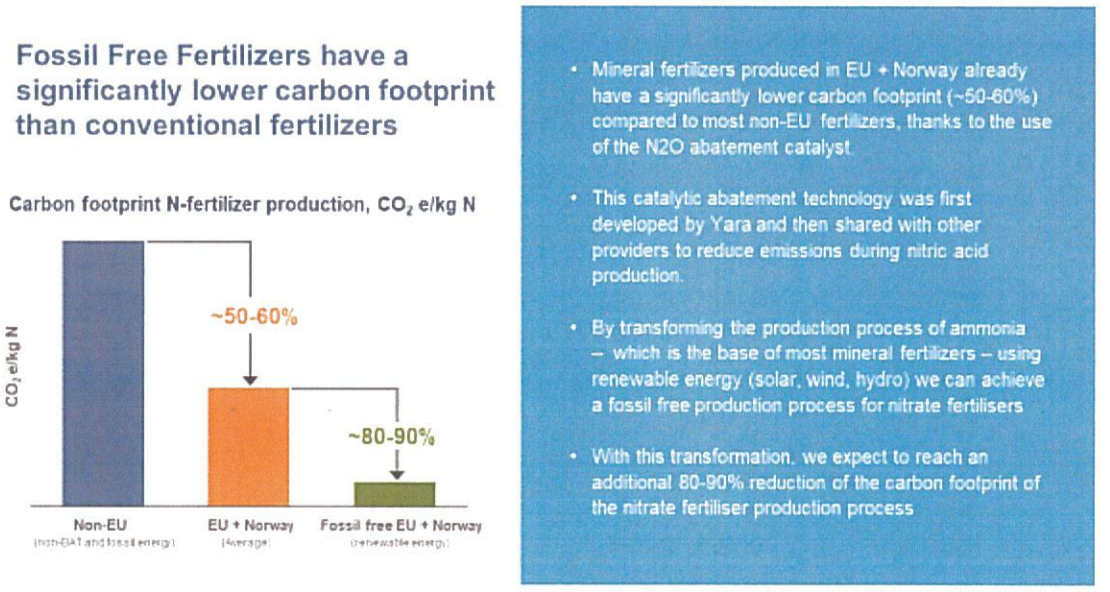



*Figure 4: Fossil-free fertilizers have a significantly lower carbon footprint than conventional fertilizers[xi], not applicable for the production of urea*

# Fast track solution 3: increasing efficiency to reduce nutrient losses

***Reducing negative impact of excess fertilization on biodiversity and ecosystems***

Nutrient losses can be further reduced by increasing efficiency and making sure that the different nutrients applied by farmers to nourish their crops end up in the harvest and not in the environment. Therefore, reducing nutrient losses and improving nutrient use efficiency are two sides of the same coin. Throughout the crop season, farmers have several possibilities for reducing the losses of nutrients, especially nitrogen.

**Did you know that removing more of the applied nitrogen from the crop is better for the environment?**

***Introducing a key metric to guide farmers' decisions for better profitability and performance***

The concept of Nitrogen Use Efficiency (NUE) describes the relationship between nitrogen supply to a crop and nitrogen removal from the field by the harvest. NUE can be described as the percentage of the nitrogen contained in the crop (kg) of the nitrogen applied (kg). The nitrogen applied is essentially composed of mineral and organic fertilization, biological nitrogen fixation, the nitrogen deposition and nitrogen residues from cultivation in the previous year. The European Nitrogen Expert Panel[xii], a network of European scientists, decision makers, and representatives from the agricultural sector and industry, does not recommend a general reduction in nitrogen quantities as a solution to effectively prevent nitrogen losses. In fact, less is not always more. It is seen as more appropriate to optimize the ratio between crop yield and nitrogen supply. A high rate of nitrogen fertilization that produces a high yield can be just as efficient and have limited losses compared with a low amount of nitrogen with a low yield.

The European Nitrogen Expert panel recommends a NUE target of between 75 % and 90 %[xiii].

A permanent value of more than 90 % indicates that:

- too much nitrogen is removed with the harvest
- too little nitrogen is supplied to the field via fertilization
- soil fertility is deteriorating, leading to soil depletion over time

On the other hand, if the NUE is below 75 %:

- too much nitrogen is lost in the environment
- too little nitrogen is taken up by the plants, leading to reduced farm profitability

***Yara's initiatives responding to the EU Green Deal***

Alone or through partnerships, Yara is investing in innovative solutions that actively contribute to the EU objective of climate neutrality. Yara takes its responsibility for its climate footprint very seriously. We have already reduced our greenhouse gas (GHG) emissions in Europe by 55% since 2005. But we cannot stop there. We aim to become climate neutral by 2050. We have set a target for reducing the $CO_2$ intensity of our operations by 10 % by 2025, with 2018 as a baseline. To reach this ambition, we're developing innovative solutions to contribute to protecting the planet while sustainably feeding the world.

- On the road to providing climate-neutral fertilizers: Yara is investing in green ammonia and hydrogen with the goal to offer carbon-free fertilizers, which would greatly contribute to further lowering agriculture's climate footprint. Through collaboration with several renewable energy focused companies, including Engie, Statkraft and Aker Horizons, pilot projects are being developed to produce ammonia with renewable energy sources, called green ammonia. This innovation will be essential to decarbonizing the food chain.
- Increasing the use of recovered and organic nutrients: Yara believes that the circular economy will change agriculture and will require a shift in the entire food industry. Through our strategic partnerships with waste management and food companies such as Veolia, Yara works to find the best avenues to close the nutrient loop and provide more organic fertilizers by improving the recycling of urban waste. Nutrients appearing as waste through or at the end of the cycle can be assessed for re-use either directly or by processing as long as food safety and farm value can be proven. While much attention is directed at wastewater and other secondary raw material sources, Yara believes it is equally important for society to continue reducing food waste and not least providing farmers with better tools to lower on-field losses of crop nutrients.
- Unleashing the potential of carbon farming: By adopting climate-positive practices, European farmers can produce Farm Carbon Credits or climate-smart certified crops and help to decarbonize food supply chains. The Agoro Carbon Alliance[xiv], recently launched by Yara International, puts farmers at the center of the solution by incentivizing and enabling them to change practices and connecting them to the growing number of businesses looking for ways to achieve their climate pledges. This will in turn enable high-quality, third-party certified carbon credits and increase farmers' income. Farmers who join Agoro Carbon can therefore generate an additional sustainability income from carbon cropping while maintaining or even increasing crop yields. Farmers can make the transition to the climate-positive practices that best fit their operation and can choose the amount of acreage to enroll in the program.

**What can the EU do to promote innovation?**

Initiatives across the food value chain and from the private sector must go hand in hand with stronger support from the EU for research and innovation, whether this is via Horizon Europe, the LIFE program, or the EU's Innovation Fund. This is the only way to bridge the gap between societal demands for a more sustainable food system and the legitimate concerns of European farmers to remain competitive and productive. In addition, a greater dissemination of research findings via advisory and outreach programs is needed to implement results of current and future research at scale.

***Yara's strategy for putting the Farm to Fork into action***

With only nine growing seasons left until 2030, key opportunities must be taken at the European and national levels via the new Common Agricultural Policy (CAP). A mix of pilots, collaborative approaches, targeted incentive mechanisms and knowledge exchanges will be needed to support farmers and the food value chain in scaling up current efforts to halve nutrient losses by 2030.

**Support farmers' profitability and sustainability via the CAP Strategic Plans:**

- Upscale best nutrient management practices at farm level beyond the current baseline by focusing interventions on the need to improve nitrogen use efficiency.
- Include targeted nutrient management programs supported by the deployment of affordable precision farming and digital tools to increase the share of agricultural land committed to improving nutrient management.
- Undertake a comprehensive impact assessment of the cumulative effects of the different F2F targets.

**Reward famers for sustainable nutrient management practices beyond the baseline:**

- Ensure that eco-schemes can be adopted by a sufficiently high number of farmers and cover a large area of land by being simple and avoiding further administrative burdens for farmers. This can be best achieved by including an incentive component to encourage farmers who want to transition towards more sustainable farming practices.
- Create an eco-scheme to support the implementation of Soil Management Plans (SMPs), which include a clear nutrient management plan component (via the concept of balanced plant nutrition), address concerns like erosion, compaction, soil health, water status, nutrient losses and ammonia volatilization.
- Reward low-emitting farm activities that contribute to climate mitigation, for instance by financing farms that have lower GHG emissions ($CO_2$ equivalents per ton of product) than the national mean or median. The Cool Farm Tool[xv], an online greenhouse gas calculator, could be used to assess the climate impact of the various farm practices.
- Offer an eco-scheme supporting farmers' efforts to transition towards a more sustainable way of farming via the use of precision farming tools that can demonstrate the efficient management of natural resources, primarily water and nutrients, e.g. improvement in water use or nitrogen use efficiency. Here, the use of decision-support and digital tools should be recognized as an acceptable approach to support the efficient use of nitrogen by basing the nutrient management plans on the recommendation resulting from such tools.

**Boost peer learning via Rural Development funds:**

- Offer investment support to encourage farmers to adapt their fertilization practices so that they lead to less ammonia emissions by investing in the necessary equipment to switch from the use of liquid to solid mineral fertilizers. This could build on the voluntary recommendation of the National Emissions Ceiling Directive (NECD), which encourages farmers to switch from urea-based products to ammonium nitrate-based fertilizers.
- Set up demonstration and pilot farms to increase farmers' knowledge about nutrient flows and the economic and environmental benefits of adopting sustainable nutrient management plans.

- Support productive investments that could be undertaken by machinery rings or farm contractors. This scheme could be used to offer precision farming tools and specialized equipment (like variable rate fertilization). It would accompany growers in the uptake of best nutrient management practices.

**Enhance Farm Advisory Services and knowledge exchanges:**

- Offer farmers the possibility to doing nutrient planning via the Farm Sustainability Tool for Nutrients (FaST) (or a similar tool) to encourage a more efficient use of fertilizers and to monitor progress towards the F2F target by embedding the Nitrogen Use Efficiency (NUE) indicator as an additional metric.
- Use advisory services as a platform for farmer-to-farmer exchanges and events to disseminate information and expertise on the uptake of new practices such as sustainable nutrient management or carbon farming to a broader number of farmers (i.e. beyond a specific scheme).

**Pilot innovative farming practices:**

- Make use of the possibilities for allowing piloting and testing of new types of schemes by using the EIP-AGRI Operational Groups (OGs), which are supported under the Rural Development Pillar of the CAP Cooperation measure.
- Facilitate carbon farming practices, such as conservation agriculture, soil cover with cover crops, afforestation and grassland management, via such a pilot scheme. This could take the form of a result-based system for $CO_2$ equivalents removed or emissions avoided, and would offer a potential new source of revenue, either in the form of CAP payments or from private sector players seeking to offset their emissions.
- Develop pilot/testing schemes to improve soil quality by encouraging farmers to use new CE-marked fertilizing products (such as micronutrients, recycled fertilizers, biostimulants), whereby scientists, farmers and the private sector would together carry out experimental tests to improve and restore soil structure together with soil analysis.

*Transforming the food system in Europe, while securing long term profitability for EU farmers, can only be successful if supported via collective efforts. If the Farm to Fork vision is to become tomorrow's reality, the entire food chain needs to share responsibilities for improving the environment by halving nutrient losses. Yara will do its part and empower farmers to rise to the challenge. EU policy measures also have an essential role to play to lift barriers, which today impede the implementation of best practices and the upscaling of precision and digital farming tools.*

## **FACT BOX 1:** Plant nutrients are like pieces of a puzzle

Farmers usually first apply organic nutrients if they are available in their farm or in their area, in the form of manure or slurry. This is the very basis of crop nutrition. These organic sources provide nutrients as well as organic matter, which is crucial for soil fertility/health. Organic and synthetic nutrients are complementary, not mutually exclusive. Used in the right quantities and forms, they are both needed to provide safe, affordable and sustainable food to the end consumer. However, on-farm sources of nutrients are rarely sufficient to meet all crop needs as they generally do not provide the full range of nutrients or lead to soil depletion in the long run. Organic sources of nutrients are rarely sufficient to meet all crop needs as they generally do not provide the full range of nutrients. The nutrients available in manure, composts or food wastes must be used to the maximum effect possible by minimizing losses in storage and transportation, by working them actively into the soils and/or by preprocessing before applying.

Mineral fertilizers are thus an essential complementary product to help close the gap between the nutrient supply from the soil and the plant's nutrient requirement for optimum development and to provide nutrients that can be immediately taken up by the plant. This is best practice for an efficient use of nutrients, where manure and mineral fertilizers are used in combination.

In a nutshell, by following the principles of balanced plant nutrition and by replenishing what is removed by the harvest, European farmers and crop advisors are on the best track for maintaining soil fertility in the long term and not depleting the soils. In addition to being different pieces of the same puzzle, plant nutrients are interlinked with each other. For instance, if there is a lack of phosphorus in the soil or in the crop, it will reduce the ability of the plant to take up other nutrients.

## **FACT BOX 2:** Improving land use efficiency in Europe and beyond

The environmental ambition of the European Green Deal and the Farm to Fork Strategy are also reflected in Yara's mission of responsibly feeding the world and protecting the planet. The different targets set by the Farm to Fork Strategy may reduce the productivity of the EU farming sector and lead to our food needs as Europeans being covered by production in other parts of the world with lower climate and environmental standards. This can also accelerate land-use change in third countries and make Europe more dependent on imports from the rest of the world. Agricultural land use and land use change are today, however, already a significant driver of climate change, being responsible for 9.2 % of the global greenhouse gas emissions[xvi]. Research and innovation must be encouraged to bridge the gap between the Green Deal ambition, food security and science-based decision-making. Yara strongly recommends not increasing additional arable land, but instead focusing on more efficient use of existing cropland. More efficient land use enables the production of more crops on the same amount of land with less environmental impact, together with a higher crop diversity, which is overall positive for biodiversity. This approach is particularly suited for Europe, where different competing uses urbanization, bioeconomy, nature restoration...) for agricultural land in the EU increase the overall pressure on farmland availability. Here mineral fertilizers help optimize the yield and quality of the crops that farmers nurture every day.

## **FACT BOX 3:** Striving for a lower environmental and climate footprint by choosing the right fertilizer from the start

The consolidated summary of 59 annual and long-term trials carried out by Yara's research and agronomy teams in 39 different plots between 2011 and 2017 demonstrated a significant difference in agronomic efficiency in favor of ammonium nitrate fertilizer and at the expense of urea. Let's take the case here of winter barley.

| | |
|---|---|
| | Higher yields: + 3 % additional yield |
| | Higher protein content in the grains: + 0.3 pt |
| | Higher total amount of nitrogen absorbed by the crop: + 16 kg nitrogen (N)/ ha for 141 kg N supplied or nearly 8% of additional nitrogen absorption, so not lost to the environment. |
| | Higher quantities of nitrogen absorbed by the grains: + 7 kg N / ha for 158 kg N supplied |
| | Higher Nitrogen Use Efficiency: 85% against 80 % |

## **FACT BOX 4:** Enhancing phosphorus efficiency to protect water and biodiversity

Next to nitrogen, phosphorus is the other essential plant nutrient covered by the Farm to Fork target of halving losses by 2030. This is particularly relevant for reducing excess nutrients' surface runoff from fields, which pollute rivers and oceans. A strategy to minimize phosphorus losses at field level is the proper incorporation into soils. The application method of mineral phosphorus sources, combined with a better utilization of phosphorus in on-farm organic sources, contributes to increasing phosphorus use efficiency and to reducing losses. Yara's R&D hubs in Germany and Finland have conducted field trials comparing different application methods. Banding phosphate containing fertilizers to seeds at planting increases phosphorus use efficiency, in comparison with surface application (followed by soil incorporation). This is how it looks in the field:

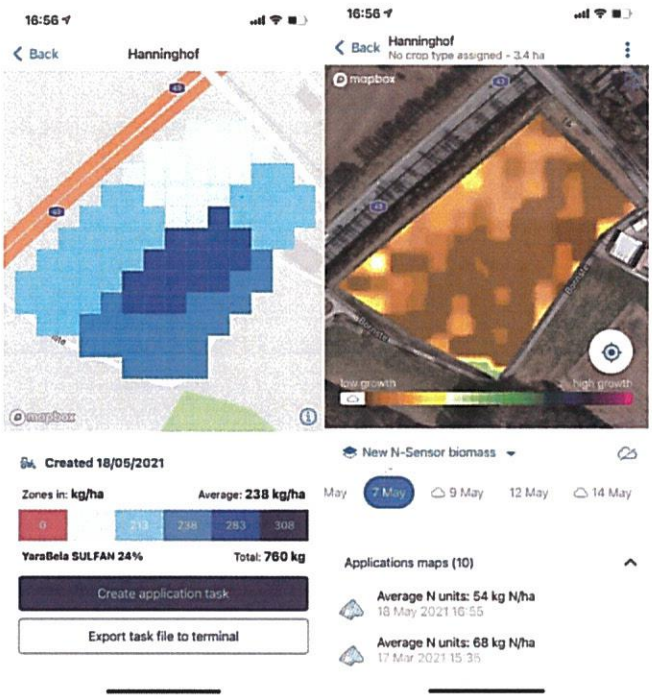
| Surface application followed by soil incorporation | Banding in the soil close to the seeds |
|---|---|
|  |  |
|  |  |

Banding of phosphorus fertilizer is a widespread practice for growing corn in the United States and was recently tested in our field trials for spring cereals in Finland[xvii]. Benefits for the crops, the soil and the environment were improved availability of the different nutrients, which are thus not lost in the environment; and higher phosphorus use efficiency, which means more phosphorus captured in the crop and lower costs for the farmers.

## **FACT BOX 5:** How precision and digital tools can make a difference for the environment and climate

As weather conditions change rapidly throughout the growing season, farmers must review and fine-tune their fertilization plan during the season. Here the use of advisory services and recommendation systems that take such changes into account are essential to minimizing environmental pollution and to guaranteeing economic profitably by harvesting high quality, healthy crops. For this reason, Yara has developed different and complementary tools, which are already available today to farmers at an affordable price, to help them optimize fertilization over the growing season. Precision agriculture refers to using new technology, such as in-field sensors and satellites, to provide advice on the preferred action that can be taken in the field, improving both fertilizer efficiency at farm level and the impact on the environment by reducing nutrient losses and GHG emissions. In addition, as the climate is already changing, it leads to more dynamic weather situations so that the need of farmers to adapt fertilization, especially for nitrogen, during the season will increase.

- AtFarm – how a mobile app can make a difference: AtFarm is an affordable tool for farmers to monitor crops' growth and create variable-rate application maps based on satellite images. In this way different zones in a field can be fertilized differently according to the yield potential and crop need. In simple steps, farmers start with the N-Tester measurement and then create an application map, helping them to monitor the growth of their fields with satellite images and to adapt their nutrient planning to existing variability. AtFarm covers key crops for the different EU countries and helps farmers to identify areas of their field that are behaving in an unexpected way. This is a powerful tool that can be combined with existing farm equipment to empower variable rate fertilization. It helps to reduce nutrient losses by giving crops just what they require at the different stages of the season in different areas of the field.




- Applying "usual" nitrogen rates from one season to the other is not the way forward as nutrient supply will not meet crop demand. Nitrogen use efficiency in particular will be sub-optimal, leading to a poorer carbon footprint, potential leaching, additional costs and lower crop yield and quality when growing conditions are better than anticipated. This is where the N-sensor helps farmers by removing the guesswork since nitrogen supply from the soil and nitrogen uptake from the plant vary from year to year. The Yara N-Tester BT is a handheld device, which determines nitrogen requirements in real-time by measuring the chlorophyll content of the leaf, supporting farmers' nutrient planning for split applications, i.e. applying nitrogen several times during the season instead of just once.
- The N-Sensor technology BT which was developed in 2000 with Yara's expertise in precision fertilization and years of field trials, is the technology behind AtFarm. Mounted on the tractor roof and directly connected to the fertilizer spreader, it adjusts fertilization rates instantaneously as nitrogen needs vary significantly across an individual field. Measuring actual crop needs in real-time and adapting fertilization rates accordingly during spreading is the most advanced form of precision farming available today. The Yara N-Sensor™ is an optical device. It measures light reflectance from the crop canopy in different spectral ranges with built-in light sources.

The potential of precision and digital farming tools is backed up by recent research. A study prepared by France's new National Research Institute for Agriculture, Food and Environment (INRAE) confirmed that optimizing fertilizer use by using several precision farming solutions together can reduce fertilizer use by 10 %[xviii].

## FACT BOX 6: Organic farming — Increasing production and sustainability

At present, about 8.5 % of EU agricultural area is farmed organically, and the trends show that with the present growth rate, the EU will reach 15-18% by 2030. The recent EU Action Plan for organic farming[xix] provides a toolkit for reaching the Farm to Fork target of 25 % EU farmland under organic by 2030. The EU countries can decide – depending on the current starting point – to identify the further development of organic farming as one of their priorities under the future CAP Strategic Plans. The focus could be set on conservation practices, such as crop rotation, reduced tillage, mulching and cover cropping, which are good ways of reducing nitrogen losses to the environment while improving soil health and productivity. This is relevant, regardless of whether growers are using organic or mineral fertilizers.

Yara's solutions and knowledge related to best nutrient management practices and improving land use efficiency are relevant for all farming systems, including organic farming. To meet the goal of the Farm to Fork Strategy and to avoid soil depletion in the long run, greater research on suitable nutrient sources for organic farming will be needed. Several studies[xx] show that organic farms often have negative balances for phosphorus and potassium, particularly in specialist arable organic farms (without livestock). In addition, inefficient use of sulphur is usually linked to inefficient use of phosphorus (P) and potassium (K), making it difficult to follow the principles of balanced plant nutrition. Farms that rely largely on biological nitrogen fixation have more negative P and K balances. For instance, 14 % of soils across one sample of organic farms showed soil phosphorus below agronomic optimal levels, which reduces crop production. This would ultimately increase the risk of soil depletion and also decrease soil health.

The principle of recycling from waste in organic farming should be more widely implemented for recycled sources of nutrients, especially phosphorus, to avoid long-term nutrient deficits. Otherwise, these would increasingly handicap organic farming in Europe and prevent the realization of the Farm-to-Fork target. Further recycled materials, containing phosphorus, but also potassium or even nitrogen, should therefore be assessed for future addition to the EU organic farming Regulation[xxi] list of input materials in coherence with organic farming principles, quality, safety and consumer confidence. This could be the case, for instance, for other sources of recycled nutrients such as ammonium sulfate, ammonium nitrate and other ammonium salts, originating from physico-chemical (stripping) processes of organic streams (especially wastewater and digestate out of non-factory farming substrates).

**About Yara International**

Yara grows knowledge to responsibly feed the world and protect the planet. Supporting our vision of a world without hunger and a planet respected, we pursue a strategy of sustainable value growth, promoting climate-friendly crop nutrition and zero-emission energy solutions. Yara's ambition is focused on growing a climate positive food future that creates value for our customers, shareholders and society at large and delivers a more sustainable food value chain.

To achieve our ambition, we have taken the lead in developing digital farming tools for precision farming, and work closely with partners throughout the food value chain to improve the efficiency and sustainability of food production. Through our focus on clean ammonia production, we aim to enable the hydrogen economy, driving a green transition of shipping, fertilizer production and other energy intensive industries.

Founded in 1905 to solve the emerging famine in Europe, Yara has established a unique position as the industry's only global crop nutrition company. We operate an integrated business model with around 17,000 employees and operations in over 60 countries, with a proven track record of strong returns. In 2020, Yara reported revenues of USD 11.6 billion.

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# Yara Ireland's response to the 'Ag-Climatise' Public Consultation.

Mark Tucker | | January 10, 2020

Yara International fully accepts and supports the need to address climate change and reduce greenhouse gas (GHG) emissions. Indeed, it has taken a global lead through its mission statement **'Responsibly feed the world and protect the planet'.** Feeding the world embodies knowledge, economic empowerment and new innovative ideas. Protecting the planet represents our commitment to emission abatement and sustainable agricultural practices. In July 2019 Yara linked its fiscal arrangements to meeting its sustainability goals which includes Green Ammonia production by 2028 and the development of digital farming tools and services towards improving Nitrogen Use Efficiency.

This document gives responses to some of the questions posed within this consultation highlighting the concerns and proposes the preferred approach towards meeting sustainability objectives.

## Question 1. Are there other actions that could be considered for inclusion to further enhance progress and credibility of agricultural actions? Is there more that farmers and the food industry itself can do?

**Nutrient Use Efficiency (especially nitrogen and phosphate, but not exclusively)** should be the main priority above all other mitigation strategies. The current Nitrogen Use Efficiency is typically around 24% (Teagasc National Farm Survey 2017 Sustainability Report) demonstrating the huge room for improvement that exists. Agriculture and more specifically the Farmer, is faced with numerous challenges as they look to respond to the demands to be more productive both agriculturally and environmentally. The 'measures of success' for them can change according to the policy with the most urgency. Such 'measures of success' can determine the actions taken which may be inappropriate for other policies. Inappropriate actions can of course lead to 'unintended consequences.' Such 'unintended consequences,' can lead to 'pollution swapping'. The development of the framework under consultation is a potential example of this. By way of examples:

1. Ammonia is currently economically the most damaging of pollutants when compared to N2O and nitrates (see Fig.1).

   Figure 1. Damage costs associated with the main reactive nitrogens.

| | Health € per kg N | Ecosystem € per kg N | Climate € per kg N | Total cost € per kg N |
|---|---|---|---|---|
| $NO_3$ leaching | 0-4 | 5-20 | | 5-24 |
| $NH_3$ volatilization | 2-20 | 2-10 | | 4-30 |
| NOx to air | 10-30 | 2-10 | | 12-40 |
| $N_2O$ to air | 1-3 | | 5-15 | 6-18 |

A policy to meet the current ammonia targets would promote the use of nitrate-based fertilizer products (as described in the UK Clean Air Strategy). With the approach outlined in 'Ag-Climatise', where the extensive use of protected urea is promoted to replace the nitrates, it is inevitable that higher ammonia emissions will result compared to what could be achieved.

2. Agriculture is needing to respond to a global society demanding a **reduction in its use and reliance on 'chemical' inputs**. The 'European Green Deal', a new strategy under development includes the 'Farm to Fork' plan that focuses the CAP towards climate action. Within 'Farm to Fork' there is an intention to reduce agricultures reliance on chemical inputs. The transition to a fertilizer market dominated by 'protected urea' will potentially introduce an extra **1,208,025 litres** of chemical in the form of a urease inhibitor such as NBPT (applied at 3l/t for example).

Ammonia, phosphate, nitrate leaching and N2O are all single-issue challenges, but they all represent losses from the nutrient cycles that a farmer and agronomist are managing. Having a 'one size fits all' approach such as chemically protected urea lacks credibility and removes the 'freedom to operate' that is required for farmers and advisers to make 'appropriate' site and season specific decisions. However, Nutrient Use Efficiency is the common thread that brings these challenges together. Having efficiency targets is a much more credible alternative that enables site, season, crop specific fertilizer recommendations to be made. The last three seasons have demonstrated the challenges that lay ahead with more extremes of weather, with droughts to excess rainfall. Having an efficiency driven approach focuses on the 4R's. The 4R Nutrient Stewardship concept is universal and describes that the Best Management Practice comes from applying the Right Source of nutrients, at the Right Rate, at the Right Time and in the Right Place. The right source means matching the fertilizer to the crop need and soil properties.

Soil is the farms #1 asset and must be protected. Its properties encompass biological, physical and chemical characteristics. Soil health is currently considered to be a valuable metric for sustainable productivity and can be anticipated to play an ever-increasing role with targeted improvements being critical. Chemical inhibitors, whether 'urease' or 'nitrification', clearly have biological activity as this is how they achieve the reductions in nitrogen losses observed in research. In a recent article (CPM) AHDB's Dr. Sajjad Awan described his concerns about the long-term effects of inhibited urea use on soil health and biology. "Scientific literature suggests that up to 30% of soil microbiome produces urease as part of their natural biochemical processes and if we manipulate this biological process it could prove detrimental to

the vital balances in soil microbiology. He believes that it's imperative for the industry to carry out independent research regarding the long-term effects of using fertilizers containing urease inhibitors before their widespread use in agriculture is fully accepted.

A soil's physical condition is critical in minimizing GHG emissions. The great work and MACC analysis conducted by Teagasc highlights this through the benefit/impact of drainage. There is other good evidence that N2O emissions from soils are minimized when it is free draining. Dobbie and Smith, 2002 reported that N2O emissions from 'the arable soil increased about 30-fold as the Water Filled Poor Space increased from 60 to 80%, while that from the grassland soil increased 12-fold.' They also demonstrated how temperature had a significant impact with highest emissions as temperatures rise between 5–12°C. The Harty paper also clearly shows the impact of poorly drained soil, with emissions of N2O two to three-fold higher. Yara fully support the promotion of managing soils towards optimizing productivity and sustainability and are concerned that policy could show chemical inhibitors to be a 'silver bullet' with farmers losing a focus on long term investment towards optimal, sustainable soil management. Indeed, the Harty data could be used to argue that if N2O emissions are overriding, then drainage-impeded soils are the solution, achieving the lowest EF.

***Yara proposes that farmers should be guided towards having a 10-year Integrated Soil Fertility Management (ISFM) Plan as is practised in regions across the world. To ensure this ISFM remains dynamic and appropriate, farmers and their advisers require a 'toolbox' that contains existing tools (e.g. all nutrient sources, destructive and non-destructive analytical sampling tools, datasets, Apps etc) but also room for new 'tools' as technology develops (e.g. CAN + Nitrification inhibitors, nitrate fertilizers produced from green energy/ammonia, Sensors etc). Tools and services are being developed. The Yara N -Sensor is one example that has been shown in the 'Innovate Grass Sense Project 2014' to increase 1st and 2nd cut yields by up to 22% in 2014 validation trials. Such an approach that has Nutrient Use Efficiency at its heart will lead to minimal losses from nutrient cycles, whilst maximizing productivity, and ultimately producing 'more from less' which must happen if 'absolute' emissions are to be reduced.***

## Question 2. Have you any feedback on how uptake of these actions can be encouraged and facilitated?

The most important feature coming out of the Ag-Climatise consultation is that measures that are adopted need to have positive outcomes, as opposed to just being a 'spreadsheet calculation' with no means of validation. In view of such a requirement then 'agreed, achievable targets' need to be established for a farm to base his/her plans around. As these targets are achieved 'incentive payments' can be used which are outcome driven.

If 'chemically protected urea' was a feature of a farmer's plan and therefore outcomes depended upon it (and by definition, payments) then consideration needs to be given towards individual effectiveness of such products. By way of clarification, data being used to define Emission Factors in the consultation document are based on product / active ingredient and rate-specific trials. This data is then used to predict/extrapolate the outcomes. However, research has also demonstrated that the active ingredients that 'chemically protects' the urea are unstable, degrading with time and in the presence of other nutrients (most notably sulphur and phosphate). The question that this pose is how to ensure these products maintain their effectiveness? What is also not clear is how appropriate is the Emission Factor for N2O as the applied rate decreases with time? Further research is required to establish the 'chemical inhibitor' rate response associated with N2O EF's.

The instability of chemical inhibitors in the presence of sulphur is a significant challenge. Maximum nitrogen use efficiency comes from multiple 'little and often' applications of NS fertilizer grades (as communicated by Teagasc). The unreliability of protected NS grades means that extra applications of inappropriate products must be made, increasing cost and possibly emissions (for example ammonium sulphate and ammonia emissions).

If the 'chemically protected urea' does not work as described, and therefore improved Emission Factors not realised, CO2 emissions will be increased. This is because all urea brought into Ireland contains CO2 at 1.56 kg CO2 / tonne that is released immediately following its application as hydrolysis starts. This is different to CAN that contains **no** CO2.

### Question 3. Are there other actions that could be considered to maximise the contribution of sustainable land management? Is there more that farmers and the food industry itself can do?

The food industry / agricultural supply chain is Global, just as is the GHG issue associated with the changing climate. Indeed "Bord Bia brings Ireland's outstanding food, drink and horticulture produce to the world. "The Bord Bia Quality Mark means that food has been produced to the highest Bord Bia quality standards and you know where it comes from. ... So, by looking for food with the Quality Mark when shopping, you can rest assured that it will look after you and your family." Yara therefore considers that sustainable land management is also a challenge that needs addressing with a global approach. Such an approach means adopting an LCA (Life Cycle Analysis) methodology. This addresses the danger of countries exporting their environmental responsibility and hence making no impact in tackling the global climate emergency. Such an approach will bring awareness to the variation in carbon footprints associated with different fertilizers and their origin. A fertilizers origin of manufacture can have a huge impact on its carbon footprint with coal-based manufacturing in China, and Russian based products typically having the highest carbon footprints. Urease and Nitrification inhibitors themselves will have an associated carbon footprint embedded in their manufacturing and transport which is currently ignored in any current calculations.

### Question 4. Have you any feedback on how uptake of these actions can be encouraged and facilitated?

Collaboration by bringing farmers, manufacturers and supply chains together through which 'common' methodologies can be adopted such that all are working towards the same 'goals'. Such an example would be to use the same 'carbon calculator' such as 'The Cool Farm Tool' or Teagasc 'carbon navigator'. Such an approach will minimise confusion and misinterpretation leading to greater adoption rates.

### Question 10. Do you have views on how the market could better incentivise and/or reward primary producers for adopting and implementing the necessary actions?

History has shown that adoption of new technology in agriculture is slow, with farmers being mindful towards change if gains are marginal. Such slow adoption is further exasperated when 'risks' are also associated with any change of practice. Irish

farmers are currently 'world class' in managing and growing grass which has come about through decades of tried and tested nutrient management plans. Being 'forced' to move away from such success is understandably met with a level of reluctance. Such reluctance is further reinforced with the other issues 'associated' with the 'chemically protected urea' products under consideration and the mixed messages coming from policy makers. These risks fall into the category of Food Safety, Operator Safety and the Sustainability Agenda. Farmers are being asked to respond to a global society demanding a **reduction in its use and reliance on 'chemical' inputs**. The 'European Green Deal', a new strategy under development includes the 'Farm to Fork' plan that focuses the CAP towards climate action. Within 'Farm to Fork' there is an intention to reduce agriculture's reliance on chemical inputs. The transition to a fertilizer market dominated by 'chemically protected urea' will potentially introduce an extra **1,208,025 litres** of chemical in the form of a urease inhibitor such as NBPT (applied at 3l/t for example). The 'Farm to Fork' document states that European Food **must remain 'safe'**. With a switch towards very extensive use of 'chemical inhibitors' does this pose a risk to food safety? Yara International ASA have always had a strict company policy when it comes to mineral nutrients and chemicals. Mineral nutrients are targeted at the crop, whether grass or grain, to improve yield and quality of the harvested material. Indeed, the minerals remain in the crop and harvested products to be consumed as part of a diet whether human or ruminant. Chemicals are target-specific, which can be a pest, pathogen, plant or biological metabolic process, that is designed to be in the plant for a limited timeframe, hence the need for 'Harvest Intervals' on many chemical products to minimize the risk of them appearing as residues in harvested produce. By combining a mineral nutrient with a chemical, as is the case with 'protected urea' products, then the risk of contaminating the food chain increases. "Bord Bia brings Ireland's outstanding food, drink and horticulture produce to the world. "The Bord Bia Quality Mark means that food has been produced to the highest Bord Bia quality standards and you know where it comes from. ... So, by looking for food with the Quality Mark when shopping, you can rest assured that it will look after you and your family." With a switch towards very extensive use of 'chemical inhibitors' has this been evaluated by Bord Bia? In addition, has Bord Bia achieved acceptance from other Global Food companies? "A site and season specific approach to the use of chemically protected urea would be much more aligned with the principles of good agricultural practice, giving farmers the flexibility to choose a range of appropriate fertilizer products, while achieving the same reduction of GHG's.

**Farmer operator safety** is an area for critical thinking. Neglecting the potential effect of long term, regular exposure to the group of urease inhibitor chemicals

should not be ignored. The ongoing debate surrounding 'glyphosate' serves as a reminder towards this. In the production of chemically protected urea products, urea is coated with the active chemical (typically NBPT (N-(n-butyl) thiophosphoric triamide)). Such a process is not the same as 'diluting' a chemical in solution. During the coating process, inherent 'dust' within the urea fertilizer product will also be coated and therefore increase the exposure risk as this dust can be inhaled during application of the fertilizer, and build up on machinery parts, increasing the 'chemical concentration' and risk of damaging effects to operators. Research in the Yara laboratory has shown that the inhibitor concentration in dust of 2-NPT treated products is up to 4 times as high as in the granules. The safety data sheets associated with these 'chemical' products indicates irreversible damage.

The **precautionary principle** is one of the fundamental **principles** of the **EU** that governs policies related to the environment, health and food safety. It aims to prevent harm before a hazard has come into existence. This same principle should be applied when it comes to the introduction of chemical inhibitors.

To whom it may concern:

Responses from [redacted]

**Organic Farming p91**

1. Organic manures, derived from natural processes including green waste and animal waste have an important part to play in organic farming in Ireland and waste materials produced on farm should be encouraged to be primarily used on farm or at a local level ( specified distance).

2. Acidification (soil/water) and run off from slurry spreading must be prevented to comply with water quality standards, a simple solution would be to ban slatted units. Animals bedded on dry material thrive better and the slurry issue is negated as dry bedding absorbs and neutralises the acidity of animal waste at source.

3. Generally, digestate and stabilised green waste compost can meet the limits for organic farming. (Cré, 2021) Composted biowaste to land must be standardized and QA approved to prevent soil contamination, particularly with regard to Micro and Nano plastics.

4. Organic farmers import conventional farmyard manure provided it is composted for three months. All farmers should be encouraged to compost on farm manures and grants and educational programmes should encourage composting ie benefits of compost to land is not widely understood and should form a corner stone for agriculture - Regenerative Agriculture practices should be encouraged.

**Irish agriculture could also play an important role in decarbonising other sectors of the economy through the production of bioenergy and biogas.**

**P54**

1. For excess organic waste from the agriculture centralised anaerobic digestion plants, possibly through farmer co- ops, could provide viable scale for local farmers with traceable outlets for excess manure and when processed / stabilised farmers can take back nutrient rich fertiliser thereby displacing chemical fertilisers. Capital grants for PTO driven windrow turners for farmers co-ops or for agricultural contracting companies providing services to farmers composting on site should also be considered.

2. Field trial longterm research is required to clarify the benefits of all soil additives including farmyard manure, composted biowaste, various forms of sewage sludge and food processing sludges, to soil health and carbon sequestration potential, through improved soil. A National Research programme should be undertaken to show this benefit.

3. Educational support should be made available for farmers to navigate the value of the various soil ameliorants available, not just in terms of NPK, but on soil health, humic levels and microbiology .

4. Low risk organic sludges and recovered nutrients from food and drink processing should be accessible for some applications proven of nutrient value and soil improvement value as proven by research trials.

5. Consider imposing tariffs on bioenergy imports.

6. Consider incentives for co-operative farming structures producing biogas and bio-energy. Digestate has positive effects, reduced
$CH_4$ and $CO_2$ when spread, compared to slurry ( FIRM,2019) - also proven reduction of $N_2O$ emissions. However, the reduced productivity levels from farmyard feedstocks must be balanced by improved fiscal incentives. AD is a proven and environmentally friendly technology which has potential to deliver multiple energy, climate, environmental, societal and economic benefits

7. Remove maximum of 30% for renewable electricity ( RE) sold to the grid and 70% onsite. This is unnecessarily restrictive and does not encourage energy efficiency.

8. Incentivise the use of bioCNG and bioLNG for Heavy Goods Vehicles (HGV) and long-haul transport will provide a market for green gas and carbon trading (RTFO). Biomethane is best placed to replace transport fossil fuel in the short to medium term, prior to the roll out of new fuel cell technologies, expected after 2030.

There is an opportunity to capture $CO_2$ from the upgrading of Biogas into biomethane, thereby creating a market for green $CO_2$ which can be used to replace industrial and potentially food grade $CO_2$

**P93**

1. Scale up on farm renewable energy (RE) potential, focus on energy efficiency and removal of potential barriers (planning) to the roll-out of RE at farm level, including necessary support for microgeneration and access to the grid. Maximise the potential for wind, roof top solar PV, AD with suitable locations for grid access.

**Carbon-farming offers a potentially new source of income for farmers, but it is still in the early stages of development. The Ag-Climatise Roadmap proposes a pilot scheme for on-farm carbon trading to reward farmers for the public goods they are providing. This should align with the proposed EU Carbon Farming Initiative as set out in the Farm to Fork (F2F) Strategy, whereby a new regulatory framework for certifying carbon removals will underpin a payment to farmers- P18**

1. If farmers were paid for sequestering carbon in a regulated carbon credit scheme, it would encourage regenerative agriculture practices, improve soil health and sequester carbon up to 1m deep, most soil analysis measure up to 200mm deep a d this must be considered in analysis techniques used.

2. An EU wide or globally agreed sampling and analysis methodology for soil organic carbon (SOC) is required.

3. Farmers should be supported and encouraged to process their own liquid and solid manures and Regenerative and Silvo pastoral agricultural practices should be encouraged as one of the best ways for farmers to manage soils; using multi species swards, symbiotic cover crops, substituting organic fertilizer for inorganic, combined with improved farming practices -minimising volatilisation and leaching of nutrients to air and water.

4. Farmers should be encouraged to trade carbon credits and this should be done on a farm specific basis, where soil baseline analysis is taken and after a specified period Re- taken to prove increases in carbon sequestration in soil, various examples already exist.

5. Support mechanisms-

Farmers need to be supported:

- ☐ Reward sustainable farming practices; organic and regenerative agriculture
- ☐ Adopt an organic fertiliser obligation - % use

- Support for farmer co-ops for renewal energy generation, with community based anaerobic digestion plants and /or composting of manure, straw bedding and green waste, thereby producing quality local clean biofertiliser, with communities less likely to contaminate their own fertiliser feedstock.
- Access to specialist advice relevant to diversification and uptake of alternative farming enterprise. Educated specialist advice on alternatives, subsidised by government.
- Agricultural courses and webinars such as the NOTs courses, Connected online and BioFarm have a key roles to play in education.
- Agricultural courses must include modules with input from relevant experts outside the traditional agricultural modules, climate change, biodiversity.
- The advisory services public and private sector must upskill, be educated and trained on the purpose of the measures introduced and the implementation practices required in order to explain to farmers. Effective knowledge transfer is key.

**P93**

1. Scale up on farm renewable energy (RE) potential, focus on energy efficiency; and examine potential barriers (planning) to the roll-out of RE at farm level, including necessary support for microgeneration and access to the grid. Maximise the potential for wind, roof top solar PV, AD with suitable locations for grid access.

**page 54 "Conduct appropriate and relevant assessments of the impact of the more detailed Commission proposals for pesticide use reduction"**

Ireland should conduct relevant pesticide and aphicide trials on top 10 used products, to provide relevant input on the local impact of their use in line with Commission proposals to reduce use.
Anecdotal evidence would suggest that the net benefit from aphicides is limited relative to the negative effect on overall insect biodiversity and their use should be prevented.

**Page 69- "Scale up resource-efficient, circular and low carbon solutions based on principles of renewable energy, cascading and circular use of sustainable biological resources"**

There is continuous pressure for fast delivery of End of waste criteria and regulation to enable said criteria. will play a big role in achieving this goal. As with metals at EU level, at national level for "a sustainable BioEconomy " a do not

harm approach must be paramount. To achieve End of waste classification, material must provide sufficient study/qualitative assurance of the raw material collection, processing and end product quality and safety characteristics to allow,secondary raw materials to attain End of waste status. Standards and internationally accepted QA criteria for best practice must apply.

Please also refer to the document submitted by the Environmental Pillar in response to Ag Climatise, which should be taken into account.
Particularly, regarding drained and semi-drained peatlands. (Attached).

Kind regards,

[redacted]

Dear Minister Mc Conalogue and colleagues,
you are in a good position here to do some really good work for the country and the world as a whole.
It may take a firm resolve and strong nerves but I'm sure you can find them. **Be a manager of nature conservation in Ireland,** not a mismanager.

The last government took a dim ignorant view of conservation and preservation of species and the reasons why. I know FF and FG are interested in pleasing industry leaders and **growth and profit** above all else but **this stance has to change. It is costing the earth.**
*When we were concerned with reducing carbon emissions and had to get new cars when old cars rightly failed the test, the government saw fit to remove the quota on cattle herds and raise the size of the National Herd , causing greenhouse gas emissions to soar**,** many species declining to extinction, water quality declining at an enormous rate, directly due to dairy expansion, especially in the south east.
In the rural west the fever of destruction was also insane, to grab the subsidies, jump through the EU hoops. Rock breaking, ripping out scrub, draining fields, ripping out hedgerows, ..." when one man does this, it is called vandalism, when many men do it , it is called progress"

Most Irish towns are situated on rivers, so now vast concrete structures and ridiculous amounts of money have been wasted in the last 10years trying to prevent these towns flooding. Ugly, these flood defences take from the charm of the town, they were never required when the uplands, bogs and boggy fields were left for the natural good of all, they

slowed the watershed. Now plastic and concrete drains, forestry, windfarms and ancillary works redirecting water, the water flows too fast, ripping banks and gouging out streams and rivers , depositing huge amounts of silt and soil on the riverbed causing more flooding and species loss.
We are ordinary people doing our best, taking great care how we impact our environment **please be one of us**

*The Environmental Pillar must have better representation, **including an expert in each field of biodiversity, climate, and water.**

*The new Strategy may contain greater emphasis on meeting environmental targets, but it is still a long way off from acknowledging the scale of the crisis and what needs to be done about it. **What we really need is less growth.**

* Stop plundering the country, stripping her natural resources.

* Plant oaks in the uplands rather than Sitka plantations that are so dead for wildlife, especially when they are so flammable. **Oaks and real natives provide habitat,** create soil, do not catch fire readily, **sequester carbon** and **hold moisture** in the soil. Sitka spruce with their shallow needle leaves actually create rain clouds ( read Peter Wohlleben - Hidden Life of Trees )

* MPA's. Enforcement of fishing laws. **Stop trawling and dredging now,** most of the Carbon Emission and climate chaos is directly due to the obsession with destroying the

ocean floor, there is strong evidence to say that redistribution of Fisheries subsidy, can be used to protect the inshore and ocean against transgression, back to stability, sequester carbon to bring back not only fish, but a stable weather pattern.
It is vital now to have an independent Nature Conservation Agency, that does not rely on the ever-changing whims of government and EU

* The "Band-Aid on a Cancer approach" of pushing larger and larger Windfarms, in bitty applications on to small rural communities has to stop, and the massive subsidies, used to prop up this vast industrial drain on resources, to be used for real good, to get up to speed with the 2030 target to support habitats, wildlife, and help rural farmers with nature based solutions to look after the land instead of destroying her with misguided EU directives and machinery that is too large, madCAP policies that change with every government are no good for nature that has worked in perfect harmony for millions of years.

Even though you are with the FF party, I have faith in your abilities to steer a good course
yours sincerely
[redacted]