Appendix F: Inventory Results

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This Appendix provides detailed results and discussion for all land in Oregon and for each land category. Biomass burning is considered separately because it crosses all land categories.

Land in Oregon

Oregon covers 62.9 million acres and has a diverse landscape ranging from coastal forests to high desert to volcanic peaks. For the purposes of the Inventory, all the land was classified into six (6) categories as described in Appendix B, and conversions between these categories were analyzed. The land categories include Forest Land, Grassland, Cropland, Wetland, Developed Land, and Other Land (e.g., bare rock, ice, sand). Most of Oregon's forests are concentrated in western and central Oregon, in the Cascade Range and the Coast Range. Oregon's grasslands are primarily located in the arid high desert in the eastern and southeastern parts of the state. The majority of croplands are located in the Willamette Valley in the western part of the state and the Columbia Plateau in the northeast. Oregon's wine grapes, hazelnuts, and berries are produced in the Willamette Valley.

Most of Oregon's wetlands are found in the Klamath Basin, the Willamette Valley, and along the coast. The Klamath Basin is home to large marsh systems, the Willamette Valley has floodplain wetlands, and coastal areas feature estuarine wetlands where freshwater meets saltwater. Willamette Valley is also home to about 70% of Oregon's residents and where the largest cities are located. To account for GHG emissions and removals in such diverse landscapes, the Inventory utilizes the U.S. EPA's ecoregions, also used by the Oregon Conservation Strategy, to further stratify land categories to assign appropriate characteristics and emission parameters to the land categories, in addition to numerous other attributes for each land category that will be detailed further.

Across the 1990–2021 period, Oregon's landscape remained dominated by Grassland and Forest Land, which together account for most of the state's area. The largest single category is Grassland remaining Grassland, totaling approximately 39 million acres over the time series. In contrast, the smallest category is Developed Land converted to Other Land, representing only about 2,000 acres of change over three decades—indicating that developed land rarely transitions back to other uses once established.

The land classification and analysis of trends were conducted using the National Land Cover Database (NLCD) layer on land cover. The detailed methodology is available in Appendix E. While it is a powerful dataset, it has limitations that impact the interpretation of land use change trends. NLCD data captures land cover (i.e., what is on the surface) and not land use (i.e., management and function), and may reflect specific seasonal conditions and temporary changes from land management, leading to a potentially high incidence of misinterpretation of land use and land use change. Specifically, the land classification analysis revealed challenges in discerning functional land conversion between Forest Land to Grassland solely from land cover characteristics. Areas for conversions from Forest Land to Grassland and Grassland to Forest Land, based on NLCD data, were not estimated. Further analysis and refinement of the land categorization process is needed before results for conversions between Forest Land to Grassland can confidently be included in the Inventory. This limitation is recorded and improvements recommended within the report for the next iteration of the Inventory.

Nonetheless, over the full time series, shown in Table 1, several clear trends emerge in the land-use dynamics:

- Forest Land has shown modest but measurable change. While total forest area has remained relatively stable, there has been a gradual net decline, with presumed losses to Grassland (which are not estimated) and detected losses to Developed Land. Some compensating gains occur through Cropland conversions back to Forest Land.

- Grassland, though still extensive, has also decreased slightly over time. These losses are primarily due to conversion to urban development (i.e., Developed Land). Some may also be due to Grassland conversion to Forest Land, but the specific extent is unknown at this time. However, Grassland remains the dominant land type statewide, indicating the persistence of large rangeland and open-space systems in Oregon.
- Cropland shows the most substantial decrease among major categories, reflecting both agricultural land retirement and conversion to other uses. The largest single land-use change is Cropland converted to Grassland, which may represent extensive reversion of marginal farmland to perennial cover. This trend likely reflects both ecological restoration initiatives and changing economic or climatic conditions that make some lands less viable for cultivation.
- Developed Land (settlements) has steadily increased throughout the period. Most new development has occurred on land previously classified as cropland or grassland, following expected patterns of population growth and urban expansion.
- Wetland occupies a relatively small share of total area but show localized increases, particularly conversions from Cropland to Wetland.
- Other Land categories remain limited and stable, with exchanges involving grasslands and wetlands, which are increasing over time.

Overall, Oregon's land-use trends from 1990 to 2021 reflect a combination of rural land conversion, reforestation of former agricultural areas, and ongoing development growth, balanced by targeted efforts to restore and protect wetlands. The dominant processes shaping the state's landscape are the decline of cropland, moderate forest loss, persistence of extensive grassland, and steady expansion of developed areas.

Table 1: Land and land use change in Oregon in acres

Category	1990	1996	2001	2006	2011	2016	2021
Forest Land remaining Forest Land	25,802,707	24,400,772	22,671,452	22,528,716	22,021,718	22,224,833	21,848,584
Grassland converted to Forest Land	NE	NE	NE	NE	NE	NE	NE
Cropland converted to Forest Land	-	13,321	16,706	17,831	19,784	8,994	7,295
Wetland converted to Forest Land	-	4,329	9,837	9,188	9,834	10,212	8,758
Developed Land converted to Forest Land	-	1,639	2,068	6,077	16,482	41,338	47,542
Other Land converted to Forest Land	-	399	536	624	722	676	698

Grassland remaining Grassland	30,732,713	29,542,375	28,403,991	27,390,383	26,797,077	26,680,666	26,721,070
Forest Land converted to Grassland	NE	NE	NE	NE	NE	NE	NE
Cropland converted to Grassland	-	151,145	251,902	312,401	358,425	306,215	290,002
Wetland converted to Grassland	-	11,318	54,448	26,505	34,531	106,258	117,819
Developed Land converted to Grassland	-	1,037	1,501	5,399	13,677	27,506	41,334
Other Land converted to Grassland	-	12,443	16,795	19,407	19,228	11,376	17,663
Cropland remaining Cropland	5,115,988	4,883,654	4,735,706	4,629,714	4,526,225	4,541,519	4,533,745
Forest Landconverted to Cropland	-	25,515	24,989	29,038	31,706	24,123	26,869
Grassland converted to Cropland	-	91,880	198,959	233,987	283,401	288,662	253,340
Wetland converted to Cropland	-	31,174	38,980	49,323	54,959	62,280	60,481
Developed Land converted to Cropland	-	2,614	3,688	5,058	7,324	8,843	11,750
Other Land converted to Cropland	-	639	681	739	781	405	558
Wetland remaining Wetland	2,775,488	2,721,254	2,640,169	2,624,061	2,605,597	2,550,897	2,493,917
Forest Land converted to Wetland	-	4,861	4,886	8,100	9,790	7,683	6,825

Grassland converted to Wetland	-	53,382	28,761	66,177	77,756	30,224	19,552
Cropland converted to Wetland	-	20,028	38,984	45,684	56,389	41,449	51,964
Developed Land converted to Wetland	-	1,090	1,216	1,640	1,994	1,491	1,595
Other Land converted to Wetland	-	10,949	9,194	43,995	32,233	25,872	7,307
Developed Land remaining Developed Land	1,860,802	1,854,330	1,852,189	1,842,712	1,822,983	1,898,766	1,944,671
Forest Land converted to Developed Land	-	42,259	70,101	95,935	111,590	85,294	74,627
Grassland converted to Developed Land	-	27,561	45,991	70,354	94,726	93,686	101,104
Cropland converted to Developed Land	-	47,602	75,080	109,352	139,988	118,573	121,139
Wetland converted to Developed Land	-	2,148	3,730	4,521	5,153	4,082	3,646
Other Land converted to Developed Land	-	809	1,216	1,404	1,557	923	659
Other Land remaining Other Land	342,296	317,058	310,101	303,005	300,303	301,596	320,977
Forest Land converted to Other Land	-	483	952	1,203	2,140	2,282	2,755

Grassland converted to Other Land	-	1,967	2,854	3,832	5,051	6,753	9,363
Cropland converted to Other Land	-	238	371	470	528	403	443
Wetlands converted to Other Land	-	5,265	58,273	29,576	46,558	68,750	91,222
Developed Land converted to Other Land	-	93	123	174	214	203	215

“NE” means not estimated.

Forest Land

Oregon’s Forest Land represents one of the state’s most significant natural assets, supporting a diverse timber economy while serving as a major carbon reservoir. The state’s forests store substantial amounts of carbon in biomass, dead wood, litter, and soils, and play a critical role in carbon fluxes through ongoing growth, harvest, disturbance, and regeneration processes. The inventory quantified these emissions and removals, and this section summarizes Oregon’s forest land carbon stocks and annual fluxes. The detailed methodology is provided in Appendix E.

Forest Land Remaining Forest Land

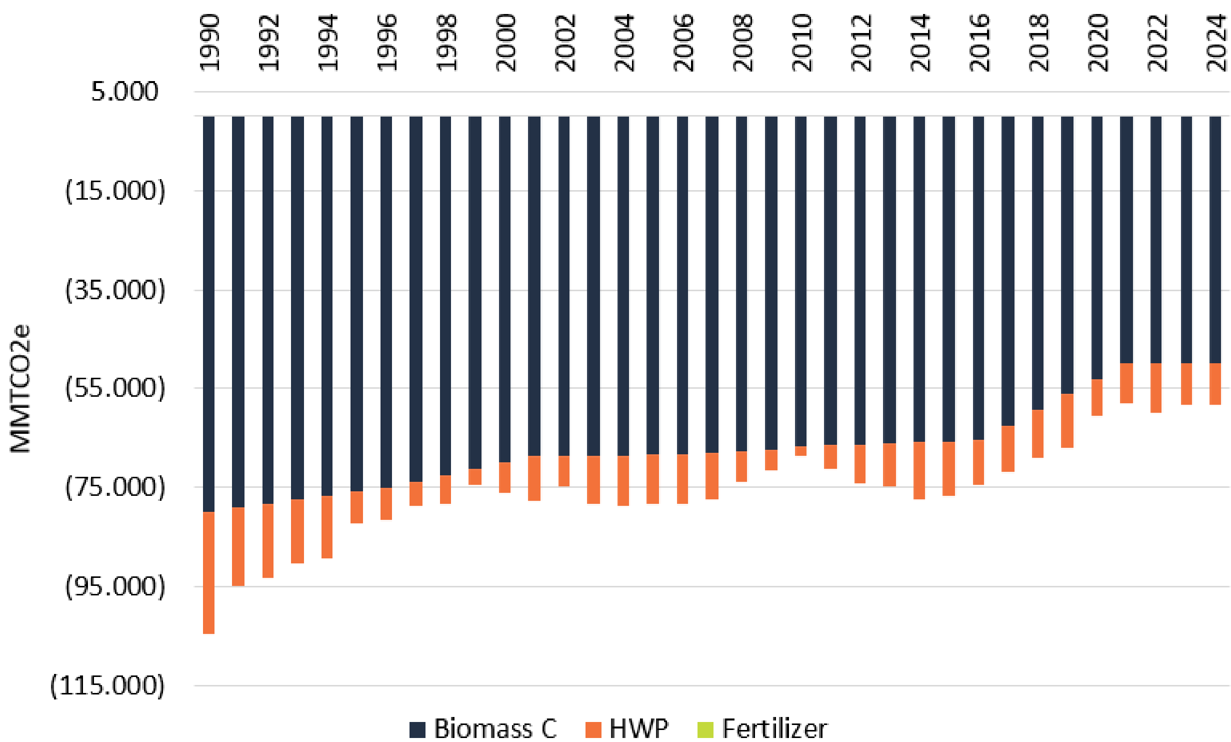
Oregon's forests remained a net carbon sink in 2024, removing 58.2 million metric tons of CO_2 equivalent (MMTCO2e) from the atmosphere annually. However, the state's forest carbon sequestration capacity has declined by 46.3 MMTCO2e over the past 34 years (Figure 1, Table 2) as a result of declining sequestration across all subcategories, excluding fertilizer application (which is an emissions source only), with the largest percent decline occurring in the harvested wood products.

Table 2: Emissions and removals from Forest Land remaining Forest Land in MMTCO2e

Land Type	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Forest Land remaining Forest Land (biomass)	(79.87)	(68.34)	(65.44)	(62.34)	(59.23)	(56.13)	(53.03)	(49.93)	(49.93)	(49.93)	(49.93)
Harvested wood products	(24.66)	(9.84)	(8.92)	(9.49)	(9.55)	(10.82)	(7.49)	(8.17)	(9.82)	(8.31)	(8.31)
Fertilizer application	0.034	0.034	0.048	0.051	0.038	0.035	0.016	0.024	0.023	0.024	0.035

Total	(104.49)	(78.14)	(74.31)	(71.78)	(68.75)	(66.92)	(60.51)	(58.08)	(59.73)	(58.22)	(58.21)

Figure 1: Emissions and removals from Forest Land remaining Forest Land in MMTCO2e



Fertilizer is not visible due to its relatively small magnitude; see Table 2

The Forest Land remaining Forest Land subcategory removed 49.9 MMTCO2e from the atmosphere in 2024. This subcategory encompasses 16 forest type groups across 21.8 million acres (Table 3), with carbon sequestration varying substantially among forest types (Table 4).

Table 3: Forest Land remaining Forest Land area by forest type groups in acres

Forest Type Group	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Alder / maple	446,640	327,118	276,861	273,872	270,884	267,896	264,907	261,919	261,919	261,919	261,919
Aspen / birch	2,762	2,354	2,243	2,228	2,213	2,197	2,182	2,167	2,167	2,167	2,167
Douglas-fir	12,831,669	10,816,537	10,690,397	10,652,377	10,614,357	10,576,337	10,538,317	10,500,298	10,500,298	10,500,298	10,500,298
Elm / ash / cottonwood	1,080	887	922	910	898	886	874	862	862	862	862
Fir / spruce / mountain hemlock	4,060,006	3,825,328	3,798,660	3,795,439	3,792,217	3,788,996	3,785,775	3,782,554	3,782,554	3,782,554	3,782,554
Hemlock / Sitka spruce	302,911	244,548	238,739	233,550	228,360	223,170	217,980	212,791	212,791	212,791	212,791
Lodgepole pine	921,097	795,251	794,089	792,291	790,494	788,696	786,899	785,101	785,101	785,101	785,101
Mixed Conifer	79,965	66,050	65,780	65,181	64,581	63,982	63,382	62,783	62,783	62,783	62,783
Other hardwoods	134,589	122,695	124,823	123,398	121,973	120,548	119,123	117,697	117,697	117,697	117,697
Other western softwoods	13,753	12,197	12,399	12,390	12,381	12,372	12,363	12,354	12,354	12,354	12,354
Pinyon / juniper	91,147	80,012	78,547	78,689	78,831	78,972	79,114	79,256	79,256	79,256	79,256
Ponderosa pine	4,928,742	4,505,475	4,478,124	4,474,941	4,471,759	4,468,576	4,465,393	4,462,210	4,462,210	4,462,210	4,462,210
Tanoak / laurel	189,232	162,259	159,961	160,173	160,386	160,598	160,810	161,022	161,022	161,022	161,022
Unknown	1,566,736	1,349,933	1,286,856	1,271,260	1,255,664	1,240,068	1,224,473	1,208,877	1,208,877	1,208,877	1,208,877
Western larch	30,124	27,976	28,480	28,511	28,542	28,574	28,605	28,636	28,636	28,636	28,636

Western oak	167,961	158,279	156,156	152,626	149,095	145,564	142,034	138,503	138,503	138,503	138,503
Western white pine	34,291	31,815	31,795	31,747	31,699	31,650	31,602	31,554	31,554	31,554	31,554
Total Area	**25,802,707**	**22,528,716**	**22,224,833**	**22,149,583**	**22,074,333**	**21,999,084**	**21,923,834**	**21,848,584**	**21,848,584**	**21,848,584**	**21,848,584**

Table 4: Total carbon stocks by forest type group in MMTCO2e

Forest Type Group	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Alder / maple	158.70	111.00	99.70	99.90	100.10	100.30	100.50	100.70	100.70	100.70	100.70
Aspen / birch	0.80	0.70	0.70	0.90	1.10	1.30	1.50	1.60	1.60	1.60	1.60
Douglas-fir	5,504.80	4,799.40	4,924.60	4,940.60	4,956.50	4,972.50	4,988.50	5,004.40	5,004.40	5,004.40	5,004.40
Elm / ash / cottonwood	0.30	0.20	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Fir / spruce / mountain hemlock	1,475.90	1,482.60	1,511.30	1,514.90	1,518.60	1,522.30	1,526.00	1,529.60	1,529.60	1,529.60	1,529.60
Hemlock / Sitka spruce	196.70	129.90	122.20	121.10	120.00	118.90	117.80	116.70	116.70	116.70	116.70
Lodgepole pine	234.50	200.30	204.00	203.90	203.80	203.70	203.60	203.50	203.50	203.50	203.50
Mixed Conifer	18.90	15.90	14.20	14.20	14.20	14.20	14.20	14.20	14.20	14.20	14.20
Other hardwoods	79.40	72.40	62.60	61.90	61.20	60.50	59.80	59.10	59.10	59.10	59.10
Other western softwoods	7.50	3.80	4.00	4.00	4.00	3.90	3.90	3.90	3.90	3.90	3.90
Pinyon / juniper	19.80	17.80	17.60	17.60	17.60	17.60	17.60	17.60	17.60	17.60	17.60
Ponderosa pine	942.90	887.70	800.40	799.80	799.20	798.70	798.10	797.50	797.50	797.50	797.50
Tanoak / laurel	55.30	46.70	46.90	46.80	46.80	46.80	46.80	46.80	46.80	46.80	46.80

Unknown	701.10	604.10	575.80	568.90	561.90	554.90	547.90	540.90	540.90	540.90	540.90
Western larch	9.70	10.00	9.30	9.40	9.50	9.60	9.70	9.80	9.80	9.80	9.80
Western oak	46.60	43.70	43.50	44.10	44.60	45.20	45.70	46.30	46.30	46.30	46.30
Western white pine	11.70	12.00	10.50	9.90	9.20	8.60	7.90	7.20	7.20	7.20	7.20
Total	**9,464.40**	**8,438.10**	**8,447.60**	**8,458.10**	**8,468.60**	**8,479.00**	**8,489.50**	**8,500.00**	**8,500.00**	**8,500.00**	**8,500.00**

Douglas-fir, the most dominant forest type group covering 10.5 million acres in 2024, accounted for a total removal of 42.72 MMTCO2e (85% of total removals) in 2024. Notably, Aspen/birch, Mixed Conifer, and Western Oak forest groups were net emitters rather than carbon sinks in 2024 (Table 5). FIA plot data shows negative carbon accumulation across aspen/birch, mixed conifer, and western oak forests (2001-2022), resulting in net CO_2 emissions rather than sequestration. The strongest evidence exists for mixed conifers, where the unprecedented 2022 die-off affected 1.1 million acres and research links fire exclusion to increased drought sensitivity (https://extension.oregonstate.edu/forests/health-managment/true-fir-douglas-fir-mortality-oregon). For western oak and aspen/birch, insufficient Oregon-specific data prevent determining primary mortality drivers, though competition and climate stress are likely factors. These trends warrant continued monitoring and targeted research to understand drivers across all three forest types.

Table 5: Emissions and removals from Forest Land remaining Forest land by forest type group in MMTCO2e

Forest Type Group	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Alder / maple	(2.21)	(1.62)	(1.07)	(0.97)	(0.88)	(0.78)	(0.69)	(0.59)	(0.59)	(0.59)	(0.59)
Aspen / birch	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.02	0.02
Douglas-fir	(55.31)	(46.62)	(52.79)	(50.78)	(48.76)	(46.75)	(44.73)	(42.72)	(42.72)	(42.72)	(42.72)
Elm / ash / cottonwood	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fir / spruce / mountain hemlock	(4.07)	(3.83)	(6.46)	(6.14)	(5.81)	(5.48)	(5.15)	(4.83)	(4.83)	(4.83)	(4.83)
Hemlock / Sitka spruce	(1.44)	(1.16)	(0.95)	(0.94)	(0.94)	(0.93)	(0.93)	(0.92)	(0.92)	(0.92)	(0.92)
Lodgepole pine	(0.81)	(0.70)	(0.68)	(0.70)	(0.72)	(0.74)	(0.76)	(0.78)	(0.78)	(0.78)	(0.78)
Mixed Conifer	0.20	0.16	0.05	0.08	0.10	0.12	0.15	0.17	0.17	0.17	0.17
Other hardwoods	(1.06)	(0.97)	(0.99)	(0.98)	(0.96)	(0.95)	(0.94)	(0.93)	(0.93)	(0.93)	(0.93)
Other western softwoods	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.01)	0.00	0.01	0.01	0.01	0.01
Pinyon / juniper	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Ponderosa pine	(10.03)	(9.17)	(0.24)	(0.24)	(0.24)	(0.24)	(0.24)	(0.24)	(0.24)	(0.24)	(0.24)
Tanoak / laurel	(0.29)	(0.25)	(0.24)	(0.23)	(0.23)	(0.22)	(0.22)	(0.21)	(0.21)	(0.21)	(0.21)
Unknown	(4.77)	(4.11)	(1.77)	(1.19)	(0.60)	(0.02)	0.56	1.15	1.15	1.15	1.15
Western larch	(0.02)	(0.02)	(0.04)	(0.04)	(0.04)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Western oak	0.03	0.03	(0.19)	(0.15)	(0.10)	(0.06)	(0.02)	0.02	0.02	0.02	0.02

Western white pine	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	0.00	0.00	0.00	0.00
Forest remaining forest (total)	**(79.87)**	**(68.34)**	**(65.44)**	**(62.34)**	**(59.23)**	**(56.13)**	**(53.03)**	**(49.93)**	**(49.93)**	**(49.93)**	**(49.93)**

Land Converted to Forest Land

When land is converted to Forest Land, pre-transition biomass is assumed to be lost in the year of transition only for land transitioning from Cropland to Forest Land. In all other cases, natural regeneration is assumed and carbon accumulations are equal to the mean growth rate of trees younger than 20 years old.

Total area of land converted to Forest Land from other land categories is summarized in Table 6. Area of land on mineral soils converted to Forest Land is provided in Table 7.

Table 6: Area of land converted to Forest Land in acres

Land converted to Forest Land from	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Cropland	-	17,831	8,994	8,654	8,314	7,975	7,635	7,295	7,295	7,295	7,295
Other Land	-	624	676	680	685	689	693	698	698	698	698
Developed Land	-	6,077	41,338	42,579	43,820	45,061	46,302	47,542	47,542	47,542	47,542
Wetlands	-	9,187	10,210	9,919	9,628	9,336	9,045	8,754	8,754	8,754	8,754
Grassland*	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

*NE = not estimated

Table 7: Area of land with mineral soils converted to Forest Land in acres

Land converted to Forest Land from	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Developed Land	-	5,764	39,838	40,977	42,116	43,255	44,394	45,533	45,533	45,533	45,533
Cropland	-	15,921	7,925	7,630	7,335	7,040	6,745	6,451	6,451	6,451	6,451
Wetlands	-	8,667	9,677	9,383	9,090	8,797	8,504	8,210	8,210	8,210	8,210

The land converted to Forest Land subcategory sequestered 0.42 MMTCO2e in 2024 (Table 8, Figure 2). Carbon sequestration in this subcategory is gradually increasing due to accumulation of carbon in growing trees.

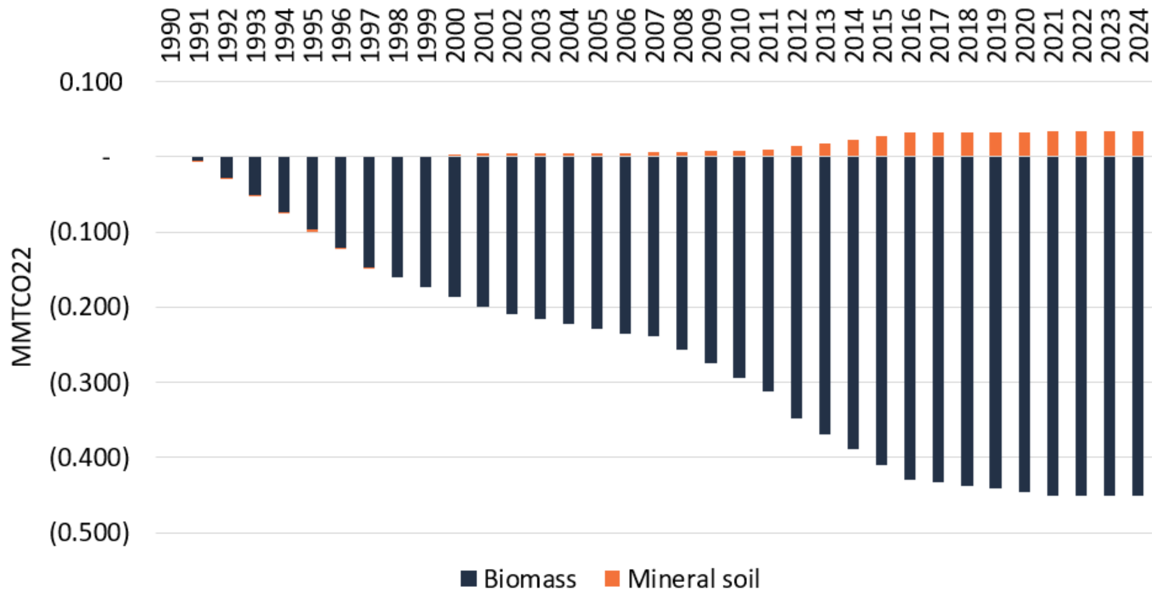
Table 8: Emissions and removals from land converted to Forest Land in MMTCO2e

Land converted to forests from	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Grassland*	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Cropland (biomass)	-	(0.123)	(0.061)	(0.058)	(0.056)	(0.053)	(0.051)	(0.048)	(0.048)	(0.048)	(0.048)
Cropland (mineral soil)	-	(0.016)	(0.008)	(0.008)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Wetlands (biomass)	-	(0.065)	(0.072)	(0.070)	(0.068)	(0.066)	(0.064)	(0.062)	(0.062)	(0.062)	(0.062)
Wetlands (mineral soil)	-	0.018	0.020	0.020	0.019	0.018	0.018	0.017	0.017	0.017	0.017
Developed Land (biomass)	-	(0.043)	(0.291)	(0.300)	(0.309)	(0.318)	(0.326)	(0.335)	(0.335)	(0.335)	(0.335)
Developed Land (mineral soil)	-	0.003	0.020	0.021	0.021	0.022	0.022	0.023	0.023	0.023	0.023
Other Land (biomass)	-	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Total	**-**	**(0.230)**	**(0.397)**	**(0.400)**	**(0.404)**	**(0.408)**	**(0.413)**	**(0.417)**	**(0.417)**	**(0.417)**	**(0.417)**

*NE = not estimated

When land is converted to Forest Land, changes in mineral soil carbon stocks occur. Over the time series, soils in land converted to Forest Land are a small source of emissions for most of the years, averaging approximately 0.03 MMTCO2e from 2016 to 2024. While Cropland converted to Forest Land results in removal of carbon by soil, carbon is released when Wetland or Developed Land is converted to Forest Land. The loss in soil carbon when converting from developed land to forests is because we assume that open space is converted rather than areas that are paved. While data is lacking on soil carbon dynamics, it is assumed that soil characteristics for the open space class of developed land are similar to those of improved grasslands.

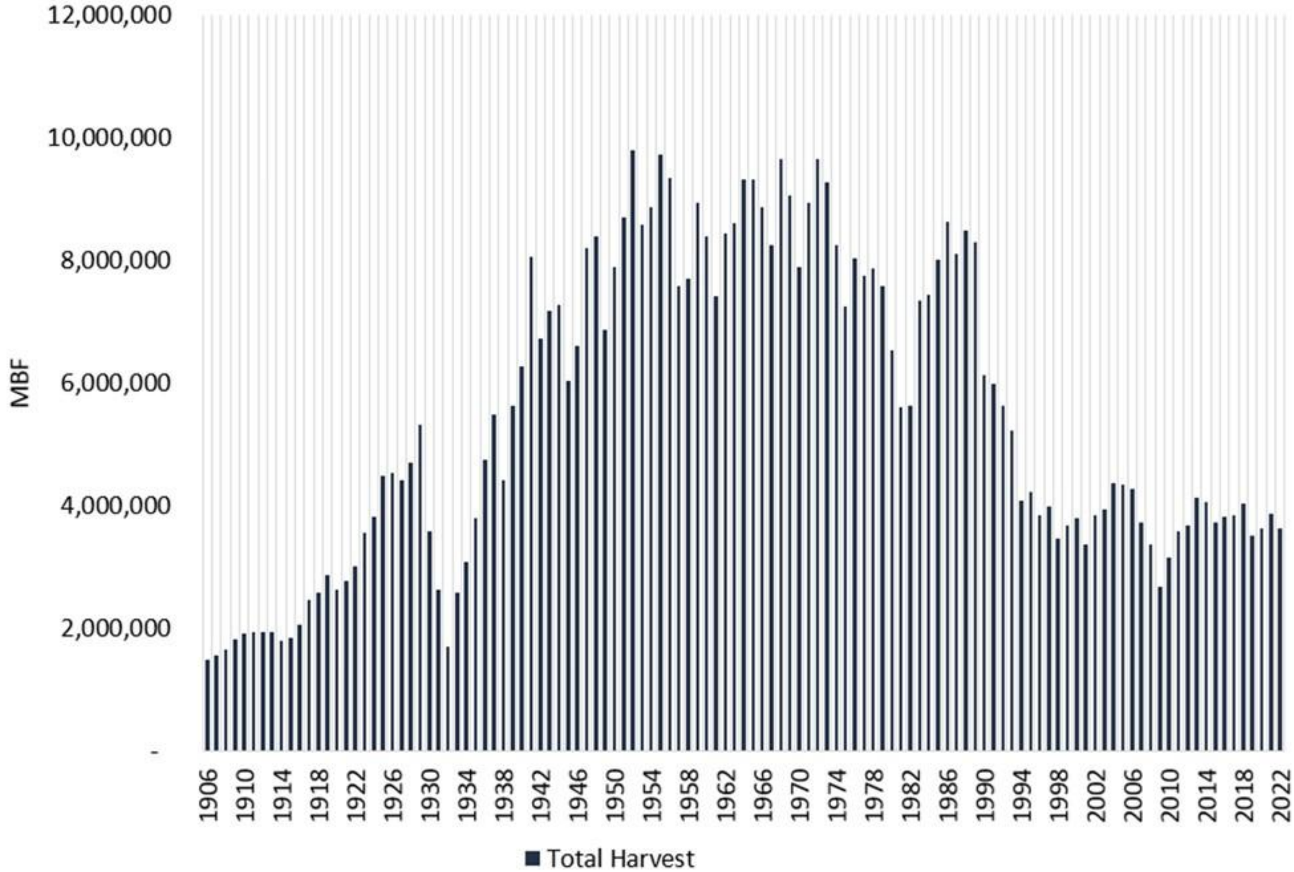
Figure 2: Emissions and removals from land converted to Forest Land in MMTCO2e



Harvested Wood Products

Carbon in harvested timber is not released immediately. Instead, part of it enters the Harvested Wood Products (HWP) pool, where it is stored in wood products that gradually emit carbon—mostly as CO_2—as they decompose or are burned. When wood products are discarded in solid waste disposal sites (SWDS), the carbon is either released through decomposition or retained long-term in the landfill. The HWP pool therefore, includes both products in use and those in SWDS. Carbon flows into the pool when new wood is added and leaves the pool through decay or combustion. The net balance of these flows determines whether the HWP pool is a source or sink of CO_2 at any point in time. The estimates are based on the production approach (implemented in Oregon using the HWP vR model), which is based on the timber harvested in Oregon only and is consistent with the methodology utilized by the Oregon Department of Forestry (ODF). The detailed methodology is available in Appendix E. The amount of timber harvested in Oregon for 1906 to 2002 is shown in Figure 3.

Figure 3: Oregon timber harvest in thousand board feet (MBF)



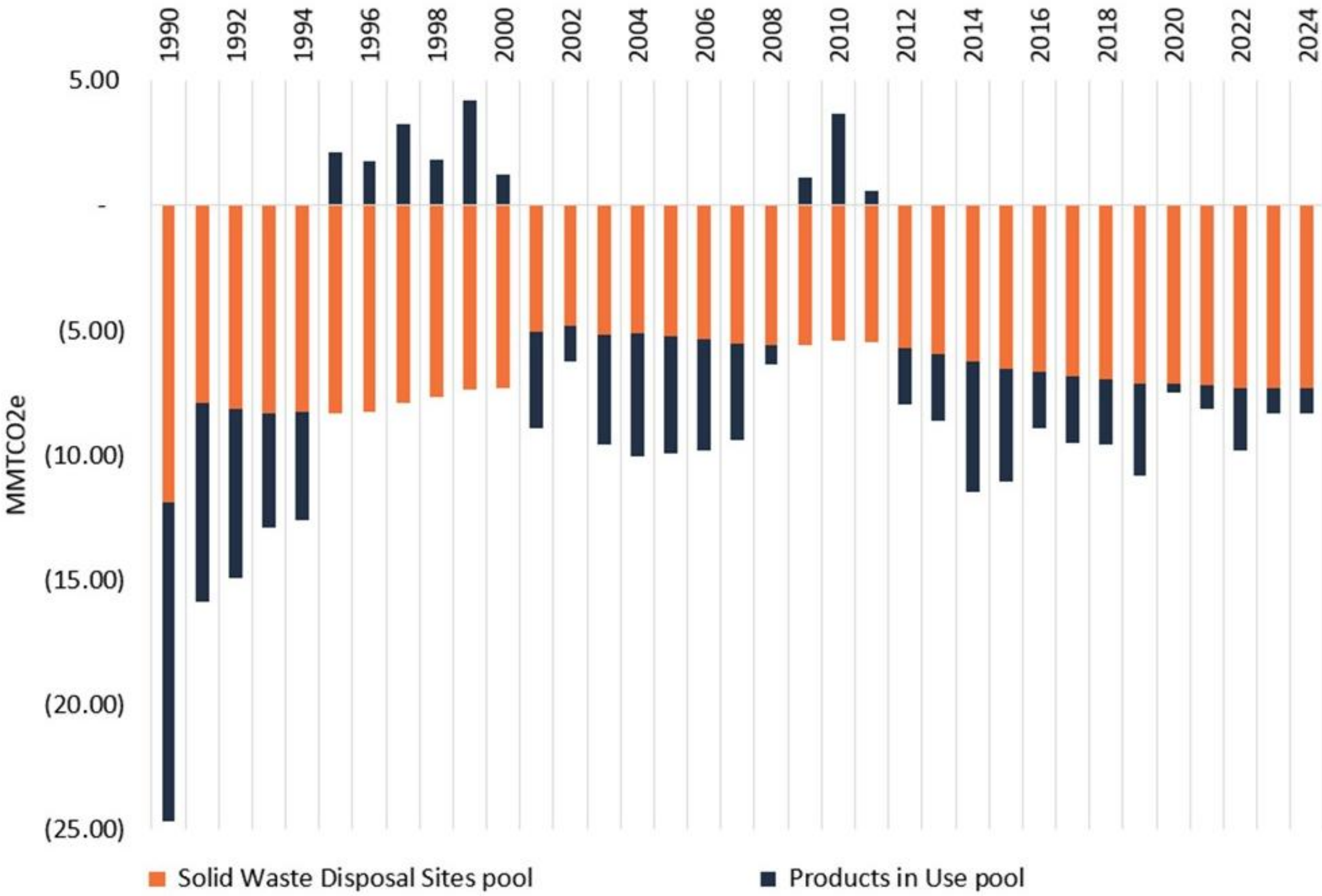
From 1990 to 2024, Oregon's Harvested Wood Products (HWP) consistently show net carbon removals, but the magnitude and the contribution of each pool change over time (Table 9, Figure 4). The largest carbon removals occurred in the early 1990s, especially 1990–1993. Total carbon removed through the HWP in 1990 is 24.66 MMTCO2e. In the mid to late 1990s, the net carbon removal became much smaller as the Products in Use pool declined, resulting in emissions in the years 1995–2000. This is likely attributable to restrictions on logging on federal land in Oregon in the early 1990s.

Table 9: Emissions and removals from HWP in MMTCO2e

Harvested Wood Products Carbon Pool	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Solid Waste Disposal Sites	(11.91)	(5.36)	(6.68)	(6.82)	(6.95)	(7.12)	(7.16)	(7.19)	(7.29)	(7.34)	(7.34)
Products in Use	(12.75)	(4.48)	(2.24)	(2.67)	(2.60)	(3.70)	(0.33)	(0.98)	(2.53)	(0.97)	(0.97)
Total	**(24.66)**	**(9.84)**	**(8.92)**	**(9.49)**	**(9.55)**	**(10.82)**	**(7.49)**	**(8.17)**	**(9.82)**	**(8.31)**	**(8.31)**

2024 values equal to 2023, to be recalculated when harvest data is available for 2024

Figure 4: Emissions and removals from HWP in MMTCO2e



From about 2000 to 2008, total HWP carbon removals increased again (Figure 4), with the Products in Use pool contributing approximately the same amount as the SWDS pool to the overall HWP carbon removal. Around 2009-2011, there was a brief shift where Products in Use again showed an emission. This corresponds to the period of an economic recession, when harvest levels dropped, reducing net HWP emissions for a short period.

Over the years 2012-2024, the SWDS removals are increasing slowly, which suggests a slight increase in the amount of wood products landfilled (Figure 4). The Products in Use removals are gradually decreasing in magnitude, although with more fluctuations, indicating generally reduced harvest volumes. In 2023, the last year for which data are available, the HWP pool removed net 8.31 MMTCO2e. Overall, the long-term trend is a reduction in the amount of carbon removed by the HWP pool. While the removals through SWDS remain steady, most variability in total HWP carbon stock change is driven by the Products in Use pool, which is linked to harvest levels more directly.

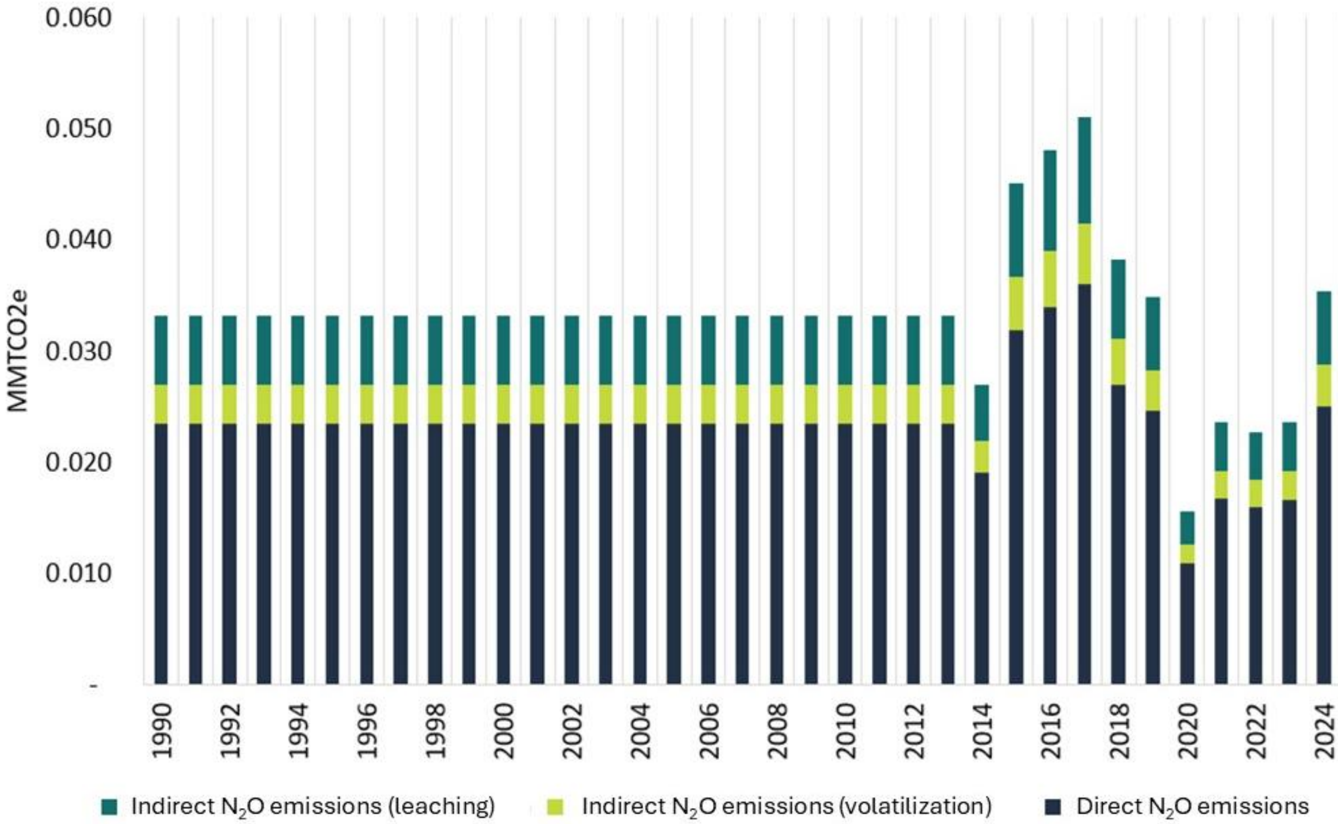
Fertilizer emissions

Nitrous oxide (N_2O) emissions from fertilizer applied to intensively-managed commercial Douglas-fir forests in Oregon represent a small component of land-based greenhouse gas fluxes (Table 10, Figure 5). When nitrogen fertilizers are added to soils to enhance tree growth, a portion of that nitrogen is transformed by microbial processes—primarily nitrification and denitrification—into N_2O. Emissions depend on the nitrogen content of the fertilizer and application rate. Emissions from fertilizer application are estimated together for forest land remaining forest land and land converted to forest land. The methodology to estimate direct and indirect N_2O emissions is available in Appendix E.

Table 10: Amount of N applied to soil in million kg and associated N_2O emissions in MMTCO2e

Year and N applied	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
N applied (million kg)	5.742	5.742	8.163	8.668	6.496	5.917	2.643	4.012	3.852	4.002	6.005
N_2O emissions, direct (MMTCO2e)	0.024	0.024	0.034	0.036	0.027	0.025	0.011	0.017	0.016	0.017	0.025
N_2O emissions, indirect volatilization (MMTCO2e)	0.004	0.004	0.005	0.005	0.004	0.004	0.002	0.003	0.002	0.002	0.004
N_2O emissions, indirect leaching (MMTCO2e)	0.006	0.006	0.009	0.010	0.007	0.007	0.003	0.004	0.004	0.004	0.007
N_2O emissions, total (MMTCO2e)	0.034	0.034	0.048	0.051	0.038	0.035	0.016	0.024	0.023	0.024	0.035

Figure 5: N_2O emissions from application of fertilizer to soil on Forest Land in MMTCO2e



Data on fertilizer use in Oregon Forest Land is limited. The current estimates are based on ODF's notification database, indicating landowners' intent to apply fertilizer (by area), rather than reports of actual application. Therefore, the results likely overestimate the emissions for the 2014-2024 period. Nitrogen (N) application data for 1990-2013 is not available; therefore, emissions are estimated based on surrogate data—the average amount of N applied for years 2014 to 2024. Summed together, direct and indirect emissions in the period 1990 to 2013 are estimated to be 0.033 MMTCO2e. Between 2014 and 2024, emissions fluctuate with a weak declining trend. In 2024, the estimated emissions equaled 0.035 MMTCO2e. However, estimates for the 1990-2000 period are likely underestimating emissions because fertilizer use is declining due to changes in the management approaches over the last 20 years. To reduce cost, managers have shifted to planting lower tree densities to avoid the need for precommercial thinning and associated management entrances that are also coupled with instances of fertilizer application.

Grasslands

Grasslands in Oregon span a diverse set of ecosystems shaped by the state's varied climate and topography—from Willamette Valley wet prairies of the west to the expansive sagebrush-steppe and bunchgrass communities of Eastern Oregon. These landscapes support a wide range of native plants and wildlife, provide important grazing lands, and play a key role in regional fire regimes and watershed health.

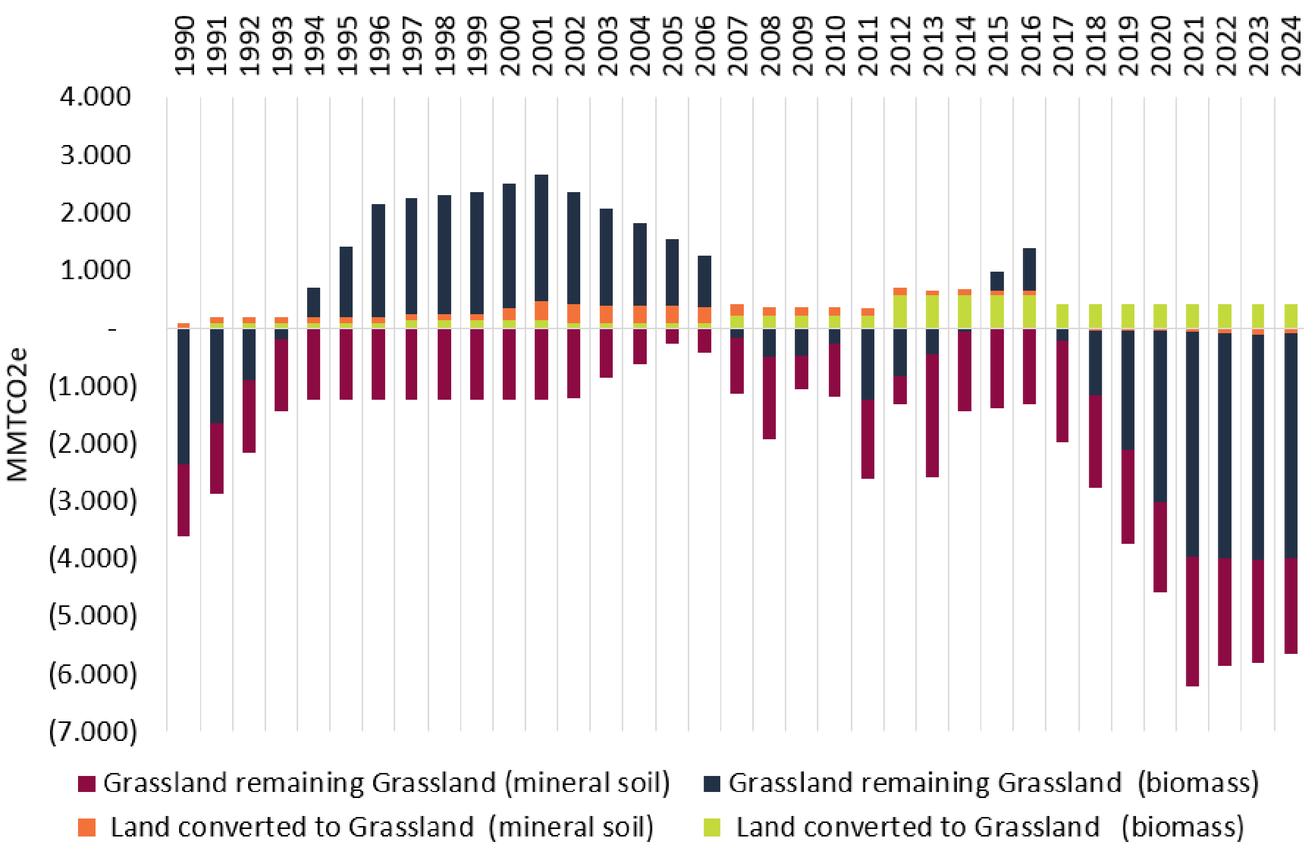
Grassland Remaining Grassland

Table 11: Area of Grassland remaining Grassland by Ecoregion in acres

Ecoregion	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Blue Mountains	8,489,929	8,502,492	8,407,186	8,431,608	8,456,031	8,480,453	8,504,875	8,529,298	8,529,298	8,529,298	8,529,298
Coast Range	1,241,400	663,572	683,174	652,989	622,804	592,620	562,435	532,250	532,250	532,250	532,250
Columbia Plateau	2,497,249	2,494,809	2,512,768	2,512,252	2,511,735	2,511,219	2,510,702	2,510,185	2,510,185	2,510,185	2,510,185
Eastern Cascades	2,283,532	2,138,398	2,002,802	2,006,464	2,010,127	2,013,789	2,017,452	2,021,114	2,021,114	2,021,114	2,021,114
Klamath Mountains	902,008	666,945	806,941	811,432	815,922	820,413	824,904	829,394	829,394	829,394	829,394
Northern Basin and Range	13,938,241	13,853,858	13,817,743	13,826,944	13,836,145	13,845,346	13,854,547	13,863,748	13,863,748	13,863,748	13,863,748
West Cascades	1,100,057	539,517	610,465	624,380	638,295	652,210	666,125	680,040	680,040	680,040	680,040
Willamette Valley	191,725	199,899	163,155	153,956	144,756	135,557	126,358	117,158	117,158	117,158	117,158
Grassland remaining Grassland (total)	30,644,141	29,059,490	29,004,234	29,020,025	29,035,815	29,051,607	29,067,398	29,083,187	29,083,187	29,083,187	29,083,187

Aboveground biomass in the state's Grassland tends to be relatively modest compared to forested systems. Grassland stores the majority of its carbon belowground, with deep-rooted perennial grasses and mineral soils contributing to removals of carbon from the atmosphere. Estimates of biomass carbon density are based on models of net primary production (NPP) for perennial herbaceous and shrub vegetation classes. NPP in grasslands represents the total plant growth each year, including both the aboveground vegetation and the extensive root systems growing below ground. In grassland ecosystems, these underground roots are particularly important—they often account for more biomass growth than what's visible at the surface. Estimates of soil carbon primarily rely on information about grazing regimes and aboveground biomass utilization by livestock. The detailed methodology is available in Appendix E. The Inventory estimated carbon fluxes associated with biomass and mineral soils in Grassland remaining Grassland and Land converted to Grassland (Figure 6, Table 12).

Figure 6: Emissions and removals from Grasslands in MMTCO2e



Grassland emissions and removals fluctuate over the time series. Starting in mid-2000, Grassland has been a net remover of carbon from the atmosphere. Aboveground biomass in Grassland remaining Grassland sequestered 3.9 MMTCO2e in 2024. Removals from mineral soils were 1.6 MMTCO2e (see Tables 12 and 13, Figure 7). Biomass emissions and removals show a fluctuation over the time series (Table 13, Figure 7) with a shift toward removals starting in 2017. These fluctuations are indicative of changes in vegetation distribution between shrub/scrub and herbaceous vegetation classes and variability in carbon densities across ecoregions. There is an increasing proportion of area characterized by herbaceous perennial vegetation in the Blue Mountains, Columbia Plateau, and Northern Basin and Range ecoregions, where the majority of Oregon's Grassland is located. Mineral soils consistently remove carbon from the atmosphere over the time series, increasing the removal by 32%.

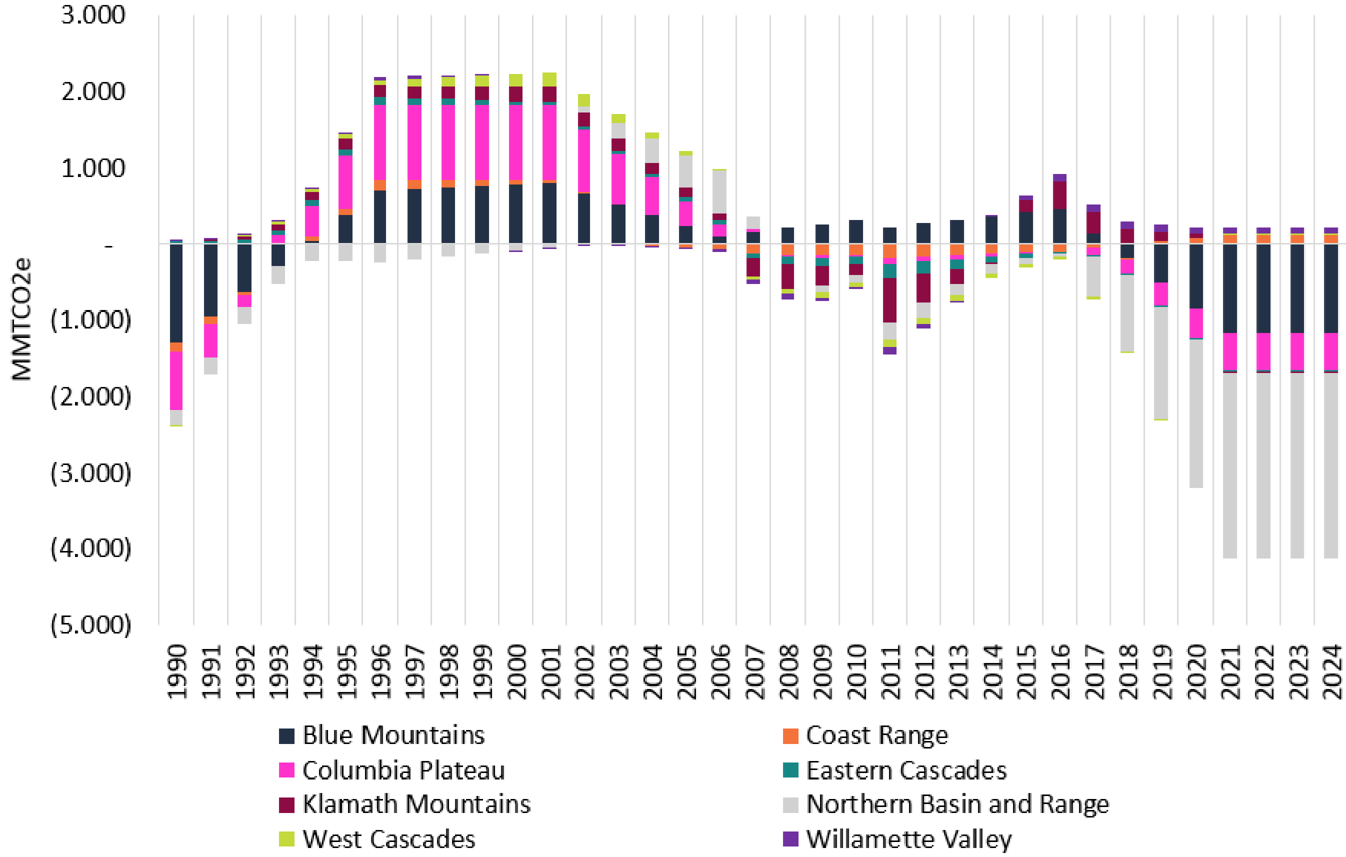
Table 12: Emissions and removals from Grassland remaining Grassland in MMTCO2e

Type	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Bio-mass	(2.35)	0.89	0.72	(0.20)	(1.13)	(2.05)	(2.98)	(3.91)	(3.91)	(3.91)	(3.91)
Mineral soils	(1.24)	(0.42)	(1.30)	(1.76)	(1.62)	(1.64)	(1.55)	(2.24)	(1.84)	(1.80)	(1.64)
Total	**(3.60)**	**0.47**	**(0.58)**	**(1.96)**	**(2.75)**	**(3.69)**	**(4.53)**	**(6.15)**	**(5.75)**	**(5.70)**	**(5.55)**

Table 13: Emissions and removals from Grassland remaining Grassland by Ecoregion in MMTCO2e

Ecoregions	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Blue Mountains	(1.286)	0.093	0.467	0.140	(0.186)	(0.513)	(0.839)	(1.166)	(1.166)	(1.166)	(1.166)
Coast Range	(0.132)	(0.065)	(0.093)	(0.050)	(0.006)	0.037	0.080	0.124	0.124	0.124	0.124
Columbia Plateau	(0.745)	0.170	0.005	(0.092)	(0.189)	(0.286)	(0.383)	(0.479)	(0.479)	(0.479)	(0.479)
Eastern Cascades	0.032	0.051	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)
Klamath Mountains	(0.006)	0.094	0.354	0.279	0.205	0.131	0.056	(0.018)	(0.018)	(0.018)	(0.018)
Northern Basin and Range	(0.209)	0.553	(0.045)	(0.521)	(0.997)	(1.473)	(1.949)	(2.426)	(2.426)	(2.426)	(2.426)
West Cascades	(0.009)	0.025	(0.034)	(0.025)	(0.015)	(0.006)	0.003	0.013	0.013	0.013	0.013
Willamette Valley	0.001	(0.028)	0.100	0.095	0.090	0.086	0.081	0.076	0.076	0.076	0.076
Grassland remaining Grassland	**(2.354)**	**0.894**	**0.724**	**(0.202)**	**(1.128)**	**(2.053)**	**(2.979)**	**(3.905)**	**(3.905)**	**(3.905)**	**(3.905)**

Figure 7: Emissions and removals from biomass on Grasslands remaining Grassland by ecoregion in MMTCO2e



Land Converted to Grassland

When land is converted to Grassland, the biomass carbon pool removes CO_2 over the time series, while soil emits CO_2 between 1990 and 2016 and removes CO_2 starting in 2017 (Table 14). Without systematic data on land management, it is challenging to elucidate the main drivers of these trends.

Table 14: Emissions and Removals from Land converted to Grassland in MMTCO2e

Type	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Biomass	-	0.096	0.578	0.420	0.420	0.420	0.420	0.420	0.420	0.420	0.420
Mineral soils	(0.09)	0.29	0.08	(0.01)	(0.03)	(0.04)	(0.04)	(0.06)	(0.09)	(0.11)	(0.10)
Total	**(0.09)**	**(0.38)**	**0.66**	**0.41**	**0.39**	**0.38**	**0.38**	**0.36**	**0.33**	**0.31**	**0.32**

Excludes forest land converted to grassland

Cropland

The Cropland category includes the GHG emissions and removals on land dominated by the cultivation of annual crops, managed pasture and hay production, and perennial crops such as orchards and vineyards. Soil organic carbon fluxes in mineral soils were estimated using a combination of methodological approaches. Modelling (Tier 3) was applied for dominant cropping systems in Oregon, representing approximately 83% of the cultivated area (Table 15). A simpler calculation approach (Tier 2) was used for various specialty crops that cannot be modeled, representing approximately 8% of cultivated area (Table 16). The detailed methodology is available in Appendix E.

Cropland remaining Cropland

Area of Cropland remaining Cropland per county using Tier 3 methodology or by crop using Tier 2 methodology is shown in Tables 15 and 16, respectively.

Table 15: Area of Cropland remaining Cropland in acres (Tier 3 approach)

County	Climate zone	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Baker	Cool Temperate Dry	125,199	119,426	116,370	116,023	115,677	115,331	114,985	114,638	114,262	113,920	113,578
Benton	Warm Temperate Moist	82,217	73,239	64,084	62,841	61,597	60,353	59,109	57,866	60,992	60,454	59,916
Clackamas	Warm Temperate Moist	114,463	99,588	85,401	84,264	83,128	81,991	80,855	79,718	78,755	77,640	76,524
Clatsop	Warm Temperate Moist	8,610	8,564	8,174	8,182	8,190	8,198	8,206	8,214	9,571	9,850	10,129
Columbia	Warm Temperate Moist	28,966	26,628	25,946	25,617	25,288	24,959	24,630	24,301	24,459	24,318	24,177
Coos	Warm Temperate Moist	28,761	28,040	28,311	27,604	26,898	26,191	25,485	24,778	26,180	26,099	26,019
Crook	Cool Temperate Dry	47,440	51,100	53,092	52,943	52,795	52,646	52,497	52,349	54,054	54,364	54,674
Curry	Warm Temperate Moist	16,533	7,508	4,991	3,993	2,995	1,996	998	-	76	-	-
Deschutes	Cool Temperate Dry	41,100	36,192	34,817	34,165	33,514	32,863	32,211	31,560	31,867	31,578	31,290
Douglas	Warm Temperate Moist	184,269	181,771	174,894	173,882	172,869	171,857	170,844	169,832	170,036	169,602	169,173
Gilliam	Warm Temperate Dry	189,403	181,488	169,753	171,893	174,034	176,175	178,315	180,456	175,620	175,478	175,336
Harney	Cool Temperate Dry	73,684	80,623	90,053	90,587	91,121	91,654	92,188	92,722	90,149	90,664	91,178
Hood River	Cool Temperate Dry	1,897	1,175	762	639	516	393	270	146	425	379	333
Hood River	Warm Temperate Moist	29	18	12	10	8	6	4	2	6	6	5
Jackson	Warm Temperate Moist	71,995	66,646	62,114	60,508	58,902	57,296	55,690	54,084	58,402	57,987	57,631
Jefferson	Cool Temperate Dry	65,358	62,433	58,400	58,104	57,807	57,511	57,214	56,917	56,566	56,348	56,131
Josephine	Warm Temperate Moist	21,459	18,157	15,671	14,823	13,976	13,129	12,281	11,434	12,804	12,533	12,263
Klamath	Cool Temperate Dry	237,640	223,306	218,169	216,051	213,933	211,815	209,696	207,578	209,699	208,826	207,953
Lake	Cool Temperate Dry	91,050	95,464	100,394	100,859	101,324	101,789	102,254	102,719	100,824	101,129	101,435
Lane	Warm Temperate Moist	140,704	138,718	134,331	133,737	133,143	132,549	131,955	131,361	132,137	131,869	131,602
Lincoln	Warm Temperate Moist	9,858	9,547	9,319	9,310	9,301	9,292	9,283	9,274	9,425	9,469	9,514

County	Climate zone	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Linn	Warm Temperate Moist	338,823	343,107	312,797	311,429	310,061	308,692	307,324	305,956	298,335	295,808	293,282
Marion	Warm Temperate Moist	234,458	214,472	173,650	175,318	176,987	178,656	180,324	181,993	172,219	170,274	168,329
Morrow	Warm Temperate Dry	329,130	315,334	310,422	314,464	318,507	322,549	326,591	330,633	312,123	311,591	311,060
Multnomah	Warm Temperate Moist	19,950	14,624	9,270	9,030	8,789	8,549	8,309	8,068	8,950	8,788	8,625
Polk	Warm Temperate Moist	233,658	228,480	155,342	162,439	169,537	176,635	183,732	190,830	160,521	157,565	154,608
Sherman	Warm Temperate Dry	213,856	211,671	206,485	207,358	208,231	209,103	209,976	210,849	212,972	214,039	215,107
Tillamook	Warm Temperate Moist	32,303	21,770	-	3,561	7,122	10,683	14,244	17,805	6,471	5,829	5,188
Umatilla	Cool Temperate Dry	261	40	35	34	34	33	33	32	0	-	-
Umatilla	Warm Temperate Dry	607,737	558,333	518,773	517,740	516,707	515,674	514,640	513,607	500,927	497,915	495,318
Union	Cool Temperate Dry	121,861	121,224	121,601	123,079	124,557	126,036	127,514	128,992	125,780	125,902	126,025
Wallowa	Cool Temperate Dry	72,327	66,678	63,508	63,396	63,285	63,173	63,062	62,950	61,337	60,993	60,650
Wasco	Cool Temperate Dry	16,770	14,747	13,239	13,477	13,714	13,951	14,188	14,425	13,155	13,069	12,983
Wasco	Warm Temperate Dry	105,845	97,657	97,304	97,340	97,376	97,412	97,448	97,484	94,783	94,626	94,469
Washington	Warm Temperate Moist	56,023	56,116	49,715	49,878	50,041	50,204	50,367	50,530	51,010	50,853	50,696
Yamhill	Warm Temperate Moist	111,573	99,497	85,715	84,605	83,495	82,386	81,276	80,166	78,646	77,754	76,865
Total acres	**All**	**4,075,209**	**3,873,377**	**3,572,914**	**3,579,186**	**3,585,457**	**3,591,729**	**3,598,000**	**3,604,272**	**3,513,538**	**3,497,523**	**3,482,065**

Table 16: Area of Cropland remaining Cropland in acres (Tier 2 approach)

Crop Areas	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Apples	11,134	9,423	8,355	8,248	8,141	8,034	7,927	7,820	7,713	7,606	7,499
Blackberries	9,039	8,825	8,691	8,678	8,664	8,651	8,637	8,624	8,611	8,597	8,584
Blueberries	-	5,515	12,701	13,419	14,138	14,857	15,575	16,294	17,012	17,731	18,449
Boysenberries	2,011	1,159	627	573	520	467	414	360	307	254	201
Broccoli	4,310	2,733	1,747	1,648	1,549	1,451	1,352	1,254	1,155	1,056	958
Carrots	-	852	1,713	1,799	1,885	1,971	2,057	2,143	2,229	2,315	2,402
Cauliflower	3,142	2,320	1,806	1,754	1,703	1,652	1,600	1,549	1,498	1,446	1,395
Cherries	25,489	23,434	22,150	22,021	21,893	21,765	21,636	21,508	21,379	21,251	21,122
Christmas Trees	9,250	7,019	5,624	5,484	5,345	5,205	5,066	4,926	4,787	4,648	4,508
Cranberries	2,239	3,984	5,075	5,184	5,293	5,402	5,511	5,620	5,729	5,838	5,947
Cucumbers	3,713	1,928	812	701	589	477	366	254	143	31	(80)

Crop Areas	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Garlic	2,560	2,042	1,719	1,687	1,654	1,622	1,589	1,557	1,525	1,492	1,460
Grapes	4,616	24,157	36,370	37,591	38,813	40,034	41,255	42,477	43,698	44,919	46,141
Hazelnuts	-	51,246	97,849	102,510	107,170	111,831	116,491	121,151	125,812	130,472	135,132
Hops	4,934	7,489	9,086	9,246	9,406	9,566	9,725	9,885	10,045	10,204	10,364
Mint	73,794	45,818	28,332	26,584	24,835	23,087	21,338	19,590	17,841	16,093	14,344
Onions	25,623	30,194	33,050	33,336	33,622	33,907	34,193	34,479	34,765	35,050	35,336
Peaches	1,549	1,232	1,033	1,013	994	974	954	934	914	895	875
Pears	30,813	27,017	24,645	24,407	24,170	23,933	23,696	23,458	23,221	22,984	22,747
Plums	4,058	2,572	1,643	1,550	1,458	1,365	1,272	1,179	1,086	993	900
Pumpkins	1,563	2,466	3,030	3,086	3,143	3,199	3,255	3,312	3,368	3,425	3,481
Raspberries	7,581	5,041	3,454	3,295	3,136	2,977	2,819	2,660	2,501	2,342	2,184
Squash	3,449	3,969	4,295	4,327	4,360	4,392	4,425	4,457	4,490	4,523	4,555
Strawberries	6,694	4,318	2,833	2,685	2,536	2,388	2,239	2,091	1,942	1,794	1,645
Watermelon	1,232	1,314	1,364	1,369	1,374	1,380	1,385	1,390	1,395	1,400	1,405
Total Acres	**238,793**	**276,067**	**318,004**	**322,198**	**326,391**	**330,585**	**334,779**	**338,972**	**343,166**	**347,360**	**351,554**

In 2024, drained organic soils were the largest emissions source for Cropland remaining Cropland at 5.6 MMTCO2e (Table 17, Figure 8). Mineral soils emitted 0.74 MMTCO2e in 2024. On the other hand, perennial woody crops removed 0.03 MMTCO2e in 2024. Net emissions decreased over the time series from 7.35 MMTCO2e MMTCO2e in 1990 to 6.31 MMTCO2e in 2024, likely due to an overall decline in cropland area.

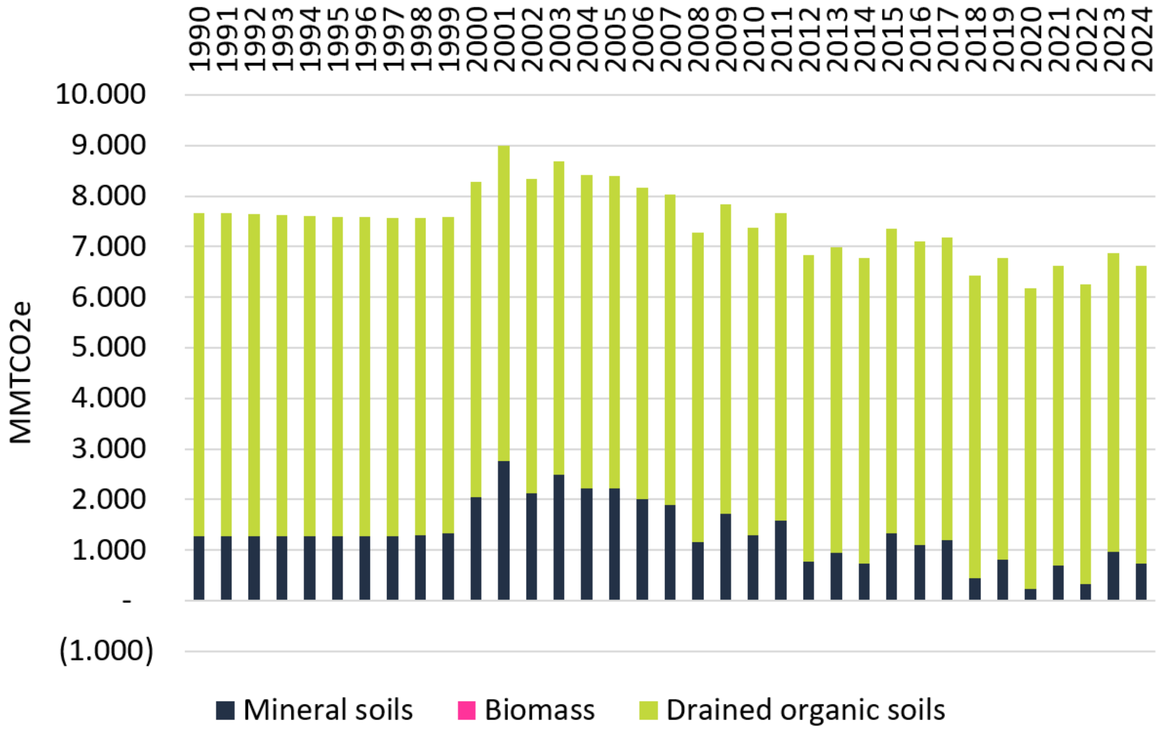
Table 17: Emissions and removals from Cropland remaining Cropland by carbon pool/GHG in MMTCO2e

Carbon pool	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Biomass (CO_2)	-	(0.008)	(0.021)	(0.023)	(0.024)	(0.025)	(0.027)	(0.028)	(0.028)	(0.028)	(0.028)
Mineral soil (CO_2)	1.276	1.999	1.096	1.190	0.441	0.805	0.226	0.689	0.335	0.967	0.736
Drained organic soils (CO_2, CH_4, N_2O)	6.393	6.157	6.010	5.996	5.981	5.966	5.951	5.937	5.922	5.907	5.893
Total	**7.669**	**8.148**	**7.085**	**7.163**	**6.398**	**6.746**	**6.151**	**6.597**	**6.229**	**6.846**	**6.600**

Drainage of organic soils is common when wetland areas are used for cultivation of crops. Organic soils are classified as those with histosols taxonomic order. Drainage of organic soils leads to aeration of the soil that accelerates decomposition rate and CO_2 emissions. Due to the depth and richness of the organic layers, carbon loss from drained organic soils can continue over long periods of time. Emissions for CO_2, N_2O, and CH_4 were estimated using the methodology in the 2013 Wetland Supplement to the IPCC guidelines using Tier 1 emission factors. Methodology is described in detail in Appendix E.

Emissions from organic soils were the largest category of emissions from croplands. While emissions decreased 8% between 1990 and 2024, there are significant opportunities to further reduce emission through strategies such as restoration of the land to wetlands, shifting from cropland to grassland, or changing to cropping systems that are more appropriate to organic soils.

Figure 8: Emissions and removals from Cropland remaining Cropland in MMTCO2e



Areas of woody crops such as orchards and vineyards are summarized in Table 17. Biomass from orchards and vineyards, which includes Oregon's large hazelnut, Christmas tree, and pear crops, is the smallest category of carbon flux for Oregon's cropland Inventory sequestering about 28,000 tonnes (0.028 MMTCO2e) in 2024 (Table 18).

Table 18: Area of Cropland with perennial biomass in acres

Cropland	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Trees	58,973	121,943	161,299	165,235	169,170	173,106	177,041	180,977	184,913	188,848	192,784
Vines	4,616	24,157	36,370	37,591	38,813	40,034	41,255	42,477	43,698	44,919	46,141
Total acres	**63,589**	**146,100**	**197,669**	**202,826**	**207,983**	**213,140**	**218,297**	**223,454**	**228,611**	**233,768**	**238,925**

Table 19: Emissions and removals from perennial biomass in MMTCO2e

Crop	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Trees	0.000	(0.006)	(0.015)	(0.016)	(0.017)	(0.017)	(0.018)	(0.019)	(0.019)	(0.019)	(0.019)
Vines	0.000	(0.003)	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)	(0.009)
Total	**-**	**(0.008)**	**(0.021)**	**(0.023)**	**(0.024)**	**(0.025)**	**(0.027)**	**(0.028)**	**(0.028)**	**(0.028)**	**(0.028)**

Total area of organic soils in Cropland remaining Cropland category is provided in Table 20. Organic soils are assumed to be drained, resulting in emissions of CO_2, CH_4, and N_2O. Emissions are summarized in Table 21.

Table 20: Area of Cropland remaining Cropland with organic soils in acres

Cropland	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Organic Soil Acres	68,904	66,367	64,782	64,623	64,465	64,306	64,148	63,989	63,830	63,672	63,513

Table 21: Emissions and removals from drained organic soils on Cropland remaining Cropland in MMTCO2e

GHG	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
CO_2	5.12	4.93	4.81	4.80	4.79	4.78	4.77	4.76	4.74	4.73	4.72
N_2O	0.92	0.89	0.87	0.86	0.86	0.86	0.86	0.86	0.85	0.85	0.85
CH_4	0.35	0.34	0.33	0.33	0.33	0.33	0.33	0.33	0.32	0.32	0.32
Total	**6.393**	**6.157**	**6.010**	**5.996**	**5.981**	**5.966**	**5.951**	**5.937**	**5.922**	**5.907**	**5.893**

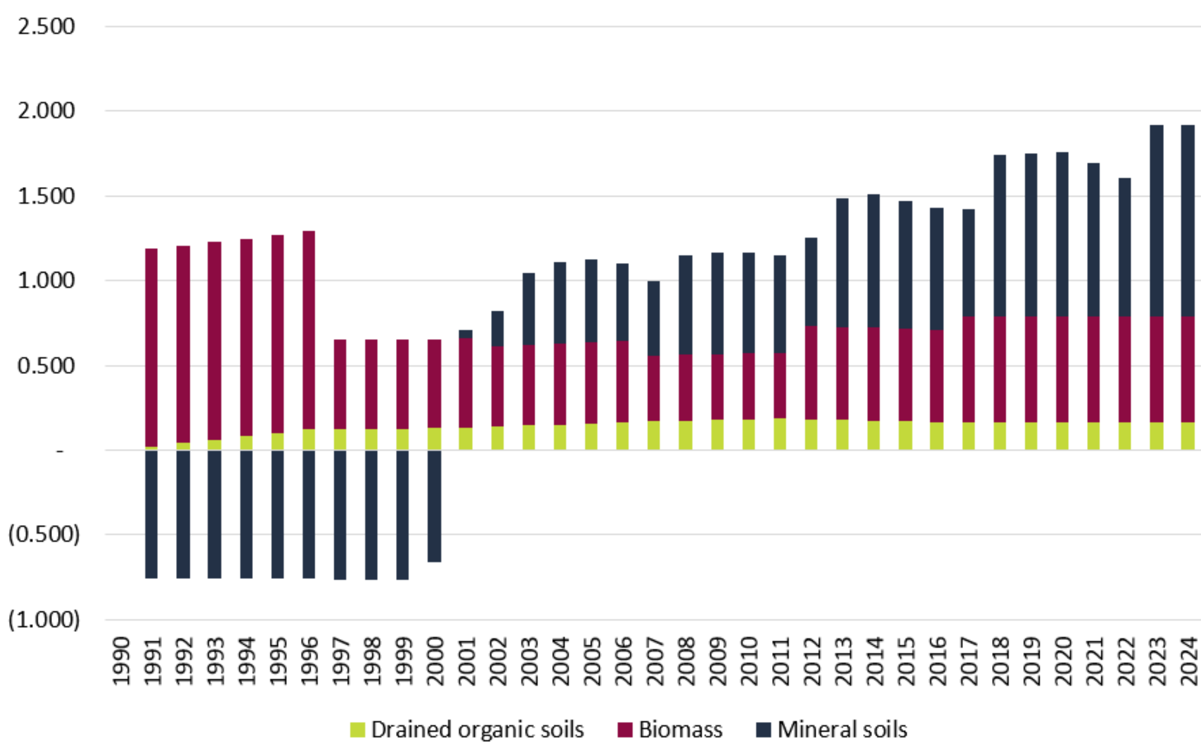
Land converted to Cropland

The most significant emissions associated with Land conversions to Cropland are due to losses of soil carbon, reaching 1.75 MMTCO2e in 2024 (Table 22, Figure 9). The amount of soil carbon loss has gradually increased over the time series, reflecting a gradual loss of soil carbon as more land is converted to Cropland. Conversion of land to Cropland also results in emissions from the loss of biomass, reaching 0.62 MMTCO2. Forest conversions represent the second largest number of acres converted, which contributes the most to the biomass emissions. Biomass emissions have decreased over time likely due to a slower rate of conversion from forest land to cropland.

Table 22: Emissions and removals for land converted to Cropland in MMTCO2e

Carbon Pool	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Mineral soil	-	0.457	0.718	0.638	0.955	0.965	0.974	0.908	0.818	1.130	1.131
Drained organic soil	-	0.166	0.163	0.163	0.164	0.164	0.164	0.164	0.164	0.164	0.164
Biomass	-	0.479	0.548	0.622	0.622	0.622	0.622	0.622	0.622	0.622	0.622
Total	**-**	**1.102**	**1.429**	**1.423**	**1.741**	**1.751**	**1.760**	**1.694**	**1.604**	**1.916**	**1.917**

Figure 9: Emissions from land converted to Cropland in MMTCO2e



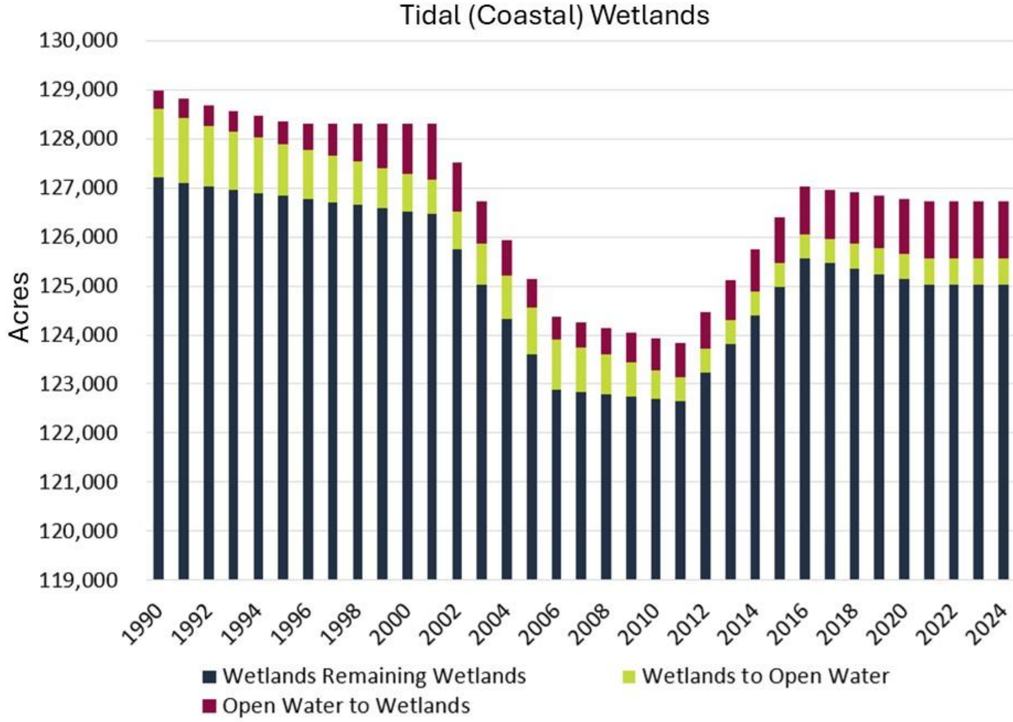
Wetland

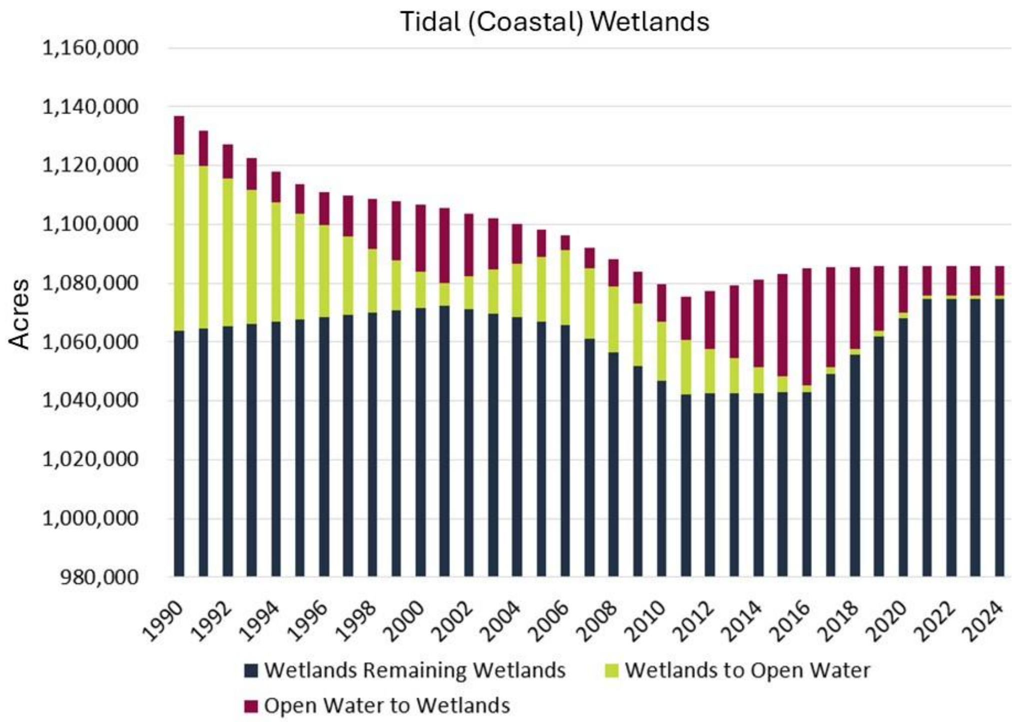
Oregon's wetlands are ecologically rich systems that provide critical habitat, water filtration, flood mitigation, and significant carbon storage. These wetland types—ranging from tidal marshes and estuaries to freshwater marshes, peatlands, and riparian complexes—are important components of the state's greenhouse gas (GHG) inventory because they can act as both sources and sinks of carbon dioxide and methane. Wetland GHG fluxes are influenced by hydrology, land use, restoration activities, and natural disturbances, making their contributions to statewide emissions highly variable across space and time. This section summarizes emissions and removals from Oregon's wetlands. The detailed quantification methodology is provided in Appendix E.

Wetland Remaining Wetland

Wetland remaining Wetland has only varied by 2% for tidal and less than 1% for non-tidal wetlands (Figure 10, Table 23).

Figure 10: Area of Wetland remaining Wetland, Open Water converted to Wetland, and Wetland converted to Open Water for Coastal and Inland wetlands in acres





Readers please note the different axes values when comparing charts in Figure 10.

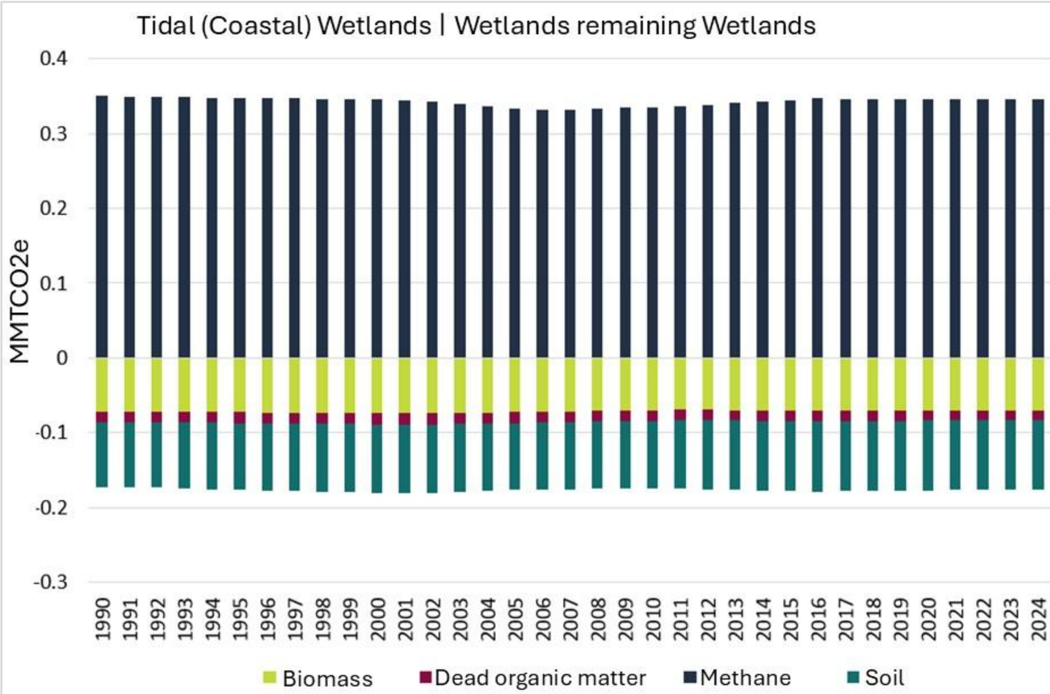
Within coastal Wetland, high methane emissions are driven by the large area of land classified as palustrine Wetland (66% of tidal wetland) (Table 23). The two new classes, "pasture wetland and cropland wetland", within the coastal zone act as net emitters of CO_2 (primarily from soils) and methane (CH_4) (Table 23). While the area of these Wetland types has decreased since the 1990s, restoration and management could turn these wetlands into net sinks of CO_2.

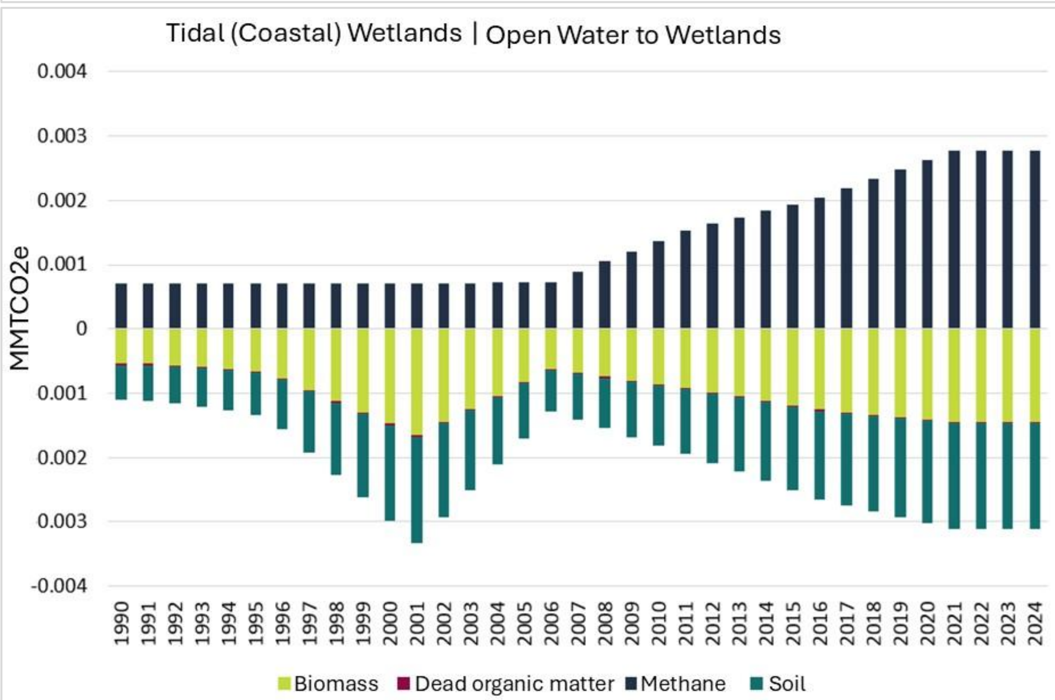
Table 23: Area of Wetland remaining Wetland for Coastal and Inland wetlands in acres

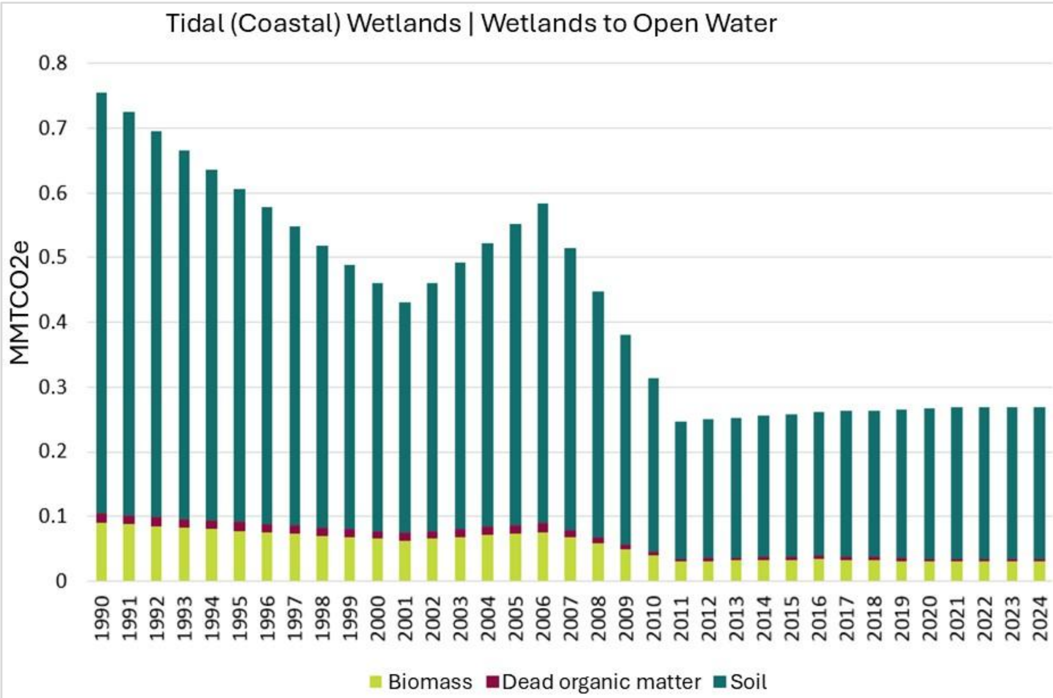
Coastal or Inland	Wetland Type	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Coastal	Cropland	2,009	1,724	1,723	1,721	1,719	1,717	1,715	1,713	1,713	1,713	1,713
Coastal	Emergent Herbaceous	16,417	16,305	16,181	16,232	16,282	16,333	16,384	16,434	16,434	16,434	16,434
Coastal	Estuarine Emergent	10,629	10,580	10,551	10,476	10,401	10,326	10,251	10,176	10,176	10,176	10,176
Coastal	Estuarine Forested	1	1	1	1	1	1	1	1	1	1	1
Coastal	Estuarine Scrub-Shrub	5	5	5	5	5	5	5	5	5	5	5
Coastal	Palustrine Emergent	50,031	46,937	48,797	48,746	48,695	48,644	48,593	48,542	48,542	48,542	48,542
Coastal	Palustrine Forested	21,648	20,741	20,146	20,130	20,114	20,098	20,082	20,065	20,065	20,065	20,065
Coastal	Palustrine Scrub-Shrub	14,941	14,452	16,020	16,022	16,024	16,026	16,028	16,031	16,031	16,031	16,031
Coastal	Pasture	9,101	8,657	8,639	8,658	8,677	8,696	8,715	8,735	8,735	8,735	8,735
Coastal	Woody	2,432	3,491	3,496	3,462	3,429	3,395	3,361	3,328	3,328	3,328	3,328
Inland	Emergent Herbaceous	821,549	793,083	764,082	768,273	772,464	776,655	780,847	785,038	785,038	785,038	785,038
Inland	Woody	242,130	272,589	278,822	280,932	283,041	285,151	287,260	289,370	289,370	289,370	289,370
Coastal	**Total**	**127,215**	**122,893**	**125,559**	**125,453**	**125,347**	**125,241**	**125,135**	**125,029**	**125,029**	**125,029**	**125,029**
Inland	**Total**	**1,063,679**	**1,065,672**	**1,042,904**	**1,049,205**	**1,055,506**	**1,061,806**	**1,068,107**	**1,074,408**	**1,074,408**	**1,074,408**	**1,074,408**

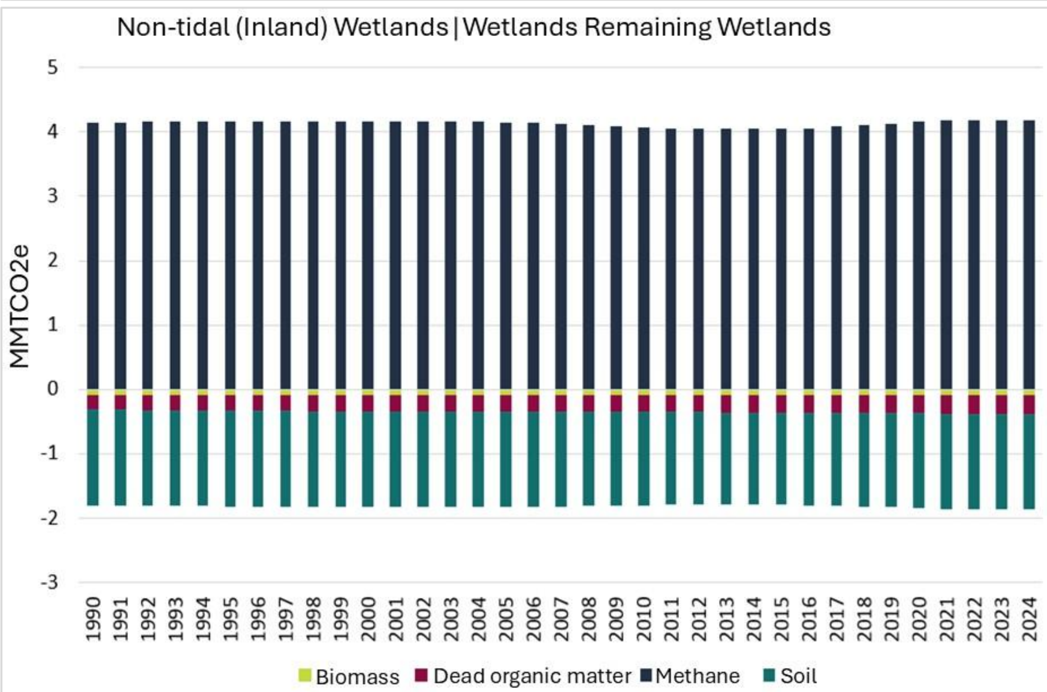
Emissions across Wetland remaining Wetland have remained relatively stable across Coastal and Inland wetlands (Figure 11, Table 24) since 1990 due to minimal change in the overall area of Wetland remaining Wetland.

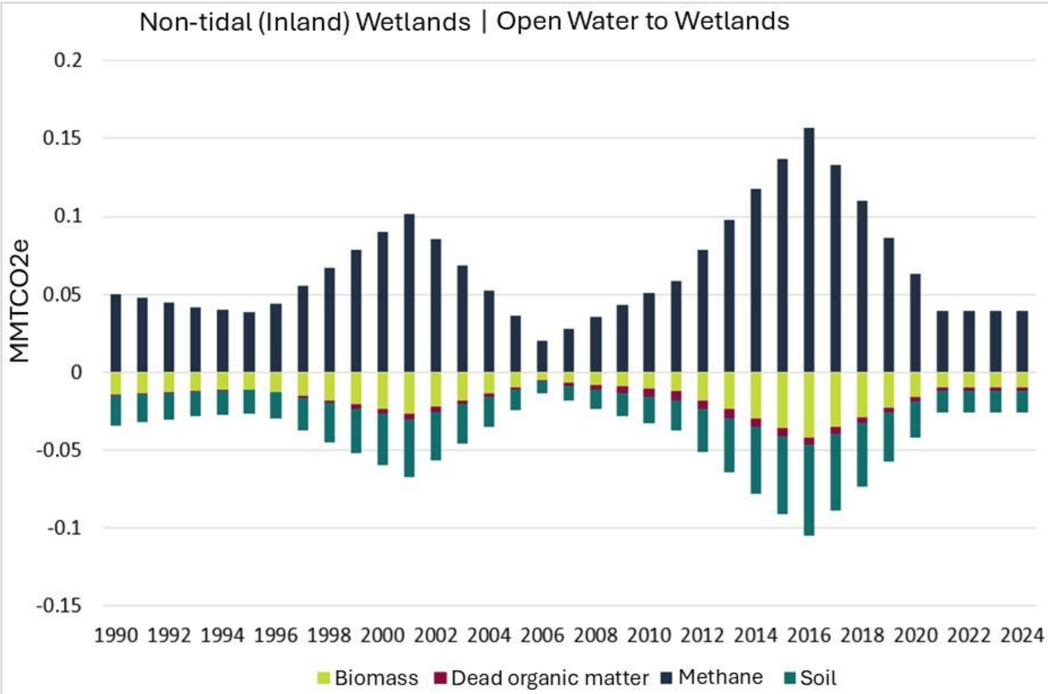
Figure 11: Emissions and removals from Wetland remaining Wetland, Open Water converted to Wetland, and Wetland converted to Open Water for all carbon pools in MMTCO2e

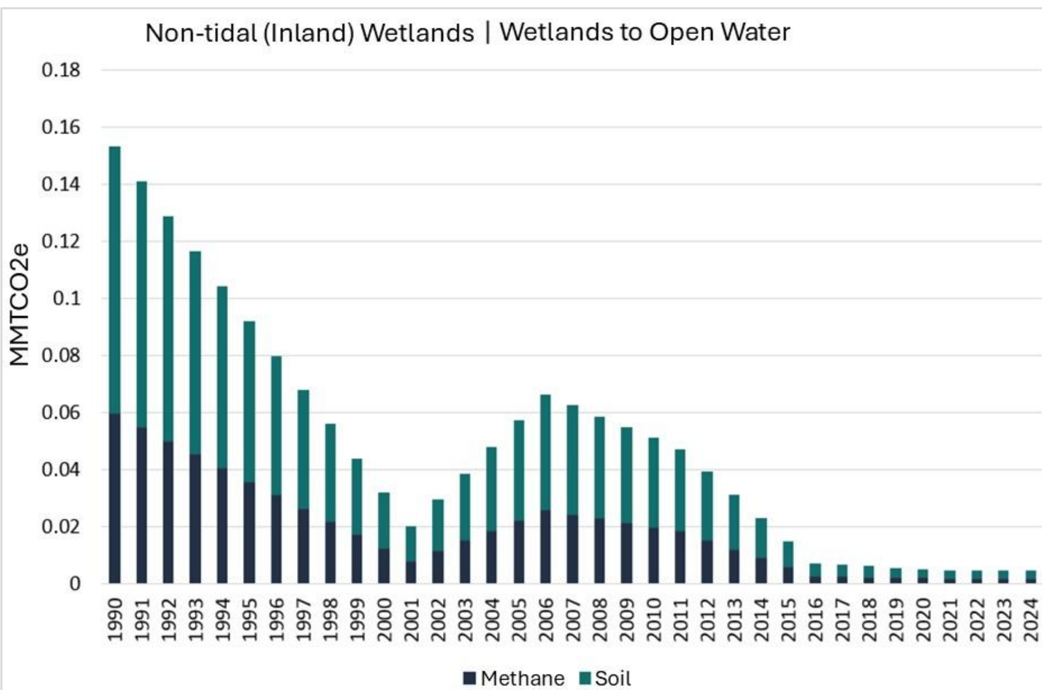





Tidal (Coastal) Wetlands | Wetlands to Open Water
MMTCO2e
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024
Biomass
Dead organic matter
Soil


Non-tidal (Inland) Wetlands | Wetlands Remaining Wetlands
MMTCO2e
5
4
3
2
1
0
-1
-2
-3
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024
Biomass
Dead organic matter
Methane
Soil


Non-tidal (Inland) Wetlands | Open Water to Wetlands
MMTCO2e
0.2
0.15
0.1
0.05
0
-0.05
-0.1
-0.15
1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022 2024
Biomass
Dead organic matter
Methane
Soil


Non-tidal (Inland) Wetlands | Wetlands to Open Water
MMTCO2e
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024
Methane
Soil

In 2024, coastal Wetland remaining Wetland emitted 0.170 MMTCO2e and inland Wetland remaining Wetland emitted 2.323 MMTCO$_2$e (Table 24). Within coastal and inland Wetlands, soils contribute to the greatest removal of CO_2 in addition to biomass and dead organic matter, but CH_4 emissions offset total removals (Table 24).

Table 24: Emissions and removals from Wetland remaining Wetland in MMTCO2e

Coastal or Inland	Carbon Pool	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Coastal	Biomass	(0.071)	(0.072)	(0.070)	(0.070)	(0.070)	(0.070)	(0.070)	(0.069)	(0.069)	(0.069)	(0.069)
Coastal	Dead Organic Matter	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Coastal	Soil	(0.086)	(0.089)	(0.094)	(0.094)	(0.094)	(0.093)	(0.093)	(0.093)	(0.093)	(0.093)	(0.093)
Coastal	Methane	0.350	0.331	0.347	0.346	0.346	0.346	0.346	0.346	0.346	0.346	0.346
Inland	Biomass	(0.083)	(0.093)	(0.095)	(0.096)	(0.097)	(0.097)	(0.098)	(0.099)	(0.099)	(0.099)	(0.099)
Inland	Dead Organic Matter	(0.234)	(0.263)	(0.269)	(0.271)	(0.273)	(0.275)	(0.277)	(0.279)	(0.279)	(0.279)	(0.279)
Inland	Soil	(1.493)	(1.475)	(1.438)	(1.447)	(1.455)	(1.464)	(1.472)	(1.481)	(1.481)	(1.481)	(1.481)
Inland	Methane	4.152	4.146	4.058	4.083	4.107	4.132	4.157	4.182	4.182	4.182	4.182
Coastal	**Total**	**0.178**	**0.155**	**0.168**	**0.169**	**0.169**	**0.169**	**0.169**	**0.170**	**0.170**	**0.170**	**0.170**
Inland	**Total**	**2.343**	**2.314**	**2.256**	**2.269**	**2.283**	**2.296**	**2.310**	**2.323**	**2.323**	**2.323**	**2.323**

The area of Open Water to Wetland conversions across tidal Wetlands has steadily increased since the 1990s (Table 25). The area of Open Water to Wetland conversions across non-tidal wetlands has fluctuated slightly with an initial increase across the 1990s-2000s, and steady decrease from to 2010s-2020s (Table 25).

Table 25: Area of Open Water converted to Wetland for coastal and inland wetlands in acres

Coastal or Inland	Wetland Type	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Coastal	Cropland	1	1	1	1	1	1	1	1	1	1	1
Coastal	Emergent Herbaceous	165	228	450	454	459	464	469	474	474	474	474
Coastal	Estuarine Emergent	31	31	38	38	38	38	38	38	38	38	38
Coastal	Palustrine Emergent	93	99	394	428	463	497	531	565	565	565	565
Coastal	Palustrine Forested	3	3	8	8	8	8	8	8	8	8	8
Coastal	Palustrine Scrub-Shrub	57	57	43	40	37	35	32	29	29	29	29
Coastal	Pasture	2	2	3	3	3	3	3	3	3	3	3
Coastal	Woody	34	30	31	31	32	32	32	32	32	32	32
Inland	Emergent Herbaceous	12,372	4,181	34,591	29,194	23,797	18,400	13,002	7,605	7,605	7,605	7,605
Inland	Woody	427	1,030	5,163	4,612	4,060	3,509	2,958	2,407	2,407	2,407	2,407
Coastal	**Total**	**385**	**451**	**968**	**1,005**	**1,041**	**1,078**	**1,115**	**1,151**	**1,151**	**1,151**	**1,151**
Inland	**Total**	**12,799**	**5,212**	**39,754**	**33,806**	**27,857**	**21,909**	**15,960**	**10,012**	**10,012**	**10,012**	**10,012**

The area of Wetland to Open Water conversions across tidal wetlands and non-tidal wetlands has decreased since 1990 (Table 26). Conversions of Open Water to Coastal Wetland in 2024 led to the emission of less than 0.268 MMTCO2e while Open Water to Inland Wetland conversions emitted 0.005 MMTCO2e.

Table 26: Area of Wetland converted to Open Water across for coastal inland wetlands in acres

Coastal or Inland	Wetland Type	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Coastal	Cropland	0	0	0	0	0	0	0	0	0	0	0
Coastal	Emergent Herbaceous	952	597	313	295	278	260	243	225	225	225	225
Coastal	Estuarine Emergent	13	13	20	31	42	53	64	76	76	76	76
Coastal	Estuarine Scrub-Shrub	0	0	0	0	0	0	0	0	0	0	0
Coastal	Palustrine Emergent	153	153	94	110	125	141	157	172	172	172	172
Coastal	Palustrine Forested	79	79	13	13	14	14	14	15	15	15	15
Coastal	Palustrine Scrub-Shrub	123	123	9	9	9	9	9	9	9	9	9
Coastal	Pasture	13	13	13	13	13	13	13	13	13	13	13
Coastal	Woody	45	36	35	32	30	27	24	21	21	21	21
Inland	Emergent Herbaceous	50,420	21,734	2,126	1,950	1,775	1,599	1,424	1,248	1,248	1,248	1,248
Inland	Woody	9,760	3,705	340	330	321	311	301	291	291	291	291
Coastal	**Total**	**1,380**	**1,016**	**497**	**504**	**511**	**517**	**524**	**531**	**531**	**531**	**531**
Inland	**Total**	**60,179**	**25,439**	**2,466**	**2,280**	**2,095**	**1,910**	**1,725**	**1,539**	**1,539**	**1,539**	**1,539**

Conversions of Open Water to coastal Wetland in 2024 led to the emission of less than 0.001 MMTCO2e (Table 28) while Open Water to inland Wetland conversions emitted 0.014 MMTCO2e (Table 27).

Table 27: Emissions and removals from Open Water converted to Wetland in MMTCO2e

Coastal or Inland	Carbon Pool	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Coastal	Biomass	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Coastal	Dead Organic Matter	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coastal	Soil	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Coastal	Methane	0.001	0.001	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003	0.003
Inland	Biomass	(0.014)	(0.005)	(0.042)	(0.035)	(0.029)	(0.022)	(0.016)	(0.010)	(0.010)	(0.010)	(0.010)
Inland	Dead Organic Matter	0.000	(0.001)	(0.005)	(0.004)	(0.004)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)

Inland	Soil	(0.019)	(0.007)	(0.058)	(0.049)	(0.040)	(0.032)	(0.023)	(0.014)	(0.014)	(0.014)	(0.014)
Inland	Methane	0.050	0.021	0.157	0.133	0.110	0.086	0.063	0.040	0.040	0.040	0.040
Coastal	**Total**	**0.000**	**(0.001)**	**(0.001)**	**(0.001)**	**(0.001)**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
Inland	**Total**	**0.016**	**0.007**	**0.052**	**0.044**	**0.037**	**0.029**	**0.021**	**0.014**	**0.014**	**0.014**	**0.014**

Table 28: Emissions and removals from Wetland converted to Open Water in MMTCO2e

Coastal or Inland	Carbon Pool	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Coastal	Biomass	0.091	0.076	0.034	0.033	0.033	0.032	0.031	0.030	0.030	0.030	0.030
Coastal	Dead Organic Matter	0.015	0.014	0.006	0.005	0.005	0.005	0.004	0.004	0.004	0.004	0.004
Coastal	Soil	0.650	0.493	0.221	0.224	0.227	0.229	0.232	0.234	0.234	0.234	0.234
Inland	Soil	0.094	0.041	0.004	0.004	0.004	0.003	0.003	0.003	0.003	0.003	0.003
Inland	Methane	0.060	0.026	0.003	0.003	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Coastal	**Total**	**0.755**	**0.583**	**0.261**	**0.263**	**0.264**	**0.266**	**0.267**	**0.268**	**0.268**	**0.268**	**0.268**
Inland	**Total**	**0.153**	**0.066**	**0.007**	**0.007**	**0.006**	**0.006**	**0.005**	**0.005**	**0.005**	**0.005**	**0.005**

Land Converted to Wetland

Majority of land converted to Wetland occurs for Inland Wetland. For both Coastal and Inland Wetlands, Cropland is the dominant category that transitions to Wetland (Tables 29 and 30, Figure 12)

Figure 12: Area of land converted to Wetland for Coastal and Inland Wetlands in acres

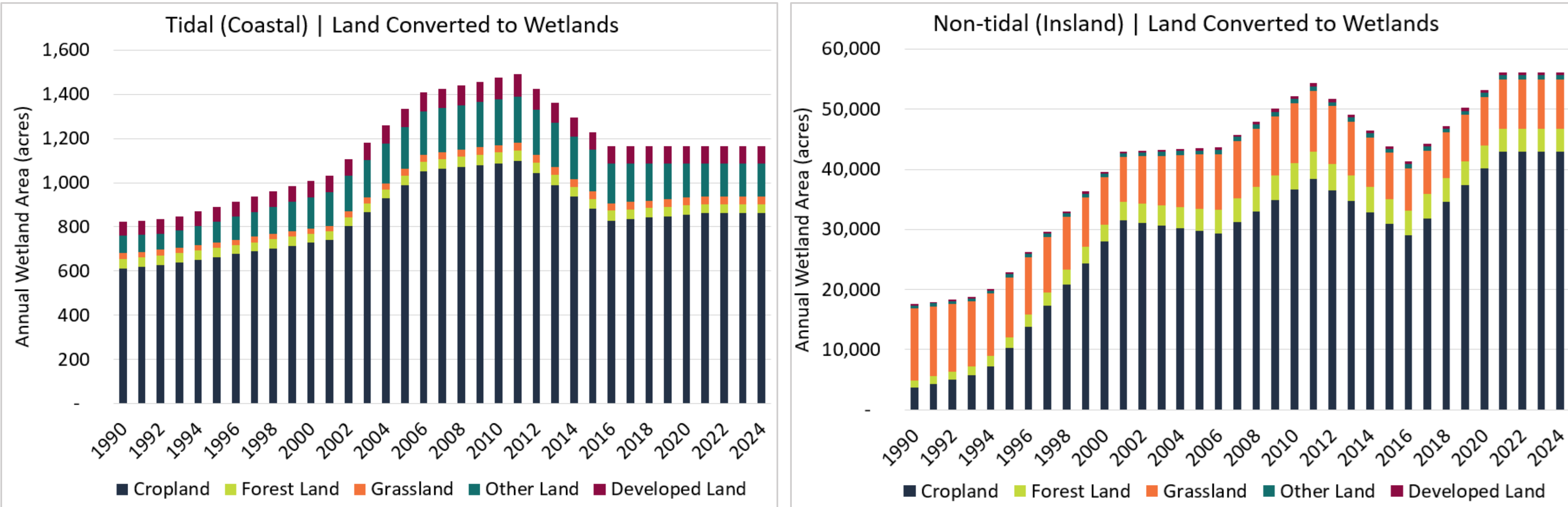


Table 29: Area of land converted to Wetland for Coastal Wetland in acres

Other Land	Wetland Type	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Cropland	Cropland	70	209	162	164	166	168	170	172	172	172	172
Cropland	Emergent Herbaceous	173	288	219	216	212	209	205	202	202	202	202
Cropland	Estuarine Emergent	0	0	0	0	0	0	0	0	0	0	0
Cropland	Palustrine Forested	51	66	30	30	31	31	32	32	32	32	32
Cropland	Palustrine Scrub-Shrub	19	22	16	16	16	15	15	14	14	14	14
Cropland	Pasture	228	332	285	303	321	339	357	375	375	375	375
Cropland	Woody	69	135	116	106	96	86	76	66	66	66	66
Forest Land	Cropland	1	1	0	0	0	0	0	0	0	0	0
Forest Land	Emergent Herbaceous	1	1	1	1	1	1	1	1	1	1	1

Forest Land	Estuarine Emergent	4	4	4	4	4	4	4	4	4	4	4
Forest Land	Palustrine Forested	16	15	18	18	18	18	18	18	18	18	18
Forest Land	Palustrine Scrub-Shrub	7	8	8	8	7	7	7	7	7	7	7
Forest Land	Pasture	1	1	1	1	1	1	1	1	1	1	1
Forest Land	Woody	14	15	11	11	10	10	10	10	10	10	10
Grassland	Cropland	1	1	1	1	1	1	1	1	1	1	1
Grassland	Emergent Herbaceous	2	4	3	3	3	3	3	3	3	3	3
Grassland	Estuarine Emergent	2	3	2	2	2	2	3	3	3	3	3
Grassland	Palustrine Forested	5	6	6	6	6	6	7	7	7	7	7
Grassland	Palustrine Scrub-Shrub	7	6	7	7	7	7	7	7	7	7	7
Grassland	Pasture	7	4	5	5	5	5	5	5	5	5	5
Grassland	Woody	3	8	11	11	11	11	11	10	10	10	10
Other Land	Cropland	19	5	5	4	4	4	3	3	3	3	3
Other Land	Emergent Herbaceous	8	142	124	120	115	110	106	101	101	101	101
Other Land	Estuarine Emergent	12	20	24	23	23	22	21	20	20	20	20
Other Land	Palustrine Forested	7	7	6	6	6	6	6	6	6	6	6
Other Land	Palustrine Scrub-Shrub	5	5	7	7	6	6	5	5	5	5	5
Other Land	Pasture	24	12	10	10	10	10	10	10	10	10	10
Other Land	Woody	3	6	5	4	4	4	4	4	4	4	4
Developed Land	Cropland	3	3	3	3	3	3	3	3	3	3	3
Developed Land	Emergent Herbaceous	24	46	35	34	34	34	34	33	33	33	33
Developed Land	Estuarine Emergent	3	3	4	4	4	4	3	3	3	3	3
Developed Land	Palustrine Forested	8	6	6	7	7	8	8	8	8	8	8

Developed Land	Palustrine Scrub-Shrub	8	6	10	9	9	9	9	9	9	9	9
Developed Land	Pasture	12	14	11	11	12	12	12	12	12	12	12
Developed Land	Woody	5	7	8	8	8	8	8	8	8	8	8
Cropland	**Total**	**611**	**1,052**	**828**	**835**	**841**	**848**	**855**	**861**	**861**	**861**	**861**
Forest Land	**Total**	**44**	**44**	**44**	**44**	**43**	**43**	**42**	**41**	**41**	**41**	**41**
Grassland	**Total**	**27**	**31**	**34**	**34**	**35**	**35**	**35**	**35**	**35**	**35**	**35**
Other Land	**Total**	**78**	**197**	**181**	**175**	**169**	**162**	**156**	**150**	**150**	**150**	**150**
Developed Land	**Total**	**63**	**85**	**76**	**76**	**76**	**76**	**76**	**77**	**77**	**77**	**77**
All	**Total**	**823**	**1,409**	**1163**	**1164**	**1164**	**1164**	**1164**	**1164**	**1164**	**1164**	**1164**

Table 30: Area of land converted to Wetland for Inland Wetlands in acres

Other Land	Wetland Type	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Cropland	Emergent Herbaceous	2,407	26,308	27,212	29,837	32,463	35,089	37,715	40,341	40,341	40,341	40,341
Cropland	Woody	1,294	3,062	1,834	1,972	2,110	2,248	2,386	2,524	2,524	2,524	2,524
Forest Land	Emergent Herbaceous	158	295	257	257	257	257	258	258	258	258	258
Forest Land	Woody	958	3,567	3,806	3,770	3,735	3,700	3,665	3,630	3,630	3,630	3,630
Grassland	Emergent Herbaceous	9,497	5,391	3,460	3,540	3,621	3,702	3,782	3,863	3,863	3,863	3,863
Grassland	Woody	2,539	3,917	3,605	3,761	3,917	4,072	4,228	4,384	4,384	4,384	4,384
Other Land	Emergent Herbaceous	507	666	618	619	620	621	622	622	622	622	622
Other Land	Woody	30	46	32	32	32	32	32	32	32	32	32
Developed Land	Emergent Herbaceous	71	192	258	267	276	285	294	302	302	302	302
Developed Land	Woody	116	200	191	197	203	209	215	221	221	221	221
Cropland	**Total**	**3,701**	**29,369**	**29,045**	**31,809**	**34,573**	**37,337**	**40,101**	**42,865**	**42,865**	**42,865**	**42,865**

Forest Land	**Total**	**1,116**	**3,862**	**4,062**	**4,027**	**3,993**	**3,958**	**3,923**	**3,888**	**3,888**	**3,888**	**3,888**
Grassland	**Total**	**12,037**	**9,308**	**7,065**	**7,301**	**7,538**	**7,774**	**8,010**	**8,247**	**8,247**	**8,247**	**8,247**
Other Land	**Total**	**537**	**711**	**650**	**651**	**652**	**652**	**653**	**654**	**654**	**654**	**654**
Developed Land	**Total**	**187**	**392**	**449**	**464**	**479**	**494**	**509**	**524**	**524**	**524**	**524**
All	**Total**	**17,578**	**43,642**	**41,271**	**44,252**	**47,235**	**50,215**	**53,196**	**56,178**	**56,178**	**56,178**	**56,178**

In 2024, land converted to Coastal Wetland emitted 0.004 MMTCO2e (Table 31) and land converted to Inland Wetland emitted 0.047 MMTCO2e (Table 32).

Table 31: Emissions and removals from land converted to Wetland for Coastal Wetland in MMTCO2e

Other Land	Carbon Pool	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Cropland	Biomass	(0.003)	(0.005)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
Cropland	Dead Organic Matter	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Cropland	Soil	0.002	0.005	0.004	0.004	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Cropland	Methane	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Forest Land	Biomass	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Forest Land	Dead Organic Matter	-	-	-	-	-	-	-	-	-	-	-
Forest Land	Soil	-	-	-	-	-	-	-	-	-	-	-
Forest Land	Methane	-	-	-	-	-	-	-	-	-	-	-

Grassland	Biomass	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Grassland	Dead Organic Matter	-	-	-	-	-	-	-	-	-	-	-
Grassland	Soil	-	-	-	-	-	-	-	-	-	-	-
Grassland	Methane	0.000	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other Land	Biomass	(0.000)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Other Land	Dead Organic Matter	-	-	-	-	-	-	-	-	-	-	-
Other Land	Soil	0.001	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Other Land	Methane	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Developed Land	Biomass	-	0.000	-	-	-	-	-	-	-	-	-
Developed Land	Dead Organic Matter	-	-	-	-	-	-	-	-	-	-	-
Developed Land	Soil	0.000	-	-	-	-	-	-	-	-	-	-
Developed Land	Methane	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Cropland	**Total**	**0.001**	**0.002**	**0.002**	**0.003**	**0.003**	**0.004**	**0.004**	**0.005**	**0.005**	**0.005**	**0.005**

Forest Land	**Total**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Grassland	**Total**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Other Land	**Total**	**0.000**	**(0.001)**	**(0.001)**	**(0.001)**	**(0.001)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**	**(0.000)**
Developed Land	**Total**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**
All	**Total**	**0.001**	**0.002**	**0.001**	**0.002**	**0.002**	**0.003**	**0.003**	**0.004**	**0.004**	**0.004**	**0.004**

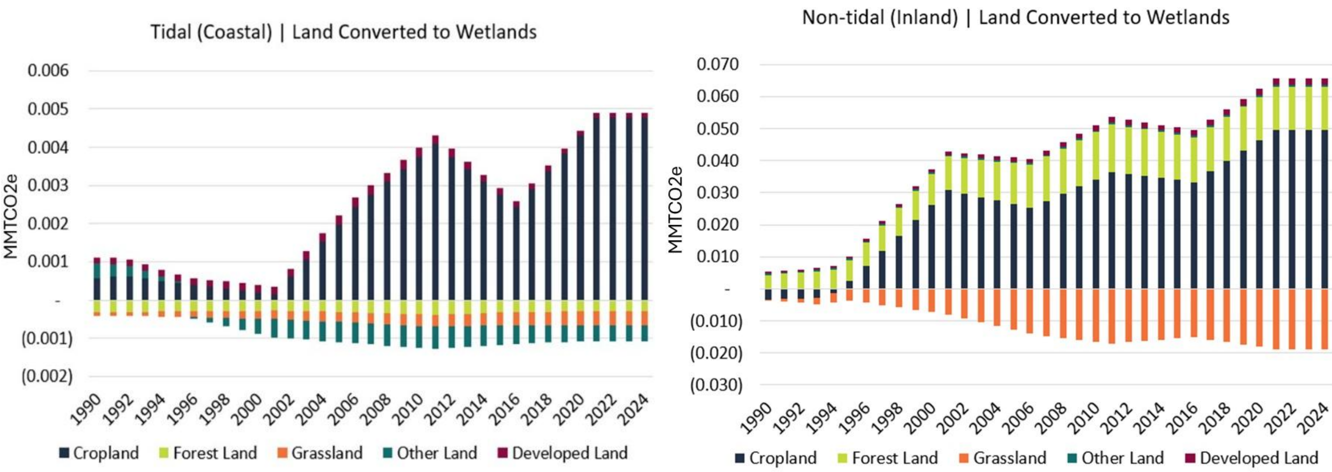
Table 32: Emissions and removals from land converted to Wetland for Inland Wetland in MMTCO2e

Other Land	Carbon Pool	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Cropland	Biomass	(0.012)	(0.044)	(0.036)	(0.039)	(0.042)	(0.045)	(0.048)	(0.051)	(0.051)	(0.051)	(0.051)
Cropland	Dead Organic Matter	(0.001)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Cropland	Soil	(0.005)	(0.043)	(0.043)	(0.048)	(0.052)	(0.056)	(0.061)	(0.065)	(0.065)	(0.065)	(0.065)
Cropland	Methane	0.014	0.115	0.114	0.125	0.136	0.147	0.157	0.168	0.168	0.168	0.168
Forest Land	Biomass	0.002	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
Forest Land	Dead Organic Matter	(0.001)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Forest Land	Soil	(0.001)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Forest Land	Methane	0.004	0.015	0.016	0.016	0.016	0.016	0.016	0.015	0.015	0.015	0.015
Grassland	Biomass	(0.028)	(0.035)	(0.030)	(0.032)	(0.033)	(0.034)	(0.035)	(0.037)	(0.037)	(0.037)	(0.037)
Grassland	Dead Organic Matter	(0.002)	(0.004)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Grassland	Soil	(0.017)	(0.012)	(0.009)	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Grassland	Methane	0.047	0.036	0.028	0.029	0.030	0.031	0.031	0.032	0.032	0.032	0.032
Other Land	Biomass	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)

Other Land	Dead Organic Matter	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other Land	Soil	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Other Land	Methane	0.002	0.003	0.002	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Developed Land	Biomass	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Developed Land	Dead Organic Matter	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Developed Land	Soil	0.000	0.000	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Developed Land	Methane	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Cropland	**Total**	**(0.003)**	**0.025**	**0.033**	**0.037**	**0.040**	**0.043**	**0.046**	**0.050**	**0.050**	**0.050**	**0.050**
Forest Land	**Total**	**0.004**	**0.013**	**0.014**	**0.014**	**0.014**	**0.014**	**0.014**	**0.013**	**0.013**	**0.013**	**0.013**
Grassland	**Total**	**0.000**	**(0.014)**	**(0.015)**	**(0.016)**	**(0.017)**	**(0.017)**	**(0.018)**	**(0.019)**	**(0.019)**	**(0.019)**	**(0.019)**
Other Land	**Total**	**0.000**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.001**
Developed Land	**Total**	**0.000**	**0.001**	**0.002**	**0.002**	**0.002**	**0.002**	**0.002**	**0.002**	**0.002**	**0.002**	**0.002**
All	**Total**	**0.002**	**0.026**	**0.034**	**0.037**	**0.039**	**0.042**	**0.044**	**0.047**	**0.047**	**0.047**	**0.047**

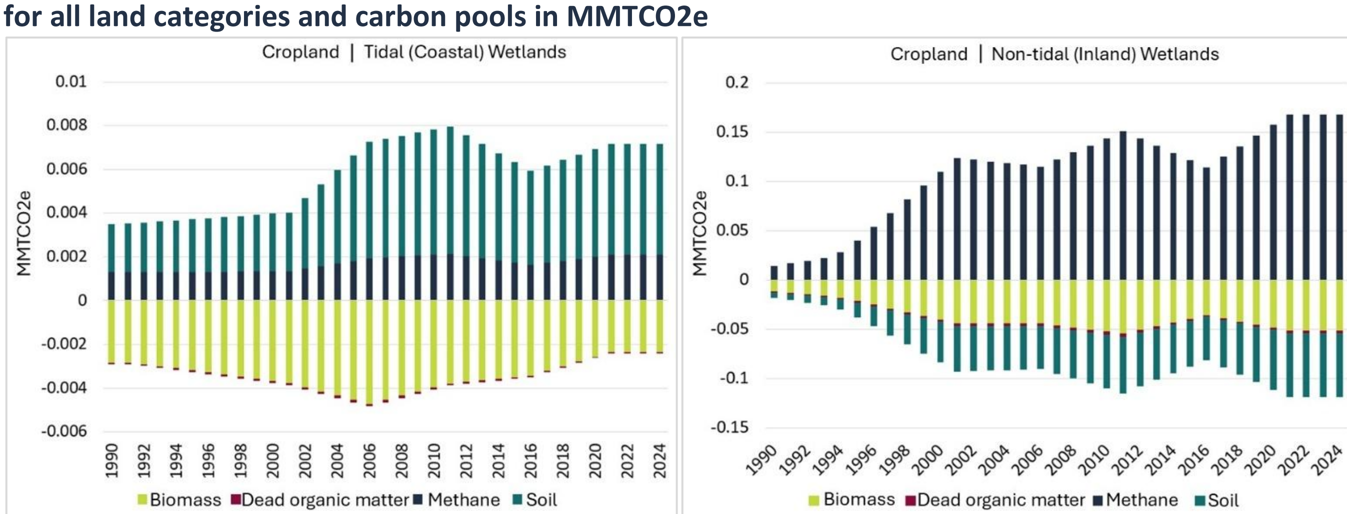
The majority of emissions from land converted to Coastal Wetland are driven by Cropland to Pasture and Cropland Wetland conversions (Table 32, Figure 13), which may correspond to historically tidally-disconnected coastal wetland areas in Oregon that were previously used for agriculture and are now seasonally wetted.

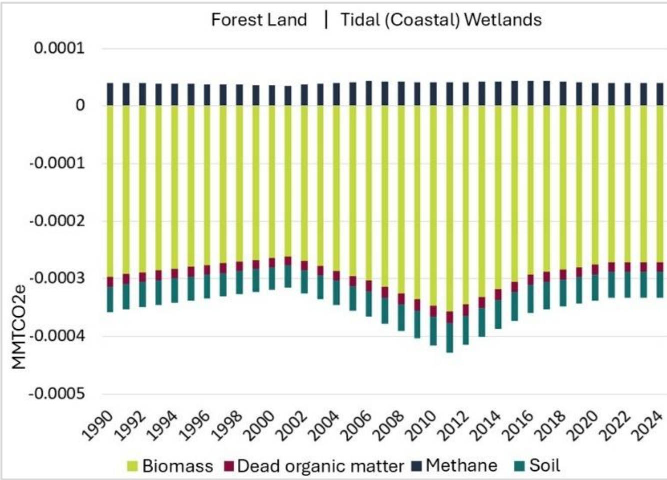
Figure 13: Emissions and removals from land converted to Wetland for Coastal and Inland Wetlands for all land categories in MMTCO2e

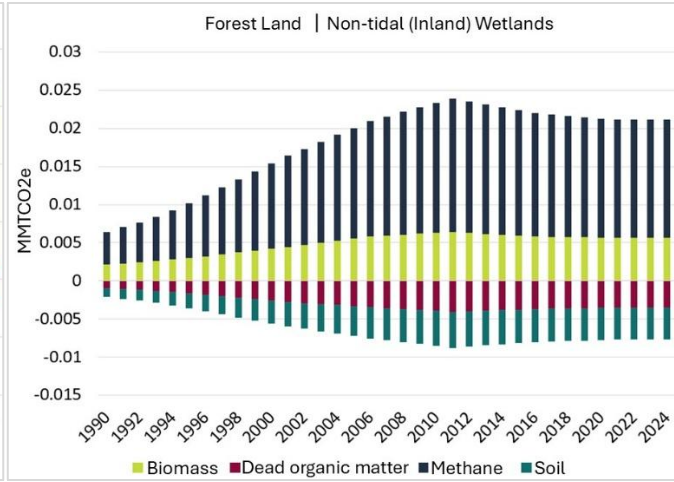


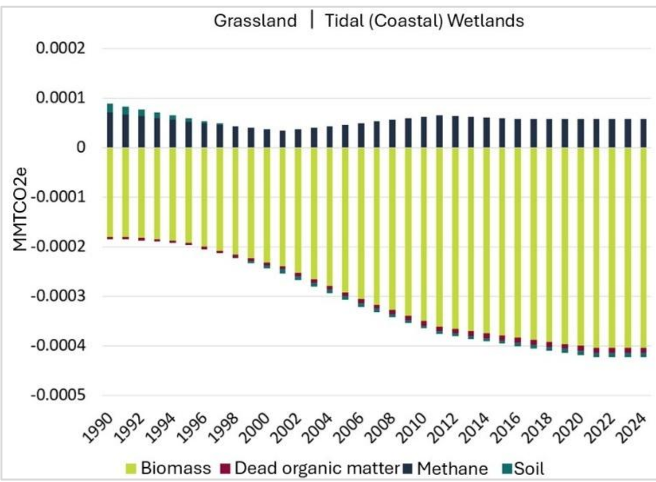
Forest Land, Grassland, and Other Land conversions resulted in CO_2 removals (Figure 13) driven by biomass carbon removals (Figure 14). The majority of emissions from land converted to non-Inland Wetland are driven by Cropland to Emergent Herbaceous Wetland (Table 32, Figure 13). Grassland conversions to Wetland resulted in CO_2 (Figure 13) driven by biomass, dead organic matter, and soil carbon removals offsetting CH_4 emissions (Figure 14).

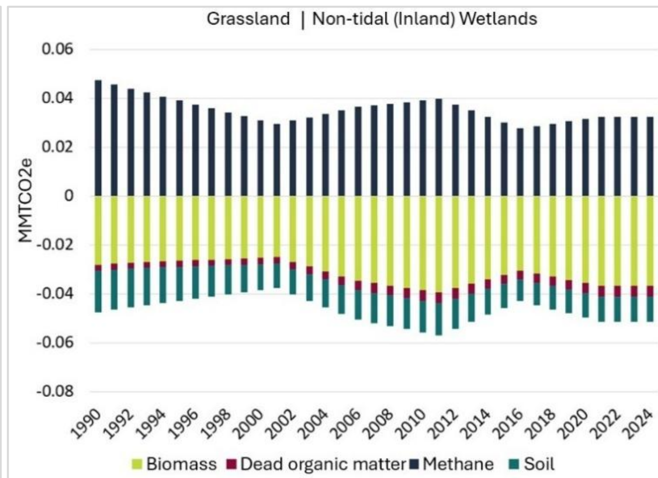
Figure 14: Emissions and removals from land converted to Wetland for Coastal and Inland Wetlands for all land categories and carbon pools in MMTCO2e

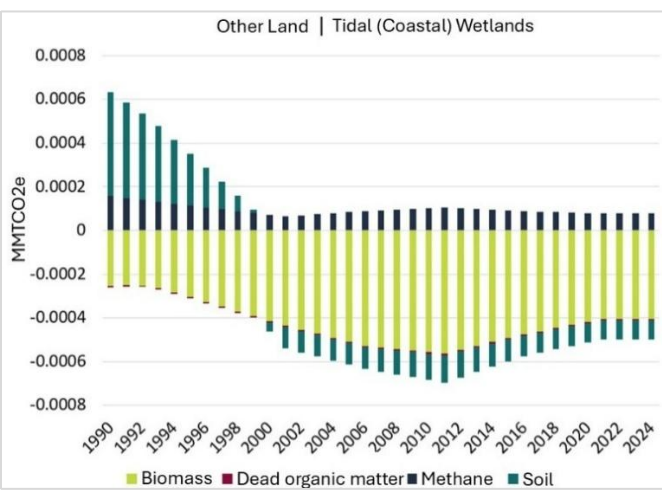


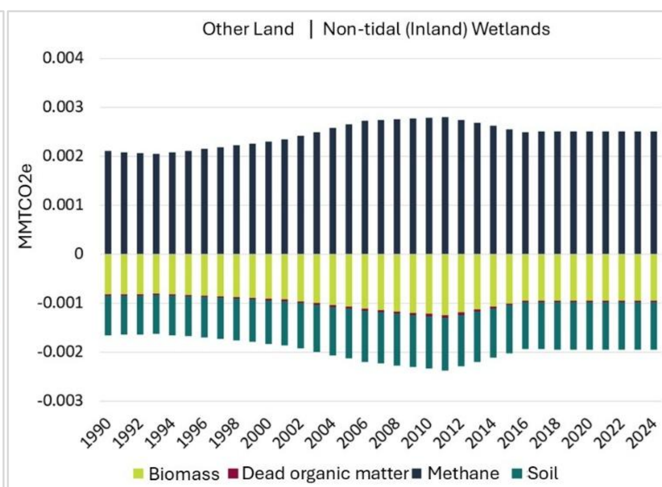

Forest Land | Tidal (Coastal) Wetlands
MMTCO2e
Biomass
Dead organic matter
Methane
Soil

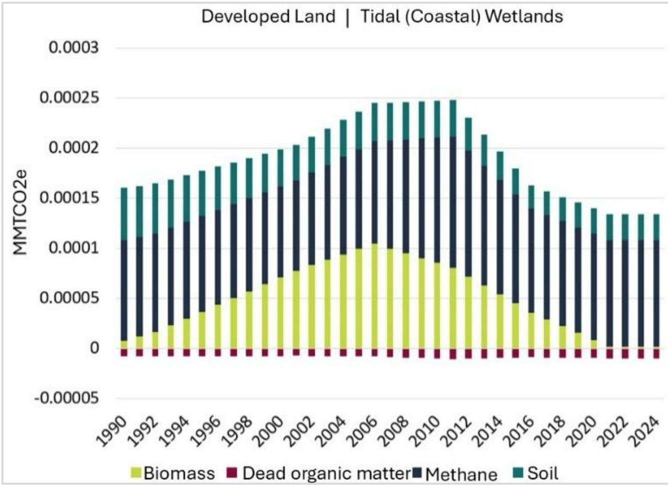

Forest Land | Non-tidal (Inland) Wetlands
MMTCO2e
Biomass
Dead organic matter
Methane
Soil

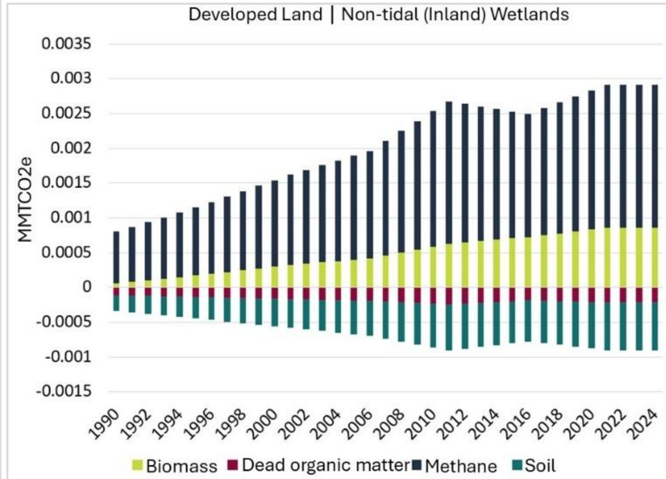

Grassland | Tidal (Coastal) Wetlands
MMTCO2e
Biomass
Dead organic matter
Methane
Soil


Grassland | Non-tidal (Inland) Wetlands
MMTCO2e
Biomass
Dead organic matter
Methane
Soil


Other Land | Tidal (Coastal) Wetlands
MMTCO2e
Biomass
Dead organic matter
Methane
Soil


Other Land | Non-tidal (Inland) Wetlands
MMTCO2e
Biomass
Dead organic matter
Methane
Soil



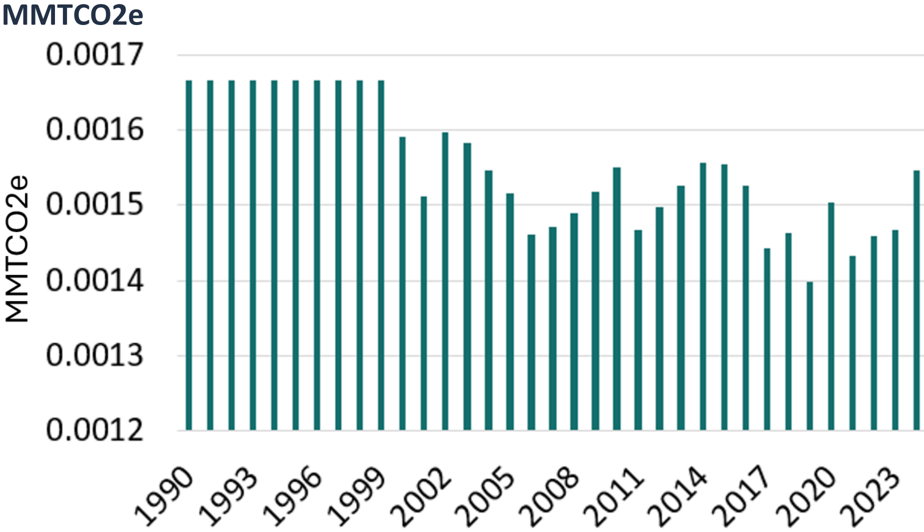


Nitrous Oxide Emissions from Hatcheries

Aquaculture results in nitrous oxide (N_2O) emissions within managed coastal wetlands, driven by nutrient inputs to fish ponds. These emissions arise directly from wetland systems—such as tidal marshes, and seagrass meadows—when they are used for aquaculture or fish cages. As such, emissions associated with aquaculture are included in the Wetland category of the Inventory. For existing aquaculture activities, N_2O can be estimated using fish production data and basic nitrification–denitrification pathways. [1]

In 2024, N_2O emissions from hatcheries production resulted in the emission of 0.002 MMTCO2e. Across the years of analysis (1990-2024) emissions of N_2O have remained relatively stable between 0.001 and 0.002 MMTCO2e. Overall, emissions of N_2O make up less than 0.1% of emissions from Wetland (Table 33, Figure 15).

Figure 15: Annual emissions of nitrous oxide (N_2O) from hatcheries (aquaculture) on Wetland in MMTCO2e



[1] Aquaculture in wetlands is treated as a **direct** N_2O source within the wetland itself, rather than an **indirect** emission resulting from upstream terrestrial activities, ensuring it is accounted for only once in national inventories.

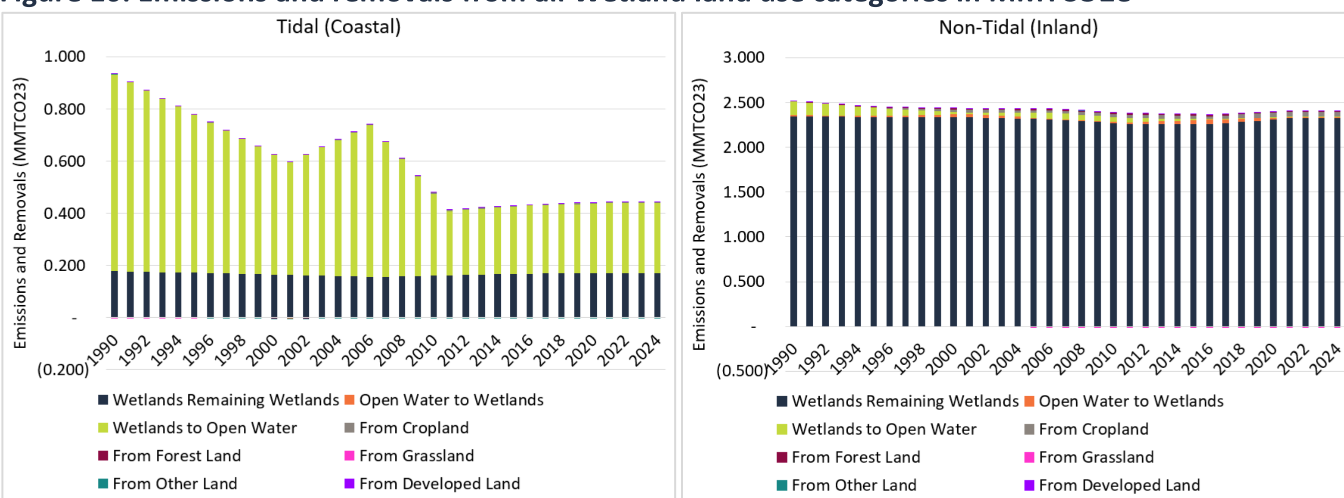
Table 33: Annual emissions of N_2O from hatcheries (aquaculture) on Wetland in MMTCO2e

Emission Source	GHG	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Aquaculture	Nitrous Oxide (N_2O)	0.002	0.001	0.002	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.002

Trends Across All Wetlands

Across all Wetland types and land-use categories (Wetland remaining Wetland, Open Water to Wetland, Wetland to Open Water, and Land converted to Wetland), CO_2 emissions and removals dominate the net GHG flux, while CH_4 partially or fully offsets carbon dioxide removals. Nitrous oxide emissions from aquaculture are minimal, contributing less than 0.1% of total Wetland emissions. The largest CO_2 emission source originates from Wetland remaining Wetland and Wetland to Open Water conversions (Table 34, Figure 16). These two categories dominate the GHG balance, reflecting both ongoing carbon cycling within existing wetlands and carbon losses associated with wetland degradation and conversion.

Figure 16: Emissions and removals from all Wetland land use categories in MMTCO2e



In Coastal Wetland, total emissions have declined substantially since 1990, from 0.93 MMTCO2e to approximately 0.44 MMTCO2e in 2024 and have remained relatively stable over the past decade (Table 34). This reduction corresponds with a marked decrease in Wetland to Open Water conversions, suggesting that large-scale historical habitat loss has slowed and that restoration and protection efforts may be stabilizing carbon dynamics along the coast. Among Costal Wetland categories, Wetland to Open Water transitions continue to generate the largest CO_2 emissions, primarily due to the loss of biomass, dead organic matter, and soil carbon stocks. However, emerging research indicates that not all carbon is immediately remineralized following conversion; rather, oxidation occurs over varying timescales with both fast and slow biogeochemical components. Incorporating these temporal dynamics into IPCC methodologies could improve the accuracy of emission estimates. The current methodology used to estimate CH_4 emissions relies on C-CAP classifications, which distinguish wetlands as either palustrine (CH_4 producing) or estuarine (not CH_4 producing) but are not based on direct measurements of salinity or elevation. In Coastal Wetland, CH_4 emissions are strongly regulated by hydrologic position (e.g., elevation and tidal inundation frequency) and salinity gradients. Accounting for these environmental controls could better quantify methane emissions and potentially turn tidal wetlands into net carbon sinks under present conditions.

Inland Wetland is the largest contributor to total Wetland emissions in Oregon, with annual CO_2 emissions around 2.3 MMTCO2e and little change since 1990 (Table 34). This stability reflects minimal variation in Wetland extent (<1%) and relatively consistent carbon fluxes from vegetation and soils. Emissions are dominated by Wetland remaining Wetland, with smaller contributions from Wetland to Open Water and land converted to Wetland categories. There are, however, uncertainties in the estimated area and emissions of inland wetlands. Much of the data are drawn from nationallevel datasets, rather than direct measurements in Oregon, making it difficult to accurately assess the Wetland's extent and fluxes representation at the state scale. Despite these uncertainties, the environmental setting of Inland Wetland creates biogeochemical conditions conducive to CH_4 production, which, together with their large areal extent, explains the high emissions in CO_2e terms compared to Coastal Wetland.

Table 34: Emissions and removals for all Wetland subcategories in MMTCO2e

Land Use Category	Tidal Status	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Wetland remaining Wetland	Coastal	0.178	0.155	0.168	0.169	0.169	0.169	0.169	0.170	0.170	0.170	0.170
Wetland remaining Wetland	Inland	2.343	2.314	2.256	2.269	2.283	2.296	2.310	2.323	2.323	2.323	2.323
Open Water to Wetland	Coastal	0.000	(0.001)	(0.001)	(0.001)	(0.001)	0.000	0.000	0.000	0.000	0.000	0.000
Open Water to Wetland	Inland	0.016	0.007	0.052	0.044	0.037	0.029	0.021	0.014	0.014	0.014	0.014
Wetland to Open Water	Coastal	0.755	0.583	0.261	0.263	0.264	0.266	0.267	0.268	0.268	0.268	0.268
Wetland to Open Water	Inland	0.153	0.066	0.007	0.007	0.006	0.006	0.005	0.005	0.005	0.005	0.005
Cropland converted to Wetland	Coastal	0.001	0.002	0.002	0.003	0.003	0.004	0.004	0.005	0.005	0.005	0.005
Cropland converted to Wetland	Inland	(0.003)	0.025	0.033	0.037	0.040	0.043	0.046	0.050	0.050	0.050	0.050
Forest Land converted to Wetlands	Coastal	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Forest Land converted to Wetland	Inland	0.004	0.013	0.014	0.014	0.014	0.014	0.014	0.013	0.013	0.013	0.013
Grassland converted to Wetland	Coastal	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Grassland converted to Wetland	Inland	0.000	(0.014)	(0.015)	(0.016)	(0.017)	(0.017)	(0.018)	(0.019)	(0.019)	(0.019)	(0.019)
Other Land converted to Wetland	Coastal	0.000	(0.001)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other Land converted to Wetland	Inland	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Developed Land converted to Wetland	Coastal	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Developed Land converted to Wetland	Inland	0.000	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Aquaculture	All	0.002	0.001	0.002	0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.002
All	**Coastal**	**0.933**	**0.739**	**0.430**	**0.433**	**0.435**	**0.437**	**0.439**	**0.442**	**0.442**	**0.442**	**0.442**
All	**Inland**	**2.514**	**2.414**	**2.349**	**2.357**	**2.365**	**2.373**	**2.381**	**2.388**	**2.388**	**2.388**	**2.388**
All	**Both**	**3.449**	**3.155**	**2.781**	**2.791**	**2.801**	**2.811**	**2.821**	**2.831**	**2.831**	**2.831**	**2.832**

Developed Land

The amount of Developed Land increased in Oregon from 1.86M acres in 1990 to a total of 2.25M acres in 2021. This is the sum of Developed Land remaining Developed Land (1.95M acres) and land that was converted to Developed Land, 0.3M acres, from other land categories (Table 35). Over the time series, Forest Land, Grassland, and Cropland were converted to Developed Land in roughly equal amounts, with approximately 10,000 acres of each being developed every 5 years. Conversion of Forest Land appears to have slowed down, from 17,000 acres in 1996 to approximately 7,000 acres, while conversion of Grassland and Cropland continues at a similar rate since the year 2000. The majority of Developed Land is classified as either low-intensity development or open space. These categories represent land that has a mixture of constructed materials, but mostly vegetation in the form of lawn grasses (less than 20% of total cover) and land with a mixture of constructed materials and vegetation with impervious surfaces (20% to 49% of total cover), commonly including single-family housing units. These two subcategories of Developed Land are also the ones that expand the most due to land conversion and loss of natural landscapes and cultivated land.

Table 35: Area of Developed Land by development intensity class in acres

Land Type	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Developed land remaining Developed Land (total)	**1,860,802**	**1,842,712**	**1,898,766**	**1,907,947**	**1,917,128**	**1,926,309**	**1,935,490**	**1,944,671**	**1,944,671**	**1,944,671**	**1,944,671**
High Intensity	44,303	53,921	60,043	60,915	61,788	62,661	63,534	64,407	64,407	64,407	64,407
Low Intensity	661,741	685,681	726,339	729,297	732,256	735,215	738,173	741,132	741,132	741,132	741,132
Medium Intensity	192,695	240,667	259,590	261,544	263,499	265,453	267,408	269,362	269,362	269,362	269,362
Open Space	962,062	862,443	852,794	856,189	859,585	862,980	866,375	869,770	869,770	869,770	869,770
Cropland converted to Developed Land (total)	**-**	**109,352**	**118,573**	**119,086**	**119,599**	**120,113**	**120,626**	**121,139**	**121,139**	**121,139**	**121,139**
High Intensity	-	3,730	3,543	3,440	3,337	3,234	3,131	3,028	3,028	3,028	3,028
Low Intensity	-	38,103	41,452	41,066	40,680	40,295	39,909	39,523	39,523	39,523	39,523
Medium Intensity	-	22,459	20,268	19,907	19,546	19,186	18,825	18,464	18,464	18,464	18,464
Open Space	-	45,060	53,310	54,673	56,036	57,398	58,761	60,124	60,124	60,124	60,124
Forest land converted to Developed Land (total)	**-**	**95,935**	**85,294**	**83,160**	**81,027**	**78,894**	**76,761**	**74,627**	**74,627**	**74,627**	**74,627**

Developed, High Intensity	-	87	68	66	64	62	61	59	59	59	59
Developed, Low Intensity	-	20,500	23,638	23,276	22,915	22,553	22,192	21,830	21,830	21,830	21,830
Developed, Medium Intensity	-	2,968	2,558	2,477	2,395	2,313	2,232	2,150	2,150	2,150	2,150
Developed, Open Space	-	72,379	59,029	57,341	55,653	53,965	52,277	50,589	50,589	50,589	50,589
Grassland converted to Developed Land (total)	**-**	**70,354**	**93,686**	**95,170**	**96,653**	**98,137**	**99,620**	**101,104**	**101,104**	**101,104**	**101,104**
High Intensity	-	685	737	724	710	696	683	669	669	669	669
Low Intensity	-	17,646	22,181	22,111	22,041	21,972	21,902	21,832	21,832	21,832	21,832
Medium Intensity	-	6,958	7,224	7,122	7,020	6,919	6,817	6,715	6,715	6,715	6,715
Open Space	-	45,065	63,544	65,213	66,881	68,550	70,219	71,888	71,888	71,888	71,888
Wetland converted to Developed Land (total)	**-**	**4,521**	**4,082**	**3,994**	**3,907**	**3,820**	**3,733**	**3,646**	**3,646**	**3,646**	**3,646**
Developed, High Intensity	-	105	151	152	153	154	156	157	157	157	157
Developed, Low Intensity	-	1,728	1,691	1,657	1,624	1,591	1,557	1,524	1,524	1,524	1,524

Developed, Medium Intensity	-	1,094	1,188	1,152	1,115	1,079	1,042	1,006	1,006	1,006	1,006
Developed, Open Space	-	1,595	1,052	1,034	1,015	996	978	959	959	959	959
Other Land converted to Developed Land (total)	**-**	**1,404**	**923**	**870**	**817**	**765**	**712**	**659**	**659**	**659**	**659**
Developed, High Intensity	-	96	83	82	81	80	79	79	79	79	79
Developed, Low Intensity	-	441	259	245	230	215	200	186	186	186	186
Developed, Medium Intensity	-	523	395	379	363	347	331	316	316	316	316
Developed, Open Space	-	344	187	165	144	122	101	79	79	79	79

Developed Land Remaining Developed Land

Developed Land is the area where human populations and activities are concentrated. For the purposes of the Inventory and estimating carbon stock fluxes, these areas were disaggregated by development intensity according to NLCD subclasses as open space, low intensity, medium intensity, and high intensity. Estimates in this section include net carbon flux from trees on Developed Land remaining Developed Land and all land converted to Developed Land, as there are no data available to estimate carbon flux on converted lands separately. GHG emissions from biomass loss as a result of conversion are summarized in the land converted to Developed Land section. To quantify the carbon stored in urban trees, the methodology utilized by the National GHG Inventory was adopted. It is described in detail in Appendix E. The methodology requires analysis per unit area of tree cover, rather than per unit of total land area (as is done for Forest Land). Area, percentages of tree canopy cover, and sequestration rate for urban trees are used (Table 36, Figure 16) to estimate carbon sequestration by urban trees.

Table 36: Percentage tree canopy cover in Oregon averaged by NLCD development intensity subclass and adjusted

Percentage Tree Cover	1990	1996	2001	2006	2011	2016	2021
High intensity	0%	0%	1%	1%	1%	1%	1%
Low intensity	17%	19%	20%	20%	21%	21%	20%
Medium intensity	13%	14%	14%	14%	14%	15%	14%
Open space	34%	37%	38%	41%	42%	42%	38%

Urban trees in Oregon are estimated to have an annual net sequestration of 1.33 MMTCO2e in 1990 which increased to 1.74 MMTCO2e in 2024. Dominant factors affecting carbon flux trends for urban trees are changes in the amount of area and tree cover. The total area increased from about 1.86 to 1.94 million acres between 1990 and 2021, and net changes in tree cover increased between 1990 and 2016, with a slight decline by 2021 as tree canopy cover declined (Table 37, Figure 17).

Figure 17: Urban tree C accumulation in MMTCO2e

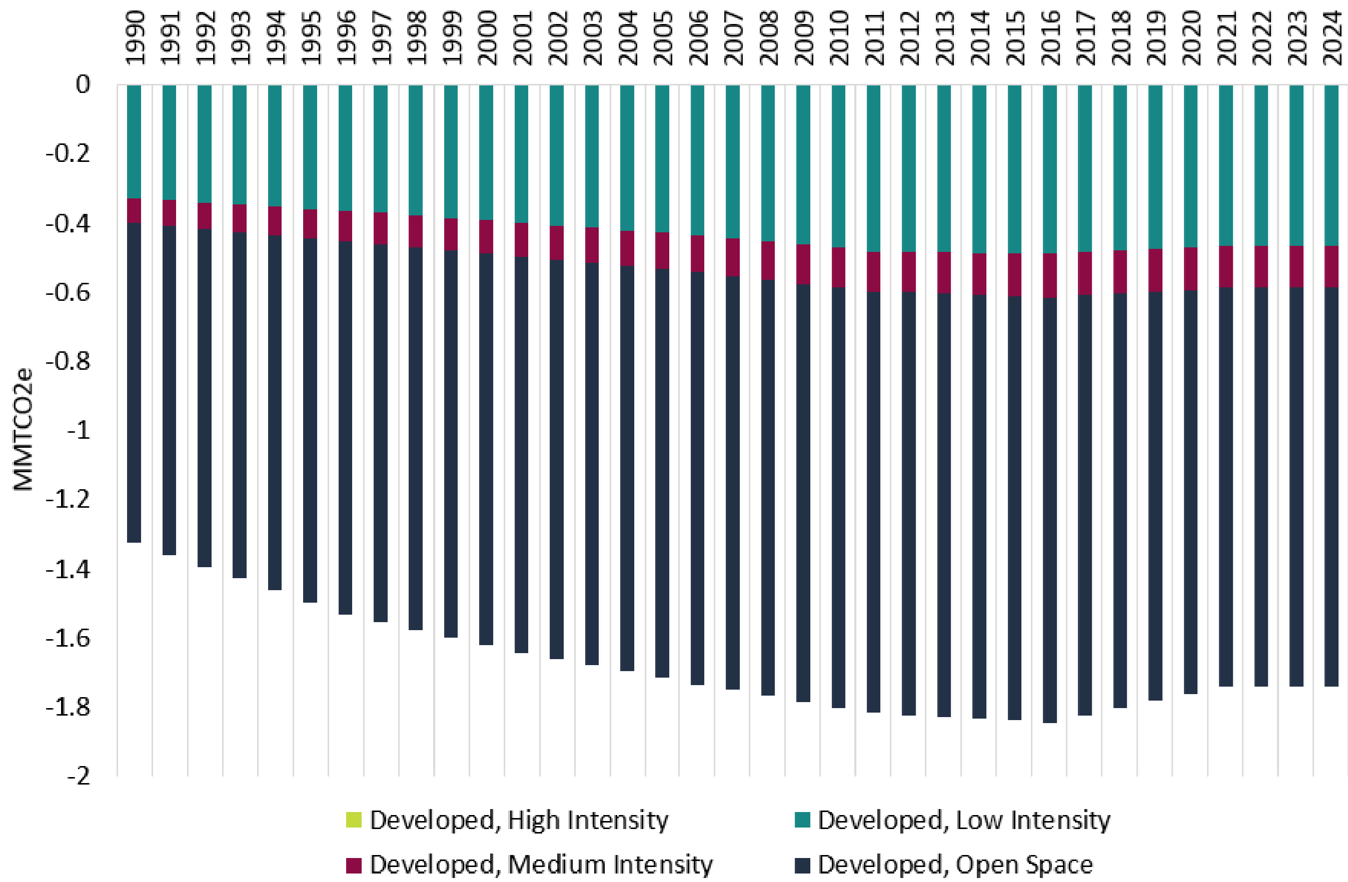


Table 37: Urban tree C accumulation in MMTCO2e

Urban tree C accumulation	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Urban tree C accumulation, high intensity	-	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
Urban tree C accumulation, low intensity	(0.329)	(0.431)	(0.487)	(0.483)	(0.479)	(0.474)	(0.470)	(0.466)	(0.466)	(0.466)	(0.466)
Urban tree C accumulation, medium intensity	(0.070)	(0.109)	(0.126)	(0.124)	(0.123)	(0.121)	(0.120)	(0.119)	(0.119)	(0.119)	(0.119)
Urban tree C accumulation, open space	(0.926)	(1.193)	(1.230)	(.215)	(1.200)	(1.184)	(1.169)	(1.154)	(1.154)	(1.154)	(1.154)
Total	**(1.326)**	**(1.735)**	**(1.845)**	**(1.824)**	**(1.803)**	**(1.782)**	**(1.761)**	**(1.741)**	**(1.741)**	**(1.741)**	**(1.741)**

The open space and low-intensity Developed Lands contribute the most in terms of area as well as percentage tree cover level. In Oregon open space areas, the percent tree cover increased from 34% to 42% between 1990 and 2016. Percent tree cover in open spaces then decreased to 38% in 2021, leading to an observed maximum removal in 2016.

Soil organic C stock changes for Developed Land remaining Developed Land occur in both mineral and organic soils. Changes in soil organic C stocks on mineral soils are assumed to be zero, which is consistent with the assumption of the Tier 1 method in the IPCC Guidelines (IPCC 2006) and the National GHG Inventory that inputs equal outputs.

Drainage of organic soils is common when historic Wetland areas have been developed. Organic soils are classified as those with a histosol taxonomic order. Drainage of organic soils leads to aeration of the soil that accelerates the decomposition rate and CO_2 emissions. Due to the depth and richness of the organic layers, carbon loss from drained organic soils can continue over long periods of time. Emissions of CO_2, N_2O, and CH_4 were estimated using the methodology in the 2013 Wetland Supplement to the IPCC Guidelines using Tier 1 emission factors. Since specific emission factors for Developed Land are not available, emission factors for Cropland were used, assuming similar deep drainage conditions. The full calculation methodology is described in detail in Appendix E.

Emissions from drained organic soils in Developed Land remaining Developed Land were relatively steady at about 2.3 MMTCO2e from 1990 to 2006, and increased slightly to 2.5 MMTCO2e by 2024 due to an increase in total area of drained organic soils (Table 38, Table 39, Figure 18).

Figure 18: Drained organic soil emissions from Developed Land remaining Developed Land in MMTCO2e

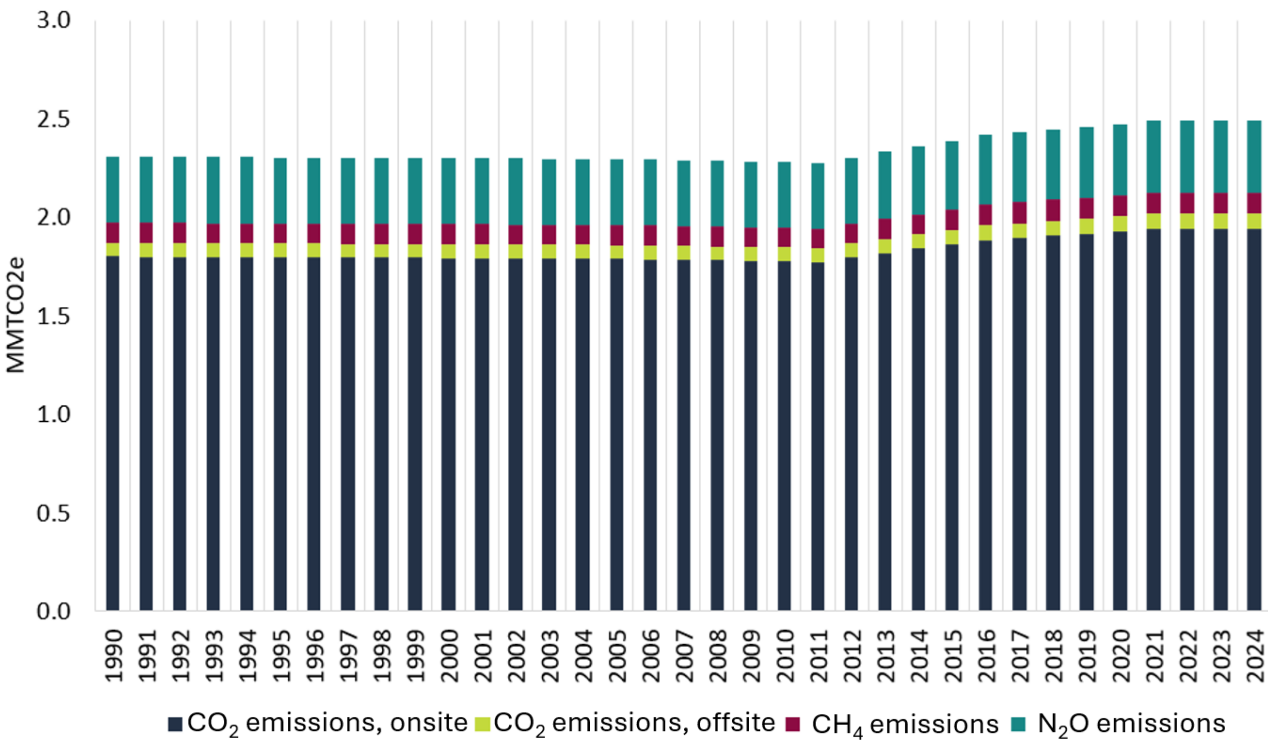


Table 38: Area of drained organic soils in acres

Land Type	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Developed Land remaining Developed Land	153,680	152,499	160,790	161,742	162,695	163,648	164,600	165,553	165,553	165,553	165,553
Land converted to Developed Land	-	25,050	24,861	24,653	24,445	24,237	24,030	23,822	23,822	23,822	23,822

Table 39: Drained organic soil emissions in MMTCO2e

Land Type	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Developed Land remaining Developed Land	2.311	2.294	2.418	2.433	2.447	2.461	2.476	2.490	2.490	2.490	2.490
Land converted to Developed Land	-	0.377	0.374	0.371	0.368	0.365	0.361	0.358	0.358	0.358	0.358

Land Converted to Developed Land

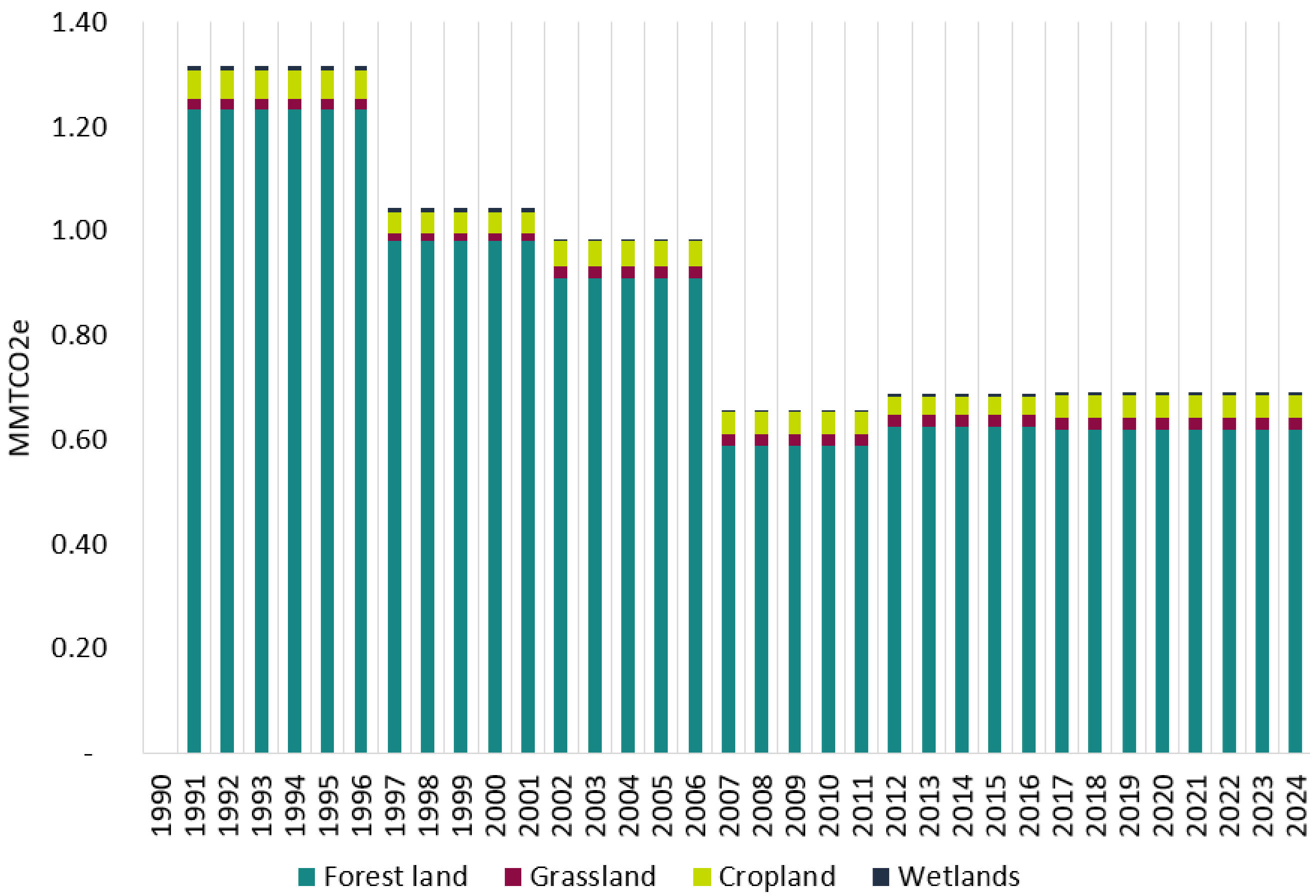
When land is converted to Developed Land, it is assumed that vegetation is cleared and biomass is lost in the year of conversion. Biomass emissions from land converted to Developed Land are summarized in Table 40 and Figure 19. The conversion of Forest Land to Developed Land contributes the most to the emissions, with a total of 1.32 MMTCO2e emitted. Emissions gradually decrease and, starting in 2007, remain steady at approximately 0.7 MMTCO2e due to decreased areas of deforestation. Gains in biomass resulting from accumulation of carbon in urban trees following land conversionare included in the Developed Land remaining Developed Land urban tree subcategory.

Table 40: Emissions and removals from land converted to Developed Land in MMTCO2e

Land Type	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Forest Land converted to Developed Land	-	0.91	0.63	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62
Grassland converted to Developed Land	-	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Cropland converted to Developed Land	-	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04

Wetland converted to Developed Land	-	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Total	**-**	**0.99**	**0.69**	**0.69**	**0.69**	**0.69**	**0.69**	**0.69**	**0.69**	**0.69**	**0.69**

Figure 19: Emissions and removals from biomass land converted to Developed Land in MMTCO2e



Mineral soil carbon fluxes were estimated for land converted to Developed Land. The total area of land converted to Developed Land occurring on mineral soils is summarized in Table 41. The mineral soils sequester carbon and remove, on average, 0.1 MMTCO2e annually (Table 42, Figure 20). Emissions occur when natural lands with generally undisturbed soils are converted to Developed Land. These emissions are small and are countered by removals occurring on land converted to open spaces (parks, turf fields, etc.) that are assumed to behave similarly to improved grasslands with herbaceous vegetation. Areas that get paved and developed at higher intensities make up a small proportion of the land converted and lose 10-20% of the carbon stock. Areas that are converted to open space increase carbon stock by 14%. Furthermore, when land is converted from Cropland to Developed Land (primarily open space or low-intensity development), carbon removal is expected to occur because perennial vegetation will reduce soil disturbance and microbial decomposition of carbon in the soil. It is assumed that lands that have been in long-term cultivation with conventional tillage are those that are converted. Wetland to Developed Land conversions result in losses of soil carbon stock and associated emissions of 0.006 – 0.008 MMTCO2e annually.

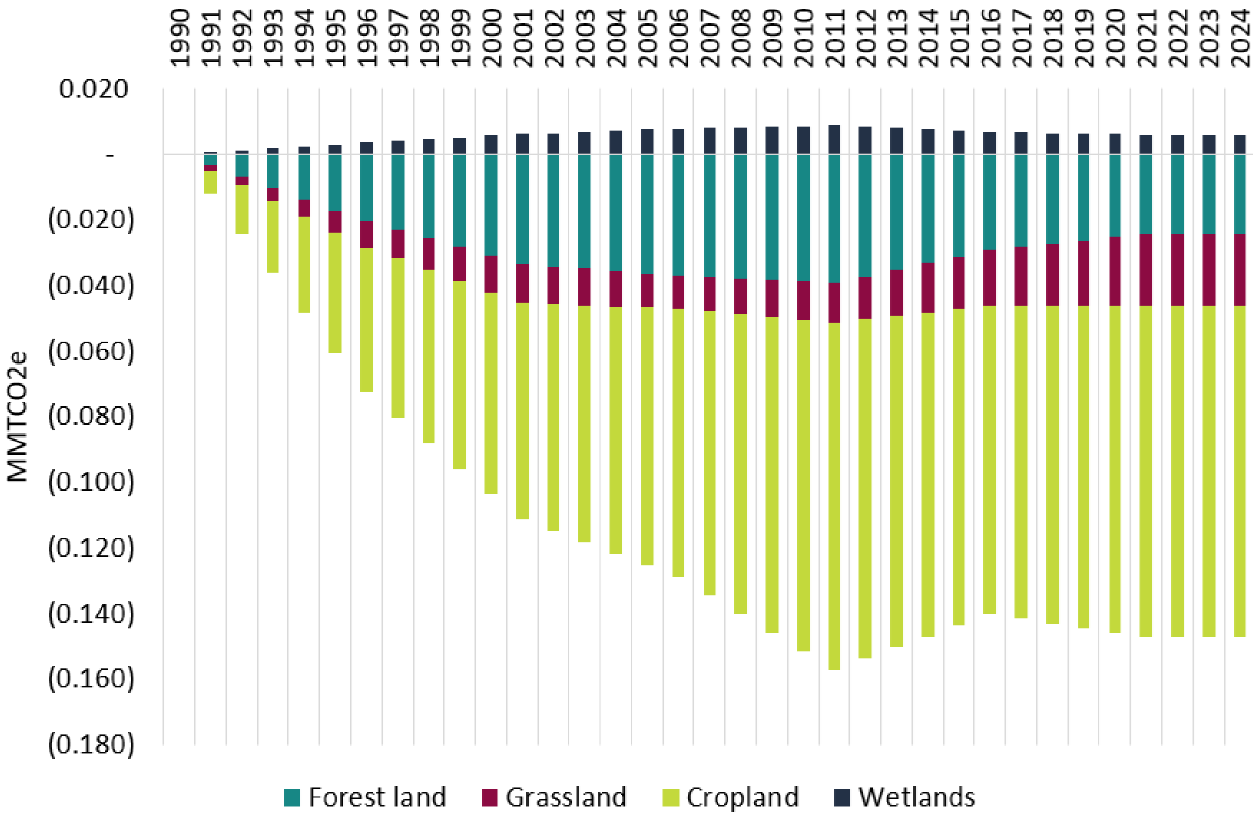
Table 41: Area of mineral soils converted to Developed Lands in acres

Land Category	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Forest Land	-	88,059	78,862	76,927	74,991	73,056	71,120	69,184	69,184	69,184	69,184
Grassland	-	67,599	90,086	91,488	92,891	94,293	95,695	97,097	97,097	97,097	97,097
Cropland	-	95,120	103,874	104,476	105,078	105,681	106,283	106,885	106,885	106,885	106,885
Wetland	-	3,772	3,276	3,213	3,151	3,088	3,026	2,963	2,963	2,963	2,963

Table 42: Soil CO_2 flux from land converted to Developed Land in MMTCO2e

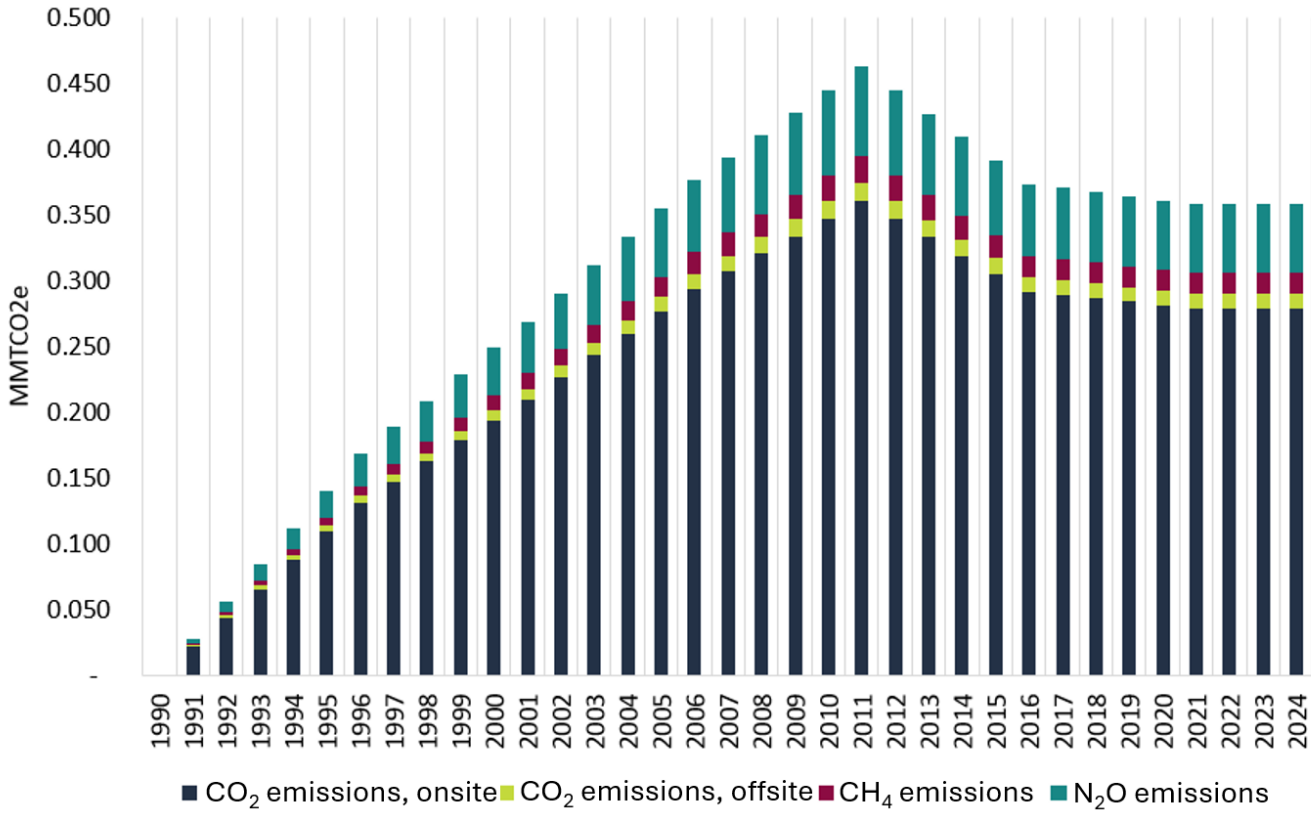
Land Category	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Forest Land	-	(0.037)	(0.029)	(0.028)	(0.027)	(0.026)	(0.025)	(0.024)	(0.024)	(0.024)	(0.024)
Grassland	-	(0.010)	(0.017)	(0.018)	(0.019)	(0.020)	(0.021)	(0.022)	(0.022)	(0.022)	(0.022)
Cropland	-	(0.082)	(0.094)	(0.095)	(0.097)	(0.098)	(0.100)	(0.101)	(0.101)	(0.101)	(0.101)
Wetland	-	0.008	0.007	0.007	0.007	0.006	0.006	0.006	0.006	0.006	0.006
Total	**-**	**(0.121)**	**(0.133)**	**(0.135)**	**(0.136)**	**(0.138)**	**(0.140)**	**(0.141)**	**(0.141)**	**(0.141)**	**(0.141)**

Figure 20: Emissions and removals from mineral soil from land converted to Developed Land in MMTCO2e



Emissions from drained organic soils on land converted to Developed Land are estimated the same way as for Developed Land remaining Developed Land. The main driver of emissions is the area of land converted to Developed Land with drained organic soils. The emissions increased between 1990 and 2011, peaking at 0.46 MMTCO2e in 2011. Between 2011 and 2024, emissions decreased gradually to 0.36 MMTCO2e (Table 40, Table 42, Figure 21).

Figure 21: Drained organic soil emissions from land converted to Developed Land in MMTCO2e



Biomass Burning

Wildfires and prescribed burning occurring in Oregon result in emissions of CO_2, CH_4,and N_2O. CO_2 emissions are accounted for as changes in biomass C stocks in the Forest Land and Grassland categories. This section summarizes non-CO_2 emission estimates (i.e., CH_4 and N_2O) from biomass burning occurring on Forest Land and Grassland. Non-CO_2 emissions from agricultural residue burning are reported in the Oregon Sector Based GHG Inventory. The methodology for estimating non-CO_2 emissions from wildfires is based on the Wildland Fire Emissions Inventory System calculator (https://wfeis.mtri.org/calculator), the same tool used by the US EPA to estimate forest fire emissions for the National GHG Inventory. Emissions from prescribed burns are also estimated. The methodology is described in detail in Appendix E.

Wildfires

Wildfires have increased significantly in area and corresponding emissions between 1990 and 2024, with fluctuations due to the episodic nature of wildfires (Table 43, Table 44, Figure 22). In 1990, the total burn area was approximately 85,000 acres, resulting in emissions of 0.17 MMTCO2e. A significant increase in 2024, with total area burned of 1.3M acres, resulted in emissions of 2.39 MMTCO2e (Figure 23). While large areas of Grassland are affected, for example, in years 2006, 2012, and 2024, emissions are primarily driven by wildfires occurring on Forest Land due to the high amount of fuel (i.e., amount of biomass) available in forest ecosystems. In 2020, the emissions reached the highest value at 10.74 MMTCO2e. The area burned totaled 1 million acres, and 85% of that land was classified as Forest Land.

For comparison, the 1.3M acres wildfire in 2024 only had 42% forest land within the burn perimeter recorded and resulted in emissions of 2.39 MMTCO2e.

Figure 22: Area of wildfires on Forest Land and Grassland in acres

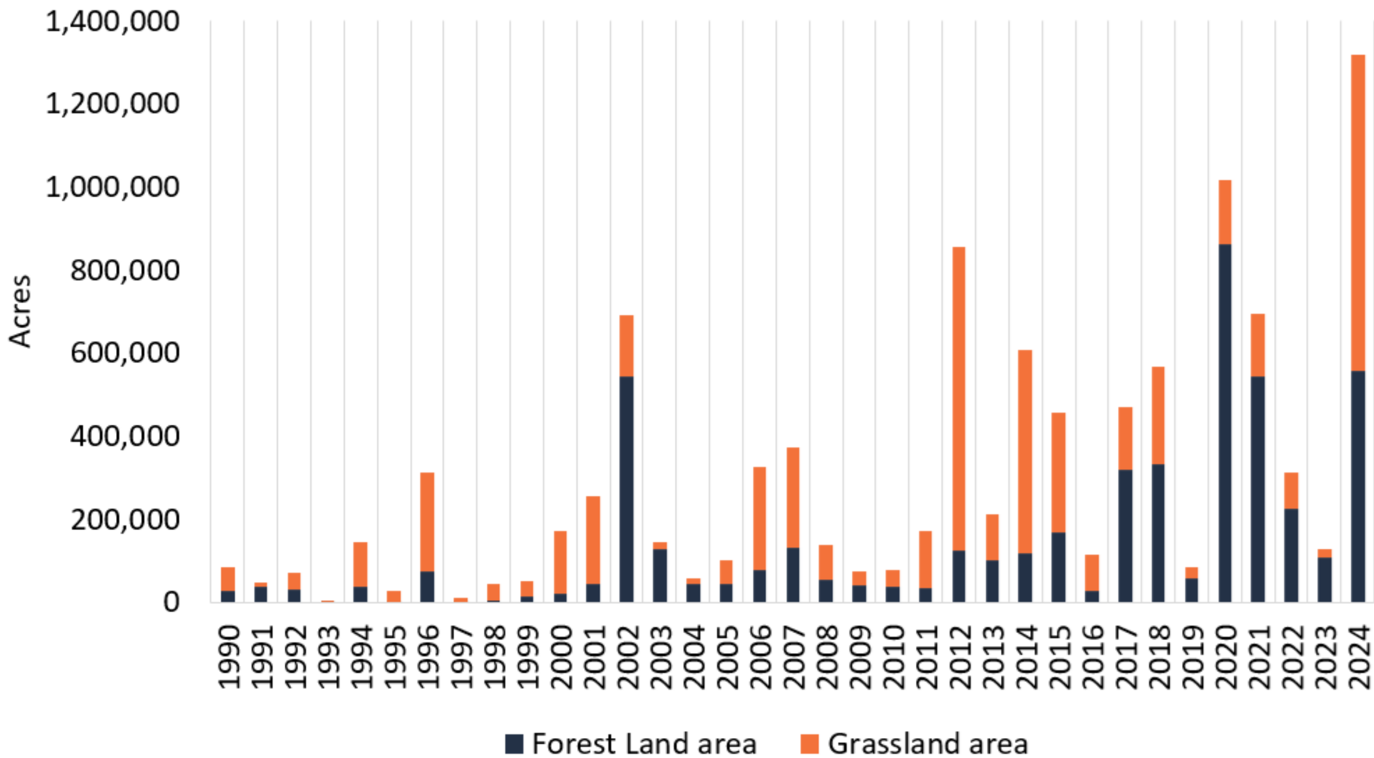


Figure 23: Wildfire emissions on Forest Land and Grassland in MMTCO2e

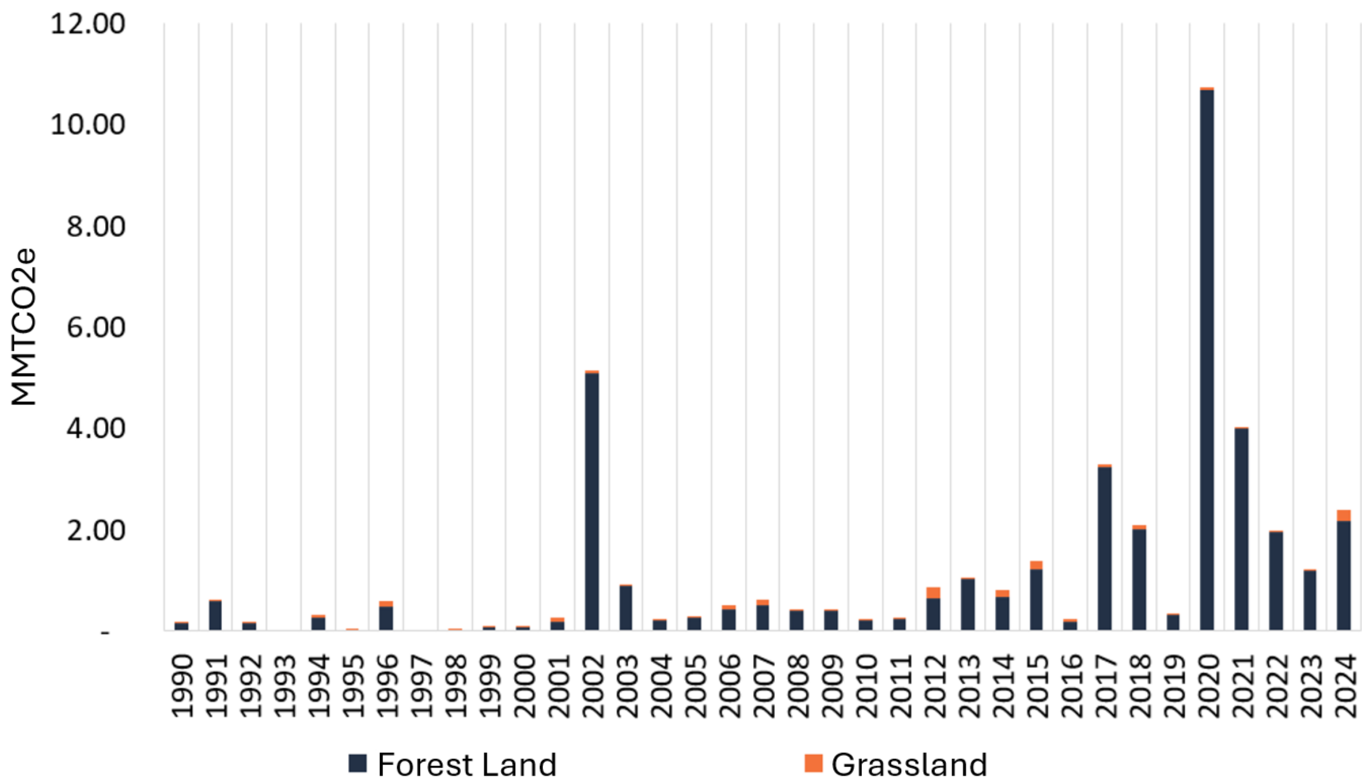


Table 43: Wildfire areas on Forest Land and Grassland in acres

Land Type	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Forest Land	27,081	79,636	28,778	320,389	333,442	58,495	861,562	543,960	226,127	107,441	559,297
Grassland	57,779	245,426	86,023	148,806	234,176	25,523	156,803	152,036	86,798	20,289	758,257
Total	84,860	325,062	114,801	469,195	567,618	84,018	1,018,365	695,996	312,925	127,730	1,317,554

Table 44: Emissions due to on Forest Land and Grassland in MMTCO2e

Land Type	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Forest Land	0.15	0.43	0.20	3.24	2.01	0.31	10.68	4.00	1.97	1.19	2.18
Grassland	0.02	0.08	0.04	0.04	0.07	0.01	0.06	0.04	0.02	0.01	0.22
Total	**0.17**	**0.51**	**0.23**	**3.28**	**2.08**	**0.32**	**10.74**	**4.04**	**1.99**	**1.20**	**2.39**

Prescribed burns

The following prescribed burn types are included in the analysis:

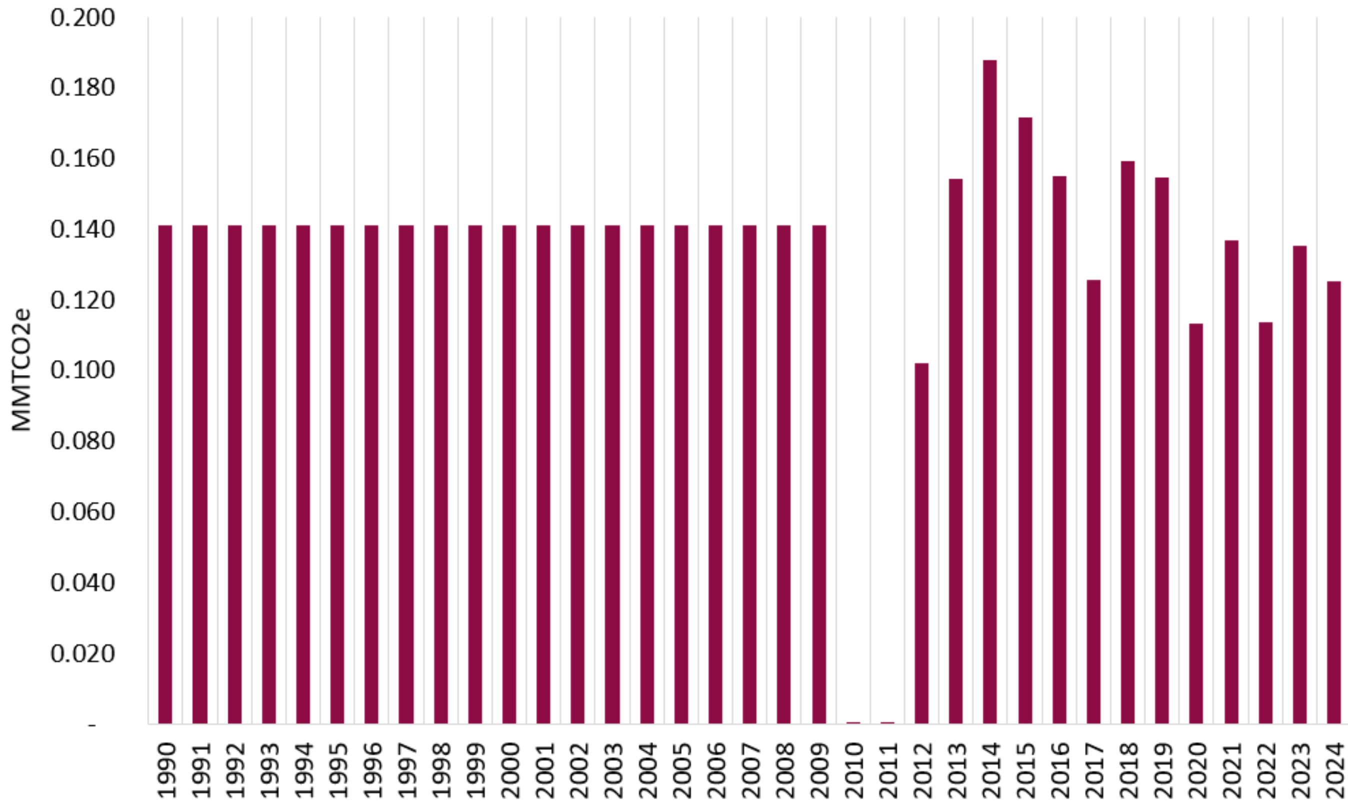
- Broadcast Activity: Ignition across an area, active fuel distribution
- Underburn Activity: Low-intensity burning mostly in the understory layer
- Pile: Piled woody debris (may be created manually, by grapple machine, or by tractor)
- Landing: Burn restricted to logging landing area only (no broadcast/underburn)
- Right-of-way: Burning along rights-of-way (e.g., access roads, utility corridors)
- Rangeland: Burning on rangeland fuels (grass, sagebrush, etc.)

Emissions from prescribed burns average 0.14 MMTCO2e over the time series, with pile and landing burns contributing the most due to high amounts of fuel (i.e., amount of biomass) (Table 45, Figure 24). Data was only available for the years 2010-2024, therefore emission estimates were based on the average of fuel tonnage between 2012 and 2024, by burn type. Note that years 2010 and 2011 were omitted from the average as they appear to be outliers, having essentially no data recorded in the database, which may be attributed to a change in the data collection process rather than actual changes in burning activities.

Table 45: Emissions from prescribed burn emissions in MMTCO2e

Prescribed Burns and Years	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Prescribed burns	0.141	0.141	0.155	0.126	0.159	0.154	0.113	0.137	0.114	0.135	0.125

Figure 24: Prescribed burn emissions in MMTCO2e



Summary Emissions and Removals

Table 46: Total emissions and removals in Oregon by category in MMTCO2e

Category	1990	2006	2016	2017	2018	2019	2020	2021	2022	2023	2024
Forest Land	(104.503)	(78.372)	(74.707)	(72.176)	(69.151)	(67.327)	(60.909)	(58.494)	(60.144)	(58.634)	(58.622)
Grassland	(3.506)	0.853	0.082	(1.554)	(2.359)	(3.308)	(4.147)	(5.789)	(5.422)	(5.393)	(5.226)
Cropland	7.669	9.250	8.514	8.586	8.138	8.497	7.911	8.291	7.833	8.762	8.517
Developed Land	0.986	1.800	1.503	1.536	1.567	1.598	1.628	1.659	1.659	1.659	1.659
Wetlands	3.449	3.155	2.781	2.791	2.801	2.811	2.821	2.831	2.831	2.831	2.832
Biomass Burning	0.313	0.654	0.389	3.407	2.244	0.474	10.856	4.179	2.099	1.334	2.518
Total	(95.592)	(62.661)	(61.437)	(57.409)	(56.760)	(57.256)	(41.840)	(47.323)	(51.144)	(49.440)	(48.323)