

Forestry Ecosystem Accounts: Deep Dive into Greenhouse Gas regulating

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Agenda

- What are regulating services?
- Introduction to greenhouse gas regulating account
- What we measure in the ONS:
- Our data sources:
- Our methods & results
- Advice for next steps

Regulating services

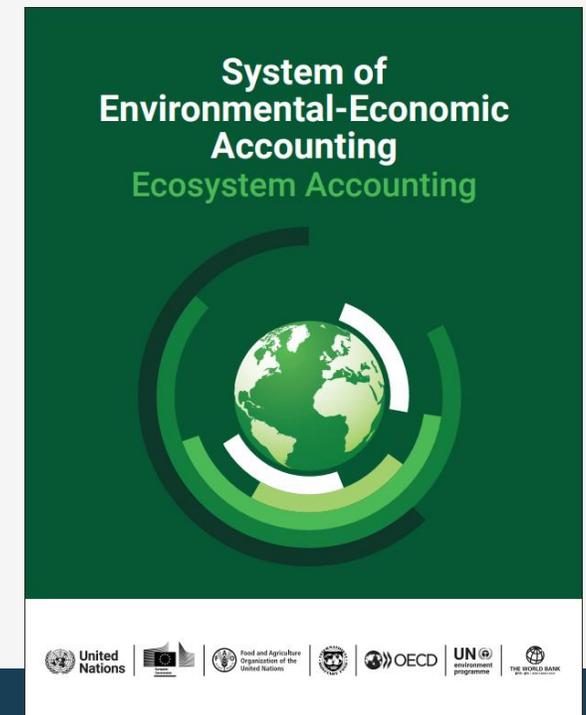
SEEA Guidance



System of Environmental Economic Accounting

- Integrated spatial statistical framework for organising biophysical information about ecosystems
- Developed to make the contributions of nature to the economy and people more visible
- SEEA guidance suggests three main types of ecosystem services (section 6.51 in SEEA-EA):

- *Provisioning services are those ecosystem services representing the contributions to benefits that are extracted or harvested from ecosystems.*
- *Regulating and maintenance services are those ecosystem services resulting from the ability of ecosystems to regulate biological processes and to influence climate, hydrological and biochemical cycles and thereby maintain environmental conditions beneficial to individuals and society.*
- *Cultural services⁷² are the experiential and intangible services related to the perceived or actual qualities of ecosystems whose existence and functioning contribute to a range of cultural benefits.*



SEEA Guidance

System of Environmental Economic Accounting



Table 6.3

Reference list of selected ecosystem services

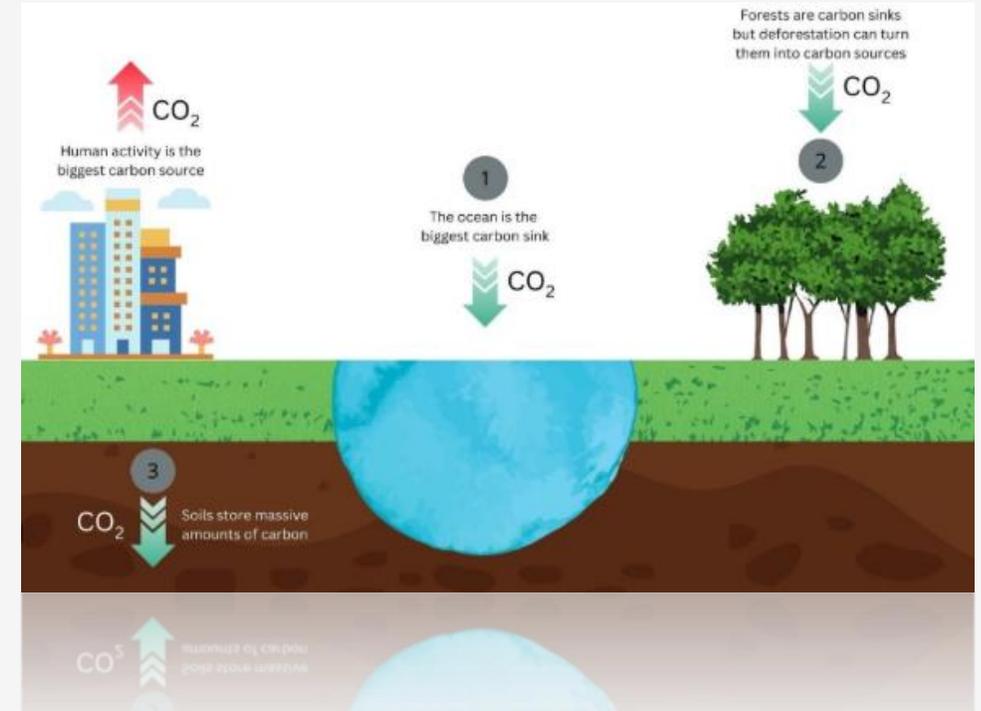
Regulating and maintenance services	
Global climate regulation services	Global climate regulation services are ecosystem contributions to reducing concentrations of GHGs in the atmosphere through the removal (sequestration) of carbon from the atmosphere and the retention (storage) of carbon in ecosystems. These services, which support the regulation of the chemical composition of the atmosphere and oceans, are final ecosystem services.
Rainfall pattern regulation services (at subcontinental scale)	Rainfall pattern regulation services are ecosystem contributions of vegetation, in particular forests, to maintaining rainfall patterns through evapotranspiration at the subcontinental scale. Forests and other vegetation recycle moisture back to the atmosphere where it is available for the generation of rainfall. Rainfall in interior parts of continents fully depends upon this recycling. These may be final or intermediate ecosystem services.
Local (micro and meso) climate regulation services	Local climate regulation services are ecosystem contributions to the regulation of ambient atmospheric conditions (including micro- and mesoscale climates) through the presence of vegetation that improve people's living conditions and support economic production. Examples include evaporative cooling provided by urban trees ("green space"), the contribution of urban water bodies ("blue space") and the contribution of trees to providing shade for humans and livestock. These may be final or intermediate ecosystem services.

Greenhouse Gas Regulating services

System of Environmental-Ecosystem Accounting (SEEA) proposes two accounting principles:

- **Sequestration:** flow of carbon removal and uptake up by an ecosystem; measured over time
- **Storage:** stock of the amount of carbon held within an ecosystem at a specific point in time

- Carbon emissions and removal can occur from a variety of natural and non-natural sources.



Focusing on natural sources

- LULUCF (Land use, Land Use Change, and Forestry):
- These are emissions and removals from the natural environment:
 - Includes the human use of the natural environment.
 - Forests, cropland, grassland, peatland, and settlements
 - For example, forests remove carbon from the atmosphere, but deforestation can emit carbon into atmosphere,

What do we estimate in the UK?

What do we measure?

- We measure the removal of greenhouse gas and the emission of greenhouse gas by the LULUCF sector.
- We show both positive and negative values:
 - Positive values occur when removals are higher than emissions
 - Negative values occur when emissions are higher than removals
- We do differ from SEEA-EA guidance in showing negative values

Our estimates...

- Physical Flow:
 - The net amount of greenhouse gas removed or emitted by nature
- Annual Value:
 - The annual value of greenhouse gas removed or emitted by nature
- Asset:
 - The value of asset over its lifetime

Data Sources

Data Needs

- To begin, you will likely need:
 - A data source to measure the amount of greenhouse gas emissions and removals by nature
 - A way of valuing the net removals

UK Emissions Data source provider



Compiled by [DESNEZ](#) in collaboration with other UK government departments and agencies



In accordance with the reporting requirements of the United Nations Framework Convention of Climate Change (UNFCCC) and are submitted to the Framework.



Data is compiled in line with the UK NAEI (National Atmospheric Emissions Inventory) framework. (The net emission/removal data is a subset of this dataset).



Limitation: Data are model-based not actual estimate

Greenhouse gas sources and store data



Level of emission (CO₂ equ/tonnes unit) from sources: industries, energy sector, transportation, agriculture, **deforestation & land-use (WE ONLY FOCUS ON THIS)**, waste and industrial chemicals



Greenhouse gases measured: CO₂, CH₄ (methane) and N₂O – standardised to CO₂ equ



Level of sequestration by 6 land-uses/habitats: **bioenergy crops, forestry, grassland mineral soil changes, cropland mineral soil changes, peatland, settlement**



Net flows = emissions – sequestration (CO₂ equ per year and geographic area)

Forest carbon removal data modelling

- Based on a [dynamic model \(CARBINE\)](#) of changes in stored carbon, driven by land use change data
- Plant carbon, dead organic matter, soil carbon and harvested wood products are considered
- Harvested wood products are currently not included in the estimate due to limited data
- Soil carbon changes are impacted by transitions between land uses

Monetary data

- [Carbon value per tonne](#) of CO2 published by Department of Energy Security & Net Zero, developed to estimate a monetary value of the impact of greenhouse gas used in policy estimates.
 - Uses a Marginal abatement cost – which estimates the cost of cutting one tonne of emission.
 - The UK Government uses this approach to identify the carbon value required to deliver sufficient abatement to meet its targets.
- Differs from carbon pricing – which is what business actually pay for emissions permits.

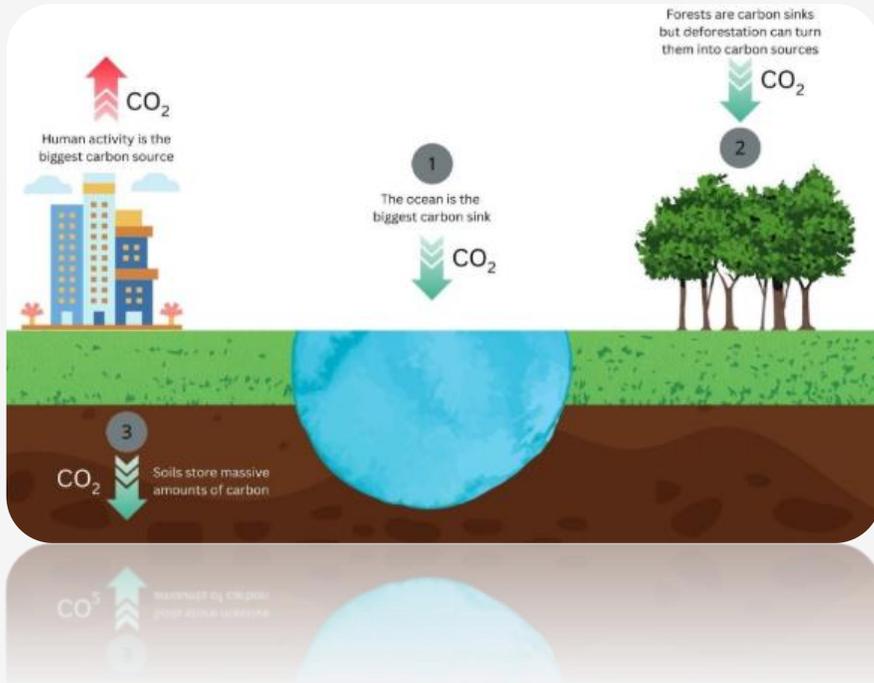
What data does your country have?

- Do you have a net sequestration (removal) data equivalent?
- Are there partnering organisation responsible for compiling a “net-zero target” related data?
- Are there national standards guiding the adoption of the UN Convention of Climate Change net-zero reporting?



Methodology

Method and evaluation



Physical flow of net sequestration from land and land-use changes



Monetary (annual and asset) value of the physical flow (gain or losses)

Physical flow estimation


Department for
Energy Security
& Net Zero



 **Forest Research**

 UK Centre for
Ecology & Hydrology


Department
for Environment
Food & Rural Affairs



- Land use, land use change and forestry (LULUCF) by local authority
- Subset of the UK National Atmospheric Emissions Inventory
- Compiled by **DESNEZ** in collaboration with other government department and agency



- Net territorial carbon stock change (emissions – removal) in CO2 equivalent of:
 - Greenhouse gases:** CO2, CH4 and N20
 - Carbon store habitat categories:** Forestry, Cropland mineral soil, Grassland mineral soil, Peatland, Bioenergy crops, settlement and others

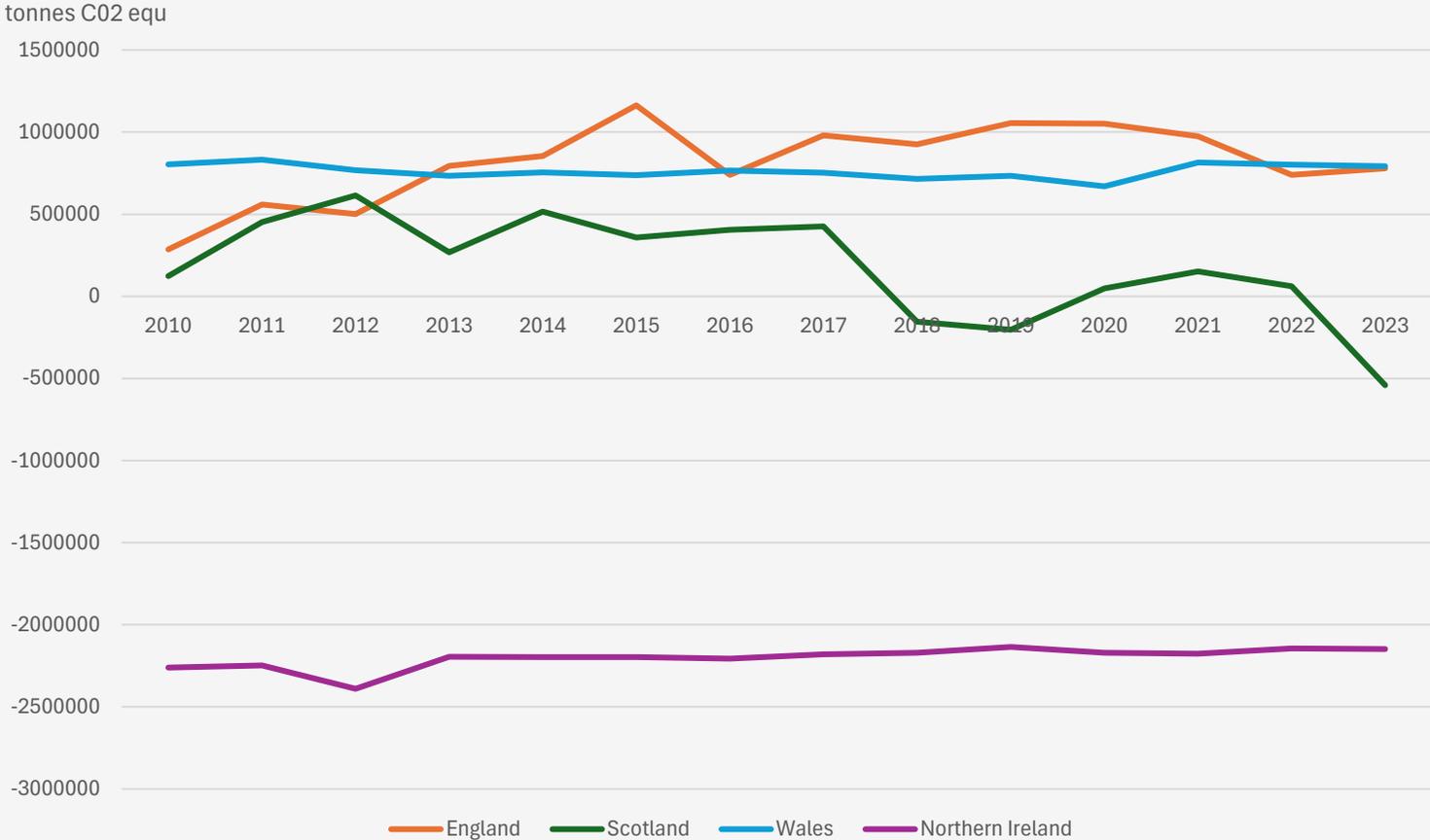


- Aggregate of the net territorial carbon stock change in unit (tonnes)

Physical flow estimates

- Higher net removal in Wales and England in 2023

Greenhouse gas removed or emitted by nature, by Country in the UK

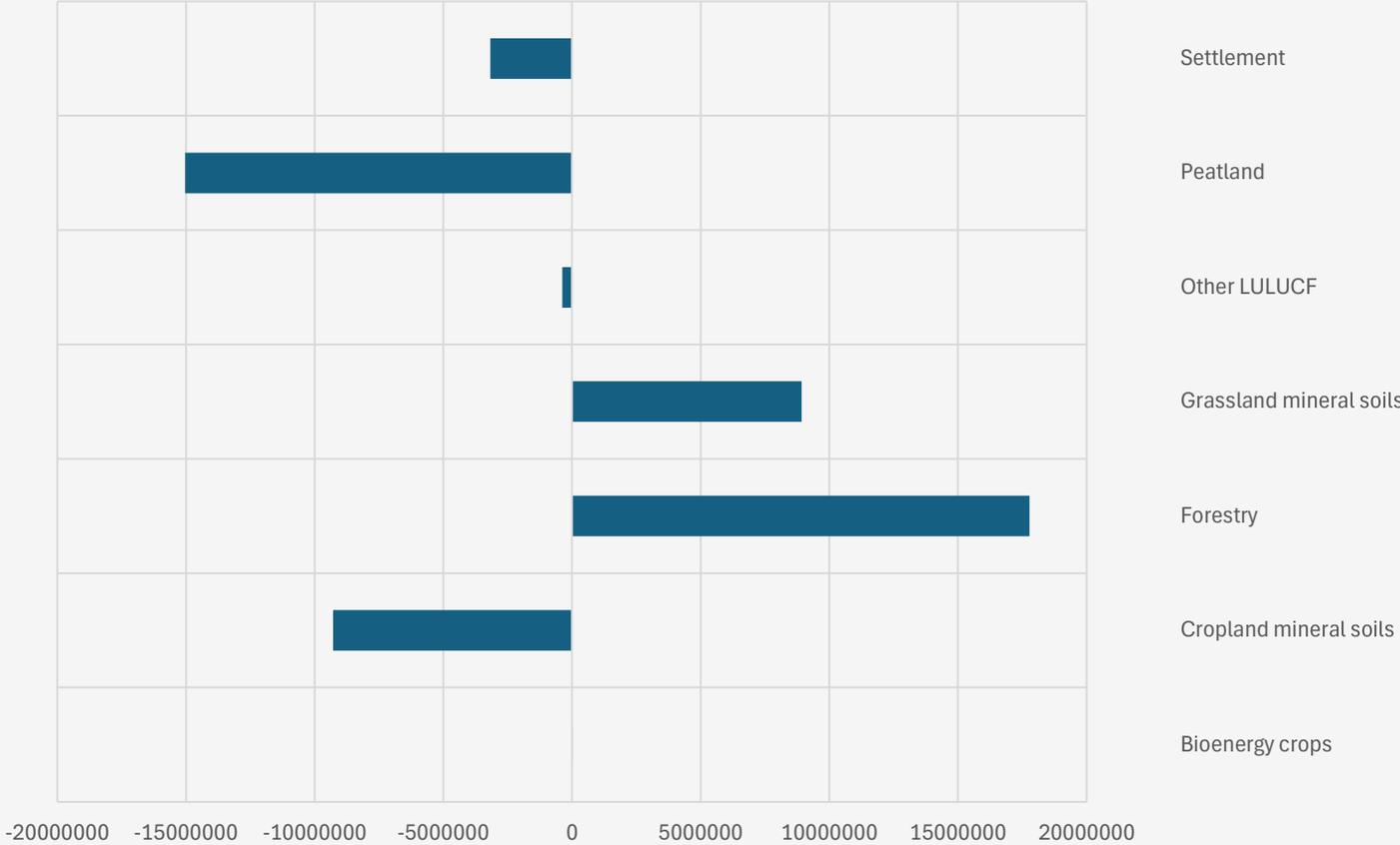


Source: Department of Energy Security and Net zero and the National Atmospheric Emissions Inventory

Physical flow estimates by habitat

- In 2023, UK greenhouse gases were mainly captured by forestry (17.8m t CO2 equ) and emitted by peatlands (-15.0m t CO2 equ)

Territorial net emissions/removal by habitat UK in 2023 (Physical flows in tonnes CO2 equivalent)



Source: Department of Energy Security and Net zero and the National Atmospheric Emissions Inventory

Annual value estimation



Department for
Energy Security
& Net Zero



HM Treasury

Data

- Land use, land use change and forestry (LULUCF) by local authority - DESNEZ
- Carbon value price data (cost per tonne of CO₂) - by DESNEZ. This include forecasted values up to 2050.
- Gross Domestic Product (GDP deflator) - HM Treasury

Variables

- **LULUCF data:** estimated physical flow
- **Carbon value price data:** Median modelled value

Estimation

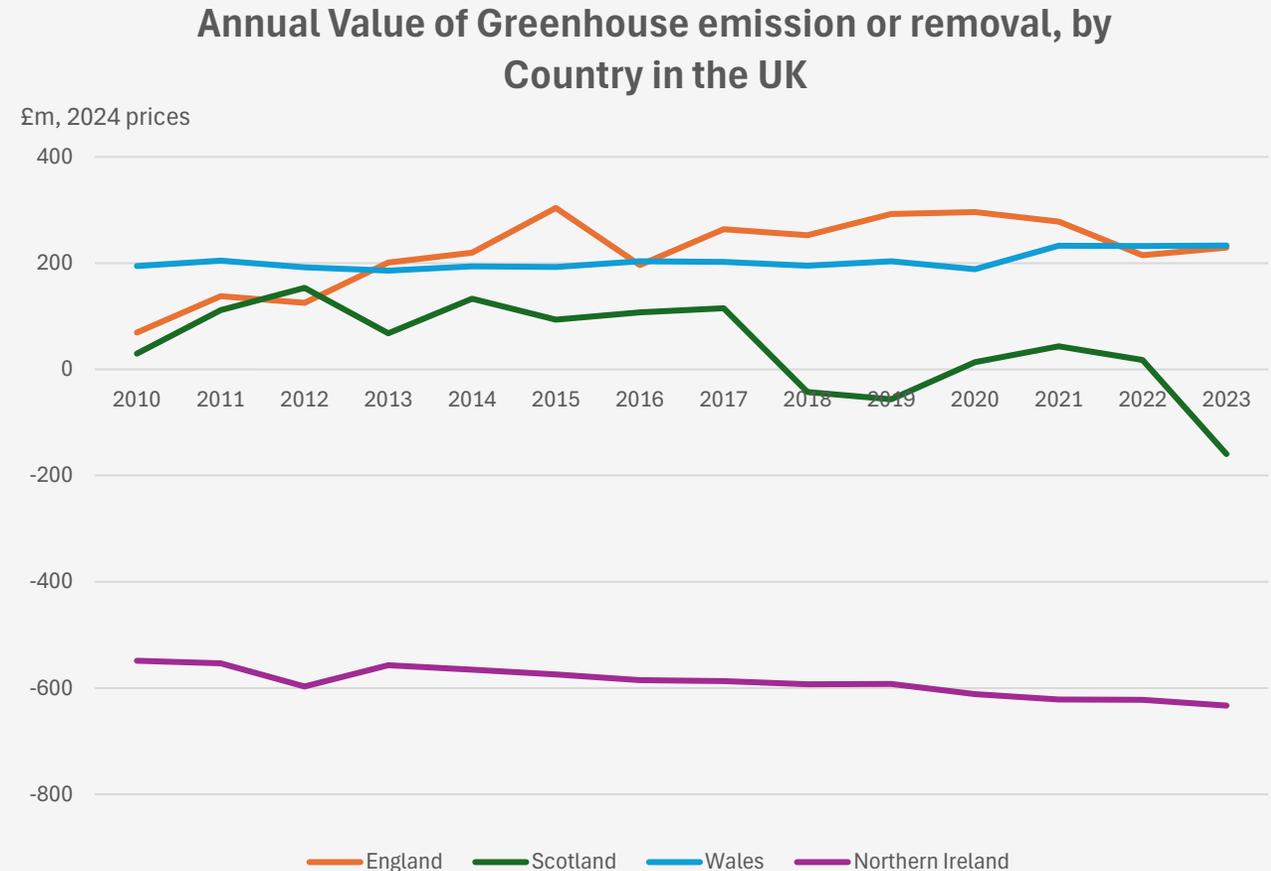
- Inflate carbon value price to constant price using the GDP deflator
- Physical flow * Inflated carbon value price

Annual value estimation

- *Annual Value = (Tonnes of Co2 removed – Tonnes of Co2 emitted by LULUCF) × Carbon Value*
- Carbon Value is on a constant price basis – using economy wide deflator

Annual value estimates

- In 2023, the estimated annual value for UK was £-330m
- Negative value is driven by lower social cost (value/benefit) per tonne of CO₂ in Scotland and Northern Ireland
- England and Wales have high positive annual value due to high net sequestration

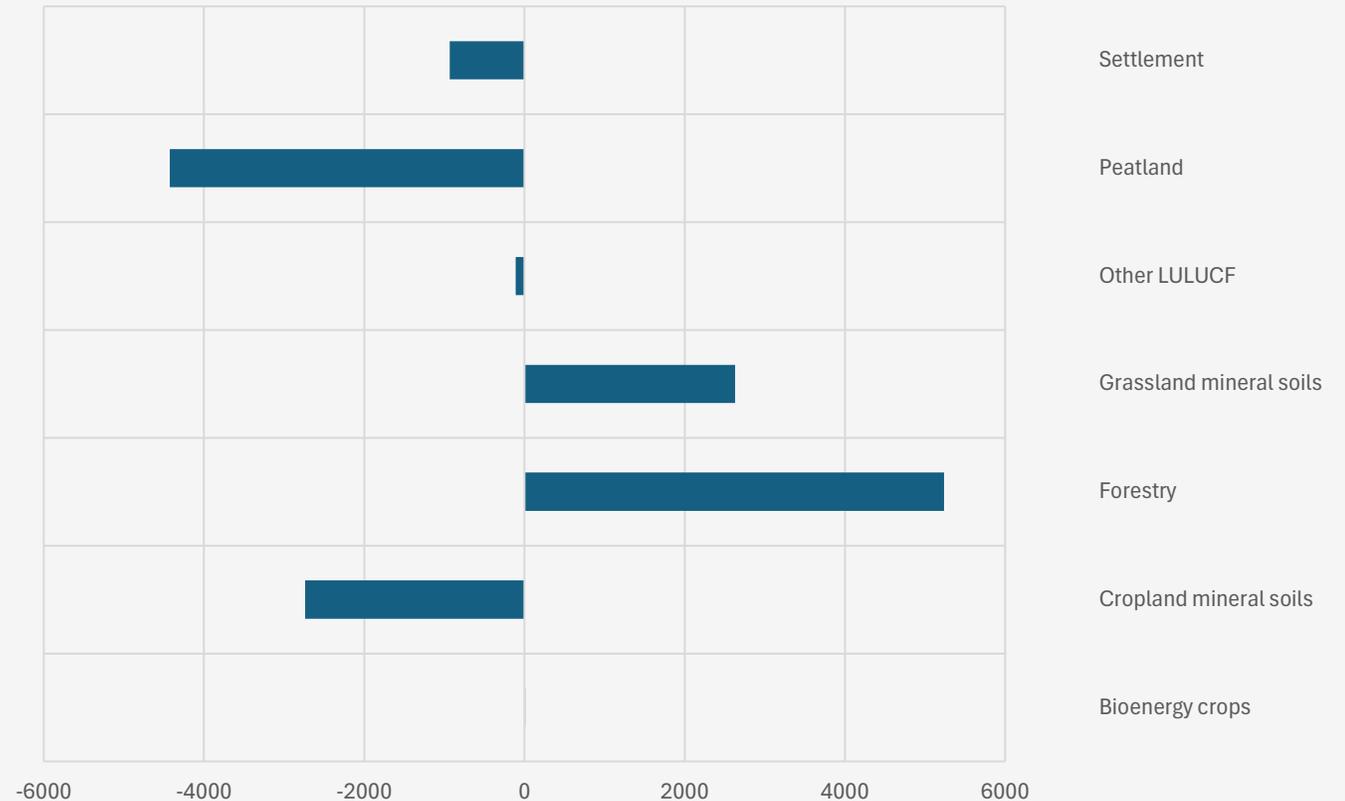


Source: Department of Energy Security and Net zero; the National Atmospheric Emissions Inventory and HM Treasury

Annual value estimate by habitat

Annual Value by habitat UK in 2023 (£ million)

- Forestry has the highest annual value (£5.2bn)
- (valued as the habitat removing the most of carbon)



Source: Department of Energy Security and Net zero; the National Atmospheric Emissions Inventory and HM Treasury

Net Present Value (NPV)

- Measure of stock recommended by SEEA-EA:
 - Calculates the stock of services of natural resources in terms of future expected supply and use over a predictable time horizon.
- NPV measures the stream of service expected to be provided over the lifetime of the asset and then discounted back to the present accounting period
- We need:
 - Pattern of expected future flows
 - Asset Life
 - Choice of discount rate

Asset value estimation



Department for
Energy Security
& Net Zero



HM Treasury

Data

- Land use, land use change and forestry (LULUCF) by local authority - DESNEZ
- LULUCF Projected regional data
- Carbon value price data (social cost per tonne of CO₂) - by DESNEZ
- Gross Domestic Product (GDP deflator) - HM Treasury
- Discount factor data - HM Treasury Green book

Variables

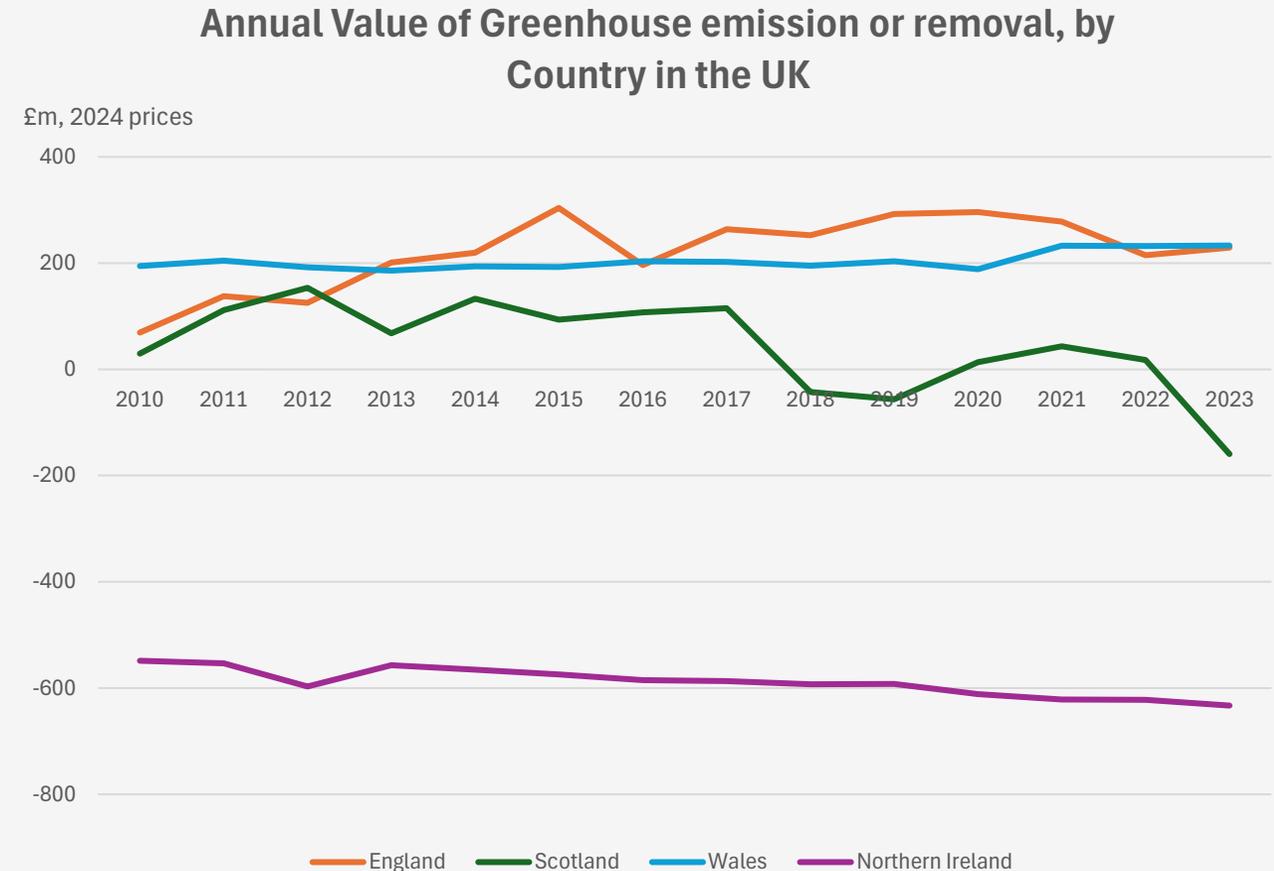
- **LULUCF/ Carbon value price/ GDP deflator data:** estimated annual value
- **Discount factor data:** Median or central modelled value
- **Asset year:** 100-year time period

Estimation

- Net present valuation:
- Asset value with:
 - future territorial emissions/removals are predicted using the LULUCF projected regional data
 - Future carbon value prices are forecasted based on the latest year value
- $\sum y \dots 100 = \text{Asset value including predicted future value} * \text{discount factor}$

Asset value estimates

- In 2023, the net present value for UK is estimated as £-21.6bn
- Negative value is driven by lower social cost (value/benefit) per tonne of CO₂ in Scotland and Northern Ireland over time



Source: Department of Energy Security and Net zero; the National Atmospheric Emissions Inventory and HM Treasury

Limitation of methods

- Based on model estimation and projections not on actual measure
- Values are susceptible to constant revisions due to frequent changes in land-use activities and climate change impact and modelling changes – frequent revisions

Advice

Advice

- Investigate sources or avenue for Carbon store change modelling (greenhouse gas emission and removal – sequestration) – is someone already doing this? Are there any submissions to the UN Framework Convention on Climate Change
- Is there a country-specific carbon price or value available for you to use?
- Speak to other government departments or researchers on data availability for carbon removal/emissions and carbon price and discount rates

Any questions or comments

Future Workshops

Thursday 12th February 2026:

- *Valuation of ecosystem services*

