Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

GREENHOUSE GAS EMISSIONS AND REMOVALS

from Land Use, Land Use Change and Forestry

July 2024

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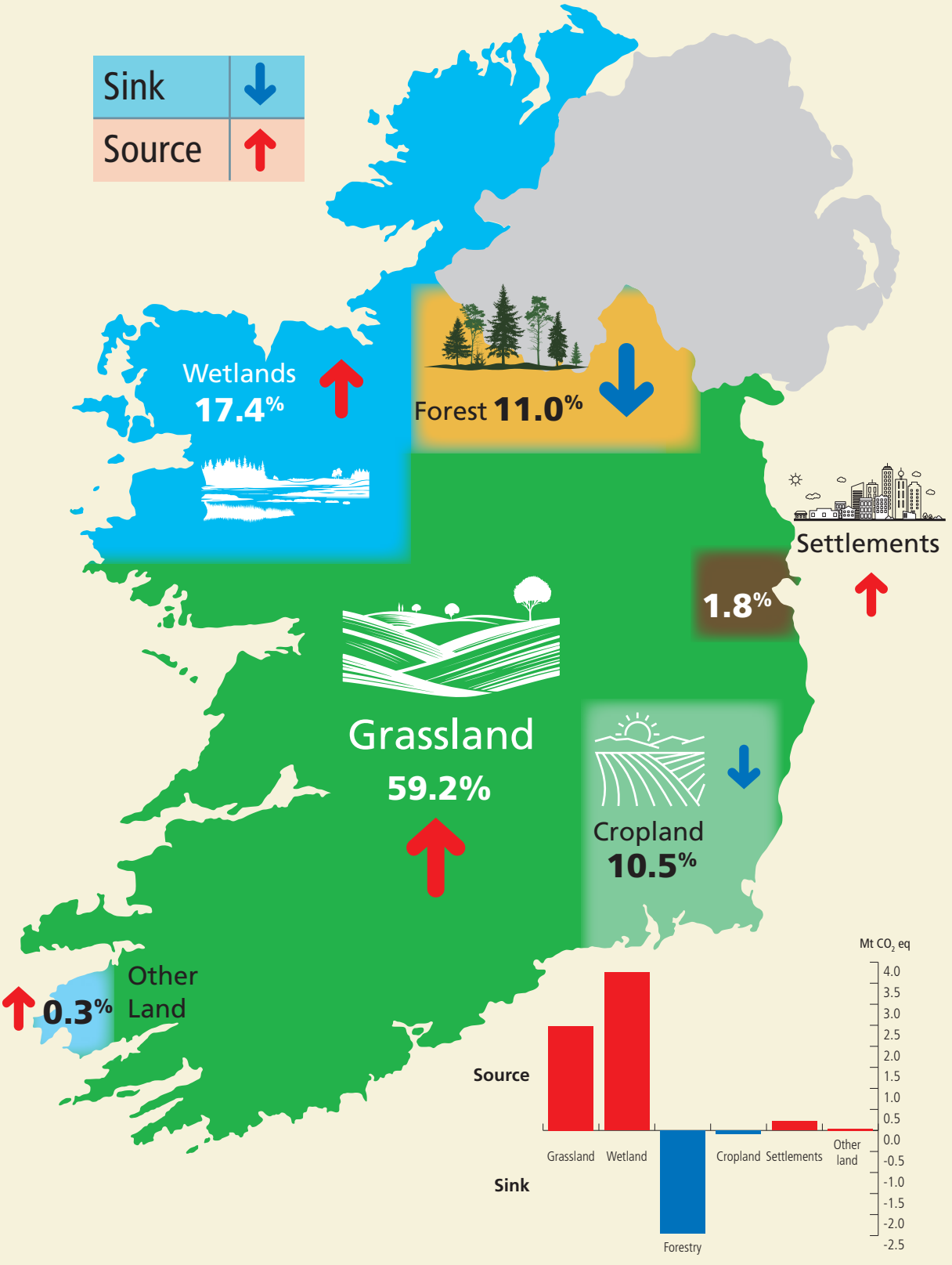
Land Use, Land Use Change and Forestry (LULUCF)

Ireland's land area by land use category
and associated emissions / removals



Infographic illustrating the proportion of Ireland's land area occupied by each LULUCF category (not representative of their actual locations) with the size of the source / sink associated with each category demonstrated in Mt CO_2 eq.

1. INTRODUCTION

The importance of greenhouse gas (GHG) emissions and removals associated with land are recognised as a significant aspect of mitigation efforts nationally and internationally. There are high levels of ambition for the use of land at both an EU and National level including the role of land as a carbon sink and an opportunity for agricultural diversification. Actions such as afforestation, rewetting, renewable energy, increased organics and tillage are referenced across different plans and strategies including the Climate Action Plan, Food Vision and the Nature Restoration Law. These recognise the potential of land use activities to remove carbon from the atmosphere, something that is otherwise only possible with expensive and energy intensive technologies that are yet unproven at scale. There is a need to understand the impacts and implications of these actions and how they work together.

The Environmental Protection Agency (EPA) is responsible for compiling the inventories of GHG emissions for Ireland and for reporting the data to the relevant European and international institutions. The EPA is also the national body with responsibility to develop, prepare and publish projections of GHG emissions for Ireland. Ireland's legal reporting obligations require that we submit Inventory data in January, March and April to the European Commission and the United Nations Framework Convention on Climate Change (UNFCCC). The EPA produces national GHG emission projections on an annual basis and submits them to the European Commission. The Inventory and Projections reports inform policy and the monitoring and reporting of Ireland's climate action performance under the Climate Act[1] and Climate Action Plans[2]. They also provide an assessment of Ireland's progress towards achieving its EU emission reduction targets for 2030 as set out under the Effort Sharing Regulation[3,4]. Land Use, Land Use Change and Forestry (LULUCF), is a sector covered under Ireland's international obligations for reporting on GHG emissions and removals. The Intergovernmental Panel on Climate Change (IPCC) provide methodological guidelines on calculating emissions and removals for LULUCF[5-10]. A detailed description of the methodologies applied to Ireland's reporting of LULUCF emissions and removals can be found in Chapter 6 the EPA's GHG Inventory Report[11].

Greenhouse gas emissions and removals associated with land use are assessed and reported under six key categories: Forestland, Cropland, Grassland, Wetlands, Settlements and Other Land. These along with the carbon captured in Harvested Wood Products (HWP), comprise the LULUCF sector in international GHG reporting terminology. This reporting process accounts for the transformation processes (e.g. fires and mineralisation) and stock changes over time of different carbon pools (i.e. above-ground biomass, below-ground biomass, dead organic matter - litter and dead wood and soils) associated with each land use category.

A large extent of Ireland is covered by peatlands consisting of raised and blanket bogs and fens that formed since the last Ice Age. It must be noted, the term peatlands is not a land use category in LULUCF terminology. However, the importance of Irish peatlands in the context of reporting Ireland's GHG emissions and removals for the categories in LULUCF cannot be understated. Over time areas of peatlands in Ireland have been reclaimed for other uses such as agriculture. As a result today, in LULUCF terms, other land use categories, like grassland and forestland for example, overlay such reclaimed areas whilst near-natural peatlands and those harvested for fuel (turf) are encountered in the wetlands category of LULUCF. Given peatlands formed by the accumulation of organic matter (peat), organic soils will underly the land use category in these locations. The underlying soil type (organic / mineral) has a significant impact on the emissions associated with given land use categories.

Carbon cycling

Carbon is contained in living plants and organisms, organic matter and soil. These above and below ground pools exchange carbon naturally between terrestrial ecosystems and the atmosphere through photosynthesis, respiration, decomposition, and combustion. Carbon removed from the atmosphere by photosynthesis accumulates in vegetation and soils over time, increasing the carbon stocks of these pools. In countries like Ireland, that are not extensively forested, the carbon stocks within soil pools are often much larger compared to vegetation pools. Human land management impacts carbon stocks and the emissions and removals of carbon to/from the atmosphere through a variety of land use, land-use change, and forestry activities (Figure 1).

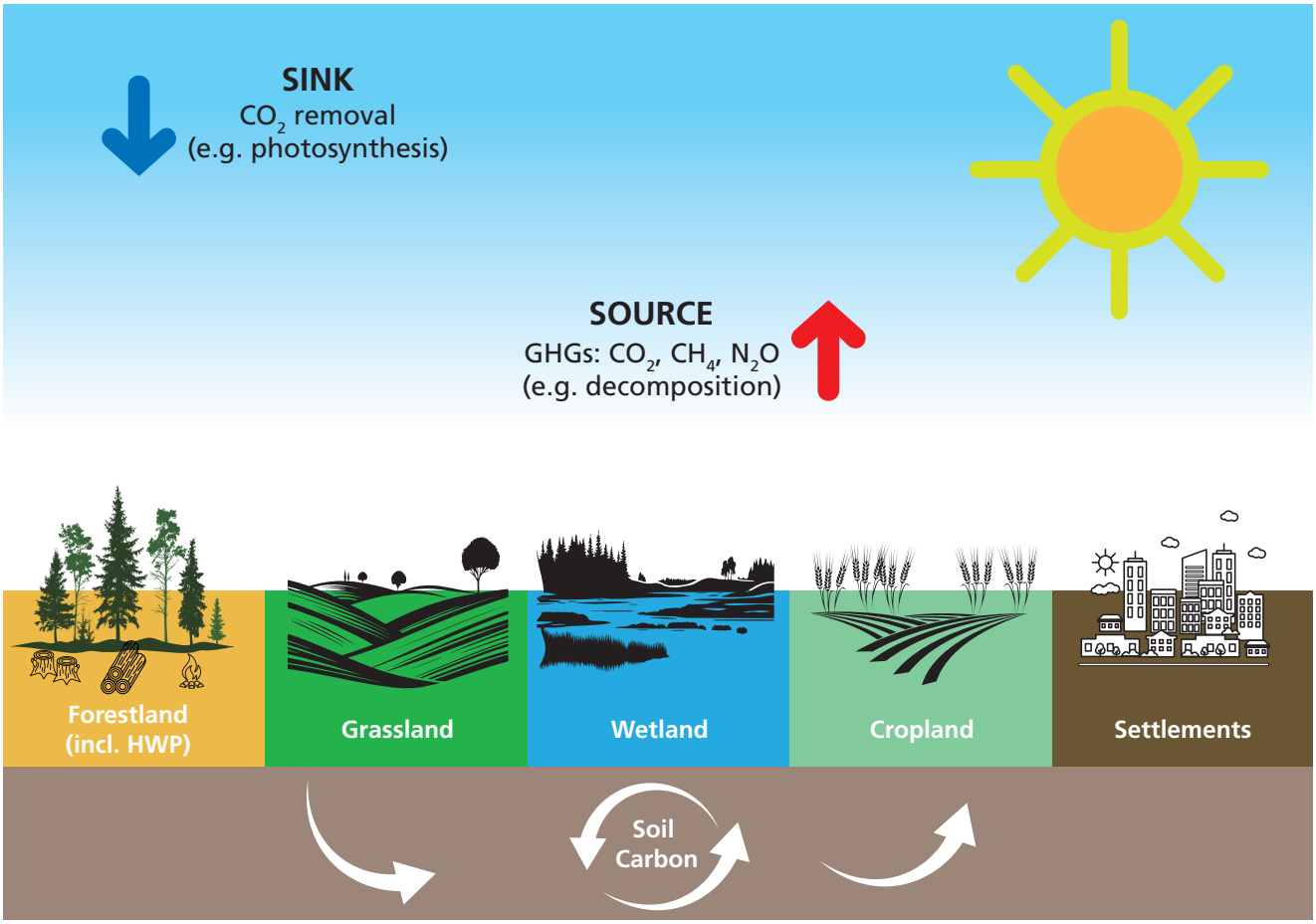


Figure 1. Conceptual diagram of emissions and removals from LULUCF categories

In Ireland our land currently acts as a source of emissions, adding to the warming of the atmosphere rather than providing greenhouse gas removals. Total LULUCF emissions in Ireland are a source of almost 4 Mt CO_2eq. per year. Emissions from this sector are projected to reach 7.9 Mt CO_2eq per year With Existing Measures (WEM) and 5 Mt CO_2eq per year With Additional Measures (WAM) by 2030.

A considerable amount of research is underway to improve understanding of how Ireland can turn land from a source to a sink, by reducing emissions and increasing removals over the next decades. This bulletin provides a historical context and overview of the current understanding of land use in Ireland and associated emissions profile.

A BRIEF HISTORY OF LAND IN IRELAND

Ireland's historical land use had a profound effect on how we manage land today. Reflecting on past land uses and how they have changed up to the present day provides a useful context to understand the nature of the LULUCF sector from the beginning of the inventory reporting timeline, 1990, to now. Many sources of evidence such as pollen records, archaeological information and historical texts provide insight to how land in Ireland has changed since the last Ice Age, 10,000 years ago[12-14]. Pollen records show Ireland's landscape was dominated by woodland as humans arrived. These early settlers were hunter gatherers and lived mainly near water. Trees remained dominant in the landscape for several thousand years until the arrival of the Neolithic period. Woodland declined as stone age farmers with improved tools cleared trees to grow crops and graze animals. Signs that a highly organised society in Ireland over 5,000 years ago were having a large impact on the landscape are evident in archaeological features that remain today such as passage tombs like Newgrange and drystone walls delineating field boundaries in North Co. Mayo. The Bronze and Iron Ages, over the next 2 – 3 thousand years, saw advanced metal tools increase the ease of tree felling for fuel and construction whilst continuously converting land to agriculture. Around this time, the first wooden ploughs, provided the means to increase the scale and pace of such land use change. The pollen records indicate a short period of decline in agricultural crops and grasses and the recovery of trees in the around 2,000 years ago. However, by the third century, agriculture returned and what is known as the "Destruction-phase" of the Irish woodlands takes hold. Historical law texts of the 7th and 8th centuries highlight a clear understanding of the suitability of land types to provide resources in how people in Ireland valued land.

In the millennia since the last Ice Age, the peatlands of Ireland formed from bogs and fens that developed due to slow anaerobic decomposition in wet conditions allowing the build-up of peat forming organic material over time. Bogs may have been seen as inhospitable and unsuitable for farming initially, but it is clear from the historical law texts that by 7th and 8th centuries people attributed some value to them for summer grazing of animals and turf cutting for fuel. As the woodlands in Ireland diminished, people turned to the bogs for an indigenous source of fuel to heat their homes. Centuries of cutting turf by hand saw vast areas of bog removed and replaced by agriculture. By the 17th century bog drainage techniques were well understood and used thus accelerating the pace of peatland reclamation. Drainage lowers the water table, changing the conditions from anaerobic to aerobic, causing the acceleration of peat decomposition and increase in CO_2 emissions from these organic peat soils. The 18th century saw Government policies (then Acts of Parliament) introduced that promoted draining and reclamation of bogs. The scale and extent of bog reclamation accelerated as a result, pushed on by increasing population and land pressure. Machines to harvest turf arrived in Ireland by the 19th century and as they improved into the 20th century the pace of peat harvesting shifted to an industrial scale for use in heat, power generation and horticulture.

We see from this brief history of the last 10,000 years, how the landscape of Ireland has changed from one dominated by large carbon stores of woodland and bog to the landscape we are familiar with today. Three important concepts were present that underpin our understanding of the LULUCF sector today. Firstly, the extent (proportion of land area) of actively photosynthesising vegetation taking CO_2 from the atmosphere and forming large carbon stocks in woodlands and intact bogs. Secondly, the rate and scale of land use change as seen by the increased pace of deforestation and bog reclamation over time as tools and techniques became more advanced. Thirdly, the soil type (organic or mineral) underlying a particular land use can make large differences to the rate of emissions or removals of carbon associated with that land use, evident by active bogs forming in wet anaerobic conditions removing CO_2 from the atmosphere and storing carbon, in contrast to drained peatlands emitting CO_2 at a faster rate due to accelerated decomposition of the underlying organic soil.

Over the course of this history, felling trees and exploiting bogs left Ireland with degraded peatlands and little woodland. These are the key challenges to address for Ireland to turn land from an emissions source to a sink.

CURRENT STATUS OF LULUCF IN IRELAND

Since the beginning of the GHG Inventory reporting period 1990-2022 grassland continues to dominate, followed by wetland and forestry. The proportion of Ireland's total land occupied by each land use category at the beginning of the reporting period, 1990, and most recently reported in 2022, is presented in Figure 2. This is a significantly different land use structure compared to the EU overall, even with variation amongst member states due to different geography, geology, climate and agricultural practices. Ireland's emissions and removals associated with each land use category in 1990 and 2022 is shown in Table 1.

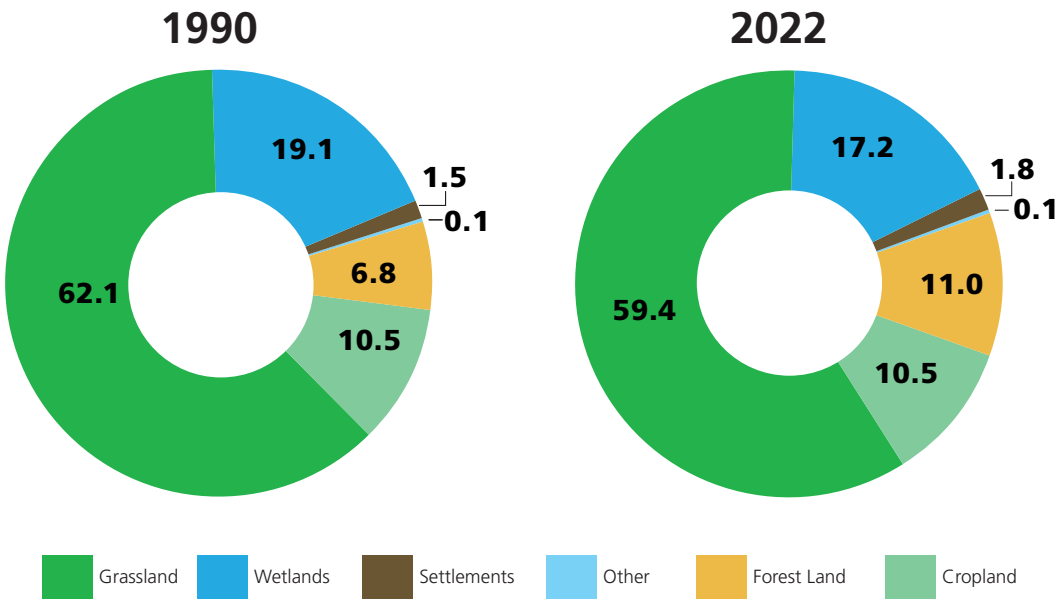


Figure 2. Proportion of land use in Ireland in 1990 (left) compared to 2022 (right).

Table 1. Comparison of the proportion of Ireland's total land area occupied by LULUCF categories and their associated emissions / removals from 1990 to 2022.

Land Use Category	Area (ha) 1990	% of Total Area	Emissions / Removals (Mt CO_2 eq)	Area (ha) 2022	% of Total Area	Emissions / Removals (Mt CO_2 eq)
Forest Land	481,074	6.8	-3.14	780,536	11.0	-2.44
Cropland	749,075	10.5	-0.05	747,634	10.5	-0.08
Grassland	4,416,808	62.1	3.93	4,224,631	59.4	2.48
Wetlands	1,329,863	19.1	4.20	1,224,496	17.2	3.76
Settlements	103,739	1.5	0.06	128,179	1.8	0.22
Other	4,227	0.1	0.001	6,310	0.1	0.04

Note: Forest Land emissions / removals values include Harvested Wood Products (HWP).

Two future scenarios are estimated for LULUCF in the EPA's latest GHG projections[15], both indicating that the sector will continue to be a source of emissions out to 2030. Figure 3 demonstrates that With Existing Measures (WEM), LULUCF emissions continue to rise on average by just under 0.5 Mt CO_2 eq per year reaching a predicted value for emissions in 2030 of 7.9 Mt CO_2 eq that year. The rate of increase in emissions With Additional Measures (WAM) out to 2030 is flatter, however LULUCF still remains a large source of emissions in the region of 5 Mt CO_2 eq each year. Both scenarios are set to miss the EU target explained in Section 3 below. These trends in both the WEM and WAM scenarios are primarily due to the continuing high emissions from the Grassland and Wetlands categories along with a decline in removals from Forest land as this category becomes a source of emissions during that period.

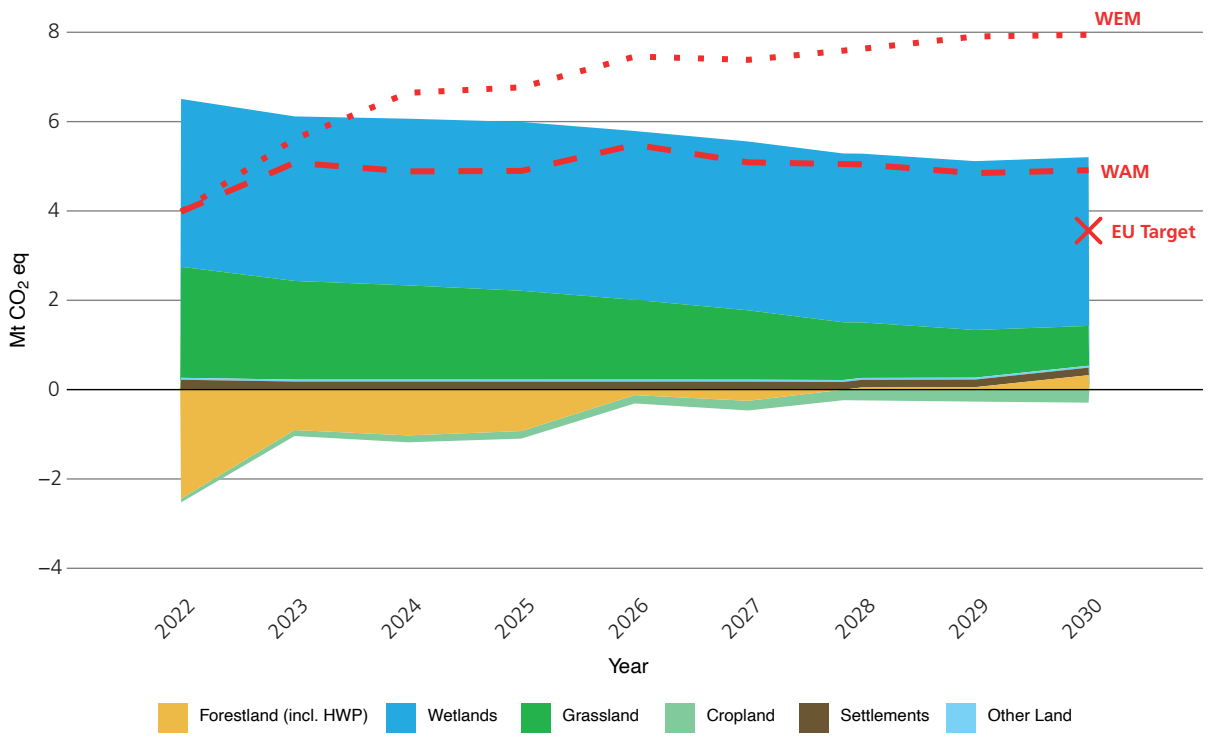


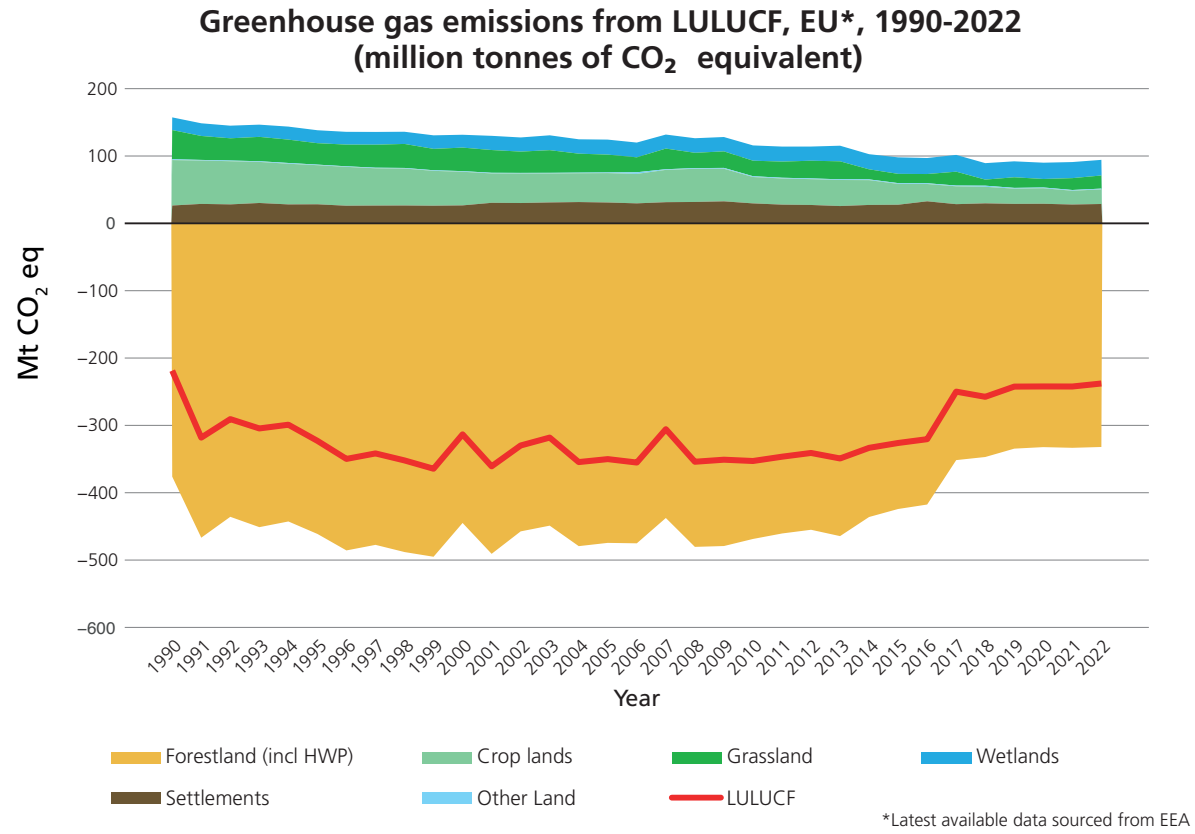
Figure 3. Projected LULUCF emissions / removals to 2030 with categories demonstrated for WAM scenario. (Note: The EU Target displayed for visualisation purposes is calculated based on the required emissions reductions from the average of emissions in 2016, 2017 and 2018 reported for LULUCF in the latest National GHG Inventory as explained in Section 3 below).

Increased afforestation and water table management of drained organic peat soils in the Grassland category are examples of key actions in the WAM scenario to delivering lower emissions compared to the WEM scenario. Measures specific to categories within LULUCF such as those set out in the 2024 Climate Action Plan[19] are incorporated into the WAM scenario. The average annual emissions savings of these combined measures compared to the WAM scenario is approximately 2.1 Mt CO_2 eq per year, producing a cumulative difference in emissions by 2030 of 17.1 Mt CO_2 eq (Table 2). It is notable that Forestland and Grassland actions are the main drivers of the lower WEM emissions, emphasising the need for greater implementation of these actions at a faster pace if emissions reductions targets are to be met.

Table 2. Average annual emissions savings for LULUCF categories of measures in projected WAM scenario vs WEM and the cumulative difference between the two scenarios from 2022-2030.

	Average annual emissions saving (WAM vs WEM)	Cumulative difference between WEM and WAM (2022-2030)
	Mt CO_2 eq yr-1	Mt CO_2 eq
Forestland (incl. HWP)	1.11	8.86
Cropland	0.09	0.75
Grassland	0.83	6.64
Wetlands	0.11	0.87
Total	**2.14**	**17.1**

Across the EU, large areas of forestry contribute substantial CO_2 removals that outweigh the emissions associated with the other land use categories, as demonstrated in Figure 4 (top). Whereas Figure 4 (bottom) demonstrates the opposite is the case for Ireland, whereby emissions from Grassland and Wetland outweigh removals from Forest land (incl. HWP), therefore making Ireland's LULUCF sector an overall source of emissions. The changing areas of these land use categories over time and the soils they are located on are key concepts in discussing LULUCF and to understanding how significant changes made within this sector will impact Ireland's GHG emissions and removals from land into the future and ultimately the amount of carbon stored or lost from soils and vegetation to the atmosphere.



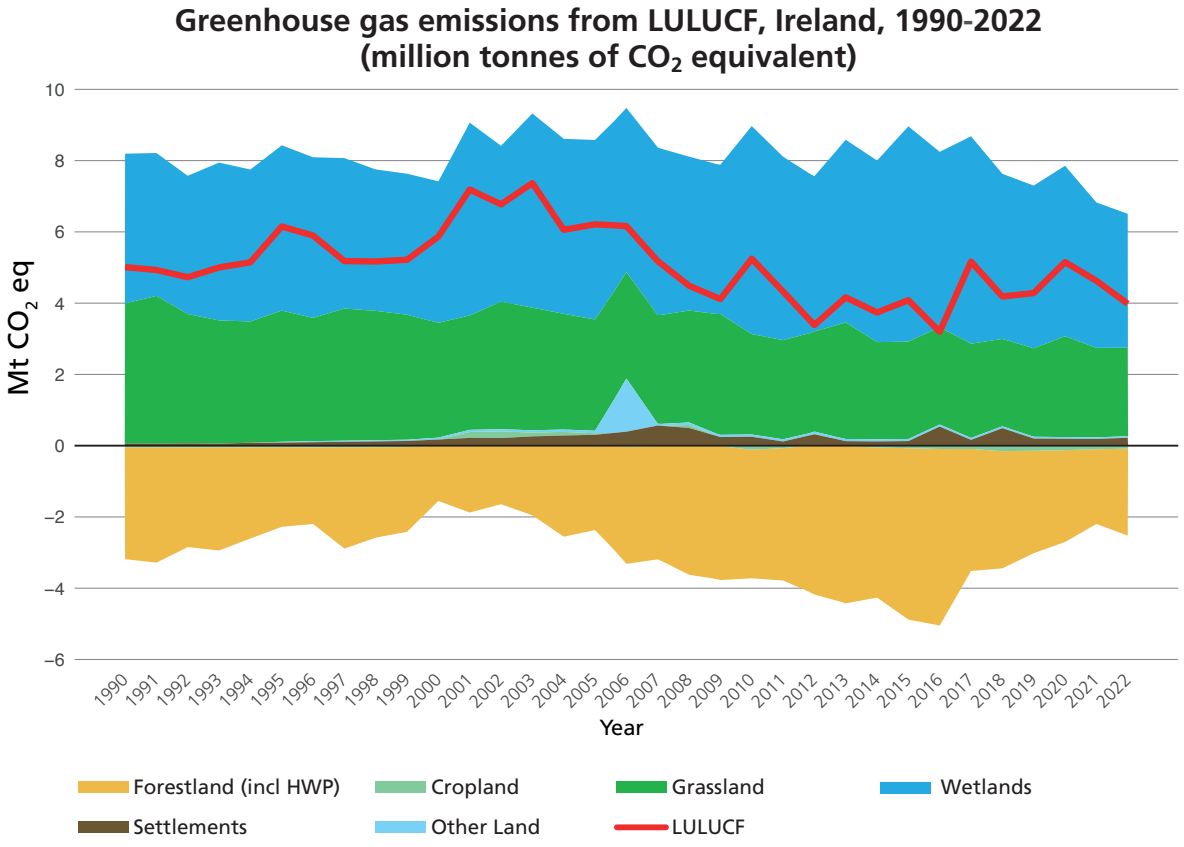


Figure 4. Balance of GHG emissions from EU indicating overall LULUCF net sink due to large CO_2 removals from forestry (top)* compared to balance of GHG emissions from Ireland indicating LULUCF net source (bottom).

2. EMISSIONS AND REMOVALS BY TYPE OF LAND USE

Overall, the LULUCF sector is currently a source of GHG emissions in Ireland. The latest inventory data shows that, just under 4 million tonnes of CO_2eq was emitted due to LULUCF activity in 2022. Since 1990, on an annual basis LULUCF has consistently been a large source of emissions for Ireland. Although forests contribute substantial removals of CO_2 from the atmosphere, the grassland and wetland categories are larger sources of emissions. The greater emissions from these categories primarily arise from the influence drainage has on organic soils, accelerating the rate of organic matter decomposition, along with the exploitation of wetlands for peat used in power generation, horticultural products and private residential heating. For grassland on organic soil the amount of CO_2 emitted is larger than the amount of CO_2 removed by grasslands on mineral soils.

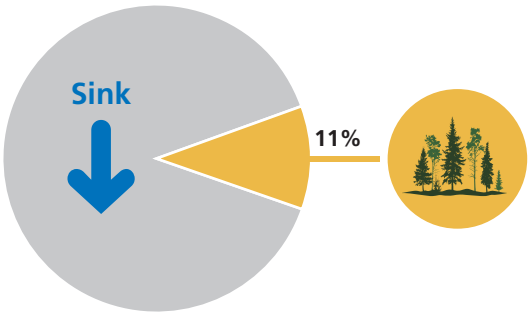
This is in contrast to LULUCF across Europe, which acts as a sink removing CO_2 from the atmosphere. Other European countries have a much larger area of Forestry resulting in removals outweighing emissions from the other land use categories as can be seen in Figure 4(top). The relatively small Forest area in Ireland highlights an opportunity to enhance large scale CO_2 removals for LULUCF through increased afforestation.

The EPA's latest GHG projections[15] indicate that the LULUCF sector will continue to be a source of emissions out to 2030. In the With Existing Measures (WEM) scenario LULUCF emissions will continue to rise on average by just under 0.5 Mt CO_2 eq per year reaching a predicted value for emissions in 2030 of 7.9 Mt CO_2 eq that year. In the With Additional Measures (WAM) scenario the rate of increase in emissions out to 2030 is flatter, however LULUCF still remains a large source of emissions in the region of 5 Mt CO_2 eq each year. These trends in both the WEM and WAM scenarios are primarily due to the continuing high emissions from the Grassland and Wetlands categories along with a decline in removals from Forest land as this category becomes a source of emissions during that period.

2.1 FOREST LAND AND HARVESTED WOOD PRODUCTS

For LULUCF reporting purposes, Forest land encompasses all public and private plantation forests that use an area of land where tree crown cover is greater than 20% of the total area occupied. The minimum forest width is 20m and minimum forest area is 0.1ha and includes all trees with a potential to reach 5m in height in situ. Additionally, CO_2 removals associated with Harvested Wood Products (HWP) are included as a separate category under the LULUCF sector. This encompasses wood-based products for example, furniture, plywood, paper and paper-like products and reflects an estimation of the carbon stored in these timber products over their lifespan.

Forest land contributed a removal of approximately 1.5 Mt CO_2 eq in 2022 covering 0.78 Mha of land with an additional removal of approx. 0.9 Mt CO_2 eq from HWP in the same year. In the period from 1990 to 2022 the largest removals (4.1 Mt CO_2 eq) from Forest land occurred in 2016 whilst the lowest



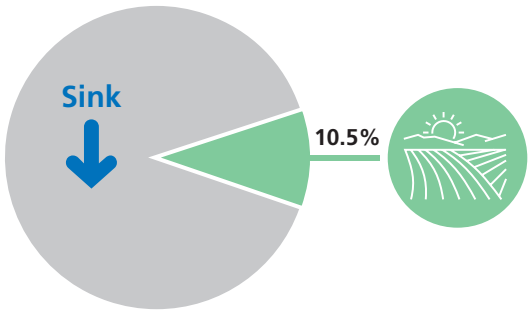
reported removals (0.4 Mt CO_2 eq) from this category occurred in 2000. From year to year the amount of deforestation and afforestation along with other factors such as the age profile of the forest stands, the tree species and underlying soil types will impact the overall size of the removals associated with Forest land. Forestry that was planted on organic peat soils results in a higher CO_2 emission factor. Legislation now prohibits further planting of forestry on such soils unless specific criteria are met.

The EPA's most up to date GHG projections[15] with existing measures out to 2030 indicate that the strength of CO_2 removals from Forest land (incl. HWP) is declining and will become a source of emissions by the year 2024. From the year 2028 the projected WAM scenario highlights that this category including HWP becomes a source of emissions to the atmosphere. This is due to current low rates of afforestation that have been declining since the 1990's and the current age of our forests which are reaching harvesting stage. In the WEM and WAM scenarios the pivotal points in time are 2023/24 and 2025/26 respectively when this land use category reaches what is referred to in LULUCF parlance as the 'carbon cliff'. This term refers to the time when the amount of photosynthesis from forest cover providing removals of CO_2 from the atmosphere drops dramatically due to large amounts of forest harvesting and carbon emitted from the deforested land increases. Contributing to this 'carbon cliff' effect is the inadequate rates of afforestation to date, resulting in too little forest cover remaining to offset the emissions from the large number of harvested stands. While the afforestation that did take place will not be sufficient nor reach an age in time to avoid this category turning into a source of emissions. Additionally, as forest stands mature, they reach a peak in terms of net removal after which the amount of deadwood and litter fall exceeds the carbon sequestered in an individual year.

2.2 CROPLAND

Cropland incorporates "all annual and perennial crops as well as temporary fallow land". This definition includes crops and temporary grassland managed as part of crop rotation systems. Cropland in LULUCF terms also includes hedgerows associated with cropland systems and trees grown for fruit or horticulture plus non-tree woody species such as furze and rhododendron.

In the latest Inventory Report[11], Cropland contributed a small removal of approximately 0.08 Mt CO_2 eq in 2022 and occupied a land area of just under 750 kha. In the period from 1990 to 2022 the largest removals (0.15 Mt CO_2 eq) from Cropland occurred in 2018 while in 2005 this category was a source of emissions (0.04 Mt CO_2 eq). Year to year variation in the value of emissions or removals associated with Cropland arises mainly due to the dynamic between annual cropping and the use of temporary grasslands in crop rotations.



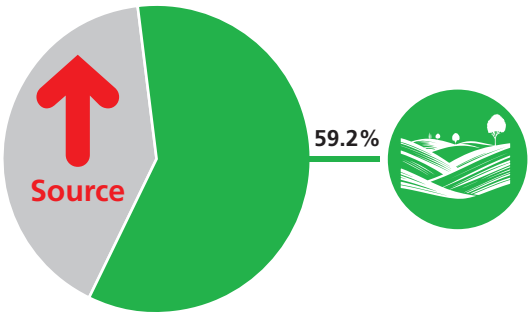
The EPA's latest GHG projections[15] indicate that the Cropland category with existing measures will maintain a stable small removal of CO_2 from the atmosphere in the order of 0.1 Mt CO_2 eq on a yearly basis out to 2030. In the projected WAM scenario, Cropland's removals from the atmosphere would increase gradually each year at a rate of 0.02 Mt CO_2 eq per year reaching predicted removals of 0.28 Mt CO_2 eq for 2030.

2.3 GRASSLAND

Grassland is the dominant land-use category in Ireland. This category includes improved grasslands, unimproved grasslands, and grasslands not currently in use. Improved grasslands include areas identified as lands managed for livestock grazing and grass-based feed and winter fodder production (pasture, silage and hay). Unimproved grasslands are identified as rough grazing for livestock, predominantly sheep or low intensity beef farming. Grasslands not in use are those lands identified as dominated by grass habitats, but not currently managed (in any one year) for livestock. The definition of grasslands also includes hedgerows which are an integral part of livestock and land management practice in Ireland.

Anthropogenic management of grasslands is long standing and profound. In the latest Inventory Report[11], Grassland contributed an emission of approximately 2.5 Mt CO_2 eq in 2022 and occupied a land area of approx. 4.2 Mha. In the period from 1990 to 2022 the largest emissions (3.9 Mt CO_2 eq) from Grassland occurred in 1990. From the starting point of inventory reporting, 1990, to the latest reported year, 2022, Grassland has been a consistent and large source of emissions to the atmosphere. This is mostly due to the significant amount of CO_2 released per hectare to the atmosphere from grasslands on drained organic (peat) soils (~350 thousand ha). Drainage lowers the water table and exposes the large store of carbon in peat soils to aerobic conditions leading to faster organic matter decomposition and greater CO_2 emissions. Grasslands on mineral soils (~3.8 million ha) on the other hand can remove very small amounts of CO_2 on a per hectare basis from the atmosphere. However, the CO_2 release due to the drainage of grasslands on organic peat soils is far larger than the small amount of CO_2 removed by grasslands on mineral soils and as a result, grasslands overall are an emitter of CO_2 to the atmosphere.

Hedgerows are a traditional means of establishing field and ownership boundaries and protecting crops from livestock incursion. In recent years, environmental payment schemes have included incentives for hedgerow plantation, maintenance, and protection. Hedgerows are an important feature of the Irish landscape that are classified as part of grasslands and croplands (in Inventory reporting).



Hedgerows are not currently separately identified within the cropland or grassland land categories as the information necessary to accurately assess their biomass content and thus sequestration potential is not yet fully available for this purpose. In emission inventory terms they are included in what is known as non-forest woody biomass features in the landscape which also includes areas of trees which do not meet the definition of a forest as reported in the Forest land category.

Two EPA funded projects[16,17] have shown that the length of hedgerows in the country can be assessed, however what is not known is the total reservoir of biomass in the national hedgerow stock (type of trees, height, width, growth patterns), year on year changes in hedgerow stock and the differences in biomass accumulation between different types of hedges and management regimes. The earlier of the two studies suggests that hedgerows have the potential to sequester 0.27–1.4 Mt CO_2 per year. However, the latter project indicated that hedgerows are removed at a rate of up to 0.3% annually, suggesting that hundreds of km of hedgerows have been removed. The declining national hedgerow biomass stock will reduce the sequestration potential of hedgerows and result in emissions as CO_2 eq in terms of carbon stock change.

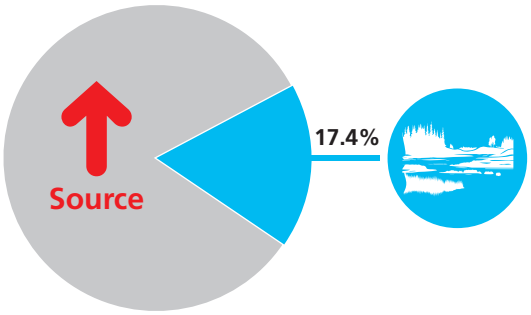
The EPA's latest GHG projections[15] indicate that the emissions from the Grassland category, with existing measures, will remain relatively stable and continue to contribute in the order of 2.5 Mt CO_2 eq each year out to 2030. In the WAM scenario, emissions from the Grassland category are predicted to decline each year out to 2030 at a rate of approximately 0.2 Mt CO_2 eq per year. The predicted emissions for the grassland category, with additional measures, in 2030 is 0.9 Mt CO_2 eq.

2.4 WETLANDS

This category is a combination of unexploited wetlands, those in a near-natural status, and managed wetland areas commercially exploited by extraction of peat harvested for fuel and horticultural products. The term Wetlands as applied to Ireland refers to those areas of peatland that have not been reported under another land use (i.e. forestry and grassland on organic soil) and that are either in a near-natural or some form of exploited status. In the context of the definition of Wetlands described in the 2006 IPCC Guidelines and the 2019 refinement to those guidelines it also includes inland marshes, salt marshes, moors and heathland and intertidal flats.

With respect to near-natural status wetlands the National Peatlands Strategy[18], suggests that peatlands in Ireland can be considered as "humanised landscapes" that have evolved and or originated in close association with land use systems and that it would be impossible to find an Irish peatland that has never been grazed or used in some way by humans. Additionally, Aitova et al. (2023) argue that in the context of peatlands in Ireland, "near-natural" is a more accurate description of those peatlands not commercially exploited as all Irish peatlands have experienced anthropogenic pressure to some extent.

The most recent Inventory Report[11] shows that the Wetland category contributed the largest source of emissions each year compared to all other categories. The emissions for 2022 were approx. 3.8 Mt CO_2 eq from a total area of just over 1.2 Mha. The

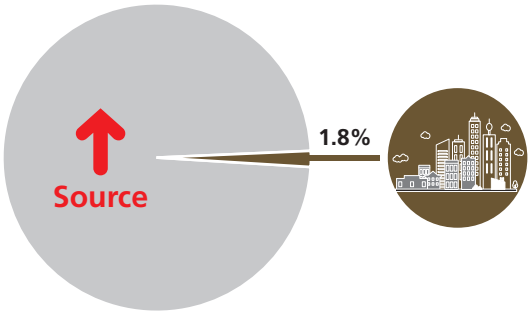


largest emissions (6 Mt CO_2 eq) for this category occurred in 2015 while the value reported for 2022 is the lowest for the period of 1990–2022. Due to tighter regulations and increased enforcement on unauthorised industrial peat harvesting and a reduction in use for power generation, the cessation of this activity and subsequent peatland restoration efforts have resulted in a declining trend in emissions from this category. The additional contribution of Bord na Móna and NPWS's large scale commitments to rehabilitation of Ireland's exploited and degraded peatlands will see further emissions savings benefits in this category into the future.

The EPA's latest GHG projections[15] indicate that the emissions from the Wetlands category, with existing measures, will remain relatively stable and continue to contribute in the order of 3.8 Mt CO_2 eq each year out to 2030. In the WAM scenario, emissions from the Wetlands category are also predicted to remain relatively stable and continue to contribute in the order of 3.7 Mt CO_2 eq each year out to 2030.

2.5 SETTLEMENTS

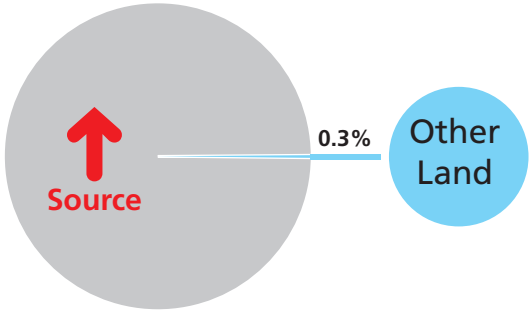
Built areas such as roads, airports and the footprint of industrial, commercial/institutional and residential buildings comprise the Settlements category. Calculating the carbon stock change for this category assumes complete biomass removal from the former land use category in the year of conversion to settlements. The most recent Inventory Report[11] shows Settlements were a source of emissions to the atmosphere each year from 1990-2022 and emitted 0.2 Mt CO_2 eq in 2022 from a land area of 0.13 Mha. The largest emissions (0.5 Mt CO_2 eq) occurred in 2016 whilst the lowest (0.06 Mt CO_2 eq) occurred in 1990.



Settlements are not accounted for under Regulation (EU) 2018/241, as such, in terms of EPA projections, it is given that emissions from this category will remain stable out to 2030.

2.6 OTHER LAND

The Other Land category includes all lands not described above such as bare soil, rock, ice, and all unmanaged land areas that do not fall into any of the other five land-use categories. It represents the difference between the sum of the categories above and the total land area of Ireland, i.e. the residual when all other land use areas have been determined. This category is not active in terms of potential for emissions or removals. The latest Inventory[11] reports emissions for this category in 2022 as 0.04 Mt CO_2 eq with the highest emissions of just under 0.07 Mt CO_2 eq in 2005 and the lowest emissions of 0.9 kt CO_2 eq in 1990. This category is a consistent but very low source of emissions on a yearly basis.



In terms of the EPA's GHG projections[15] Other Land becomes approximated from the sum of the unaccounted categories as per Regulation (EU) 2018/241. In both WEM and WAM scenarios it remains a small source of just under 0.04 Mt CO_2 eq per year.

3. LULUCF TARGETS AND ACCOUNTING

Ireland, as both an EU member state and a Party to the United Nations Framework Convention on Climate Change (UNFCCC), reports LULUCF emissions and removals annually to the European Commission and to the UNFCCC. Ireland also has its own National Targets under the Climate Act, supported by actions detailed in the latest 2024 Climate Action Plan.[19] Greenhouse gas emissions and removals associated with LULUCF, are reported in Ireland's greenhouse gas emissions Inventory prepared by the EPA.

The accounting and/or reporting rules for LULUCF emissions/removals vary depending on the legislative requirement. "Accounting" in this context refers to where the data being provided is used to assess compliance against agreed targets, i.e. reported against a reference value. "Reporting" refers to a requirement to document the level and trend of greenhouse gas emissions over time without an associated compliance target. There are currently three main approaches required of Ireland:

1. "Reporting" requirements associated with Ireland's annual GHG inventory submissions to the UNFCCC.
2. "Accounting" requirements associated with Ireland's binding targets under the revised EU LULUCF Regulation (Regulation (EU) 2023/839 amending Regulation (EU) 2018/841) for the second phase (2026-2030).
3. "Accounting" requirements associated with Ireland's binding National targets under the Climate Act and as described in the 2024 Climate Action Plan.
4. "Accounting" requirements associated with the use of flexibilities to achieve Ireland's binding targets under the EU's Effort Sharing Regulation (Regulation (EU) 2023/857 amending Regulation (EU) 2018/842). This approach is the same as that required under the LULUCF Regulation for the first phase (2021-2025).

1. UNFCCC reporting

UNFCCC inventory reporting intends to cover all anthropogenic emissions and removals (eg. from forest harvesting) as well as emissions and removals on land directly or indirectly influenced by human intervention, so called "managed land" (eg. emissions associated with drainage of peatland). Emissions and removals from "unmanaged land" (a large portion of the "Wetlands" category) are not considered anthropogenic and not included in inventory reporting. Ireland's Inventory is produced in line with IPCC guidelines and the estimation approaches for each land use type are described in greater detail in Chapter 6 of Irelands GHG National Inventory Report[11].

An aspect to be aware of in the reporting framework is the boundary between what is reported under "Agriculture" and what is reported under "LULUCF". As an example, nitrous oxide (N_2O) emissions from mineral and organic fertiliser application are included in the Agriculture sector and are not attributed to the LULUCF sector.

2. LULUCF Regulation phase 2 accounting requirements (2026-2030)

The LULUCF Regulation was amended in 2023 to reflect increased EU-wide climate action ambition under the "fit-for-55" legislative package. As part of this amendment, specific "net-removal" targets were set for each Member State for the second phase from 2026-2030. The revised accounting rules for this phase enlarged the territorial scope to cover all managed land and introduced an EU-wide target of -310 Mt CO_2 eq of net removals by 2030. The second phase has also introduced simplified compliance rules, moving to using the same reported emissions and removals approach as for UNFCCC reporting as described above.

Ireland's binding country-specific target for phase 2 of the LULUCF Regulation is to reduce the net LULUCF emissions source by 626 kt CO_2eq/year by 2030. The primary requirement of this is that Ireland's 2030 net LULUCF sector emissions are at least 626 kt CO_2eq lower than the average for 2016, 2017 and 2018. There is also a secondary element to Ireland's target requiring net LULUCF emissions from 2026-2029 to be on a linear trajectory towards achieving the 626 kt reduction in 2030. A "carbon budget" for 2026-2029 is defined based on a linear trajectory starting in 2022. This approach reflects the importance of reducing cumulative CO_2 emissions in addressing climate change

rather than focussing on the level of emissions in a specific year and is aligned with the Effort Sharing Regulation (ESR) approach and Ireland's own Carbon Budgets.

Article 13b of the LULUCF regulation potentially provides for some flexibility in meeting the targets based on Member States' area of organic soils, capped at 178 Mt CO2 eq across the EU. However, it is contingent on the EU meeting its overall LULUCF target, on all other flexibilities being exhausted and on the EU Commission being satisfied that Member States have pursued all available mitigation avenues. It's availability is therefore highly uncertain at this time.

3. Accounting requirements associated with Ireland's National targets

While no Sectoral Emissions Ceiling (SEC) has been set for the LULUCF sector, the 2024 Climate Action Plan states that *"The ambition for this sector shall now be a fixed reduction of 0.626 MtCO2eq. by 2030 below a baseline set at the average of the 2016-2018 emissions"*. The intention of this target is to pursue an approach that is more aligned to how the EU LULUCF Regulation deals with the fluctuations and limits within the LULUCF sector. Consequently the accounting rules are as described under 2 above.

4. Accounting requirements for Effort Sharing Regulation flexibility and LULUCF Regulation phase 1

The 2023 revision to the LULUCF Regulation did not affect the pre-existing "no debit" rule for phase 1 (2021-2025) according to which each Member State must ensure that accounted emissions from land use are compensated by at least an equivalent amount of accounted removals. The original LULUCF Regulation (Regulation (EU) 2018/841) established accounting mechanisms which also allowed LULUCF activities to be included in members states emission reduction targets for 2021-2030 under the ESR. Member States are given access to an ESR compliance 'flexibility' that increases the amount of emissions they can emit over the 2021-2030 period (divided into two commitment periods, 2021-2025 and 2026-2030). Ireland can potentially avail of up to 26.8 Mt CO_2 eq of "credits" or flexibility associated with land use over the period 2021 to 2030, divided equally over two commitment periods. This is in recognition of agriculture's prominence in Ireland's emissions profile.

The accounting rules for the first phase of the LULUCF Regulation and ESR flexibility calculation are complex. The guiding principles were derived from the UN Kyoto Protocol accounting (now complete), to record the effect of human interventions. The intervention must have led to a reduction in emissions or increase in removals of CO_2 from the atmosphere for net removals to be recorded. The accounting regime in the LULUCF Regulation is a combination of "gross-net" (not compared against a reference level) and "net-net" (compared to some reference level, eg. a base year) accounting. If emissions in the reported year are lower than the reference level, a quantity of emissions have been negated and this is the accounted value or "net removal". If emissions are higher in the current year than in the reference level, there is a "net emission". Both a reduction in emissions and an increase in removals, compared to what occurred in the reference period, is considered a "net removal". Reference levels are different for the different source categories, with the average of a number of base years being the general approach. Forestry uses a gross-net approach for afforestation/deforestation and Forest Management Reference Levels to assess Forest Management emissions/removals.

Based on the accounting rules applicable to phase 1, the EPA's latest Projections report[15] indicates that Ireland could avail of 13.4 Mt CO_2 eq of flexibility for 2021-2025 (or 2.68 Mt CO_2 eq per annum) if all the measures in the "With Additional Measures" (WAM) scenario are implemented in full. This includes the key afforestation and water-table management measures described in the 2024 Climate Action Plan[19]. There is a significant degree of uncertainty associated with this amount given the ongoing updates of the LULUCF Inventory as detailed in Section 4.

For phase 2 (2026-2030) an even higher level of uncertainty applies as the availability of any flexibility is contingent on the EU collectively achieving its LULUCF target of a 310 Mt CO_2 eq reduction by 2030. If that condition is met then the revised phase 2 accounting approach will be used to determine what flexibility is available to Ireland for the 2026-2030 period. The latest EPA Projections indicate that no flexibility will be available to Ireland for phase 2 as Ireland is not projected to achieve the new LULUCF target of a 626 kt CO_2 eq reduction in emissions by 2030.

4. UPDATES AND REVISIONS

Refinement of the estimation of emissions and removals is standard practice in the compilation of GHG Inventories, with data being revised back to the base year of 1990 annually. Whilst this is true of all Inventory sectors, due to the more recent focus on the LULUCF sector, more significant revisions are being seen there than is usual in the rest of the Inventory which has reached a higher degree of maturity. In 2024 significant recalculations were undertaken for the latest submission of Ireland's Inventory Report[11] in light of country specific analysis of the extent of drainage on organic soils, the utilisation of soils data with respect to the nutrient status of these soils (nutrient rich versus nutrient poor), revised characterisation of the wetlands land use and the utilisation of country specific emission factors for onsite emissions and offsite emissions. In addition, updated land management, land use and input factors were proposed in the 2019 refinement to the 2006 IPCC guidelines.

Overall: Estimates have been recalculated in six out of seven LULUCF categories with the exception of Harvested Wood Products. For the LULUCF sector as a whole there is, on average, a 22% reduction in total emissions (1.4 Mt CO_2 eq) per year (range 0.4 Mt to 2.5 Mt CO_2 eq) across the timeseries 1990-2021. Figure 5 illustrates the impact these updates had across the inventory reporting timeseries for LULUCF.

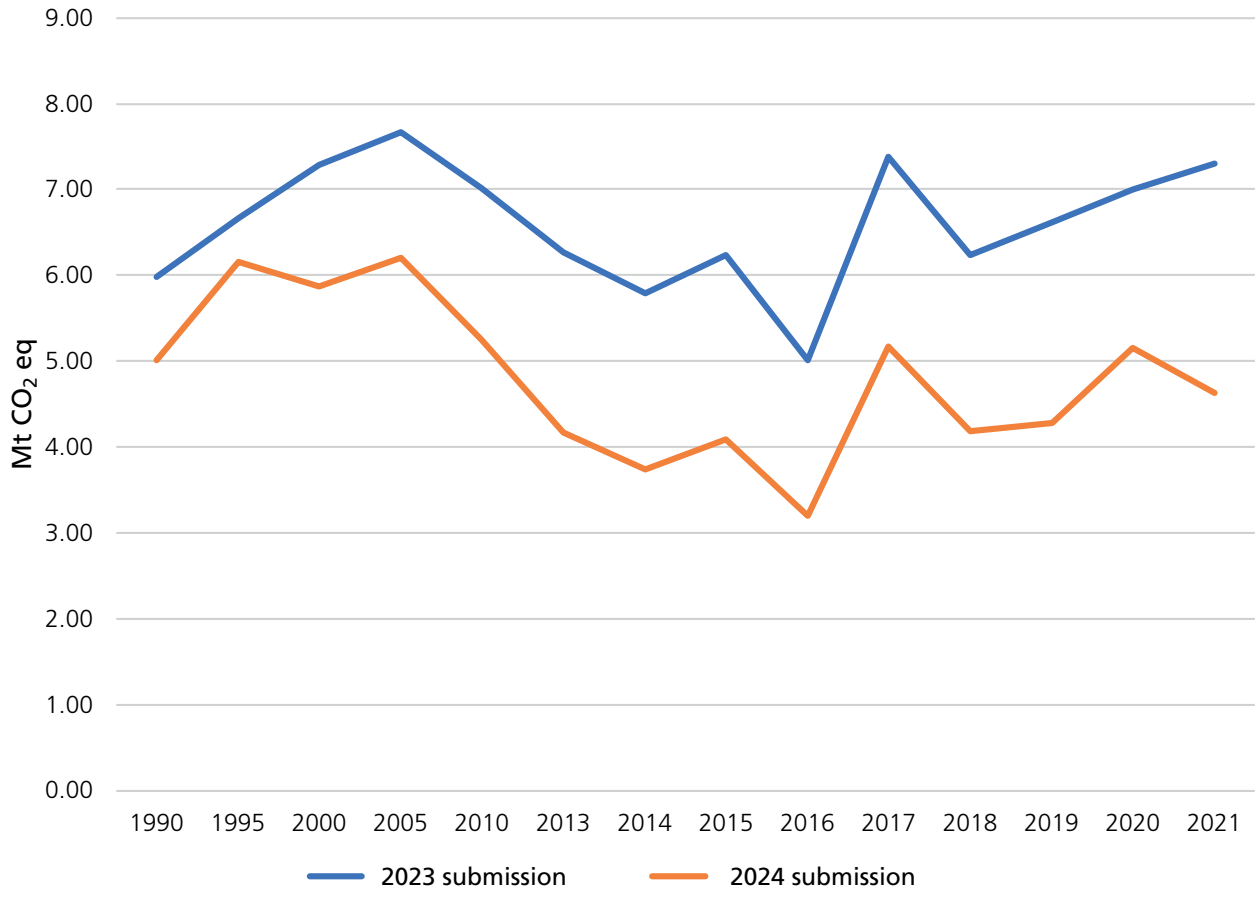


Figure 5. Impact of recalculations in LULUCF between annual submissions 1990-2021

Forestry: The correction and update of deforestation estimates and updated data on the proportion of organic soils for 2020 and 2021 results in revisions for these years in this sector.

Cropland: Updated land use factor, land management factor and soil carbon reference stocks as presented in the IPCC 2019 Refinement to the 2006 Guidelines, along with revised crop rotation analysis, are the main drivers of the recalculation. On average across the timeseries 1990-2021 there is a decrease in removals of 74% (115 kt CO_2 eq, range -20 kt to +236 kt).

Grassland: The main changes are associated with new knowledge with regard to the drainage status of grasslands on organic soils[20] and use of country specific emission factors[21] for this subset of grasslands. Furthermore, similar to cropland, updated land use and land management factors and soil carbon reference stocks as presented in the IPCC 2019 Refinement to the 2006 Guidelines are included in emission and removal estimates. On average this leads to a recalculation downwards of 3.7 Mt CO_2 eq (range 2.6 Mt to 4.6 Mt) or a 53% reduction in emissions from this category across the timeseries 1990-2021.

Wetlands: There is 2.1 Mt CO_2 eq (range 1.8 Mt to 2.3 Mt) on average increase in emissions due to changes to the classification of wetland subcategories and the adoption of a recent scientific paper[21] which provides country specific emission and removal factors based on an updated compilation of national research results.

Settlements and Other land: Minor revisions in both categories are as a result of the adoption of updated land use and land management factors and soil carbon reference stocks as presented in the IPCC 2019 Refinement to the 2006 Guidelines.

Harvested Wood Products: Unchanged.

The future of Ireland's land

Looking to the future, ambitious decision making is needed regarding the utilisation of Ireland's land to ensure it is converted from a sector that is contributing emissions to the atmosphere, to one that removes CO_2 from the atmosphere, helping to reach Ireland's targets on climate change. To do this, it is clear that a much greater area of forestry is necessary in combination with the committed and continued national scale peatland restoration and rehabilitation efforts. If Ireland is to meet its emissions reduction targets, this on the ground action must happen urgently whilst maximising co-benefits to water quality, biodiversity, and other ecosystem services.

To establish a process of being able to properly assess land use and land use change, the LULUCF Regulation states that: "To facilitate data collection and methodology improvement, land use should be inventoried and reported using geographical tracking of each land area". To achieve this goal, the EPA is developing a spatially explicit national land use map for LULUCF reporting. The agency also continues to fund research aimed at developing emission/removal factors and research knowledge gaps associated with land use activities in Ireland.

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