2026

REPUBLIC OF CHINA

NATIONAL GREENHOUSE GAS

INVENTORY REPORT | Report Summary

June, **2026**

Executive Summary

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ES.1 Background Information on National Greenhouse Gas Inventory

Pursuant to Article 4[1] of the United Nations Framework Convention on Climate Change (UNFCCC) and the transparency provisions under Article 13[2] of the Paris Agreement, namely the Enhanced Transparency Framework (ETF), Parties are required to regularly submit national greenhouse gas (GHG) inventories and related information to report their anthropogenic GHG emissions and removals, and to facilitate international technical review and transparency assessment[3].

The methodologies used for the preparation of national greenhouse gas inventories should be consistent with the *2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006 IPCC Guidelines)*. Since 2015, Taiwan has compiled its national greenhouse gas inventory in accordance with the methodologies prescribed in the *2006 IPCC Guidelines*. To further enhance the transparency, consistency, comparability, completeness, and accuracy of the inventory, this Report also adopts relevant methodologies from the *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2019 IPCC Refinement Guidelines)*, where appropriate and applicable under domestic statistical conditions and national circumstances.

In addition, this Report follows the Modalities, Procedures and Guidelines (MPGs) for the Enhanced Transparency Framework under Article 13 of the Paris Agreement (Decision 18/CMA.1, Annex) and compiles the national greenhouse gas inventory using the Common Reporting Tables (CRT). Beginning in 2024, greenhouse gas emissions and removals are calculated using the Global Warming Potentials (GWPs) from the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC).

Although Taiwan is not a Party to the UNFCCC, it has long actively participated in global climate change mitigation efforts and continuously aligned its national greenhouse gas inventory compilation with international requirements. The estimation and reporting of greenhouse gas emissions and removals serve as an essential foundation for developing climate change mitigation policies and enhancing transparency in line with international practices.

This Report has been prepared in accordance with the methodologies provided in the *2006 IPCC Guidelines* and the *2019 IPCC Refinement Guidelines*. It presents greenhouse gas emissions and removals data covering the period from 1990 to 2024, describes national greenhouse gas emission trends and sectoral statistics, and demonstrates Taiwan's ongoing efforts to improve the quality of its national greenhouse gas inventory and strengthen its alignment with international transparency requirements.

ES.2 Summary of National Emission and Absorption Related Trends

Taiwan's total GHG emissions (excluding land use, land use change and forestry, the following report abbreviated as LULUCF) decreased from 291,435 kilotons of carbon dioxide equivalents in 2005 to 273,161 kilotons of carbon dioxide equivalents in 2024, with a 6.27% decrease and a negative average annual growth rate of –0.34%. To further analyze the composition of total GHG emissions in 2024, the proportion of carbon dioxide emissions is 95.73%, a decrease of 1.93% over the previous year, and that of non-carbon dioxide is 4.27%, which was also an increase of 2.34% over last year, as shown in Figure ES2.1.

Further comparison of statistics on various greenhouse gas emissions shows that carbon dioxide accounts for the majority of greenhouse gas emissions (excluding LULUCF) in Taiwan in 2005, accounting for 91.52%, followed by methane (3.92%), fluorinated greenhouse gas (3.16%),and nitrous oxide (1.40%);

1 UNFCCC, ST/AI/189/ADD.9/REV.2, 1987.
2 UNFCCC, FCCC/CP/2015/10/Add.1, 2015.
3 UNFCCC, FCCC/CP/2002/8, 2002.

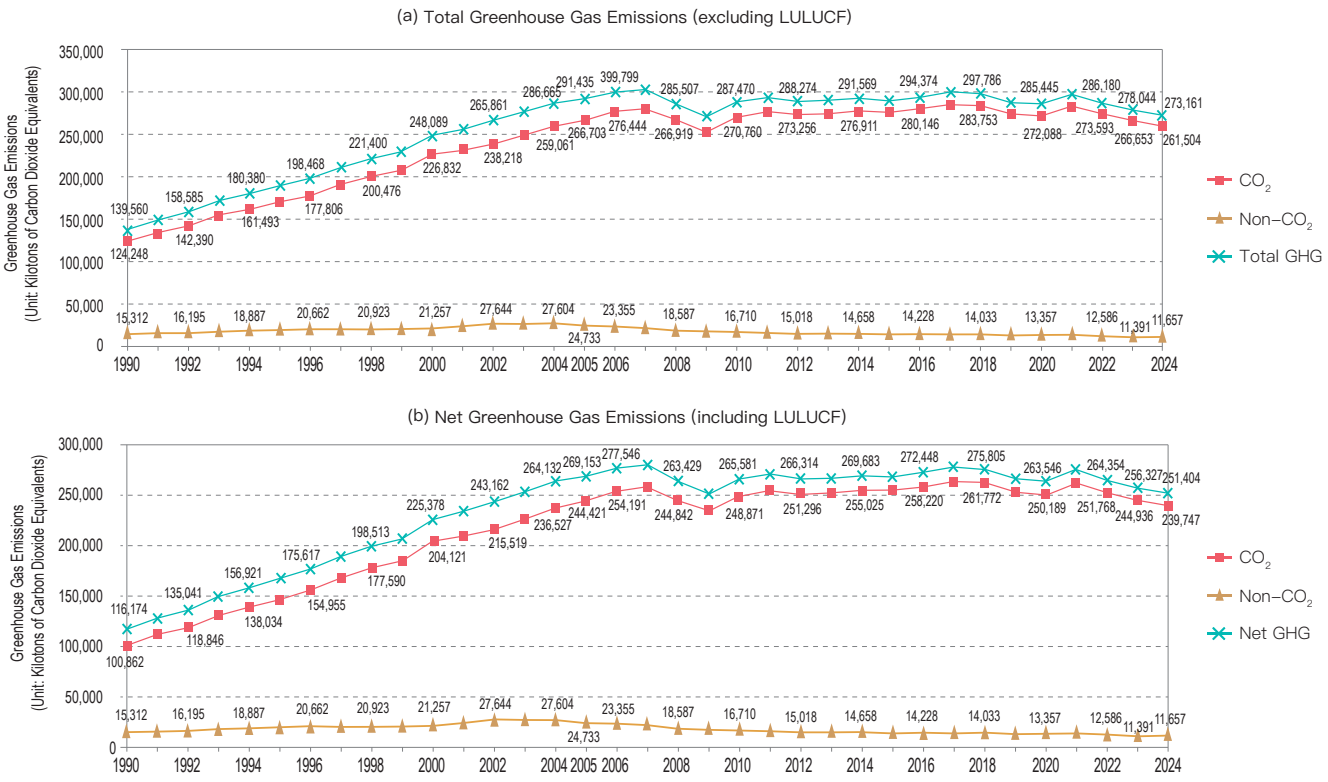

Figure ES2.1 1990–2024 Trends in Total Greenhouse Gas Emissions and Sequestration in Taiwan：(a) Emissions excluding LULUCF；(b) Emissions including LULUCF

however, carbon dioxide was still the largest proportion (95.73%) in 2024, followed by methane (1.59%), then fluorinated greenhouse gas (1.44%), and nitrous oxide (1.24%), as shown in Figure ES2.2.

Between 2005 and 2024, carbon dioxide emissions decreased by 1.95% with a negative average annual growth rate of –0.10%; carbon dioxide sequestration decreased by 2.35% with a negative average annual growth rate of –0.13%; methane emissions decreased by 61.98% with a negative average annual growth rate of –4.96%; nitrous oxide emissions decreased by 17.00% with a negative average annual growth rate of –0.98%; fluorinated greenhouse gas emissions decreased by 57.47% with a negative average annual growth rate of –4.40%, as shown in Figure ES2.3 and Table ES2.1.

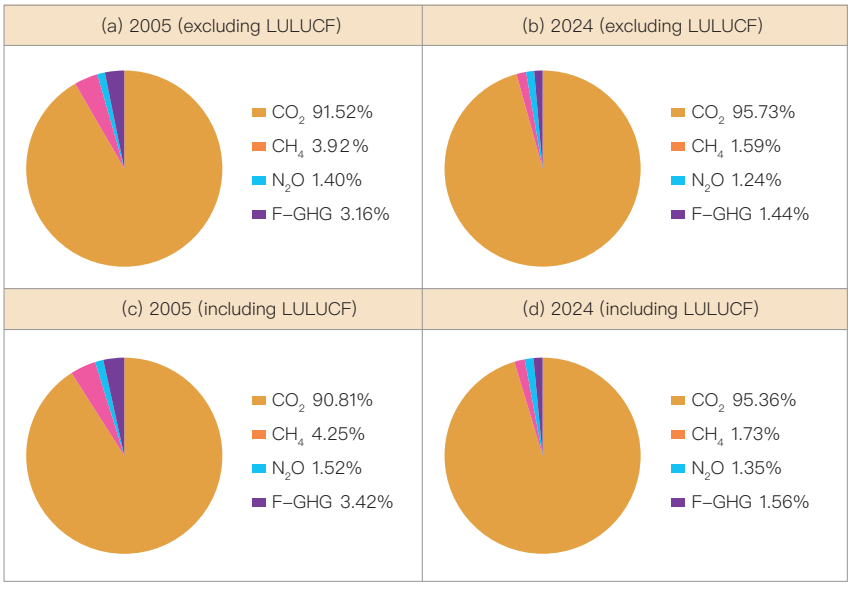

Figure ES2.2 Percentage of Various Types of Greenhouse Gas Emissions in Taiwan:(a).2005(excluding LULUCF)；(b).2024(excluding LULUCF); (c).2005(including LULUCF)；(d).2024(including LULUCF).

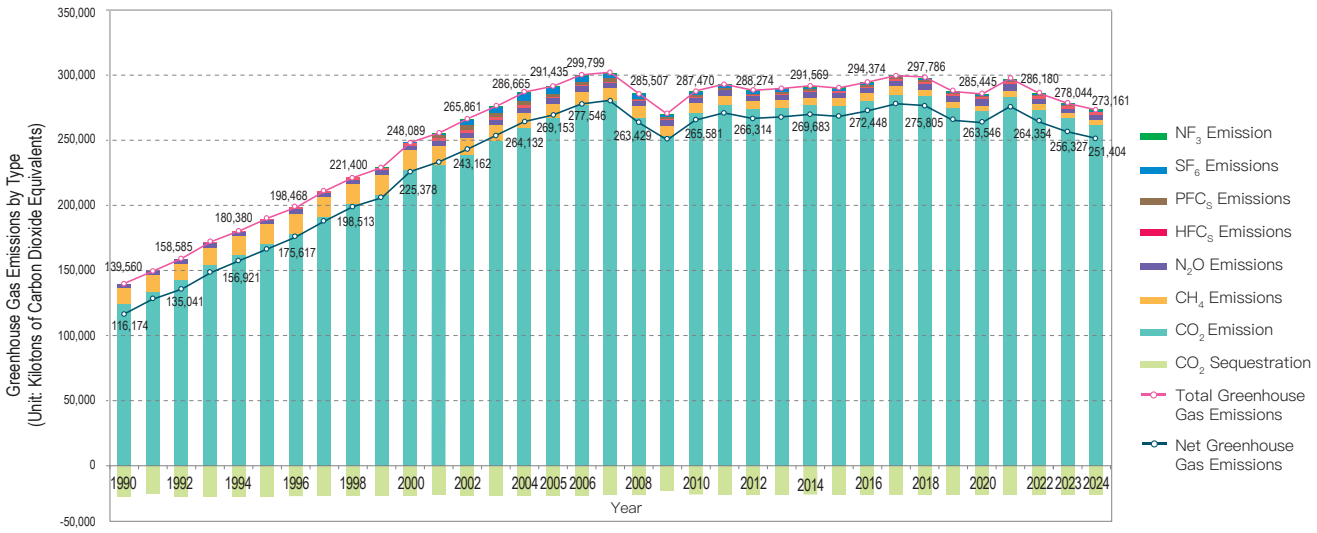

Figure ES2.3 1990–2024 Trends in Total Greenhouse Gas Emissions and Sequestration by Type in Taiwan

Table ES2.1 1990–2024 Greenhouse Gas Emissions and Sequestration in Taiwan by Type

(Unit: Kilotons of Carbon Dioxide Equivalents)

GHG	GWP	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
CO_2	1	124,248	133,631	142,390	154,005	161,493	169,825	177,806	190,737	200,476	207,987	226,832	231,030
CH_4	28	12,272	12,690	12,862	13,914	14,706	15,694	15,890	15,664	15,804	15,870	15,216	14,399
N_2O	265	3,041	3,354	3,333	3,402	3,465	3,559	3,659	3,389	3,325	3,370	3,872	3,874
HFCs	HFC–134a(1,300) etc.	NE	NE	NE	633	716	678	1,113	1,271	1,794	1,413	2,024	2,293
PFCs	PFC–14(6,630) etc.	NE	NE	NE	NE	NE	NE	NE	NE	NE	2	12	2,665
SF_6	23,500	NE	NE	NE	NE	NE	NE	NE	NE	NE	120	124	769
NF_3	16,100	NE	NE	NE	NE	NE	NE	NE	NE	NE	10	9	220
CO_2 Sequestration	1	–23,386	–21,490	–23,544	–23,546	–23,459	–23,340	–22,851	–23,060	–22,887	–22,762	–22,711	–21,842
Net GHG Emission (including LULUCF)		**116,174**	**128,184**	**135,041**	**148,407**	**156,921**	**166,417**	**175,617**	**188,001**	**198,513**	**206,010**	**225,378**	**233,407**
Total GHG Emission (excluding LULUCF)		**139,560**	**149,675**	**158,585**	**171,953**	**180,380**	**189,757**	**198,468**	**211,061**	**221,400**	**228,771**	**248,089**	**255,249**
GHG	**GWP**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
CO_2	1	238,218	248,814	259,061	266,703	276,444	279,985	266,919	252,988	270,760	276,769	273,256	274,529
CH_4	28	13,615	12,790	12,045	11,428	10,661	9,870	9,020	8,098	7,564	7,219	6,727	6,256
N_2O	265	3,934	3,881	4,064	4,087	4,458	4,512	4,116	4,286	4,599	4,592	4,512	4,316
HFCs	HFC–134a(1,300) etc.	1,973	1,806	1,642	271	298	370	326	377	369	350	453	582
PFCs	PFC–14(6,630) etc.	3,764	3,814	3,949	3,178	3,355	3,102	1,932	1,464	1,650	1,665	1,054	1,253
SF_6	23,500	3,986	4,471	5,288	5,052	3,940	3,485	3,001	2,527	2,286	1,976	1,909	2,059
NF_3	16,100	373	506	617	716	644	747	191	540	241	393	363	723
CO_2 Sequestration	1	–22,699	–22,615	–22,534	–22,282	–22,253	–22,068	–22,077	–19,384	–21,889	–21,947	–21,960	–21,974
Net GHG Emission (including LULUCF)		**243,162**	**253,466**	**264,132**	**269,153**	**277,546**	**280,003**	**263,429**	**250,898**	**265,581**	**271,018**	**266,314**	**267,744**
Total GHG Emission (excluding LULUCF)		**265,861**	**276,081**	**286,665**	**291,435**	**299,799**	**302,072**	**285,507**	**270,282**	**287,470**	**292,965**	**288,274**	**289,718**
GHG	**GWP**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	
CO_2	1	276,911	276,215	280,146	285,706	283,753	274,322	272,088	283,346	273,593	266,653	**261,504**	
CH_4	28	5,832	5,715	5,770	5,523	5,137	5,000	4,885	4,792	4,580	4,414	**4,345**	
N_2O	265	4,269	4,233	4,425	4,548	4,597	4,409	4,421	4,839	4,048	3,598	**3,392**	
HFCs	HFC–134a(1,300) etc.	677	708	798	924	1,059	1,187	1,320	1,446	1,594	1,672	**1,807**	
PFCs	PFC–14(6,630) etc.	1,449	1,250	1,336	1,304	1,421	1,315	1,336	1,354	1,250	878	**876**	
SF_6	23,500	1,807	1,569	1,458	1,459	1,342	963	867	882	660	481	**542**	
NF_3	16,100	624	626	442	412	477	443	528	556	455	348	**695**	
CO_2 Sequestration	1	–21,886	–21,900	–21,926	–21,961	–21,980	–21,915	–21,899	–21,843	–21,826	–21,717	**–21,757**	
Net GHG Emission (including LULUCF)		**269,683**	**268,415**	**272,448**	**277,915**	**275,805**	**265,724**	**263,546**	**275,371**	**264,354**	**256,327**	**251,404**	
Total GHG Emission (excluding LULUCF)		**291,569**	**290,316**	**294,374**	**299,876**	**297,786**	**287,639**	**285,445**	**297,214**	**286,180**	**278,044**	**273,161**	

Note: 1. Global Warming Potential (hereinafter referred to as GWP) is cited from the IPCC *Fifth Assessment Report*.
2. NE (not estimated) refers to the exclusion of estimation on existing emissions and sequestration.

1. Carbon Dioxide Emissions

The energy sector, industrial processes and product use (IPPU) sector, agriculture sector, and waste sector are the main sources of carbon dioxide emissions in Taiwan. The inventories of carbon dioxide emissions and removals by sector during the period 1990—2024 are presented in Table ES2.2. Between 1990 and 2024, carbon dioxide emissions increased by 110.47%, with an average annual growth rate of 2.21%.

In 2005, Taiwan's carbon dioxide emissions amounted to 266,703 kilotons of carbon dioxide equivalent. In 2024, carbon dioxide emissions were 261,504 kilotons of carbon dioxide equivalent, representing a decrease of 1.95% and an average annual negative growth rate of 0.10%. Among the various sectors, emissions from the energy sector decreased by 1.08%, emissions from the IPPU sector decreased by 15.48%, emissions from the agriculture sector decreased by 70.88%, removals from the land use, land-use change and forestry (LULUCF) sector decreased by 2.35%, while emissions from the waste sector increased by 57.02%.

In 2024, carbon dioxide emissions accounted for 95.73% of total greenhouse gas emissions. The energy sector accounted for 93.79%, the IPPU sector 5.85%, the agriculture sector 0.01%, and the waste sector 0.35%.

Compared with 2023, carbon dioxide emissions in 2024 decreased by 1.93%, mainly due to a 2.07% decrease in the energy sector, a 0.84% decrease in the IPPU sector, a 7.76% decrease in the agriculture sector, a 0.19% increase in removals from the LULUCF sector, and a 22.13% increase in emissions from the waste sector.

2. Methane Emissions

Methane emissions in Taiwan mainly originate from the agriculture sector, waste sector, and energy sector. Methane emissions by sector during the period 1990—2024 are presented in Table ES2.3. Between 1990 and 2024, methane emissions decreased substantially by 64.59%, with an average annual negative growth rate of 3.01%.

Table ES2.2 1990–2024 Carbon Dioxide Emissions and Sequestration in Taiwan

(Unit: Kilotons of Carbon Dioxide Equivalents)

GHG Emission Sources and Sinks	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1. Energy Sector	109,465	118,443	126,058	135,206	143,103	150,810	158,579	170,835	181,518	190,446	208,724	212,554
1.A.1 Energy Industry	49,123	55,126	57,508	64,745	69,487	75,214	80,103	90,168	99,375	104,827	119,268	123,880
1.A.2 Manufacturing and Construction Industry	30,124	31,963	34,410	34,835	35,876	36,956	37,942	40,323	40,360	42,269	45,284	44,234
1.A.3 Transportation	19,646	20,888	24,033	26,103	27,540	28,822	29,801	30,536	31,844	32,772	33,207	33,267
1.A.4 Other Sectors	10,572	10,466	10,107	9,523	10,200	9,819	10,733	9,808	9,939	10,579	10,965	11,174
1.A.4.a Service Industry	3,621	3,529	2,989	2,490	3,018	2,446	3,175	2,482	2,948	3,128	3,205	3,538
1.A.4.b Residential	4,005	4,238	4,446	4,359	4,461	4,596	4,754	4,851	4,950	5,410	5,398	5,181
1.A.4.c Agriculture, Forestry, Fishery, and Husbandry	2,946	2,700	2,672	2,675	2,721	2,777	2,805	2,475	2,041	2,040	2,362	2,455
1.A.5 Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
1.B.1 Solid Fuel	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
1.B.2 Oil and Natural Gas and Other Emissions from Energy Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Industrial Process and Product Use Sector	14,562	15,013	15,932	18,414	17,834	17,536	17,684	19,490	18,416	17,185	17,395	16,191
2.A Mining Industry	10,688	10,703	11,861	13,885	13,266	12,773	12,652	13,400	11,571	10,753	10,493	9,980
2.B Chemical Industry	575	551	575	617	770	858	999	1,026	1,007	1,079	1,148	1,232
2.C Metal Industry	3,275	3,735	3,474	3,888	3,774	3,884	4,013	5,045	5,817	5,333	5,734	4,960
2.D Non-Energy Products from Fuels and Solvent Use	0.00006	0.00006	0.00006	0.00007	0.00009	0.00008	0.00008	0.00008	0.00009	0.00009	0.00008	0.00007
2.G Other Product Manufacture and Use	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2.H Other	23	23	23	24	23	21	20	19	22	21	20	20
3. Agriculture Sector	142	146	139	131	135	151	151	134	127	118	131	94
4. Land Use, Land Use Change and Forestry Sector	−23,386	−21,490	−23,544	−23,546	−23,459	−23,340	−22,851	−23,060	−22,887	−22,762	−22,711	−21,842
5. Waste Sector	79	29	261	254	421	1,328	1,393	278	414	236	583	2,190
Net GHG Emission (including LULUCF)	**100,862**	**112,140**	**118,846**	**130,459**	**138,034**	**146,486**	**154,955**	**167,677**	**177,590**	**185,225**	**204,121**	**209,188**
Total GHG Emission (excluding LULUCF)	**124,248**	**133,631**	**142,390**	**154,005**	**161,493**	**169,825**	**177,806**	**190,737**	**200,476**	**207,987**	**226,832**	**231,030**

Continued from the table below

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GHG Emission Sources and Sinks	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1. Energy Sector	220,123	229,841	239,929	247,956	255,330	259,215	247,537	235,868	251,708	257,097	253,201	254,109
1.A.1 Energy Industry	128,157	139,316	147,288	155,014	162,298	168,580	162,125	153,989	164,270	168,491	166,837	167,023
1.A.2 Manufacturing and Construction Industry	46,373	44,211	44,551	44,008	45,309	44,845	41,410	37,874	42,612	43,691	42,515	43,307
1.A.3 Transportation	34,542	34,509	35,859	36,846	36,771	35,419	33,216	33,541	34,652	35,107	34,284	34,209
1.A.4 Other Sectors	11,052	11,806	12,230	12,089	10,952	10,371	10,785	10,463	10,174	9,808	9,566	9,571
1.A.4.a Service Industry	3,487	3,952	4,120	4,227	4,272	4,232	4,226	4,264	4,203	3,898	3,635	3,812
1.A.4.b Residential	5,107	5,042	5,133	5,235	5,033	5,047	5,017	5,030	4,857	4,786	4,672	4,484
1.A.4.c Agriculture, Forestry, Fishery, and Husbandry	2,459	2,811	2,977	2,627	1,647	1,091	1,543	1,169	1,113	1,123	1,259	1,274
1.A.5 Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
1.B.1 Solid Fuel	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
1.B.2 Oil and Natural Gas and Other Emissions from Energy Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Industrial Process and Product Use Sector	16,082	17,149	17,365	18,101	20,404	20,060	18,734	16,474	18,321	18,951	19,369	19,605
2.A Mining Industry	10,654	10,347	10,698	11,265	11,029	10,373	9,380	8,462	8,618	9,574	9,333	9,866
2.B Chemical Industry	1,313	1,384	1,485	1,751	1,721	1,845	1,601	1,601	1,778	1,737	1,714	1,749
2.C Metal Industry	4,096	5,399	5,162	5,066	7,633	7,823	7,733	6,389	7,905	7,620	8,301	7,970
2.D Non-Energy Products from Fuels and Solvent Use	0.00008	0.00009	0.00011	0.00010	0.00007	0.00007	0.00007	0.00006	0.00005	0.00004	0.00004	0.00005
2.G Other Product Manufacture and Use	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2.H Other	18	18	19	20	21	20	20	21	20	20	21	19
3. Agriculture Sector	93	82	84	62	59	57	57	55	54	53	55	45
4. Land Use, Land Use Change and Forestry Sector	−22,699	−22,615	−22,534	−22,282	−22,253	−22,068	−22,077	−19,384	−21,889	−21,947	−21,960	−21,974
5. Waste Sector	1,919	1,741	1,684	583	650	653	592	591	677	669	631	770
Net GHG Emission (including LULUCF)	**215,519**	**226,199**	**236,527**	**244,421**	**254,191**	**257,917**	**244,842**	**233,604**	**248,871**	**254,822**	**251,296**	**252,555**
Total GHG Emission (excluding LULUCF)	**238,218**	**248,814**	**259,061**	**266,703**	**276,444**	**279,985**	**266,919**	**252,988**	**270,760**	**276,769**	**273,256**	**274,529**

GHG Emission Sources and Sinks	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	
1. Energy Sector	258,480	258,475	262,982	269,461	267,142	258,811	257,390	266,922	258,012	250,454	245,271	
1.A.1 Energy Industry	173,749	173,697	177,211	185,763	187,957	180,289	179,510	188,460	181,773	176,783	172,978	
1.A.2 Manufacturing and Construction Industry	40,384	39,575	39,653	38,112	34,729	33,809	32,777	35,331	32,165	29,494	29,025	
1.A.3 Transportation	34,666	35,506	36,584	36,202	35,202	35,438	35,715	33,905	34,696	34,616	33,892	
1.A.4 Other Sectors	9,681	9,698	9,533	9,384	9,254	9,275	9,387	9,227	9,378	9,562	9,376	
1.A.4.a Service Industry	3,928	3,941	3,720	3,779	3,593	3,620	3,790	3,739	3,744	3,926	3,946	
1.A.4.b Residential	4,411	4,469	4,537	4,402	4,145	4,137	4,269	4,170	4,266	4,104	3,815	
1.A.4.c Agriculture, Forestry, Fishery, and Husbandry	1,343	1,287	1,276	1,203	1,515	1,518	1,328	1,318	1,368	1,532	1,615	
1.A.5 Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
1.B.1 Solid Fuel	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
1.B.2 Oil and Natural Gas and Other Emissions from Energy Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
2. Industrial Process and Product Use Sector	17,703	17,253	16,592	15,631	16,024	14,889	14,001	15,670	14,778	15,430	15,299	
2.A Mining Industry	8,728	8,347	7,117	6,269	6,408	6,500	6,563	6,835	6,473	5,982	6,050	
2.B Chemical Industry	1,884	1,842	1,760	1,709	1,684	1,666	1,550	1,730	1,270	1,192	1,182	
2.C Metal Industry	7,072	7,044	7,696	7,634	7,913	6,706	5,870	7,090	7,020	8,242	8,054	
2.D Non-Energy Products from Fuels and Solvent Use	0.00006	0.00010	0.00008	0.00007	0.00006	0.00006	0.00006	0.00007	0.00006	0.00006	0.00006	
2.G Other Product Manufacture and Use	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
2.H Other	19	20	19	20	19	17	18	15	15	15	14	
3. Agriculture Sector	40	38	34	31	30	29	29	27	22	20	18	
4. Land Use, Land Use Change and Forestry Sector	−21,886	−21,900	−21,926	−21,961	−21,980	−21,915	−21,899	−21,843	−21,826	−21,717	−21,757	
5. Waste Sector	687	448	539	583	557	593	668	727	781	749	915	
Net GHG Emission (including LULUCF)	**255,025**	**254,314**	**258,220**	**263,745**	**261,772**	**252,407**	**250,189**	**261,503**	**251,768**	**244,936**	**239,747**	
Total GHG Emission (excluding LULUCF)	**276,911**	**276,215**	**280,146**	**285,706**	**283,753**	**274,322**	**272,088**	**283,346**	**273,593**	**266,653**	**261,504**	

Note: 1. NE (not estimated) refers to the exclusion of estimation on existing emissions and sequestration.
2. NO (not happened) means that the emission source is not produced or used.

In 2005, total methane emissions amounted to 11,428 kilotons of carbon dioxide equivalent. By 2024, methane emissions had decreased to 4,345 kilotons of carbon dioxide equivalent, representing a reduction of 61.98% and an average annual negative growth rate of 4.96%. Among the sectors, emissions from the energy sector increased by 17.24%, emissions from the IPPU sector increased by 10.46%, while emissions from the agriculture sector decreased by 19.27% and emissions from the waste sector decreased by 82.47%.

In 2024, methane emissions accounted for 1.59% of total greenhouse gas emissions. The agriculture sector was the largest source of methane emissions, accounting for 46.35%, followed by the waste sector at 32.93%, the energy sector at 20.21%, and the IPPU sector at 0.51%.

Table ES2.3 1990–2024 Methane Emissions in Taiwan

(Unit: Kilotons of Carbon Dioxide Equivalents)

GHG Emission Sources and Sinks	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1. Energy Sector	592	567	558	573	592	602	589	585	611	646	667	665
2. Industrial Process and Product Use Sector	6	8	7	8	9	11	13	13	11	13	15	20
3. Agriculture Sector	3,264	3,472	3,381	3,388	3,374	3,449	3,455	2,993	2,703	2,820	2,813	2,717
3.A Enteric Fermentation	750	819	826	868	883	921	921	820	755	778	775	739
3.B Manure Management	1,246	1,460	1,418	1,436	1,470	1,535	1,565	1,190	990	1,088	1,123	1,074
3.C Rice Cultivations	1,226	1,166	1,084	1,059	998	984	961	976	953	947	899	887
3.D Agricultural Soils	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
3.E Prescribed Burning of Savannas	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
3.F Field Burning of Agricultural Residues	42	28	53	24	23	8	8	8	6	8	15	17
5. Waste Sector	8,410	8,643	8,917	9,945	10,731	11,632	11,833	12,073	12,479	12,391	11,722	10,996
5.A Solid Waste Disposal	7,102	7,206	7,431	8,492	9,252	10,112	10,231	10,496	10,962	10,958	10,310	9,655
5.B Biological Treatment of Solid Waste	13	0.6	0.9	0.5	0.2	0.7	0.3	1.6	0.06	2.2	0.3	0.02
5.C Incineration and Open Burning of Waste	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5.D Wastewater Treatment and Discharge	1,295	1,436	1,485	1,452	1,479	1,520	1,602	1,575	1,517	1,431	1,411	1,341
5.D.1 Domestic Wastewater	935	945	953	962	970	977	983	990	982	935	894	883
5.D.2 Industrial Wastewater	360	492	531	490	509	542	619	586	534	497	517	458
Total Methane Emissions	**12,272**	**12,690**	**12,862**	**13,914**	**14,706**	**15,694**	**15,890**	**15,664**	**15,804**	**15,870**	**15,216**	**14,399**
GHG Emission Sources and Sinks	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
1. Energy Sector	689	746	782	749	743	741	724	713	753	779	789	804
2. Industrial Process and Product Use Sector	21	24	31	20	20	26	25	27	26	25	26	28
3. Agriculture Sector	2,565	2,451	2,363	2,495	2,461	2,371	2,303	2,247	2,244	2,278	2,252	2,237
3.A Enteric Fermentation	712	701	688	698	688	682	655	640	648	660	653	649
3.B Manure Management	1,022	1,019	1,024	1,071	1,058	994	965	924	931	944	904	874
3.C Rice Cultivations	816	721	643	717	706	690	676	678	659	668	688	710
3.D Agricultural Soils	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
3.E Prescribed Burning of Savannas	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
3.F Field Burning of Agricultural Residues	14	10	9	9	9	5	7	6	6	6	6	4
5. Waste Sector	10,339	9,569	8,868	8,164	7,437	6,732	5,968	5,111	4,542	4,137	3,660	3,187
5.A Solid Waste Disposal	8,976	8,192	7,482	6,786	6,066	5,349	4,644	3,942	3,347	2,862	2,432	2,054
5.B Biological Treatment of Solid Waste	0.4	3	7	11	13	16	18	20	23	29	27	25
5.C Incineration and Open Burning of Waste	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5.D Wastewater Treatment and Discharge	1,363	1,375	1,379	1,367	1,359	1,367	1,306	1,149	1,171	1,246	1,201	1,108
5.D.1 Domestic Wastewater	868	860	833	808	783	752	728	700	689	661	631	609
5.D.2 Industrial Wastewater	495	515	546	559	576	615	578	449	482	584	570	499
Total Methane Emissions	**13,615**	**12,790**	**12,045**	**11,428**	**10,661**	**9,870**	**9,020**	**8,098**	**7,564**	**7,219**	**6,727**	**6,256**
GHG Emission Sources and Sinks	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	
1. Energy Sector	815	843	864	871	855	851	865	870	879	877	878	
2. Industrial Process and Product Use Sector	29	29	30	27	30	29	28	29	24	23	22	
3. Agriculture Sector	2,180	2,157	2,166	2,166	2,165	2,174	2,172	2,115	2,052	2,004	2,014	
3.A Enteric Fermentation	634	641	628	632	640	643	650	665	655	643	621	
3.B Manure Management	840	834	829	827	832	844	845	842	821	819	806	
3.C Rice Cultivations	702	678	705	704	689	684	677	608	576	542	586	
3.D Agricultural Soils	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
3.E Prescribed Burning of Savannas	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
3.F Field Burning of Agricultural Residues	4	5	4	4	3	2	0.8	0.7	0.8	1.3	0.5	
5. Waste Sector	2,808	2,686	2,710	2,458	2,088	1,946	1,819	1,778	1,624	1,511	1,431	
5.A Solid Waste Disposal	1,736	1,469	1,252	1,065	920	821	754	668	633	582	538	
5.B Biological Treatment of Solid Waste	23	22	22	23	26	28	29	30	28	26	26	
5.C Incineration and Open Burning of Waste	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
5.D Wastewater Treatment and Discharge	1,049	1,195	1,436	1,371	1,142	1,098	1,036	1,081	963	903	867	
5.D.1 Domestic Wastewater	593	572	537	512	491	445	423	395	373	355	353	
5.D.2 Industrial Wastewater	456	623	899	859	651	653	612	686	590	548	515	
Total Methane Emissions	**5,832**	**5,715**	**5,770**	**5,523**	**5,137**	**5,000**	**4,885**	**4,792**	**4,580**	**4,414**	**4,345**	

Note: 1. NE (not estimated) refers to the exclusion of estimation on existing emissions and sequestration.
2. NO (not happened) means that the emission source is not produced or used.

Compared with 2023, methane emissions in 2024 decreased by 1.56%, with emissions from the energy sector increasing by 0.18%, emissions from the IPPU sector decreasing by 2.44%, emissions from the agriculture sector increasing by 0.48%, and emissions from the waste sector decreasing by 5.28%.

3. Nitrous oxide emissions

Nitrous oxide emissions in Taiwan mainly originate from the IPPU sector, the agriculture sector, and the energy sector, with minor emissions from the waste sector. Nitrous oxide emissions by sector during the period 1990—2024 are presented in Table ES2.4. Between 1990 and 2024, nitrous oxide emissions increased by 18.31%, with an average annual growth rate of 0.32%.

In 2005, total nitrous oxide emissions amounted to 4,087 kilotons of carbon dioxide equivalent. By 2024, nitrous oxide emissions had decreased to 3,392 kilotons of carbon dioxide equivalent, representing a reduction of 17.00% and an average annual negative growth rate of 0.98%. Among the sectors, emissions from the energy sector decreased by 9.66%, emissions from the IPPU sector increased by 7.21%, while emissions from the agriculture sector decreased by 31.72% and emissions from the waste sector decreased by 35.72%.

In 2024, nitrous oxide emissions accounted for 1.24% of total greenhouse gas emissions. The agriculture sector was the largest source of nitrous oxide emissions, accounting for 37.08%, followed by the energy sector at 31.54%, the IPPU sector at 28.17%, and the waste sector at 3.21%.

Compared with 2023, nitrous oxide emissions in 2024 decreased by 5.71%, with emissions from the energy sector decreasing by 3.22%, emissions from the IPPU sector decreasing by 15.70%, emissions from the agriculture sector increasing by 0.49%, and emissions from the waste sector increasing by 1.71%.

4. Fluorinated Gas Emissions

In Taiwan, fluorinated greenhouse gases are primarily used in key industries that support economic development, including the semiconductor, optoelectronics, power facilities, and magnesium alloy industries, which are characterized by relatively concentrated emissions. Emissions of fluorinated greenhouse gases are presented in Table ES2.5. In particular, hydrofluorocarbons (HFCs) emissions increased from 633 kilotons of carbon dioxide equivalent in 1993 to 1,807 kilotons of carbon dioxide equivalent in 2024. Perfluorocarbons (PFCs) emissions increased from 2 kilotons of carbon dioxide equivalent in 1999 to 876 kilotons of carbon dioxide equivalent in 2024. Sulfur hexafluoride (SF_6) emissions increased from 120 kilotons of carbon dioxide equivalent in 1999 to 542 kilotons of carbon dioxide equivalent in 2024. Nitrogen trifluoride (NF_3) emissions increased from 10 kilotons of carbon dioxide equivalent in 1999 to 695 kilotons of carbon dioxide equivalent in 2024.

Regarding total fluorinated greenhouse gas emissions, emissions decreased from 9,218 kilotons of carbon dioxide equivalent in 2005 (approximately 3.16% of total greenhouse gas emissions in that year) to 3,920 kilotons of carbon dioxide equivalent in 2024 (approximately 1.44% of total greenhouse gas emissions in 2024), representing a reduction of 57.47% and an average annual negative growth rate of 4.40%.

Compared with 2023, fluorinated greenhouse gas emissions in 2024 increased by 16.01%. Among them, hydrofluorocarbons (HFCs) increased by 8.12%, while perfluorocarbons (PFCs) decreased by 0.28%, and sulfur hexafluoride (SF_6) increased by 12.72%, mainly due to increased emissions from magnesium production in the metal industry. In addition, driven by the advancement of artificial intelligence technologies and the expansion of semiconductor manufacturing capacity, nitrogen trifluoride (NF_3) emissions increased significantly by 99.49%.

Table ES2.4 1990–2024 Nitrous Oxide Emissions in Taiwan

(Unit: Kilotons of Carbon Dioxide Equivalents)

GHG Emission Sources and Sinks	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1. Energy Sector	478	516	583	628	664	698	743	785	834	888	966	1,004
1.A.1 Energy Industry	124	141	164	185	200	218	248	276	307	340	401	435
1.A.2 Manufacturing and Construction Industry	80	84	91	91	93	96	100	107	109	118	129	133
1.A.3 Transportation	259	275	314	340	357	372	381	389	406	417	423	422
1.A.4 Other Sectors	15	15	14	12	14	13	14	12	12	13	14	14
1.A.5 Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
1.B.1 Solid Fuel	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
1.B.2 Oil and Natural Gas and Other Emissions from Energy Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Industrial Process and Product Use Sector	147	313	289	268	283	307	305	333	340	277	556	635
3. Agriculture Sector	2,225	2,345	2,271	2,308	2,319	2,338	2,394	2,059	1,951	2,011	2,163	2,039
3.B Manure Management	129	146	145	147	154	160	167	143	129	137	140	135
3.D Agricultural Soils	2,086	2,192	2,113	2,155	2,159	2,176	2,225	1,914	1,820	1,871	2,019	1,900
3.E Prescribed Burning of Savannahs	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3.F Field Burning of Agricultural Residues	10	7	13	6	6	2	2	2	2	2	4	4
5. Waste Sector	190	181	190	198	200	216	218	213	200	194	186	196
Total Nitrous Oxide Emissionsl	**3,041**	**3,354**	**3,333**	**3,402**	**3,465**	**3,559**	**3,659**	**3,389**	**3,325**	**3,370**	**3,872**	**3,874**
GHG Emission Sources and Sinks	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
1. Energy Sector	1,051	1,107	1,147	1,184	1,213	1,218	1,164	1,136	1,172	1,190	1,172	1,168
1.A.1 Energy Industry	456	513	534	560	586	610	592	570	579	584	580	574
1.A.2 Manufacturing and Construction Industry	141	138	141	141	145	144	134	126	137	144	139	141
1.A.3 Transportation	441	440	456	469	469	452	425	428	444	450	442	442
1.A.4 Other Sectors	14	15	16	15	13	12	13	12	11	11	11	11
1.A.5 Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
1.B.1 Solid Fuel	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
1.B.2 Oil and Natural Gas and Other Emissions from Energy Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Industrial Process and Product Use Sector	661	739	742	891	1,227	1,314	1,104	1,266	1,563	1,605	1,527	1,407
3. Agriculture Sector	2,027	1,840	1,989	1,842	1,869	1,831	1,712	1,750	1,731	1,661	1,684	1,619
3.B Manure Management	131	131	130	136	136	130	129	125	125	126	123	122
3.D Agricultural Soils	1,893	1,706	1,857	1,704	1,731	1,700	1,582	1,624	1,605	1,533	1,559	1,497
3.E Prescribed Burning of Savannahs	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3.F Field Burning of Agricultural Residues	4	2	2	2	2	1	2	1.4	1.5	1.5	1.5	0.9
5. Waste Sector	195	195	185	169	149	149	136	134	133	136	129	122
Total Nitrous Oxide Emissions	**3,934**	**3,881**	**4,064**	**4,087**	**4,458**	**4,512**	**4,116**	**4,286**	**4,599**	**4,592**	**4,512**	**4,316**
GHG Emission Sources and Sinks	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	
1. Energy Sector	1,170	1,168	1,185	1,194	1,180	1,159	1,152	1,145	1,116	1,105	1,070	
1.A.1 Energy Industry	577	566	574	595	609	586	577	591	566	564	537	
1.A.2 Manufacturing and Construction Industry	136	134	133	125	108	106	104	107	95	86	86	
1.A.3 Transportation	446	457	468	463	453	457	461	437	446	444	436	
1.A.4 Other Sectors	11	11	11	10	10	10	10	10	10	11	11	
1.A.5 Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
1.B.1 Solid Fuel	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
1.B.2 Oil and Natural Gas and Other Emissions from Energy Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
2. Industrial Process and Product Use Sector	1,384	1,378	1,550	1,729	1,838	1,743	1,709	2,227	1,526	1,134	956	
3. Agriculture Sector	1,594	1,562	1,568	1,503	1,453	1,387	1,439	1,346	1,291	1,252	1,258	
3.B Manure Management	121	121	122	123	125	129	130	130	130	131	131	
3.D Agricultural Soils	1,472	1,440	1,445	1,378	1,327	1,257	1,309	1,216	1,161	1,120	1,127	
3.E Prescribed Burning of Savannahs	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
3.F Field Burning of Agricultural Residues	1.0	1.2	0.9	1.0	0.7	0.6	0.2	0.2	0.2	0.3	0.1	
5. Waste Sector	121	124	121	122	126	120	121	121	114	107	109	
Total Nitrous Oxide Emissions	**4,269**	**4,233**	**4,425**	**4,548**	**4,597**	**4,409**	**4,421**	**4,839**	**4,048**	**3,598**	**3,392**	

Note: 1. NE (not estimated) refers to the exclusion of estimation on existing emissions and sequestration.
2. NO (not happened) means that the emission source is not produced or used.

ES.3 Emission Estimation and Trends Overview for Emission Source and Sinks Classification

Of all sectors, the energy sector has consistently been the largest source of greenhouse gas emissions in Taiwan over the years. In 2005 and 2024, greenhouse gas emissions (excluding LULUCF) from the energy sector accounted for approximately 85.74% and 90.50% of total emissions, respectively. The IPPU sector accounted for 9.69% and 7.39%, the agriculture sector accounted for 1.51% and 1.21%, and the waste sector accounted for 3.06% and 0.90%, as shown in Figure ES3.1.

The greenhouse gas emissions and trends by sector in Taiwan from 1990 to 2024 are presented in Figure ES3.2 and Table ES3.1. Total greenhouse gas emissions in 2024 decreased by 1.76% compared with 2023. In particular, emissions from the energy sector decreased by 2.07%, while emissions from the IPPU sector increased by 1.16%, the agriculture sector increased by 0.44%, and the waste sector increased by 3.71%. In addition, carbon removals from the LULUCF sector increased by 0.19%.

Table ES2.5 1990–2024 Fluorinated Greenhouse Gas Emissions in Taiwan

(Unit: Kilotons of Carbon Dioxide Equivalents))

GHG Emission Sources and Sinks	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Total HFCs Emissions	NE	NE	NE	633	716	678	1,113	1,271	1,794	1,413	2,024	2,293
2.B Chemical Industry	NE	NE	NE	633	716	671	1,094	1,238	1,745	1,348	1,943	2,151
2.E Electronics Industry	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	43
2.F Product Uses as Substitutes for ODS	NE	NE	NE	NE	0.2	6	19	33	49	65	82	99
Total PFCs Emissions (2.E Electronics Industry)	NE	NE	NE	NE	NE	NE	NE	NE	NE	2	12	2,665
Total SF_6 Emissions	NE	NE	NE	NE	NE	NE	NE	NE	NE	120	124	769
2.C Metal Industry	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2.E Electronics Industry	NE	NE	NE	NE	NE	NE	NE	NE	NE	120	124	769
2.G Other Product Manufacture and Use	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Total NF_3 Emissions (2.E Electronics Industry)	NE	NE	NE	NE	NE	NE	NE	NE	NE	10	9	220
Total Fluoride-Containing Gas Emissions	**NE**	**NE**	**NE**	**633**	**716**	**678**	**1,113**	**1,271**	**1,794**	**1,545**	**2,169**	**5,946**
GHG Emission Sources and Sinks	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Total HFCs Emissions	1,973	1,806	1,642	271	298	370	326	377	369	350	453	582
2.B Chemical Industry	1,807	1,623	1,433	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.E Electronics Industry	49	49	49	85	100	167	123	172	169	144	104	173
2.F Product Uses as Substitutes for ODS	116	134	160	186	198	203	203	205	201	206	349	409
Total PFCs Emissions (2.E Electronics Industry)	3,764	3,814	3,949	3,178	3,355	3,102	1,932	1,464	1,650	1,665	1,054	1,253
Total SF_6 Emissions	3,986	4,471	5,288	5,052	3,940	3,485	3,001	2,527	2,286	1,976	1,909	2,059
2.C Metal Industry	1,009	1,009	1,334	1,046	757	454	149	242	59	52	31	39
2.E Electronics Industry	973	1,458	1,838	2,457	2,389	2,049	1,930	1,561	1,983	1,665	1,678	1,855
2.G Other Product Manufacture and Use	2,003	2,003	2,116	1,549	794	982	923	724	245	260	201	165
Total NF_3 Emissions (2.E Electronics Industry)	373	506	617	716	644	747	191	540	241	393	363	723
Total Fluoride-Containing Gas Emissions	**10,095**	**10,596**	**11,496**	**9,218**	**8,237**	**7,704**	**5,451**	**4,909**	**4,546**	**4,385**	**3,779**	**4,617**
GHG Emission Sources and Sinks	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	
Total HFCs Emissions	677	708	798	924	1,059	1,187	1,320	1,446	1,594	1,672	1,807	
2.B Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
2.E Electronics Industry	184	142	160	169	169	152	161	156	151	110	120	
2.F Product Uses as Substitutes for ODS	493	566	638	754	890	1,035	1,159	1,290	1,443	1,561	1,687	
Total PFCs Emissions (2.E Electronics Industry)	1,449	1,250	1,336	1,304	1,421	1,315	1,336	1,354	1,250	878	876	
Total SF_6 Emissions	1,807	1,569	1,458	1,459	1,342	963	867	882	660	481	542	
2.C Metal Industry	58	44	39	61	84	45	37	62	27	22	109	
2.E Electronics Industry	1,600	1,393	1,334	1,317	1,105	805	693	716	507	374	359	
2.G Other Product Manufacture and Use	150	132	85	81	154	113	137	103	127	85	74	
Total NF_3 Emissions (2.E Electronics Industry)	624	626	442	412	477	443	528	556	455	348	695	
Total Fluoride-Containing Gas Emissions	**4,558**	**4,152**	**4,034**	**4,099**	**4,298**	**3,908**	**4,051**	**4,237**	**3,959**	**3,379**	**3,920**	

Note: 1. NO (not happened) means that the emission source is not produced or used.
2. NE (Not Estimated) means that there is no estimate for existing GHG emission source or sink.

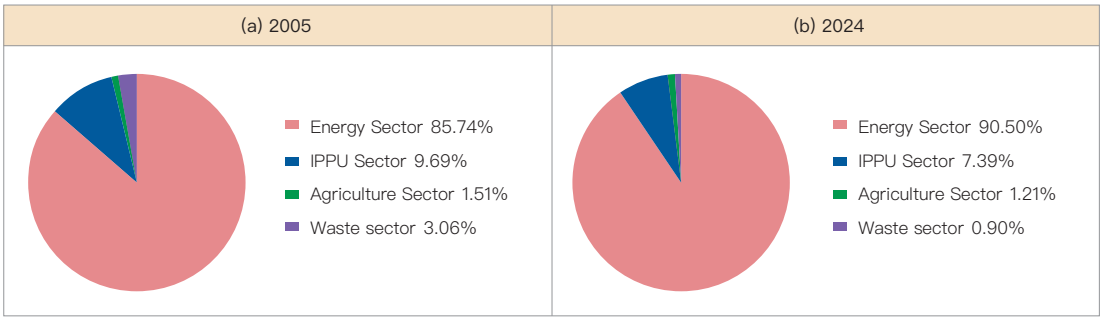

Figure ES3.1 Percentage of Greenhouse Gas Emissions (exclude LULUCF) by Sectors in Taiwan in (a) 2005 and (b) 2024.

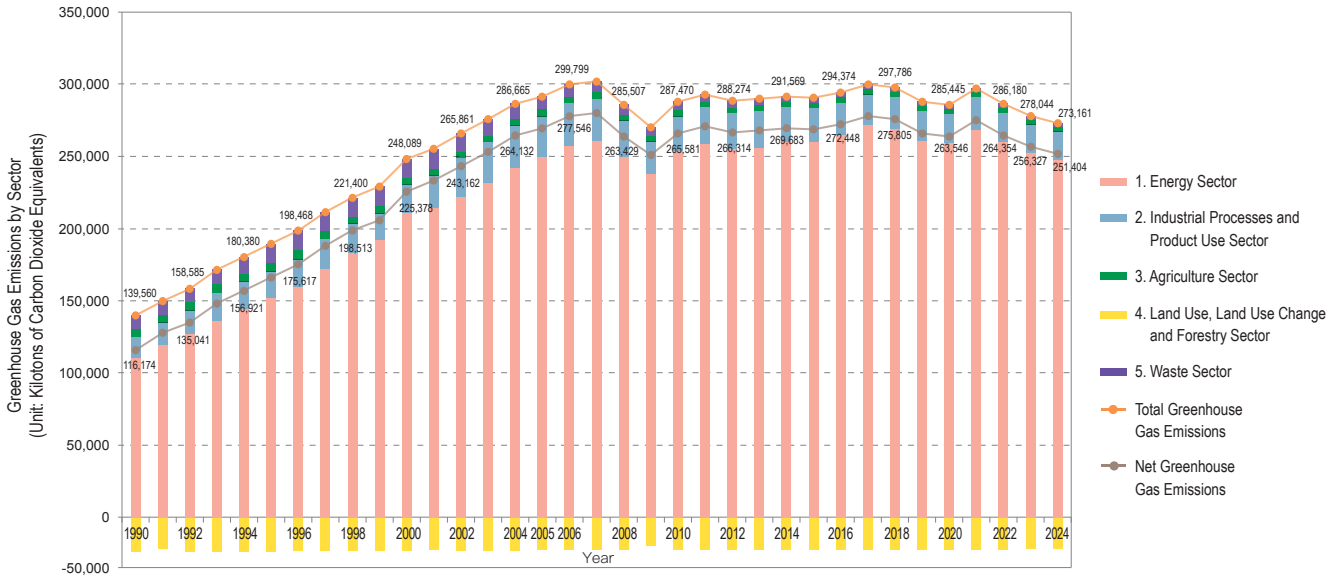

Figure ES3.2 1990–2024 Trends in Greenhouse Gas Emission by Sector in Taiwan

Table ES3.1 1990–2024 Greenhouse Gas Emission in Taiwan by Sector

(Unit: Kilotons of Carbon Dioxide Equivalents)

GHG Emission Sources and Sinks	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1. Energy Sector	110,536	119,525	127,198	136,407	144,359	152,110	159,910	172,204	182,963	191,980	210,357	214,224
2. IPPU Sector	14,715	15,333	16,229	19,322	18,842	18,532	19,114	21,107	20,562	19,021	20,135	22,793
3. Agriculture Sector	5,630	5,964	5,791	5,826	5,827	5,938	5,999	5,185	4,781	4,949	5,107	4,850
4. LULUCF Sector	−23,386	−21,490	−23,544	−23,546	−23,459	−23,340	−22,851	−23,060	−22,887	−22,762	−22,711	−21,842
5. Waste Sector	8,679	8,853	9,367	10,397	11,352	13,177	13,444	12,564	13,093	12,821	12,490	13,382
Net GHG Emission (including LULUCF)	**116,174**	**128,184**	**135,041**	**148,407**	**156,921**	**166,417**	**175,617**	**188,001**	**198,513**	**206,010**	**225,378**	**233,407**
Total GHG Emission (excluding LULUCF)	**139,560**	**149,675**	**158,585**	**171,953**	**180,380**	**189,757**	**198,468**	**211,061**	**221,400**	**228,771**	**248,089**	**255,249**
GHG Emission Sources and Sinks	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
1. Energy Sector	221,864	231,695	241,859	249,889	257,285	261,174	249,425	237,717	253,632	259,066	255,163	256,081
2. IPPU Sector	26,859	28,508	29,634	28,231	29,887	29,105	25,314	22,676	24,458	24,965	24,700	25,657
3. Agriculture Sector	4,686	4,373	4,436	4,399	4,390	4,259	4,071	4,053	4,028	3,992	3,990	3,901
4. LULUCF Sector	−22,699	−22,615	−22,534	−22,282	−22,253	−22,068	−22,077	−19,384	−21,889	−21,947	−21,960	−21,974
5. Waste Sector	12,453	11,505	10,737	8,916	8,237	7,534	6,696	5,836	5,351	4,942	4,420	4,079
Net GHG Emission (including LULUCF)	**243,162**	**253,466**	**264,132**	**269,153**	**277,546**	**280,003**	**263,429**	**250,898**	**265,581**	**271,018**	**266,314**	**267,744**
Total GHG Emission (excluding LULUCF)	**265,861**	**276,081**	**286,665**	**291,435**	**299,799**	**302,072**	**285,507**	**270,282**	**287,470**	**292,965**	**288,274**	**289,718**
GHG Emission Sources and Sinks	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	
1. Energy Sector	260,465	260,486	265,031	271,526	269,177	260,820	259,407	268,936	260,008	252,436	247,219	
2. IPPU Sector	23,674	22,814	22,206	21,486	22,191	20,570	19,789	22,165	20,287	19,965	20,197	
3. Agriculture Sector	3,814	3,757	3,767	3,700	3,647	3,590	3,641	3,487	3,366	3,276	3,290	
4. LULUCF Sector	−21,886	−21,900	−21,926	−21,961	−21,980	−21,915	−21,899	−21,843	−21,826	−21,717	−21,757	
5. Waste Sector	3,616	3,259	3,370	3,163	2,771	2,658	2,608	2,626	2,519	2,367	2,455	
Net GHG Emission (including LULUCF)	**269,683**	**268,415**	**272,448**	**277,915**	**275,805**	**265,724**	**263,546**	**275,371**	**264,354**	**256,327**	**251,404**	
Total GHG Emission (excluding LULUCF)	**291,569**	**290,316**	**294,374**	**299,876**	**297,786**	**287,639**	**285,445**	**297,214**	**286,180**	**278,044**	**273,161**	

Compared with 2005, total greenhouse gas emissions in 2024 decreased by 6.27%. By sector, emissions from the energy sector decreased by 1.07%, emissions from the IPPU sector decreased by 28.46%, emissions from the agriculture sector decreased by 25.21%, and emissions from the waste sector decreased by 72.47%. In addition, carbon removals from the LULUCF sector decreased by 2.35%, as shown in Figure ES3.3.

1. Energy sector

Greenhouse gas emissions from the energy sector during the period 1990—2024 are presented in Table ES3.2. Compared with 1990, greenhouse gas emissions from the energy sector in 2024 increased by 123.66%, with an average annual growth rate of 2.40%. During this period, greenhouse gas emissions from the energy sector showed a downward trend for the first time in 2008, followed by further declines in 2009, 2012, and during the period from 2018 to 2020. Compared with 2023, greenhouse gas emissions from the energy sector in 2024 decreased by 2.07%.

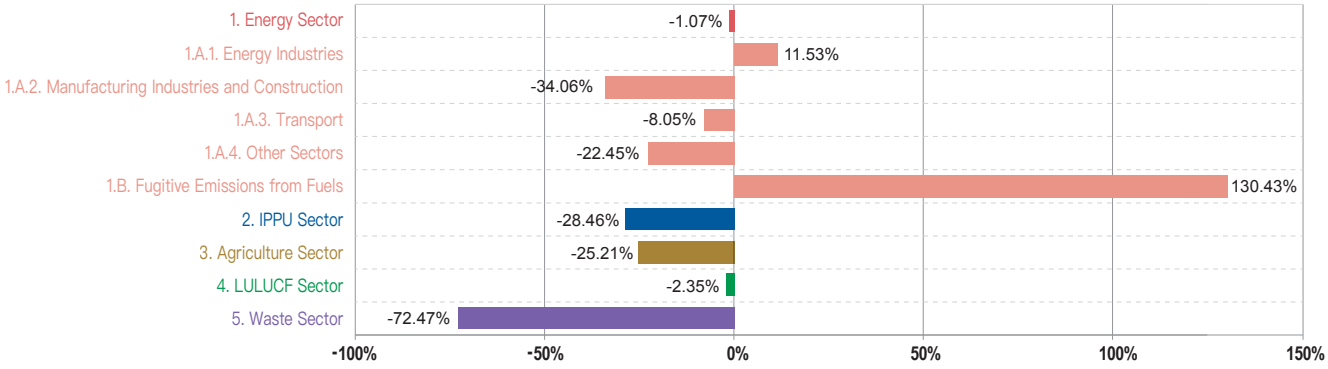

Figure ES3.3 Changes in Greenhouse Gas Emissions and Sequestrations by Sectors in Taiwan from 2005 to 2024.

Table ES3.2 1990–2024 Greenhouse Gas Emissions Produced by Energy Sector in Taiwan

(Unit: Kilotons of Carbon Dioxide Equivalents)

GHG Emission Sources and Sinks	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Total CO_2 Emission	109,465	118,443	126,058	135,206	143,103	150,810	158,579	170,835	181,518	190,446	208,724	212,554
1.A.1 Energy Industry	49,123	55,126	57,508	64,745	69,487	75,214	80,103	90,168	99,375	104,827	119,268	123,880
1.A.2 Manufacturing and Construction Industry	30,124	31,963	34,410	34,835	35,876	36,956	37,942	40,323	40,360	42,269	45,284	44,234
1.A.3 Transportation	19,646	20,888	24,033	26,103	27,540	28,822	29,801	30,536	31,844	32,772	33,207	33,267
1.A.4 Others Sectors	10,572	10,466	10,107	9,523	10,200	9,819	10,733	9,808	9,939	10,579	10,965	11,174
1.A.5 Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
1.B.1 Solid Fuels	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
1.B.2 Oil and Natural Gas and Other Emissions from Energy Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total CH_4 Emission	592	567	558	573	592	602	589	585	611	646	667	665
1.A.1 Energy Industry	29	33	32	36	41	49	51	58	66	80	92	103
1.A.2 Manufacturing and Construction Industry	51	54	58	58	60	62	65	68	70	75	84	88
1.A.3 Transportation	170	183	209	226	241	256	268	275	288	298	303	305
1.A.4 Others Sectors	34	33	31	29	31	30	33	29	30	31	33	34
1.A.5 Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
1.B.1 Solid Fuels	182	155	129	126	110	90	57	38	30	35	32	NO
1.B.2 Oil and Natural Gas and Other Emissions from Energy Production	127	109	98	97	108	115	115	117	128	126	124	136
Total N_2O Emission	478	516	583	628	664	698	743	785	834	888	966	1,004
1.A.1 Energy Industry	124	141	164	185	200	218	248	276	307	340	401	435
1.A.2 Manufacturing and Construction Industry	80	84	91	91	93	96	100	107	109	118	129	133
1.A.3 Transportation	259	275	314	340	357	372	381	389	406	417	423	422
1.A.4 Others Sectors	15	15	14	12	14	13	14	12	12	13	14	14
1.A.5 Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
1.B.1 Solid Fuels	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
1.B.2 Oil and Natural Gas and Other Emissions from Energy Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total Emission from Energy Sector	**110,536**	**119,525**	**127,198**	**136,407**	**144,359**	**152,110**	**159,910**	**172,204**	**182,963**	**191,980**	**210,357**	**214,224**

Continued from the table below

Continued from the table

GHG Emission Sources and Sinks	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total CO_2 Emission	220,123	229,841	239,929	247,956	255,330	259,215	247,537	235,868	251,708	257,097	253,201	254,109
1.A.1 Energy Industry	128,157	139,316	147,288	155,014	162,298	168,580	162,125	153,989	164,270	168,491	166,837	167,023
1.A.2 Manufacturing and Construction Industry	46,373	44,211	44,551	44,008	45,309	44,845	41,410	37,874	42,612	43,691	42,515	43,307
1.A.3 Transportation	34,542	34,509	35,859	36,846	36,771	35,419	33,216	33,541	34,652	35,107	34,284	34,209
1.A.4 Others Sectors	11,052	11,806	12,230	12,089	10,952	10,371	10,785	10,463	10,174	9,808	9,566	9,571
1.A.5 Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
1.B.1 Solid Fuels	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
1.B.2 Oil and Natural Gas and Other Emissions from Energy Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total CH_4 Emission	689	746	782	749	743	741	724	713	753	779	789	804
1.A.1 Energy Industry	103	119	123	126	131	135	134	125	131	132	132	131
1.A.2 Manufacturing and Construction Industry	94	92	95	95	97	97	91	86	93	99	96	98
1.A.3 Transportation	311	321	330	339	333	324	308	314	319	322	318	318
1.A.4 Others Sectors	33	36	37	37	33	30	32	31	30	29	28	28
1.A.5 Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
1.B.1 Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2 Oil and Natural Gas and Other Emissions from Energy Production	148	178	197	153	148	155	159	157	180	197	216	228
Total N_2O Emission	1,051	1,107	1,147	1,184	1,213	1,218	1,164	1,136	1,172	1,190	1,172	1,168
1.A.1 Energy Industry	456	513	534	560	586	610	592	570	579	584	580	574
1.A.2 Manufacturing and Construction Industry	141	138	141	141	145	144	134	126	137	144	139	141
1.A.3 Transportation	441	440	456	469	469	452	425	428	444	450	442	442
1.A.4 Others Sectors	14	15	16	15	13	12	13	12	11	11	11	11
1.A.5 Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
1.B.1 Solid Fuels	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
1.B.2 Oil and Natural Gas and Other Emissions from Energy Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total Emission from Energy Sector	**221,864**	**231,695**	**241,859**	**249,889**	**257,285**	**261,174**	**249,425**	**237,717**	**253,632**	**259,066**	**255,163**	**256,081**

GHG Emission Sources and Sinks	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	
Total CO_2 Emission	258,480	258,475	262,982	269,461	267,142	258,811	257,390	266,922	258,012	250,454	245,271	
1.A.1 Energy Industry	173,749	173,697	177,211	185,763	187,957	180,289	179,510	188,460	181,773	176,783	172,978	
1.A.2 Manufacturing and Construction Industry	40,384	39,575	39,653	38,112	34,729	33,809	32,777	35,331	32,165	29,494	29,025	
1.A.3 Transportation	34,666	35,506	36,584	36,202	35,202	35,438	35,715	33,905	34,696	34,616	33,892	
1.A.4 Others Sectors	9,681	9,698	9,533	9,384	9,254	9,275	9,387	9,227	9,378	9,562	9,376	
1.A.5 Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
1.B.1 Solid Fuels	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
1.B.2 Oil and Natural Gas and Other Emissions from Energy Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
Total CH_4 Emission	815	843	864	871	855	851	865	870	879	877	878	
1.A.1 Energy Industry	134	139	139	140	142	139	137	140	137	139	140	
1.A.2 Manufacturing and Construction Industry	95	94	94	89	77	76	75	77	69	64	64	
1.A.3 Transportation	320	327	337	331	321	321	325	301	309	311	295	
1.A.4 Others Sectors	29	28	28	27	27	27	27	27	27	28	28	
1.A.5 Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
1.B.1 Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
1.B.2 Oil and Natural Gas and Other Emissions from Energy Production	238	254	267	284	288	288	302	325	337	335	352	
Total N_2O Emission	1,170	1,168	1,185	1,194	1,180	1,159	1,152	1,145	1,116	1,105	1,070	
1.A.1 Energy Industry	577	566	574	595	609	586	577	591	566	564	537	
1.A.2 Manufacturing and Construction Industry	136	134	133	125	108	106	104	107	95	86	86	
1.A.3 Transportation	446	457	468	463	453	457	461	437	446	444	436	
1.A.4 Others Sectors	11	11	11	10	10	10	10	10	10	11	11	
1.A.5 Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
1.B.1 Solid Fuels	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	
1.B.2 Oil and Natural Gas and Other Emissions from Energy Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	
Total Emission from Energy Sector	**260,465**	**260,486**	**265,031**	**271,526**	**269,177**	**260,820**	**259,407**	**268,936**	**260,008**	**252,436**	**247,219**	

Note: 1. NO (not happened) means that the emission source is not produced or used.
2. NE (Not Estimated) means that there is no estimate for existing GHG emission source or sink.

In 2005, greenhouse gas emissions from the energy sector amounted to 249,889 kilotons of carbon dioxide equivalent. By 2024, emissions had decreased slightly to 247,219 kilotons of carbon dioxide equivalent, representing a decrease of 1.07% and an average annual negative growth rate of 0.06%. Specifically, emissions from category 1.A.1 "Energy Industries" increased by 11.53%, while emissions from 1.A.2 "Manufacturing Industries and Construction" decreased by 34.06%, emissions from 1.A.3 "Transport" decreased by 8.05%, emissions from 1.A.4 "Other Sectors" (including commercial/institutional, residential, and agriculture/forestry/fishing) decreased by 22.45%, and emissions from 1.B.2 "Oil and Natural Gas and Other Emissions from Energy Production" increased by 130.43%. The substantial increase in emissions from category 1.B.2 was mainly attributable to the expansion of natural gas supply and consumption in recent years, which led to increased fugitive emissions during natural gas transmission and storage.

In 2024, greenhouse gas emissions from the energy sector accounted for 90.50% of Taiwan's total greenhouse gas emissions. In particular, category 1.A.1 "Energy Industries" was responsible for 173,655 kilotons of carbon dioxide equivalent, accounting for 70.24% of total greenhouse gas emissions from the energy sector. Category 1.A.2 "Manufacturing Industries and Construction" was responsible for 29,175 kilotons of carbon dioxide equivalent (11.80%), category 1.A.3 "Transport" for 34,622 kilotons of carbon dioxide equivalent (14.01%), category 1.A.4 "Other Sectors" (including commercial/institutional, residential, and agriculture/forestry/fishing) for 9,415 kilotons of carbon dioxide equivalent (3.81%), and category 1.B.2 "Oil and Natural Gas and Other Emissions from Energy Production" for 352 kilotons of carbon dioxide equivalent (0.14%), as shown in Figure ES3.4.

2. Industrial Process and Product Use (IPPU) Sector

Greenhouse gas emissions from the IPPU sector during the period 1990—2024 are presented in Table ES3.3. Compared with 1990, greenhouse gas emissions from the IPPU sector in 2024 increased by 37.25%, with an average annual growth rate of 0.94%. Compared with 2023, emissions increased by 1.16% in 2024.

In 2005, greenhouse gas emissions from the IPPU sector amounted to 28,231 kilotons of carbon dioxide equivalent. By 2024, emissions had decreased to 20,197 kilotons of carbon dioxide equivalent, representing a reduction of 28.46% and an average annual negative growth rate of 1.75%. Specifically, emissions from category 2.A "Mineral Industry" decreased by 46.30%, emissions from 2.B "Chemical Industry" decreased by 34.27%, emissions from 2.C "Metal Industry" increased by 33.58%, emissions from 2.D "Non-Energy Products from Fuels and Solvent Use" decreased by 39.31%, emissions from 2.E "Electronics Industry" decreased by 61.64%, emissions from 2.F "Product Uses as Substitutes for Ozone Depleting Substances(ODS)" increased by 808.43%, emissions from 2.G "Other Product Manufacture and Use" decreased by 95.23%, and emissions from 2.H "Other" decreased by 31.03%.

In 2024, greenhouse gas emissions from the IPPU sector accounted for 7.39% of Taiwan's total greenhouse gas emissions. Category 2.C "Metal Industry" was responsible for 8,164 kilotons of carbon dioxide equivalent, accounting for 40.42% of total greenhouse gas emissions from the IPPU sector and representing the

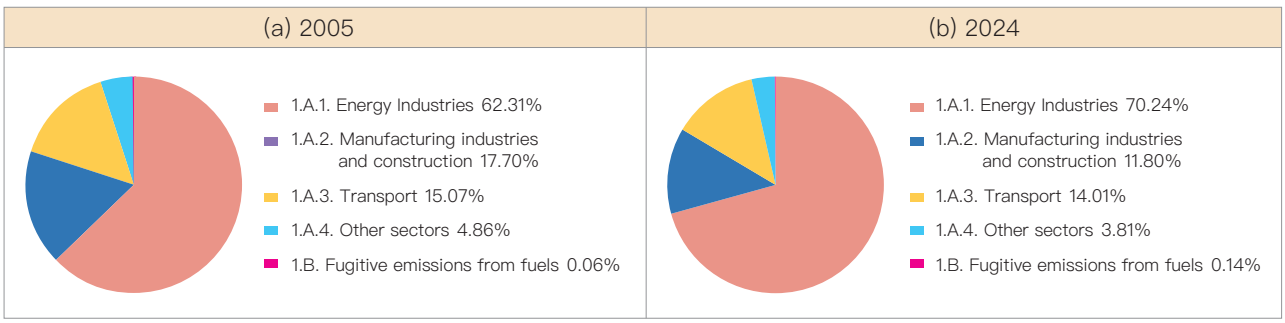

Figure ES3.4 Percentage of Greenhouse Gas Emissions by Energy Sectors in Taiwan in (a)2005 and (b)2024.

Table ES3.3 1990–2024 Greenhouse Gas Emissions Produced by Industrial Process and Product Use Sector (IPPU) in Taiwan

(Unit: Kilotons of Carbon Dioxide Equivalents)

GHG Emission Sources and Sinks	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Total CO_2 Emission	14,562	15,013	15,932	18,414	17,834	17,536	17,684	19,490	18,416	17,185	17,395	16,191
2.A Mining Industry	10,688	10,703	11,861	13,885	13,266	12,773	12,652	13,400	11,571	10,753	10,493	9,980
2.B Chemical Industry	575	551	575	617	770	858	999	1,026	1,007	1,079	1,148	1,232
2.C Metal Industry	3,275	3,735	3,474	3,888	3,774	3,884	4,013	5,045	5,817	5,333	5,734	4,960
2.D Non-Energy Products from Fuels and Solvent Use	0.00006	0.00006	0.00006	0.00007	0.00009	0.00008	0.00008	0.00008	0.00009	0.00009	0.00008	0.00007
2.G Other Product Manufacture and Use	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2.H Other	23	23	23	24	23	21	20	19	22	21	20	20
Total CH_4 Emission	6	8	7	8	9	11	13	13	11	13	15	20
2.B Chemical Industry	6	6	6	7	8	10	12	12	10	13	15	20
2.C Metal Industry	0.2	2.0	1.5	1.2	1.0	1.4	1.3	1.3	1.3	0.4	0.2	0.1
Total N_2O Emission	147	313	289	268	283	307	305	333	340	277	556	635
2.B Chemical Industry	147	313	289	268	283	307	305	333	340	277	556	635
2.E Electronics Industry	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Total HFCs Emission	NE	NE	NE	633	716	678	1,113	1,271	1,794	1,413	2,024	2,293
2.B Chemical Industry	NE	NE	NE	633	716	671	1,094	1,238	1,745	1,348	1,943	2,151
2.E Electronics Industry	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	43
2.F Product Uses as Substitutes for ODS	NE	NE	NE	NE	0.2	6	19	33	49	65	82	99
Total PFCs Emission (2.E Electronics Industry)	NE	NE	NE	NE	NE	NE	NE	NE	NE	2	12	2,665
Total SF_6 Emission	NE	NE	NE	NE	NE	NE	NE	NE	NE	120	124	769
2.C Metal Industry	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2.E Electronics Industry	NE	NE	NE	NE	NE	NE	NE	NE	NE	120	124	769
2.G Other Product Manufacture and Use	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Total NF_3 Emission (2.E Electronics Industry)	NE	NE	NE	NE	NE	NE	NE	NE	NE	10	9	220
Total Emission from IPPU Sector	14,715	15,333	16,229	19,322	18,842	18,532	19,114	21,107	20,562	19,021	20,135	22,793

GHG Emission Sources and Sinks	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total CO_2 Emission	16,082	17,149	17,365	18,101	20,404	20,060	18,734	16,474	18,321	18,951	19,369	19,605
2.A Mining Industry	10,654	10,347	10,698	11,265	11,029	10,373	9,380	8,462	8,618	9,574	9,333	9,866
2.B Chemical Industry	1,313	1,384	1,485	1,751	1,721	1,845	1,601	1,601	1,778	1,737	1,714	1,749
2.C Metal Industry	4,096	5,399	5,162	5,066	7,633	7,823	7,733	6,389	7,905	7,620	8,301	7,970
2.D Non-Energy Products from Fuels and Solvent Use	0.00008	0.00009	0.00011	0.00010	0.00007	0.00007	0.00007	0.00006	0.00005	0.00004	0.00004	0.00005
2.G Other Product Manufacture and Use	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2.H Other	18	18	19	20	21	20	20	21	20	20	21	19
Total CH_4 Emission	21	24	31	20	20	26	25	27	26	25	26	28
2.B Chemical Industry	21	24	31	20	20	26	24	27	26	25	26	28
2.C Metal Industry	0.2	0.2	NO	NO	NO	NO	0.9	0.00008	0.2	0.02	0.07	0.1
Total N_2O Emission	661	739	742	891	1,227	1,314	1,104	1,266	1,563	1,605	1,527	1,407
2.B Chemical Industry	661	739	742	854	861	886	697	895	1,040	1,062	904	694
2.E Electronics Industry	NE	NE	NE	37	365	428	407	371	523	543	623	713
Total HFCs Emission	1,973	1,806	1,642	271	298	370	326	377	369	350	453	582
2.B Chemical Industry	1,807	1,623	1,433	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.E Electronics Industry	49	49	49	85	100	167	123	172	169	144	104	173
2.F Product Uses as Substitutes for ODS	116	134	160	186	198	203	203	205	201	206	349	409
Total PFCs Emission (2.E Electronics Industry)	3,764	3,814	3,949	3,178	3,355	3,102	1,932	1,464	1,650	1,665	1,054	1,253
Total SF_6 Emission	3,986	4,471	5,288	5,052	3,940	3,485	3,001	2,527	2,286	1,976	1,909	2,059
2.C Metal Industry	1,009	1,009	1,334	1,046	757	454	149	242	59	52	31	39
2.E Electronics Industry	973	1,458	1,838	2,457	2,389	2,049	1,930	1,561	1,983	1,665	1,678	1,855
2.G Other Product Manufacture and Use	2,003	2,003	2,116	1,549	794	982	923	724	245	260	201	165
Total NF_3 Emission (2.E Electronics Industry)	373	506	617	716	644	747	191	540	241	393	363	723
Total Emission from IPPU Sector	26,859	28,508	29,634	28,231	29,887	29,105	25,314	22,676	24,458	24,965	24,700	25,657

Continued from the table below

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GHG Emission Sources and Sinks	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Total CO_2 Emission	17,703	17,253	16,592	15,631	16,024	14,889	14,001	15,670	14,778	15,430	15,299
2.A Mining Industry	8,728	8,347	7,117	6,269	6,408	6,500	6,563	6,835	6,473	5,982	6,050
2.B Chemical Industry	1,884	1,842	1,760	1,709	1,684	1,666	1,550	1,730	1,270	1,192	1,182
2.C Metal Industry	7,072	7,044	7,696	7,634	7,913	6,706	5,870	7,090	7,020	8,242	8,054
2.D Non-Energy Products from Fuels and Solvent Use	0.00006	0.00010	0.00008	0.00007	0.00006	0.00006	0.00006	0.00007	0.00006	0.00006	0.00006
2.G Other Product Manufacture and Use	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2.H Other	19	20	19	20	19	17	18	15	15	15	14
Total CH_4 Emission	29	29	30	27	30	29	28	29	24	23	22
2.B Chemical Industry	29	29	30	27	30	29	28	29	24	23	22
2.C Metal Industry	0.2	0.2	0.2	0.0001	0.01	0.01	0.0001	NO	NO	0.0003	0.001
Total N_2O Emission	1,384	1,378	1,550	1,729	1,838	1,743	1,709	2,227	1,526	1,134	956
2.B Chemical Industry	647	614	854	991	987	828	541	1,053	679	531	521
2.E Electronics Industry	737	764	696	738	851	916	1,168	1,174	847	602	434
Total HFCs Emission	677	708	798	924	1,059	1,187	1,320	1,446	1,594	1,672	1,807
2.B Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.E Electronics Industry	184	142	160	169	169	152	161	156	151	110	120
2.F Product Uses as Substitutes for ODS	493	566	638	754	890	1,035	1,159	1,290	1,443	1,561	1,687
Total PFCs Emission (2.E Electronics Industry)	1,449	1,250	1,336	1,304	1,421	1,315	1,336	1,354	1,250	878	876
Total SF_6 Emission	1,807	1,569	1,458	1,459	1,342	963	867	882	660	481	542
2.C Metal Industry	58	44	39	61	84	45	37	62	27	22	109
2.E Electronics Industry	1,600	1,393	1,334	1,317	1,105	805	693	716	507	374	359
2.G Other Product Manufacture and Use	150	132	85	81	154	113	137	103	127	85	74
Total NF_3 Emission (2.E Electronics Industry)	624	626	442	412	477	443	528	556	455	348	695
Total Emission from IPPU Sector	23,674	22,814	22,206	21,486	22,191	20,570	19,789	22,165	20,287	19,965	20,197

Note: 1. NE (Not Estimated) means that there is no estimate for existing GHG emission source or sink.
2. NO (not happened) means that the emission source is not produced or used. For example, HCFC-22 has been put into production since 1993 and was discontinued in 2005.

largest share. This was followed by category 2.A "Mineral Industry" with 6,050 kilotons of carbon dioxide equivalent (29.95%), category 2.E "Electronics Industry" with 2,484 kilotons of carbon dioxide equivalent (12.30%), category 2.B "Chemical Industry" with 1,725 kilotons of carbon dioxide equivalent (8.54%), category 2.F "Product Uses as Substitutes for Ozone Depleting Substances(ODS)" with 1,687 kilotons of carbon dioxide equivalent (8.35%), category 2.G "Other Product Manufacture and Use" with 74 kilotons of carbon dioxide equivalent (0.37%), category 2.H "Other" with 14 kilotons of carbon dioxide equivalent (0.07%), and category 2.D "Non-Energy Products from Fuels and Solvent Use" with 0.00006 kilotons of carbon dioxide equivalent (0.0000003%), as shown in Figure ES3.5.

3. Agriculture Sector

Greenhouse gas emissions from the agriculture sector during the period 1990—2024 are presented in Table ES3.4. Compared with 1990, greenhouse gas emissions from the agriculture sector in 2024 decreased by 41.56%, with an average annual negative growth rate of 1.57%. Compared with 2023, emissions increased slightly by 0.44%.

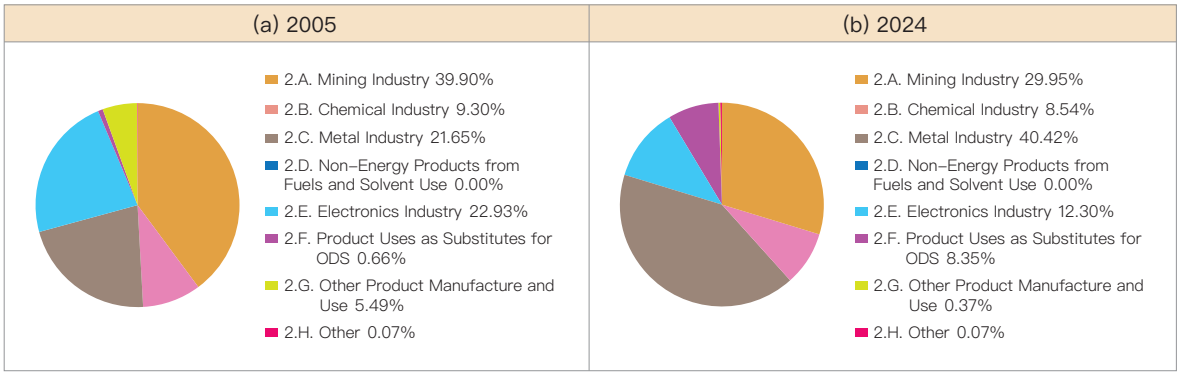

Figure ES3.5 Percentage of Greenhouse Gas Emissions by Industrial Process and Product Use Sectors in Taiwan in (a) 2005 and (b) 2024.

In 2005, greenhouse gas emissions from the agriculture sector were 4,399 kilotons of carbon dioxide equivalent. By 2024, emissions had decreased to 3,290 kilotons of carbon dioxide equivalent, representing a reduction of 25.21% and an average annual negative growth rate of 1.57%. Specifically, emissions from category 3.A "Enteric Fermentation" decreased by 10.91%, while emissions from 3.B"Manure Management" decreased by 22.38%, emissions from 3.C "Rice Cultivation" decreased by 18.31%, emissions from 3.D "Agricultural Soils" decreased by 33.86%, emissions from 3.F "Field Burning of Agricultural Residues"decreased by 94.87%, and emissions from 3.H "Urea Application" decreased by 70.88%, as shown in Table ES3.4.

In 2024, greenhouse gas emissions from the agriculture sector accounted for approximately 1.21% of Taiwan's total greenhouse gas emissions. Among the agricultural emissions, category 3.D "Agricultural Soils" represented the largest share at 34.25%, followed by category 3.B "Manure Management" at 28.48%, category 3.A "Enteric Fermentation" at 18.89%, and category 3.C "Rice Cultivation" at 17.81%. Emissions from category 3.H "Urea Application" and category 3.F "Field Burning of Agricultural Residues" were relatively minor, accounting for 0.55% and 0.02%, respectively, as illustrated in Figure ES3.6.

Table ES3.4 1990–2024 Greenhouse Gas Emissions Produced by Agriculture Sector in Taiwan

(Unit: Kilotons of Carbon Dioxide Equivalents)

GHG Emission Sources and Sinks	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Total CO_2 Emission	142	146	139	131	135	151	151	134	127	118	131	94
3.G Liming	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
3.H Urea Application	142	146	139	131	135	151	151	134	127	118	131	94
3.I Other Carbon-Containing Fertilizers	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Total CH_4 Emission	3,264	3,472	3,381	3,388	3,374	3,449	3,455	2,993	2,703	2,820	2,813	2,717
3.A Enteric Fermentation	750	819	826	868	883	921	921	820	755	778	775	739
3.B Manure Management	1,246	1,460	1,418	1,436	1,470	1,535	1,565	1,190	990	1,088	1,123	1,074
3.C Rice Cultivation	1,226	1,166	1,084	1,059	998	984	961	976	953	947	899	887
3.D Agricultural Soils	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
3.E Prescribed Burning of Savannahs	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
3.F Field Burning of Agricultural Residues	42	28	53	24	23	8	8	8	6	8	15	17
Total N_2O Emission	2,225	2,345	2,271	2,308	2,319	2,338	2,394	2,059	1,951	2,011	2,163	2,039
3.B Manure Management	129	146	145	147	154	160	167	143	129	137	140	135
3.D Agricultural Soils	2,086	2,192	2,113	2,155	2,159	2,176	2,225	1,914	1,820	1,871	2,019	1,900
3.E Prescribed Burning of Savannahs	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
3.F Field Burning of Agricultural Residues	10	7	13	6	6	2	2	2	2	2	4	4
Total Emission From Agriculture Sector	**5,630**	**5,964**	**5,791**	**5,826**	**5,827**	**5,938**	**5,999**	**5,185**	**4,781**	**4,949**	**5,107**	**4,850**

GHG Emission Sources and Sinks	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total CO_2 Emission	93	82	84	62	59	57	57	55	54	53	55	45
3.G Liming	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
3.H Urea Application	93	82	84	62	59	57	57	55	54	53	55	45
3.I Other Carbon-Containing Fertilizers	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Total CH_4 Emission	2,565	2,451	2,363	2,495	2,461	2,371	2,303	2,247	2,244	2,278	2,252	2,237
3.A Enteric Fermentation	712	701	688	698	688	682	655	640	648	660	653	649
3.B Manure Management	1,022	1,019	1,024	1,071	1,058	994	965	924	931	944	904	874
3.C Rice Cultivation	816	721	643	717	706	690	676	678	659	668	688	710
3.D Agricultural Soils	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
3.E Prescribed Burning of Savannahs	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
3.F Field Burning of Agricultural Residues	14	10	9	9	9	5	7	6	6	6	6	4
Total N_2O Emission	2,027	1,840	1,989	1,842	1,869	1,831	1,712	1,750	1,731	1,661	1,684	1,619
3.B Manure Management	131	131	130	136	136	130	129	125	125	126	123	122
3.D Agricultural Soils	1,893	1,706	1,857	1,704	1,731	1,700	1,582	1,624	1,605	1,533	1,559	1,497
3.E Prescribed Burning of Savannahs	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
3.F Field Burning of Agricultural Residues	4	2	2	2	2	1	2	1	1	1	1	1
Total Emission From Agriculture Sector	**4,686**	**4,373**	**4,436**	**4,399**	**4,390**	**4,259**	**4,071**	**4,053**	**4,028**	**3,992**	**3,990**	**3,901**

Continued from the table below

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GHG Emission Sources and Sinks	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Total CO_2 Emission	40	38	34	31	30	29	29	27	22	20	18
3.G Liming	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
3.H Urea Application	40	38	34	31	30	29	29	27	22	20	18
3.I Other Carbon-Containing Fertilizers	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Total CH_4 Emission	2,180	2,157	2,166	2,166	2,165	2,174	2,172	2,115	2,052	2,004	2,014
3.A Enteric Fermentation	634	641	628	632	640	643	650	665	655	643	621
3.B Manure Management	840	834	829	827	832	844	845	842	821	819	806
3.C Rice Cultivation	702	678	705	704	689	684	677	608	576	542	586
3.D Agricultural Soils	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
3.E Prescribed Burning of Savannahs	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
3.F Field Burning of Agricultural Residues	4	5	4	4	3	2	0.8	0.7	0.8	1.3	0.5
Total N_2O Emission	1,594	1,562	1,568	1,503	1,453	1,387	1,439	1,346	1,291	1,252	1,258
3.B Manure Management	121	121	122	123	125	129	130	130	130	131	131
3.D Agricultural Soils	1,472	1,440	1,445	1,378	1,327	1,257	1,309	1,216	1,161	1,120	1,127
3.E Prescribed Burning of Savannahs	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
3.F Field Burning of Agricultural Residues	1	1	1	1.0	0.7	0.6	0.2	0.2	0.2	0.3	0.1
Total Emission From Agriculture Sector	**3,814**	**3,757**	**3,767**	**3,700**	**3,647**	**3,590**	**3,641**	**3,487**	**3,366**	**3,276**	**3,290**

Note: 1. NO (not happened) means that the emission source is not produced or used.
2. NE (Not Estimated) means that there is no estimate for existing GHG emission source or sink.

4 .Land use, land use change and forestry (LULUCF) sector

The main greenhouse gas sequestrated by the land use, land use change and forestry (LULUCF) sector is carbon dioxide, while the change in the annual sequestration does not vary much with the exception of trends in minor fluctuations for the sequestration in the past. It is mainly because of the increased sequestration from the annual growth of forest resources while the sequestration reduced from the increased sequestration of forestation and the forest interference is less. The greenhouse gas emission from land use and forestry sector in Taiwan from 1990 to 2024 (mainly consisting of carbon dioxide sequestration by forestry resources) is shown in Table ES3.5.

The carbon dioxide sequestration between 1990 and 2024 decreased by 6.96%, with an average annual negative growth rate of 0.21%. Compared with 2023, the sequestration in 2024 increased by 0.19%. In 2005, carbon dioxide sequestration was 22,282 kilotons of carbon dioxide equivalent. By 2024, sequestration had decreased to 21,757 kilotons of carbon dioxide equivalent, representing a reduction of 2.35% and an average annual negative growth rate of 0.13%.

5. Waste sector

Greenhouse gas emissions from the waste sector during the period 1990—2024 are presented in Table ES3.6. Compared with 1990, greenhouse gas emissions from the waste sector in 2024 decreased substantially by 71.72%, with an average annual negative growth rate of 3.65%. Compared with 2023, emissions increased by 3.71%.

In 2005, greenhouse gas emissions from the waste sector were 8,916 kilotons of carbon dioxide equivalent. By 2024, emissions had decreased to 2,455 kilotons of

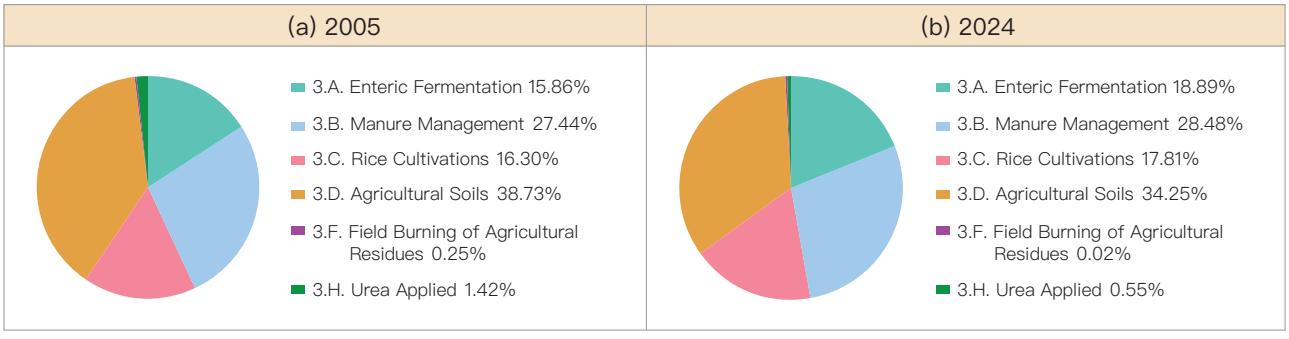

Figure ES3.6 Percentage of Greenhouse Gas Emissions by Agriculture Sectors in Taiwan in (a) 2005 and (b) 2024.

Table ES3.5 1990–2024 Changes in Carbon Sequestration by LULUCF Sector in Taiwan

(Unit: Kilotons of Carbon Dioxide Equivalents)

GHG Emission Sources and Sinks		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
4.A.1 Forest Land Remaining Forest Land	Carbon Sequestration ($\triangle CO_{2G}$)	−23,902	−23,902	−23,741	−23,580	−23,418	−23,257	−23,095	−22,934	−22,772	−22,611	−22,449	−22,288
	Carbon Emissions ($\triangle CO_{2L}$)	607	2,503[1]	333	216	190	202	559	266	326	401	389	1,112[2]
4.A.2 Land Converted to Forest Land	Carbon Sequestration ($\triangle CO_{2B}$)	−91	−91	−136	−182	−230	−285	−315	−392	−440	−551	−650	−666
Total Carbon Sequestration from LULUCF Sector ($\triangle CO_2$)		**-23,386**	**-21,490**	**-23,544**	**-23,546**	**-23,459**	**-23,340**	**-22,851**	**-23,060**	**-22,887**	**-22,762**	**-22,711**	**-21,842**
GHG Emission Sources and Sinks		**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
4.A.1 Forest Land Remaining Forest Land	Carbon Sequestration ($\triangle CO_{2G}$)	−22,127	−21,965	−21,804	−21,642	−21,481	−21,319	−21,158	−20,997	−20,889	−20,907	−20,932	−20,970
	Carbon Emissions ($\triangle CO_{2L}$)	167	227	243	369	251	308	199	2,753[3]	218	140	145	135
4.A.2 Land Converted to Forest Land	Carbon Sequestration ($\triangle CO_{2B}$)	−739	−877	−974	−1,008	−1,023	−1,057	−1,118	−1,141	−1,218	−1,181	−1,173	−1,139
Total Carbon Sequestration from LULUCF Sector ($\triangle CO_2$)		**-22,699**	**-22,615**	**-22,534**	**-22,282**	**-22,253**	**-22,068**	**-22,077**	**-19,384**	**-21,889**	**-21,947**	**-21,960**	**-21,974**
GHG Emission Sources and Sinks		**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	
4.A.1 Forest Land Remaining Forest Land	Carbon Sequestration ($\triangle CO_{2G}$)	−21,004	−21,040	−21,068	−21,105	−21,148	−21,200	−21,265	−21,311	−21,350	−21,411	−21,469	
	Carbon Emissions ($\triangle CO_{2L}$)	197	189	153	107	86	116	90	121	113	187	103	
4.A.2 Land Converted to Forest Land	Carbon Sequestration ($\triangle CO_{2B}$)	−1,079	−1,049	−1,011	−963	−918	−831	−724	−654	−589	−492	−391	
Total Carbon Sequestration from LULUCF Sector ($\triangle CO_2$)		**-21,886**	**-21,900**	**-21,926**	**-21,961**	**-21,980**	**-21,915**	**-21,899**	**-21,843**	**-21,826**	**-21,717**	**-21,757**	

Note:

1. In 1991, other natural disasters included seven typhoon events, affecting a total forest area of 295.74 hectares. The damaged growing stock volume amounted to 1,348,998.61 m^3, of which 1,348,992.06 m^3 was classified as loss of growing stock.
2. In addition to the five major forest fires that occurred in Danda, Lishan, the East Peak of Mt. Syue, and Yangmingshan National Park in 2001, another 59 minor forest fire incidents were recorded. The total area affected by these fires reached 395 hectares, resulting in substantial losses of forest resources.
3. In 2009, Typhoon Morakot caused severe damage in central and southern Taiwan. More than 2,500 mm of rainfall was recorded within three days in parts of Kaohsiung and Pingtung, generating approximately 1.25 million tonnes of driftwood and resulting in significant losses of growing stock volume.

carbon dioxide equivalent, representing a reduction of 72.47% and an average annual negative growth rate of 6.56%. Specifically, emissions from category 5.A “Solid Waste Disposal” decreased by 92.08%, while emissions from 5.B “Biological Treatment of Solid Waste” increased by 137.22%, emissions from 5.C “Incineration and Open Burning of Waste” increased by 56.75%, and emissions from 5.D “Wastewater Treatment and Discharge” decreased by 37.72%, as shown in Table ES3.6.

In 2024, greenhouse gas emissions from the waste sector accounted for approximately 0.90% of Taiwan’s total greenhouse gas emissions, as shown in Table ES3.6. Among the waste sector emissions, category 5.D “Wastewater Treatment and Discharge” accounted for the largest share at 38.58%, followed by category 5.C “Incineration and Open Burning of Waste” at 37.71%. The remaining emissions were contributed by category 5.A “Solid Waste Disposal” at 21.90% and category 5.B “Biological Treatment of Solid Waste” at 1.81%, as illustrated in Figure ES3.7.

ES.4 Other Information

In accordance with the provisions of the “Climate Change Response Act”, Taiwan has established a national greenhouse gas (GHG) reporting and management system that reflects national circumstances, sectoral responsibilities, and a hierarchical database management framework. Under this system, the relevant competent authorities are responsible for conducting investigations and compiling greenhouse gas emissions data within their respective sectors. Experts and scholars from relevant fields are invited to review and refine the statistical data, methodologies, and improvement plans. The results are submitted annually to the Ministry of Environment for compilation. Following inter–ministerial consultations, discussions, editing, and proofreading, the National Greenhouse Gas Inventory Report is prepared and made publicly available.

In addition, Taiwan established an electronic National Greenhouse Gas Inventory Registry in 2013, through which the relevant competent authorities submit inventory data online. To align with the requirements of the UNFCCC, Taiwan has compiled and updated its National Greenhouse Gas Inventory Report annually in accordance with the 2006 IPCC Guidelines since 2015, in parallel with the inventory preparation practices adopted by UNFCCC Parties.

Table ES3.6 1990–2024 Greenhouse Gas Emissions in Taiwan by Waste Sector

(Unit: Kilotons of Carbon Dioxide Equivalents)

GHG Emission Sources and Sinks	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Total CO_2 Emission (5.C Incineration and Open Burning of Waste)	79	29	261	254	421	1,328	1,393	278	414	236	583	2,190
Total CH_4 Emission	8,410	8,643	8,917	9,945	10,731	11,632	11,833	12,073	12,479	12,391	11,722	10,996
5.A Solid Waste Disposal	7,102	7,206	7,431	8,492	9,252	10,112	10,231	10,496	10,962	10,958	10,310	9,655
5.B Biological Treatment of Solid Waste	13	0.6	0.9	0.5	0.2	0.7	0.3	2	0.06	2	0.3	0.02
5.C Incineration and Open Burning of Waste	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5.D Wastewater Treatment and Discharge	1,295	1,436	1,485	1,452	1,479	1,520	1,602	1,575	1,517	1,431	1,411	1,341
Total N_2O Emission	190	181	190	198	200	216	218	213	200	194	186	196
5.B Biological Treatment of Solid Waste	9	0.4	0.6	0.4	0.1	0.5	0.2	1.1	0.04	1.5	0.2	0.02
5.C Incineration and Open Burning of Waste	1.0	0.4	3	3	5	16	17	3	5	3	7	27
5.D Wastewater Treatment and Discharge	180	180	186	194	194	199	201	209	195	189	179	169
Total Emission from Waste Sector	**8,679**	**8,853**	**9,367**	**10,397**	**11,352**	**13,177**	**13,444**	**12,564**	**13,093**	**12,821**	**12,490**	**13,382**
GHG Emission Sources and Sinks	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Total CO_2 Emission (5.C Incineration and Open Burning of Waste)	1,919	1,741	1,684	583	650	653	592	591	677	669	631	770
Total CH_4 Emission	10,339	9,569	8,868	8,164	7,437	6,732	5,968	5,111	4,542	4,137	3,660	3,187
5.A Solid Waste Disposal	8,976	8,192	7,482	6,786	6,066	5,349	4,644	3,942	3,347	2,862	2,432	2,054
5.B Biological Treatment of Solid Waste	0.4	3	7	11	13	16	18	20	23	29	27	25
5.C Incineration and Open Burning of Waste	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5.D Wastewater Treatment and Discharge	1,363	1,375	1,379	1,367	1,359	1,367	1,306	1,149	1,171	1,246	1,201	1,108
Total N_2O Emission	195	195	185	169	149	149	136	134	133	136	129	122
5.B Biological Treatment of Solid Waste	0.3	2	5	8	9	11	13	14	17	21	19	18
5.C Incineration and Open Burning of Waste	23	21	21	8	9	9	8	7	8	8	8	8
5.D Wastewater Treatment and Discharge	171	172	159	154	131	129	115	112	109	107	102	96
Total Emission from Waste Sector	**12,453**	**11,505**	**10,737**	**8,916**	**8,237**	**7,534**	**6,696**	**5,836**	**5,351**	**4,942**	**4,420**	**4,079**
GHG Emission Sources and Sinks	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	
Total CO_2 Emission (5.C Incineration and Open Burning of Waste)	687	448	539	583	557	593	668	727	781	749	**915**	
Total CH_4 Emission	2,808	2,686	2,710	2,458	2,088	1,946	1,819	1,778	1,624	1,511	**1,431**	
5.A Solid Waste Disposal	1,736	1,469	1,252	1,065	920	821	754	668	633	582	**538**	
5.B Biological Treatment of Solid Waste	23	22	22	23	26	28	29	30	28	26	**26**	
5.C Incineration and Open Burning of Waste	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	**NO**	
5.D Wastewater Treatment and Discharge	1,049	1,195	1,436	1,371	1,142	1,098	1,036	1,081	963	903	**867**	
Total N_2O Emission	121	124	121	122	126	120	121	121	114	107	**109**	
5.B Biological Treatment of Solid Waste	16	16	16	16	18	20	21	21	20	19	**18**	
5.C Incineration and Open Burning of Waste	8	5	6	6	7	7	8	9	9	9	**11**	
5.D Wastewater Treatment and Discharge	97	103	99	100	101	93	92	91	86	79	**80**	
Total Emission from Waste Sector	**3,616**	**3,259**	**3,370**	**3,163**	**2,771**	**2,658**	**2,608**	**2,626**	**2,519**	**2,367**	**2,455**	

Note: NO (not happened) means that the emission source is not produced or used.

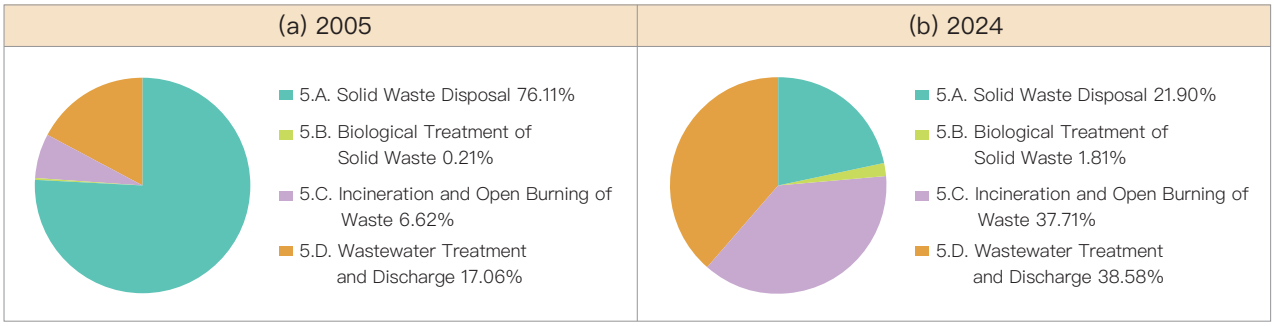

Figure ES3.7 Percentage of Greenhouse Gas Emissions by Waste Sectors in Taiwan in (a)2005 and (b)2024.

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