

REPUBLIC OF CHINA

NATIONAL

GREENHOUSE GAS

INVENTORY REPORT



TAIWAN

Report Summary

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June, 2024



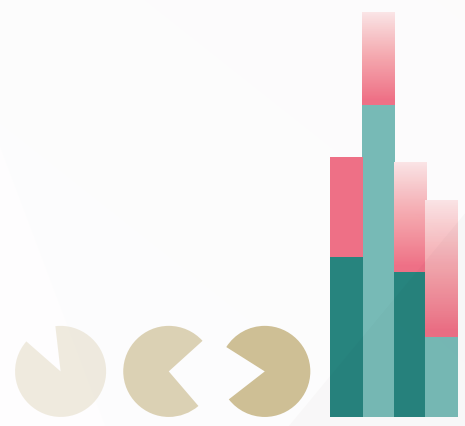
# Executive Summary

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# Executive Summary

## ES.1 Background Information on National Greenhouse Gas Inventory

The guidelines in Article 4<sup>1</sup> of the United Nations Framework Convention on Climate Change (UNFCCC), Article 13<sup>2</sup> of the Paris Agreement, and Article 5 of the Kyoto Protocol state that each party shall submit information of National Inventory Report (NIR) in response to climate change to the UNFCCC Convention of the Parties for review<sup>3</sup>. Although Taiwan is not a UNFCCC party, it has long been committed to fulfilling its responsibility as a member of the global community by endeavoring to take initiatives to help slow down global warming. The establishment of a national GHG inventory report and the estimation of GHG emission and sequestration are the fundamental obligation of a country to UNFCCC as well as one of the essential steps in reducing global warming.

Decision 18/CMA.1 of United Nations Climate Change Conference (COP 24) has stated that in order to implement the Enhanced Transparency Framework (ETF)<sup>4</sup>. Relevant reports submitted by UNFCCC Annex I Parties must comply with the requirements of Modalities, Procedures and Guidelines (MPGs), and the National Inventory Report (NIR) electronically reports national greenhouses in the Common Reporting Tables (CRT) every year showing greenhouse gas inventory preparation procedures, emission trend description, statistics of various departments, recalculations, etc. In addition, it is required to adopt the GWP of the IPCC Fifth Assessment Report (AR5) from 2024.

Since 1998, Taiwan has taken initiatives to prepare the national GHG inventory. According to Decision 15/CP.17<sup>5</sup> of the 17th Convention of the Parties (COP17) of the United Nations Framework Convention on

Climate Change and the 7th Session of the Conference of the Parties (CMP7) to the Kyoto Protocol held in Durban, requesting developed countries to submit an Annual National Inventory Report starting from 2015 in accordance with the *2006 Intergovernmental Panel on Climate Change Guidelines (2006 IPCC Guidelines)* for National Greenhouse Gas Inventories proposed by the Intergovernmental Panel on Climate Change (IPCC) in 2006.

However, science and other technologies have continued to advance and improve since 2006, the *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2019 IPCC Refinement Guidelines)* was released by IPCC to support the compilation and continuous improvement of national greenhouse gas emissions by sources and removals by sinks as the latest scientific basis applicable to all Parties after 2020 to the Paris Agreement. The *2019 IPCC Refinement Guidelines* are the most detailed and professional greenhouse gas inventory guidelines to date and need to be used together with the *2006 IPCC Guidelines*.

The Report also carried out the statistics and compilation in accordance with the *2006 IPCC Guidelines and the 2019 IPCC Refinement Guidelines*, where the Refinement methodology are more applicable, to actively demonstrate the efforts and resolution to abide by the convention. Today, Taiwan has established a greenhouse gas inventory database covering the period from 1990 to 2022. The database provides an overview on greenhouse gas inventory statistics to reflect the GHG trends in Taiwan. It also aims to quantify future greenhouse gas emissions and provide an overview of Taiwan's greenhouse gas statistics, thereby receiving comments from all fields for the continuous improvement on the quality of national greenhouse gas inventories.

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.

4 UNFCCC, FCCC/PA/CMA/2018/3/Add.2, 2018.

5 UNFCCC, FCCC/CP/2011/9/Add.2, 2011.

## 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 291,183 kilotons of carbon dioxide equivalents in 2005 to 285,967 kilotons of carbon dioxide equivalents in 2022, with a 1.79% decrease and a negative average annual growth rate of -0.11%. To further analyze the composition of total GHG emissions in 2022, the proportion of carbon dioxide emissions is 95.70%, a decrease of 3.51% over the previous year, and that of non-carbon dioxide is 4.30%, which was also a decrease of 9.43% 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 91.66%, followed by methane (3.90%), fluorinated greenhouse gas (3.18%), and nitrous oxide (1.26%); however, carbon dioxide was still the largest of proportion (95.70%) in 2022, followed by methane

(1.60%), then fluorinated greenhouse gas (1.37%), and nitrous oxide (1.33%), as shown in Figure ES2.2.

Between 2005 and 2022, carbon dioxide emissions grew by 2.55% with an average annual growth rate of 0.15%; carbon dioxide sequestration decreased by 2.04% with a negative average annual growth rate of -0.12%; methane emissions decreased by 59.91% with a negative average annual growth rate of -5.24%; nitrous oxide emissions increased by 3.90% with an annual growth rate of 0.23%; fluorinated greenhouse gas emissions decreased by 57.62% with a negative average annual growth rate of -4.92%, as shown in Figure ES2.3 and Table ES2.1.

### 1. Carbon Dioxide Emissions

The energy sector, industrial process and product use (IPPU) sector, agriculture sector, and waste sector are the main emission sources of carbon dioxide in Taiwan, as shown in Table ES2.2. In 2005, Taiwan's carbon dioxide emissions amounted to 266,888 kilotons of carbon dioxide equivalents. In 2022, that figure was 273,683 kilotons of carbon dioxide equivalents, with a 2.55% increase and an average annual growth rate of

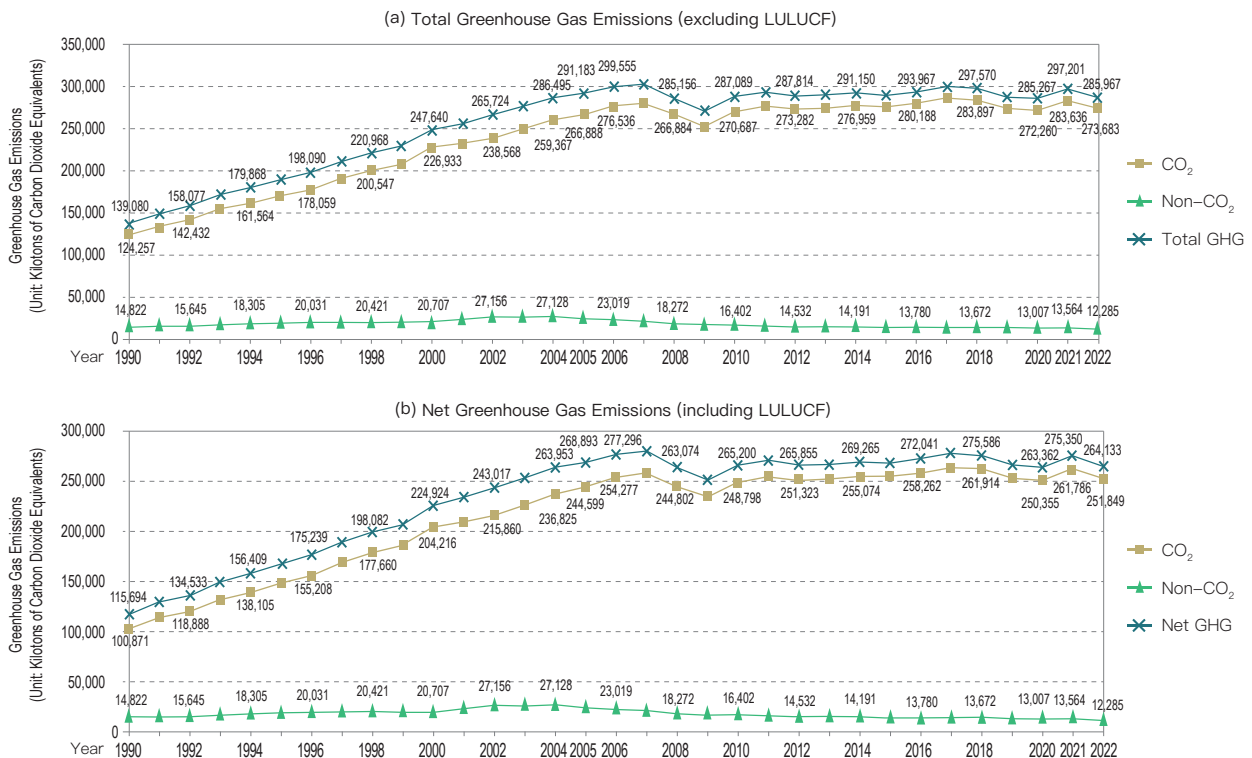


Figure ES2.1 1990–2022 Trends in Total Greenhouse Gas Emissions and Sequestration in Taiwan : (a) Emissions excluding LULUCF ; (b) Emissions including LULUCF

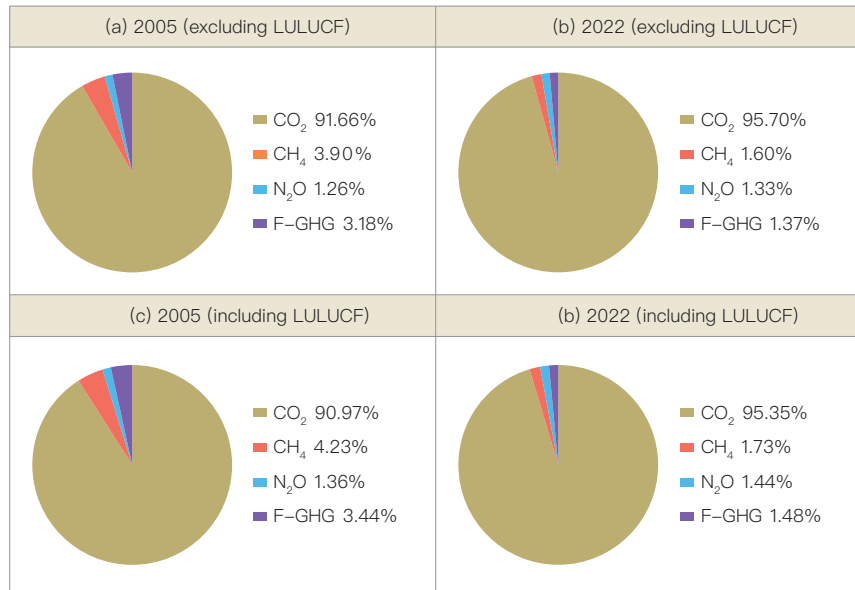


Figure ES2.2 Percentage of Various Types of Greenhouse Gas Emissions in Taiwan:(a).2005(excluding LULUCF); (b).2022(excluding LULUCF); (c).2005(including LULUCF);(d).2022(including LULUCF).

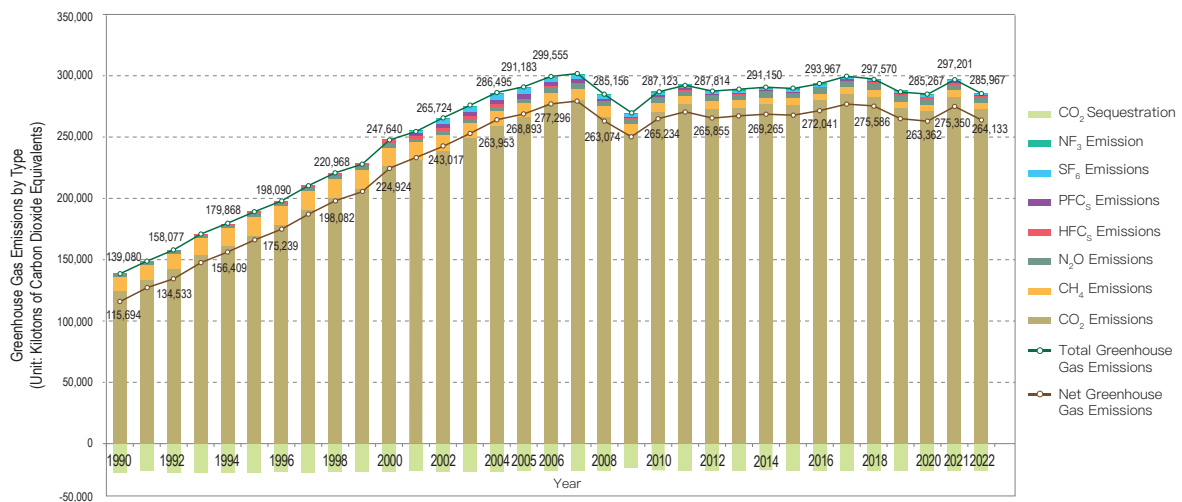


Figure ES2.3 1990–2022 Trends in Total Greenhouse Gas Emissions and Sequestration by Type in Taiwan

Table ES2.1 1990–2022 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
CO <sub>2</sub>	1	124,257	133,631	142,432	154,046	161,564	170,065	178,059	190,782	200,547	208,024	226,933
CH <sub>4</sub>	28	12,271	12,689	12,861	13,913	14,704	15,690	15,883	15,654	15,793	15,852	15,193
N <sub>2</sub> O	265	2,551	2,791	2,784	2,841	2,885	2,951	3,028	2,882	2,817	2,843	3,315
HFCs	HFC–134a(1,300) etc.	NE	NE	NE	633	716	680	1,120	1,284	1,812	1,437	2,054
PFCs	PFC–14(6,630) etc.	NE	NE	NE	NE	NE	NE	NE	NE	NE	2	12
SF <sub>6</sub>	23,500	NE	NE	NE	NE	NE	NE	NE	NE	NE	120	124
NF <sub>3</sub>	16,100	NE	NE	NE	NE	NE	NE	NE	NE	NE	10	9
CO <sub>2</sub> Sequestration	1	-23,386	-21,490	-23,544	-23,546	-23,459	-23,340	-22,851	-23,060	-22,887	-22,764	-22,717
<b>Net GHG Emission (including LULUCF)</b>		<b>115,694</b>	<b>127,621</b>	<b>134,533</b>	<b>147,886</b>	<b>156,409</b>	<b>166,045</b>	<b>175,239</b>	<b>187,541</b>	<b>198,082</b>	<b>205,524</b>	<b>224,924</b>
<b>Total GHG Emission (excluding LULUCF)</b>		<b>139,080</b>	<b>149,111</b>	<b>158,077</b>	<b>171,432</b>	<b>179,868</b>	<b>189,385</b>	<b>198,090</b>	<b>210,601</b>	<b>220,968</b>	<b>228,288</b>	<b>247,640</b>

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GHG	GWP	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
CO <sub>2</sub>	1	231,431	238,568	249,129	259,367	266,888	276,536	280,076	266,884	253,033	270,715	276,773
CH <sub>4</sub>	28	14,367	13,580	12,750	12,004	11,386	10,623	9,831	8,978	8,058	7,525	7,173
N <sub>2</sub> O	265	3,366	3,437	3,447	3,584	3,657	4,124	4,168	3,811	3,957	4,311	4,211
HFCs	HFC-134a(1,300) etc.	2,330	2,017	1,859	1,687	304	333	403	358	406	395	373
PFCs	PFC-14(6,630) etc.	2,665	3,764	3,814	3,949	3,178	3,355	3,102	1,932	1,464	1,650	1,665
SF <sub>6</sub>	23,500	769	3,986	4,471	5,288	5,052	3,940	3,485	3,001	2,527	2,286	1,976
NF <sub>3</sub>	16,100	220	373	506	617	716	644	747	191	540	241	393
CO <sub>2</sub> Sequestration	1	-21,850	-22,707	-22,624	-22,542	-22,290	-22,259	-22,074	-22,082	-19,388	-21,889	-21,947
<b>Net GHG Emission (including LULUCF)</b>		<b>233,297</b>	<b>243,017</b>	<b>253,351</b>	<b>263,953</b>	<b>268,893</b>	<b>277,296</b>	<b>279,739</b>	<b>263,074</b>	<b>250,598</b>	<b>265,234</b>	<b>270,618</b>
<b>Total GHG Emission (excluding LULUCF)</b>		<b>255,147</b>	<b>265,724</b>	<b>275,975</b>	<b>286,495</b>	<b>291,183</b>	<b>299,555</b>	<b>301,813</b>	<b>285,156</b>	<b>269,986</b>	<b>287,123</b>	<b>292,565</b>
GHG	GWP	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
CO <sub>2</sub>	1	273,282	274,577	276,959	276,263	280,188	285,730	283,897	274,446	272,260	283,636	273,683
CH <sub>4</sub>	28	6,681	6,209	5,785	5,668	5,723	5,493	5,107	4,968	4,853	4,772	4,564
N <sub>2</sub> O	265	4,127	3,938	3,910	3,879	4,064	4,210	4,282	4,112	4,120	4,573	3,800
HFCs	HFC-134a(1,300) etc.	398	534	616	650	757	895	1,043	1,163	1,304	1,429	1,555
PFCs	PFC-14(6,630) etc.	1,054	1,253	1,449	1,250	1,336	1,304	1,421	1,315	1,336	1,354	1,250
SF <sub>6</sub>	23,500	1,909	2,059	1,807	1,569	1,458	1,459	1,342	963	867	882	660
NF <sub>3</sub>	16,100	363	723	624	626	442	412	477	443	528	556	455
CO <sub>2</sub> Sequestration	1	-21,960	-21,974	-21,886	-21,900	-21,926	-21,961	-21,984	-21,917	-21,905	-21,850	-21,834
<b>Net GHG Emission (including LULUCF)</b>		<b>265,855</b>	<b>267,320</b>	<b>269,265</b>	<b>268,005</b>	<b>272,041</b>	<b>277,542</b>	<b>275,586</b>	<b>265,493</b>	<b>263,362</b>	<b>275,350</b>	<b>264,133</b>
<b>Total GHG Emission (excluding LULUCF)</b>		<b>287,814</b>	<b>289,294</b>	<b>291,150</b>	<b>289,905</b>	<b>293,967</b>	<b>299,504</b>	<b>297,570</b>	<b>287,410</b>	<b>285,267</b>	<b>297,201</b>	<b>285,967</b>

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.

Table ES2.2 1990–2022 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
<b>1. Energy Sector</b>	109,465	118,443	126,058	135,206	143,103	150,810	158,579	170,835	181,518	190,446	208,724
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
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
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
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
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
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
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
<b>2. Industrial Process and Product Use Sector</b>	14,557	15,007	15,926	18,408	17,826	17,528	17,677	19,483	18,410	17,179	17,388
2.A Mining Industry (Non-metal Process)	10,683	10,698	11,854	13,879	13,259	12,766	12,645	13,394	11,564	10,746	10,486
2.B Chemical Industry	575	551	575	617	770	858	999	1,026	1,007	1,079	1,148
2.C Metal Process	3,275	3,735	3,474	3,888	3,774	3,884	4,013	5,045	5,817	5,333	5,734
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
2.H Others	23	23	23	24	23	21	20	19	22	21	20
<b>3. Agriculture Sector</b>	142	146	139	131	135	151	151	134	127	118	131
<b>4. Land Use, Land Use Change and Forestry Sector</b>	-23,386	-21,490	-23,544	-23,546	-23,459	-23,340	-22,851	-23,060	-22,887	-22,764	-22,717
<b>5. Waste Sector</b>	94	35	309	301	500	1,575	1,652	330	491	280	691
Net GHG Emission (including LULUCF)	100,871	112,141	118,888	130,500	138,105	146,725	155,208	167,722	177,660	185,260	204,216
Total GHG Emission (excluding LULUCF)	124,257	133,631	142,432	154,046	161,564	170,065	178,059	190,782	200,547	208,024	226,933

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GHG Emission Sources and Sinks	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
<b>1. Energy Sector</b>	212,554	220,123	229,841	239,929	247,956	255,330	259,215	247,537	235,868	251,708	257,097
1.A.1 Energy Industry	123,880	128,157	139,316	147,288	155,014	162,298	168,580	162,125	153,989	164,270	168,491
1.A.2 Manufacturing and Construction Industry	44,234	46,373	44,211	44,551	44,008	45,309	44,845	41,410	37,874	42,612	43,691
1.A.3 Transportation	33,267	34,542	34,509	35,859	36,846	36,771	35,419	33,216	33,541	34,652	35,107
1.A.4 Other Sectors	11,174	11,052	11,806	12,230	12,089	10,952	10,371	10,785	10,463	10,174	9,808
1.A.4.a Service Industry	3,538	3,487	3,952	4,120	4,227	4,272	4,232	4,226	4,264	4,203	3,898
1.A.4.b Residential	5,181	5,107	5,042	5,133	5,235	5,033	5,047	5,017	5,030	4,857	4,786
1.A.4.c Agriculture, Forestry, Fishery, and Husbandry	2,455	2,459	2,811	2,977	2,627	1,647	1,091	1,543	1,169	1,113	1,123
<b>2. Industrial Process and Product Use Sector</b>	16,186	16,075	17,141	17,358	18,094	20,299	19,967	18,558	16,407	18,206	18,954
2.A Mining Industry (Non-metal Process)	9,974	10,648	10,341	10,691	11,257	11,014	10,369	9,289	8,467	8,616	9,577
2.B Chemical Industry	1,232	1,313	1,384	1,485	1,751	1,721	1,845	1,601	1,601	1,778	1,737
2.C Metal Process	4,960	4,096	5,397	5,162	5,066	7,544	7,733	7,648	6,317	7,792	7,620
2.D Non-Energy Products from Fuels and Solvent Use	0.00007	0.00008	0.00009	0.00011	0.00010	0.00007	0.00007	0.00007	0.00006	0.00005	0.00004
2.H Others	20	18	18	19	20	21	20	20	21	20	20
<b>3. Agriculture Sector</b>	94	93	82	84	62	59	57	57	55	54	53
<b>4. Land Use, Land Use Change and Forestry Sector</b>	-21,850	-22,707	-22,624	-22,542	-22,290	-22,259	-22,074	-22,082	-19,388	-21,889	-21,947
<b>5. Waste Sector</b>	2,597	2,276	2,065	1,996	776	848	837	733	703	747	670
Net GHG Emission (including LULUCF)	209,582	215,860	226,505	236,825	244,599	254,277	258,002	244,802	233,645	248,826	254,826
Total GHG Emission (excluding LULUCF)	231,431	238,568	249,129	259,367	266,888	276,536	280,076	266,884	253,033	270,715	276,773
GHG Emission Sources and Sinks	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
<b>1. Energy Sector</b>	253,201	254,109	258,480	258,475	262,982	269,461	267,209	258,823	257,433	267,037	257,958
1.A.1 Energy Industry	166,836	167,021	173,747	173,695	177,209	185,761	187,895	180,206	179,435	188,383	181,621
1.A.2 Manufacturing and Construction Industry	42,515	43,309	40,386	39,577	39,656	38,115	34,858	33,902	32,895	35,520	32,261
1.A.3 Transportation	34,284	34,209	34,666	35,506	36,584	36,202	35,202	35,438	35,715	33,905	34,696
1.A.4 Other Sectors	9,566	9,571	9,681	9,698	9,533	9,384	9,254	9,277	9,389	9,229	9,380
1.A.4.a Service Industry	3,635	3,812	3,928	3,941	3,720	3,779	3,593	3,622	3,792	3,741	3,746
1.A.4.b Residential	4,672	4,484	4,411	4,469	4,537	4,402	4,145	4,137	4,269	4,170	4,266
1.A.4.c Agriculture, Forestry, Fishery, and Husbandry	1,259	1,274	1,343	1,287	1,276	1,203	1,515	1,518	1,328	1,318	1,368
<b>2. Industrial Process and Product Use Sector</b>	19,369	19,605	17,704	17,251	16,583	15,625	16,019	14,890	13,999	15,663	14,770
2.A Mining Industry (Non-metal Process)	9,333	9,866	8,728	8,345	7,108	6,262	6,403	6,501	6,561	6,828	6,464
2.B Chemical Industry	1,714	1,749	1,884	1,842	1,760	1,709	1,684	1,666	1,550	1,730	1,270
2.C Metal Process	8,301	7,970	7,072	7,044	7,696	7,634	7,913	6,706	5,870	7,090	7,020
2.D Non-Energy Products from Fuels and Solvent Use	0.00004	0.00005	0.00006	0.00010	0.00008	0.00007	0.00006	0.00006	0.00006	0.00007	0.00006
2.H Others	21	19	19	20	19	20	19	17	18	15	15
<b>3. Agriculture Sector</b>	55	45	40	38	34	31	30	29	29	27	22
<b>4. Land Use, Land Use Change and Forestry Sector</b>	-21,960	-21,974	-21,886	-21,900	-21,926	-21,961	-21,984	-21,917	-21,905	-21,850	-21,834
<b>5. Waste Sector</b>	657	817	736	499	589	613	639	703	798	910	933
Net GHG Emission (including LULUCF)	251,323	252,603	255,074	254,363	258,262	263,769	261,914	252,529	250,355	261,786	251,849
Total GHG Emission (excluding LULUCF)	273,282	274,577	276,959	276,263	280,188	285,730	283,897	274,446	272,260	283,636	273,683



0.15%. In 2022, carbon dioxide emissions accounted for 95.70% of total GHG emissions. The energy sector accounted for 94.25%, the industrial process and product use (IPPU) sector 5.40%, the agriculture sector 0.01%, and the waste sector 0.34%. Compared with 2021, the emissions in 2022 decreased by 3.51% mainly because of the 3.40% decrease in the energy sector, the 5.70% decrease in the IPPU sector, the 15.93%

decrease in the agriculture sector, the 0.08% decrease in the LULUCF sector and the 2.50% increase in the waste sector.

## 2. Methane Emissions

Methane emissions in Taiwan mainly come from the agriculture sector, waste sector, and energy sector, as shown in Table ES2.3. In 2005, the total methane

Table ES2.3 1990–2022 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
<b>1. Energy Sector</b>	592	567	557	572	589	597	582	575	599	628	643
<b>2. Industrial Process and Product Use Sector</b>	6	8	7	8	9	11	13	13	11	13	15
<b>3. Agriculture Sector</b>	3,264	3,472	3,381	3,388	3,374	3,449	3,455	2,993	2,703	2,820	2,813
3.A Livestock Gastrointestinal Fermentation	750	819	826	868	883	921	921	820	755	778	775
3.B Livestock Waste Treatment	1,246	1,460	1,418	1,436	1,470	1,535	1,565	1,190	990	1,088	1,123
3.C Rice Culturing	1,226	1,166	1,084	1,059	998	984	961	976	953	947	899
3.F Field Burning of Agricultural Residues	42	28	53	24	23	8	8	8	6	8	15
<b>5. Waste Sector</b>	8,410	8,643	8,917	9,945	10,731	11,632	11,833	12,073	12,479	12,391	11,722
5.A Garbage Landfill	7,102	7,206	7,431	8,492	9,252	10,112	10,231	10,496	10,962	10,958	10,310
5.B Garbage Biological Treatment	13	0.6	0.9	0.5	0.2	0.7	0.3	1.6	0.06	2.2	0.3
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
5.D.1 Domestic Wastewater Treatment and discharge	935	945	953	962	970	977	983	990	982	935	894
5.D.2 Industrial Wastewater Treatment and discharge	360	492	531	490	509	542	619	586	534	497	517
<b>Total Methane Emissions</b>	<b>12,271</b>	<b>12,689</b>	<b>12,861</b>	<b>13,913</b>	<b>14,704</b>	<b>15,690</b>	<b>15,883</b>	<b>15,654</b>	<b>15,793</b>	<b>15,852</b>	<b>15,193</b>
GHG Emission Sources and Sinks	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
<b>1. Energy Sector</b>	633	655	705	740	707	700	697	677	669	707	733
<b>2. Industrial Process and Product Use Sector</b>	20	21	24	31	20	25	31	30	31	32	25
<b>3. Agriculture Sector</b>	2,717	2,565	2,451	2,363	2,495	2,461	2,371	2,303	2,247	2,244	2,278
3.A Livestock Gastrointestinal Fermentation	739	712	701	688	698	688	682	655	640	648	660
3.B Livestock Waste Treatment	1,074	1,022	1,019	1,024	1,071	1,058	994	965	924	931	944
3.C Rice Culturing	887	816	721	643	717	706	690	676	678	659	668
3.F Field Burning of Agricultural Residues	17	14	10	9	9	9	5	7	6	6	6
<b>5. Waste Sector</b>	10,996	10,339	9,569	8,868	8,164	7,437	6,732	5,968	5,111	4,542	4,137
5.A Garbage Landfill	9,655	8,976	8,192	7,482	6,786	6,066	5,349	4,644	3,942	3,347	2,862
5.B Garbage Biological Treatment	0.02	0.4	3	7	11	13	16	18	20	23	29
5.D Wastewater Treatment and Discharge	1,341	1,363	1,375	1,379	1,367	1,359	1,367	1,306	1,149	1,171	1,246
5.D.1 Domestic Wastewater Treatment and discharge	883	868	860	833	808	783	752	728	700	689	661
5.D.2 Industrial Wastewater Treatment and discharge	458	495	515	546	559	576	615	578	449	482	584
<b>Total Methane Emissions</b>	<b>14,367</b>	<b>13,580</b>	<b>12,750</b>	<b>12,004</b>	<b>11,386</b>	<b>10,623</b>	<b>9,831</b>	<b>8,978</b>	<b>8,058</b>	<b>7,525</b>	<b>7,173</b>
GHG Emission Sources and Sinks	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
<b>1. Energy Sector</b>	743	757	769	795	818	826	807	802	818	823	834
<b>2. Industrial Process and Product Use Sector</b>	26	28	29	29	30	27	30	29	28	29	24
<b>3. Agriculture Sector</b>	2,252	2,237	2,180	2,158	2,166	2,166	2,165	2,174	2,172	2,115	2,052
3.A Livestock Gastrointestinal Fermentation	653	649	634	641	628	632	640	643	650	665	655
3.B Livestock Waste Treatment	904	874	840	834	829	827	832	844	845	842	821
3.C Rice Culturing	688	710	702	678	705	704	689	684	677	608	576
3.F Field Burning of Agricultural Residues	6	4	4	5	4	4	3	2	1	1	1
<b>5. Waste Sector</b>	3,660	3,187	2,808	2,686	2,710	2,474	2,106	1,963	1,834	1,805	1,654
5.A Garbage Landfill	2,432	2,054	1,736	1,469	1,252	1,080	937	837	769	694	663
5.B Garbage Biological Treatment	27	25	23	22	22	23	26	28	29	30	28
5.D Wastewater Treatment and Discharge	1,201	1,108	1,049	1,195	1,436	1,371	1,142	1,098	1,036	1,081	963
5.D.1 Domestic Wastewater Treatment and discharge	631	609	593	572	537	512	491	445	423	395	373
5.D.2 Industrial Wastewater Treatment and discharge	570	499	456	623	899	859	651	653	612	686	590
<b>Total Methane Emissions</b>	<b>6,681</b>	<b>6,209</b>	<b>5,785</b>	<b>5,668</b>	<b>5,723</b>	<b>5,493</b>	<b>5,107</b>	<b>4,968</b>	<b>4,853</b>	<b>4,772</b>	<b>4,564</b>



emission in Taiwan was 11,386 kilotons of carbon dioxide equivalents. In 2022, the total methane emission was 4,564 kilotons of carbon dioxide equivalents, down by 59.91% compared with 2005, with a negative average annual growth rate of -5.24%. In 2022, methane emissions accounted for 1.60% of the total GHG emissions. In particular, the agriculture sector was the largest source of methane emissions, which accounted for 44.97%, followed by the waste sector (36.23%), energy sector (18.27%), and IPPU sector (0.53%).

Compared to 2021, the methane emission in 2022 was down by 4.35%, with the energy sector up by 1.34%,

the IPPU sector down by 17.21%, the agriculture sector down by 2.96%, and the waste sector down by 8.36%.

### 3. Nitrous oxide emissions

Nitrous oxide emissions in Taiwan are mainly from the IPPU sector, the agriculture sector, and energy sector with minor emissions from the waste sector, as shown in Table ES2.4. In 2005, the total nitrous oxide emission in Taiwan was 3,657 kilotons of carbon dioxide equivalents. In 2022, the total nitrous oxide emission was 3,800 kilotons of carbon dioxide equivalents, up by 3.90% with an average growth rate of 0.23%. In 2022, nitrous oxide emissions accounted for 1.33% of the total GHG

Table ES2.4 1990–2022 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
<b>1. Energy Sector</b>	477	514	580	626	660	692	734	770	815	861	933
1.A.1 Energy Industry	123	140	162	183	197	213	240	266	294	321	377
1.A.2 Manufacturing and Construction Industry	80	84	90	90	92	95	98	102	103	110	121
1.A.3 Transportation	259	275	314	340	357	372	381	389	406	417	423
1.A.4 Other Sectors	15	15	14	12	14	13	14	12	12	13	14
<b>2. Industrial Process and Product Use Sector</b>	147	313	289	268	283	307	305	333	340	277	556
<b>3. Agriculture Sector</b>	1,736	1,783	1,724	1,750	1,743	1,736	1,772	1,566	1,461	1,511	1,640
3.B Livestock Waste Treatment	129	146	145	147	154	160	167	143	129	137	140
3.D Agricultural Soil	1,597	1,630	1,567	1,597	1,583	1,574	1,603	1,422	1,331	1,372	1,496
3.F Field Burning of Agricultural Residues	10	7	13	6	6	2	2	2	2	2	4
<b>5. Waste Sector</b>	190	181	190	198	200	216	218	213	200	194	186
<b>Total Nitrous Oxide Emissions</b>	<b>2,551</b>	<b>2,791</b>	<b>2,784</b>	<b>2,841</b>	<b>2,885</b>	<b>2,951</b>	<b>3,028</b>	<b>2,882</b>	<b>2,817</b>	<b>2,843</b>	<b>3,315</b>
GHG Emission Sources and Sinks	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
<b>1. Energy Sector</b>	961	1,005	1,052	1,092	1,128	1,155	1,158	1,102	1,077	1,110	1,127
1.A.1 Energy Industry	403	423	472	492	518	543	566	546	526	535	539
1.A.2 Manufacturing and Construction Industry	122	128	125	127	127	130	129	118	111	121	129
1.A.3 Transportation	422	441	440	456	469	469	452	425	427	442	449
1.A.4 Other Sectors	14	14	15	16	15	13	12	13	12	11	11
<b>2. Industrial Process and Product Use Sector</b>	635	661	741	742	891	1,311	1,399	1,185	1,334	1,670	1,605
<b>3. Agriculture Sector</b>	1,574	1,576	1,460	1,565	1,468	1,493	1,462	1,388	1,413	1,398	1,343
3.B Livestock Waste Treatment	135	131	131	130	136	136	130	129	125	125	126
3.D Agricultural Soil	1,435	1,441	1,326	1,433	1,330	1,355	1,331	1,258	1,286	1,272	1,215
3.F Field Burning of Agricultural Residues	4	4	2	2	2	2	1	2	1	1	1
<b>5. Waste Sector</b>	196	195	195	185	169	164	149	136	134	133	136
<b>Total Nitrous Oxide Emissions</b>	<b>3,366</b>	<b>3,437</b>	<b>3,447</b>	<b>3,584</b>	<b>3,657</b>	<b>4,124</b>	<b>4,168</b>	<b>3,811</b>	<b>3,957</b>	<b>4,311</b>	<b>4,211</b>
GHG Emission Sources and Sinks	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
<b>1. Energy Sector</b>	1,109	1,104	1,108	1,104	1,124	1,135	1,118	1,095	1,090	1,083	1,057
1.A.1 Energy Industry	534	528	531	519	527	550	561	537	530	544	520
1.A.2 Manufacturing and Construction Industry	124	126	120	119	118	111	93	91	89	92	80
1.A.3 Transportation	440	439	445	456	468	463	453	457	461	437	446
1.A.4 Other Sectors	11	11	11	11	11	10	10	10	10	10	10
<b>2. Industrial Process and Product Use Sector</b>	1,527	1,407	1,384	1,378	1,550	1,729	1,838	1,743	1,709	2,227	1,526
<b>3. Agriculture Sector</b>	1,363	1,306	1,298	1,272	1,270	1,225	1,203	1,154	1,201	1,141	1,104
3.B Livestock Waste Treatment	123	122	121	121	122	123	125	129	130	130	130
3.D Agricultural Soil	1,238	1,184	1,176	1,150	1,146	1,101	1,077	1,025	1,071	1,011	973
3.F Field Burning of Agricultural Residues	1.5	0.9	1.0	1.2	0.9	1.0	0.7	0.6	0.2	0.2	0.2
<b>5. Waste Sector</b>	128	121	120	124	120	121	123	119	121	121	114
<b>Total Nitrous Oxide Emissions</b>	<b>4,127</b>	<b>3,938</b>	<b>3,910</b>	<b>3,879</b>	<b>4,064</b>	<b>4,210</b>	<b>4,282</b>	<b>4,112</b>	<b>4,120</b>	<b>4,573</b>	<b>3,800</b>

emissions. In particular, the IPPU sector accounted for 40.15%, followed by the agriculture sector (29.04%), the energy sector (27.81%), and the waste sector (2.99%).

Compared to 2021, the nitrous oxide emission in 2022 down by 16.90%, with the energy sector down by 2.45%, the IPPU sector down by 31.50%, the agriculture sector down by 3.31%, and the waste sector down by 5.69%.

#### 4. Fluoride-Containing Gas Emissions

In Taiwan, the majority of fluorinated greenhouse gases come from industries critical to economic development, namely the semiconductor, optoelectronics, power facilities, and magnesium alloy industries, all of which are emission-heavy industries. The fluorinated greenhouse gas emissions are shown in Table ES2.5. In particular, Taiwan's hydrofluorocarbons (HFCs) emission increased from 633 kilotons of carbon dioxide equivalents in 1993 to 1,555 kilotons of carbon dioxide equivalents in

Table ES2.5 1990–2022 Fluoride-Containing 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
<b>Total HFCs Emissions</b>	NE	NE	NE	633	716	680	1,120	1,284	1,812	1,437	2,054
2.B Chemical Industry	NE	NE	NE	633	716	671	1,094	1,238	1,745	1,348	1,943
2.E Electronics Industry	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2.F Alternatives to Ozone-depleting Substances	NE	NE	NE	NE	NE	8	26	46	67	89	112
<b>Total PFCs Emissions (2.E Electronics Industry)</b>	NE	NE	NE	NE	NE	NE	NE	NE	NE	2	12
<b>Total SF<sub>6</sub> Emissions</b>	NE	NE	NE	NE	NE	NE	NE	NE	NE	120	124
2.C Metal Process	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
2.G Manufacturing and Use of Other Products	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
<b>Total NF<sub>3</sub> Emissions (2.E Electronics Industry)</b>	NE	NE	NE	NE	NE	NE	NE	NE	NE	10	9
<b>Total Fluoride-Containing Gas Emissions</b>	NE	NE	NE	633	716	680	1,120	1,284	1,812	1,569	2,199
GHG Emission Sources and Sinks	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
<b>Total HFCs Emissions</b>	2,330	2,017	1,859	1,687	304	333	403	358	406	395	373
2.B Chemical Industry	2,151	1,807	1,623	1,433	NO	NO	NO	NO	NO	NO	NO
2.E Electronics Industry	43	49	49	49	85	100	167	123	172	169	144
2.F Alternatives to Ozone-depleting Substances	136	160	187	205	219	233	236	235	233	226	229
<b>Total PFCs Emissions (2.E Electronics Industry)</b>	2,665	3,764	3,814	3,949	3,178	3,355	3,102	1,932	1,464	1,650	1,665
<b>Total SF<sub>6</sub> Emissions</b>	769	3,986	4,471	5,288	5,052	3,940	3,485	3,001	2,527	2,286	1,976
2.C Metal Process	NE	1,009	1,009	1,334	1,046	757	454	149	242	59	52
2.E Electronics Industry	769	973	1,458	1,838	2,457	2,389	2,049	1,930	1,561	1,983	1,665
2.G Manufacturing and Use of Other Products	NE	2,003	2,003	2,116	1,549	794	982	923	724	245	260
<b>Total NF<sub>3</sub> Emissions (2.E Electronics Industry)</b>	220	373	506	617	716	644	747	191	540	241	393
<b>Total Fluoride-Containing Gas Emissions</b>	5,983	10,139	10,649	11,541	9,251	8,272	7,738	5,483	4,938	4,572	4,408
GHG Emission Sources and Sinks	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
<b>Total HFCs Emissions</b>	398	534	616	650	757	895	1,043	1,163	1,304	1,429	1,555
2.B Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.E Electronics Industry	104	173	184	142	160	169	169	152	161	156	151
2.F Alternatives to Ozone-depleting Substances	294	361	431	508	597	725	875	1,012	1,143	1,273	1,405
<b>Total PFCs Emissions (2.E Electronics Industry)</b>	1,054	1,253	1,449	1,250	1,336	1,304	1,421	1,315	1,336	1,354	1,250
<b>Total SF<sub>6</sub> Emissions</b>	1,909	2,059	1,807	1,569	1,458	1,459	1,342	963	867	882	660
2.C Metal Process	31	39	58	44	39	61	84	45	37	62	27
2.E Electronics Industry	1,678	1,855	1,600	1,393	1,334	1,317	1,105	805	693	716	507
2.G Manufacturing and Use of Other Products	201	165	150	132	85	81	154	113	137	103	127
<b>Total NF<sub>3</sub> Emissions (2.E Electronics Industry)</b>	363	723	624	626	442	412	477	443	528	556	455
<b>Total Fluoride-Containing Gas Emissions</b>	3,724	4,569	4,496	4,094	3,992	4,070	4,283	3,884	4,035	4,220	3,921

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.

2022. The perfluorocarbons (PFCs) emission increased from 2 kilotons of carbon dioxide equivalents in 1999 to 1,250 kilotons of carbon dioxide equivalents in 2022, while the sulfur hexafluoride (SF<sub>6</sub>) emission increased from 120 kilotons of carbon dioxide equivalents in 1999 to 660 kilotons of carbon dioxide equivalents in 2022. The nitrogen trifluoride (NF<sub>3</sub>) emission increased from 10 kilotons of carbon dioxide equivalents in 1999 to 455 kilotons of carbon dioxide equivalents in 2022.

For the total emission of fluorinated greenhouse gases, it decreased from 9,251 kilotons of carbon dioxide equivalents in 2005 (about 3.18% of the total greenhouse gas emissions in 2005) to 3,921 kilotons of carbon dioxide equivalents in 2022 (about 1.37% of the total greenhouse gas emissions in 2021), down by 57.62% with a negative average annual growth rate of -4.92%. Compared to 2021, the emission in 2022 decreased by 7.10%.

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

Of all the sectors, the energy sector has long been the one accounting for the largest total greenhouse gas emission in Taiwan over the years. In 2005 and 2022, greenhouse gas emissions (excluding LULUCF) from energy sectors were responsible for approximately 85.79% and 90.87% of the total emissions, while the IPPU sector accounted for 9.70% and 7.08%, the agricultural sector accounted for 1.38% and 1.11%, and the waste sector accounted for 3.13% and 0.94%, as shown in Figure ES3.1.

The GHG emission and trends for Taiwan from 1990 to 2022 by sector are shown in Figure ES3.2 and Table ES3.1. The total greenhouse gas emission in Taiwan in 2022 decreased by 3.78% compared with 2021. In particular, the GHG emission from the energy sector was down by 3.38%, the IPPU sector was down by 8.58%, the

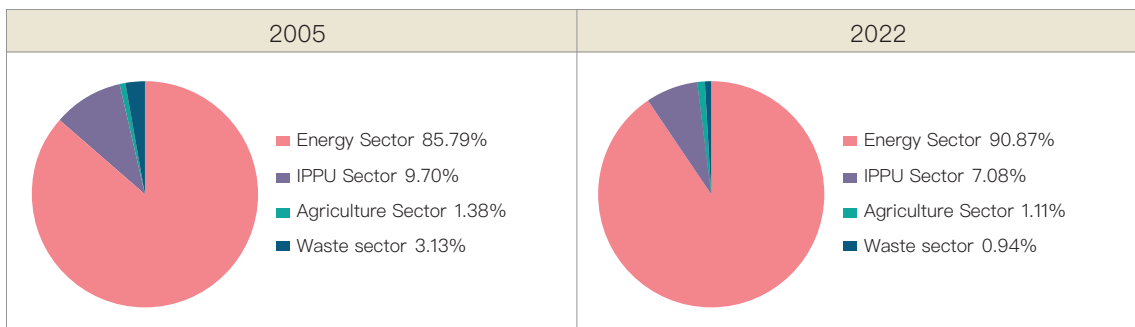


Figure ES3.1 Percentage of Greenhouse Gas Emissions (excluding LULUCF) by Sectors in Taiwan in (a) 2005 and (b) 2022.

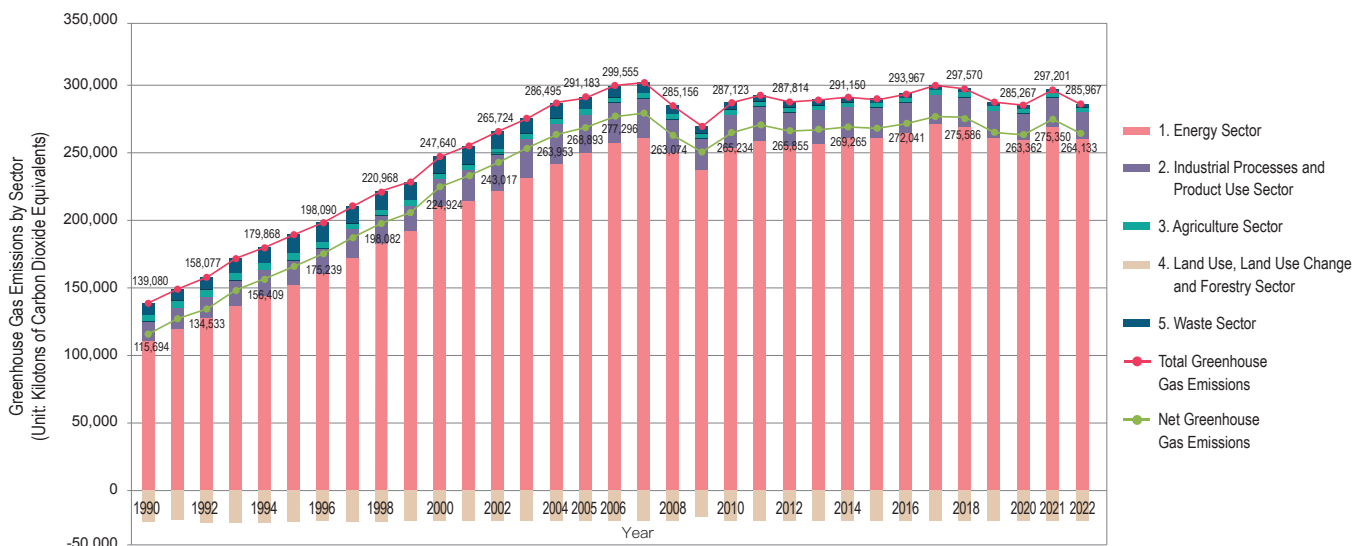


Figure ES3.2 1990–2022 Trends in Greenhouse Gas Emission by Sector in Taiwan

Table ES3.1 1990–2022 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
1. Energy Sector	110,535	119,523	127,195	136,404	144,352	152,099	159,894	172,180	182,933	191,935	210,300
2. IPPU Sector	14,710	15,328	16,222	19,316	18,834	18,526	19,114	21,113	20,574	19,038	20,158
3. Agriculture Sector	5,141	5,402	5,244	5,268	5,251	5,336	5,378	4,692	4,292	4,449	4,583
4. LULUCF Sector	-23,386	-21,490	-23,544	-23,546	-23,459	-23,340	-22,851	-23,060	-22,887	-22,764	-22,717
5. Waste Sector	8,694	8,858	9,415	10,444	11,430	13,424	13,703	12,616	13,170	12,865	12,599
Net GHG Emission (including LULUCF)	115,694	127,621	134,533	147,886	156,409	166,045	175,239	187,541	198,082	205,524	224,924
Total GHG Emission (excluding LULUCF)	139,080	149,111	158,077	171,432	179,868	189,385	198,090	210,601	220,968	228,288	247,640
GHG Emission Sources and Sinks	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1. Energy Sector	214,149	221,783	231,599	241,762	249,792	257,186	261,070	249,316	237,614	253,526	258,957
2. IPPU Sector	22,824	26,897	28,555	29,672	28,257	29,906	29,135	25,256	22,709	24,481	24,991
3. Agriculture Sector	4,385	4,234	3,993	4,012	4,026	4,013	3,890	3,748	3,716	3,696	3,674
4. LULUCF Sector	-21,850	-22,707	-22,624	-22,542	-22,290	-22,259	-22,074	-22,082	-19,388	-21,889	-21,947
5. Waste Sector	13,789	12,810	11,829	11,050	9,109	8,450	7,719	6,836	5,948	5,421	4,943
Net GHG Emission (including LULUCF)	233,297	243,017	253,351	263,953	268,893	277,296	279,739	263,074	250,598	265,234	270,618
Total GHG Emission (excluding LULUCF)	255,147	265,724	275,975	286,495	291,183	299,555	301,813	285,156	269,986	287,123	292,565
GHG Emission Sources and Sinks	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1. Energy Sector	255,053	255,970	260,357	260,375	264,923	271,422	269,134	260,720	259,341	268,943	259,849
2. IPPU Sector	24,646	25,609	23,613	22,753	22,156	21,451	22,170	20,547	19,771	22,140	20,240
3. Agriculture Sector	3,670	3,588	3,518	3,468	3,469	3,423	3,397	3,358	3,402	3,283	3,178
4. LULUCF Sector	-21,960	-21,974	-21,886	-21,900	-21,926	-21,961	-21,984	-21,917	-21,905	-21,850	-21,834
5. Waste Sector	4,446	4,126	3,663	3,309	3,420	3,208	2,868	2,785	2,753	2,835	2,700
Net GHG Emission (including LULUCF)	265,855	267,320	269,265	268,005	272,041	277,542	275,586	265,493	263,362	275,350	264,133
Total GHG Emission (excluding LULUCF)	287,814	289,294	291,150	289,905	293,967	299,504	297,570	287,410	285,267	297,201	285,967

agriculture sector was down by 3.19%, and the waste sector was down by 4.76%. Additionally, the carbon dioxide sequestration of the LULUCF sector was down by 0.08%.

Compared to 2005(Base year), the emission in 2022 decreased by 1.79%. In particular, the GHG emission from the energy sector was up by 4.03%, the IPPU sector was down by 28.37%, the agriculture sector was down by 21.05%, and the waste sector was down by 70.36%. Additionally, the carbon dioxide sequestration of the LULUCF sector was down by 2.04%, as shown in Figure ES3.3.

### 1. Energy sector

The total greenhouse gas emission from the energy sector in 2005 was 249,792 kilotons of carbon dioxide equivalents and increased to 259,849 kilotons of carbon dioxide equivalents in 2022 with a growth of 4.03% and an annual average growth of 0.23%, as shown in Table ES3.2. During this period, the greenhouse gas emissions from the energy sector showed a downward trend in 2008 for the first time and declined again in 2009 and 2012, followed by more reduction in 2018 to 2020 period. Compared with 2021, the greenhouse gas emissions in 2022 decreased by 3.38%. The total greenhouse gas

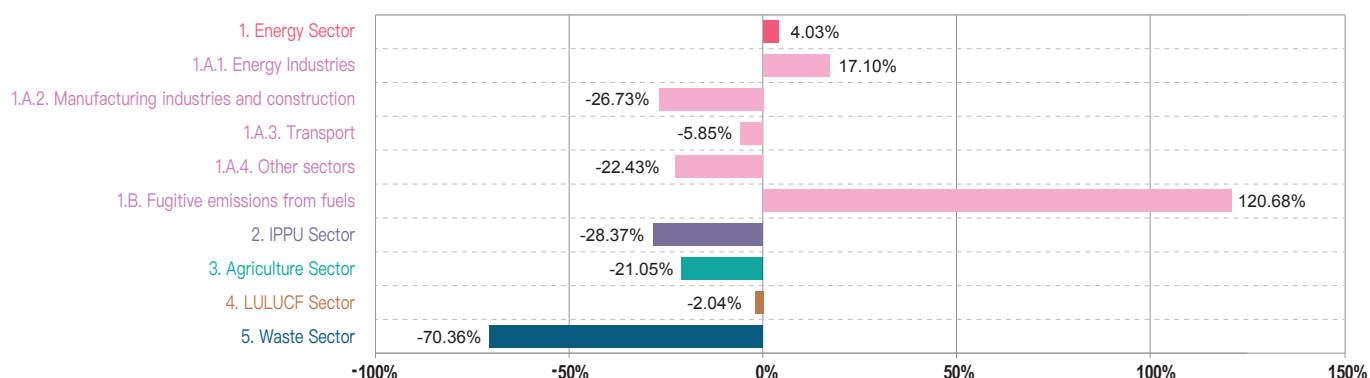


Figure ES3.3 Changes in Greenhouse Gas Emissions and Sequestrations by Sectors in Taiwan from 2005 to 2022.

**Table ES3.2 1990–2022 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
<b>Total CO<sub>2</sub> Emission</b>	109,465	118,443	126,058	135,206	143,103	150,810	158,579	170,835	181,518	190,446	208,724
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
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
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
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
<b>Total CH<sub>4</sub> Emission</b>	592	567	557	572	589	597	582	575	599	628	643
1.A.1 Energy Industry	29	32	31	36	39	45	46	51	56	65	73
1.A.2 Manufacturing and Construction Industry	51	54	58	58	60	61	63	66	67	71	79
1.A.3 Transportation	170	183	209	226	241	256	268	275	288	298	303
1.A.4 Others Sectors	34	33	31	29	31	30	33	29	30	31	33
1.B.1 Solid Fuel	182	155	129	126	110	90	57	38	30	35	32
1.B.2 Oil and Gas	127	109	98	97	108	115	115	117	128	126	124
<b>Total N<sub>2</sub>O Emission</b>	477	514	580	626	660	692	734	770	815	861	933
1.A.1 Energy Industry	123	140	162	183	197	213	240	266	294	321	377
1.A.2 Manufacturing and Construction Industry	80	84	90	90	92	95	98	102	103	110	121
1.A.3 Transportation	259	275	314	340	357	372	381	389	406	417	423
1.A.4 Others Sectors	15	15	14	12	14	13	14	12	12	13	14
<b>Total Emission from Energy Sector</b>	<b>110,535</b>	<b>119,523</b>	<b>127,195</b>	<b>136,404</b>	<b>144,352</b>	<b>152,099</b>	<b>159,894</b>	<b>172,180</b>	<b>182,933</b>	<b>191,935</b>	<b>210,300</b>
GHG Emission Sources and Sinks	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
<b>Total CO<sub>2</sub> Emission</b>	212,554	220,123	229,841	239,929	247,956	255,330	259,215	247,537	235,868	251,708	257,097
1.A.1 Energy Industry	123,880	128,157	139,316	147,288	155,014	162,298	168,580	162,125	153,989	164,270	168,491
1.A.2 Manufacturing and Construction Industry	44,234	46,373	44,211	44,551	44,008	45,309	44,845	41,410	37,874	42,612	43,691
1.A.3 Transportation	33,267	34,542	34,509	35,859	36,846	36,771	35,419	33,216	33,541	34,652	35,107
1.A.4 Others Sectors	11,174	11,052	11,806	12,230	12,089	10,952	10,371	10,785	10,463	10,174	9,808
<b>Total CH<sub>4</sub> Emission</b>	633	655	705	740	707	700	697	677	669	707	733
1.A.1 Energy Industry	78	77	87	90	93	98	100	98	91	96	97
1.A.2 Manufacturing and Construction Industry	81	85	83	86	85	88	87	80	76	83	89
1.A.3 Transportation	305	311	321	330	339	333	324	308	314	319	322
1.A.4 Others Sectors	34	33	36	37	37	33	30	32	31	30	28
1.B.1 Solid Fuel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2 Oil and Gas	136	148	178	197	153	148	155	159	157	180	197
<b>Total N<sub>2</sub>O Emission</b>	961	1,005	1,052	1,092	1,128	1,155	1,158	1,102	1,077	1,110	1,127
1.A.1 Energy Industry	403	423	472	492	518	543	566	546	526	535	539
1.A.2 Manufacturing and Construction Industry	122	128	125	127	127	130	129	118	111	121	129
1.A.3 Transportation	422	441	440	456	469	469	452	425	427	442	449
1.A.4 Others Sectors	14	14	15	16	15	13	12	13	12	11	11
<b>Total Emission from Energy Sector</b>	<b>214,149</b>	<b>221,783</b>	<b>231,599</b>	<b>241,762</b>	<b>249,792</b>	<b>257,186</b>	<b>261,070</b>	<b>249,316</b>	<b>237,614</b>	<b>253,526</b>	<b>258,957</b>
GHG Emission Sources and Sinks	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
<b>Total CO<sub>2</sub> Emission</b>	253,201	254,109	258,480	258,475	262,982	269,461	267,209	258,823	257,433	267,037	257,958
1.A.1 Energy Industry	166,836	167,021	173,747	173,695	177,209	185,761	187,895	180,206	179,435	188,383	181,621
1.A.2 Manufacturing and Construction Industry	42,515	43,309	40,386	39,577	39,656	38,115	34,858	33,902	32,895	35,520	32,261
1.A.3 Transportation	34,284	34,209	34,666	35,506	36,584	36,202	35,202	35,438	35,715	33,905	34,696
1.A.4 Others Sectors	9,566	9,571	9,681	9,698	9,533	9,384	9,254	9,277	9,389	9,229	9,380
<b>Total CH<sub>4</sub> Emission</b>	743	757	769	795	818	826	807	802	818	823	834
1.A.1 Energy Industry	96	95	98	102	103	105	105	101	100	103	102
1.A.2 Manufacturing and Construction Industry	86	88	85	84	84	79	67	66	65	67	59
1.A.3 Transportation	317	318	320	327	337	331	321	321	325	301	309
1.A.4 Others Sectors	28	28	29	28	28	27	27	27	27	27	27
1.B.1 Solid Fuel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2 Oil and Gas	216	228	238	254	267	284	288	288	302	325	337
<b>Total N<sub>2</sub>O Emission</b>	1,109	1,104	1,108	1,104	1,124	1,135	1,118	1,095	1,090	1,083	1,057
1.A.1 Energy Industry	534	528	531	519	527	550	561	537	530	544	520
1.A.2 Manufacturing and Construction Industry	124	126	120	119	118	111	93	91	89	92	80
1.A.3 Transportation	440	439	445	456	468	463	453	457	461	437	446
1.A.4 Others Sectors	11	11	11	11	11	10	10	10	10	10	10
<b>Total Emission from Energy Sector</b>	<b>255,053</b>	<b>255,970</b>	<b>260,357</b>	<b>260,375</b>	<b>264,923</b>	<b>271,422</b>	<b>269,134</b>	<b>260,720</b>	<b>259,341</b>	<b>268,943</b>	<b>259,849</b>

Note: 1. NO (not happened) means that the emission source is not produced or used. For example, coal production has been suspended since 2001.

emission from the energy sector in 2022 accounted for 90.87% of the total greenhouse gas emission in Taiwan. In particular, 1.A.1 “energy industry” was responsible for 182,243 kilotons of carbon dioxide equivalents, accounting for 70.14% of the total greenhouse gas emission from the energy sector; 1.A.2 “manufacturing and construction industry” was responsible for 32,400 kilotons of carbon dioxide equivalents (accounting for 12.47%); 1.A.3 “transportation” was responsible for 35,451 kilotons of carbon dioxide equivalents (accounting for 13.64%); 1.A.4 “other sectors (including service industry, residential and agriculture, forestry, fishery and husbandry)” was responsible for 9,417

kilotons of carbon dioxide equivalents (accounting for 3.62%); 1.B.2 “oil and gas” was responsible for 337 kilotons of carbon dioxide equivalents (accounting for 0.13%), as shown in Figure ES3.4.

## 2. Industrial Process and Product Use (IPPU) Sector

The greenhouse gas emission from the IPPU sector in 2005 was 28,257 kilotons of carbon dioxide equivalents and decreased to 20,240 kilotons in 2022, down by 28.37% with a negative average annual growth rate of -1.75%, as shown in Table ES3.3. Compared with 2021, the greenhouse gas emissions in 2022 decreased by 8.58%. The total greenhouse gas emission in 2022

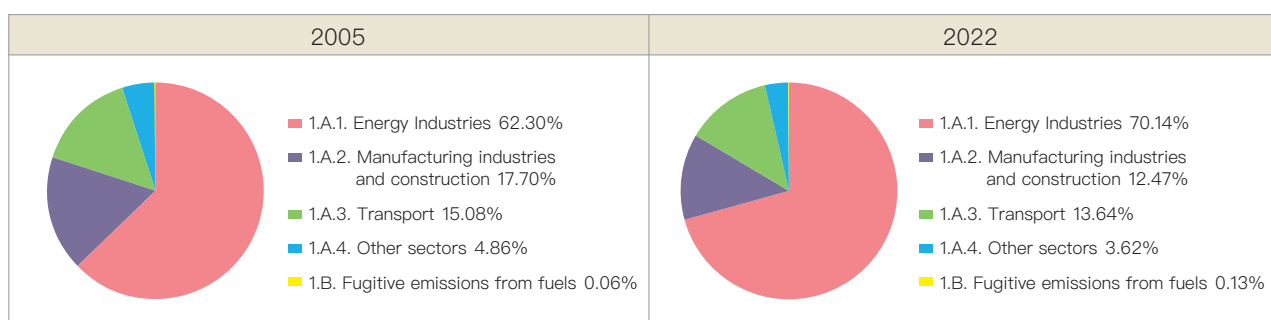


Figure ES3.4 Percentage of Greenhouse Gas Emissions by Energy Sectors in Taiwan in (a)2005 and (b)2022.

Table ES3.3 1990–2022 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
<b>Total CO<sub>2</sub> Emission</b>	14,557	15,007	15,926	18,408	17,826	17,528	17,677	19,483	18,410	17,179	17,388
2.A Mining Industry (Non-metal Products)	10,683	10,698	11,854	13,879	13,259	12,766	12,645	13,394	11,564	10,746	10,486
2.B Chemical Industry	575	551	575	617	770	858	999	1,026	1,007	1,079	1,148
2.C Metal Process	3,275	3,735	3,474	3,888	3,774	3,884	4,013	5,045	5,817	5,333	5,734
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
2.H Others	23	23	23	24	23	21	20	19	22	21	20
<b>Total CH<sub>4</sub> Emission</b>	6	8	7	8	9	11	13	13	11	13	15
2.B Chemical Industry	6	6	6	7	8	10	12	12	10	13	15
2.C Metal Process	0.2	2.0	1.5	1.2	1.0	1.4	1.3	1.3	1.3	0.4	0.2
<b>Total N<sub>2</sub>O Emission</b>	147	313	289	268	283	307	305	333	340	277	556
2.B Chemical Industry	147	313	289	268	283	307	305	333	340	277	556
2.C Metal Process	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.E Electronics Industry	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
<b>Total HFCs Emission</b>	NE	NE	NE	633	716	680	1,120	1,284	1,812	1,437	2,054
2.B Chemical Industry	NE	NE	NE	633	716	671	1,094	1,238	1,745	1,348	1,943
2.E Electronics Industry	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
2.F Alternatives to Ozone-depleting Substances	NE	NE	NE	NE	NE	8	26	46	67	89	112
<b>Total PFCs Emission (2.E Electronics Industry)</b>	NE	NE	NE	NE	NE	NE	NE	NE	NE	2	12
<b>Total SF<sub>6</sub> Emission</b>	NE	NE	NE	NE	NE	NE	NE	NE	NE	120	124
2.C Metal Process	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
2.G Manufacturing and Use of Other Products	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
<b>Total NF<sub>3</sub> Emission (2.E Electronics Industry)</b>	NE	NE	NE	NE	NE	NE	NE	NE	NE	10	9
<b>Total Emission from IPPU Sector</b>	<b>14,710</b>	<b>15,328</b>	<b>16,222</b>	<b>19,316</b>	<b>18,834</b>	<b>18,526</b>	<b>19,114</b>	<b>21,113</b>	<b>20,574</b>	<b>19,038</b>	<b>20,158</b>

Continued from the table below



Continued from the above table

GHG Emission Sources and Sinks	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
<b>Total CO<sub>2</sub> Emission</b>	16,186	16,075	17,141	17,358	18,094	20,299	19,967	18,558	16,407	18,206	18,954
2.A Mining Industry (Non-metal Products)	9,974	10,648	10,341	10,691	11,257	11,014	10,369	9,289	8,467	8,616	9,577
2.B Chemical Industry	1,232	1,313	1,384	1,485	1,751	1,721	1,845	1,601	1,601	1,778	1,737
2.C Metal Process	4,960	4,096	5,397	5,162	5,066	7,544	7,733	7,648	6,317	7,792	7,620
2.D Non-Energy Products from Fuels and Solvent Use	0.00007	0.00008	0.00009	0.00011	0.00010	0.00007	0.00007	0.00007	0.00006	0.00005	0.00004
2.H Others	20	18	18	19	20	21	20	20	21	20	20
<b>Total CH<sub>4</sub> Emission</b>	20	21	24	31	20	25	31	30	31	32	25
2.B Chemical Industry	20	21	24	31	20	20	26	24	27	26	25
2.C Metal Process	0.1	0.2	0.3	NO	NO	4.8	4.8	5.5	3.9	6.2	0.02
<b>Total N<sub>2</sub>O Emission</b>	635	661	741	742	891	1,311	1,399	1,185	1,334	1,670	1,605
2.B Chemical Industry	635	661	739	742	854	861	886	697	895	1,040	1,062
2.C Metal Process	NO	0.4	1.5	NO	NO	84	85	81	68	107	NO
2.E Electronics Industry	NE	NE	NE	NE	37	365	428	407	371	523	543
<b>Total HFCs Emission</b>	2,330	2,017	1,859	1,687	304	333	403	358	406	395	373
2.B Chemical Industry	2,151	1,807	1,623	1,433	NO	NO	NO	NO	NO	NO	NO
2.E Electronics Industry	43	49	49	49	85	100	167	123	172	169	144
2.F Alternatives to Ozone-depleting Substances	136	160	187	205	219	233	236	235	233	226	229
<b>Total PFCs Emission (2.E Electronics Industry)</b>	2,665	3,764	3,814	3,949	3,178	3,355	3,102	1,932	1,464	1,650	1,665
<b>Total SF<sub>6</sub> Emission</b>	769	3,986	4,471	5,288	5,052	3,940	3,485	3,001	2,527	2,286	1,976
2.C Metal Process	NE	1,009	1,009	1,334	1,046	757	454	149	242	59	52
2.E Electronics Industry	769	973	1,458	1,838	2,457	2,389	2,049	1,930	1,561	1,983	1,665
2.G Manufacturing and Use of Other Products	NE	2,003	2,003	2,116	1,549	794	982	923	724	245	260
<b>Total NF<sub>3</sub> Emission (2.E Electronics Industry)</b>	220	373	506	617	716	644	747	191	540	241	393
<b>Total Emission from IPPU Sector</b>	<b>22,824</b>	<b>26,897</b>	<b>28,555</b>	<b>29,672</b>	<b>28,257</b>	<b>29,906</b>	<b>29,135</b>	<b>25,256</b>	<b>22,709</b>	<b>24,481</b>	<b>24,991</b>
GHG Emission Sources and Sinks	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
<b>Total CO<sub>2</sub> Emission</b>	19,369	19,605	17,704	17,251	16,583	15,625	16,019	14,890	13,999	15,663	14,770
2.A Mining Industry (Non-metal Products)	9,333	9,866	8,728	8,345	7,108	6,262	6,403	6,501	6,561	6,828	6,464
2.B Chemical Industry	1,714	1,749	1,884	1,842	1,760	1,709	1,684	1,666	1,550	1,730	1,270
2.C Metal Process	8,301	7,970	7,072	7,044	7,696	7,634	7,913	6,706	5,870	7,090	7,020
2.D Non-Energy Products from Fuels and Solvent Use	0.00004	0.00005	0.00006	0.00010	0.00008	0.00007	0.00006	0.00006	0.00006	0.00007	0.00006
2.H Others	21	19	19	20	19	20	19	17	18	15	15
<b>Total CH<sub>4</sub> Emission</b>	26	28	29	29	30	27	30	29	28	29	24
2.B Chemical Industry	26	28	29	29	30	27	30	29	28	29	24
2.C Metal Process	0.07	0.1	0.2	0.2	0.2	NO	0.01	0.01	0.0001	NO	NO
<b>Total N<sub>2</sub>O Emission</b>	1,527	1,407	1,384	1,378	1,550	1,729	1,838	1,743	1,709	2,227	1,526
2.B Chemical Industry	904	694	647	614	854	991	987	828	541	1,053	679
2.C Metal Process	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.E Electronics Industry	623	713	737	764	696	738	851	916	1,168	1,174	847
<b>Total HFCs Emission</b>	398	534	616	650	757	895	1,043	1,163	1,304	1,429	1,555
2.B Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.E Electronics Industry	104	173	184	142	160	169	169	152	161	156	151
2.F Alternatives to Ozone-depleting Substances	294	361	431	508	597	725	875	1,012	1,143	1,273	1,405
<b>Total PFCs Emission (2.E Electronics Industry)</b>	1,054	1,253	1,449	1,250	1,336	1,304	1,421	1,315	1,336	1,354	1,250
<b>Total SF<sub>6</sub> Emission</b>	1,909	2,059	1,807	1,569	1,458	1,459	1,342	963	867	882	660
2.C Metal Process	31	39	58	44	39	61	84	45	37	62	27
2.E Electronics Industry	1,678	1,855	1,600	1,393	1,334	1,317	1,105	805	693	716	507
2.G Manufacturing and Use of Other Products	201	165	150	132	85	81	154	113	137	103	127
<b>Total NF<sub>3</sub> Emission (2.E Electronics Industry)</b>	363	723	624	626	442	412	477	443	528	556	455
<b>Total Emission from IPPU Sector</b>	<b>24,646</b>	<b>25,609</b>	<b>23,613</b>	<b>22,753</b>	<b>22,156</b>	<b>21,451</b>	<b>22,170</b>	<b>20,547</b>	<b>19,771</b>	<b>22,140</b>	<b>20,240</b>

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.

accounted for 7.08% of the total greenhouse gas emission in Taiwan. In particular, 2.C “metal process” was responsible for 7,047 kilotons of carbon dioxide equivalents, accounting for 34.82% (the majority) of the greenhouse gases from the IPPU sector, followed by 2.A “mining industry (non-metal process)”, which

was responsible for 6,464 kilotons of carbon dioxide equivalents (accounting for 31.94%), 2.E “electronics industry”, which was responsible for 3,209 kilotons of carbon dioxide equivalents (accounting for 15.85%), 2.B “chemical industry”, which was responsible for 1,974 kilotons of carbon dioxide equivalents (accounting

for 9.75%), 2.F “alternatives to ozone-depleting substances”, which was responsible for 1,405 kilotons of carbon dioxide equivalents (accounting for 6.94%), 2.G. “manufacturing and use of other products”, which was responsible for 127 kilotons of carbon dioxide equivalents (accounting for 0.63%), 2.H. “others”, which was responsible for 15 kilotons of carbon dioxide equivalents (accounting for 0.07%) and 2.D. “Non-Energy Products from Fuels and Solvent Use”, which was responsible for 0.00006 kilotons of carbon dioxide equivalents (accounting for 0.000003%), as shown in Figure ES3.5.

### 3. Agriculture Sector

In 2022, the greenhouse gas emissions from the agriculture sector totaled 3,178 kilotons of carbon dioxide equivalents, accounting for 1.11% of the total greenhouse gas emission in Taiwan, approximately down by 21.05% compared to 4,026 kilotons of carbon dioxide equivalents in 2005, with a negative average annual growth rate of -1.38%, as shown in Table ES3.4. Compared to 2021, the greenhouse gas emissions from the agriculture sector in 2022 slightly fall by 3.19%. In particular, greenhouse gas emissions from 3.D

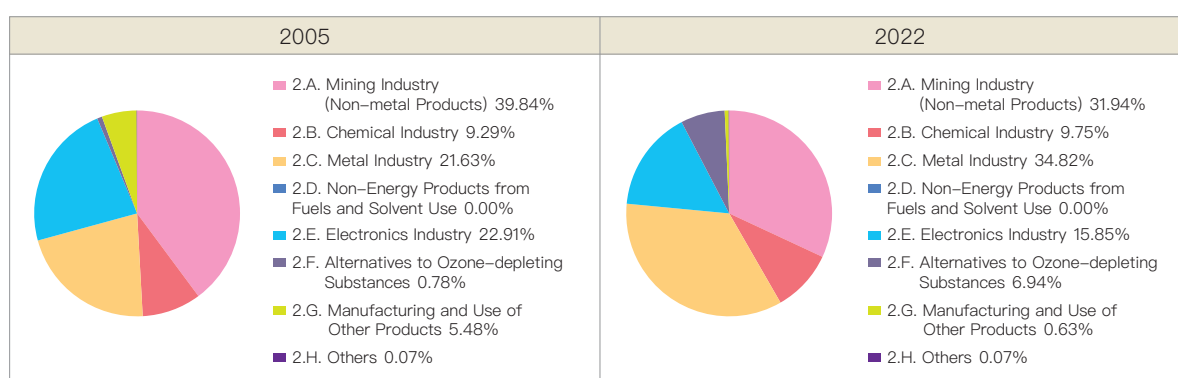


Figure ES3.5 Percentage of Greenhouse Gas Emissions by Industrial Process and Product Use Sectors in Taiwan in (a) 2005 and (b) 2022.

Table ES3.4 1990–2022 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
Total CO <sub>2</sub> Emission (3.H Urea applied)	142	146	139	131	135	151	151	134	127	118	131
Total CH <sub>4</sub> Emission	3,264	3,472	3,381	3,388	3,374	3,449	3,455	2,993	2,703	2,820	2,813
3.A Livestock Gastrointestinal Fermentation	750	819	826	868	883	921	921	820	755	778	775
3.B Livestock Waste Treatment	1,246	1,460	1,418	1,436	1,470	1,535	1,565	1,190	990	1,088	1,123
3.C Rice Culturing	1,226	1,166	1,084	1,059	998	984	961	976	953	947	899
3.F Field Burning of Agricultural Residues	42	28	53	24	23	8	8	8	6	8	15
Total N <sub>2</sub> O Emission	1,736	1,783	1,724	1,750	1,743	1,736	1,772	1,566	1,461	1,511	1,640
3.B Livestock Waste Treatment	129	146	145	147	154	160	167	143	129	137	140
3.D Agricultural Soil	1,597	1,630	1,567	1,597	1,583	1,574	1,603	1,422	1,331	1,372	1,496
3.F Field Burning of Agricultural Residues	10	7	13	6	6	2	2	2	2	2	4
<b>Total Emission From Agriculture Sector</b>	<b>5,141</b>	<b>5,402</b>	<b>5,244</b>	<b>5,268</b>	<b>5,251</b>	<b>5,336</b>	<b>5,378</b>	<b>4,692</b>	<b>4,292</b>	<b>4,449</b>	<b>4,583</b>
GHG Emission Sources and Sinks	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Total CO <sub>2</sub> Emission (3.H Urea applied)	94	93	82	84	62	59	57	57	55	54	53
Total CH <sub>4</sub> Emission	2,717	2,565	2,451	2,363	2,495	2,461	2,371	2,303	2,247	2,244	2,278
3.A Livestock Gastrointestinal Fermentation	739	712	701	688	698	688	682	655	640	648	660
3.B Livestock Waste Treatment	1,074	1,022	1,019	1,024	1,071	1,058	994	965	924	931	944
3.C Rice Culturing	887	816	721	643	717	706	690	676	678	659	668
3.F Field Burning of Agricultural Residues	17	14	10	9	9	9	5	7	6	6	6
Total N <sub>2</sub> O Emission	1,574	1,576	1,460	1,565	1,468	1,493	1,462	1,388	1,413	1,398	1,343
3.B Livestock Waste Treatment	135	131	131	130	136	136	130	129	125	125	126
3.D Agricultural Soil	1,435	1,441	1,326	1,433	1,330	1,355	1,331	1,258	1,286	1,272	1,215
3.F Field Burning of Agricultural Residues	4	4	2	2	2	2	1	2	1	1	1
<b>Total Emission From Agriculture Sector</b>	<b>4,385</b>	<b>4,234</b>	<b>3,993</b>	<b>4,012</b>	<b>4,026</b>	<b>4,013</b>	<b>3,890</b>	<b>3,748</b>	<b>3,716</b>	<b>3,696</b>	<b>3,674</b>

Continued from the table below



Continued from the above table

GHG Emission Sources and Sinks	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Total CO <sub>2</sub> Emission (3.H Urea applied)	55	45	40	38	34	31	30	29	29	27	22
Total CH <sub>4</sub> Emission	2,252	2,237	2,180	2,158	2,166	2,166	2,165	2,174	2,172	2,115	2,052
3.A Livestock Gastrointestinal Fermentation	653	649	634	641	628	632	640	643	650	665	655
3.B Livestock Waste Treatment	904	874	840	834	829	827	832	844	845	842	821
3.C Rice Culturing	688	710	702	678	705	704	689	684	677	608	576
3.F Field Burning of Agricultural Residues	6	4	4	5	4	4	3	2	1	1	1
Total N <sub>2</sub> O Emission	1,363	1,306	1,298	1,272	1,270	1,225	1,203	1,154	1,201	1,141	1,104
3.B Livestock Waste Treatment	123	122	121	121	122	123	125	129	130	130	130
3.D Agricultural Soil	1,238	1,184	1,176	1,150	1,146	1,101	1,077	1,025	1,071	1,011	973
3.F Field Burning of Agricultural Residues	1.5	0.9	1.0	1.2	0.9	1.0	0.7	0.6	0.2	0.2	0.2
Total Emission From Agriculture Sector	3,670	3,588	3,518	3,468	3,469	3,423	3,397	3,358	3,402	3,283	3,178

“agricultural soil” accounted for 30.61%, greenhouse gas emissions from 3.B “livestock waste treatment” accounted for 29.92%, greenhouse gas emissions from 3.A “livestock gastrointestinal fermentation” accounted for 20.60%, greenhouse gas emissions from 3.C “rice culturing” accounted for 18.13%, greenhouse gas emissions from 3.H “urea use” accounted for 0.71%, and greenhouse gas emissions from 3.F “field burning of agricultural residues” accounted for 0.03%, as shown in Figure ES3.6.

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

The main greenhouse gas sequestered 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 2022 (mainly consisting of carbon dioxide sequestration by forestry resources) is shown in Table ES3.5.

The carbon dioxide sequestration by forestry sector in 2005 was 22,290 kilotons of carbon dioxide equivalents. The carbon dioxide sequestration between 2005 and 2022 decreased by 2.04% with a negative average annual growth rate of -0.12%. The sequestration in 2022 was 21,834 kilotons of carbon dioxide equivalents, down by 0.08% compared with 2021.

#### 5. Waste sector

In 2005, the greenhouse gas emissions by waste sector were 9,109 kilotons of carbon dioxide equivalents. The emissions from the waste sector in 2022 were 2,700 kilotons of carbon dioxide equivalents, approximately accounting for 0.94% of the total greenhouse gas emission in Taiwan, down by 70.36% compared with 2005, with a negative average annual growth rate of -6.90% (as shown in Table ES3.6). Compared to 2021, the greenhouse gas emissions from the waste sector in 2022 dropped by 4.76%. Among the waste sector’s emissions in 2022, greenhouse gas emissions from 5.D “wastewater treatment and discharge” accounted for 38.82%, followed by greenhouse gas emissions from 5.C “waste incineration and opening burning”, accounting for 34.87%, greenhouse gas emissions from 5.A “solid waste disposal”, accounting for 24.56%, greenhouse

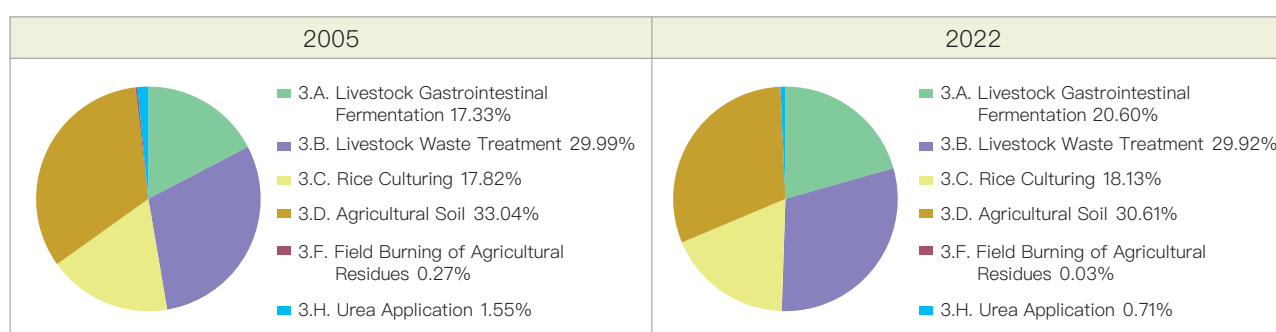


Figure ES3.6 Percentage of Greenhouse Gas Emissions by Agriculture Sectors in Taiwan in (a) 2005 and (b) 2022.

Table ES3.5 1990–2022 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
4.A.1 Forests Maintaining Forests	Biomass Carbon Sequestration ( $\Delta CO_{2g}$ )	-23,902	-23,902	-23,741	-23,580	-23,418	-23,257	-23,095	-22,934	-22,772	-22,611	-22,449
	Biomass Carbon Emissions ( $\Delta CO_{2e}$ )	607	2,503 <sup>1</sup>	333	216	190	202	559	266	326	401	389
4.A.2 Other Lands Turned to Forests	Biomass Carbon Sequestration ( $\Delta CO_{2g}$ )	-91	-91	-136	-182	-230	-285	-315	-392	-440	-553	-656
Total Carbon Sequestration from LULUCF Sector ( $\Delta CO_2$ )		-23,386	-21,490	-23,544	-23,546	-23,459	-23,340	-22,851	-23,060	-22,887	-22,764	-22,717
GHG Emission Sources and Sinks		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
4.A.1 Forests Maintaining Forests	Biomass Carbon Sequestration ( $\Delta CO_{2g}$ )	-22,288	-22,127	-21,965	-21,804	-21,642	-21,481	-21,319	-21,158	-20,997	-20,889	-20,907
	Biomass Carbon Emissions ( $\Delta CO_{2e}$ )	1,112 <sup>2</sup>	167	227	243	369	251	308	199	2,753 <sup>3</sup>	218	140
4.A.2 Other Lands Turned to Forests	Biomass Carbon Sequestration ( $\Delta CO_{2g}$ )	-673	-747	-886	-981	-1,016	-1,029	-1,062	-1,123	-1,145	-1,218	-1,181
Total Carbon Sequestration from LULUCF Sector ( $\Delta CO_2$ )		-21,850	-22,707	-22,624	-22,542	-22,290	-22,259	-22,074	-22,082	-19,388	-21,889	-21,947
GHG Emission Sources and Sinks		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
4.A.1 Forests Maintaining Forests	Biomass Carbon Sequestration ( $\Delta CO_{2g}$ )	-20,932	-20,970	-21,004	-21,040	-21,068	-21,105	-21,148	-21,202	-21,271	-21,318	-21,359
	Biomass Carbon Emissions ( $\Delta CO_{2e}$ )	145	135	197	189	153	107	83	116	90	121	114
4.A.2 Other Lands Turned to Forests	Biomass Carbon Sequestration ( $\Delta CO_{2g}$ )	-1,173	-1,139	-1,079	-1,049	-1,011	-963	-918	-831	-724	-654	-589
Total Carbon Sequestration from LULUCF Sector ( $\Delta CO_2$ )		-21,960	-21,974	-21,886	-21,900	-21,926	-21,961	-21,984	-21,917	-21,905	-21,850	-21,834

- Note:
- In 1991, a forest fire broke out in Xinyi Township, Nantou County and Tataga District, Alishan Township, Chiayi County, and it was extended to more than 300 square meters, causing large losses in volume of wood.
  - In addition to the five forest fires that occurred in Takivatan, Lishan Mountain, East Peak of Mt. Shei, and Yangmingshan National Park, there were 59 breaking out of small fire in 2001, and the fire damaged area up to 395 square meters, causing heavy loss of forest resources.
  - In 2009, the typhoon Morakot caused severe disasters in central and southern Taiwan, especially in Kaohsiung and parts of Pingtung, dropped more than 2,500 millimeters of rain and produced about 1.25 million tons of driftwood, causing large losses in volume of wood.

Table ES3.6 1990–2022 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
Total CO <sub>2</sub> Emission	94	35	309	301	500	1,575	1,652	330	491	280	691
5.C Incineration and Open Burning of Waste	94	35	309	301	500	1,575	1,652	330	491	280	691
5.D Wastewater Treatment and Discharge	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total CH <sub>4</sub> Emission	8,410	8,643	8,917	9,945	10,731	11,632	11,833	12,073	12,479	12,391	11,722
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
5.B Solid Waste Biological Disposal	13	0.6	0.9	0.5	0.2	0.7	0.3	1.6	0.06	2.2	0.3
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
Total N <sub>2</sub> O Emission	190	181	190	198	200	216	218	213	200	194	186
5.B Solid Waste Biological Disposal	9	0.4	0.6	0.4	0.1	0.5	0.2	1.1	0.04	1.5	0.2
5.C Waste Burn	1.0	0.4	3	3	5	16	17	3	5	3	7
5.D Wastewater Treatment and Discharge	180	180	186	194	194	199	201	209	195	189	179
Total Emission from Waste Sector	8,694	8,858	9,415	10,444	11,430	13,424	13,703	12,616	13,170	12,865	12,599

Continued from the table below

Continued from the above table

GHG Emission Sources and Sinks	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
<b>Total CO<sub>2</sub> Emission</b>	2,597	2,276	2,065	1,996	776	848	837	733	703	747	670
5.C Incineration and Open Burning of Waste	2,597	2,276	2,065	1,996	776	848	837	733	703	747	670
5.D Wastewater Treatment and Discharge	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
<b>Total CH<sub>4</sub> Emission</b>	10,996	10,339	9,569	8,868	8,164	7,437	6,732	5,968	5,111	4,542	4,137
5.A Solid Waste Disposal	9,655	8,976	8,192	7,482	6,786	6,066	5,349	4,644	3,942	3,347	2,862
5.B Solid Waste Biological Disposal	0.02	0.4	2.6	7	11	13	16	18	20	23	29
5.D Wastewater Treatment and Discharge	1,341	1,363	1,375	1,379	1,367	1,359	1,367	1,306	1,149	1,171	1,246
<b>Total N<sub>2</sub>O Emission</b>	196	195	195	185	169	164	149	136	134	133	136
5.B Solid Waste Biological Disposal	0.02	0.3	2	5	8	9	11	13	14	17	21
5.C Waste Burn	27	23	21	21	8	9	9	8	7	8	8
5.D Wastewater Treatment and Discharge	169	171	172	159	154	147	129	115	112	109	107
<b>Total Emission from Waste Sector</b>	<b>13,789</b>	<b>12,810</b>	<b>11,829</b>	<b>11,050</b>	<b>9,109</b>	<b>8,450</b>	<b>7,719</b>	<b>6,836</b>	<b>5,948</b>	<b>5,421</b>	<b>4,943</b>
GHG Emission Sources and Sinks	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
<b>Total CO<sub>2</sub> Emission</b>	657	817	736	499	589	613	639	703	798	910	933
5.C Incineration and Open Burning of Waste	657	817	736	498	589	613	639	703	798	909	932
5.D Wastewater Treatment and Discharge	NO	NO	NO	1.7	0.2	0.5	0.6	0.3	0.3	0.4	0.4
<b>Total CH<sub>4</sub> Emission</b>	3,660	3,187	2,808	2,686	2,710	2,474	2,106	1,963	1,834	1,805	1,654
5.A Solid Waste Disposal	2,432	2,054	1,736	1,469	1,252	1,080	937	837	769	694	663
5.B Solid Waste Biological Disposal	27	25	23	22	22	23	26	28	29	30	28
5.D Wastewater Treatment and Discharge	1,201	1,108	1,049	1,195	1,436	1,371	1,142	1,098	1,036	1,081	963
<b>Total N<sub>2</sub>O Emission</b>	128	121	120	124	120	121	123	119	121	121	114
5.B Solid Waste Biological Disposal	19	18	16	16	16	16	18	20	21	21	20
5.C Waste Burn	8	8	8	5	6	6	6	7	8	9	9
5.D Wastewater Treatment and Discharge	101	96	96	103	98	99	99	92	92	91	85
<b>Total Emission from Waste Sector</b>	<b>4,446</b>	<b>4,126</b>	<b>3,663</b>	<b>3,309</b>	<b>3,420</b>	<b>3,208</b>	<b>2,868</b>	<b>2,785</b>	<b>2,753</b>	<b>2,835</b>	<b>2,700</b>

Note: NO (not happened) means that the emission source is not produced or used. For example, Wastewater Treatment and Discharge have been included in industrial wastewater inventory data since 2015.

gas emissions from 5.B “waste biological disposal”, accounting for 1.75%, as shown in Figure ES3.7.

### ES.4 Other Information

In accordance with the “Climate Change Response Act”, Taiwan established a Greenhouse Gas (GHG) emissions report and management system complying with Taiwan’s national conditions, the work division, and the hierarchical management of database. Accordingly, the relevant competent authorities will calculate GHG emissions subject to their departments and bring together experts and scholars to review the statistical

data, methodology, and improvement plans. The results will be submitted to Environmental Protection Administration for compilation annually. After the cross-ministerial discussions, editing and proofreading, the National Inventory Report (NIR) will be established. Besides, Taiwan’s National GHG Registry has been established since 2013, allowing the competent authorities to submit their statistical data online. Furthermore, since 2015, the 2006 IPCC Guidelines has been applied for the compilation of annual NIR, the mission done in compliance with UNFCCC requirements.

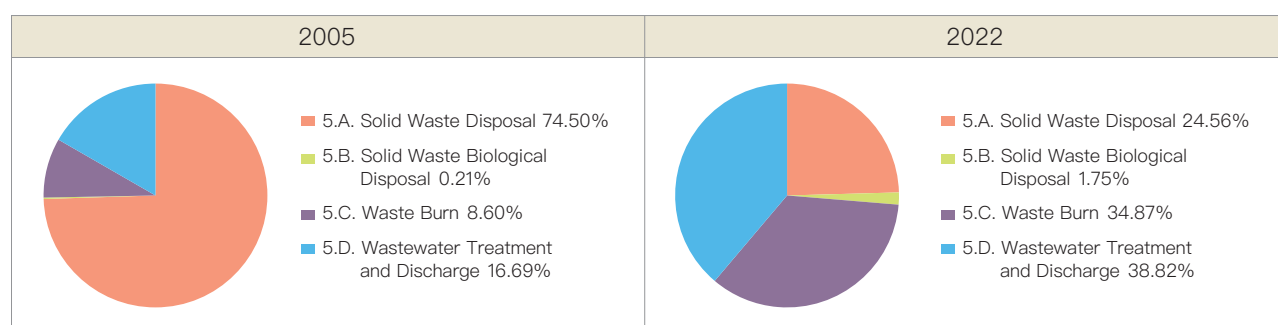


Figure ES3.7 Percentage of Greenhouse Gas Emissions by Waste Sectors in Taiwan in (a) 2005 and (b) 2022.

2024

REPUBLIC OF CHINA TAIWAN  
NATIONAL GREENHOUSE GAS  
INVENTORY REPORT



Report Summary



環境部  
Ministry of Environment