2018 Republic of China National Greenhouse Gas Inventory Report

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Taiwan Environmental Protection Administration
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Executive Summary

ES.1 Background Information on National Greenhouse Gas Inventory

The guidelines in Article 4 and Article 12 of the United Nations Framework Convention on Climate Change (UNFCCC) and Article 5 of the Kyoto Protocol state that each party shall submit information on its progress in response to climate change to the UNFCCC Convention of the Parties for review. In particular, the National Inventory Report (NIR) is a national report in which the UNFCCC[1] requires each Annex 1 country to report on its national greenhouse gas (GHG) inventory describing the procedures for GHG emission inventory preparation, information on emission trends, statistics by sectors, and a national report of re-calculation while submitting its inventory based on Common Reporting Format (CRF). 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 is the fundamental obligation of a country to UNFCCC as well as one of the essential steps in reducing global warming.

Since 1998, Taiwan has taken initiatives to prepare the national GHG inventory. According to Decision 24/CP.17 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. The Report also carried out the statistics and compilation in accordance with the 2006 IPCC Guidelines 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 2016. 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.

ES.2 Summary of National Emission and Sequestration Trends

Taiwan's total GHG emissions increased from 138,097 kilotons of carbon dioxide equivalents (excluding carbon dioxide removal) in 1990 to 293,125 kilotons of carbon dioxide equivalents (excluding carbon dioxide sequestration) in 2016, with emissions increased by 112.26% at an average annual growth rate of 2.94%. The total emissions in 2016 saw an increase of 1.22% from the previous year. The net greenhouse gas emission increased from 114,711 kilotons of carbon dioxide equivalents in 1990 to 271,707 kilotons of carbon dioxide equivalents in 2016, with emissions increased by 136.86%, at an average annual growth rate of 3.37%. The total emissions in 2016 showed an increase of 1.32% from the previous 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 in Taiwan in 2016, followed by methane, nitrous oxide and then fluorinated greenhouse gas. Between 1990 and 2016, carbon dioxide emissions grew by 125.09% with an average annual growth rate of 3.17%; carbon dioxide sequestration decreased by 8.42% with an average annual growth rate of -0.34%; methane emissions decreased by 49.48% with an average annual growth rate of -2.59%, a negative growth; nitrous oxide emissions increased by 62.37% with an annual growth rate of 1.88%. Between 1993 and 2016, fluorinated greenhouse gas emissions grew by 372.88% with an average annual growth rate of 6.99%, as shown in Table ES2.1.

The energy sector, industrial process and product use sector, agriculture sector, and waste sector are the main emission sources of carbon dioxide in Taiwan, as shown in Table ES2.2. In 1990, Taiwan's carbon dioxide emissions

[1] UNFCCC, FCCC/CP/2002/8, 2002.

amounted to 124,045 kilotons of carbon dioxide equivalents. In 2016, that figure was 279,216 kilotons of carbon dioxide equivalents, with an 125.09% increase and an average annual growth rate of 3.17%. In 2016, carbon dioxide emissions accounted for 95.26% of total GHG emissions. The energy sector accounted for 94.07%, the industrial process and product use sector 5.87%, the agriculture sector 0.01%, and the waste sector 0.05%. Compared with 2015, the emissions in 2016 increased by 1.30% mainly because of the 1.59% increase in the energy sector, the 5.87% increase in the industrial process and product use sector, the 0.01% increase in the agriculture sector, and the 0.05% increase in the waste sector.

Methane emissions in Taiwan mainly come from the agriculture sector, waste sector, and energy sector, as shown in Table ES2.3. In 1990, the total methane emission in Taiwan was 11,158 kilotons of carbon dioxide equivalents. In 2016, the total methane emission was 5,637 kilotons of carbon dioxide equivalents, down by 49.48% with an average growth rate of -2.59%, a negative growth. In 2016, methane emissions accounted for 1.92% of the total GHG emissions. In particular, the waste sector was the largest source of methane emissions in 2016, which accounted for 63.30%, followed by the agriculture sector (22.77%), energy sector (13.22%), and industrial process and product use sector (0.71%). Compared to 2015, the methane emission in 2016 was down by 0.69%, with the waste sector down by 7.40%, the agriculture sector down by 0.19%, the industrial process and product use sector up by 7.54% and the energy sector up by 6.25%.

Nitrous oxide emissions in Taiwan are mainly from the industrial process and product use sector, agriculture sector, and energy sector with minor emissions from the waste sector, as shown in Table ES2.4. In 1990, the total nitrous oxide emission in Taiwan was 2,895 kilotons of carbon dioxide equivalents. In 2016, the total nitrous oxide emission was 4,701 kilotons of carbon dioxide equivalents, up by 62.37% with an average growth rate of 1.88%. In 2016, nitrous oxide emissions accounted for 1.60% of the total GHG emissions. In particular, the industrial process and product use sector accounted for 36.29%, followed by the agriculture sector (29.67%), the energy sector (27.02%), and the waste sector (7.01%). Compared to 2015, the nitrous oxide emission in 2016 was up by 4.08%, with the industrial process and product use sector up by 12.69%, the energy sector up by 1.33%, the waste sector down by 9.38%, and the agriculture sector down by 2.26%.

In Taiwan, the majority of fluorinated greenhouse gases come from industries critical to economic development,

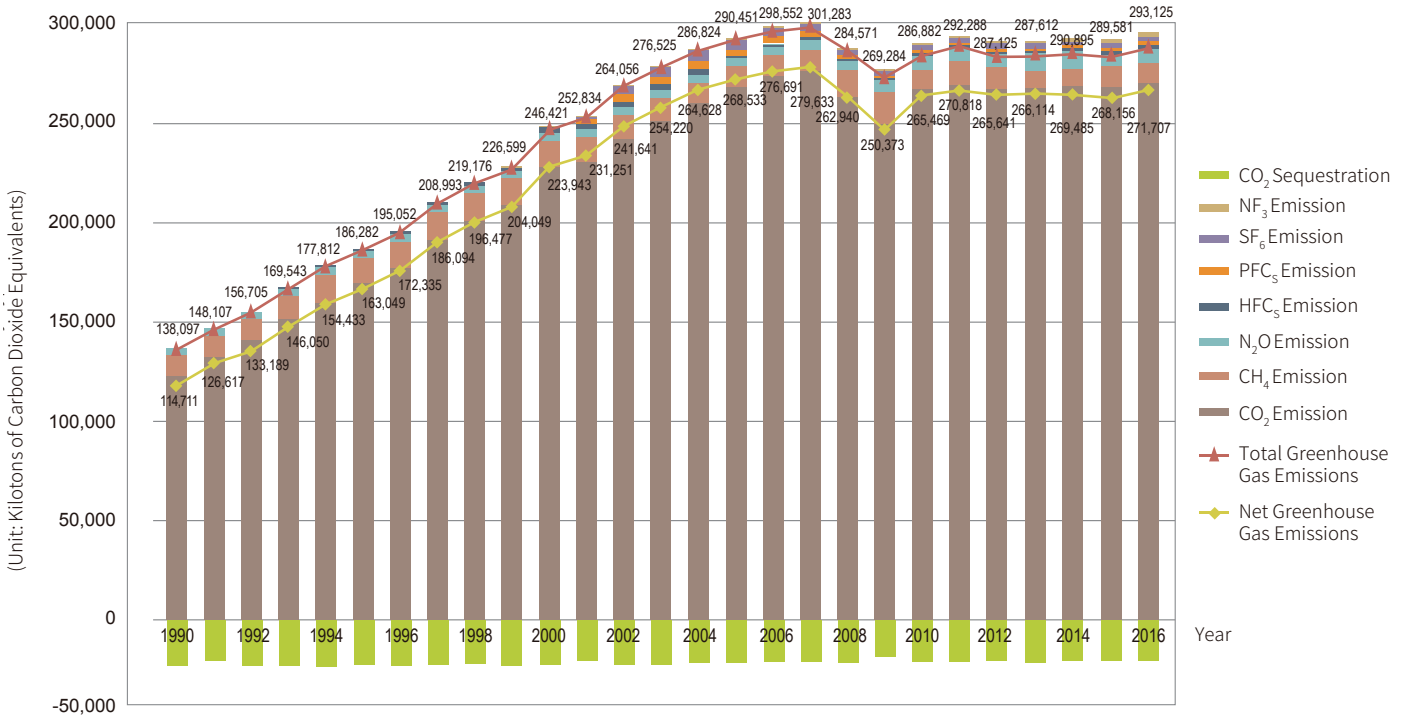

Figure ES2.1 1990-2016 Trends in Total Greenhouse Gas Emissions and Sequestration in Taiwan by Type

Table ES2.1 1990-2016 Greenhouse Gas Emissions and Sequestration in Taiwan by Type

(Unit: Kilotons of Carbon Dioxide Equivalents)

GHG	Global Warming Potential	1990	1991	1992	1993	1994	1995	1996	1997	1998
CO_2	1	124,045	133,565	142,151	153,771	161,139	168,854	176,761	190,526	200,140
CH_4	25	11,158	11,394	11,411	11,804	12,562	13,297	13,730	13,703	13,724
N_2O	298	2,895	3,148	3,143	3,213	3,257	3,329	3,255	3,287	3,229
HFCs	HFC-134a: 1,430 etc	NE	NE	NE	755	855	801	1,305	1,477	2,083
PFCs	PFC-14: 7,390 etc	NE	NE	NE	NE	NE	NE	NE	NE	NE
SF_6	22,800	NE	NE	NE	NE	NE	NE	NE	NE	NE
NF_3	17,200	NE	NE	NE	NE	NE	NE	NE	NE	NE
CO_2 Sequestration	1	-23,386	-21,490	-23,516	-23,493	-23,379	-23,233	-22,717	-22,899	-22,699
Net GHG Emission		114,711	126,617	133,189	146,050	154,433	163,049	172,335	186,094	196,477
Total GHG Emission		138,097	148,107	156,705	169,543	177,812	186,282	195,052	208,993	219,176
GHG	Global Warming Potential	1999	2000	2001	2002	2003	2004	2005	2006	2007
CO_2	1	207,804	227,011	230,089	237,658	249,730	259,449	266,619	275,886	279,586
CH_4	25	13,865	13,146	12,346	11,770	11,298	10,610	10,102	9,463	8,967
N_2O	298	3,192	3,802	3,860	3,957	3,977	4,122	4,181	4,713	4,792
HFCs	HFC-134a: 1,430 etc	1,609	2,319	2,619	2,216	2,397	2,451	1,070	987	1,093
PFCs	PFC-14:7,390 etc	3	13	2,939	4,143	4,198	4,341	3,070	3,264	2,972
SF_6	22,800	116	120	746	3,914	4,385	5,193	4,683	3,590	3,114
NF_3	17,200	11	10	235	398	540	659	726	650	759
CO_2 Sequestration	1	-22,550	-22,476	-21,583	-22,415	-22,305	-22,196	-21,918	-21,861	-21,650
Net GHG Emission		204,049	223,945	231,251	241,641	254,220	264,628	268,533	276,691	279,633
Total GHG Emission		226,599	246,421	252,834	264,056	276,525	286,824	290,451	298,552	301,283
GHG	Global Warming Potential	2008	2009	2010	2011	2012	2013	2014	2015	2016
CO_2	1	266,377	252,237	270,134	276,166	272,332	272,618	276,235	275,634	279,216
CH_4	25	8,279	7,662	7,134	6,756	6,437	6,060	5,878	5,676	5,637
N_2O	298	4,377	4,547	4,953	4,850	4,767	4,569	4,558	4,516	4,701
HFCs	HFC-134a: 1,430 etc	1,046	980	934	1,016	869	981	1,010	982	991
PFCs	PFC-14: 7,390 etc	1,682	1,143	1,354	1,365	725	929	1,139	931	1,045
SF_6	22,800	2,644	2,176	2,155	1,755	1,647	1,722	1,447	1,217	1,094
NF_3	17,200	166	538	219	381	349	734	627	623	440
CO_2 Sequestration	1	-21,631	-18,911	-21,413	-21,470	-21,484	-21,498	-21,410	-21,425	-21,418
Net GHG Emission		262,940	250,373	265,469	270,818	265,641	266,114	269,485	268,156	271,707
Total GHG Emission		284,571	269,284	286,882	292,288	287,125	287,612	290,895	289,581	293,125

Note: 1. Global Warming Potential (hereinafter referred to as GWP) is cited from the IPCC Fourth Assessment Report.

2. NE (not estimated) refers to the exclusion of estimation on existing emissions and sequestration.

Table ES2.2 1990-2016 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
1. Energy Sector	109,459	118,436	126,052	135,199	143,097	150,804	158,573	170,828	181,511
1.A.1 Energy Industry	49,123	55,126	58,529	65,962	70,771	76,400	81,254	91,407	100,415
1.A.2 Manufacturing and Construction Industry	30,117	31,956	33,383	33,611	34,586	35,763	36,785	39,075	39,311
1.A.3 Transportation	19,646	20,888	24,033	26,103	27,540	28,822	29,801	30,536	31,844
1.A.4 Other Sectors	10,572	10,466	10,107	9,523	10,200	9,820	10,733	9,809	9,940
1.A.4.a Service Industry	3,621	3,529	2,989	2,490	3,018	2,445	3,175	2,483	2,947
1.A.4.b Residential	4,005	4,238	4,446	4,359	4,461	4,597	4,754	4,851	4,952
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. Industrial Process and Product Use Sector	14,424	14,975	15,895	18,378	17,797	17,501	17,651	19,460	18,386
2.A Mining Industry (Non-metal Process)	10,584	10,698	11,854	13,879	13,259	12,766	12,645	13,394	11,564
2.B Chemical Industry	563	539	565	609	762	850	992	1,020	1,003
2.C Metal Process	3,275	3,735	3,474	3,888	3,774	3,884	4,013	5,045	5,817
2.H Others	2	2	2	2	2	2	2	2	2
3. Agriculture Sector	142	146	139	131	135	151	151	134	127
4. Land Use, Land Use Change and Forestry Sector	-23,386	-21,490	-23,516	-23,493	-23,379	-23,233	-22,717	-22,899	-22,699
5. Waste Sector	20	8	65	63	110	398	387	105	117
Net Greenhouse Gas Emissions	100,659	112,075	118,635	130,278	137,760	145,621	154,044	167,627	100,659
Total Greenhouse Gas Emissions	124,045	133,565	142,151	153,771	161,139	168,854	176,761	190,526	200,140
GHG Emission Sources and Sinks	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
1. Energy Sector	190,464	209,257	213,288	220,894	232,177	241,513	248,331	255,268	259,208
1.A.1 Energy Industry	105,782	121,158	126,128	130,492	139,461	145,554	152,060	58,450	163,040
1.A.2 Manufacturing and Construction Industry	41,305	43,955	42,716	44,802	46,393	47,864	47,324	49,089	50,374
1.A.3 Transportation	32,772	33,207	33,246	34,542	34,509	35,859	36,846	36,771	35,419
1.A.4 Other Sectors	10,605	10,936	11,198	11,058	11,814	12,235	12,102	10,958	10,375
1.A.4.a Service Industry	3,155	3,220	3,562	3,493	3,961	4,125	4,240	4,279	4,237
1.A.4.b Residential	5,410	5,354	5,181	5,107	5,042	5,133	5,235	5,033	5,047
1.A.4.c Agriculture, Forestry, Fishery, and Husbandry	2,040	2,362	2,455	2,459	2,811	2,977	2,627	1,647	1,091
2. Industrial Process and Product Use Sector	17,156	17,365	16,168	16,059	17,053	17,340	17,877	20,089	19,758
2.A Mining Industry (Non-metal Process)	10,746	10,486	9,974	10,648	10,270	10,691	11,257	11,014	10,369
2.B Chemical Industry	1,075	1,143	1,232	1,313	1,384	1,485	1,552	1,530	1,654
2.C Metal Process	5,333	5,734	4,960	4,096	5,397	5,162	5,066	7,544	7,733
2.H Others	2	2	2	2	2	2	2	2	2
3. Agriculture Sector	119	131	94	93	83	84	62	60	58
4. Land Use, Land Use Change and Forestry Sector	-22,550	-22,476	-21,583	-22,415	-22,305	-22,196	-21,918	-21,861	-21,650
5. Waste Sector	65	259	540	612	417	512	348	470	562
Net Greenhouse Gas Emissions	177,441	185,254	204,535	208,506	215,243	227,425	237,253	244,701	254,025
Total Greenhouse Gas Emissions	207,804	227,011	230,089	237,658	249,730	259,449	266,619	275,886	279,586
GHG Emission Sources and Sinks	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
1. Energy Sector	247,481	235,727	251,863	257,129	252,990	253,086	258,702	258,542	262,660
1.A.1 Energy Industry	157,980	148,721	158,795	163,451	161,481	160,886	169,049	168,912	172,327
1.A.2 Manufacturing and Construction Industry	45,485	43,000	48,239	48,760	47,655	48,415	45,276	44,345	44,186
1.A.3 Transportation	33,394	33,711	34,824	35,293	34,503	34,472	34,951	35,759	36,809
1.A.4 Other Sectors	10,624	10,295	10,005	9,625	9,352	9,312	9,427	9,525	9,338
1.A.4.a Service Industry	4,242	4,267	4,207	3,901	3,640	3,817	3,934	3,952	3,727
1.A.4.b Residential	5,017	5,030	4,857	4,786	4,672	4,484	4,411	4,469	4,537
1.A.4.c Agriculture, Forestry, Fishery, and Husbandry	1,365	998	941	937	1,041	1,011	1,082	1,105	1,074
2. Industrial Process and Product Use Sector	18,396	16,300	18,008	18,835	19,139	19,334	17,346	16,952	16,392
2.A Mining Industry (Non-metal Process)	9,289	8,467	8,616	9,577	9,333	9,866	8,728	8,345	7,108
2.B Chemical Industry	1,457	1,514	1,599	1,637	1,503	1,572	1,603	1,605	1,612
2.C Metal Process	7,648	6,317	7,792	7,620	8,301	7,894	7,013	7,000	7,670
2.H Others	2	2	2	2	2	2	2	2	2
3. Agriculture Sector	57	56	54	53	55	45	40	38	34
4. Land Use, Land Use Change and Forestry Sector	-21,631	-18,911	-21,413	-21,470	-21,484	-21,498	-21,410	-21,425	-21,418
5. Waste Sector	443	154	208	149	149	153	146	103	131
Net Greenhouse Gas Emissions	244,746	233,326	248,721	254,696	250,848	251,120	254,825	254,209	257,798
Total Greenhouse Gas Emissions	266,377	252,237	270,134	276,166	272,332	272,618	276,235	275,634	279,216

Table ES2.3 1990-2016 Methane Emissions in Taiwan

(Unit: Kilotons of Carbon Dioxide Equivalents)

GHG Emission Sources and Sinks	1990	1991	1992	1993	1994	1995	1996	1997	1998
1. Energy Sector	530	506	497	511	526	533	550	514	535
2. Industrial Process and Product Use Sector	5	7	6	7	8	10	11	12	10
3. Agriculture Sector	1,873	1,901	1,864	1,863	1,832	1,855	1,839	1,723	1,622
3. A Livestock Gastrointestinal Fermentation	670	731	738	775	789	822	822	732	674
3. B Livestock Waste Treatment	206	236	234	240	247	259	266	219	192
3. C Rice Culturing	960	908	845	825	775	767	745	765	751
3. F Agricultural Waste Burning (Crop Burning)	38	25	48	22	21	7	7	7	6
5. Waste Sector	8,750	8,980	9,044	9,423	10,196	10,899	11,329	11,454	11,556
5. A Garbage Landfill	5,832	5,917	5,928	6,323	7,061	7,719	8,080	8,212	8,372
5. B Garbage Biological Treatment	11	1	1	0	0	1	0	1	0
5. D Wastewater Treatment	2,907	3,062	3,115	3,100	3,135	3,179	3,249	3,241	3,184
Total	11,158	11,394	11,411	11,804	12,562	13,297	13,730	13,703	13,724
GHG Emission Sources and Sinks	1999	2000	2001	2002	2003	2004	2005	2006	2007
1. Energy Sector	561	574	567	586	640	674	643	637	639
2. Industrial Process and Product Use Sector	12	14	18	19	22	28	29	33	39
3. Agriculture Sector	1,644	1,618	1,565	1,479	1,394	1,320	1,387	1,368	1,341
3. A Livestock Gastrointestinal Fermentation	694	692	660	636	626	614	623	614	609
3. B Livestock Waste Treatment	205	210	201	194	192	193	195	195	185
3. C Rice Culturing	738	702	689	637	567	505	561	551	543
3. F Agricultural Waste Burning (Crop Burning)	7	14	15	13	9	8	8	8	5
5. Waste Sector	11,648	10,941	10,196	9,686	9,242	8,588	8,043	7,425	6,948
5. A Garbage Landfill	8,604	8,024	7,305	6,821	6,310	5,763	5,219	4,656	4,135
5. B Garbage Biological Treatment	2	0	0	0	2	7	10	11	14
5. D Wastewater Treatment	3,042	2,916	2,891	2,864	2,930	2,818	2,815	2,757	2,798
Total	13,865	13,146	12,346	11,770	11,298	10,610	10,102	9,463	8,967
GHG Emission Sources and Sinks	2008	2009	2010	2011	2012	2013	2014	2015	2016
1. Energy Sector	620	612	648	670	679	691	702	725	745
2. Industrial Process and Product Use Sector	37	33	35	27	35	38	37	39	40
3. Agriculture Sector	1,299	1,281	1,274	1,301	1,300	1,304	1,286	1,268	1,283
3. A Livestock Gastrointestinal Fermentation	584	571	578	590	583	579	566	573	561
3. B Livestock Waste Treatment	180	175	176	180	172	166	164	163	164
3. C Rice Culturing	529	530	514	526	540	555	552	529	555
3. F Agricultural Waste Burning (Crop Burning)	6	5	5	5	5	3	4	4	3
5. Waste Sector	6,322	5,735	5,177	4,758	4,423	4,027	3,854	3,643	3,568
5. A Garbage Landfill	3,601	3,066	2,597	2,222	1,887	1,595	1,349	1,140	950
5. B Garbage Biological Treatment	16	18	21	26	24	23	20	20	20
5. D Wastewater Treatment	2,705	2,651	2,559	2,510	2,512	2,410	2,484	2,484	2,599
Total	8,279	7,662	7,134	6,756	6,437	6,060	5,878	5,676	5,637

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 755 kilotons of carbon dioxide equivalents in 1993 to 991 kilotons of carbon dioxide equivalents in 2016. The perfluorocarbons (PFCs) emission increased from 3 kilotons of carbon dioxide equivalents in 1999 to 1,045 kilotons of carbon dioxide equivalents in 2016, while the sulfur hexafluoride (SF6) emission increased from 116 kilotons of carbon dioxide equivalents in 1999 to 1,094 kilotons of carbon dioxide equivalents in 2016. The nitrogen trifluoride (NF3) emission increased from 11 kilotons of carbon dioxide equivalents in 1999 to 440 kilotons of carbon dioxide equivalents in 2016. For the total emission of fluorinated greenhouse gases, it increased from 1,738 kilotons of carbon dioxide equivalents in 1999 (about 0.77% of the total greenhouse gas emissions in 1999) to 3,570 kilotons of carbon dioxide equivalents in 2016 (about 1.22% of the total greenhouse gas emissions in 2016), with an emissions increase of 105.39%. Compared to 2015, the emission in 2016 decreased by 4.88%.

Table ES2.4 1990-2016 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
1. Energy Sector	537	578	653	703	742	778	825	866	917
1.A.1 Energy Industry	138	158	183	207	224	242	273	301	332
1.A.2 Manufacturing and Construction Industry	90	95	101	100	102	104	107	113	115
1.A.3 Transportation	291	309	353	382	402	418	428	438	456
1.A.4 Other Sectors	17	17	15	14	15	14	16	14	14
2. Industrial Process and Product Use Sector	166	352	325	301	318	345	186	374	383
3. Agriculture Sector	1,897	1,933	1,866	1,897	1,883	1,872	1,907	1,710	1,609
3.B Livestock Waste Treatment	48	50	52	54	59	61	67	70	71
3.D Agricultural Soil	1,837	1,876	1,800	1,837	1,818	1,808	1,838	1,638	1,536
3.F Agricultural Waste Burning (Crop burning)	12	8	15	7	7	2	2	2	2
5. Waste Sector	296	285	298	311	313	334	337	337	321
Total	2,895	3,148	3,143	3,213	3,257	3,329	3,255	3,287	3,229
GHG Emission Sources and Sinks	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
1. Energy Sector	968	1,052	1,086	1,136	1,194	1,234	1,273	1,302	1,306
1.A.1 Energy Industry	362	428	459	482	525	538	565	590	606
1.A.2 Manufacturing and Construction Industry	122	133	137	143	157	165	164	171	178
1.A.3 Transportation	469	475	475	496	495	513	527	527	508
1.A.4 Other Sectors	14	15	16	16	17	18	17	15	13
2. Industrial Process and Product Use Sector	312	625	714	744	833	834	960	1,432	1,531
3. Agriculture Sector	1,583	1,794	1,720	1,729	1,597	1,710	1,598	1,629	1,595
3.B Livestock Waste Treatment	72	73	71	70	71	69	71	72	71
3.D Agricultural Soil	1,509	1,717	1,644	1,655	1,524	1,639	1,524	1,554	1,522
3.F Agricultural Waste Burning (Crop burning)	2	4	5	4	3	2	2	3	1
5. Waste Sector	329	331	340	348	353	343	350	351	360
Total	3,192	3,802	3,860	3,957	3,977	4,122	4,181	4,713	4,792
GHG Emission Sources and Sinks	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
1. Energy Sector	1,245	1,216	1,254	1,274	1,253	1,246	1,253	1,250	1,270
1.A.1 Energy Industry	588	565	573	578	573	564	571	557	567
1.A.2 Manufacturing and Construction Industry	162	155	169	176	170	172	166	164	162
1.A.3 Transportation	481	483	500	507	498	498	505	517	530
1.A.4 Other Sectors	14	13	12	12	12	12	12	12	11
2. Industrial Process and Product Use Sector	1,290	1,457	1,834	1,762	1,674	1,539	1,514	1,507	1,706
3. Agriculture Sector	1,514	1,547	1,528	1,469	1,496	1,432	1,427	1,397	1,395
3.B Livestock Waste Treatment	72	71	70	71	71	71	73	74	76
3.D Agricultural Soil	1,440	1,474	1,456	1,396	1,424	1,359	1,353	1,321	1,318
3.F Agricultural Waste Burning (Crop burning)	2	2	2	2	2	1	1	1	1
5. Waste Sector	328	327	337	346	344	352	364	363	330
Total	4,377	4,547	4,953	4,850	4,767	4,569	4,558	4,516	4,701

Table ES2.5 1990-2016 Fluoride-Containing Gas Emissions in Taiwan

(Unit: Kilotons of Carbon Dioxide Equivalents)

GHG Emission Sources and Sinks	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Total HFCs Emissions	755	855	801	1,305	1,477	2,083	1,609	2,319	2,619	2,216
Total PFCs Emissions	NE	NE	NE	NE	NE	NE	3	13	2,939	4,143
Total SF_6 Emissions	NE	NE	NE	NE	NE	NE	116	120	746	3,914
Total NF_3 Emissions	NE	NE	NE	NE	NE	NE	11	10	235	398
Total Emissions	755	855	801	1,305	1,477	2,083	1,738	2,462	6,538	10,671
GHG Emission Sources and Sinks	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Total HFCs Emissions	2,397	2,451	1,070	987	1,093	1,046	980	934	1,016	869
Total PFCs Emissions	4,198	4,341	3,070	3,264	2,972	1,682	1,143	1,354	1,365	725
Total SF_6 Emissions	4,385	5,193	4,683	3,590	3,114	2,644	2,176	2,155	1,755	1,647
Total NF_3 Emissions	540	659	726	650	759	166	538	219	381	349
Total Emissions	1,520	12,643	9,549	8,490	7,939	5,538	4,838	4,661	4,516	3,589
GHG Emission Sources and Sinks	**2013**	**2014**	**2015**	**2016**						
Total HFCs Emissions	981	1,010	982	991						
Total PFCs Emissions	929	1,139	931	1,045						
Total SF_6 Emissions	1,722	1,447	1,217	1,094						
Total NF_3 Emissions	734	627	623	440						
Total Emissions	4,365	4,224	3,754	3,570						

Note: NE (not estimated) refers to the exclusion of estimation on existing emissions and sequestration.

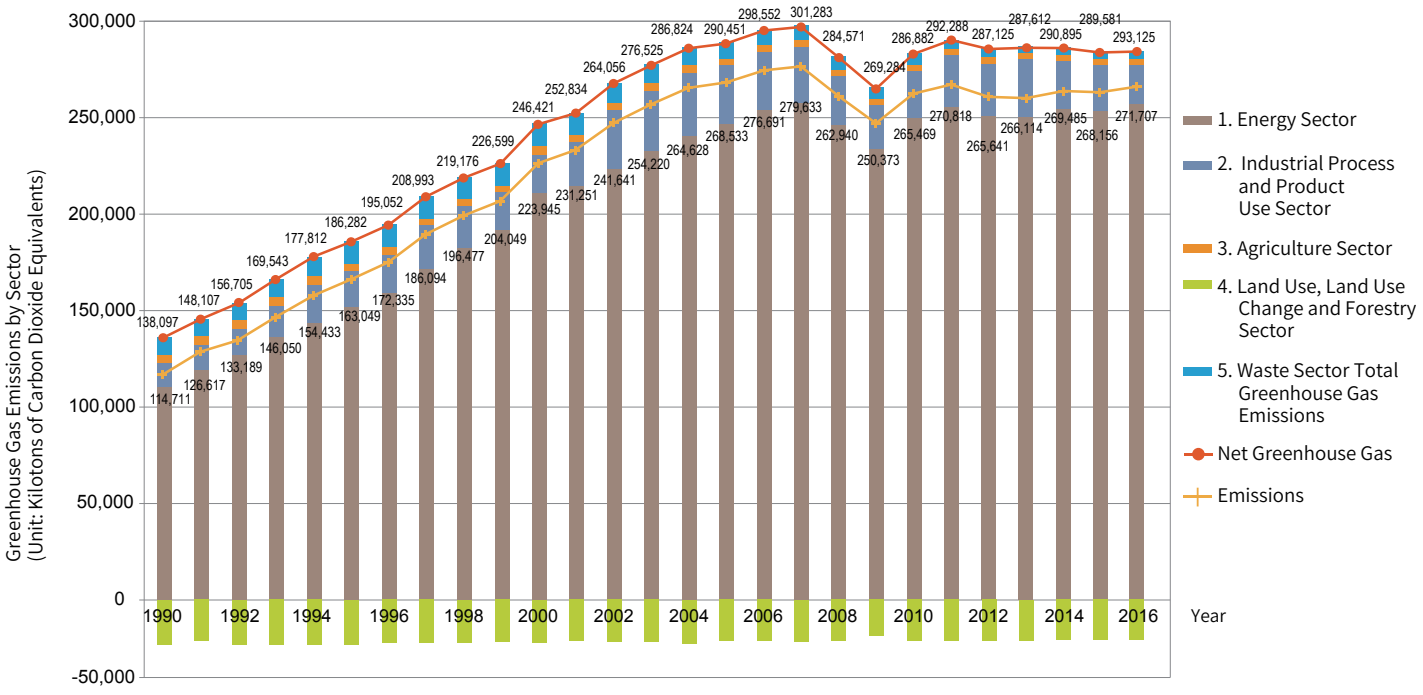

Figure ES2.2 1990-2016 Trends in Greenhouse Gas Emission in Taiwan by Sector

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. The GHG emissions for the energy sector were responsible for approximately 90.29% of the total emission in 2016 (excluding land use, land use change and forestry sequestration), the industrial process and product use sector 7.41%, the agriculture sector 0.93%, and the waste sector 1.7%. The GHG emission and trends for Taiwan from 1990 to 2016 by sector are shown in Figure ES3.1 and Table ES3.1. Between 1990 and 2016, the GHG emissions from the energy sector increased by 139.47% with an average annual growth rate of 3.42%, the industrial process and product use sector increased by 48.74% with an average growth rate of -2.44%, and the agriculture sector decreased by 30.66% with an average annual growth rate of -1.40%; the GHG emissions from the waste sector decreased by 55.56% with an average annual growth rate of -3.07%, while the GHG sequestration of land use, land use change and forestry sector decreased by 8.42% with an average annual growth rate of -0.34%. The total greenhouse gas emission in Taiwan in 2016 increased by 1.22% compared with 2015. In particular, the GHG emission from the energy sector was up by 1.60%, the industrial process and product use sector was down by 2.44%, the agriculture sector was up by 0.35%, and the waste sector was down by 1.94%. Additionally, the carbon dioxide sequestration of the land use, land use change and forestry sector was down by 0.03% with an average annual growth rate of 2.94%.

Table ES3.1 1990-2016 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
1. Energy Sector	110,525	119,521	127,202	136,414	144,365	152,115	159,948	172,207	182,963
2. Industrial Process and Product Use Sector	14,595	15,333	16,227	19,441	18,977	18,658	19,154	21,323	20,862
3. Agriculture Sector	3,911	3,980	3,869	3,890	3,850	3,878	3,897	3,567	3,359
4. Land Use, Land Use Change and Forestry Sector	-23,386	-21,490	-23,516	-23,493	-23,379	-23,233	-22,717	-22,899	-22,699
5. Waste Sector	9,066	9,273	9,407	9,798	10,619	11,631	12,053	11,896	11,993
Net Greenhouse Gas Emissions (including Land Use, Land Use Change and Forestry Sequestration)	114,711	126,617	133,189	146,050	154,433	163,049	172,335	186,094	196,477
Total Greenhouse Gas Emissions (excluding Land Use, Land Use Change and Forestry Sequestration)	138,097	148,107	156,705	169,543	177,812	186,282	195,052	208,993	219,176
GHG Emission Sources and Sinks	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
1. Energy Sector	191,993	210,882	214,941	222,616	234,011	243,421	250,247	257,207	261,153
2. Industrial Process and Product Use Sector	19,218	20,465	23,438	27,492	29,428	30,846	28,416	30,044	29,266
3. Agriculture Sector	3,345	3,543	3,379	3,301	3,074	3,114	3,047	3,056	2,993
4. Land Use, Land Use Change and Forestry Sector	-22,550	-22,476	-21,583	-22,415	-22,305	-22,196	-21,918	-21,861	-21,650
5. Waste Sector	12,042	11,530	11,076	10,646	10,012	9,444	8,741	8,245	7,871
Net Greenhouse Gas Emissions (including Land Use, Land Use Change and Forestry Sequestration)	204,049	223,945	231,251	241,641	254,220	264,628	268,533	276,691	279,633
Total Greenhouse Gas Emissions (excluding Land Use, Land Use Change and Forestry Sequestration)	226,599	246,421	252,834	264,056	276,525	286,824	290,451	298,552	301,283
GHG Emission Sources and Sinks	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
1. Energy Sector	249,346	237,555	253,765	259,073	254,922	255,023	260,657	260,517	264,675
2. Industrial Process and Product Use Sector	25,261	22,628	24,539	25,141	24,437	25,275	23,121	22,252	21,708
3. Agriculture Sector	2,870	2,884	2,856	2,823	2,851	2,781	2,753	2,703	2,712
4. Land Use, Land Use Change and Forestry Sector	-21,631	-18,911	-21,413	-21,470	-21,484	-21,498	-21,410	-21,425	-21,418
5. Waste Sector	7,094	6,216	5,722	5,252	4,916	4,532	4,364	4,109	4,030
Net Greenhouse Gas Emissions (including Land Use, Land Use Change and Forestry Sequestration)	262,940	250,372	265,469	270,818	265,641	266,114	269,485	268,156	271,707
Total Greenhouse Gas Emissions (excluding Land Use, Land Use Change and Forestry Sequestration)	284,571	269,283	286,882	292,288	287,125	287,612	290,895	289,581	293,125

Table ES3.2 1990-2016 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
Total CO_2 Emission	109,459	118,436	126,052	135,199	143,097	150,804	158,573	170,828	181,511
1.A.1 Energy Industry	49,123	55,126	58,529	65,962	70,771	76,400	81,254	91,407	100,415
1.A.2 Manufacturing and Construction Industry	30,117	31,956	33,383	33,611	34,586	35,763	36,785	39,075	39,311
1.A.3 Transportation	19,646	20,888	24,033	26,103	27,540	28,822	29,801	30,536	31,844
1.A.4 Others Sectors	10,572	10,466	10,107	9,523	10,200	9,820	10,733	9,809	9,940
Total CH_4 Emission	530	506	497	511	526	533	550	514	535
1.A.1 Energy Industry	26	29	28	32	35	41	42	46	51
1.A.2 Manufacturing and Construction Industry	46	48	51	51	52	53	55	58	59
1.A.3 Transportation	152	163	187	202	216	228	239	245	257
1.A.4 Others Sectors	30	29	28	26	28	27	29	26	27
1.B.1 Solid Fuel	162	138	115	113	98	81	81	34	27
1.B.2 Oil and Gas	115	98	88	87	97	103	103	104	115
Total N_2O Emission	537	578	653	703	742	778	825	866	917
1.A.1 Energy Industry	138	158	183	207	224	242	273	301	332
1.A.2 Manufacturing and Construction Industry	90	95	101	100	102	104	107	113	115
1.A.3 Transportation	291	309	353	382	402	418	428	438	456
1.A.4 Others Sectors	17	17	15	14	15	14	16	14	14
Total Emission from Energy Sector	110,525	119,521	127,202	136,414	144,365	152,115	159,948	172,207	182,963
GHG Emission Sources and Sinks	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Total CO_2 Emission	190,464	209,257	213,288	220,894	232,177	241,513	248,331	255,268	259,208
1.A.1 Energy Industry	105,782	121,158	126,128	130,492	139,461	145,554	152,060	158,450	163,040
1.A.2 Manufacturing and Construction Industry	41,305	43,955	42,716	44,802	46,393	47,864	47,324	49,089	50,374
1.A.3 Transportation	32,772	33,207	33,246	34,542	34,509	35,859	36,846	36,771	35,419
1.A.4 Others Sectors	10,605	10,936	11,198	11,058	11,814	12,235	12,102	10,958	10,375
Total CH_4 Emission	561	574	567	586	640	674	643	637	639
1.A.1 Energy Industry	59	66	70	70	79	81	82	86	88
1.A.2 Manufacturing and Construction Industry	63	69	72	76	84	89	88	92	97
1.A.3 Transportation	266	270	272	278	287	295	303	298	289
1.A.4 Others Sectors	28	29	30	30	32	33	33	29	27
1.B.1 Solid Fuel	31	28	NO	NO	NO	NO	NO	NO	NO
1.B.2 Oil and Gas	113	111	122	132	159	176	137	132	138
Total N_2O Emission	968	1,052	1,086	1,136	1,194	1,234	1,273	1,302	1,306
1.A.1 Energy Industry	362	428	459	482	525	538	565	590	606
1.A.2 Manufacturing and Construction Industry	122	133	137	143	157	165	164	171	178
1.A.3 Transportation	469	475	475	496	495	513	527	527	508
1.A.4 Others Sectors	14	15	16	16	17	18	17	15	13
Total Emission from Energy Sector	191,993	210,883	214,941	222,616	234,011	243,421	250,247	257,207	261,153
GHG Emission Sources and Sinks	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Total CO_2 Emission	247,481	235,727	251,863	257,129	252,990	253,086	258,702	258,542	262,660
1.A.1 Energy Industry	157,980	148,721	158,795	163,451	161,481	160,886	169,049	168,912	172,327
1.A.2 Manufacturing and Construction Industry	45,485	43,000	48,239	48,760	47,655	48,415	45,276	44,345	44,186
1.A.3 Transportation	33,394	33,711	34,824	35,293	34,503	34,472	34,951	35,759	36,809
1.A.4 Others Sectors	10,624	10,295	10,005	9,625	9,352	9,312	9,427	9,525	9,338
Total CH_4 Emission	620	612	648	670	679	691	702	725	745
1.A.1 Energy Industry	86	79	84	85	84	83	86	90	90
1.A.2 Manufacturing and Construction Industry	88	85	92	97	94	96	93	92	91
1.A.3 Transportation	276	281	285	288	284	284	286	293	301
1.A.4 Others Sectors	28	27	26	25	24	24	25	25	24
1.B.1 Solid Fuel	NO	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2 Oil and Gas	142	140	161	176	193	204	212	226	239
Total N_2O Emission	1,245	1,216	1,254	1,274	1,253	1,246	1,253	1,250	1,270
1.A.1 Energy Industry	588	565	573	578	573	564	571	557	567
1.A.2 Manufacturing and Construction Industry	162	155	169	176	170	172	166	164	162
1.A.3 Transportation	481	483	500	507	498	498	505	517	530
1.A.4 Others Sectors	14	13	12	12	12	12	12	12	11
Total Emission from Energy Sector	249,346	237,555	253,765	259,073	254,922	255,023	260,657	260,517	264,675

Table ES3-3 1990-2016 Greenhouse Gas Emissions Produced by Industrial Process and Product Use Sector in Taiwan

(Unit: Kilotons of Carbon Dioxide Equivalents)

GHG Emission Sources and Sinks	1990	1991	1992	1993	1994	1995	1996	1997	1998
Total CO_2 Emission	14,424	14,975	15,895	18,378	17,797	17,501	17,651	19,460	18,386
2.A Mining Industry (Non-metal Process)	10,584	10,698	11,854	13,879	13,259	12,766	12,645	13,394	11,564
2.B Chemical Industry	563	539	565	609	762	850	992	1,020	1,003
2.C Metal Process	3,275	3,735	3,474	3,888	3,774	3,884	4,013	5,045	5,817
2.H Others	2	2	2	2	2	2	2	2	2
Total CH_4 Emission	5	7	6	7	8	10	11	12	10
Total N_2O Emission	66	352	325	301	318	345	186	374	383
2.B Chemical Industry	166	352	325	301	318	345	186	374	383
2.C Metal Process	NE	NE	NE	NE	NE	NE	NE	NE	NE
2.E Electronics Industry	NE	NE	NE	NE	NE	NE	NE	NE	NE
Total HFCs Emission	NE	NE	NE	755	855	801	1,305	1,477	2,083
2.B Chemical Industry	NE	NE	NE	755	855	801	1,305	1,477	2,083
2.E Electronics Industry	NE	NE	NE	NE	NE	NE	NE	NE	NE
2.F Alternatives to Ozone-depleting Substances	NE	NE	NE	NE	NE	NE	NE	NE	NE
Total PFCs Emission (2.E Electronics Industry)	NE	NE	NE	NE	NE	NE	NE	NE	NE
Total SF_6 Emission	NE	NE	NE	NE	NE	NE	NE	NE	NE
2.C Metal Process	NE	NE	NE	NE	NE	NE	NE	NE	NE
2.E Electronics Industry	NE	NE	NE	NE	NE	NE	NE	NE	NE
2.G Manufacturing and Use of Other Products	NE	NE	NE	NE	NE	NE	NE	NE	NE
Total NF_3 Emission	NE	NE	NE	NE	NE	NE	NE	NE	NE
(2.E Electronics Industry)	14,595	15,333	16,227	19,441	18,977	18,658	19,154	21,323	20,862
Total Emission from Industrial Process and Product Use Sector	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Total CO_2 Emission	17,156	17,365	16,168	16,059	17,053	17,340	17,877	20,089	19,758
2.A Mining Industry (Non-metal Process)	10,746	10,486	9,974	10,648	10,270	10,691	11,257	11,014	10,369
2.B Chemical Industry	1,075	1,143	1,232	1,313	1,384	1,485	1,552	1,530	1,654
2.C Metal Process	5,333	5,734	4,960	4,096	5,397	5,162	5,066	7,544	7,733
2.H Others	2	2	2	2	2	2	2	2	2
Total CH_4 Emission	12	14	18	19	22	28	29	33	39
Total N_2O Emission	312	625	714	744	833	834	960	1,432	1,531
2.B Chemical Industry	312	625	714	743	831	834	960	969	996
2.C Metal Process	NE	NE	NE	0	2	NE	NE	94	95
2.E Electronics Industry	NE	NE	NE	NE	NE	NE	NE	369	439
Total HFCs Emission	1,609	2,319	2,619	2,216	2,397	2,451	1,070	987	1,093
2.B Chemical Industry	1,609	2,319	2,567	2,157	1,937	1,710	NE	NE	NE
2.E Electronics Industry	NE	NE	51	59	59	59	73	91	171
2.F Alternatives to Ozone-depleting Substances	NE	NE	NE	NE	401	682	996	896	922
Total PFCs Emission (2.E Electronics Industry)	3	13	2,939	4,143	4,198	4,341	3,070	3,264	2,972
Total SF_6 Emission	116	120	746	3,914	4,385	5,193	4,683	3,590	3,114
2.C Metal Process	NE	NE	NE	1,027	1,027	1,357	1,063	770	440
2.E Electronics Industry	116	120	746	944	1,415	1,783	2,117	2,050	1,721
2.G Manufacturing and Use of Other Products	NE	NE	NE	1,943	1,943	2,053	1,503	770	953
Total NF_3 Emission	11	10	235	398	540	659	726	650	759
(2.E Electronics Industry)	19,218	20,465	23,438	27,492	29,428	30,846	28,416	30,044	29,266
Total Emission from Industrial Process and Product Use Sector	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Total CO_2 Emission	18,396	16,300	18,008	18,835	19,139	19,334	17,346	16,952	16,392
2.A Mining Industry (Non-metal Process)	9,289	8,467	8,616	9,577	9,333	9,866	8,728	8,345	7,108
2.B Chemical Industry	1,457	1,514	1,599	1,637	1,503	1,572	1,603	1,605	1,612
2.C Metal Process	7,648	6,317	7,792	7,620	8,301	7,894	7,013	7,000	7,670
2.H Others	2	2	2	2	2	2	2	2	2
Total CH_4 Emission	37	33	35	27	35	38	37	39	40
Total N_2O Emission	1,290	1,457	1,834	1,762	1,674	1,539	1,514	1,507	1,706
2.B Chemical Industry	784	1,006	1,170	1,195	1,016	780	728	691	961
2.C Metal Process	90	76	119	NE	NE	NE	NE	NE	NE
2.E Electronics Industry	416	375	546	568	658	759	786	817	745
Total HFCs Emission	1,046	980	934	1,016	869	981	1,010	982	991

Total Emission from Industrial Process and Product Use Sector	2008	2009	2010	2011	2012	2013	2014	2015	2016
2.B Chemical Industry	NE	NE	NE	NE	NE	NE	NE	NE	NE
2.E Electronics Industry	118	168	164	134	86	169	182	132	156
2.F Alternatives to Ozone-depleting Substances	928	812	770	881	783	812	828	851	835
Total PFCs Emission (2.E Electronics Industry)	1,682	1,143	1,354	1,365	725	929	1,139	931	1,045
Total SF_6 Emission	2,644	2,176	2,155	1,755	1,647	1,722	1,447	1,217	1,094
2.C Metal Process	144	235	212	134	109	55	56	45	NE
2.E Electronics Industry	1,605	1,239	1,648	1,339	1,352	1,524	1,276	1,075	1,015
2.G Manufacturing and Use of Other Products	895	703	295	282	186	142	115	97	79
Total NF_3 Emission	166	538	219	381	349	734	627	623	440
(2.E Electronics Industry)	25,262	22,628	24,539	25,141	24,437	25,275	23,121	22,252	21,708

Note: NO (not happened). Taiwanes coal has been discontinued since 2001.

Table ES3.4 1990-2016 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
Total CO_2 Emission	142	146	139	131	135	151	151	134	127
Total CH_4 Emission	1,873	1,901	1,864	1,863	1,832	1,855	1,839	1,723	1,622
3.A Livestock Gastrointestinal Fermentation	670	731	738	775	789	822	822	732	674
3.B Livestock Waste Treatment	206	236	234	240	247	259	266	219	192
3.C Rice Culturing	960	908	845	825	775	767	745	765	751
3.F Agricultural Waste Burning (Crop Burning)	38	25	48	22	21	7	7	7	6
Total N_2O Emission	1,897	1,933	1,866	1,897	1,883	1,872	1,907	1,710	1,609
3.B Livestock Waste Treatment	48	50	52	54	59	61	67	70	71
3.D Agricultural Soil	1,837	1,876	1,800	1,837	1,818	1,808	1,838	1,638	1,536
3.F Agricultural Waste Burning (Crop Burning)	12	8	15	7	7	2	2	2	2
Total Emission From Agriculture Sector	3,911	3,980	3,869	3,890	3,850	3,878	3,897	3,567	3,359
GHG Emission Sources and Sinks	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Total CO_2 Emission	119	131	94	93	83	84	62	60	58
Total CH_4 Emission	1,644	1,618	1,565	1,479	1,394	1,320	1,387	1,368	1,341
3.A Livestock Gastrointestinal Fermentation	694	692	660	636	626	614	623	614	609
3.B Livestock Waste Treatment	205	210	201	194	192	193	195	195	185
3.C Rice Culturing	738	702	689	637	567	505	561	551	543
3.F Agricultural Waste Burning (Crop Burning)	7	14	15	13	9	8	8	8	5
Total N_2O Emission	1,583	1,794	1,720	1,729	1,597	1,710	1,598	1,629	1,595
3.B Livestock Waste Treatment	72	73	71	70	71	69	71	72	71
3.D Agricultural Soil	1,509	1,717	1,644	1,655	1,524	1,639	1,524	1,554	1,522
3.F Agricultural Waste Burning (Crop Burning)	2	4	5	4	3	2	2	3	1
Total Emission From Agriculture Sector	3,345	3,543	3,379	3,301	3,074	3,114	3,047	3,056	2,993
GHG Emission Sources and Sinks	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Total CO_2 Emission	57	56	54	53	55	45	40	38	34
Total CH_4 Emission	1,299	1,281	1,274	1,301	1,300	1,304	1,286	1,268	1,283
3.A Livestock Gastrointestinal Fermentation	584	571	578	590	583	579	566	573	561
3.B Livestock Waste Treatment	180	175	176	180	172	166	164	163	164
3.C Rice Culturing	529	530	514	526	540	555	552	529	555
3.F Agricultural Waste Burning (Crop Burning)	6	5	5	5	5	3	4	4	3
Total N_2O Emission	1,514	1,547	1,528	1,469	1,496	1,432	1,427	1,397	1,395
3.B Livestock Waste Treatment	72	71	70	71	71	71	73	74	76
3.D Agricultural Soil	1,440	1,474	1,456	1,396	1,424	1,359	1,353	1,321	1,318
3.F Agricultural Waste Burning (Crop Burning)	2	2	2	2	2	1	1	1	1
Total Emission From Agriculture Sector	2,870	2,884	2,856	2,823	2,851	2,781	2,753	2,703	2,712

The total greenhouse gas emission from the energy sector in 1990 was 110,525 kilotons of carbon dioxide equivalents and increased to 264,675 kilotons of carbon dioxide equivalents in 2016 with a growth of 139.47% and an annual average growth of 3.42%, 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, followed by more reduction in 2012 and in 2015. Compared with 2015, the greenhouse gas emissions in 2016 increased by 1.60%. The total greenhouse gas emission from the energy sector in 2016 accounted for 90.29% of the total greenhouse gas emission in Taiwan. In particular, 1.A.1 "energy industry" was responsible for 172,985 kilotons of carbon dioxide equivalents, accounting for 65.36% of the total greenhouse gas emission from the energy sector; 1.A.2 "manufacturing and construction industry" was responsible for 44,438 kilotons of carbon dioxide equivalents (accounting for 16.79%); 1.A.3 "transportation" was responsible for 37,640 kilotons of carbon dioxide equivalents (accounting for 14.22%); 1.A.4 "other sectors (including service industry, residential and agriculture, forestry, fishery and husbandry)" was responsible for 9,373 kilotons of carbon dioxide equivalents (accounting for 3.54%); 1.B.2 "oil and gas" was responsible for 239 kilotons of carbon dioxide equivalents (accounting for 16.79%).

ES.4 Other Information

According to the Durban Accord, all countries listed under Annex 1 shall submit the National Inventory Report, Biennial Report, and National Communications, while countries not listed under Annex 1 shall submit the Biennial Update Report and National Communications.

Table ES3.5 1990-2016 Changes in Carbon Sequestration by Forestry Sector in Taiwan

(Unit: Kilotons of Carbon Dioxide Equivalents)

Year	Forests Maintaining Forests		Other Lands Turned to Forests	Total Carbon Sequestration ($\triangle CO_2$)
	Biomass Carbon Sequestration($\triangle CO_{2G}$)	Biomass Carbon Emissions($\triangle CO_{2L}$)	Biomass Carbon Sequestration($\triangle CO_{2G}$)	
1990	-23,902	607	-91	-23,386
1991	-23,902	2,5031	-91	-21,490
1992	-23,713	333	-136	-23,516
1993	-23,524	216	-185	-23,493
1994	-23,335	190	-233	-23,379
1995	-23,146	202	-288	-23,233
1996	-22,957	559	-319	-22,717
1997	-22,768	266	-397	-22,899
1998	-22,579	326	-446	-22,699
1999	-22,390	401	-561	-22,550
2000	-22,201	389	-665	-22,476
2001	-22,012	1,1122	-683	-21,583
2002	-21,823	167	-759	-22,415
2003	-21,633	227	-899	-22,305
2004	-21,444	243	-995	-22,196
2005	-21,255	369	-1,031	-21,918
2006	-21,066	251	-1,046	-21,861
2007	-20,877	308	-1,080	-21,650
2008	-20,688	199	-1,142	-21,631
2009	-20,499	2,7533	-1,166	-18,911
2010	-20,392	218	-1,240	-21,413
2011	-20,409	140	-1,202	-21,470
2012	-20,435	145	-1,194	-21,484
2013	-20,473	135	-1,161	-21,498
2014	-20,508	197	-1,099	-21,410
2015	-20,546	189	-1,068	-21,425
2016	-20,542	153	-1,029	-21,418

These national reports all relate to the content of National Greenhouse Gas Inventory. Taiwan is currently taking the initiative in establishing a national system that is feasible to conform to Taiwan's customs, division of labor in sectors, and the hierarchical management of database. In addition to formulating regulations governing national greenhouse gas inventory review, Taiwan also established a review committee, a review on greenhouse gas inventory, and a sound management system to comply with procedures of Measurement Reporting, Verification (MRV). Moreover, to comply with the UNFCCC, Taiwan shall apply the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (hereinafter referred to as 2006 IPPC Guidelines) starting in 2015. Taiwan has started preparing a national greenhouse gas inventory with 2006 IPCC Guidelines-based statistical foundation and framework in addition to designing and establishing a registration platform for electronics national greenhouse gas inventory starting in 2013. At the same time, the relevant departments will test run this registration platform and submit the national greenhouse gas inventory statistics online. Taiwan has comprehensively adopted the 2006 IPCC Guidelines in step with the UNFCCC starting in 2015.

Table ES3.6 1990-2016 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
Total CO_2 Emission	20	8	65	63	110	398	387	105	117
Total CH_4 Emission	8,750	8,980	9,044	9,423	10,196	10,899	11,329	11,454	11,556
5.A Solid Waste Disposal	5,832	5,917	5,928	6,323	7,061	7,719	8,080	8,212	8,372
5.B Solid Waste Biological Disposal	11	1	1	0	0	1	0	1	0
5.D Wastewater Treatment and Discharge	2,907	3,062	3,115	3,100	3,135	3,179	3,249	3,241	3,184
Total N_2O Emission	296	285	298	311	313	334	337	337	321
5.B Solid Waste Biological Disposal	10	0	1	0	0	1	0	1	0
5.C Waste Burn	1	0	4	3	6	18	19	4	6
5.D Wastewater Treatment and Discharge	285	284	294	307	307	316	318	332	315
Total Emission from Waste Sector	9,066	9,273	9,407	9,798	10,619	11,631	12,053	11,896	11,993
GHG Emission Sources and Sinks	1999	2000	2001	2002	2003	2004	2005	2006	2007
Total CO_2 Emission	65	259	540	612	417	512	348	470	562
Total CH_4 Emission	11,648	10,941	10,196	9,686	9,242	8,588	8,043	7,425	6,948
5.A Solid Waste Disposal	8,604	8,024	7,305	6,821	6,310	5,763	5,219	4,656	4,135
5.B Solid Waste Biological Disposal	2	0	0	0	2	7	10	11	14
5.D Wastewater Treatment and Discharge	3,042	2,916	2,891	2,864	2,930	2,818	2,815	2,757	2,798
Total N_2O Emission	329	331	340	348	353	343	350	351	360
5.B Solid Waste Biological Disposal	2	0	0	0	2	6	9	10	13
5.C Waste Burn	3	8	30	26	24	23	27	30	30
5.D Wastewater Treatment and Discharge	324	322	310	321	327	314	314	310	318
Total Emission from Waste Sector	12,042	11,530	11,076	10,646	10,012	9,444	8,741	8,245	7,871
GHG Emission Sources and Sinks	2008	2009	2010	2011	2012	2013	2014	2015	2016
Total CO_2 Emission	443	154	208	149	149	153	146	103	131
Total CH_4 Emission	6,322	5,735	5,177	4,758	4,423	4,027	3,854	3,643	3,568
5.A Solid Waste Disposal	3,601	3,066	2,597	2,222	1,887	1,595	1,349	1,140	950
5.B Solid Waste Biological Disposal	16	18	21	26	24	23	20	20	20
5.D Wastewater Treatment and Discharge	2,705	2,651	2,559	2,510	2,512	2,410	2,484	2,484	2,599
Total N_2O Emission	328	327	337	346	344	352	364	363	330
5.B Solid Waste Biological Disposal	15	16	19	23	22	20	18	18	18
5.C Waste Burn	21	9	11	9	9	9	9	6	6
5.D Wastewater Treatment and Discharge	293	302	307	313	314	323	337	339	306
Total Emission from Waste Sector	7,094	6,216	5,722	5,252	4,916	4,532	4,364	4,109	4,029

2018 Republic of China
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