

# **Nitrogen use efficiency in Scotland: Annual Report 2023**

Laid before the Scottish Parliament by the Scottish Ministers under  
Section 5(1)(c) of the Climate Change (Nitrogen Balance Sheet)  
(Scotland) Regulations 2022

**SG/2023/95**

**May 2023**

## Introduction

This is the first annual report under section 5(1)(c) of the Climate Change (Nitrogen Balance Sheet) (Scotland) Regulations 2022 (“the Regulations”), and complements the latest published version of the [Nitrogen Balance Sheet for the year 2020](#). Section 5(1)(c) of the Regulations requires that a copy of this report is laid before the Scottish Parliament.

Section 5(2) of the Regulations requires that this report contains —

a figure for nitrogen use efficiency, and the period of time to which that figure relates, any revised figure for nitrogen use efficiency in relation to a period of time preceding the period of time to which the report relates and the reason for the revision, and

an assessment of—

progress towards implementing proposals and policies relevant to improving nitrogen use efficiency in Scotland,

any future opportunities for improving nitrogen use efficiency in Scotland, and

how nitrogen use efficiency is expected to contribute to the achievement of future emissions reduction targets (“emissions reduction target” has the meaning given by section 98 of the Climate Change (Scotland) Act 2009) i.e. an annual target, an interim target or the Net Zero emissions target.

## Overview

As outlined in the December 2021 report on [Establishing a Scottish Nitrogen Balance Sheet](#), the largest overall “engine” of nitrogen use in Scotland is associated with food production, and the nitrogen cycle for food production is also closely linked with the waste management, through the consumption of food for human nutrition and subsequent excretion.

There are also several sets of nitrogen flows that are largely independent of the food production system, including those associated with the combustion of fossil fuels (via transport, industry and wider energy use), although these are generally much smaller in magnitude and much simpler in structure (i.e. direct emissions to the air).

The Nitrogen Balance Sheet includes further information for these and other sectors and incorporates methodological improvements to the balance sheet along with a summary of these improvements.

## Nitrogen Use Efficiency

In 2020, the whole economy Nitrogen Use Efficiency (NUE) figure was 26.9%. Although the whole economy figure is dominated by food production, this figure is lower than the NUE for food production due to the inclusion of sources such as transport which produce no useful nitrogen outputs. The NUE for all food production is 29.6%, with the figures for aquaculture (29.9%) and agriculture (29.5%) being very similar. The 29.5% figure for all of agriculture comprises two extremely different

values for arable agriculture (62.5%) and livestock based agriculture (10.1%). Livestock based agriculture is inherently less nitrogen efficient than arable agriculture because only a small proportion of the ingested nitrogen by livestock ends up in useful nitrogen-containing produce.

There were no revisions to previous estimates for 2019.

## **Progress towards implementing proposals and policies relevant to improving nitrogen use efficiency in Scotland**

The Scottish Government has a range of strategies and policy initiatives in place, across sectors of the economy, to improve the use of nitrogen and thereby reduce the harms caused by losses into the environment. These measures include:

- a range of measures that can be expected to improve the efficiency of nitrogen use within food production, such as increasing uptake of climate mitigation measures by farmers, crofters, land managers and other primary food producers; increasing awareness and knowledge transfer and reduced emissions from nitrogen fertiliser, along with improved storage and use of slurry.
- a range of policies to reduce dependence on fossil fuel combustion across sectors (including transport, industry and wider energy use), for example by shifting to electric vehicles, supporting active travel choices and supporting renewable energy technologies, all of which will help reduce nitrous oxide emissions from these sectors.
- a range of policies to reduce the environmental impacts of waste management processes and support a transition towards a more circular economy, for example, delivering against our ambitious target to reduce food waste by one third by 2025 (against a 2013 baseline), through the Food Waste Reduction Action Plan, which will reduce nitrogen losses associated with food production and consumption.

## **Post Climate Change Plan Update (CCPu)**

Since the publication of Scotland's [Climate Change Plan Update \(CCPu\)](#), further actions with relevance to improving Scotland's nitrogen use have been implemented.

### **Food Production: Agriculture**

Our Vision for Agriculture outlines our aim to transform farming and food production in Scotland to become a global leader in sustainable and regenerative agriculture. From 2025, the climate and biodiversity performance of businesses will determine the level of agricultural support payments and we have announced the National Test Programme (NTP) to ensure the right tools and support will be in place. The NTP supports and encourages farmers and crofters to learn about how their work impacts on climate and nature, including supporting farmers to carry out carbon audits and nutrient management plans and works with a focus group of farmers and crofters to understand how sustainable farming can be supported and rewarded in future.

Through initiatives like the Farm Advisory Service and Farming for a Better Climate, we will continue to communicate to farmers and crofters the benefits of improving nitrogen use efficiency along with other climate actions.

### **Food Production: Aquaculture**

[Scotland's aquaculture website](#) includes data on annual levels of nitrogen emitted from fish farms, provided by the Scottish Environment Protection Agency as part of monitoring and reporting requirements it sets under the Water Environment (Controlled Activities) Regulations 2011.

### **Transport**

In terms of air quality pollutants (including ammonia and NO<sub>2</sub>), the Scottish Government in July 2021 published the [Cleaner Air for Scotland 2 \(CAFS 2\) Strategy](#), which sets out the policy framework for further air quality improvements over the period 2021-2026 to protect human health and the environment, and to fulfil legal responsibilities. It is recognised that NO<sub>2</sub> emissions from transport and combustion more generally can have a significant impact on human health, with high concentrations present close to busy roads. CAFS 2 contains a wide range of actions across a number of policy areas which will contribute to reductions in nitrogen emissions.

### **Humans and settlements (including waste management)**

We recognise that delivering a circular economy in Scotland is key to ensuring optimal, sustainable use of nitrogen inputs to the economy, for example re-using and recycling any nitrogen in waste products, and minimising losses of nitrogen into the environment. Our CCPu recognised that progress needs to be accelerated to deliver our ambitious waste reduction and recycling targets, and to enable us to meet updated waste sector emissions envelopes.

To achieve this and reduce nitrogen loss, we must: accelerate action across society to reduce the demand for raw material in products; encourage reuse and repairs through responsible production and consumption; and recycle waste and energy to maximise the value of any waste that is generated.

### **Forests, woodlands and terrestrial semi-natural ecosystems**

Woodland creation and management in Scotland are underpinned by the internationally recognised principles of Sustainable Forest Management – as defined in [The UK Forestry Standard \(UKFS\)](#). The UKFS is the technical standard for forestry in Scotland and sets out the legal and good practice requirements to be followed, and through detailed guidelines it gives considerable safeguards to protect the environment, aspects of which have relevance to the nitrogen cycle.

With regard to water protection in acid sensitive catchments, UKFS requires that where new planting or replanting of existing woodland is proposed within the catchments of water bodies at risk of acidification, an assessment of the contribution

of forestry to acidification and the recovery process should be carried out; details of the assessment procedure should be agreed with the water regulatory authority.

The UKFS also requires that forest soil fertility levels should be maintained to safeguard the soil's character and productive potential. To achieve this, one important aspect is to ensure the removal of forest products from the site, including non-timber products, does not deplete site fertility or soil carbon over the long term and maintains the site potential.

In addition, amendments have been made to the Water Environment (Controlled Activities) (Scotland) Regulations 2011. These include improving controls on the storage of slurry and digestate to reduce leakage, and more targeted spreading to maximise the nutrient benefit and reduce emissions.

## **Future opportunities for improving nitrogen use efficiency in Scotland**

In parallel to a programme of ongoing technical development and monitoring of the SNBS, the Scottish Government will also continue to explore opportunities to integrate new evidence provided by the SNBS into wider policy frameworks and structures.

### **Food Production: Agriculture**

The next Climate Change Plan, due in draft this year, will include policies and proposals to ensure that agriculture play its part in meeting our ambitious Net Zero national target and we have commissioned research through the ClimateXChange to consider the potential to set a nitrogen use efficiency target for Scottish agriculture.

### **Food Production: Aquaculture**

Our future Vision for Sustainable Aquaculture will include outcomes related to climate change with an ambition to see the aquaculture sector play its part in Scotland achieving Net Zero emissions by 2045 and transitioning to a zero waste and circular economy.

This will include delivering emissions reductions in line with our climate targets and exploring the potential to reduce waste discharge beyond regulatory limits and capturing more organic waste for the circular economy.

### **Transport**

Among the transport related actions which will play an important role is the introduction of Low Emission Zones that set minimum emission standards for vehicles entering the four cities of Glasgow, Edinburgh, Aberdeen and Dundee. The latest Euro 6 (VI) technologies to reduce NOx emissions work predominantly through Selective Catalytic Reuptake in the exhaust system, that injects an ammonia based solution to reduce NOx to N2. CAFS 2 also includes several actions intended to reduce nitrogen emissions from agricultural activities, with a particular focus on ammonia.

## **Humans and settlements (including waste management)**

Delivering a circular economy in Scotland is key to ensuring optimal, sustainable use of nitrogen inputs to the economy, for example re-using and recycling any nitrogen in waste products, and minimising losses of nitrogen into the environment. We still have a significant challenge ahead and it is unlikely that our vision for a circular economy can be met in full without large-scale, significant and rapid system changes. As we set out in the CCPu, we are developing a route map focussed on actions to deliver our waste reduction and recycling targets to 2025 and beyond, in a way that maximises carbon savings potential. In May 2022, we consulted on our draft route map<sup>[1]</sup> and set out proposed new and boosted measures to accelerate progress towards existing targets. We will publish a final Route Map later this year. We also [consulted on proposals for a circular economy bill](#), to ensure legislation is in place to support Scotland's transition to a circular economy. [Consultation analysis](#) has been recently published and we will be bringing forward legislation this parliamentary term.

These actions will complement the existing, wide-ranging measures we have in place to support delivery of these targets, set out in the CCP, improving how efficiently nitrogen is used and supporting our drive to tackle climate change. For example, we have established our £70 million Recycling Improvement Fund to improve local authority recycling infrastructure – one of the biggest investments in recycling in Scotland in a generation. To date, over £53 million has been awarded to 17 local authorities to increase the quantity and quality of recycling.

## **Forests, woodlands and terrestrial semi-natural ecosystems**

Wood products are largely composed of carbon and contain relatively little nitrogen, compared with forest residues, including leaf litter and brash, which are generally retained in the forest where nutrients are naturally recycled. Despite this to assure that high levels of nitrogen deposition will not pose challenges for Scotland's sensitive near-natural woodlands we will continue to monitor nitrogen flows in order to protect Scotland's ecosystems.

## **How nitrogen use efficiency is expected to contribute to the achievement of future emissions reduction targets**

Nitrous oxide (N<sub>2</sub>O), which is a greenhouse gas, amounts to around 7.8 kt N / yr of these total emissions. The majority of nitrous oxide emissions come from agriculture (5.5 kt N / yr) with other contributions from land use and land use change (1.5 kt N / yr) and more minor ones from industry, transport and waste processing. Nitrous oxide is a potent greenhouse gas, with a global warming potential (i.e. conversion factor to carbon dioxide equivalent) of 298. Scottish greenhouse gas emissions

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<sup>[1]</sup> [Delivering Scotland's circular economy - route map to 2025 and beyond: consultation - gov.scot \(www.gov.scot\)](https://www.gov.scot/publications/consultations/circular-economy-route-map-2025-and-beyond/consultation/html)

statistics for 2020 show that the 7.8 kt of N in the nitrous oxide emissions amounted to 3.7 Mt of CO<sub>2</sub> equivalent, which represents 9.1% of Scotland's total greenhouse gas emissions for that year. This makes it the third most significant greenhouse gas, after CO<sub>2</sub> itself (which represents 65.8% of the total) and methane (which represents 22.4% of the total).

Action to improve nitrogen efficiency can deliver a substantial contribution to the achievement of future emissions reduction targets through the actions outlined in this report. It is not possible at this stage to quantify the relative contributions that can be delivered from such actions but Nitrous Oxide emissions currently contribute around 9 % of total net GHG emissions which illustrates the contribution that current and future actions can potentially make to the achievement of future emissions reduction targets.

We are considering new opportunities to increase nitrogen use efficiency in the development of policies for the next Climate Change Plan to meet annual statutory emissions targets up to 2040 and to also contribute to the pathway to Net Zero by 2045. Further opportunities will be considered through the development of future strategies and plans for relevant sectors and will be outlined in future SNBS reports.



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