

T: 0300 244 4000
E: scottish.ministers@gov.scot

Edward Mountain MSP
Convener
Net Zero, Energy and Transport Committee
The Scottish Parliament
Edinburgh
EH99 1SP

By email: netzero.committee@parliament.scot

PUBLICATION OF THE SCOTTISH NITROGEN BALANCE SHEET

29 May 2023

Dear Convener,

I am writing to advise that the Scottish Government today published the updated version of the Scottish Nitrogen Balance Sheet (SNBS) following on from the publication of the annual update in May 2023.

A copy of the Progress Report that has been laid in Parliament is attached and the updated SNBS can be found here: <http://www.gov.scot/publications/scottish-nitrogen-balance-sheet-2021/>

This publication has been developed through utilising multiple datasets and offers an understanding of, and a method for tracking, the flow of nitrogen across different parts of Scotland's economy and environment.

By offering an insight into the flow of nitrogen used across Scotland's economy and environment, the SNBS is able to provide summary calculations regarding how efficiently nitrogen is currently being used (provided in the form of national metrics) to support emissions reduction planning in Scotland.

If you would like further information on SNBS this can be provided by contacting my official Kim Horner via email at kim.horner@gov.scot.

Yours sincerely,



MÀIRI MCALLAN

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St Andrew's House, Regent Road, Edinburgh EH1 3DG
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Nitrogen use efficiency in Scotland: Annual Report 2024

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/2024/74

May 2024

Introduction

This is the latest 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 (the third publication) of the [Nitrogen Balance Sheet for the year 2021](#). 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)

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 2021, the whole economy Nitrogen Use Efficiency (NUE) figure was 25%. 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%, with the figure for agriculture (28%) being very similar, given that agriculture dominates food production. The 28% figure for all of agriculture comprises two extremely different values for arable agriculture (65%) and livestock based agriculture (10%). 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 (meat and milk, etc).

This year is the first year that the published dataset includes a time series of Nitrogen flows and Nitrogen Use Efficiencies, with the figures for previous years incorporating this year's methodological improvements and the latest available data for these years. The methodological updates to SNBS have resulted in no change to the 2019 whole economy NUE and it remains at 25%. This was the only NUE to use the updated methodology Nitrogen flows, and changes to previous figures for the other NUE estimates is due to updates in the source datasets themselves.

The inherent uncertainties in the underlying data means that the SNBS may need to be revised in the future for purely technical reasons. Such revisions have the potential to affect all historic time periods referenced. Additionally, there will always be a variable level of uncertainty present due to the wide variety of data sources used, spread across a variety of administrative data, survey data and modelled data. The disparate methods will all have different levels of inherent uncertainty within them which means caution must always be taken when comparing between flows.

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:

- 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. Such practices are in line with a shift to sustainable and regenerative practices in line with Scotland Vision for agriculture.
- 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.

- policies to reduce the climate and environmental impacts of waste management processes and support a transition towards a more circular economy, for example, delivering against our ambitions to reduce food waste by 50% by 2030, as part of the UN Sustainable Development Goal (SDG) 12.3 target, which may help reduce nitrogen losses associated with food production and consumption. Proposals to help achieve this are outlined in the draft [Circular Economy and Waste Route Map](#) (2024).

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](#) aims to transform farming and food production in Scotland, with the goal of becoming a global leader in sustainable and regenerative agriculture. This is a holistic approach that will include reduction of nitrogen use. The [Agricultural Reform Programme](#) is transforming farming and food production in Scotland. Currently, financial assistance is being provided for the implementation of activities like carbon audits, soil testing and nutrient management planning. Preparing for Sustainable Farming (PSF) focuses on incentives to farmers and crofters to help them understand their Carbon emissions and sequestration, identifying recommendations that can lower these emissions and increase efficiencies. This includes support for soil testing and nutrient management planning which can help improve nitrogen efficiency.

In March 2024, we published the third edition of the [Agricultural Reform Route Map](#), which serves as a reliable source for upcoming information outlining the transition to a new agricultural support framework from 2026.

The [Whole Farm Plan](#) conditions commence in 2025 and will require farmers and crofters to complete two baselining activities from a list of options, including carbon audits, biodiversity audits, soil analysis, the creation of animal health and welfare plans, and integrated pest management plans. We will add Nutrient Management Plans to the Whole Farm Plans by 2028, which will support improved nitrogen efficiency, with proportionate Carbon audits being required by all farms receiving public support by 2028 at the latest. These changes are designed to help all our farmers and crofters do more to produce food sustainably, to cut emissions and to farm more for nature.

We have introduced the Agriculture and Rural Communities (Scotland) Bill which will give ministers powers to introduce, and periodically review, a Rural Support Plan aligned to the Vision for Agriculture.

The bill also seeks to establish a Code of Practice on Sustainable and Regenerative Agriculture which will outline effective regenerative practice. This will be co-developed, and cover, soil, crop and livestock management, including the use of N-fixing legumes, mixed arable/livestock systems, regenerative grazing, minimum tillage, more efficient use of synthetic nutrients, livestock efficiencies and methane inhibiting feeds.

The Scottish Government has commissioned work through our climate centre of expertise ClimateXChange (CXC) to produce a report, to be published during 2024, on the potential for setting a target for nitrogen use efficiency in agriculture in Scotland.

We also published Farm level emissions and nitrogen usage data from the [21/22 Scottish Farm Business Survey](#).

The environment, food and rural affairs Strategic Research Programme 2022-2027 has two projects which continue to run and will consider crop varieties with improved nitrogen-use efficiency. These are:

- The Impact of Novel Crops and Farming Technologies on the Scottish Agricultural Landscape
- Exploring Barley Diversity for resilience and sustainability

We are committed to providing support and guidance to demonstrating the benefits of regenerative agriculture, precision farming, and nitrogen use efficiency, for example, by offering financial support, practical advice, and skill development opportunities. Through initiatives like the [Farm Advisory Service](#) (where several specialist advice outputs covering precision farming and nitrogen use have been undertaken) and through the [Monitor Farm Programme](#).

Recent enhancements (2023) to the Forestry Grant Scheme for agroforestry and small farm woodlands aim to encourage more trees on farms and will facilitate a reduction in emissions. These are augmented by the farmer-led Integrating Trees Network initiative, supported by Scottish Government and Scottish Forestry, which offers a platform to share advice and experiences of incorporating trees on farms to encourage uptake.

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

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 NO₂), 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 NO₂ 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 dioxide (NO₂) emissions. This includes our strategic approach to transport through Scotland's National Transport Strategy (NTS), published in February 2020, which underpins our efforts to deliver additional air quality improvements in CAFS 2.

At its core, the NTS embeds the Sustainable Travel Hierarchy in decision making by promoting walking, wheeling, cycling, public transport and shared transport in preference to private car. It further embeds the Sustainable Investment Hierarchy in investment decisions that recognise the need to reduce unsustainable travel and focus on maintaining and safely operating existing assets over investment in targeted infrastructure improvements.

Annual NTS Delivery Plans set out the actions being taken across the Scottish Government to deliver our shared vision for transport. The third Delivery Plan, published in December 2023, makes reference to the Vision for Scotland's Public Electric Vehicle Charging Network, highlighting the need for a transition towards a public charging network that is largely financed and delivered by the private sector.

Humans and settlements (including waste management)

Moving to a circular economy in Scotland is key to ensuring optimal, sustainable use of nitrogen inputs to the economy, for example reducing waste, re-using and recycling nitrogen, and minimising losses of nitrogen into the environment. Our CCPu set out our circular economy vision that by 2045 Scotland's cultural, social and business norms will be driven by a focus on:

- Responsible Production, where a circular economy is embraced by the businesses and organisations that supply products, ensuring the maximum life and value from the natural resources used to make them.

- Responsible Consumption, where people and businesses demand products and services in ways which respect the limits of our natural resources. Unnecessary waste, in particular food waste, will be unacceptable in Scotland.
- Maximising Value from Waste and Energy, where the environmental and economic value of wasted resources and energy is harnessed efficiently.

To achieve this, and reduce nitrogen loss, will need fundamental changes in the way that resources are produced, consumed and managed. This means accelerating action across society to reduce the demand for raw material in products; encourage reuse and repair through responsible production and consumption; and recycle resources and energy to maximise the value of any waste that is generated, while minimising environmental and climate impacts.

To lay the foundations for this transformation, the Scottish Government published a [draft Circular Economy and Waste Route Map to 2030](#) for a second consultation in January 2024. Alongside this, the [Circular Economy \(Scotland\) Bill](#) was introduced to the Scottish Parliament in June 2023. See the 'Future opportunities' section below for more information on this.

The Route Map and Circular Economy (Scotland) Bill complement the existing, wide-ranging measures we have delivered or are delivering to meet our sustainable resource objectives, improve how efficiently nitrogen is used and support our drive to tackle climate change (including those policies and proposals outlined in the CCPu).

Helping to address nitrogen losses associated with food consumption, a range of food waste reduction measures have been delivered, in partnership with Zero Waste Scotland, since the publication of the [Food Waste Reduction Action Plan](#) in 2019. These include: completing audits for 250 businesses and recommending actions to reduce food waste; delivering communication campaigns to raise awareness of the issue of food waste and how householders can address it; and supporting FareShare to redistribute nearly 2,000 tonnes of surplus food to community groups as a result of funding by zero waste and food insecurity policy areas to help address food waste and insecurity issues.

Current measures to divert waste from landfill include a ban on biodegradable municipal waste going to landfill from 31 December 2025, and support for local authorities to secure contracts that comply with the ban. Our £70 million Recycling Improvement Fund was launched in March 2021, and more than £60 million has been awarded to 25 local authority projects to improve recycling infrastructure, projected to save over 57,000 tonnes of CO₂e per year. This includes funding improvements to food waste recycling across Scotland. By reducing food waste sent to landfill we are preventing valuable nutrients from being lost. Reducing the amount of food, and other wastes with a high nitrogen content, sent to landfill can reduce the

nitrogen content of landfill leachate, and therefore, reduce the amount [or N] released to the environment.

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. A new version of the UKFS was published in October 2023 and will come into effect in October 2024. The Scottish Government supports tree planting through the Forestry Grant Scheme for which, compliance with the UKFS is required to obtain funding. Through detailed guidelines, the UKFS gives considerable safeguards to protect the soil and water environment from nitrate saturation, leaching and runoff.

The UKFS requires forest soil fertility levels to 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, is managed with a consideration of soil type to mitigate against the depletion of site fertility or soil carbon over the long term and ensure site potential is maintained. The use of fertilisers in forestry is now very rare, particularly nitrogen based ones.

In 2023, a further Forestry Grant Scheme enhancement for woodlands for riparian benefits was launched. Similar to the agroforestry and small farm woodlands grant scheme options set out as actions in the Climate Change Plan update (2020), this grant option encourages more trees on farms, facilitates integrated land use change and supports a reduction in 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 will include policies and proposals to ensure the agriculture sector plays 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 Vision for Sustainable Aquaculture, published in July 2023, includes outcomes related to climate change with an ambition to see the aquaculture sector play its part in Scotland achieving Net-Zero emissions by 2045, transitioning to a zero waste and circular economy and improving nitrogen use efficiency by reducing waste discharge, capturing more waste and exploring more opportunities for best use.

Transport

Among the most significant transport-related actions which will continue to play an important role in reducing nitrogen use is the introduction of Low Emission Zones (LEZ) that set minimum emission standards for vehicles entering the four cities of Glasgow, Edinburgh, Aberdeen and Dundee. Enforcement having commenced in Glasgow in 2023 with Aberdeen, Dundee and Edinburgh to follow in 2024. For diesel vehicles compliance with the LEZ standards requires the latest vehicle exhaust technologies to reduce nitrogen oxide (NOx) emissions in diesel engines work using an ammonia based solution to reduce harmful NOx emissions to nitrogen (N₂).

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 by embedding sustainable production and consumption, reducing waste, maximising re-use and recycling of nitrogen, and minimising losses of nitrogen into the environment, including reducing nitrogen pollution from landfill leachate.

In January 2024, we published our [draft Circular Economy & Waste Route Map](#) for a second consultation, following a [first consultation](#) in 2022. Following analysis of the consultation feedback, the final Route Map will be published later in 2024. Alongside the Route Map, we introduced the [Circular Economy \(Scotland\) Bill](#) to the Scottish Parliament in June 2023. The Bill, which is currently on its passage through Parliament, contains provisions that require primary legislation to underpin Scotland's transition to a circular economy, and modernise Scotland's waste and recycling services.

Together the Route Map and Bill will provide the framework for delivering sustainable resource use (including nitrogen) and a more circular economy in Scotland across a range of sectors. This complements the existing, wide-ranging measures we have in place to support delivery of our objectives, as set out above, improving how efficiently nitrogen is used and supporting our drive to tackle climate change.

By reducing demand for new products and virgin materials and driving down the amount of material disposed of via landfill and energy from waste, a range of negative pollution impacts, including nitrogen, on biodiversity, air, bodies of water,

and soils can be avoided. The Route Map's [Strategic Environmental Assessment \(SEA\) Report](#) found that there was clear potential to reduce nitrogen pollution in Scotland via delivery of Route Map measures, for example as a result of a reduction in traffic congestion and reducing food waste.

As part of the draft Route Map's wide ranging policy package, priority actions are set out to reduce food waste from all sources, building on our 2019 Food Waste Reduction Action Plan. We recognise that progress to reduce food waste has not been at the scale and speed required, partly as a consequence of Covid-19, and a collective reset of our approach to tackling food waste in Scotland is required. The package of measures is designed to address the whole food system; reset our approach to food waste; enhance our circular bioeconomy through adoption of regenerative land management practices; and ensure we have the data needed to understand and drive progress.

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.

SEPA and NatureScot in partnership UKCEH have developed web application that provides access to the latest modelled estimates of nitrogen deposition and ammonia concentrations at a designated site level. The data presented in the app will allow the Scottish agencies to work more collectively towards reducing the impacts of nitrogen on the environment and towards identifying areas that require specific attention, whether it's towards promoting mitigation measures, monitoring impacts on our habitats or more direct action working with landowners to develop and implement local emission reduction measures to improve protection to sensitive habitats.

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

Nitrous oxide (N₂O), which is a greenhouse gas, amount to around 7.2 kt N / yr. The majority of nitrous oxide emissions come from agriculture (5.3 kt N / yr) with other contributions from land use and land use change (1 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 265. Scottish greenhouse gas emissions statistics for 2021¹ show that the 7.2 kt of N in the nitrous oxide emissions amounted to 3 Mt of CO₂ equivalent emissions, which represented 7.2% of Scotland's total greenhouse gas emissions for that year². This makes it the third most significant greenhouse gas, after CO₂ itself (which represents 66% of the total) and methane (which represents 24.5% 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 7.2% of 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 assist in meeting the statutory emissions targets 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.

¹ [Scottish Greenhouse Gas Statistics 2021 - gov.scot \(www.gov.scot\)](https://www.gov.scot/resources/consultations-policies/climate-change/2021/01/scottish-greenhouse-gas-statistics-2021/)

² By convention, shares of emissions are assessed against net emissions for a given year, i.e. the net CO₂ equivalent gasses added to the atmosphere in that year. However, it would also be valid to compare against gross emissions, excluding removals of CO₂ from the atmosphere from land use, land use change and forestry (LULUCF). On that basis the share of nitrous oxide to gross emissions in 2020 was 5.7 per cent.



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Any enquiries regarding this publication should be sent to us at

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Edinburgh
EH1 3DG

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