

2019 Republic of China National Greenhouse Gas Inventory Report

December 2019





Executive Summary

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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 UNFCCC¹ 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 are 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 2017. 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 Absorption Related Trends

Taiwan's total GHG emissions increased from 138,119 kilotons of carbon dioxide equivalents (excluding carbon dioxide removal) in 1990 to 298,658 kilotons of carbon dioxide equivalents (excluding carbon dioxide sequestration) in 2017, with emissions increased by 116.23% at an average annual growth rate of 2.90%. The total emissions in 2017 saw an increase of 1.77% from the previous year. The net greenhouse gas emission increased from 114,733 kilotons of carbon dioxide equivalents in 1990 to 277,176 kilotons of carbon dioxide equivalents in 2017, with emissions increased by 145.58%, at an average annual growth rate of 3.32%. The total emissions in 2017 showed an increase of 1.90% 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 2017, followed by methane, nitrous oxide and then fluorinated greenhouse gas, 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 amounted to 124,066 kilotons of carbon dioxide equivalents. In 2017, that figure was 284,803 kilotons of carbon dioxide equivalents, with an 129.56% increase and an average annual growth rate of 3.13%. In 2017, carbon dioxide emissions accounted for 95.36% of total GHG emissions. The energy sector accounted for 94.61%, the industrial process and product use sector 5.34%, the agriculture sector 0.01%, and the waste sector 0.04%. Compared with 2016, the emissions in 2017 increased by 1.89% mainly because of the 2.53% increase

¹ UNFCCC, FCCC/CP/2002/8, 2002.

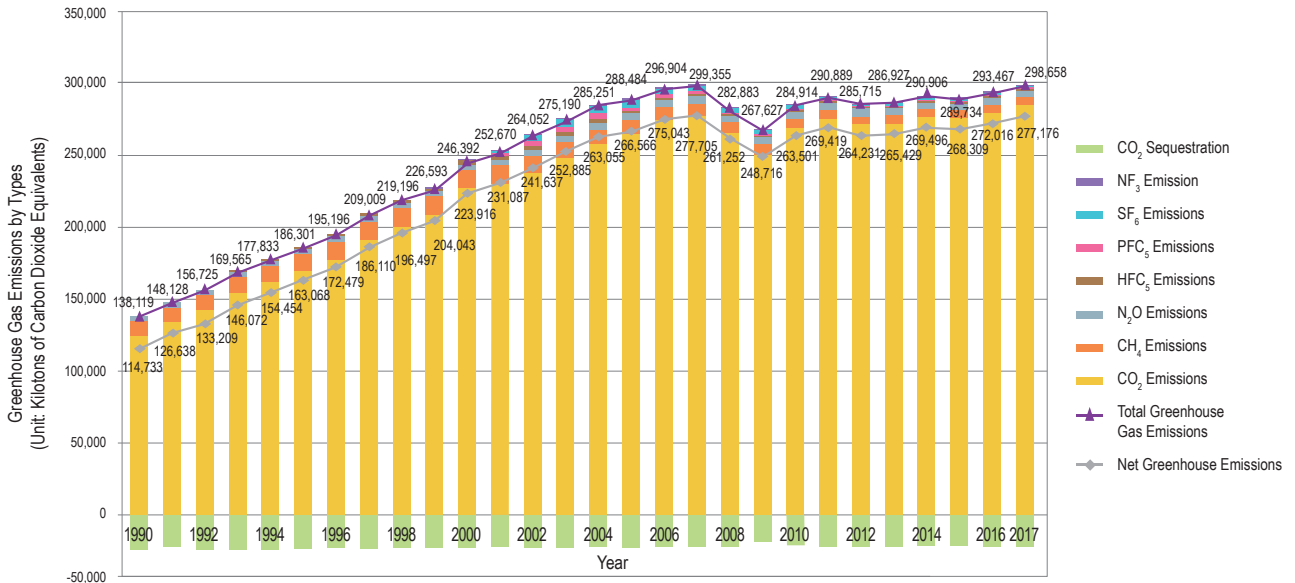


Figure ES2.1 1990-2017 Trends in Total Greenhouse Gas Emissions and Sequestration in Taiwan by Type

Table ES2.1 1990-2017 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 | 1999 |
|-------------------------------|--------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| CO ₂ | 1 | 124,066 | 133,586 | 142,172 | 153,793 | 161,160 | 168,873 | 176,779 | 190,542 | 200,158 | 207,796 |
| CH ₄ | 25 | 11,158 | 11,394 | 11,411 | 11,804 | 12,562 | 13,297 | 13,700 | 13,703 | 13,726 | 13,867 |
| N ₂ O | 298 | 2,895 | 3,148 | 3,143 | 3,213 | 3,257 | 3,329 | 3,412 | 3,287 | 3,229 | 3,192 |
| HFCs | HFC-134a: 1,430 | NE | NE | NE | 755 | 855 | 801 | 1,305 | 1,477 | 2,083 | 1,609 |
| PFCs | PFC-14:7,390 | NE | NE | NE | NE | NE | NE | NE | NE | NE | 3 |
| SF ₆ | 22,800 | NE | NE | NE | NE | NE | NE | NE | NE | NE | 116 |
| NF ₃ | 17,200 | NE | NE | NE | NE | NE | NE | NE | NE | NE | 11 |
| CO ₂ Sequestration | 1 | -23,386 | -21,490 | -23,516 | -23,493 | -23,379 | -23,233 | -22,717 | -22,899 | -22,699 | -22,550 |
| Net GHG | | 114,733 | 126,638 | 133,209 | 146,072 | 154,454 | 163,068 | 172,479 | 186,110 | 196,497 | 204,043 |
| Total GHG | | 138,119 | 148,128 | 156,725 | 169,565 | 177,833 | 186,301 | 195,196 | 209,009 | 219,196 | 226,593 |
| GHG | Global Warming Potential | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
| CO ₂ | 1 | 226,978 | 229,927 | 237,651 | 248,402 | 257,883 | 264,662 | 274,281 | 277,709 | 264,738 | 250,632 |
| CH ₄ | 25 | 13,150 | 12,348 | 11,776 | 11,298 | 10,609 | 10,100 | 9,458 | 8,955 | 8,267 | 7,650 |
| N ₂ O | 298 | 3,801 | 3,857 | 3,954 | 3,971 | 4,115 | 4,174 | 4,675 | 4,752 | 4,340 | 4,506 |
| HFCs | HFC-134a: 1,430 | 2,319 | 2,619 | 2,216 | 2,397 | 2,451 | 1,070 | 987 | 1,093 | 1,046 | 980 |
| PFCs | PFC-14:7,390 | 13 | 2,939 | 4,143 | 4,198 | 4,341 | 3,070 | 3,264 | 2,972 | 1,682 | 1,143 |
| SF ₆ | 22,800 | 120 | 746 | 3,914 | 4,385 | 5,193 | 4,683 | 3,590 | 3,114 | 2,644 | 2,176 |
| NF ₃ | 17,200 | 10 | 235 | 398 | 540 | 659 | 726 | 650 | 759 | 166 | 538 |
| CO ₂ Sequestration | 1 | -22,476 | -21,583 | -22,415 | -22,305 | -22,196 | -21,918 | -21,861 | -21,650 | -21,631 | -18,911 |
| Net GHG | | 223,916 | 231,087 | 241,637 | 252,885 | 263,055 | 266,566 | 275,043 | 277,705 | 261,252 | 248,716 |
| Total GHG | | 246,392 | 252,670 | 264,052 | 275,190 | 285,251 | 288,484 | 296,904 | 299,355 | 282,883 | 267,627 |
| GHG | Global Warming Potential | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | | |
| CO ₂ | 1 | 268,436 | 274,933 | 271,048 | 271,984 | 276,302 | 275,825 | 279,530 | 284,803 | | |
| CH ₄ | 25 | 7,120 | 6,743 | 6,421 | 6,046 | 5,853 | 5,637 | 5,629 | 5,529 | | |
| N ₂ O | 298 | 4,910 | 4,811 | 4,727 | 4,532 | 4,518 | 4,488 | 4,695 | 4,892 | | |
| HFCs | HFC-134a: 1,430 | 934 | 1,016 | 869 | 981 | 1,010 | 982 | 991 | 984 | | |
| PFCs | PFC-14:7,390 | 1,354 | 1,365 | 725 | 929 | 1,139 | 931 | 1,045 | 980 | | |
| SF ₆ | 22,800 | 1,942 | 1,642 | 1,577 | 1,722 | 1,455 | 1,247 | 1,138 | 1,079 | | |
| NF ₃ | 17,200 | 219 | 381 | 349 | 734 | 627 | 623 | 440 | 392 | | |
| CO ₂ Sequestration | 1 | -21,413 | -21,470 | -21,484 | -21,498 | -21,410 | -21,425 | -21,451 | -21,482 | | |
| Net GHG | | 263,501 | 269,419 | 264,231 | 265,429 | 269,496 | 268,309 | 272,016 | 277,176 | | |
| Total GHG | | 284,914 | 290,889 | 285,715 | 286,927 | 290,906 | 289,734 | 293,467 | 298,658 | | |

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 1990-2017 Carbon Dioxide Emissions and Sequestration in Taiwan

(Unit: Kilotons of Carbon Dioxide Equivalents)

| GHG Emission Source and Sinks | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 1. Energy Sector | 109,459 | 118,436 | 126,052 | 135,199 | 143,097 | 150,803 | 158,572 | 170,826 | 181,509 | 190,437 | 209,205 | 213,107 | 220,870 | 230,832 |
| 1.A.1. Energy Industry | 49,123 | 55,126 | 58,529 | 65,962 | 70,771 | 76,400 | 81,254 | 91,407 | 100,414 | 105,782 | 121,143 | 126,142 | 130,463 | 141,730 |
| 1.A.2. Manufacturing Industry and Construction | 30,117 | 31,956 | 33,383 | 33,611 | 34,586 | 35,763 | 36,785 | 39,075 | 39,311 | 41,305 | 43,934 | 42,545 | 44,814 | 42,788 |
| 1.A.3. Transportation | 19,646 | 20,888 | 24,033 | 26,103 | 27,540 | 28,822 | 29,801 | 30,536 | 31,844 | 32,772 | 33,207 | 33,246 | 34,542 | 34,509 |
| 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 | 10,922 | 11,174 | 11,052 | 11,806 |
| 1.A.4.a Service Industry | 3,621 | 3,529 | 2,989 | 2,490 | 3,018 | 2,445 | 3,175 | 2,482 | 2,946 | 3,128 | 3,205 | 3,538 | 3,487 | 3,952 |
| 1.A.4.b Residential | 4,005 | 4,238 | 4,446 | 4,359 | 4,461 | 4,597 | 4,754 | 4,851 | 4,952 | 5,410 | 5,354 | 5,181 | 5,107 | 5,042 |
| 1.A.4.c Agriculture, Forestry, Fishery, and Husbandry | 2,946 | 2,700 | 2,672 | 2,675 | 2,721 | 2,777 | 2,805 | 2,475 | 2,041 | 2,040 | 2,362 | 2,455 | 2,459 | 2,811 |
| 2. Industrial Processes and Product Use Sector | 14,445 | 14,996 | 15,916 | 18,400 | 17,818 | 17,521 | 17,669 | 19,477 | 18,406 | 17,175 | 17,384 | 16,186 | 16,075 | 17,070 |
| 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 | 10,746 | 10,486 | 9,974 | 10,648 | 10,270 |
| 2.B Chemical Industry | 563 | 539 | 565 | 609 | 762 | 850 | 992 | 1,020 | 1,003 | 1,075 | 1,143 | 1,232 | 1,313 | 1,384 |
| 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 | 4,960 | 4,096 | 5,397 |
| 2.H Others | 23 | 23 | 23 | 24 | 23 | 21 | 20 | 19 | 22 | 21 | 20 | 20 | 18 | 18 |
| 3. Agriculture Sector | 142 | 146 | 139 | 131 | 135 | 151 | 151 | 134 | 127 | 119 | 131 | 94 | 93 | 83 |
| 4. Land Use and Forestry Sector | -23,386 | -21,490 | -23,516 | -23,493 | -23,379 | -23,233 | -22,717 | -22,899 | -22,699 | -22,550 | -22,476 | -21,583 | -22,415 | -22,305 |
| 5. Waste Sector | 20 | 8 | 65 | 63 | 110 | 398 | 387 | 105 | 117 | 65 | 259 | 540 | 612 | 417 |
| Net Greenhouse Gas Emission | 100,680 | 112,096 | 118,656 | 130,300 | 137,781 | 145,640 | 154,062 | 167,643 | 177,459 | 185,246 | 204,502 | 208,344 | 215,236 | 226,097 |
| Total Greenhouse Gas Emission | 124,066 | 133,586 | 142,172 | 153,793 | 161,160 | 168,873 | 176,779 | 190,542 | 200,158 | 207,796 | 226,978 | 229,927 | 237,651 | 248,402 |
| GHG Emission Source and Sinks | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
| 1. Energy Sector | 239,929 | 246,356 | 253,643 | 257,313 | 245,824 | 234,103 | 250,147 | 255,878 | 251,687 | 252,434 | 258,472 | 258,467 | 262,806 | 269,452 |
| 1.A.1. Energy Industry | 148,677 | 154,751 | 61,926 | 168,230 | 162,724 | 153,406 | 163,969 | 168,674 | 166,846 | 166,645 | 175,180 | 175,198 | 178,402 | 187,135 |
| 1.A.2. Manufacturing Industry and Construction | 43,163 | 42,671 | 43,994 | 43,293 | 39,098 | 36,693 | 41,353 | 42,289 | 40,991 | 42,009 | 38,944 | 38,065 | 38,287 | 36,731 |
| 1.A.3. Transportation | 35,859 | 36,846 | 36,771 | 35,419 | 33,216 | 33,541 | 34,652 | 35,107 | 34,284 | 34,209 | 34,667 | 35,506 | 36,585 | 36,202 |
| 1.A.4. Other Sectors | 12,230 | 12,089 | 10,952 | 10,370 | 10,785 | 10,463 | 10,174 | 9,807 | 9,566 | 9,571 | 9,681 | 9,698 | 9,533 | 9,384 |
| 1.A.4.a Service Industry | 4,120 | 4,227 | 4,272 | 4,232 | 4,226 | 4,264 | 4,204 | 3,898 | 3,635 | 3,812 | 3,928 | 3,941 | 3,720 | 3,779 |
| 1.A.4.b Residential | 5,133 | 5,235 | 5,033 | 5,047 | 5,017 | 5,030 | 4,857 | 4,786 | 4,672 | 4,484 | 4,411 | 4,469 | 4,537 | 4,402 |
| 1.A.4.c Agriculture, Forestry, Fishery, and Husbandry | 2,977 | 2,627 | 1,647 | 1,091 | 1,543 | 1,169 | 1,113 | 1,123 | 1,259 | 1,274 | 1,343 | 1,287 | 1,276 | 1,203 |
| 2. Industrial Processes and Product Use Sector | 17,358 | 17,895 | 20,109 | 19,777 | 18,414 | 16,319 | 18,027 | 18,853 | 19,157 | 19,351 | 17,644 | 17,219 | 16,557 | 15,199 |
| 2.A Mining Industry (Non-Metal Process) | 10,691 | 11,257 | 11,014 | 10,369 | 9,289 | 8,467 | 8,616 | 9,577 | 9,333 | 9,866 | 8,728 | 8,345 | 7,108 | 6,262 |
| 2.B Chemical Industry | 1,485 | 1,552 | 1,530 | 1,654 | 1,457 | 1,514 | 1,599 | 1,637 | 1,503 | 1,572 | 1,884 | 1,854 | 1,760 | 1,709 |
| 2.C Metal Process | 5,162 | 5,066 | 7,544 | 7,733 | 7,648 | 6,317 | 7,792 | 7,620 | 8,301 | 7,894 | 7,013 | 7,000 | 7,670 | 7,208 |
| 2.H Others | 19 | 20 | 21 | 20 | 20 | 21 | 20 | 20 | 21 | 19 | 19 | 20 | 19 | 20 |
| 3. Agriculture Sector | 84 | 62 | 60 | 58 | 57 | 56 | 54 | 53 | 55 | 45 | 40 | 38 | 34 | 31 |
| 4. Land Use and Forestry Sector | -22,196 | -21,918 | -21,861 | -21,650 | -21,631 | -18,911 | -21,413 | -21,470 | -21,484 | -21,498 | -21,410 | -21,425 | -21,451 | -21,482 |
| 5. Waste Sector | 512 | 348 | 470 | 562 | 443 | 154 | 208 | 149 | 149 | 153 | 146 | 103 | 132 | 120 |
| Net Greenhouse Gas Emission | 235,687 | 242,744 | 252,420 | 256,059 | 243,107 | 231,721 | 247,023 | 253,463 | 249,564 | 250,486 | 254,892 | 254,400 | 258,079 | 263,321 |
| Total Greenhouse Gas Emission | 257,883 | 264,662 | 274,281 | 277,709 | 264,738 | 250,632 | 268,436 | 274,933 | 271,048 | 271,984 | 276,302 | 275,825 | 279,530 | 284,803 |



in the energy sector, the 8.20% decrease in the industrial process and product use sector, the 6.82% decrease in the agriculture sector, and the 9.00% decrease 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 2017, the total methane emission was 5,529 kilotons of carbon dioxide equivalents, down by 50.45% with an average growth rate of -2.57%, a negative growth. In 2017, methane emissions accounted for 1.85% of the total GHG emissions. In particular, the waste sector was the largest source of methane

Table ES2.3 1990-2017 Methane Emissions in Taiwan

(Unit: Kilotons of Carbon Dioxide Equivalents)

| GHG Emission Source and Sinks | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| 1. Energy Sector | 530 | 506 | 497 | 511 | 526 | 533 | 520 | 514 | 535 | 561 | 574 | 565 | 585 | 630 |
| 2. Industrial Processes and Product Use Sector | 5 | 7 | 6 | 7 | 8 | 10 | 11 | 12 | 10 | 12 | 14 | 18 | 19 | 22 |
| 3. Agriculture Sector | 1,873 | 1,901 | 1,864 | 1,863 | 1,832 | 1,855 | 1,839 | 1,723 | 1,622 | 1,644 | 1,618 | 1,565 | 1,479 | 1,394 |
| 3.A Livestock Gastrointestinal Fermentation | 670 | 731 | 738 | 775 | 789 | 822 | 822 | 732 | 674 | 694 | 692 | 660 | 636 | 626 |
| 3.B Livestock Waste Treatment | 206 | 236 | 234 | 240 | 247 | 259 | 266 | 219 | 192 | 205 | 210 | 201 | 194 | 192 |
| 3.C Rice Culturing | 960 | 908 | 845 | 825 | 775 | 767 | 745 | 765 | 751 | 738 | 702 | 689 | 637 | 567 |
| 3.F Field Burning of Agricultural Residues | 38 | 25 | 48 | 22 | 21 | 7 | 7 | 7 | 6 | 7 | 14 | 15 | 13 | 9 |
| 5. Waste Sector | 8,750 | 8,980 | 9,044 | 9,423 | 10,196 | 10,899 | 11,329 | 11,455 | 11,558 | 11,650 | 10,944 | 10,200 | 9,693 | 9,253 |
| 5.A Garbage Landfill | 5,832 | 5,917 | 5,928 | 6,323 | 7,061 | 7,719 | 8,080 | 8,213 | 8,374 | 8,606 | 8,028 | 7,309 | 6,828 | 6,321 |
| 5.B Garbage Biological Treatment | 11 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 2 |
| 5.D.1 Domestic Wastewater Treatment and discharge | 2,176 | 2,198 | 2,218 | 2,238 | 2,256 | 2,274 | 2,288 | 2,303 | 2,285 | 2,175 | 2,081 | 2,055 | 2,020 | 2,001 |
| 5.D.2 Industrial Wastewater Treatment and discharge | 731 | 864 | 896 | 862 | 879 | 905 | 961 | 938 | 899 | 868 | 835 | 836 | 844 | 929 |
| Total | 11,158 | 11,394 | 11,411 | 11,804 | 12,562 | 13,297 | 13,700 | 13,703 | 13,726 | 13,867 | 13,150 | 12,348 | 11,776 | 11,298 |
| GHG Emission Source and Sinks | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
| 1. Energy Sector | 660 | 630 | 623 | 620 | 603 | 595 | 630 | 653 | 661 | 675 | 686 | 710 | 730 | 737 |
| 2. Industrial Processes and Product Use Sector | 28 | 29 | 33 | 39 | 37 | 33 | 35 | 27 | 35 | 38 | 26 | 15 | 27 | 24 |
| 3. Agriculture Sector | 1,320 | 1,387 | 1,368 | 1,341 | 1,299 | 1,281 | 1,274 | 1,301 | 1,300 | 1,304 | 1,286 | 1,268 | 1,283 | 1,285 |
| 3.A Livestock Gastrointestinal Fermentation | 614 | 623 | 614 | 609 | 584 | 571 | 578 | 590 | 583 | 579 | 566 | 573 | 561 | 564 |
| 3.B Livestock Waste Treatment | 193 | 195 | 195 | 185 | 180 | 175 | 176 | 180 | 172 | 166 | 164 | 163 | 164 | 164 |
| 3.C Rice Culturing | 505 | 561 | 551 | 543 | 529 | 530 | 514 | 526 | 540 | 555 | 552 | 529 | 555 | 554 |
| 3.F Field Burning of Agricultural Residues | 8 | 8 | 8 | 5 | 6 | 5 | 5 | 5 | 5 | 3 | 4 | 4 | 3 | 3 |
| 5. Waste Sector | 8,601 | 8,054 | 7,434 | 6,956 | 6,328 | 5,741 | 5,180 | 4,762 | 4,425 | 4,030 | 3,855 | 3,645 | 3,588 | 3,481 |
| 5.A Garbage Landfill | 5,776 | 5,229 | 4,665 | 4,143 | 3,607 | 3,071 | 2,601 | 2,225 | 1,889 | 1,597 | 1,351 | 1,141 | 970 | 834 |
| 5.B Garbage Biological Treatment | 7 | 10 | 11 | 14 | 16 | 18 | 21 | 26 | 24 | 23 | 20 | 20 | 20 | 20 |
| 5.D.1 Domestic Wastewater Treatment and discharge | 1,939 | 1,880 | 1,822 | 1,751 | 1,694 | 1,630 | 1,579 | 1,506 | 1,433 | 1,384 | 1,339 | 1,285 | 1,233 | 1,167 |
| 5.D.2 Industrial Wastewater Treatment and discharge | 880 | 935 | 936 | 1,048 | 1,011 | 1,022 | 979 | 1,004 | 1,078 | 1,027 | 1,145 | 1,199 | 1,366 | 1,460 |
| Total | 10,609 | 10,100 | 9,458 | 8,955 | 8,267 | 7,650 | 7,120 | 6,743 | 6,421 | 6,046 | 5,853 | 5,637 | 5,629 | 5,529 |

emissions in 2017, which accounted for 62.97%, followed by the agriculture sector (23.25%), energy sector (13.34%), and industrial process and product use sector (0.44%). Compared to 2016, the methane emission in 2017 was down by 1.78%, with the waste sector down by 2.98%, the industrial process and product use sector down by 0.19%, the energy sector up by 0.97% and the agriculture sector up by 0.15%.

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 2017, the total nitrous oxide emission was 4,892 kilotons of carbon dioxide equivalents, up by 68.99% with an average growth rate of 1.96%. In 2017, nitrous oxide emissions

accounted for 1.64% of the total GHG emissions. In particular, the industrial process and product use sector accounted for 38.74%, followed by the agriculture sector (27.47%), the energy sector (26.08%), and the waste sector (7.70%). Compared to 2016, the nitrous oxide emission in 2017 was up by 4.12%, with the industrial process and product use sector up by 11.10%, the energy sector up by 0.99%, the waste sector up by 14.11%, and the agriculture sector down by 3.64%.

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 755

Table ES2.4 1990-2017 Nitrous Oxide Emissions in Taiwan

(Unit: Kilotons of Carbon Dioxide Equivalents)

| GHG Emission Source and Sinks | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 1. Energy Sector | 537 | 578 | 653 | 703 | 742 | 778 | 825 | 866 | 917 | 968 | 1,052 | 1,083 | 1,134 | 1,188 |
| 1.A.1 Energy Industry | 138 | 157 | 183 | 207 | 223 | 240 | 271 | 300 | 331 | 361 | 428 | 458 | 480 | 537 |
| 1.A.2 Manufacturing Industry and Construction | 90 | 95 | 101 | 100 | 103 | 105 | 109 | 114 | 115 | 123 | 134 | 135 | 142 | 138 |
| 1.A.3 Transportation | 291 | 309 | 353 | 382 | 402 | 418 | 428 | 438 | 456 | 469 | 475 | 475 | 496 | 495 |
| 1.A.4 Other Sectors | 17 | 17 | 15 | 14 | 15 | 14 | 16 | 14 | 14 | 14 | 15 | 16 | 16 | 17 |
| 2. Industrial Processes and Product Use Sector | 166 | 352 | 325 | 301 | 318 | 345 | 343 | 374 | 383 | 312 | 625 | 714 | 744 | 833 |
| 3. Agriculture Sector | 1,897 | 1,933 | 1,866 | 1,897 | 1,883 | 1,872 | 1,907 | 1,710 | 1,609 | 1,583 | 1,794 | 1,720 | 1,729 | 1,597 |
| 3.B Livestock Waste Treatment | 48 | 50 | 52 | 54 | 59 | 61 | 67 | 70 | 71 | 72 | 73 | 71 | 70 | 71 |
| 3.D Agricultural Soil | 1,837 | 1,876 | 1,800 | 1,837 | 1,818 | 1,808 | 1,838 | 1,638 | 1,536 | 1,509 | 1,717 | 1,644 | 1,655 | 1,524 |
| 3.F Field Burning of Agricultural Residues | 12 | 8 | 15 | 7 | 7 | 2 | 2 | 2 | 2 | 2 | 4 | 5 | 4 | 3 |
| 5. Waste Sector | 296 | 285 | 298 | 311 | 313 | 334 | 337 | 337 | 321 | 329 | 331 | 340 | 348 | 353 |
| Total | 2,895 | 3,148 | 3,143 | 3,213 | 3,257 | 3,329 | 3,412 | 3,287 | 3,229 | 3,192 | 3,801 | 3,857 | 3,954 | 3,971 |
| GHG Emission Source and Sinks | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
| 1. Energy Sector | 1,228 | 1,266 | 1,296 | 1,299 | 1,236 | 1,208 | 1,245 | 1,266 | 1,244 | 1,238 | 1,246 | 1,242 | 1,264 | 1,276 |
| 1.A.1 Energy Industry | 556 | 581 | 609 | 634 | 613 | 590 | 600 | 605 | 600 | 592 | 599 | 585 | 594 | 621 |
| 1.A.2 Manufacturing Industry and Construction | 141 | 140 | 145 | 143 | 131 | 124 | 135 | 144 | 137 | 140 | 133 | 131 | 131 | 123 |
| 1.A.3 Transportation | 513 | 527 | 527 | 508 | 478 | 480 | 497 | 505 | 495 | 494 | 500 | 513 | 526 | 521 |
| 1.A.4 Other Sectors | 18 | 17 | 15 | 13 | 14 | 13 | 13 | 12 | 12 | 12 | 13 | 13 | 12 | 12 |
| 2. Industrial Processes and Product Use Sector | 834 | 960 | 1,432 | 1,531 | 1,290 | 1,457 | 1,834 | 1,762 | 1,674 | 1,539 | 1,514 | 1,507 | 1,706 | 1,895 |
| 3. Agriculture Sector | 1,710 | 1,598 | 1,629 | 1,595 | 1,514 | 1,547 | 1,528 | 1,469 | 1,496 | 1,432 | 1,427 | 1,397 | 1,395 | 1,344 |
| 3.B Livestock Waste Treatment | 69 | 71 | 72 | 71 | 72 | 71 | 70 | 71 | 71 | 71 | 73 | 74 | 76 | 77 |
| 3.D Agricultural Soil | 1,639 | 1,524 | 1,554 | 1,522 | 1,440 | 1,474 | 1,456 | 1,396 | 1,424 | 1,359 | 1,353 | 1,321 | 1,318 | 1,266 |
| 3.F Field Burning of Agricultural Residues | 2 | 2 | 3 | 1 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 |
| 5. Waste Sector | 343 | 350 | 318 | 328 | 300 | 295 | 302 | 314 | 313 | 323 | 332 | 342 | 330 | 377 |
| Total | 4,115 | 4,174 | 4,675 | 4,752 | 4,340 | 4,506 | 4,910 | 4,811 | 4,727 | 4,532 | 4,518 | 4,488 | 4,695 | 4,892 |



kilotons of carbon dioxide equivalents in 1993 to 984 kilotons of carbon dioxide equivalents in 2017. The perfluorocarbons (PFCs) emission increased from 3 kilotons of carbon dioxide equivalents in 1999 to 980 kilotons of carbon dioxide equivalents in 2017, while the sulfur hexafluoride (SF₆) emission increased from 116 kilotons of carbon dioxide equivalents in 1999 to 1,079 kilotons of carbon dioxide equivalents in 2017. The nitrogen trifluoride (NF₃) emission increased from 11 kilotons of carbon dioxide equivalents in 1999 to 392 kilotons of carbon dioxide equivalents in 2017. 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 3,434 kilotons of carbon dioxide equivalents in 2017 (about 1.15% of the total greenhouse gas emissions in 2017), with an emissions increase of 354.88% at an average annual growth rate of 3.86%. Compared to 2016, the emission in 2017 decreased by 4.98%.

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 90.90% of the total emission in 2017 (excluding land use, land use change and forestry sequestration), the industrial process and product use sector 6.88%, the agriculture sector 0.89%, and the waste sector 1.33%. The GHG emission and trends for Taiwan from

1990 to 2017 by sector are shown in Figure ES3.1 and Table ES3.1. The total greenhouse gas emission in Taiwan in 2017 increased by 1.77% compared with 2016. In particular, the GHG emission from the energy sector was up by 2.52%, the industrial process and product use sector was down by 6.17%, the agriculture sector was down by 1.88%, and the waste sector was down by 1.78%. Additionally, the carbon dioxide sequestration of the land use, land use change and forestry sector was up by 0.14%.

The total greenhouse gas emission from the energy sector in 1990 was 110,525 kilotons of carbon dioxide equivalents and increased to 277,466 kilotons of carbon dioxide equivalents in 2017 with a growth of 145.61% and an annual average growth of 3.38%, 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. Compared with 2016, the greenhouse gas emissions in 2017 increased by 2.52%. The total greenhouse gas emission from the energy sector in 2017 accounted for 90.90% of the total greenhouse gas emission in Taiwan. In particular, 1.A.1 “energy industry” was responsible for 187,850 kilotons of carbon dioxide equivalents, accounting for 69.20% of the total greenhouse gas emission from the energy sector; 1.A.2 “manufacturing and construction industry” was responsible for 36,924 kilotons of carbon dioxide equivalents (accounting for 13.60%); 1.A.3 “transportation” was responsible for 37,018 kilotons of carbon dioxide equivalents (accounting for 13.64%);

Table ES2.5 1990-2017 Fluoride-Containing Gas Emissions in Taiwan

(Unit: Kilotons of Carbon Dioxide Equivalents)

| GHG Emission Source and Sinks | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|--------|--------|-------|-------|
| Total HFCs Emissions | 755 | 855 | 801 | 1,305 | 1,477 | 2,083 | 1,609 | 2,319 | 2,619 | 2,216 | 2,397 | 2,451 | 1,070 | 987 |
| Total PFCs Emissions | NE | NE | NE | NE | NE | NE | 3 | 13 | 2,939 | 4,143 | 4,198 | 4,341 | 3,070 | 3,264 |
| Total SF ₆ Emissions | NE | NE | NE | NE | NE | NE | 116 | 120 | 746 | 3,914 | 4,385 | 5,193 | 4,683 | 3,590 |
| Total Emissions NF ₃ | NE | NE | NE | NE | NE | NE | 11 | 10 | 235 | 398 | 540 | 659 | 726 | 650 |
| Total Emissions | 755 | 855 | 801 | 1,305 | 1,477 | 2,083 | 1,738 | 2,462 | 6,538 | 10,671 | 11,520 | 12,643 | 9,549 | 8,490 |
| GHG Emission Source and Sinks | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | | | |
| Total HFCs Emissions | 1,093 | 1,046 | 980 | 934 | 1,016 | 869 | 981 | 1,010 | 982 | 991 | 984 | | | |
| Total PFCs Emissions | 2,972 | 1,682 | 1,143 | 1,354 | 1,365 | 725 | 929 | 1,139 | 931 | 1,045 | 980 | | | |
| Total SF ₆ Emissions | 3,114 | 2,644 | 2,176 | 2,155 | 1,755 | 1,647 | 1,722 | 1,455 | 1,247 | 1,138 | 1,079 | | | |
| Total Emissions NF ₃ | 759 | 166 | 538 | 219 | 381 | 349 | 734 | 627 | 623 | 440 | 392 | | | |
| Total Emissions | 7,939 | 5,538 | 4,838 | 4,448 | 4,403 | 3,519 | 4,365 | 4,232 | 3,783 | 3,614 | 3,434 | | | |

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

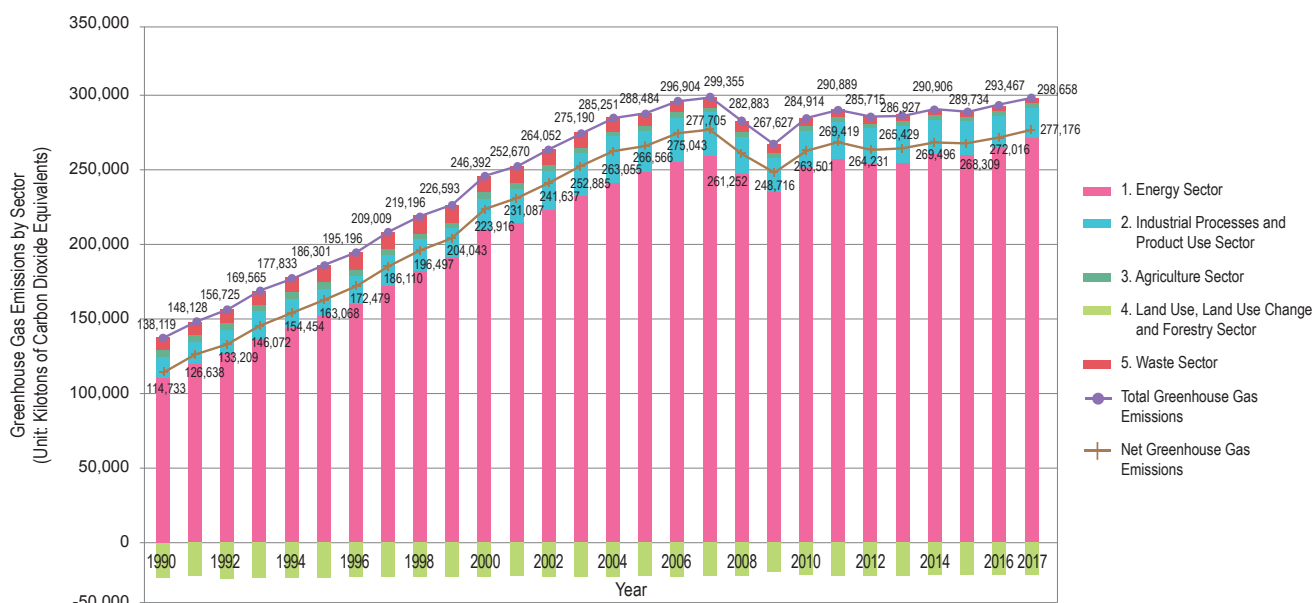


Figure ES3.1 1990-2017 Trends in Greenhouse Gas Emission in Taiwan by Sector

Table ES3.1 1990-2017 Greenhouse Gas Emission in Taiwan by Sector

(Unit: Kilotons of Carbon Dioxide Equivalents)

| GHG Emission Source and Sinks | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 1. Energy Sector | 110,525 | 119,521 | 127,202 | 136,414 | 144,365 | 152,115 | 159,917 | 172,206 | 182,961 | 191,966 | 210,831 | 214,756 | 222,589 | 232,649 |
| 2. Industrial Processes and Product Use Sector | 14,616 | 15,355 | 16,248 | 19,463 | 18,999 | 18,677 | 19,328 | 21,341 | 20,881 | 19,237 | 20,484 | 23,456 | 27,509 | 29,444 |
| 3. Agriculture Sector | 3,911 | 3,980 | 3,869 | 3,890 | 3,850 | 3,878 | 3,897 | 3,567 | 3,358 | 3,345 | 3,543 | 3,379 | 3,301 | 3,074 |
| 4. Land Use and Forestry Sector | -23,386 | -21,490 | -23,516 | -23,493 | -23,379 | -23,233 | -22,717 | -22,899 | -22,699 | -22,550 | -22,476 | -21,583 | -22,415 | -22,305 |
| 5. Waste Sector | 9,066 | 9,273 | 9,407 | 9,798 | 10,619 | 11,631 | 12,053 | 11,896 | 11,995 | 12,044 | 11,534 | 11,080 | 10,653 | 10,023 |
| Net Greenhouse Gas Emissions (including Land Use, Land Use Change and Forestry Sequestration) | 114,733 | 126,638 | 133,209 | 146,072 | 154,454 | 163,068 | 172,479 | 186,110 | 196,497 | 204,043 | 223,916 | 231,087 | 241,637 | 252,885 |
| Total Greenhouse Gas Emissions (excluding Land Use, Land Use Change and Forestry Sequestration) | 138,119 | 148,128 | 156,725 | 169,565 | 177,833 | 186,301 | 195,196 | 209,009 | 219,196 | 226,593 | 246,392 | 252,670 | 264,052 | 275,190 |
| GHG Emission Source and Sinks | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
| 1. Energy Sector | 241,818 | 248,252 | 255,562 | 259,232 | 247,662 | 235,906 | 252,023 | 257,796 | 253,592 | 254,347 | 260,404 | 260,418 | 264,800 | 271,466 |
| 2. Industrial Processes and Product Use Sector | 30,864 | 28,434 | 30,063 | 29,285 | 25,279 | 22,647 | 24,344 | 25,045 | 24,385 | 25,292 | 23,416 | 22,524 | 21,904 | 20,553 |
| 3. Agriculture Sector | 3,114 | 3,047 | 3,056 | 2,993 | 2,870 | 2,884 | 2,856 | 2,823 | 2,851 | 2,781 | 2,753 | 2,703 | 2,712 | 2,661 |
| 4. Land Use and Forestry Sector | -22,196 | -21,918 | -21,861 | -21,650 | -21,631 | -18,911 | -21,413 | -21,470 | -21,484 | -21,498 | -21,410 | -21,425 | -21,451 | -21,482 |
| 5. Waste Sector | 9,456 | 8,752 | 8,222 | 7,846 | 7,071 | 6,190 | 5,691 | 5,225 | 4,886 | 4,507 | 4,333 | 4,089 | 4,051 | 3,979 |
| Net Greenhouse Gas Emissions (including Land Use, Land Use Change and Forestry Sequestration) | 263,055 | 266,566 | 275,043 | 277,705 | 261,252 | 248,716 | 263,501 | 269,419 | 264,231 | 265,429 | 269,496 | 268,309 | 272,016 | 277,176 |
| Total Greenhouse Gas Emissions (excluding Land Use, Land Use Change and Forestry Sequestration) | 285,251 | 288,484 | 296,904 | 299,355 | 282,883 | 267,627 | 284,914 | 290,889 | 285,715 | 286,927 | 290,906 | 289,734 | 293,467 | 298,658 |



Table ES3.2 1990-2017 Greenhouse Gas Emissions Produced by Energy Sector in Taiwan

(Unit: Kilotons of Carbon Dioxide Equivalents)

| GHG Emission Source and Sinks | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|--|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Total CO ₂ Emission | 109,459 | 118,436 | 126,052 | 135,199 | 143,097 | 150,803 | 158,572 | 170,826 | 181,509 | 190,437 | 209,205 | 213,107 | 220,870 | 230,832 |
| 1.A.1. Energy Industry | 49,123 | 55,126 | 58,529 | 65,962 | 70,771 | 76,400 | 81,254 | 91,407 | 100,414 | 105,782 | 121,143 | 126,142 | 130,463 | 141,730 |
| 1.A.2. Manufacturing Industry and Construction | 30,117 | 31,956 | 33,383 | 33,611 | 34,586 | 35,763 | 36,785 | 39,075 | 39,311 | 41,305 | 43,934 | 42,545 | 44,814 | 42,788 |
| 1.A.3. Transportation | 19,646 | 20,888 | 24,033 | 26,103 | 27,540 | 28,822 | 29,801 | 30,536 | 31,844 | 32,772 | 33,207 | 33,246 | 34,542 | 34,509 |
| 1.A.4. Others | 10,572 | 10,466 | 10,107 | 9,523 | 10,200 | 9,819 | 10,733 | 9,808 | 9,939 | 10,579 | 10,922 | 11,174 | 11,052 | 11,806 |
| Total CH ₄ Emission | 530 | 506 | 497 | 511 | 526 | 533 | 520 | 514 | 535 | 561 | 574 | 565 | 585 | 630 |
| 1.A.1. Energy Industry | 26 | 29 | 28 | 32 | 35 | 40 | 41 | 46 | 50 | 58 | 66 | 70 | 69 | 78 |
| 1.A.2. Manufacturing Industry and Construction | 46 | 48 | 52 | 51 | 52 | 54 | 56 | 58 | 59 | 63 | 69 | 71 | 75 | 73 |
| 1.A.3. Transportation | 152 | 163 | 187 | 202 | 216 | 228 | 239 | 245 | 257 | 266 | 270 | 272 | 278 | 287 |
| 1.A.4. Others | 30 | 29 | 28 | 26 | 28 | 27 | 29 | 26 | 27 | 28 | 29 | 30 | 30 | 32 |
| 1.B.1 Solid Fuel | 162 | 138 | 115 | 113 | 98 | 81 | 51 | 34 | 27 | 31 | 28 | NO | NO | NO |
| 1.B.2 Oil and Gas | 115 | 98 | 88 | 87 | 97 | 103 | 103 | 104 | 115 | 113 | 111 | 122 | 132 | 159 |
| Total N ₂ O Emission | 537 | 578 | 653 | 703 | 742 | 778 | 825 | 866 | 917 | 968 | 1,052 | 1,083 | 1,134 | 1,188 |
| 1.A.1. Energy Industry | 138 | 157 | 183 | 207 | 223 | 240 | 271 | 300 | 331 | 361 | 428 | 458 | 480 | 537 |
| 1.A.2. Manufacturing Industry and Construction | 90 | 95 | 101 | 100 | 103 | 105 | 109 | 114 | 115 | 123 | 134 | 135 | 142 | 138 |
| 1.A.3. Transportation | 291 | 309 | 353 | 382 | 402 | 418 | 428 | 438 | 456 | 469 | 475 | 475 | 496 | 495 |
| 1.A.4. Others | 17 | 17 | 15 | 14 | 15 | 14 | 16 | 14 | 14 | 14 | 15 | 16 | 16 | 17 |
| Total Emission from Energy Sector | 110,525 | 119,521 | 127,202 | 136,414 | 144,365 | 152,115 | 159,917 | 172,206 | 182,961 | 191,966 | 210,831 | 214,756 | 222,589 | 232,649 |
| GHG Emission Source and Sinks | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
| Total Carbon Dioxide Emission | 239,929 | 246,356 | 253,643 | 257,313 | 245,824 | 234,103 | 250,147 | 255,878 | 251,687 | 252,434 | 258,472 | 258,467 | 262,806 | 269,452 |
| 1.A.1. Energy Industry | 148,677 | 154,751 | 161,926 | 168,230 | 162,724 | 153,406 | 163,969 | 168,674 | 166,846 | 166,645 | 175,180 | 175,198 | 178,402 | 187,135 |
| 1.A.2. Manufacturing Industry and Construction | 43,163 | 42,671 | 43,994 | 43,293 | 39,098 | 36,693 | 41,353 | 42,289 | 40,991 | 42,009 | 38,944 | 38,065 | 38,287 | 36,731 |
| 1.A.3. Transportation | 35,859 | 36,846 | 36,771 | 35,419 | 33,216 | 33,541 | 34,652 | 35,107 | 34,284 | 34,209 | 34,667 | 35,506 | 36,585 | 36,202 |
| 1.A.4. Others | 12,230 | 12,089 | 10,952 | 10,370 | 10,785 | 10,463 | 10,174 | 9,807 | 9,566 | 9,571 | 9,681 | 9,698 | 9,533 | 9,384 |
| Total CH ₄ Emission | 660 | 630 | 623 | 620 | 603 | 595 | 630 | 653 | 661 | 675 | 686 | 710 | 730 | 737 |
| 1.A.1. Energy Industry | 81 | 82 | 86 | 88 | 86 | 80 | 85 | 86 | 85 | 84 | 88 | 91 | 92 | 94 |
| 1.A.2. Manufacturing Industry and Construction | 75 | 75 | 78 | 77 | 71 | 67 | 74 | 79 | 76 | 78 | 74 | 74 | 74 | 69 |
| 1.A.3. Transportation | 295 | 303 | 298 | 289 | 275 | 281 | 284 | 287 | 283 | 284 | 285 | 292 | 301 | 295 |
| 1.A.4. Others | 33 | 33 | 29 | 27 | 28 | 27 | 26 | 25 | 25 | 25 | 25 | 25 | 25 | 24 |
| 1.B.1 Solid Fuel | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO | NO |
| 1.B.2 Oil and Gas | 176 | 137 | 132 | 138 | 142 | 140 | 161 | 176 | 193 | 204 | 213 | 227 | 239 | 254 |
| Total N ₂ O Emission | 1,228 | 1,266 | 1,296 | 1,299 | 1,236 | 1,208 | 1,245 | 1,266 | 1,244 | 1,238 | 1,246 | 1,242 | 1,264 | 1,276 |
| 1.A.1. Energy Industry | 556 | 581 | 609 | 634 | 613 | 590 | 600 | 605 | 600 | 592 | 599 | 585 | 594 | 621 |
| 1.A.2. Manufacturing Industry and Construction | 141 | 140 | 145 | 143 | 131 | 124 | 135 | 144 | 137 | 140 | 133 | 131 | 131 | 123 |
| 1.A.3. Transportation | 513 | 527 | 527 | 508 | 478 | 480 | 497 | 505 | 495 | 494 | 500 | 513 | 526 | 521 |
| 1.A.4. Others | 18 | 17 | 15 | 13 | 14 | 13 | 13 | 12 | 12 | 12 | 13 | 13 | 12 | 12 |
| Total Emission from Energy Sector | 241,818 | 248,252 | 255,562 | 259,232 | 247,662 | 235,906 | 252,023 | 257,796 | 253,592 | 254,347 | 260,404 | 260,418 | 264,800 | 271,466 |

1.A.4 “other sectors (including service industry, residential and agriculture, forestry, fishery and husbandry)” was responsible for 9,420 kilotons of carbon dioxide equivalents (accounting for 3.54%); 1.B.2 “oil and gas” was responsible for 254 kilotons of carbon dioxide equivalents (accounting for 0.09%).

The greenhouse gas emission from the industrial process and product use sector in 1990 was 14,616 kilotons of carbon dioxide equivalents and increased to 20,553 kilotons in 2017, a growth of 40.62% and an annual average growth of 1.27%, as shown in Table ES3.3. The total greenhouse gas emission in 2017 accounted for 6.88% of the total greenhouse gas emission in Taiwan. In particular, 2.C “metal process” was responsible for 7,267 kilotons of carbon dioxide equivalents, accounting for 35.36% (the majority) of the greenhouse gases from the industrial process and product use sector, followed by 2.A “mining industry (non-metal process)”, which was responsible for 6,262 kilotons of carbon dioxide equivalents (accounting for 30.47%), 2.E “electronics industry”, which was responsible for 3,256 kilotons of carbon dioxide equivalents (accounting for 15.84%), 2.B “chemical industry”, which was responsible for 2,848 kilotons of carbon dioxide equivalents (accounting for 13.86%), 2.F “alternatives to ozone-depleting substances”, which was responsible for 821 kilotons of carbon dioxide equivalents (accounting for 4.00%), 2.G. “manufacturing and use of other products”, which was responsible for 79 kilotons of carbon dioxide equivalents (accounting for 0.38%), and 2.H. “others”, which was responsible for 20 kilotons of carbon dioxide equivalents (accounting for 0.10%).

In 2017, the greenhouse gas emissions from the agriculture sector totaled 2,661 kilotons of carbon dioxide equivalents, accounting for 0.89% of the total greenhouse gas emission in Taiwan, approximately down by 31.96% compared to 3,911 kilotons of carbon dioxide equivalents in 1990, with an average annual growth rate of -1.42%, as shown in Table ES3.4. Compared to 2016, the greenhouse gas emissions from the agriculture sector in 2017 were up by 1.88%. In particular, nitrous dioxide emissions from 3.D “agricultural soil” accounted for 47.57%, methane emissions from 3.A “livestock gastrointestinal fermentation” accounted for 21.20%, methane emissions from 3.C “rice culturing” accounted for 20.83%, methane emissions from 3.B “livestock waste treatment” accounted for 6.15%, nitrous dioxide emissions from 3.B

“livestock waste treatment” accounted for 2.91%, carbon dioxide emissions from 3.H “urea use” accounted for 1.18%, methane emissions from 3.F “field burning of agricultural residues” accounted for 0.13%, and nitrous dioxide emissions from 3.F “field burning of agricultural residues” accounted for 0.04%.

The main greenhouse gas sequestered by the land use and forestry 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 2017 (mainly consisting of carbon dioxide sequestration by forestry resources) is shown in Table ES3.5. The sequestration in 2017 was 21,482 kilotons of carbon dioxide equivalents, up by 0.14% compared with 2016. The carbon dioxide sequestration between 1990 and 2017 decreased by 8.42% with an average annual growth rate of -0.31%.

The greenhouse gas emissions from the waste sector in 2017 were 3,979 kilotons of carbon dioxide equivalents, approximately accounting for 1.33% of the total greenhouse gas emission in Taiwan (as shown in Table ES3.6), down by 56.12% compared with 1990, with an average annual growth of -3.00%. Among the waste sector’s emissions in 2017, methane emissions from 5.D “wastewater treatment and discharge” accounted for 66.02%, followed by methane emissions from 5.A “solid waste disposal”, accounting for 20.97%, nitrous oxide emissions from 5.D “wastewater treatment and discharge”, accounting for 8.86%; the remaining carbon dioxide emissions were from 5.C “waste incineration and opening burning”, accounting for 3.02%, methane emissions from 5.B “waste biological disposal”, accounting for 0.51%, nitrous oxide emissions from 5.B “waste biological disposal” accounted for 0.46%, and nitrous oxide emissions from 5.C “waste burning” accounted for 0.15%.

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



Table ES3-3 1990-2017 Greenhouse Gas Emissions Produced by Industrial Process and Product Use Sector in Taiwan

(Unit: Kilotons of Carbon Dioxide Equivalents)

| GHG Emission Source and Sinks | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Total CO ₂ Emission | 14,445 | 14,996 | 15,916 | 18,400 | 17,818 | 17,521 | 17,669 | 19,477 | 18,406 | 17,175 | 17,384 | 16,186 | 16,075 | 17,070 |
| 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 | 10,746 | 10,486 | 9,974 | 10,648 | 10,270 |
| 2.B Mining Industry (Non-Metal Process) | 563 | 539 | 565 | 609 | 762 | 850 | 992 | 1,020 | 1,003 | 1,075 | 1,143 | 1,232 | 1,313 | 1,384 |
| 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 | 4,960 | 4,096 | 5,397 |
| 2.H Others | 23 | 23 | 23 | 24 | 23 | 21 | 20 | 19 | 22 | 21 | 20 | 20 | 18 | 18 |
| Total CH ₄ Emission | 5 | 7 | 6 | 7 | 8 | 10 | 11 | 12 | 10 | 12 | 14 | 18 | 19 | 22 |
| Total N ₂ O Emission | 166 | 352 | 325 | 301 | 318 | 345 | 343 | 374 | 383 | 312 | 625 | 714 | 744 | 833 |
| 2.B Chemical Industry | 166 | 352 | 325 | 301 | 318 | 345 | 343 | 374 | 383 | 312 | 625 | 714 | 743 | 831 |
| 2.C Metal Process | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | 0 | 2 |
| 2.E Electronics | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| Total HFCs Emission | NE | NE | NE | 755 | 855 | 801 | 1,305 | 1,477 | 2,083 | 1,609 | 2,319 | 2,619 | 2,216 | 2,397 |
| 2.B Chemical Industry | NE | NE | NE | 755 | 855 | 801 | 1,305 | 1,477 | 2,083 | 1,609 | 2,319 | 2,567 | 2,157 | 1,937 |
| 2.E Electronics | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | 51 | 59 | 59 |
| 2.F Alternatives to Ozone-Depleting Substances | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | 401 |
| Total PFCs Emission (2.E Electronics) | NE | NE | NE | NE | NE | NE | NE | NE | NE | 3 | 13 | 2,939 | 4,143 | 4,198 |
| Total SF ₆ Emission | NE | NE | NE | NE | NE | NE | NE | NE | NE | 116 | 120 | 746 | 3,914 | 4,385 |
| 2.C Metal Process | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | 1,027 | 1,027 |
| 2.E Electronics | NE | NE | NE | NE | NE | NE | NE | NE | NE | 116 | 120 | 746 | 944 | 1,415 |
| 2.G Manufacturing and Use of Other Products | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | 1,943 | 1,943 |
| Total NF ₃ Emission (2.E Electronics) | NE | NE | NE | NE | NE | NE | NE | NE | NE | 11 | 10 | 235 | 398 | 540 |
| Total Emission from Industrial Processes and Product Use Sector | 14,616 | 15,355 | 16,248 | 19,463 | 18,999 | 18,677 | 19,328 | 21,341 | 20,881 | 19,237 | 20,484 | 23,456 | 27,509 | 29,444 |
| GHG Emission Source and Sinks | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
| Total CO ₂ Emission | 17,358 | 17,895 | 20,109 | 9,777 | 18,414 | 16,319 | 18,027 | 18,853 | 19,157 | 19,351 | 17,644 | 17,219 | 16,557 | 15,199 |
| 2.A Mining Industry (Non-Metal Process) | 10,691 | 11,257 | 11,014 | 10,369 | 9,289 | 8,467 | 8,616 | 9,577 | 9,333 | 9,866 | 8,728 | 8,345 | 7,108 | 6,262 |
| 2.B Mining Industry (Non-Metal Process) | 1,485 | 1,552 | 1,530 | 1,654 | 1,457 | 1,514 | 1,599 | 1,637 | 1,503 | 1,572 | 1,884 | 1,854 | 1,760 | 1,709 |
| 2.C Metal Process | 5,162 | 5,066 | 7,544 | 7,733 | 7,648 | 6,317 | 7,792 | 7,620 | 8,301 | 7,894 | 7,013 | 7,000 | 7,670 | 7,208 |
| 2.H Others | 19 | 20 | 21 | 20 | 20 | 21 | 20 | 20 | 21 | 19 | 19 | 20 | 19 | 20 |
| Total CH ₄ Emission | 28 | 29 | 33 | 39 | 37 | 33 | 35 | 27 | 35 | 38 | 26 | 15 | 27 | 24 |
| Total N ₂ O Emission | 834 | 960 | 1,432 | 1,531 | 1,290 | 1,457 | 1,834 | 1,762 | 1,674 | 1,539 | 1,514 | 1,507 | 1,706 | 1,895 |
| 2.B Chemical Industry | 834 | 960 | 969 | 996 | 784 | 1,006 | 1,170 | 1,195 | 1,016 | 780 | 728 | 691 | 961 | 1,114 |
| 2.C Metal Process | NE | NE | 94 | 95 | 90 | 76 | 119 | NE | NE | NE | NE | NE | NE | NE |
| 2.E Electronics | NE | NE | 369 | 439 | 416 | 375 | 546 | 568 | 658 | 759 | 786 | 817 | 745 | 781 |
| Total HFCs Emission | 2,451 | 1,070 | 987 | 1,093 | 1,046 | 980 | 934 | 1,016 | 869 | 981 | 1,010 | 982 | 991 | 984 |
| 2.B Chemical Industry | 1,710 | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| 2.E Electronics | 59 | 73 | 91 | 171 | 118 | 168 | 164 | 134 | 86 | 169 | 182 | 132 | 156 | 163 |
| 2.F Alternatives to Ozone-Depleting Substances | 682 | 996 | 896 | 922 | 928 | 812 | 770 | 881 | 783 | 812 | 828 | 851 | 835 | 821 |
| Total PFCs Emission (2.E Electronics) | 4,341 | 3,070 | 3,264 | 2,972 | 1,682 | 1,143 | 1,354 | 1,365 | 725 | 929 | 1,139 | 931 | 1,045 | 980 |
| Total SF ₆ Emission | 5,193 | 4,683 | 3,590 | 3,114 | 2,644 | 2,176 | 1,942 | 1,642 | 1,577 | 1,722 | 1,455 | 1,247 | 1,138 | 1,079 |
| 2.C Metal Process | 1,357 | 1,063 | 770 | 440 | 144 | 235 | 57 | 50 | 30 | 38 | 33 | 43 | 41 | 59 |
| 2.E Electronics | 1,783 | 2,117 | 2,050 | 1,721 | 1,605 | 1,239 | 1,648 | 1,339 | 1,352 | 1,524 | 1,276 | 1,075 | 1,015 | 941 |
| 2.G Manufacturing and Use of Other Products | 2,053 | 1,503 | 770 | 953 | 895 | 703 | 238 | 252 | 195 | 160 | 146 | 128 | 82 | 79 |
| Total NF ₃ Emission (2.E Electronics) | 659 | 726 | 650 | 759 | 166 | 538 | 219 | 381 | 349 | 734 | 627 | 623 | 440 | 392 |
| Total Emission from Industrial Processes and Product Use Sector | 30,864 | 28,434 | 30,063 | 29,285 | 25,279 | 22,647 | 24,344 | 25,045 | 24,385 | 25,292 | 23,416 | 22,524 | 21,904 | 20,553 |

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

not listed under Annex 1 shall submit the Biennial Update Report and National Communications. 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, and 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 IPCC 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 ES3.4 1990-2017 Greenhouse Gas Emissions Produced by Agriculture Sector in Taiwan

(Unit: Kilotons of Carbon Dioxide Equivalents)

| GHG Emission Source and Sinks | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Total CO ₂ Emission | 142 | 146 | 139 | 131 | 135 | 151 | 151 | 134 | 127 | 119 | 131 | 94 | 93 | 83 |
| Total CH ₄ Emission | 1,873 | 1,901 | 1,864 | 1,863 | 1,832 | 1,855 | 1,839 | 1,723 | 1,622 | 1,644 | 1,618 | 1,565 | 1,479 | 1,394 |
| 3.A Livestock Gastrointestinal Fermentation | 670 | 731 | 738 | 775 | 789 | 822 | 822 | 732 | 674 | 694 | 692 | 660 | 636 | 626 |
| 3.B Livestock Waste Treatment | 206 | 236 | 234 | 240 | 247 | 259 | 266 | 219 | 192 | 205 | 210 | 201 | 194 | 192 |
| 3.C Rice Culturing | 960 | 908 | 845 | 825 | 775 | 767 | 745 | 765 | 751 | 738 | 702 | 689 | 637 | 567 |
| 3.F Field Burning of Agricultural Residues | 38 | 25 | 48 | 22 | 21 | 7 | 7 | 7 | 6 | 7 | 14 | 15 | 13 | 9 |
| Total N ₂ O Emission | 1,897 | 1,933 | 1,866 | 1,897 | 1,883 | 1,872 | 1,907 | 1,710 | 1,609 | 1,583 | 1,794 | 1,720 | 1,729 | 1,597 |
| 3.B Livestock Waste Treatment | 48 | 50 | 52 | 54 | 59 | 61 | 67 | 70 | 71 | 72 | 73 | 71 | 70 | 71 |
| 3.D Agricultural Soil | 1,837 | 1,876 | 1,800 | 1,837 | 1,818 | 1,808 | 1,838 | 1,638 | 1,536 | 1,509 | 1,717 | 1,644 | 1,655 | 1,524 |
| 3.F Field Burning of Agricultural Residues | 12 | 8 | 15 | 7 | 7 | 2 | 2 | 2 | 2 | 2 | 4 | 5 | 4 | 3 |
| Total Emission From Agriculture Sector | 3,911 | 3,980 | 3,869 | 3,890 | 3,850 | 3,878 | 3,897 | 3,567 | 3,358 | 3,345 | 3,543 | 3,379 | 3,301 | 3,074 |
| GHG Emission Source and Sinks | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
| Total CO ₂ Emission | 84 | 62 | 60 | 58 | 57 | 56 | 54 | 53 | 55 | 45 | 40 | 38 | 34 | 31 |
| Total CH ₄ Emission | 1,320 | 1,387 | 1,368 | 1,341 | 1,299 | 1,281 | 1,274 | 1,301 | 1,300 | 1,304 | 1,286 | 1,268 | 1,283 | 1,285 |
| 3.A Livestock Gastrointestinal Fermentation | 614 | 623 | 614 | 609 | 584 | 571 | 578 | 590 | 583 | 579 | 566 | 573 | 561 | 564 |
| 3.B Livestock Waste Treatment | 193 | 195 | 195 | 185 | 180 | 175 | 176 | 180 | 172 | 166 | 164 | 163 | 164 | 164 |
| 3.C Rice Culturing | 505 | 561 | 551 | 543 | 529 | 530 | 514 | 526 | 540 | 555 | 552 | 529 | 555 | 554 |
| 3.F Field Burning of Agricultural Residues | 8 | 8 | 8 | 5 | 6 | 5 | 5 | 5 | 5 | 3 | 4 | 4 | 3 | 3 |
| Total N ₂ O Emission | 1,710 | 1,598 | 1,629 | 1,595 | 1,514 | 1,547 | 1,528 | 1,469 | 1,496 | 1,432 | 1,427 | 1,397 | 1,395 | 1,344 |
| 3.B Livestock Waste Treatment | 69 | 71 | 72 | 71 | 72 | 71 | 70 | 71 | 71 | 71 | 73 | 74 | 76 | 77 |
| 3.D Agricultural Soil | 1,639 | 1,524 | 1,554 | 1,522 | 1,440 | 1,474 | 1,456 | 1,396 | 1,424 | 1,359 | 1,353 | 1,321 | 1,318 | 1,266 |
| 3.F Field Burning of Agricultural Residues | 2 | 2 | 3 | 1 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 |
| Total Emission From Agriculture Sector | 3,114 | 3,047 | 3,056 | 2,993 | 2,870 | 2,884 | 2,856 | 2,823 | 2,851 | 2,781 | 2,753 | 2,703 | 2,712 | 2,661 |



Table ES3.5 1990-2017 Changes in Carbon Sequestration by Forestry Sector in Taiwan

(Unit: Kilotons of Carbon Dioxide Equivalents)

| Year | | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
|---|--|---------|--------------------|---------|---------|---------|---------|---------|---------|---------|--------------------|
| Forests Maintaining Forests | Biomass Carbon Sequestration (Δ CO ₂ G) | -23,902 | -23,902 | -23,713 | -23,524 | -23,335 | -23,146 | -22,957 | -22,768 | -22,579 | -22,390 |
| | Biomass Carbon Emissions (Δ CO ₂ L) | 607 | 2,503 ^a | 333 | 216 | 190 | 202 | 559 | 266 | 326 | 401 |
| Other Lands Turned to Forests | Biomass Carbon Sequestration (Δ CO ₂ G) | -91 | -91 | -136 | -185 | -233 | -288 | -319 | -397 | -446 | -561 |
| Total Carbon Sequestration (Δ CO ₂) | | -23,386 | -21,490 | -23,516 | -23,493 | -23,379 | -23,233 | -22,717 | -22,899 | -22,699 | -22,550 |
| Year | | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
| Forests Maintaining Forests | Biomass Carbon Sequestration (Δ CO ₂ G) | -22,201 | -22,012 | -21,823 | -21,633 | -21,444 | -21,255 | -21,066 | -20,877 | -20,688 | -20,499 |
| | Biomass Carbon Emissions (Δ CO ₂ L) | 389 | 1,112 ^b | 167 | 227 | 243 | 369 | 251 | 308 | 199 | 2,753 ^c |
| Other Lands Turned to Forests | Biomass Carbon Sequestration (Δ CO ₂ G) | -665 | -683 | -759 | -899 | -995 | -1,031 | -1,046 | -1,080 | -1,142 | -1,166 |
| Total Carbon Sequestration (Δ CO ₂) | | -22,476 | -21,583 | -22,415 | -22,305 | -22,196 | -21,918 | -21,861 | -21,650 | -21,631 | -18,911 |
| Year | | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | | |
| Forests Maintaining Forests | Biomass Carbon Sequestration (Δ CO ₂ G) | -20,392 | -20,409 | -20,435 | -20,473 | -20,508 | -20,546 | -20,575 | -20,612 | | |
| | Biomass Carbon Emissions (Δ CO ₂ L) | 218 | 140 | 145 | 135 | 197 | 189 | 153 | 111 | | |
| Other Lands Turned to Forests | Biomass Carbon Sequestration (Δ CO ₂ G) | -1,240 | -1,202 | -1,194 | -1,161 | -1,099 | -1,068 | -1,029 | -980 | | |
| Total Carbon Sequestration (Δ CO ₂) | | -21,413 | -21,470 | -21,484 | -21,498 | -21,410 | -21,425 | -21,451 | -21,482 | | |

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 1990-2017 Greenhouse Gas Emissions in Taiwan by Waste Sector

(Unit: Kilotons of Carbon Dioxide Equivalents)

| GHG Emission Source and Sinks | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 |
|--|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Total CO ₂ emission | 20 | 8 | 65 | 63 | 110 | 398 | 387 | 105 | 117 | 65 | 259 | 540 | 612 | 417 |
| Total CH ₄ Emission | 8,750 | 8,980 | 9,044 | 9,423 | 10,196 | 10,899 | 11,329 | 11,455 | 11,558 | 11,650 | 10,944 | 10,200 | 9,693 | 9,253 |
| 5.A Solid Waste Disposal | 5,832 | 5,917 | 5,928 | 6,323 | 7,061 | 7,719 | 8,080 | 8,213 | 8,374 | 8,606 | 8,028 | 7,309 | 6,828 | 6,321 |
| 5.B Solid Waste Biological Disposal | 11 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 2 |
| 5.D Wastewater Treatment and Discharge | 2,907 | 3,062 | 3,115 | 3,100 | 3,135 | 3,179 | 3,249 | 3,241 | 3,184 | 3,042 | 2,916 | 2,891 | 2,864 | 2,930 |
| Total N ₂ O Emission | 296 | 285 | 298 | 311 | 313 | 334 | 337 | 337 | 321 | 329 | 331 | 340 | 348 | 353 |
| 5.B Solid Waste Biological Disposal | 10 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 2 |
| 5.C Waste Burn | 1 | 0 | 4 | 3 | 6 | 18 | 19 | 4 | 6 | 3 | 8 | 30 | 26 | 24 |
| 5.D Wastewater Treatment and Discharge | 284 | 284 | 294 | 307 | 307 | 316 | 318 | 332 | 315 | 324 | 322 | 310 | 321 | 327 |
| Total Emission from Waste Sector | 11,036 | 11,255 | 11,334 | 11,727 | 12,503 | 13,229 | 13,663 | 13,788 | 13,877 | 13,978 | 13,275 | 12,541 | 12,043 | 11,608 |
| GHG Emission Source and Sinks | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
| Total CO ₂ emission | 512 | 348 | 470 | 562 | 443 | 154 | 208 | 149 | 149 | 153 | 146 | 103 | 132 | 120 |
| Total CH ₄ Emission | 8,601 | 8,054 | 7,434 | 6,956 | 6,328 | 5,741 | 5,180 | 4,762 | 4,425 | 4,030 | 3,855 | 3,645 | 3,588 | 3,481 |
| 5.A Solid Waste Disposal | 5,776 | 5,229 | 4,665 | 4,143 | 3,607 | 3,071 | 2,601 | 2,225 | 1,889 | 1,597 | 1,351 | 1,141 | 970 | 834 |
| 5.B Solid Waste Biological Disposal | 7 | 10 | 11 | 14 | 16 | 18 | 21 | 26 | 24 | 23 | 20 | 20 | 20 | 20 |
| 5.D Wastewater Treatment and Discharge | 2,819 | 2,815 | 2,758 | 2,798 | 2,704 | 2,652 | 2,558 | 2,511 | 2,511 | 2,410 | 2,484 | 2,484 | 2,599 | 2,627 |
| Total N ₂ O Emission | 343 | 350 | 318 | 328 | 300 | 295 | 302 | 314 | 313 | 323 | 332 | 342 | 330 | 377 |
| 5.B Solid Waste Biological Disposal | 6 | 9 | 10 | 13 | 15 | 16 | 19 | 23 | 22 | 20 | 18 | 18 | 18 | 18 |
| 5.C Waste Burn | 23 | 27 | 30 | 30 | 21 | 9 | 11 | 9 | 9 | 9 | 9 | 6 | 7 | 6 |
| 5.D Wastewater Treatment and Discharge | 314 | 314 | 278 | 285 | 264 | 270 | 273 | 282 | 282 | 294 | 305 | 318 | 306 | 352 |
| Total Emission from Waste Sector | 10,948 | 10,409 | 9,758 | 9,291 | 8,636 | 8,044 | 7,492 | 7,087 | 6,749 | 6,366 | 6,201 | 6,002 | 5,935 | 5,875 |

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