Origin
FERTILISERS

Fertile *Future*

Our roadmap to sustainable agriculture

Index:

References:
1. The Greenhouse Gas Action Plan (GHGAP) is an industry-led initiative for delivering reductions in emissions from agriculture in England
2. Department for Environment Food and Rural Affairs Clean Air Strategy 2019
3. The Reduction and Prevention of Agricultural Diffuse Pollution (England) Regulations 2018
4. Ammonia emissions from nitrogen fertilizer applications to grassland and tillage land - Component report for Defra Project NT2605
5. Teagasc and the Irish Agriculture and Food Development Authority (2013-2016) Grassland emissions
6. Phillips, Clive & M Waita, J & Arney, David & C Chiy, P. (1999). The effects of sodium and potassium fertilizers on the grazing behaviour of dairy cows.
7. Department for Business, Energy & Industrial Strategy 2018 UK Greenhouse Gas Emissions national statistics

Welcome to 'Fertile *Future*'

Welcome to 'Fertile *Future*' which outlines Origin Fertilisers roadmap to sustainable agriculture.

Sustainable agriculture is a system in which farmers can balance the twin-pillars of food production and environmental enhancement, underpinned by economic viability.

Our core strategy is the development of science-led, innovative products and services which improve soil fertility, nutrient use efficiency and crop productivity, whilst also protecting the environment.

This is our role in improving the sustainability of agriculture and it requires us to be committed, challenging, visionary and proactive. The biggest challenge is transferring sustainability from words into practice on farm, 'making it happen'.

'Fertile *Future*' is a dynamic document which commits us to action and transparency. We will update it regularly to report our progress against our targets and to highlight where we need to do more.

'Fertile *Future*' describes the products, tools and services that Origin Fertilisers is developing to help deliver against key objectives, including:

- Improving soil fertility and health
- Increasing nutrient efficiency and crop yields
- Achieving net zero carbon by 2040
- Reducing atmospheric pollutant emissions
- Improving water quality
- Increasing resource efficiency and minimising waste

'Partnership and trust'

Origin Fertilisers has put sustainability at the centre of its business model and in sharing our vision, we aim to work in partnership with you – our colleagues, suppliers, customers and stakeholders – to achieve common goals.

We will work with you to deliver industry-leading products and services that offer tangible solutions to identifiable problems and help British farmers meet the challenge of increasing food production and protecting the environment.

Michael Pater, Managing Director
January 2021

Background

Soil and crop nutrients are integral to the global food productivity challenge: food production needs to increase by 60% from 2020 to 2050 to feed an estimated global population of 9.3 billion people by the half century.

Nutrients embody the twin-pillar challenge of sustainable agriculture:

1. **Nutrients are essential for producing sufficient, safe, secure and nutritious food**
2. **Nutrients can have an adverse environmental impact if not managed properly**

UN Sustainability Development Goals:

The role of soil and crop nutrients is a common thread interlinking several of the UN Sustainability Development Goals (SDGs) across economic, environmental and societal aspects of sustainability, including:

- **food production**
- **responsible resource management**
- **protecting the environment, particularly soil, air and water**

Future

Our approach

We have adopted a systematic approach to evaluate the role of soil and crop nutrients in sustainable agriculture; *'making it happen'.*

1. The challenges:

We have identified the key environmental challenges within the soil, air and water biospheres in relation to soil and crop nutrients and their role in sustainable agriculture. These challenges are presented on pages 4 to 7.

SOIL

AIR

WATER

1. Our solutions:

Our sustainability roadmap comprises three interconnected areas and articulates our ambitions and targets. Further information is outlined on page 8 to 15.

NUTRI-CHECK

Operational sustainability:

Purchasing
Production
Product stewardship
Customer support

NUTRI-MATCH®

Fertiliser product range:

Prescription nutrition
Matching soil and crop needs
Enhanced efficiency
Reduced emissions

NUTRI-CO_2OL®

Carbon footprint tool:

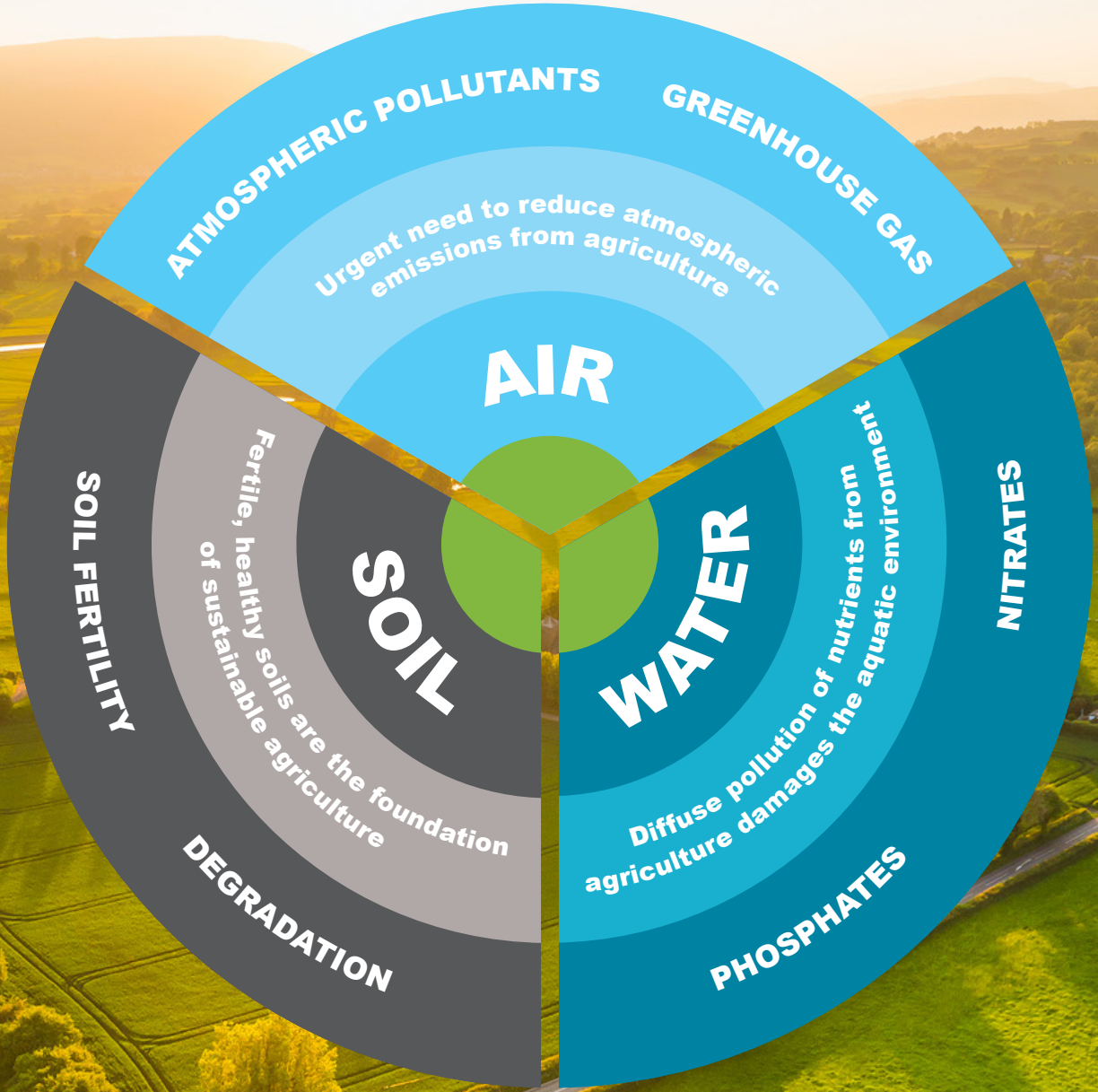
Verified by ADAS
Product and site specific
'Real time' footprints
'What-if' scenarios

The challenges

The first step in our approach to sustainable agriculture is identifying the environmental problems and challenges associated with nutrient inputs from inorganic fertilisers and organic manures.

Although essential to increasing food production, nutrients can adversely impact the environment if not managed and used properly.

We have identified the key challenges from a nutrient perspective within and between the soil, air and water environments. These are summarised at a high level in the 'environment wheel' below and further detail is outlined on pages 5 to 7.



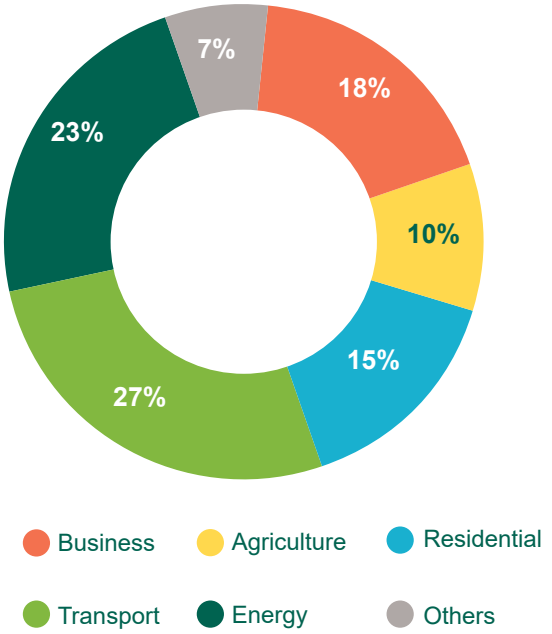
Air

Agriculture generates emissions of greenhouse gases (GHG) and atmospheric pollutants, both of which are closely connected to the management and use of nutrients, particularly nitrogen, from inorganic fertilisers and organic manures.

Climate change

Agricultural GHG emissions are 45.6 million tonnes of carbon dioxide equivalent ($MtCO_2e$) per annum, 10% of the UK total[7]. Within this, agriculture accounts for 70% of total nitrous oxide (N_2O) emissions and 50% of total methane (CH_4) emissions, which both have far greater impact on climate change than carbon dioxide (CO_2).

Nitrous oxide emissions are predominantly from the soil and relate to the application of inorganic and organic nitrogen fertiliser.



Greenhouse gas	% of UK total	CO_2e GWP*
Carbon dioxide (CO_2)	1.6%	1
Nitrous oxide (N_2O)	70.1%	298
Methane (CH_4)	49.3%	25

* GWP = global warming potential relative to CO_2

Soil and nutrient management are key components of the mitigation measures outlined in the Agriculture Industry GHG Action Plan[1], including:

- Improving soil health, structure and fertility
- Increasing agricultural productivity and efficiency
- Reducing the soil nitrogen balance
- Increasing Nitrogen Use Efficiency
- Enhanced efficiency fertilisers
- Increasing livestock nutrient efficiency

Putting these measures into practice will reduce emissions of N_2O and CH_4, mitigate climate change and improve agricultural productivity and efficiency.

greenhouse gas action plan

Atmospheric pollutants

Ammonia (NH_3) gas is an atmospheric pollutant with detrimental impacts on both human health and the environment. The UK has committed to reduce ammonia emissions by 16% by 2030 compared to 2005 levels.

Agriculture accounts for 88% of the UK's total ammonia emissions and the reduction targets are therefore largely focussed on changing farm practice.

Ammonia emissions arise from the storage and application of livestock manures (circa 80%) and the application of urea fertiliser (circa 20%).

Defra's Clean Air Strategy[2] proposes ammonia mitigation measures which include treating urea with inhibitors to enhance efficiency, covering manure stores and using low emission slurry spreaders.

Soil

Fertile healthy soils are the foundation of sustainable agriculture, helping to balance food production and environmental enhancement.

Not only do soils produce 95% of global food, they also provide habitats for a highly biodiverse ecosystem, reduce the risk of flooding and store vast quantities of carbon. The UK's soils currently store around 10 billion tonnes of carbon – the equivalent to 80 years of UK GHG emissions. Soils, and the biomass they support, are integral to mitigating climate change.

Soil is a finite and fragile resource which requires careful management to protect it from the degradation pressures of:

- **Increasing food demand from a growing population**
- **Increasing desertification and flooding caused by climate change**
- **Increasing global urbanisation**
- **Potential pollution from waste materials**

The cost associated with soil degradation in the UK is currently estimated at £1.2 billion per annum:

- £576m through loss of organic matter
- £480m through compaction
- £144m through erosion

Soil fertility and structure play a fundamental role in optimising Nitrogen Use Efficiency, a key metric in agricultural productivity and reducing nutrient losses to the atmosphere and water courses.

Data from the Professional Agricultural Analysis Group (PAAG) shows that only 10% of soils analysed in the UK each year have optimal fertility. The majority of soils have a degree of nutrient imbalance or sub-optimal pH.

Improving soil fertility, structure and health are key to efficient food production and mitigating the risks of greenhouse gas emissions and nutrient losses to water.

Soil degradation in the UK limits productivity and biodiversity, and increases the risks of flooding and greenhouse gas emissions leading to climate change.

Water

Sustainable agriculture requires sufficient clean water for food production, drinking and to support marine ecosystems.

Diffuse pollution of nutrients from agriculture can have a significant detrimental impact on water quality and the marine environment. Surface and sub-surface run-off of nitrates and phosphates from organic manures, inorganic fertilisers and soil erosion are the primary concerns in the context of diffuse nutrient pollution.

Nitrates

Excess nitrates in water can be damaging to both human health and the environment. The Nitrates Directive imposes a maximum limit of 50mg of nitrate per litre of water which is implemented through action programmes in designated high-risk Nitrate Vulnerable Zones (NVZs). Practical measures include restrictions on the amount and timing of manure and fertiliser applications.

Phosphates

High levels of phosphates – and nitrates – create eutrophic conditions in surface waters which result in algal blooms that deplete oxygen and destroy aquatic ecosystems.

'Farming rules for water'[3] give practical guidance for farmers to reduce diffuse pollution from nutrients

Regulations to reduce diffuse pollution from agriculture are in place throughout the UK which require farmers to manage nutrient losses from soils, manures and fertilisers by following specific 'Farming rules for water', including:

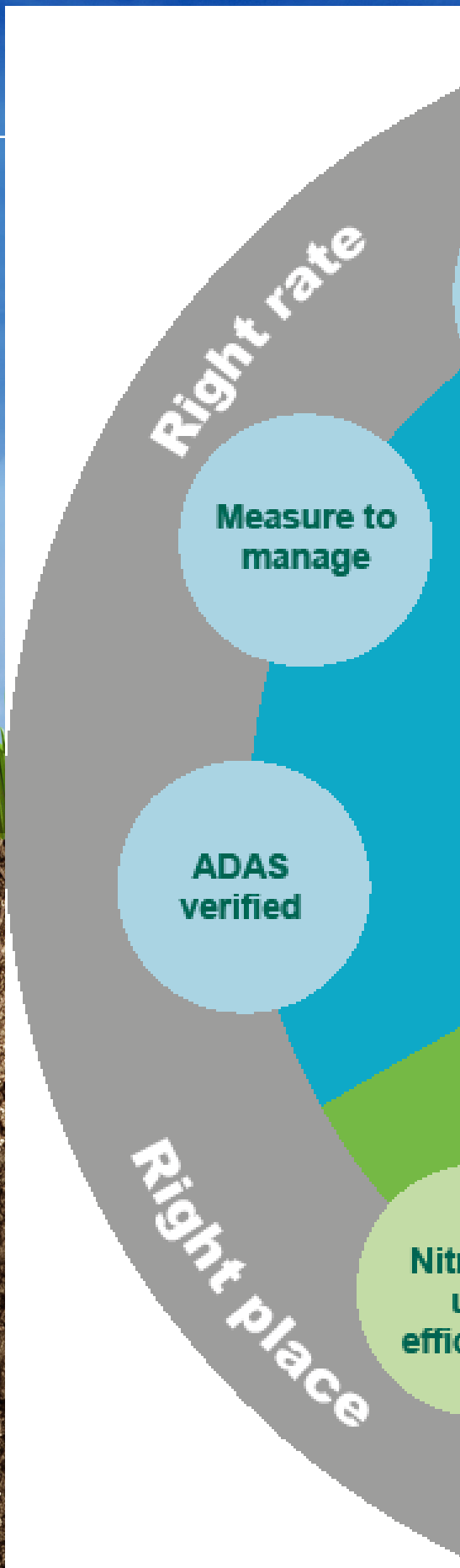
- Planning use of manures and fertilisers
- Mandatory soil analyses every 5 years
- Nutrient management plans
- Safe storage of organic manures
- Accurate application of manures and fertilisers
- Precautions to prevent soil erosion

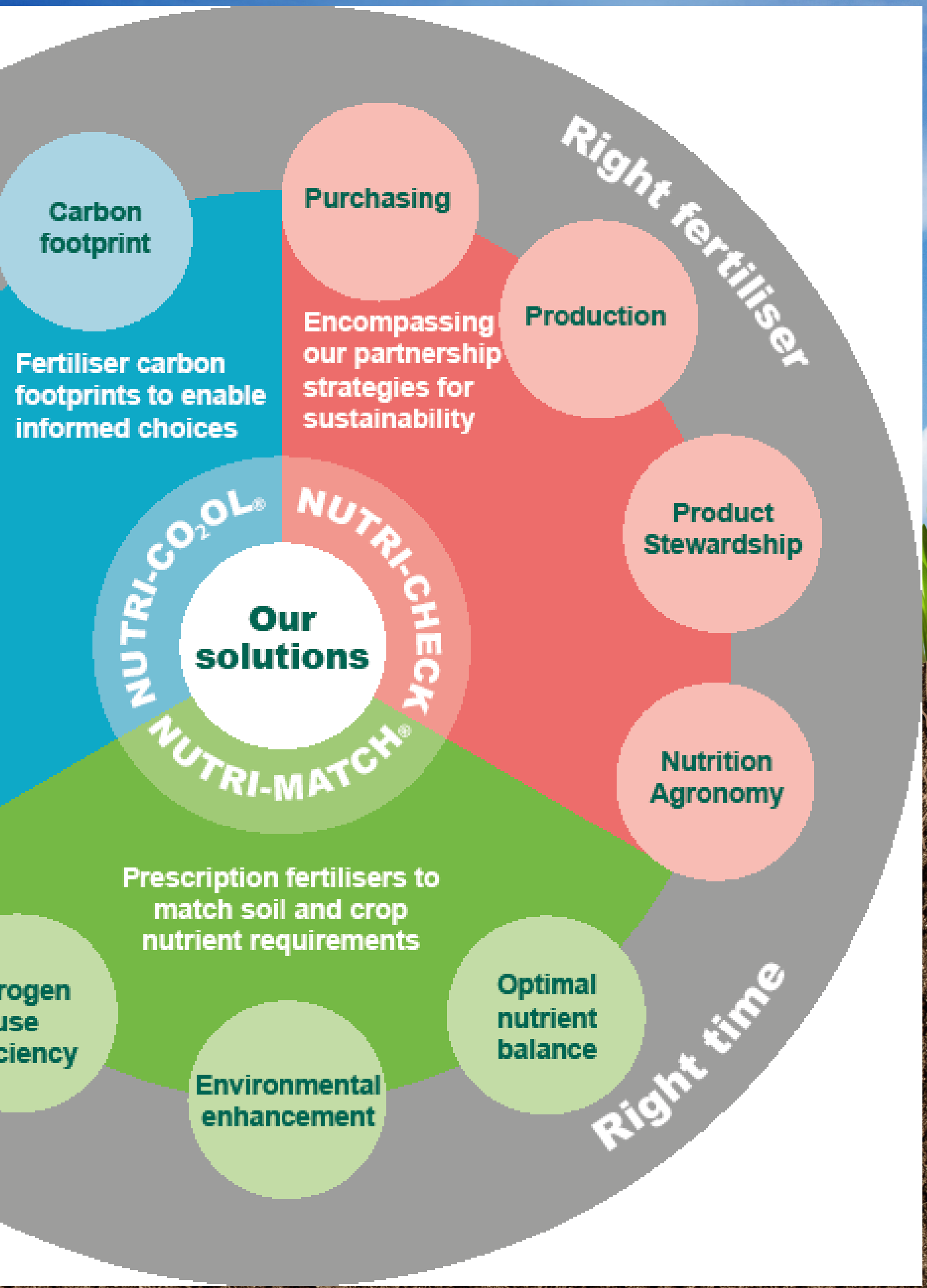
Our solutions

Applying the right fertiliser, at the right rate, at the right time, in the right place can help farmers meet the environmental challenges identified in the sections on air, soil and water.

We have grouped the progress we are making to improve farmers sustainability under three headings - NUTRI-CHECK, NUTRI-MATCH® and NUTRI-CO_2OL®.

These are summarised at a high level in the wheel and further detail is outlined on pages 10 to 15.




Right fertiliser
Carbon footprint
Fertiliser carbon footprints to enable informed choices
Purchasing
Encompassing our partnership strategies for sustainability
Production
Product Stewardship
NUTRI-CO2OL®
NUTRI-CHECK
NUTRI-MATCH®
Our solutions
Nutrition Agronomy
Prescription fertilisers to match soil and crop nutrient requirements
rogen use ciency
Optimal nutrient balance
Environmental enhancement
Right time

NUTRI-CHECK

NUTRI-CHECK is an umbrella term in relation to purchasing, production, quality assurance and nutrition agronomy to help us achieve our financial and sustainability objectives.

Purchasing:

- We purchase raw materials from suppliers with whom we have had long-term partnerships and who uphold internationally-recognised sustainability standards and practices.
- We are proactively engaged with suppliers in relation to de-carbonised raw materials including initiatives such as 'green ammonia' and nutrient sources from the circular economy.
- We are actively working with bag suppliers to trial the strength and protection of fertiliser bags containing at least 30% recycled material and will adopt as available
- We annually review and measure suppliers' sustainability scores and raw material carbon footprint

Production:

- We continue to focus on Scope 1 and scope 2 greenhouse gas emissions, and will expand to cover on site waste, recycling, disposal and water emissions
- We will implement electric-powered site vehicles when commercially viable
- Our continuous investment in inhibitor and additive production equipment will deliver new fertiliser technologies that increase nutrient efficiencies.

Sustainability Roadmap Targets, 2

NUTRI-CHECK

Further develop supplier sustainability assessments to inclu 'green ammonia' and nutrients from recycled
20% of site electricity to be from renewable
All plastic packaging to contain recycled ma
Reduce fertiliser road miles by **10%**
Provide NUTRI-CHECK data within 48 hours (b
Automate NUTRI-CHECK data (by **202**

Our 12 strategically located sites give us national coverage from local facilities. Using local hauliers to deliver from local plants minimises our road miles, reducing the carbon footprint of our distribution.

We take leadership roles within industry bodies and assurance schemes, and are proactive in consultation with government and other stakeholders on forward-looking policies and strategies around agriculture, the environment and sustainability.

Product stewardship model:

- Annual rigorous NUTRI-CHECK assessments quantify:
  - Raw material compatibility
  - Theoretical spatial distribution of granules and nutrients
  - Granule size distribution
  - Bulk density
  - Crush strength
- Our batch level NUTRI-CHECK model provides important indicators on blend evenness and accuracy of spread to ensure optimum nutrient distribution

Nutrition Agronomy:

- We produce and sell sustainable products through our Enhanced Efficiency Fertilisers (EEF) range
- Our supporting team are FACTS qualified and maintain their status through annual CPD programmes
- Our team of Nutrition Agronomists educate and advise customers on soil and crop nutrition, including:
  - Integrated nutrient management planning
  - Interpreting soil, leaf, slurry analyses
  - Improving soil fertility and health
  - Minimising the risk of nutrient losses to air and water

2020–2030

ude initiatives such as
sources

sources

aterial

by **2021**)

23)

UN SDGs

NUTRI-MATCH® prescription fertiliser

NUTRI-MATCH® is an umbrella brand that covers our prescription fertiliser offering which currently stands at over 13,000 grades, made from a choice of 14 essential nutrients:

N P K S Ca Mg Na B Cu Fe Mn Mo Se Zn

Every soil is unique in terms of its chemical, biological and physical properties. We create prescription fertiliser to match soil requirement based on broad spectrum analyses and agronomic expertise to provide the optimum amount of each nutrient.

Benefits of the NUTRI-MATCH® range

Food production

- Ensures crop yield is not limited by the under-supply of one or two nutrients – whether that be macro or micro-nutrients
- Prevents 'locking-up' of nutrients in response to soil nutrient efficiencies
- Maximises nutrient uptake (eg nitrogen use efficiency, phosphate use efficiency, potash use efficiency)
- Enhances crop quality, resulting in increased marketability of the final product
- Helps mitigate biotic and abiotic crop stress

Environment

- Minimises phosphate losses to water via run-off and/or soil erosion
- Reduces losses of nitrogen to the air via ammonia volatilisation and/ or denitrification
- Limits nitrogen losses to water via nitrate leaching
- Can reduce the number of fertiliser passes, thus reducing fuel usage and carbon emissions

Sustainability Roadmap Targets, 2

NUTRI-MATCH®

Increase proportion of broad-spectrum soil analys
Increase integrated Nutrient Management Plans
Increase proportion of EEF prescription fertiliser
Increase sales of products containing urease inhibi
Develop and increase sales of products that improve nut

Case study: **Nitrogen source**

NUTRI-MATCH® enables farmers to select a nitrogen source which is less likely to be lost to air and/or water, based on risk factors associated with their individual farming system.

The UK government NT26 research programme[4], carried out by ADAS in 2002-2005 showed that ammonia volatilisation losses associated with urea were 24% on average and ranged from 10% to 58% of the nitrogen applied.

The research showed urea + NBPT (the source in the research is now branded as SUSTAIN®) reduced volatilisation losses by 70% on average compared with unprotected urea.

SUSTAIN
Powered by AGROTAIN®

Where nitrous oxide emissions are a potential problem, a simple switch from nitrate-based fertiliser to SUSTAIN® reduced nitrous oxide emissions by 73% on average, according to joint research by Teagasc and Agrifood and BioSciences Institute[5].

Origin Enhanced-N

Trial work carried out by the NIAB-TAG at the John Innes Centre shows the addition of Origin Enhanced-N - a dual-action urease and nitrification inhibitor - to nitrogen fertiliser reduced leaching losses by up to 55%.

By reducing nitrogen losses from the system, we can ensure more nitrogen is available for crop uptake – leading to potential yield improvements.

Case study: **Sodium**

Of the grassland soil samples conducted on behalf of Origin Fertilisers in 2019/20, 87% of those which tested for sodium showed chronically low levels.

By using NUTRI-MATCH® to address these deficiencies, farmers can expect to see improvements in forage palatability and intake. In a dairy scenario, better utilisation of grass can lead to significant improvements in milk yield and quality without increasing the rate of nitrogen used.

Independent research by Bangor University[6] showed use of sodium alongside nitrogen applications, increased milk yield by 9.3% on average.

Milk quality also improved with a 15.6% increase in butterfat content and significantly reduced somatic cell counts when compared with straight nitrogen.

Parameter	N only	N+ Sodium	% +/-
Digestibility (D value, %)	71.6	72.9	+ 1.8%
Sugar content (%)	29.4	32.3	+ 9.9%
Intake (kg DM/cow/day)	14.0	16.6	+ 18.6%
Milk yield (l/cow/day)	22.6	24.7	+ 9.3%
Butterfat (g/cow/day)	833	963	+ 15.6%
Somatic cell count (SCC)	Significantly reduced		

2020–2030

- ses by **25%**
- s by **25%**
- s by **50%**
- tors by **50%**
- trient use efficiency

UN SDGs

NUTRI-CO_2OL®

NUTRI-CO_2OL® is our independently verified model that enables us to quantify the carbon footprint for any individual product. It provides site-specific carbon footprints for our 13,000+ grades from source to Origin's site gate.

NUTRI-CO_2OL® has been developed to provide customers, farmers and the food supply chain with carbon footprint data to help make more informed decisions.

NUTRI-CO_2OL® is the first independently verified UK carbon footprint model for blends, and accounts for changes in raw material sourcing, production and blending location.

Independently verified by ADAS:

- ADAS assessed relevance, completeness, consistency, accuracy and transparency of NUTRI-CO_2OL® against PAS2050:2011 *Specification for the assessment of the life cycle greenhouse gas emissions of goods and services*
- The verification covers emissions from cradle-to-gate

Helping reduce carbon footprint

- Providing a specific carbon footprint emission statement for any product that we produce
- Improving the accuracy for recording and reporting carbon footprint
- Enabling carbon footprint information to be part of the purchase decision
- Sharing how fertiliser choice can reduce end product carbon footprint in the broader food supply chain

Sustainability Roadmap Targets, 2

NUTRI-CO_2OL®

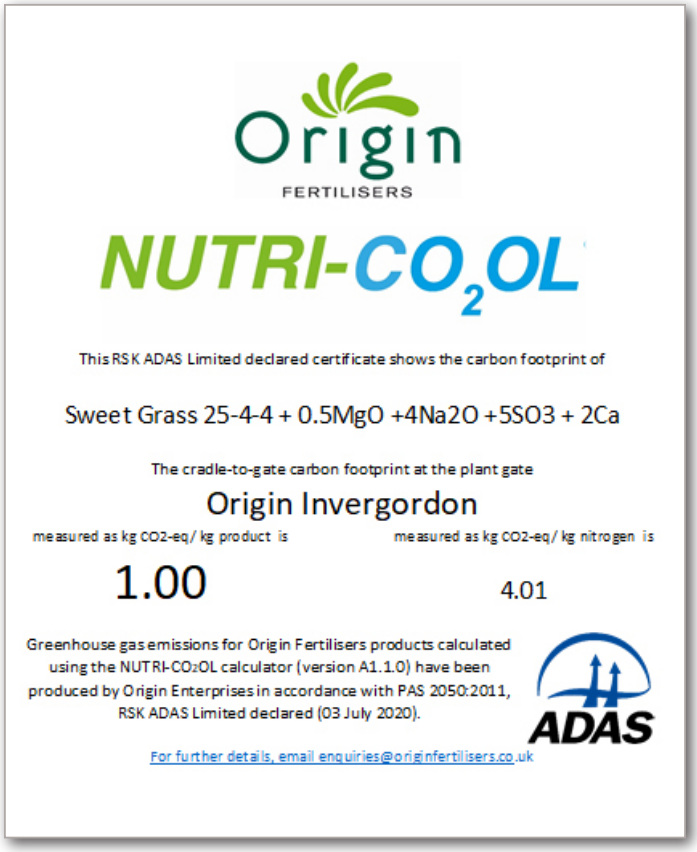
Complete NUTRI-CO_2OL® requests within 48 ho
Automate NUTRI-CO_2OL® on despatch documents
Provide NUTRI-CO_2OL® data and product comparisons recommendation and Nutrient Management Plan
Replace all default GHG emission data with supplier

Case study: **Vegetables**

A large UK vegetable producer identified in their supermarket audit that fertiliser was a significant part of their carbon footprint and discussed with their agronomist ways to reduce it.

Our NUTRI-CO_2OL® tool was used to identify how they could match the nutrient requirement of the crop to retain yield and quality, but significantly reduce the GHG from the manufacture of the fertiliser. A small change to the analysis and the raw materials making the grade produced a significant carbon footprint saving.

By reducing nitrogen losses from the system, we ensure more nitrogen is available for crop uptake – leading to potential yield improvements.


Origin
FERTILISERS
NUTRI-CO_2OL

This RSK ADAS Limited declared certificate shows the carbon footprint of

Sweet Grass 25-4-4 + 0.5MgO +4Na2O +5SO3 + 2Ca

The cradle-to-gate carbon footprint at the plant gate

Origin Invergordon

measured as kg CO2-eq/ kg product is	measured as kg CO2-eq/ kg nitrogen is
1.00	4.01

Greenhouse gas emissions for Origin Fertilisers products calculated using the NUTRI-CO2OL calculator (version A1.1.0) have been produced by Origin Enterprises in accordance with PAS 2050:2011, RSK ADAS Limited declared (03 July 2020).

ADAS

For further details, email enquiries@originfertilisers.co.uk

Case study: **Malting barley**

Origin Fertilisers supplies prescription fertilisers to key growers producing malting barley.

Significant reductions in carbon footprints were achieved in the mid-2010s through switching to abated nitrogen fertilisers, but what more can be done for the drinks market with an increasing demand for more sustainable crop production practices?

Working with a key customer supplying fertiliser to malting barley growers, our range of enhanced efficiency prescription grades provided a 9% reduction in carbon footprint when compared to a competitor standard complex compound.

Case study: **What if scenarios show CO_2-eq savings**

Fertiliser grade	Carbon footprint kg CO_2-eq/ kg product	Applied at kg/ha	Fertiliser production kg CO_2-eq per hectare kg CO_2-eq per hectare
Carrot grade A	0.25	900kg/ha	225kg CO_2-eq per ha
Carrot grade B	0.15	900kg/ha	135kg CO_2-eq per ha
Carbon footprint saving	40% reduction		Reduction of 90kg CO_2-eq per ha
Spring barley grade A	0.57	400kg/ha	228kg CO_2-eq per ha
Spring barley grade B	0.52	400kg/ha	208kg CO_2-eq per ha
Carbon footprint saving	9% reduction		Reduction of 20kg CO_2-eq per ha

2020–2030

urs (**now**)

s (by **2023**)

with every fertiliser
(by **2021**)

data (by **2030**)

UN SDGs

Origin Fertilisers at a glance

Skilled, dedicated and professional staff across all aspects of our business

12 production sites giving national coverage with local service

Infinite range of prescription products from a choice of 14 nutrients

Comprehensive training programmes and continuous development

Highly experienced staff nurturing our succeeding generation

Proactive management to ensure the safety and wellbeing of our people

The Origin way - Living our values

Our vision:

To be the trusted partner of choice in providing leading fertiliser products and services to the customers we serve.

Our purpose:

Optimising sustainable agriculture through R&D, innovation, operational excellence and nutrition agronomy expertise.

Our values:

Everything we do is directed towards achieving our Vision and Purpose. We do this by 'Living our Values', which creates an environment that enables us to deliver success for our people, our customers, our partners and for our communities.

A leading voice in the industry

We proactively engage with our industry associations in the UK, Europe and globally to promote the principles of sustainable agriculture and the practices, products and policies that will help achieve it. Our people take leadership and committee roles to support industry strategies for economic, environmental and societal sustainability.

Origin
FERTILISERS

Origin Fertilisers is a national manufacturer and distributor of fertilisers operating from a network of 12 modern production sites strategically located throughout Great Britain.

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