

# 2023 TAIWAN

REPUBLIC OF CHINA

## NATIONAL GREENHOUSE GAS

INVENTORY REPORT Report Summary



August, 2023

# 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 UNFCCC<sup>1</sup> 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 2021. 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 (excluding land use, land use change and forestry, the following report abbreviated as LULUCF) had decreased by 290,551 kilotons of carbon dioxide equivalents from 285,071 kilotons of carbon dioxide equivalents in 2005 to 2020, with 1.89% reduction in emissions; due to the economic recovery affected by the epidemic, it rebounded slightly to 297,007 kilotons of carbon dioxide equivalents in 2021, an increase of 2.22% over 2005 with an average annual growth rate of 0.14%. To further analyze the composition of total GHG emissions in 2021, the proportion of carbon dioxide emissions is 95.32%, an increase of 4.22% over the previous year, and that of non-carbon dioxide is 4.68%, which was also an increase of 3.51% over last year, as shown in Figure ES2.1.

Further comparison of statistics on various greenhouse gas emissions shows that carbon dioxide accounts for the majority of greenhouse gas emissions (excluding LULUCF) in Taiwan in 2005, accounting for 91.71%, followed by methane (3.27%), nitrous oxide (1.48%), and fluorinated greenhouse gas (3.54%); however, carbon dioxide was still the largest of proportion (95.32%) in 2021, followed by methane (1.82%), nitrous oxide (1.50%), and then fluorinated greenhouse gas (1.36%), as shown in Figure ES2.2.

Between 2005 and 2021, carbon dioxide emissions grew by 6.25% with an average annual growth rate of 0.38%; carbon dioxide sequestration decreased by 1.97%

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

with a negative average annual growth rate of  $-0.12\%$ ; methane emissions decreased by  $53.16\%$  with a negative average annual growth rate of  $-4.63\%$ ; nitrous oxide emissions increased by  $25.89\%$  with an annual growth rate of  $1.45\%$ ; fluorinated greenhouse gas emissions decreased by  $60.83\%$  with a negative average annual growth rate of  $-5.69\%$ , as shown in Figure ES2.3 and Table ES2.1.

### 1. Carbon Dioxide Emissions

The energy sector, industrial process and product use (IPPU) sector, agriculture sector, and waste sector are the main emission sources of carbon dioxide in Taiwan, as shown in Table ES2.2. In 2005, Taiwan's carbon dioxide emissions amounted to 266,460 kilotons of carbon dioxide equivalents. In 2021, that figure was 283,114 kilotons of

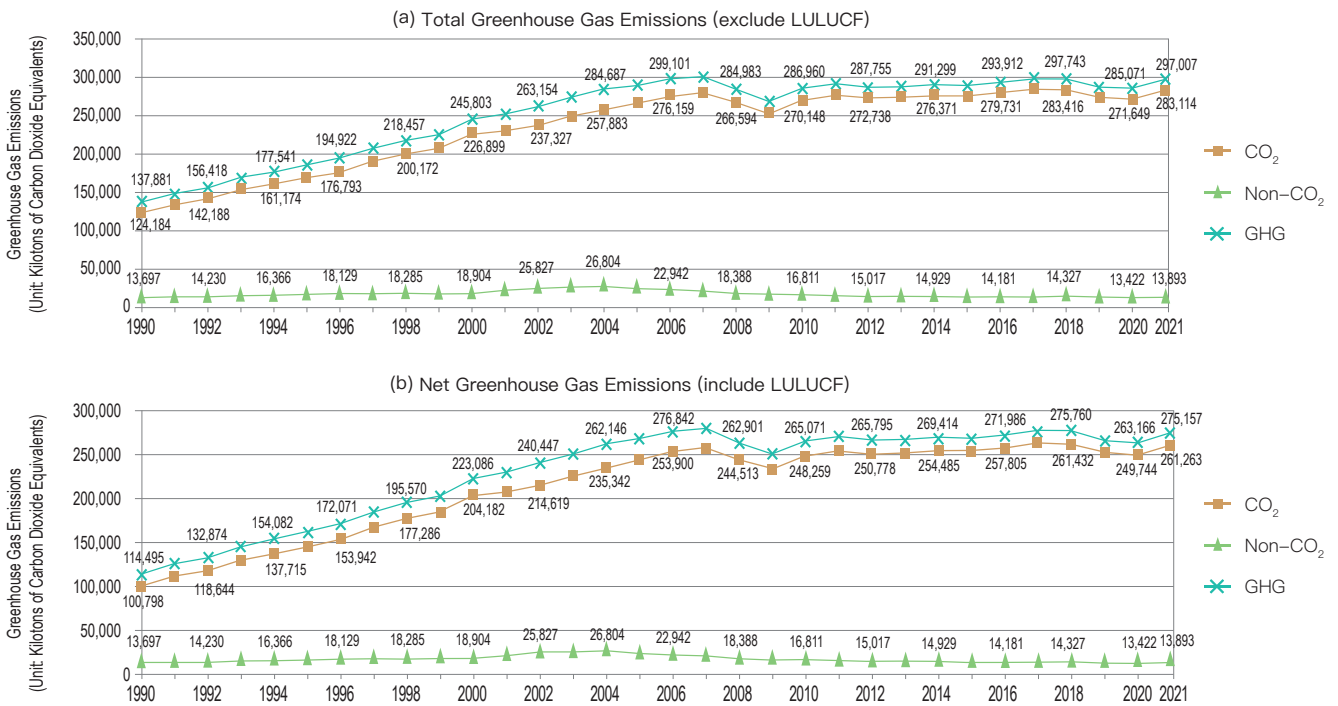


Figure ES2.1 1990–2021 Trends in Total Greenhouse Gas Emissions and Sequestration in Taiwan : (a) Emissions exclude LULUCF ; (b) Emissions include LULUCF

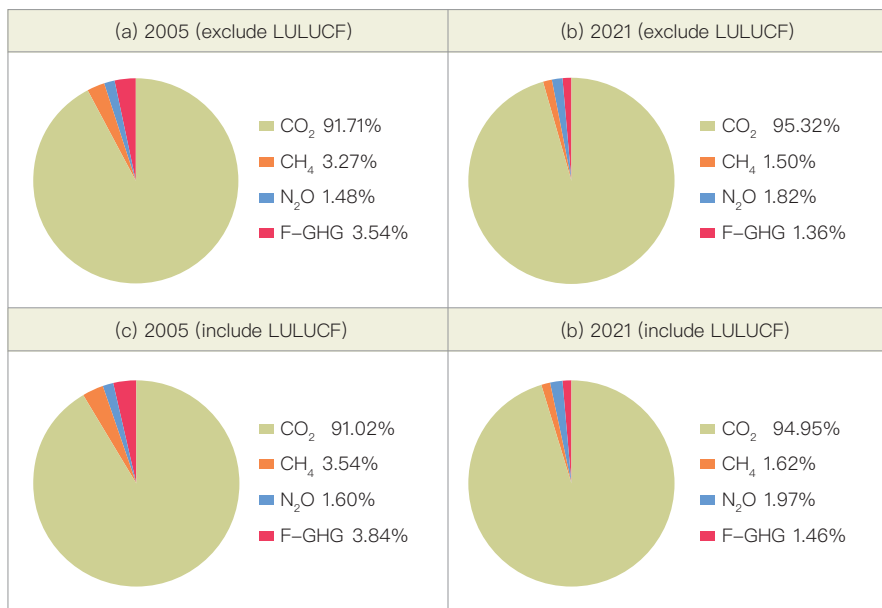


Figure ES2.2 Percentage of Various Types of Greenhouse Gas Emissions in Taiwan: (a).2005(exclude LULUCF);(b).2021(exclude LULUCF); (c).2005(include LULUCF);(d).2021(include LULUCF).

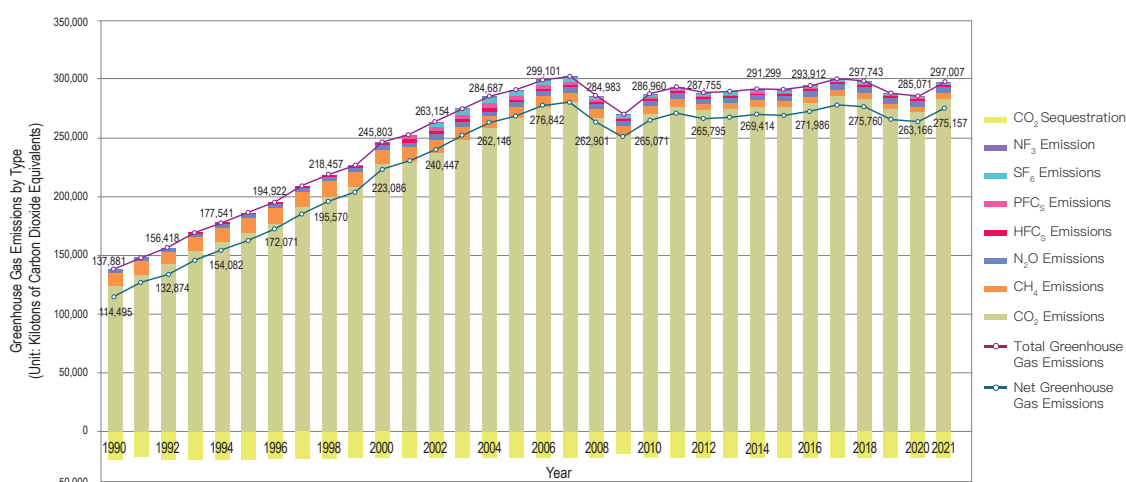


Figure ES2.3 1990–2021 Trends in Total Greenhouse Gas Emissions and Sequestration by Type in Taiwan

Table ES2.1 1990–2021 Greenhouse Gas Emissions and Sequestration in Taiwan by Type

(Unit: Kilotons of Carbon Dioxide Equivalents)

| GHG                                   | GWP                  | 1990    | 1991    | 1992    | 1993    | 1994    | 1995    | 1996    | 1997    | 1998    | 1999    | 2000    |
|---------------------------------------|----------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| CO <sub>2</sub>                       | 1                    | 124,184 | 133,604 | 142,188 | 153,808 | 161,174 | 168,887 | 176,793 | 190,557 | 200,172 | 207,809 | 226,899 |
| CH <sub>4</sub>                       | 25                   | 10,705  | 11,030  | 10,977  | 11,383  | 12,141  | 12,899  | 13,291  | 13,001  | 12,899  | 13,188  | 12,556  |
| N <sub>2</sub> O                      | 298                  | 2,992   | 3,262   | 3,253   | 3,324   | 3,371   | 3,447   | 3,533   | 3,376   | 3,303   | 3,273   | 3,886   |
| HFCs                                  | HFC–134a(1,430) etc. | NE      | NE      | NE      | 755     | 855     | 801     | 1,305   | 1,477   | 2,083   | 1,609   | 2,319   |
| PFCs                                  | PFC–14(7,390) etc.   | NE      | NE      | NE      | NE      | NE      | NE      | NE      | NE      | NE      | 3       | 13      |
| SF <sub>6</sub>                       | 22,800               | NE      | NE      | NE      | NE      | NE      | NE      | NE      | NE      | NE      | 116     | 120     |
| NF <sub>3</sub>                       | 17,200               | NE      | NE      | NE      | NE      | NE      | NE      | NE      | NE      | NE      | 11      | 10      |
| CO <sub>2</sub> Sequestration         | 1                    | -23,386 | -21,490 | -23,544 | -23,546 | -23,459 | -23,340 | -22,851 | -23,060 | -22,887 | -22,764 | -22,717 |
| Net GHG Emission (including LULUCF)   |                      |         | 126,406 | 132,874 | 145,723 | 154,082 | 162,696 | 172,071 | 185,351 | 195,570 | 203,245 | 223,086 |
| Total GHG Emission (excluding LULUCF) |                      |         | 147,896 | 156,418 | 169,269 | 177,541 | 186,035 | 194,922 | 208,411 | 218,457 | 226,009 | 245,803 |
| GHG                                   | GWP                  | 2001    | 2002    | 2003    | 2004    | 2005    | 2006    | 2007    | 2008    | 2009    | 2010    | 2011    |
| CO <sub>2</sub>                       | 1                    | 229,777 | 237,327 | 248,248 | 257,883 | 266,460 | 276,159 | 279,800 | 266,594 | 252,506 | 270,148 | 276,282 |
| CH <sub>4</sub>                       | 25                   | 11,734  | 11,128  | 10,606  | 9,969   | 9,508   | 8,886   | 8,318   | 7,659   | 7,044   | 6,570   | 6,226   |
| N <sub>2</sub> O                      | 298                  | 3,937   | 4,029   | 4,045   | 4,191   | 4,299   | 4,831   | 4,871   | 4,456   | 4,620   | 5,024   | 4,925   |
| HFCs                                  | HFC–134a(1,430) etc. | 2,619   | 2,216   | 2,397   | 2,451   | 1,098   | 1,015   | 1,122   | 1,074   | 1,018   | 971     | 1,053   |
| PFCs                                  | PFC–14(7,390) etc.   | 2,939   | 4,143   | 4,198   | 4,341   | 3,470   | 3,664   | 3,372   | 2,082   | 1,560   | 1,770   | 1,781   |
| SF <sub>6</sub>                       | 22,800               | 746     | 3,914   | 4,385   | 5,193   | 4,951   | 3,858   | 3,381   | 2,912   | 2,452   | 2,218   | 1,918   |
| NF <sub>3</sub>                       | 17,200               | 235     | 398     | 540     | 659     | 765     | 688     | 798     | 204     | 577     | 258     | 420     |
| CO <sub>2</sub> Sequestration         | 1                    | -21,850 | -22,707 | -22,624 | -22,542 | -22,290 | -22,259 | -22,074 | -22,082 | -19,388 | -21,889 | -21,947 |
| Net GHG Emission (including LULUCF)   |                      |         | 240,447 | 251,795 | 262,146 | 268,261 | 276,842 | 279,590 | 262,901 | 250,389 | 265,071 | 270,658 |
| Total GHG Emission (excluding LULUCF) |                      |         | 263,154 | 274,419 | 284,687 | 290,551 | 299,101 | 301,663 | 284,983 | 269,777 | 286,960 | 292,605 |
| GHG                                   | GWP                  | 2012    | 2013    | 2014    | 2015    | 2016    | 2017    | 2018    | 2019    | 2020    | 2021    |         |
| CO <sub>2</sub>                       | 1                    | 272,738 | 273,873 | 276,371 | 275,867 | 279,731 | 285,247 | 283,416 | 273,955 | 271,649 | 283,114 |         |
| CH <sub>4</sub>                       | 25                   | 5,890   | 5,547   | 5,305   | 5,105   | 5,032   | 4,922   | 4,891   | 4,775   | 4,618   | 4,453   |         |
| N <sub>2</sub> O                      | 298                  | 4,839   | 4,642   | 4,623   | 4,591   | 4,793   | 5,001   | 5,076   | 4,903   | 4,899   | 5,412   |         |
| HFCs                                  | HFC–134a(1,430) etc. | 907     | 1,019   | 1,048   | 1,020   | 1,026   | 1,023   | 1,013   | 1,027   | 1,053   | 1,106   |         |
| PFCs                                  | PFC–14(7,390) etc.   | 1,141   | 1,345   | 1,556   | 1,347   | 1,441   | 1,409   | 1,536   | 1,420   | 1,447   | 1,472   |         |
| SF <sub>6</sub>                       | 22,800               | 1,852   | 1,997   | 1,730   | 1,523   | 1,418   | 1,416   | 1,302   | 935     | 842     | 857     |         |
| NF <sub>3</sub>                       | 17,200               | 388     | 773     | 667     | 662     | 472     | 440     | 509     | 473     | 564     | 594     |         |
| CO <sub>2</sub> Sequestration         | 1                    | -21,960 | -21,974 | -21,886 | -21,900 | -21,926 | -21,961 | -21,984 | -21,917 | -21,905 | -21,850 |         |
| Net GHG Emission (including LULUCF)   |                      | 265,795 | 267,222 | 269,414 | 268,215 | 271,986 | 277,497 | 275,760 | 265,571 | 263,166 | 275,157 |         |
| Total GHG Emission (excluding LULUCF) |                      | 287,755 | 289,196 | 291,299 | 290,115 | 293,912 | 299,458 | 297,743 | 287,488 | 285,071 | 297,007 |         |

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.

carbon dioxide equivalents, with an 6.25% increase and an average annual growth rate of 0.38%. In 2021, carbon dioxide emissions accounted for 95.32% of total GHG emissions. The energy sector accounted for 94.31%, the industrial process and product use (IPPU) sector 5.51%, the waste sector 0.18%, and the agriculture sector 0.01%. Compared with 2020, the emissions in 2021 increased by 4.22% mainly because of the 3.73% increase in the energy sector, the 11.87% increase in the IPPU sector,

the 9.72% decrease in the agriculture sector, the 0.25% decrease in the LULUCF sector and the 67.95% increase in the waste sector.

## 2. Methane Emissions

Methane emissions in Taiwan mainly come from the agriculture sector, waste sector, and energy sector, as shown in Table ES2.3. In 2005, the total methane emission in Taiwan was 9,508 kilotons of carbon dioxide equivalents.

Table ES2.2 1990–2021 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    |
|---|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| <b>1. Energy Sector</b>                                 | 109,465 | 118,443 | 126,058 | 135,206 | 143,103 | 150,810 | 158,579 | 170,835 | 181,518 | 190,446 | 209,122 |
| 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 |
| 1.A.2 Manufacturing and Construction Industry           | 30,124  | 31,963  | 33,389  | 33,618  | 34,592  | 35,769  | 36,791  | 39,084  | 39,321  | 41,314  | 43,850  |
| 1.A.3 Transportation                                    | 19,646  | 20,888  | 24,033  | 26,103  | 27,540  | 28,822  | 29,801  | 30,536  | 31,844  | 32,772  | 33,207  |
| 1.A.4 Other Sectors                                     | 10,572  | 10,466  | 10,107  | 9,523   | 10,200  | 9,819   | 10,733  | 9,808   | 9,939   | 10,579  | 10,922  |
| 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   |
| 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   |
| 1.A.4.c Agriculture, Forestry, Fishery, and Husbandry   | 2,946   | 2,700   | 2,672   | 2,675   | 2,721   | 2,777   | 2,805   | 2,475   | 2,041   | 2,040   | 2,362   |
| <b>2. Industrial Process and Product Use Sector</b>     | 14,557  | 15,007  | 15,926  | 18,408  | 17,826  | 17,528  | 17,677  | 19,483  | 18,410  | 17,179  | 17,388  |
| 2.A Mining Industry (Non-metal Process)                 | 10,683  | 10,698  | 11,854  | 13,879  | 13,259  | 12,766  | 12,645  | 13,394  | 11,564  | 10,746  | 10,486  |
| 2.B Chemical Industry                                   | 575     | 551     | 575     | 617     | 770     | 858     | 999     | 1,026   | 1,007   | 1,079   | 1,148   |
| 2.C Metal Process                                       | 3,275   | 3,735   | 3,474   | 3,888   | 3,774   | 3,884   | 4,013   | 5,045   | 5,817   | 5,333   | 5,734   |
| 2.D Non-Energy Products from Fuels and Solvent Use      | 0.00006 | 0.00006 | 0.00006 | 0.00007 | 0.00009 | 0.00008 | 0.00008 | 0.00008 | 0.00009 | 0.00009 | 0.00008 |
| 2.H Others  | 23      | 23      | 23      | 24      | 23      | 21      | 20      | 19      | 22      | 21      | 20      |
| <b>3. Agriculture Sector</b>                            | 142     | 146     | 139     | 131     | 135     | 151     | 151     | 134     | 127     | 118     | 131     |
| <b>4. Land Use, Land Use Change and Forestry Sector</b> | -23,386 | -21,490 | -23,544 | -23,546 | -23,459 | -23,340 | -22,851 | -23,060 | -22,887 | -22,764 | -22,717 |
| <b>5. Waste Sector</b>                                  | 20      | 8       | 65      | 63      | 110     | 398     | 387     | 105     | 117     | 65      | 259     |
| Net GHG Emission (including LULUCF)                     | 100,798 | 112,114 | 118,644 | 130,261 | 137,715 | 145,548 | 153,942 | 167,497 | 177,286 | 185,045 | 204,182 |
| Total GHG Emission (excluding LULUCF)                   | 124,184 | 133,604 | 142,188 | 153,808 | 161,174 | 168,887 | 176,793 | 190,557 | 200,172 | 207,809 | 226,899 |
| GHG Emission Source and Sinks                           | 2001    | 2002    | 2003    | 2004    | 2005    | 2006    | 2007    | 2008    | 2009    | 2010    | 2011    |
| <b>1. Energy Sector</b>                                 | 212,957 | 220,546 | 230,607 | 239,929 | 247,956 | 255,331 | 259,214 | 247,536 | 235,868 | 251,708 | 257,096 |
| 1.A.1 Energy Industry                                   | 126,142 | 130,463 | 141,730 | 148,677 | 156,351 | 163,615 | 170,131 | 164,432 | 155,166 | 165,522 | 169,884 |
| 1.A.2 Manufacturing and Construction Industry           | 42,395  | 44,489  | 42,563  | 43,163  | 42,671  | 43,994  | 43,293  | 39,104  | 36,698  | 41,360  | 42,298  |
| 1.A.3 Transportation                                    | 33,246  | 34,542  | 34,509  | 35,859  | 36,846  | 36,771  | 35,419  | 33,216  | 33,541  | 34,652  | 35,107  |
| 1.A.4 Other Sectors                                     | 11,174  | 11,052  | 11,806  | 12,230  | 12,089  | 10,952  | 10,370  | 10,785  | 10,463  | 10,174  | 9,807   |
| 1.A.4.a Service Industry                                | 3,538   | 3,487   | 3,952   | 4,120   | 4,227   | 4,272   | 4,232   | 4,226   | 4,264   | 4,204   | 3,898   |
| 1.A.4.b Residential                                     | 5,181   | 5,107   | 5,042   | 5,133   | 5,235   | 5,033   | 5,047   | 5,017   | 5,030   | 4,857   | 4,786   |
| 1.A.4.c Agriculture, Forestry, Fishery, and Husbandry   | 2,455   | 2,459   | 2,811   | 2,977   | 2,627   | 1,647   | 1,091   | 1,543   | 1,169   | 1,113   | 1,123   |
| <b>2. Industrial Process and Product Use Sector</b>     | 16,186  | 16,075  | 17,141  | 17,358  | 18,094  | 20,299  | 19,967  | 18,558  | 16,428  | 18,178  | 18,985  |
| 2.A Mining Industry (Non-metal Process)                 | 9,974   | 10,648  | 10,341  | 10,691  | 11,257  | 11,014  | 10,369  | 9,289   | 8,467   | 8,616   | 9,577   |
| 2.B Chemical Industry                                   | 1,232   | 1,313   | 1,384   | 1,485   | 1,751   | 1,721   | 1,845   | 1,601   | 1,623   | 1,750   | 1,768   |
| 2.C Metal Process                                       | 4,960   | 4,096   | 5,397   | 5,162   | 5,066   | 7,544   | 7,733   | 7,648   | 6,317   | 7,792   | 7,620   |
| 2.D Non-Energy Products from Fuels and Solvent Use      | 0.00007 | 0.00008 | 0.00009 | 0.00011 | 0.00010 | 0.00007 | 0.00007 | 0.00007 | 0.00006 | 0.00005 | 0.00004 |
| 2.H Others  | 20      | 18      | 18      | 19      | 20      | 21      | 20      | 20      | 21      | 20      | 20      |
| <b>3. Agriculture Sector</b>                            | 94      | 93      | 82      | 84      | 62      | 59      | 57      | 57      | 55      | 54      | 53      |
| <b>4. Land Use, Land Use Change and Forestry Sector</b> | -21,850 | -22,707 | -22,624 | -22,542 | -22,290 | -22,259 | -22,074 | -22,082 | -19,388 | -21,889 | -21,947 |
| <b>5. Waste Sector</b>                                  | 540     | 612     | 418     | 512     | 348     | 470     | 562     | 443     | 154     | 208     | 149     |
| Net GHG Emission (including LULUCF)                     | 207,927 | 214,619 | 225,624 | 235,342 | 244,170 | 253,900 | 257,726 | 244,513 | 233,118 | 248,259 | 254,335 |
| Total GHG Emission (excluding LULUCF)                   | 229,777 | 237,327 | 248,248 | 257,883 | 266,460 | 276,159 | 279,800 | 266,594 | 252,506 | 270,148 | 276,282 |

Continued from the table below



Continued from the above table

| GHG Emission Source and Sinks                           | 2012    | 2013    | 2014    | 2015    | 2016    | 2017    | 2018    | 2019    | 2020    | 2021    |
|---|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| <b>1. Energy Sector</b>                                 | 253,166 | 254,070 | 258,481 | 258,476 | 262,982 | 269,462 | 267,208 | 258,821 | 257,381 | 266,991 |
| 1.A.1 Energy Industry                                   | 168,333 | 168,271 | 175,180 | 175,198 | 178,569 | 187,135 | 189,212 | 181,334 | 180,502 | 189,455 |
| 1.A.2 Manufacturing and Construction Industry           | 40,983  | 42,019  | 38,953  | 38,074  | 38,296  | 36,741  | 33,480  | 32,726  | 31,722  | 34,334  |
| 1.A.3 Transportation                                    | 34,284  | 34,209  | 34,666  | 35,506  | 36,584  | 36,202  | 35,207  | 35,443  | 35,727  | 33,917  |
| 1.A.4 Other Sectors                                     | 9,566   | 9,571   | 9,681   | 9,698   | 9,533   | 9,384   | 9,310   | 9,318   | 9,430   | 9,285   |
| 1.A.4.a Service Industry                                | 3,635   | 3,812   | 3,928   | 3,941   | 3,720   | 3,779   | 3,317   | 3,337   | 3,499   | 3,469   |
| 1.A.4.b Residential                                     | 4,672   | 4,484   | 4,411   | 4,469   | 4,537   | 4,402   | 4,480   | 4,467   | 4,605   | 4,501   |
| 1.A.4.c Agriculture, Forestry, Fishery, and Husbandry   | 1,259   | 1,274   | 1,343   | 1,287   | 1,276   | 1,203   | 1,512   | 1,514   | 1,326   | 1,315   |
| <b>2. Industrial Process and Product Use Sector</b>     | 19,369  | 19,605  | 17,704  | 17,251  | 16,583  | 15,625  | 16,019  | 14,890  | 13,942  | 15,597  |
| 2.A Mining Industry (Non-metal Process)                 | 9,333   | 9,866   | 8,728   | 8,345   | 7,108   | 6,262   | 6,403   | 6,501   | 6,504   | 6,762   |
| 2.B Chemical Industry                                   | 1,714   | 1,749   | 1,884   | 1,842   | 1,760   | 1,709   | 1,684   | 1,666   | 1,550   | 1,730   |
| 2.C Metal Process                                       | 8,301   | 7,970   | 7,072   | 7,044   | 7,696   | 7,634   | 7,913   | 6,706   | 5,870   | 7,090   |
| 2.D Non-Energy Products from Fuels and Solvent Use      | 0.00004 | 0.00005 | 0.00006 | 0.00010 | 0.00008 | 0.00007 | 0.00006 | 0.00006 | 0.00006 | 0.00007 |
| 2.H Others  | 21      | 19      | 19      | 20      | 19      | 20      | 19      | 17      | 18      | 15      |
| <b>3. Agriculture Sector</b>                            | 55      | 45      | 40      | 38      | 34      | 31      | 30      | 29      | 29      | 27      |
| <b>4. Land Use, Land Use Change and Forestry Sector</b> | -21,960 | -21,974 | -21,886 | -21,900 | -21,926 | -21,961 | -21,984 | -21,917 | -21,905 | -21,850 |
| <b>5. Waste Sector</b>                                  | 149     | 153     | 146     | 103     | 132     | 129     | 159     | 214     | 297     | 499     |
| Net GHG Emission (including LULUCF)                     | 250,778 | 251,899 | 254,485 | 253,967 | 257,805 | 263,286 | 261,432 | 252,038 | 249,744 | 261,263 |
| Total GHG Emission (excluding LULUCF)                   | 272,738 | 273,873 | 276,371 | 275,867 | 279,731 | 285,247 | 283,416 | 273,955 | 271,649 | 283,114 |

Table ES2.3 1990–2021 Methane Emissions in Taiwan

(Unit: Kilotons of Carbon Dioxide Equivalents)

| GHG Emission Sources and Sinks                      | 1990          | 1991          | 1992          | 1993          | 1994          | 1995          | 1996          | 1997          | 1998          | 1999          | 2000          |
|---|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| <b>1. Energy Sector</b>                             | 530           | 506           | 497           | 511           | 526           | 533           | 520           | 514           | 535           | 561           | 574           |
| <b>2. Industrial Process and Product Use Sector</b> | 5             | 7             | 6             | 7             | 8             | 10            | 11            | 12            | 10            | 12            | 14            |
| <b>3. Agriculture Sector</b>                        | 2,914         | 3,100         | 3,018         | 3,025         | 3,012         | 3,079         | 3,085         | 2,672         | 2,421         | 2,517         | 2,511         |
| 3.A Livestock Gastrointestinal Fermentation         | 670           | 731           | 738           | 775           | 789           | 822           | 822           | 732           | 674           | 694           | 692           |
| 3.B Livestock Waste Treatment                       | 1,112         | 1,304         | 1,266         | 1,282         | 1,312         | 1,371         | 1,398         | 1,062         | 884           | 971           | 1,003         |
| 3.C Rice Culturing                                  | 1,094         | 1,040         | 968           | 946           | 891           | 879           | 858           | 871           | 858           | 845           | 802           |
| 3.F Field Burning of Agricultural Residues          | 38            | 25            | 48            | 22            | 21            | 7             | 7             | 7             | 6             | 7             | 14            |
| <b>5. Waste Sector</b>                              | 7,257         | 7,416         | 7,455         | 7,839         | 8,595         | 9,277         | 9,675         | 9,803         | 9,933         | 10,098        | 9,457         |
| 5.A Garbage Landfill                                | 5,833         | 5,919         | 5,930         | 6,325         | 7,063         | 7,721         | 8,082         | 8,215         | 8,376         | 8,608         | 8,030         |
| 5.B Garbage Biological Treatment                    | 11            | 1             | 1             | 0.5           | 0.1           | 1             | 0.3           | 1             | 0.05          | 2             | 0.3           |
| 5.D Wastewater Treatment and Discharge              | 1,412         | 1,497         | 1,525         | 1,514         | 1,532         | 1,555         | 1,593         | 1,587         | 1,557         | 1,488         | 1,427         |
| 5.D.1 Domestic Wastewater Treatment and discharge   | 1,001         | 1,011         | 1,020         | 1,029         | 1,038         | 1,046         | 1,053         | 1,059         | 1,051         | 1,000         | 957           |
| 5.D.2 Industrial Wastewater Treatment and discharge | 411           | 486           | 504           | 485           | 494           | 509           | 541           | 527           | 505           | 488           | 470           |
| <b>Total Methane Emissions</b>                      | <b>10,705</b> | <b>11,030</b> | <b>10,977</b> | <b>11,383</b> | <b>12,141</b> | <b>12,899</b> | <b>13,291</b> | <b>13,001</b> | <b>12,899</b> | <b>13,188</b> | <b>12,556</b> |
| GHG Emission Sources and Sinks                      | 2001          | 2002          | 2003          | 2004          | 2005          | 2006          | 2007          | 2008          | 2009          | 2010          | 2011          |
| <b>1. Energy Sector</b>                             | 565           | 584           | 629           | 661           | 631           | 625           | 622           | 604           | 597           | 631           | 654           |
| <b>2. Industrial Process and Product Use Sector</b> | 18            | 19            | 22            | 28            | 18            | 22            | 28            | 27            | 21            | 23            | 15            |
| <b>3. Agriculture Sector</b>                        | 2,425         | 2,290         | 2,188         | 2,110         | 2,228         | 2,197         | 2,116         | 2,056         | 2,006         | 2,003         | 2,034         |
| 3.A Livestock Gastrointestinal Fermentation         | 660           | 636           | 626           | 614           | 623           | 614           | 609           | 584           | 571           | 578           | 590           |
| 3.B Livestock Waste Treatment                       | 959           | 913           | 909           | 915           | 957           | 945           | 888           | 861           | 825           | 831           | 843           |
| 3.C Rice Culturing                                  | 792           | 729           | 644           | 574           | 640           | 630           | 616           | 604           | 605           | 589           | 596           |
| 3.F Field Burning of Agricultural Residues          | 15            | 13            | 9             | 8             | 8             | 8             | 5             | 6             | 5             | 5             | 5             |
| <b>5. Waste Sector</b>                              | 8,726         | 8,235         | 7,767         | 7,171         | 6,631         | 6,042         | 5,553         | 4,972         | 4,420         | 3,913         | 3,523         |
| 5.A Garbage Landfill                                | 7,311         | 6,830         | 6,322         | 5,777         | 5,231         | 4,666         | 4,144         | 3,608         | 3,072         | 2,601         | 2,226         |
| 5.B Garbage Biological Treatment                    | 0.02          | 0.4           | 2             | 7             | 10            | 11            | 14            | 16            | 18            | 21            | 26            |
| 5.D Wastewater Treatment and Discharge              | 1,416         | 1,404         | 1,443         | 1,387         | 1,391         | 1,365         | 1,395         | 1,348         | 1,330         | 1,290         | 1,271         |
| 5.D.1 Domestic Wastewater Treatment and discharge   | 945           | 929           | 920           | 892           | 865           | 838           | 805           | 779           | 755           | 740           | 706           |
| 5.D.2 Industrial Wastewater Treatment and discharge | 471           | 475           | 523           | 495           | 526           | 527           | 589           | 569           | 575           | 551           | 565           |
| <b>Total Methane Emissions</b>                      | <b>11,734</b> | <b>11,128</b> | <b>10,606</b> | <b>9,969</b>  | <b>9,508</b>  | <b>8,886</b>  | <b>8,318</b>  | <b>7,659</b>  | <b>7,044</b>  | <b>6,570</b>  | <b>6,226</b>  |

Continued from the table below

Continued from the above table

| GHG Emission Sources and Sinks                      | 2012         | 2013         | 2014         | 2015         | 2016         | 2017         | 2018         | 2019         | 2020         | 2021         |
|---|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| <b>1. Energy Sector</b>                             | 663          | 676          | 686          | 710          | 730          | 738          | 721          | 717          | 731          | 735          |
| <b>2. Industrial Process and Product Use Sector</b> | 23           | 25           | 26           | 26           | 27           | 24           | 27           | 26           | 25           | 26           |
| <b>3. Agriculture Sector</b>                        | 2,010        | 1,997        | 1,947        | 1,927        | 1,933        | 1,932        | 1,932        | 1,942        | 1,938        | 1,883        |
| 3.A Livestock Gastrointestinal Fermentation         | 583          | 579          | 566          | 573          | 561          | 564          | 572          | 575          | 580          | 593          |
| 3.B Livestock Waste Treatment                       | 807          | 781          | 750          | 744          | 740          | 738          | 743          | 754          | 755          | 752          |
| 3.C Rice Culturing                                  | 614          | 634          | 626          | 605          | 629          | 626          | 615          | 611          | 602          | 537          |
| 3.F Field Burning of Agricultural Residues          | 5            | 3            | 4            | 5            | 3            | 3            | 2            | 2            | 1            | 1            |
| <b>5. Waste Sector</b>                              | 3,194        | 2,849        | 2,647        | 2,442        | 2,342        | 2,228        | 2,211        | 2,091        | 1,925        | 1,808        |
| 5.A Garbage Landfill                                | 1,890        | 1,598        | 1,351        | 1,141        | 970          | 835          | 723          | 645          | 596          | 544          |
| 5.B Garbage Biological Treatment                    | 24           | 23           | 20           | 20           | 20           | 20           | 23           | 25           | 26           | 26           |
| 5.D Wastewater Treatment and Discharge              | 1,279        | 1,228        | 1,275        | 1,281        | 1,352        | 1,373        | 1,465        | 1,421        | 1,303        | 1,238        |
| 5.D.1 Domestic Wastewater Treatment and discharge   | 673          | 651          | 631          | 606          | 583          | 551          | 526          | 481          | 452          | 420          |
| 5.D.2 Industrial Wastewater Treatment and discharge | 607          | 578          | 644          | 674          | 768          | 821          | 940          | 941          | 851          | 818          |
| <b>Total Methane Emissions</b>                      | <b>5,890</b> | <b>5,547</b> | <b>5,305</b> | <b>5,105</b> | <b>5,032</b> | <b>4,922</b> | <b>4,891</b> | <b>4,775</b> | <b>4,618</b> | <b>4,453</b> |

In 2021, the total methane emission was 4,453 kilotons of carbon dioxide equivalents, down by 53.16% compared with 2005, with a negative average annual growth rate of -4.63%. In 2021, methane emissions accounted for 1.50% of the total GHG emissions. In particular, the agriculture sector was the largest source of methane emissions, which accounted for 42.29%, followed by the waste sector (40.61%), energy sector (16.51%), and IPPU sector (0.59%).

Compared to 2020, the methane emission in 2021 was down by 3.57%, with the waste sector down by 6.04%, the agriculture sector down by 2.82%, the IPPU sector up by 4.74%, and the energy sector up by 0.66%.

### 3. Nitrous oxide emissions

Nitrous oxide emissions in Taiwan are mainly from the IPPU sector, the agriculture sector, and energy sector with minor emissions from the waste sector, as shown in Table ES2.4. In 2005, the total nitrous oxide emission in Taiwan was 4,299 kilotons of carbon dioxide equivalents. In 2021, the total nitrous oxide emission was 5,412 kilotons of carbon dioxide equivalents, up by 25.89% with an average growth rate of 1.45%. In 2021, nitrous oxide emissions accounted for 1.82% of the total GHG emissions. In particular, the IPPU sector accounted for 46.28%, followed by the agriculture sector (24.42%), the energy sector (22.43%), and the waste sector (6.87%).

Compared to 2020, the nitrous oxide emission in 2021 grew by 10.48%, with the energy sector down by 0.48%, the IPPU sector up by 30.31%, the agriculture sector down by 3.90%, and the waste sector down by 2.54%.

### 4. Fluoride-Containing Gas Emissions

In Taiwan, the majority of fluorinated greenhouse gases come from industries critical to economic development, namely the semiconductor, optoelectronics, power facilities, and magnesium alloy industries, all of which are emission-heavy industries. The fluorinated greenhouse gas emissions are shown in Table ES2.5. In particular, Taiwan's hydrofluorocarbons (HFCs) emission increased from 755 kilotons of carbon dioxide equivalents in 1993 to 1,106 kilotons of carbon dioxide equivalents in 2021. The perfluorocarbons (PFCs) emission increased from 3 kilotons of carbon dioxide equivalents in 1999 to 1,472 kilotons of carbon dioxide equivalents in 2021, while the sulfur hexafluoride (SF<sub>6</sub>) emission increased from 116 kilotons of carbon dioxide equivalents in 1999 to 857 kilotons of carbon dioxide equivalents in 2021. The nitrogen trifluoride (NF<sub>3</sub>) emission increased from 11 kilotons of carbon dioxide equivalents in 1999 to 594 kilotons of carbon dioxide equivalents in 2021.

For the total emission of fluorinated greenhouse gases, it decreased from 10,284 kilotons of carbon dioxide equivalents in 2005 (about 3.54% of the total greenhouse gas emissions in 2005) to 4,028 kilotons of carbon dioxide equivalents in 2021 (about 1.36% of the total greenhouse gas emissions in 2021), down by 60.83% with a negative average annual growth rate of -5.69%. Compared to 2020, the emission in 2021 increased by 3.14%.



Table ES2.4 1990–2021 Nitrous Oxide Emissions in Taiwan

(Unit: Kilotons of Carbon Dioxide Equivalents)

| GHG Emission Sources and Sinks                      | 1990         | 1991         | 1992         | 1993         | 1994         | 1995         | 1996         | 1997         | 1998         | 1999         | 2000         |
|---|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| <b>1. Energy Sector</b>                             | 537          | 578          | 653          | 703          | 742          | 778          | 825          | 866          | 917          | 968          | 1,052        |
| 1.A.1 Energy Industry                               | 138          | 157          | 183          | 207          | 223          | 240          | 271          | 300          | 331          | 361          | 428          |
| 1.A.2 Manufacturing and Construction Industry       | 90           | 95           | 101          | 100          | 103          | 105          | 109          | 114          | 115          | 123          | 133          |
| 1.A.3 Transportation                                | 291          | 309          | 353          | 382          | 402          | 418          | 428          | 438          | 456          | 469          | 475          |
| 1.A.4 Other Sectors                                 | 17           | 17           | 15           | 14           | 15           | 14           | 16           | 14           | 14           | 14           | 15           |
| <b>2. Industrial Process and Product Use Sector</b> | 166          | 352          | 325          | 301          | 318          | 345          | 343          | 374          | 383          | 312          | 625          |
| <b>3. Agriculture Sector</b>                        | 1,994        | 2,048        | 1,977        | 2,008        | 1,997        | 1,990        | 2,028        | 1,800        | 1,683        | 1,664        | 1,878        |
| 3.B Livestock Waste Treatment                       | 145          | 164          | 163          | 165          | 173          | 180          | 188          | 160          | 145          | 154          | 158          |
| 3.D Agricultural Soil                               | 1,837        | 1,876        | 1,799        | 1,836        | 1,818        | 1,808        | 1,838        | 1,637        | 1,536        | 1,508        | 1,717        |
| 3.F Field Burning of Agricultural Residues          | 12           | 8            | 15           | 7            | 6            | 2            | 2            | 2            | 2            | 2            | 4            |
| <b>5. Waste Sector</b>                              | 296          | 285          | 298          | 311          | 313          | 334          | 337          | 337          | 321          | 329          | 331          |
| <b>Total Nitrous Oxide Emissions</b>                | <b>2,992</b> | <b>3,262</b> | <b>3,253</b> | <b>3,324</b> | <b>3,371</b> | <b>3,447</b> | <b>3,533</b> | <b>3,376</b> | <b>3,303</b> | <b>3,273</b> | <b>3,886</b> |
| GHG Emission Sources and Sinks                      | 2001         | 2002         | 2003         | 2004         | 2005         | 2006         | 2007         | 2008         | 2009         | 2010         | 2011         |
| <b>1. Energy Sector</b>                             | 1,083        | 1,132        | 1,187        | 1,228        | 1,269        | 1,299        | 1,303        | 1,239        | 1,211        | 1,248        | 1,268        |
| 1.A.1 Energy Industry                               | 458          | 480          | 537          | 556          | 584          | 612          | 638          | 616          | 593          | 603          | 607          |
| 1.A.2 Manufacturing and Construction Industry       | 134          | 141          | 137          | 141          | 140          | 145          | 143          | 131          | 124          | 135          | 144          |
| 1.A.3 Transportation                                | 475          | 496          | 495          | 513          | 527          | 527          | 508          | 478          | 480          | 497          | 505          |
| 1.A.4 Other Sectors                                 | 16           | 16           | 17           | 18           | 17           | 15           | 13           | 14           | 13           | 13           | 12           |
| <b>2. Industrial Process and Product Use Sector</b> | 714          | 744          | 833          | 834          | 1,002        | 1,474        | 1,573        | 1,332        | 1,500        | 1,877        | 1,805        |
| <b>3. Agriculture Sector</b>                        | 1,800        | 1,805        | 1,672        | 1,787        | 1,678        | 1,708        | 1,668        | 1,585        | 1,615        | 1,596        | 1,538        |
| 3.B Livestock Waste Treatment                       | 152          | 147          | 148          | 147          | 153          | 153          | 146          | 145          | 141          | 141          | 142          |
| 3.D Agricultural Soil                               | 1,644        | 1,654        | 1,522        | 1,638        | 1,523        | 1,552        | 1,521        | 1,439        | 1,473        | 1,454        | 1,394        |
| 3.F Field Burning of Agricultural Residues          | 5            | 4            | 3            | 2            | 2            | 3            | 1            | 2            | 2            | 2            | 2            |
| <b>5. Waste Sector</b>                              | 340          | 348          | 353          | 343          | 350          | 350          | 328          | 300          | 295          | 302          | 314          |
| <b>Total Nitrous Oxide Emissions</b>                | <b>3,937</b> | <b>4,029</b> | <b>4,045</b> | <b>4,191</b> | <b>4,299</b> | <b>4,831</b> | <b>4,871</b> | <b>4,456</b> | <b>4,620</b> | <b>5,024</b> | <b>4,925</b> |
| GHG Emission Sources and Sinks                      | 2012         | 2013         | 2014         | 2015         | 2016         | 2017         | 2018         | 2019         | 2020         | 2021         |              |
| <b>1. Energy Sector</b>                             | 1,247        | 1,241        | 1,246        | 1,242        | 1,264        | 1,276        | 1,257        | 1,226        | 1,220        | 1,214        |              |
| 1.A.1 Energy Industry                               | 603          | 595          | 599          | 585          | 595          | 621          | 633          | 605          | 597          | 613          |              |
| 1.A.2 Manufacturing and Construction Industry       | 137          | 140          | 133          | 131          | 131          | 123          | 103          | 101          | 99           | 102          |              |
| 1.A.3 Transportation                                | 495          | 494          | 500          | 513          | 526          | 521          | 510          | 508          | 513          | 488          |              |
| 1.A.4 Other Sectors                                 | 12           | 12           | 13           | 13           | 12           | 12           | 11           | 11           | 12           | 11           |              |
| <b>2. Industrial Process and Product Use Sector</b> | 1,717        | 1,582        | 1,557        | 1,550        | 1,744        | 1,944        | 2,067        | 1,961        | 1,922        | 2,505        |              |
| <b>3. Agriculture Sector</b>                        | 1,563        | 1,495        | 1,488        | 1,457        | 1,455        | 1,404        | 1,384        | 1,328        | 1,375        | 1,322        |              |
| 3.B Livestock Waste Treatment                       | 139          | 137          | 136          | 136          | 138          | 139          | 141          | 145          | 146          | 146          |              |
| 3.D Agricultural Soil                               | 1,422        | 1,357        | 1,351        | 1,320        | 1,316        | 1,264        | 1,242        | 1,182        | 1,229        | 1,175        |              |
| 3.F Field Burning of Agricultural Residues          | 1.7          | 1.0          | 1.1          | 1.4          | 1.0          | 1.1          | 0.8          | 0.8          | 0.4          | 0.3          |              |
| <b>5. Waste Sector</b>                              | 313          | 323          | 332          | 342          | 330          | 377          | 368          | 388          | 382          | 372          |              |
| <b>Total Nitrous Oxide Emissions</b>                | <b>4,839</b> | <b>4,642</b> | <b>4,623</b> | <b>4,591</b> | <b>4,793</b> | <b>5,001</b> | <b>5,076</b> | <b>4,903</b> | <b>4,899</b> | <b>5,412</b> |              |

Table ES2.5 1990–2021 Fluoride-Containing Gas Emissions in Taiwan

(Unit: Kilotons of Carbon Dioxide Equivalents)

| GHG Emission Sources and Sinks                                   | 1990      | 1991      | 1992      | 1993       | 1994       | 1995       | 1996         | 1997         | 1998         | 1999         | 2000         |
|--|-----------|-----------|-----------|------------|------------|------------|--------------|--------------|--------------|--------------|--------------|
| <b>Total HFCs Emissions</b>                                      | NE        | NE        | NE        | 755        | 855        | 801        | 1,305        | 1,477        | 2,083        | 1,609        | 2,319        |
| 2.B Chemical Industry  | NE        | NE        | NE        | 755        | 855        | 801        | 1,305        | 1,477        | 2,083        | 1,609        | 2,319        |
| 2.E Electronics Industry   | NE        | NE        | NE        | NE         | NE         | NE         | NE           | NE           | NE           | NE           | NE           |
| 2.F Alternatives to Ozone-depleting Substances                   | NE        | NE        | NE        | NE         | NE         | NE         | NE           | NE           | NE           | NE           | NE           |
| <b>Total PFCs Emissions (2.E Electronics Industry)</b>           | NE        | NE        | NE        | NE         | NE         | NE         | NE           | NE           | NE           | 3            | 13           |
| <b>Total SF<sub>6</sub> Emissions</b>                            | NE        | NE        | NE        | NE         | NE         | NE         | NE           | NE           | NE           | 116          | 120          |
| 2.C Metal Process  | NE        | NE        | NE        | NE         | NE         | NE         | NE           | NE           | NE           | NE           | NE           |
| 2.E Electronics Industry   | NE        | NE        | NE        | NE         | NE         | NE         | NE           | NE           | NE           | 116          | 120          |
| 2.G Manufacturing and Use of Other Products                      | NE        | NE        | NE        | NE         | NE         | NE         | NE           | NE           | NE           | NE           | NE           |
| <b>Total NF<sub>3</sub> Emissions (2.E Electronics Industry)</b> | NE        | NE        | NE        | NE         | NE         | NE         | NE           | NE           | NE           | 11           | 10           |
| <b>Total Fluoride-Containing Gas Emissions</b>                   | <b>NE</b> | <b>NE</b> | <b>NE</b> | <b>755</b> | <b>855</b> | <b>801</b> | <b>1,305</b> | <b>1,477</b> | <b>2,083</b> | <b>1,738</b> | <b>2,462</b> |

Continued from the table below

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| GHG Emission Sources and Sinks                                   | 2001         | 2002          | 2003          | 2004          | 2005          | 2006         | 2007         | 2008         | 2009         | 2010         | 2011         |
|--|--------------|---------------|---------------|---------------|---------------|--------------|--------------|--------------|--------------|--------------|--------------|
| <b>Total HFCs Emissions</b>                                      | 2,619        | 2,216         | 2,397         | 2,451         | 1,098         | 1,015        | 1,122        | 1,074        | 1,018        | 971          | 1,053        |
| 2.B Chemical Industry  | 2,567        | 2,157         | 1,937         | 1,710         | NO            | NO           | NO           | NO           | NO           | NO           | NO           |
| 2.E Electronics Industry   | 51           | 59            | 59            | 59            | 102           | 119          | 199          | 146          | 206          | 201          | 172          |
| 2.F Alternatives to Ozone-depleting Substances                   | NE           | NE            | 401           | 682           | 996           | 896          | 922          | 928          | 812          | 770          | 881          |
| <b>Total PFCs Emissions (2.E Electronics Industry)</b>           | 2,939        | 4,143         | 4,198         | 4,341         | 3,470         | 3,664        | 3,372        | 2,082        | 1,560        | 1,770        | 1,781        |
| <b>Total SF<sub>6</sub> Emissions</b>                            | 746          | 3,914         | 4,385         | 5,193         | 4,951         | 3,858        | 3,381        | 2,912        | 2,452        | 2,218        | 1,918        |
| 2.C Metal Process  | NE           | 1,027         | 1,027         | 1,357         | 1,063         | 770          | 440          | 144          | 235          | 57           | 50           |
| 2.E Electronics Industry   | 746          | 944           | 1,415         | 1,783         | 2,384         | 2,318        | 1,988        | 1,872        | 1,514        | 1,923        | 1,615        |
| 2.G Manufacturing and Use of Other Products                      | NE           | 1,943         | 1,943         | 2,053         | 1,503         | 770          | 953          | 895          | 703          | 238          | 252          |
| <b>Total NF<sub>3</sub> Emissions (2.E Electronics Industry)</b> | 235          | 398           | 540           | 659           | 765           | 688          | 798          | 204          | 577          | 258          | 420          |
| <b>Total Fluoride-Containing Gas Emissions</b>                   | <b>6,538</b> | <b>10,671</b> | <b>11,520</b> | <b>12,643</b> | <b>10,284</b> | <b>9,225</b> | <b>8,673</b> | <b>6,273</b> | <b>5,607</b> | <b>5,217</b> | <b>5,172</b> |
| GHG Emission Sources and Sinks                                   | 2012         | 2013          | 2014          | 2015          | 2016          | 2017         | 2018         | 2019         | 2020         | 2021         |              |
| <b>Total HFCs Emissions</b>                                      | 907          | 1,019         | 1,048         | 1,020         | 1,026         | 1,023        | 1,013        | 1,027        | 1,053        | 1,106        |              |
| 2.B Chemical Industry  | NO           | NO            | NO            | NO            | NO            | NO           | NO           | NO           | NO           | NO           |              |
| 2.E Electronics Industry   | 124          | 207           | 220           | 170           | 191           | 202          | 201          | 181          | 192          | 186          |              |
| 2.F Alternatives to Ozone-depleting Substances                   | 783          | 812           | 828           | 851           | 835           | 821          | 811          | 846          | 861          | 920          |              |
| <b>Total PFCs Emissions (2.E Electronics Industry)</b>           | 1,141        | 1,345         | 1,556         | 1,347         | 1,441         | 1,409        | 1,536        | 1,420        | 1,447        | 1,472        |              |
| <b>Total SF<sub>6</sub> Emissions</b>                            | 1,852        | 1,997         | 1,730         | 1,523         | 1,418         | 1,416        | 1,302        | 935          | 842          | 857          |              |
| 2.C Metal Process  | 30           | 38            | 33            | 43            | 41            | 59           | 81           | 43           | 36           | 62           |              |
| 2.E Electronics Industry   | 1,628        | 1,800         | 1,552         | 1,351         | 1,295         | 1,278        | 1,072        | 781          | 672          | 695          |              |
| 2.G Manufacturing and Use of Other Products                      | 195          | 160           | 146           | 128           | 82            | 79           | 149          | 110          | 133          | 100          |              |
| <b>Total NF<sub>3</sub> Emissions (2.E Electronics Industry)</b> | 388          | 773           | 667           | 662           | 472           | 440          | 509          | 473          | 564          | 594          |              |
| <b>Total Fluoride-Containing Gas Emissions</b>                   | <b>4,288</b> | <b>5,134</b>  | <b>5,001</b>  | <b>4,552</b>  | <b>4,356</b>  | <b>4,288</b> | <b>4,360</b> | <b>3,855</b> | <b>3,906</b> | <b>4,028</b> |              |

Note: 1. NE (not estimated) refers to the exclusion of estimation on existing emissions and sequestration.

2. NO (not happened) means that the emission source is not produced or used. HCFC-22 has been put into production since 1993 and was discontinued in 2005.

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

Of all the sectors, the energy sector has long been the one accounting for the largest total greenhouse gas emission in Taiwan over the years. In 2005 and 2021, greenhouse gas emissions (exclude LULUCF) from energy sectors were responsible for approximately 85.99% and 90.55% of the total emissions, while the IPPU sector accounted for 10.12% and 7.46%, the agricultural sector accounted for 1.37% and 1.09%, and the waste sector accounted for 2.52% and 0.90%, as shown in Figure ES3.1.

The GHG emission and trends for Taiwan from 1990 to 2021 by sector are shown in Figure ES3.2 and Table ES3.1. The total greenhouse gas emission in Taiwan in 2021 increased by 4.19% compared with 2020. In particular, the GHG emission from the energy sector was up by 3.71%, the IPPU sector was up by 11.93%, the agriculture sector was down by 3.32%, and the waste sector was up by 2.92%. Additionally, the carbon dioxide sequestration of the LULUCF sector was down by 0.25%.

Compared to 2005(Base year), the emission in 2021 increased by 2.22%. In particular, the GHG emission

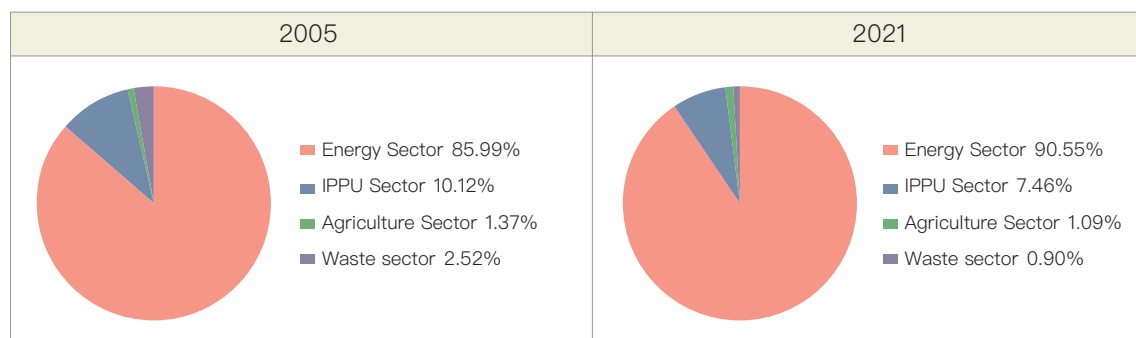


Figure ES3.1 Percentage of Greenhouse Gas Emissions (exclude LULUCF) by Sectors in Taiwan in (a) 2005 and (b) 2021.

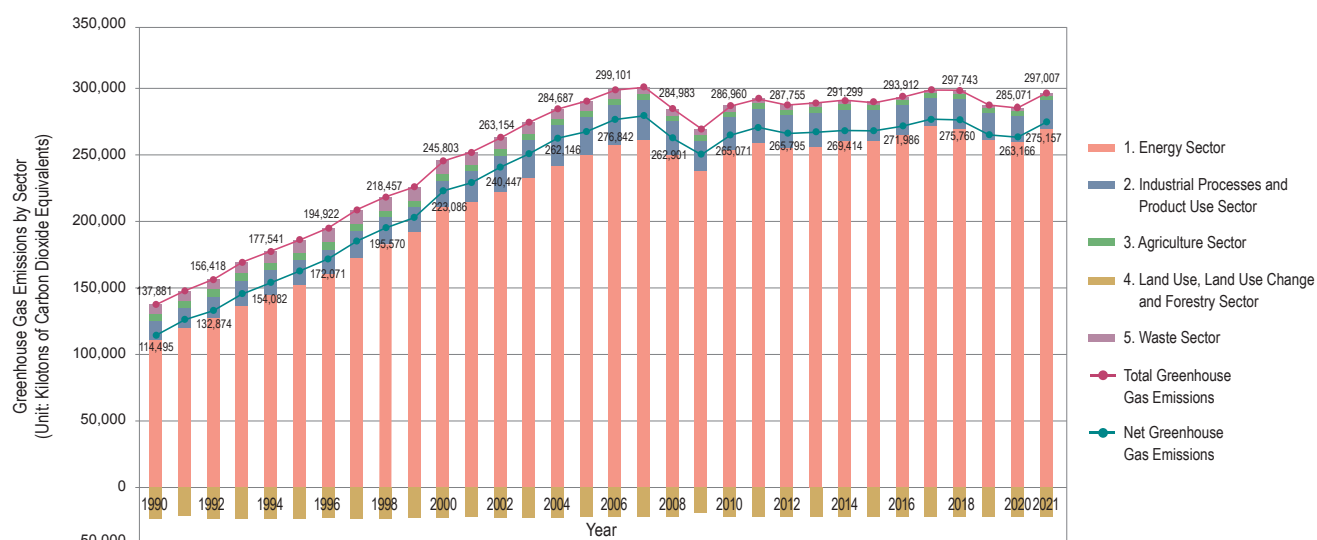


Figure ES3.2 1990–2021 Trends in Greenhouse Gas Emission by Sector in Taiwan

Table ES3.1 1990–2021 Greenhouse Gas Emission in Taiwan by Sector

(Unit: Kilotons of Carbon Dioxide Equivalents)

| GHG Emission Sources and Sinks        | 1990    | 1991    | 1992    | 1993    | 1994    | 1995    | 1996    | 1997    | 1998    | 1999    | 2000    |
|---------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| 1. Energy Sector                      | 110,532 | 119,527 | 127,208 | 136,421 | 144,371 | 152,121 | 159,923 | 172,215 | 182,970 | 191,975 | 210,747 |
| 2. IPPU Sector                        | 14,728  | 15,366  | 16,257  | 19,471  | 19,007  | 18,685  | 19,336  | 21,346  | 20,886  | 19,241  | 20,488  |
| 3. Agriculture Sector                 | 5,049   | 5,294   | 5,134   | 5,164   | 5,144   | 5,220   | 5,263   | 4,605   | 4,231   | 4,300   | 4,520   |
| 4. LULUCF Sector                      | -23,386 | -21,490 | -23,544 | -23,546 | -23,459 | -23,340 | -22,851 | -23,060 | -22,887 | -22,764 | -22,717 |
| 5. Waste Sector                       | 7,573   | 7,709   | 7,818   | 8,214   | 9,018   | 10,009  | 10,399  | 10,245  | 10,370  | 10,493  | 10,047  |
| Net GHG Emission (including LULUCF)   | 114,495 | 126,406 | 132,874 | 145,723 | 154,082 | 162,696 | 172,071 | 185,351 | 195,570 | 203,245 | 223,086 |
| Total GHG Emission (excluding LULUCF) | 137,881 | 147,896 | 156,418 | 169,269 | 177,541 | 186,035 | 194,922 | 208,411 | 218,457 | 226,009 | 245,803 |
| GHG Emission Sources and Sinks        | 2001    | 2002    | 2003    | 2004    | 2005    | 2006    | 2007    | 2008    | 2009    | 2010    | 2011    |
| 1. Energy Sector                      | 214,604 | 222,262 | 232,423 | 241,818 | 249,855 | 257,255 | 261,138 | 249,380 | 237,676 | 253,588 | 259,018 |
| 2. IPPU Sector                        | 23,456  | 27,509  | 29,516  | 30,864  | 29,398  | 31,019  | 30,241  | 26,190  | 23,557  | 25,296  | 25,977  |
| 3. Agriculture Sector                 | 4,320   | 4,188   | 3,943   | 3,980   | 3,968   | 3,964   | 3,842   | 3,698   | 3,677   | 3,653   | 3,625   |
| 4. LULUCF Sector                      | -21,850 | -22,707 | -22,624 | -22,542 | -22,290 | -22,259 | -22,074 | -22,082 | -19,388 | -21,889 | -21,947 |
| 5. Waste Sector                       | 9,606   | 9,195   | 8,538   | 8,026   | 7,329   | 6,862   | 6,443   | 5,715   | 4,868   | 4,423   | 3,986   |
| Net GHG Emission (including LULUCF)   | 230,137 | 240,447 | 251,795 | 262,146 | 268,261 | 276,842 | 279,590 | 262,901 | 250,389 | 265,071 | 270,658 |
| Total GHG Emission (excluding LULUCF) | 251,986 | 263,154 | 274,419 | 284,687 | 290,551 | 299,101 | 301,663 | 284,983 | 269,777 | 286,960 | 292,605 |
| GHG Emission Sources and Sinks        | 2012    | 2013    | 2014    | 2015    | 2016    | 2017    | 2018    | 2019    | 2020    | 2021    |         |
| 1. Energy Sector                      | 255,075 | 255,987 | 260,413 | 260,428 | 264,977 | 271,475 | 269,186 | 260,764 | 259,331 | 268,940 |         |
| 2. IPPU Sector                        | 25,397  | 26,346  | 24,287  | 23,379  | 22,710  | 21,882  | 22,473  | 20,732  | 19,794  | 22,156  |         |
| 3. Agriculture Sector                 | 3,628   | 3,538   | 3,475   | 3,422   | 3,422   | 3,367   | 3,346   | 3,299   | 3,343   | 3,231   |         |
| 4. LULUCF Sector                      | -21,960 | -21,974 | -21,886 | -21,900 | -21,926 | -21,961 | -21,984 | -21,917 | -21,905 | -21,850 |         |
| 5. Waste Sector                       | 3,655   | 3,325   | 3,125   | 2,886   | 2,804   | 2,734   | 2,738   | 2,693   | 2,603   | 2,679   |         |
| Net GHG Emission (including LULUCF)   | 265,795 | 267,222 | 269,414 | 268,215 | 271,986 | 277,497 | 275,760 | 265,571 | 263,166 | 275,157 |         |
| Total GHG Emission (excluding LULUCF) | 287,755 | 289,196 | 291,299 | 290,115 | 293,912 | 299,458 | 297,743 | 287,488 | 285,071 | 297,007 |         |

from the energy sector was up by 7.64%, the IPPU sector was down by 24.64%, the agriculture sector was down by 18.56%, and the waste sector was down by 63.44%. Additionally, the carbon dioxide sequestration of the LULUCF sector was down by 1.97%, as shown in Figure ES3.3.

### 1. Energy sector

The total greenhouse gas emission from the energy sector in 2005 was 249,855 kilotons of carbon dioxide

equivalents and increased to 268,940 kilotons of carbon dioxide equivalents in 2021 with a growth of 7.64% and an annual average growth of 0.46%, as shown in Table ES3.2. During this period, the greenhouse gas emissions from the energy sector showed a downward trend in 2008 for the first time and declined again in 2009 and 2012, followed by more reduction in 2018 to 2020 period. Compared with 2020, the greenhouse gas emissions in 2021 increased by 3.71%. The total greenhouse gas emission from the energy sector in 2021 accounted for

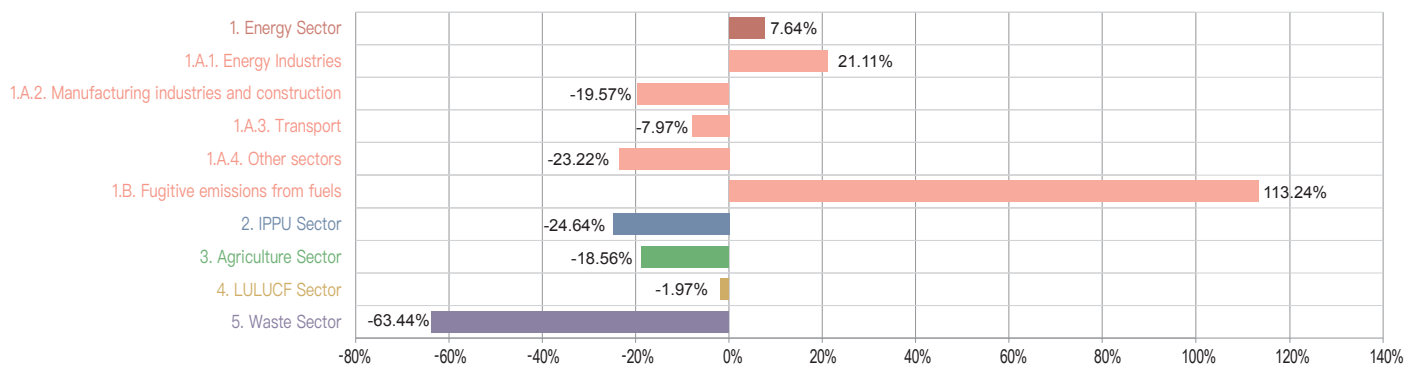


Figure ES3.3 Changes in Greenhouse Gas Emissions and Sequestrations by Sectors in Taiwan from 2005 to 2021.

Table ES3.2 1990–2021 Greenhouse Gas Emissions Produced by Energy Sector in Taiwan

(Unit: Kilotons of Carbon Dioxide Equivalents)

| GHG Emission Sources and Sinks                | 1990           | 1991           | 1992           | 1993           | 1994           | 1995           | 1996           | 1997           | 1998           | 1999           | 2000           |
|---|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| <b>Total CO<sub>2</sub> Emission</b>          | 109,465        | 118,443        | 126,058        | 135,206        | 143,103        | 150,810        | 158,579        | 170,835        | 181,518        | 190,446        | 209,122        |
| 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        |
| 1.A.2 Manufacturing and Construction Industry | 30,124         | 31,963         | 33,389         | 33,618         | 34,592         | 35,769         | 36,791         | 39,084         | 39,321         | 41,314         | 43,850         |
| 1.A.3 Transportation                          | 19,646         | 20,888         | 24,033         | 26,103         | 27,540         | 28,822         | 29,801         | 30,536         | 31,844         | 32,772         | 33,207         |
| 1.A.4 Others Sectors                          | 10,572         | 10,466         | 10,107         | 9,523          | 10,200         | 9,819          | 10,733         | 9,808          | 9,939          | 10,579         | 10,922         |
| <b>Total CH<sub>4</sub> Emission</b>          | 530            | 506            | 497            | 511            | 526            | 533            | 520            | 514            | 535            | 561            | 574            |
| 1.A.1 Energy Industry                         | 26             | 29             | 28             | 32             | 35             | 40             | 41             | 46             | 50             | 58             | 66             |
| 1.A.2 Manufacturing and Construction Industry | 46             | 48             | 52             | 51             | 52             | 54             | 56             | 58             | 59             | 63             | 69             |
| 1.A.3 Transportation                          | 152            | 163            | 187            | 202            | 216            | 228            | 239            | 245            | 257            | 266            | 270            |
| 1.A.4 Others Sectors                          | 30             | 29             | 28             | 26             | 28             | 27             | 29             | 26             | 27             | 28             | 29             |
| 1.B.1 Solid Fuel                              | 162            | 138            | 115            | 113            | 98             | 81             | 51             | 34             | 27             | 31             | 28             |
| 1.B.2 Oil and Gas                             | 115            | 98             | 88             | 87             | 97             | 103            | 103            | 104            | 115            | 113            | 111            |
| <b>Total N<sub>2</sub>O Emission</b>          | 537            | 578            | 653            | 703            | 742            | 778            | 825            | 866            | 917            | 968            | 1,052          |
| 1.A.1 Energy Industry                         | 138            | 157            | 183            | 207            | 223            | 240            | 271            | 300            | 331            | 361            | 428            |
| 1.A.2 Manufacturing and Construction Industry | 90             | 95             | 101            | 100            | 103            | 105            | 109            | 114            | 115            | 123            | 133            |
| 1.A.3 Transportation                          | 291            | 309            | 353            | 382            | 402            | 418            | 428            | 438            | 456            | 469            | 475            |
| 1.A.4 Others Sectors                          | 17             | 17             | 15             | 14             | 15             | 14             | 16             | 14             | 14             | 14             | 15             |
| <b>Total Emission from Energy Sector</b>      | <b>110,532</b> | <b>119,527</b> | <b>127,208</b> | <b>136,421</b> | <b>144,371</b> | <b>152,121</b> | <b>159,923</b> | <b>172,215</b> | <b>182,970</b> | <b>191,975</b> | <b>210,747</b> |
| GHG Emission Sources and Sinks                | 2001           | 2002           | 2003           | 2004           | 2005           | 2006           | 2007           | 2008           | 2009           | 2010           | 2011           |
| <b>Total CO<sub>2</sub> Emission</b>          | 212,957        | 220,546        | 230,607        | 239,929        | 247,956        | 255,331        | 259,214        | 247,536        | 235,868        | 251,708        | 257,096        |
| 1.A.1 Energy Industry                         | 126,142        | 130,463        | 141,730        | 148,677        | 156,351        | 163,615        | 170,131        | 164,432        | 155,166        | 165,522        | 169,884        |
| 1.A.2 Manufacturing and Construction Industry | 42,395         | 44,489         | 42,563         | 43,163         | 42,671         | 43,994         | 43,293         | 39,104         | 36,698         | 41,360         | 42,298         |
| 1.A.3 Transportation                          | 33,246         | 34,542         | 34,509         | 35,859         | 36,846         | 36,771         | 35,419         | 33,216         | 33,541         | 34,652         | 35,107         |
| 1.A.4 Others Sectors                          | 11,174         | 11,052         | 11,806         | 12,230         | 12,089         | 10,952         | 10,370         | 10,785         | 10,463         | 10,174         | 9,807          |
| <b>Total CH<sub>4</sub> Emission</b>          | 565            | 584            | 629            | 661            | 631            | 625            | 622            | 604            | 597            | 631            | 654            |
| 1.A.1 Energy Industry                         | 70             | 69             | 78             | 81             | 84             | 88             | 90             | 88             | 81             | 86             | 86             |
| 1.A.2 Manufacturing and Construction Industry | 71             | 74             | 73             | 75             | 75             | 78             | 77             | 71             | 67             | 74             | 79             |
| 1.A.3 Transportation                          | 272            | 278            | 287            | 295            | 303            | 298            | 289            | 275            | 281            | 284            | 287            |
| 1.A.4 Others Sectors                          | 30             | 30             | 32             | 33             | 33             | 29             | 27             | 28             | 27             | 26             | 25             |
| 1.B.1 Solid Fuel                              | NO             | NO             | NO             | NO             | NO             | NO             | NO             | NO             | NO             | NO             | NO             |
| 1.B.2 Oil and Gas                             | 122            | 132            | 159            | 176            | 137            | 133            | 138            | 142            | 141            | 161            | 176            |
| <b>Total N<sub>2</sub>O Emission</b>          | 1,083          | 1,132          | 1,187          | 1,228          | 1,269          | 1,299          | 1,303          | 1,239          | 1,211          | 1,248          | 1,268          |
| 1.A.1 Energy Industry                         | 458            | 480            | 537            | 556            | 584            | 612            | 638            | 616            | 593            | 603            | 607            |
| 1.A.2 Manufacturing and Construction Industry | 134            | 141            | 137            | 141            | 140            | 145            | 143            | 131            | 124            | 135            | 144            |
| 1.A.3 Transportation                          | 475            | 496            | 495            | 513            | 527            | 527            | 508            | 478            | 480            | 497            | 505            |
| 1.A.4 Others Sectors                          | 16             | 16             | 17             | 18             | 17             | 15             | 13             | 14             | 13             | 13             | 12             |
| <b>Total Emission from Energy Sector</b>      | <b>214,604</b> | <b>222,262</b> | <b>232,423</b> | <b>241,818</b> | <b>249,855</b> | <b>257,255</b> | <b>261,138</b> | <b>249,380</b> | <b>237,676</b> | <b>253,588</b> | <b>259,018</b> |

Continued from the table below

Continued from the above table

| GHG Emission Sources and Sinks                | 2012           | 2013           | 2014           | 2015           | 2016           | 2017           | 2018           | 2019           | 2020           | 2021           |
|---|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| <b>Total CO<sub>2</sub> Emission</b>          | 253,166        | 254,070        | 258,481        | 258,476        | 262,982        | 269,462        | 267,208        | 258,821        | 257,381        | 266,991        |
| 1.A.1 Energy Industry                         | 168,333        | 168,271        | 175,180        | 175,198        | 178,569        | 187,135        | 189,212        | 181,334        | 180,502        | 189,455        |
| 1.A.2 Manufacturing and Construction Industry | 40,983         | 42,019         | 38,953         | 38,074         | 38,296         | 36,741         | 33,480         | 32,726         | 31,722         | 34,334         |
| 1.A.3 Transportation                          | 34,284         | 34,209         | 34,666         | 35,506         | 36,584         | 36,202         | 35,207         | 35,443         | 35,727         | 33,917         |
| 1.A.4 Others Sectors                          | 9,566          | 9,571          | 9,681          | 9,698          | 9,533          | 9,384          | 9,310          | 9,318          | 9,430          | 9,285          |
| <b>Total CH<sub>4</sub> Emission</b>          | 663            | 676            | 686            | 710            | 730            | 738            | 721            | 717            | 731            | 735            |
| 1.A.1 Energy Industry                         | 86             | 85             | 88             | 91             | 92             | 94             | 94             | 90             | 89             | 92             |
| 1.A.2 Manufacturing and Construction Industry | 76             | 78             | 74             | 74             | 74             | 69             | 59             | 58             | 57             | 59             |
| 1.A.3 Transportation                          | 283            | 284            | 285            | 292            | 301            | 295            | 286            | 287            | 290            | 269            |
| 1.A.4 Others Sectors                          | 25             | 25             | 25             | 25             | 25             | 24             | 24             | 24             | 24             | 24             |
| 1.B.1 Solid Fuel                              | NO             | NO             | NO             | NO             | NO             | NO             | NO             | NO             | NO             | NO             |
| 1.B.2 Oil and Gas                             | 193            | 205            | 214            | 228            | 239            | 255            | 258            | 258            | 270            | 291            |
| <b>Total N<sub>2</sub>O Emission</b>          | 1,247          | 1,241          | 1,246          | 1,242          | 1,264          | 1,276          | 1,257          | 1,226          | 1,220          | 1,214          |
| 1.A.1 Energy Industry                         | 603            | 595            | 599            | 585            | 595            | 621            | 633            | 605            | 597            | 613            |
| 1.A.2 Manufacturing and Construction Industry | 137            | 140            | 133            | 131            | 131            | 123            | 103            | 101            | 99             | 102            |
| 1.A.3 Transportation                          | 495            | 494            | 500            | 513            | 526            | 521            | 510            | 508            | 513            | 488            |
| 1.A.4 Others Sectors                          | 12             | 12             | 13             | 13             | 12             | 12             | 11             | 11             | 12             | 11             |
| <b>Total Emission from Energy Sector</b>      | <b>255,075</b> | <b>255,987</b> | <b>260,413</b> | <b>260,428</b> | <b>264,977</b> | <b>271,475</b> | <b>269,186</b> | <b>260,764</b> | <b>259,331</b> | <b>268,940</b> |

Note: 1. NO (not happened). Taiwanese coal has been discontinued since 2001.

90.55% of the total greenhouse gas emission in Taiwan. In particular, 1.A.1 “energy industry” was responsible for 190,160 kilotons of carbon dioxide equivalents, accounting for 70.71% of the total greenhouse gas emission from the energy sector; 1.A.2 “manufacturing and construction industry” was responsible for 34,495 kilotons of carbon dioxide equivalents (accounting for 12.83%); 1.A.3 “transportation” was responsible for 34,673 kilotons of carbon dioxide equivalents (accounting for 12.89%); 1.A.4 “other sectors (including service industry, residential and agriculture, forestry, fishery and husbandry)” was responsible for 9,320 kilotons of carbon dioxide equivalents (accounting for 3.47%); 1.B.2 “oil and gas” was responsible for 291 kilotons of carbon dioxide equivalents (accounting for 0.11%), as shown in Figure ES3.4.

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

The greenhouse gas emission from the IPPU sector in 2005 was 29,398 kilotons of carbon dioxide equivalents and decreased to 22,156 kilotons in 2021, down by 24.64% with a negative average annual growth rate of -1.75%, as shown in Table ES3.3. Compared with 2020, the greenhouse gas emissions in 2021 increased by 11.93%. The total greenhouse gas emission in 2021 accounted for 7.46% of the total greenhouse gas emission in Taiwan. In particular, 2.C “metal process” was responsible for 7,153 kilotons of carbon dioxide equivalents, accounting for 32.28% (the majority) of the greenhouse gases from the IPPU sector, followed by 2.A “mining industry (non-metal process)”, which was responsible for 6,762 kilotons of carbon dioxide equivalents (accounting for 30.52%), 2.E “electronics industry”, which was responsible for 4,266 kilotons of carbon dioxide equivalents (accounting for

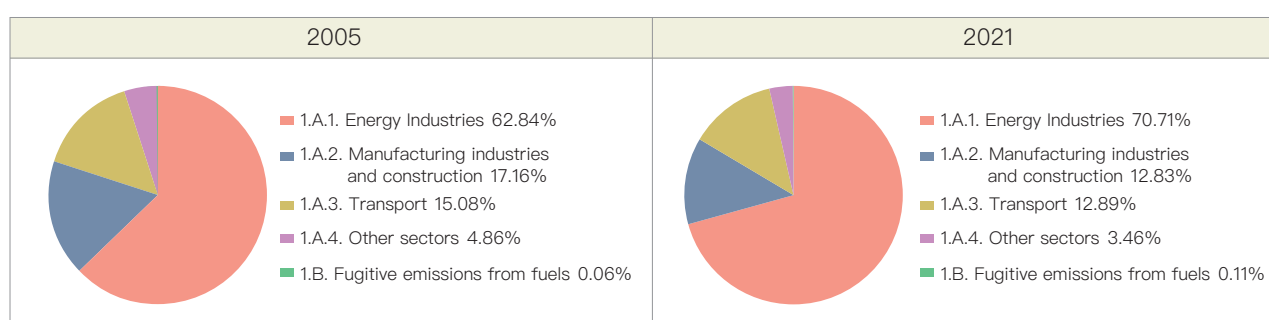


Figure ES3.4 Percentage of Greenhouse Gas Emissions by Energy Sectors in Taiwan in (a)2005 and (b)2021.

Table ES3.3 1990–2021 Greenhouse Gas Emissions Produced by Industrial Process and Product Use Sector (IPPU) in Taiwan

(Unit: Kilotons of Carbon Dioxide Equivalents)

| GHG Emission Sources and Sinks                                  | 1990          | 1991          | 1992          | 1993          | 1994          | 1995          | 1996          | 1997          | 1998          | 1999          | 2000          |
|---|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| <b>Total CO<sub>2</sub> Emission</b>                            | 14,557        | 15,007        | 15,926        | 18,408        | 17,826        | 17,528        | 17,677        | 19,483        | 18,410        | 17,179        | 17,388        |
| 2.A Mining Industry (Non-metal Products)                        | 10,683        | 10,698        | 11,854        | 13,879        | 13,259        | 12,766        | 12,645        | 13,394        | 11,564        | 10,746        | 10,486        |
| 2.B Chemical Industry   | 575           | 551           | 575           | 617           | 770           | 858           | 999           | 1,026         | 1,007         | 1,079         | 1,148         |
| 2.C Metal Process   | 3,275         | 3,735         | 3,474         | 3,888         | 3,774         | 3,884         | 4,013         | 5,045         | 5,817         | 5,333         | 5,734         |
| 2.D Non-Energy Products from Fuels and Solvent Use              | 0.00006       | 0.00006       | 0.00006       | 0.00007       | 0.00009       | 0.00008       | 0.00008       | 0.00008       | 0.00009       | 0.00009       | 0.00008       |
| 2.H Others  | 23            | 23            | 23            | 24            | 23            | 21            | 20            | 19            | 22            | 21            | 20            |
| <b>Total CH<sub>4</sub> Emission</b>                            | 5             | 7             | 6             | 7             | 8             | 10            | 11            | 12            | 10            | 12            | 14            |
| 2.B Chemical Industry   | 5             | 5             | 5             | 6             | 7             | 9             | 10            | 11            | 9             | 11            | 13            |
| 2.C Metal Process   | 0.2           | 1.8           | 1.4           | 1.1           | 0.9           | 1.2           | 1.1           | 1.2           | 1.1           | 0.4           | 0.2           |
| <b>Total N<sub>2</sub>O Emission</b>                            | 166           | 352           | 325           | 301           | 318           | 345           | 343           | 374           | 383           | 312           | 625           |
| 2.B Chemical Industry   | 166           | 352           | 325           | 301           | 318           | 345           | 343           | 374           | 383           | 312           | 625           |
| 2.C Metal Process   | NO            | NO            | NO            | NO            | NO            | NO            | NO            | NO            | NO            | NO            | NO            |
| 2.E Electronics Industry  | NE            | NE            | NE            | NE            | NE            | NE            | NE            | NE            | NE            | NE            | NE            |
| <b>Total HFCs Emission</b>                                      | NE            | NE            | NE            | 755           | 855           | 801           | 1,305         | 1,477         | 2,083         | 1,609         | 2,319         |
| 2.B Chemical Industry   | NE            | NE            | NE            | 755           | 855           | 801           | 1,305         | 1,477         | 2,083         | 1,609         | 2,319         |
| 2.E Electronics Industry  | NE            | NE            | NE            | NE            | NE            | NE            | NE            | NE            | NE            | NE            | NE            |
| 2.F Alternatives to Ozone-depleting Substances                  | NE            | NE            | NE            | NE            | NE            | NE            | NE            | NE            | NE            | NE            | NE            |
| <b>Total PFCs Emission (2.E Electronics Industry)</b>           | NE            | NE            | NE            | NE            | NE            | NE            | NE            | NE            | NE            | 3             | 13            |
| <b>Total SF<sub>6</sub> Emission</b>                            | NE            | NE            | NE            | NE            | NE            | NE            | NE            | NE            | NE            | 116           | 120           |
| 2.C Metal Process   | NE            | NE            | NE            | NE            | NE            | NE            | NE            | NE            | NE            | NE            | NE            |
| 2.E Electronics Industry  | NE            | NE            | NE            | NE            | NE            | NE            | NE            | NE            | NE            | 116           | 120           |
| 2.G Manufacturing and Use of Other Products                     | NE            | NE            | NE            | NE            | NE            | NE            | NE            | NE            | NE            | NE            | NE            |
| <b>Total NF<sub>3</sub> Emission (2.E Electronics Industry)</b> | NE            | NE            | NE            | NE            | NE            | NE            | NE            | NE            | NE            | 11            | 10            |
| <b>Total Emission from IPPU Sector</b>                          | <b>14,728</b> | <b>15,366</b> | <b>16,257</b> | <b>19,471</b> | <b>19,007</b> | <b>18,685</b> | <b>19,336</b> | <b>21,346</b> | <b>20,886</b> | <b>19,241</b> | <b>20,488</b> |
| GHG Emission Sources and Sinks                                  | 2001          | 2002          | 2003          | 2004          | 2005          | 2006          | 2007          | 2008          | 2009          | 2010          | 2011          |
| <b>Total CO<sub>2</sub> Emission</b>                            | 16,186        | 16,075        | 17,141        | 17,358        | 18,094        | 20,299        | 19,967        | 18,558        | 16,428        | 18,178        | 18,985        |
| 2.A Mining Industry (Non-metal Products)                        | 9,974         | 10,648        | 10,341        | 10,691        | 11,257        | 11,014        | 10,369        | 9,289         | 8,467         | 8,616         | 9,577         |
| 2.B Chemical Industry   | 1,232         | 1,313         | 1,384         | 1,485         | 1,751         | 1,721         | 1,845         | 1,601         | 1,623         | 1,750         | 1,768         |
| 2.C Metal Process   | 4,960         | 4,096         | 5,397         | 5,162         | 5,066         | 7,544         | 7,733         | 7,648         | 6,317         | 7,792         | 7,620         |
| 2.D Non-Energy Products from Fuels and Solvent Use              | 0.00007       | 0.00008       | 0.00009       | 0.00011       | 0.00010       | 0.00007       | 0.00007       | 0.00007       | 0.00006       | 0.00005       | 0.00004       |
| 2.H Others  | 20            | 18            | 18            | 19            | 20            | 21            | 20            | 20            | 21            | 20            | 20            |
| <b>Total CH<sub>4</sub> Emission</b>                            | 18            | 19            | 22            | 28            | 18            | 22            | 28            | 27            | 21            | 23            | 15            |
| 2.B Chemical Industry   | 18            | 19            | 22            | 28            | 18            | 18            | 23            | 22            | 18            | 18            | 15            |
| 2.C Metal Process   | 0.1           | 0.2           | 0.2           | NO            | NO            | 4.3           | 4.3           | 5.0           | 3.4           | 5.5           | 0.01          |
| <b>Total N<sub>2</sub>O Emission</b>                            | 714           | 744           | 833           | 834           | 1,002         | 1,474         | 1,573         | 1,332         | 1,500         | 1,877         | 1,805         |
| 2.B Chemical Industry   | 714           | 743           | 831           | 834           | 960           | 969           | 996           | 784           | 1,006         | 1,170         | 1,195         |
| 2.C Metal Process   | NO            | 0.4           | 1.7           | NO            | NO            | 94            | 95            | 90            | 76            | 119           | NO            |
| 2.E Electronics Industry  | NE            | NE            | NE            | NE            | 42            | 411           | 481           | 458           | 417           | 588           | 611           |
| <b>Total HFCs Emission</b>                                      | 2,619         | 2,216         | 2,397         | 2,451         | 1,098         | 1,015         | 1,122         | 1,074         | 1,018         | 971           | 1,053         |
| 2.B Chemical Industry   | 2,567         | 2,157         | 1,937         | 1,710         | NO            | NO            | NO            | NO            | NO            | NO            | NO            |
| 2.E Electronics Industry  | 51            | 59            | 59            | 59            | 102           | 119           | 199           | 146           | 206           | 201           | 172           |
| 2.F Alternatives to Ozone-depleting Substances                  | NE            | NE            | 401           | 682           | 996           | 896           | 922           | 928           | 812           | 770           | 881           |
| <b>Total PFCs Emission (2.E Electronics Industry)</b>           | 2,939         | 4,143         | 4,198         | 4,341         | 3,470         | 3,664         | 3,372         | 2,082         | 1,560         | 1,770         | 1,781         |
| <b>Total SF<sub>6</sub> Emission</b>                            | 746           | 3,914         | 4,385         | 5,193         | 4,951         | 3,858         | 3,381         | 2,912         | 2,452         | 2,218         | 1,918         |
| 2.C Metal Process   | NE            | 1,027         | 1,027         | 1,357         | 1,063         | 770           | 440           | 144           | 235           | 57            | 50            |
| 2.E Electronics Industry  | 746           | 944           | 1,415         | 1,783         | 2,384         | 2,318         | 1,988         | 1,872         | 1,514         | 1,923         | 1,615         |
| 2.G Manufacturing and Use of Other Products                     | NE            | 1,943         | 1,943         | 2,053         | 1,503         | 770           | 953           | 895           | 703           | 238           | 252           |
| <b>Total NF<sub>3</sub> Emission (2.E Electronics Industry)</b> | 235           | 398           | 540           | 659           | 765           | 688           | 798           | 204           | 577           | 258           | 420           |
| <b>Total Emission from IPPU Sector</b>                          | <b>23,456</b> | <b>27,509</b> | <b>29,516</b> | <b>30,864</b> | <b>29,398</b> | <b>31,019</b> | <b>30,241</b> | <b>26,190</b> | <b>23,557</b> | <b>25,296</b> | <b>25,977</b> |
| GHG Emission Sources and Sinks                                  | 2012          | 2013          | 2014          | 2015          | 2016          | 2017          | 2018          | 2019          | 2020          | 2021          |               |
| <b>Total CO<sub>2</sub> Emission</b>                            | 19,369        | 19,605        | 17,704        | 17,251        | 16,583        | 15,625        | 16,019        | 14,890        | 13,942        | 15,597        |               |
| 2.A Mining Industry (Non-metal Products)                        | 9,333         | 9,866         | 8,728         | 8,345         | 7,108         | 6,262         | 6,403         | 6,501         | 6,504         | 6,762         |               |
| 2.B Chemical Industry   | 1,714         | 1,749         | 1,884         | 1,842         | 1,760         | 1,709         | 1,684         | 1,666         | 1,550         | 1,730         |               |
| 2.C Metal Process   | 8,301         | 7,970         | 7,072         | 7,044         | 7,696         | 7,634         | 7,913         | 6,706         | 5,870         | 7,090         |               |
| 2.D Non-Energy Products from Fuels and Solvent Use              | 0.00004       | 0.00005       | 0.00006       | 0.00010       | 0.00008       | 0.00007       | 0.00006       | 0.00006       | 0.00006       | 0.00007       |               |
| 2.H Others  | 21            | 19            | 19            | 20            | 19            | 20            | 19            | 17            | 18            | 15            |               |
| <b>Total CH<sub>4</sub> Emission</b>                            | 23            | 25            | 26            | 26            | 27            | 24            | 27            | 26            | 25            | 26            |               |
| 2.B Chemical Industry   | 23            | 25            | 26            | 26            | 26            | 24            | 27            | 26            | 25            | 26            |               |
| 2.C Metal Process   | 0.06          | 0.1           | 0.2           | 0.2           | 0.2           | NO            | 0.01          | 0.01          | 0.0001        | NO            |               |
| <b>Total N<sub>2</sub>O Emission</b>                            | 1,717         | 1,582         | 1,557         | 1,550         | 1,744         | 1,944         | 2,067         | 1,961         | 1,922         | 2,505         |               |
| 2.B Chemical Industry   | 1,016         | 780           | 728           | 691           | 961           | 1,114         | 1,110         | 931           | 608           | 1,184         |               |
| 2.C Metal Process   | NO            | NO            | NO            | NO            | NO            | NO            | NO            | NO            | NO            | NO            |               |
| 2.E Electronics Industry  | 701           | 802           | 829           | 860           | 783           | 830           | 957           | 1,030         | 1,314         | 1,320         |               |
| <b>Total HFCs Emission</b>                                      | 907           | 1,019         | 1,048         | 1,020         | 1,026         | 1,023         | 1,013         | 1,027         | 1,053         | 1,106         |               |
| 2.B Chemical Industry   | NO            | NO            | NO            | NO            | NO            | NO            | NO            | NO            | NO            | NO            |               |
| 2.E Electronics Industry  | 124           | 207           | 220           | 170           | 191           | 202           | 201           | 181           | 192           | 186           |               |
| 2.F Alternatives to Ozone-depleting Substances                  | 783           | 812           | 828           | 851           | 835           | 821           | 811           | 846           | 861           | 920           |               |
| <b>Total PFCs Emission (2.E Electronics Industry)</b>           | 1,141         | 1,345         | 1,556         | 1,347         | 1,441         | 1,409         | 1,536         | 1,420         | 1,447         | 1,472         |               |
| <b>Total SF<sub>6</sub> Emission</b>                            | 1,852         | 1,997         | 1,730         | 1,523         | 1,418         | 1,416         | 1,302         | 935           | 842           | 857           |               |
| 2.C Metal Process   | 30            | 38            | 33            | 43            | 41            | 59            | 81            | 43            | 36            | 62            |               |
| 2.E Electronics Industry  | 1,628         | 1,800         | 1,552         | 1,351         | 1,295         | 1,278         | 1,072         | 781           | 672           | 695           |               |
| 2.G Manufacturing and Use of Other Products                     | 195           | 160           | 146           | 128           | 82            | 79            | 149           | 110           | 133           | 100           |               |
| <b>Total NF<sub>3</sub> Emission (2.E Electronics Industry)</b> | 388           | 773           | 667           | 662           | 472           | 440           | 509           | 473           | 564           | 594           |               |
| <b>Total Emission from IPPU Sector</b>                          | <b>25,397</b> | <b>26,346</b> | <b>24,287</b> | <b>23,379</b> | <b>22,710</b> | <b>21,882</b> | <b>22,473</b> | <b>20,732</b> | <b>19,794</b> | <b>22,156</b> |               |

Note: 1. NE (Not Estimated), which means that there is no estimate for existing GHG emission source or sink.

2. NO (not happened) means that the emission source is not produced or used. For example, HCFC-22 has been put into production since 1993 and was discontinued in 2005.

19.26%), 2.B “chemical industry”, which was responsible for 2,940 kilotons of carbon dioxide equivalents (accounting for 13.27%), 2.F “alternatives to ozone-depleting substances”, which was responsible for 920 kilotons of carbon dioxide equivalents (accounting for 4.15%), 2.G. “manufacturing and use of other products”, which was responsible for 100 kilotons of carbon dioxide equivalents (accounting for 0.45%), 2.H. “others”, which was responsible for 15 kilotons of carbon dioxide equivalents (accounting for 0.07%) and 2.D. “Non-Energy Products from Fuels and Solvent Use”, which was responsible for 0.00007 kilotons

of carbon dioxide equivalents (accounting for 0.0000003%), as shown in Figure ES3.5.

### 3. Agriculture Sector

In 2021, the greenhouse gas emissions from the agriculture sector totaled 3,231 kilotons of carbon dioxide equivalents, accounting for 1.09% of the total greenhouse gas emission in Taiwan, approximately down by 18.56% compared to 3,968 kilotons of carbon dioxide equivalents in 2005, with a negative average annual growth rate of -1.28%, as shown in Table ES3.4. Compared to 2020,

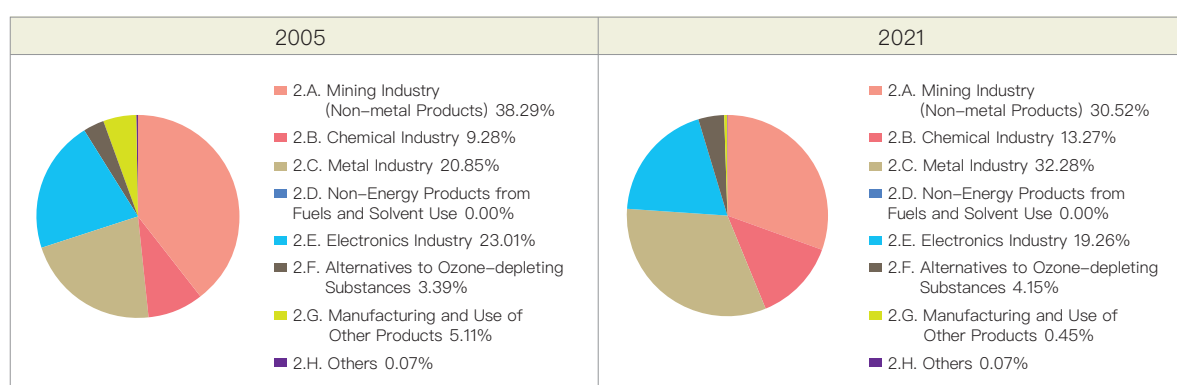


Figure ES3.5 Percentage of Greenhouse Gas Emissions by Industrial Process and Product Use Sectors in Taiwan in (a) 2005 and (b) 2021.

Table ES3.4 1990–2021 Greenhouse Gas Emissions Produced by Agriculture Sector in Taiwan

| GHG Emission Sources and Sinks                          | (Unit: Kilotons of Carbon Dioxide Equivalents) |              |              |              |              |              |              |              |              |              |              |
|---|--|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
|   | 1990   | 1991         | 1992         | 1993         | 1994         | 1995         | 1996         | 1997         | 1998         | 1999         | 2000         |
| <b>Total CO<sub>2</sub> Emission (3.H Urea applied)</b> | 142  | 146          | 139          | 131          | 135          | 151          | 151          | 134          | 127          | 118          | 131          |
| <b>Total CH<sub>4</sub> Emission</b>                    | 2,914  | 3,100        | 3,018        | 3,025        | 3,012        | 3,079        | 3,085        | 2,672        | 2,421        | 2,517        | 2,511        |
| 3.A Livestock Gastrointestinal Fermentation             | 670  | 731          | 738          | 775          | 789          | 822          | 822          | 732          | 674          | 694          | 692          |
| 3.B Livestock Waste Treatment                           | 1,112  | 1,304        | 1,266        | 1,282        | 1,312        | 1,371        | 1,398        | 1,062        | 884          | 971          | 1,003        |
| 3.C Rice Culturing                                      | 1,094  | 1,040        | 968          | 946          | 891          | 879          | 858          | 871          | 858          | 845          | 802          |
| 3.F Field Burning of Agricultural Residues              | 38   | 25           | 48           | 22           | 21           | 7            | 7            | 7            | 6            | 7            | 14           |
| <b>Total N<sub>2</sub>O Emission</b>                    | 1,994  | 2,048        | 1,977        | 2,008        | 1,997        | 1,990        | 2,028        | 1,800        | 1,683        | 1,664        | 1,878        |
| 3.B Livestock Waste Treatment                           | 145  | 164          | 163          | 165          | 173          | 180          | 188          | 160          | 145          | 154          | 158          |
| 3.D Agricultural Soil                                   | 1,837  | 1,876        | 1,799        | 1,836        | 1,818        | 1,808        | 1,838        | 1,637        | 1,536        | 1,508        | 1,717        |
| 3.F Field Burning of Agricultural Residues              | 12   | 8            | 15           | 7            | 6            | 2            | 2            | 2            | 2            | 2            | 4            |
| <b>Total Emission From Agriculture Sector</b>           | <b>5,049</b>                                   | <b>5,294</b> | <b>5,134</b> | <b>5,164</b> | <b>5,144</b> | <b>5,220</b> | <b>5,263</b> | <b>4,605</b> | <b>4,231</b> | <b>4,300</b> | <b>4,520</b> |
| GHG Emission Sources and Sinks                          | 2001   | 2002         | 2003         | 2004         | 2005         | 2006         | 2007         | 2008         | 2009         | 2010         | 2011         |
| <b>Total CO<sub>2</sub> Emission (3.H Urea applied)</b> | 94   | 93           | 82           | 84           | 62           | 59           | 57           | 57           | 55           | 54           | 53           |
| <b>Total CH<sub>4</sub> Emission</b>                    | 2,425  | 2,290        | 2,188        | 2,110        | 2,228        | 2,197        | 2,116        | 2,056        | 2,006        | 2,003        | 2,034        |
| 3.A Livestock Gastrointestinal Fermentation             | 660  | 636          | 626          | 614          | 623          | 614          | 609          | 584          | 571          | 578          | 590          |
| 3.B Livestock Waste Treatment                           | 959  | 913          | 909          | 915          | 957          | 945          | 888          | 861          | 825          | 831          | 843          |
| 3.C Rice Culturing                                      | 792  | 729          | 644          | 574          | 640          | 630          | 616          | 604          | 605          | 589          | 596          |
| 3.F Field Burning of Agricultural Residues              | 15   | 13           | 9            | 8            | 8            | 8            | 5            | 6            | 5            | 5            | 5            |
| <b>Total N<sub>2</sub>O Emission</b>                    | 1,800  | 1,805        | 1,672        | 1,787        | 1,678        | 1,708        | 1,668        | 1,585        | 1,615        | 1,596        | 1,538        |
| 3.B Livestock Waste Treatment                           | 152  | 147          | 148          | 147          | 153          | 153          | 146          | 145          | 141          | 141          | 142          |
| 3.D Agricultural Soil                                   | 1,644  | 1,654        | 1,522        | 1,638        | 1,523        | 1,552        | 1,521        | 1,439        | 1,473        | 1,454        | 1,394        |
| 3.F Field Burning of Agricultural Residues              | 5  | 4            | 3            | 2            | 2            | 2.6          | 1.4          | 1.9          | 1.6          | 1.6          | 1.7          |
| <b>Total Emission From Agriculture Sector</b>           | <b>4,320</b>                                   | <b>4,188</b> | <b>3,943</b> | <b>3,980</b> | <b>3,968</b> | <b>3,964</b> | <b>3,842</b> | <b>3,698</b> | <b>3,677</b> | <b>3,653</b> | <b>3,625</b> |

Continued from the table below

Continued from the above table

| GHG Emission Sources and Sinks                    | 2012  | 2013  | 2014  | 2015  | 2016  | 2017  | 2018  | 2019  | 2020  | 2021  |
|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Total CO <sub>2</sub> Emission (3.H Urea applied) | 55    | 45    | 40    | 38    | 34    | 31    | 30    | 29    | 29    | 27    |
| Total CH <sub>4</sub> Emission                    | 2,010 | 1,997 | 1,947 | 1,927 | 1,933 | 1,932 | 1,932 | 1,942 | 1,938 | 1,883 |
| 3.A Livestock Gastrointestinal Fermentation       | 583   | 579   | 566   | 573   | 561   | 564   | 572   | 575   | 580   | 593   |
| 3.B Livestock Waste Treatment                     | 807   | 781   | 750   | 744   | 740   | 738   | 743   | 754   | 755   | 752   |
| 3.C Rice Culturing                                | 614   | 634   | 626   | 605   | 629   | 626   | 615   | 611   | 602   | 537   |
| 3.F Field Burning of Agricultural Residues        | 5     | 3     | 4     | 5     | 3     | 3     | 2     | 2     | 1     | 1     |
| Total N <sub>2</sub> O Emission                   | 1,563 | 1,495 | 1,488 | 1,457 | 1,455 | 1,404 | 1,384 | 1,328 | 1,375 | 1,322 |
| 3.B Livestock Waste Treatment                     | 139   | 137   | 136   | 136   | 138   | 139   | 141   | 145   | 146   | 146   |
| 3.D Agricultural Soil                             | 1,422 | 1,357 | 1,351 | 1,320 | 1,316 | 1,264 | 1,242 | 1,182 | 1,229 | 1,175 |
| 3.F Field Burning of Agricultural Residues        | 1.7   | 1.0   | 1.1   | 1.4   | 1.0   | 1.1   | 0.8   | 0.8   | 0.4   | 0.3   |
| Total Emission From Agriculture Sector            | 3,628 | 3,538 | 3,475 | 3,422 | 3,422 | 3,367 | 3,346 | 3,299 | 3,343 | 3,231 |

the greenhouse gas emissions from the agriculture sector in 2021 slightly fall by 3.32%. In particular, greenhouse gas emissions from 3.D “agricultural soil” accounted for 36.37%, greenhouse gas emissions from 3.B “livestock waste treatment” accounted for 27.78%, greenhouse gas emissions from 3.A “livestock gastrointestinal fermentation” accounted for 18.36%, greenhouse gas emissions from 3.C “rice culturing” accounted for 16.62%, greenhouse gas emissions from 3.H “urea use” accounted for 0.82%, and greenhouse gas emissions from 3.F “field burning of agricultural residues” accounted for 0.04%, as shown in Figure ES3.6.

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

The main greenhouse gas sequestered by the land use, land use change and forestry (LULUCF) sector is carbon dioxide, while the change in the annual sequestration does not vary much with the exception of trends in minor fluctuations for the sequestration in the past. It is mainly because of the increased sequestration from the annual growth of forest resources while the sequestration reduced from the increased sequestration

of forestation and the forest interference is less. The greenhouse gas emission from land use and forestry sector in Taiwan from 1990 to 2021 (mainly consisting of carbon dioxide sequestration by forestry resources) is shown in Table ES3.5.

The carbon dioxide sequestration by forestry sector in 2005 was 22,290 kilotons of carbon dioxide equivalents. The carbon dioxide sequestration between 2005 and 2021 decreased by 1.97% with a negative average annual growth rate of -0.12%. The sequestration in 2021 was 21,850 kilotons of carbon dioxide equivalents, down by 0.25% compared with 2020.

#### 5. Waste sector

In 2005, the greenhouse gas emissions by waste sector were 7,329 kilotons of carbon dioxide equivalents. The emissions from the waste sector in 2021 were 2,679 kilotons of carbon dioxide equivalents, approximately accounting for 0.90% of the total greenhouse gas emission in Taiwan, down by 63.44% compared with 2005, with a negative average annual growth rate of -6.10% (as shown in Table ES3.6). Compared to 2020, the greenhouse gas

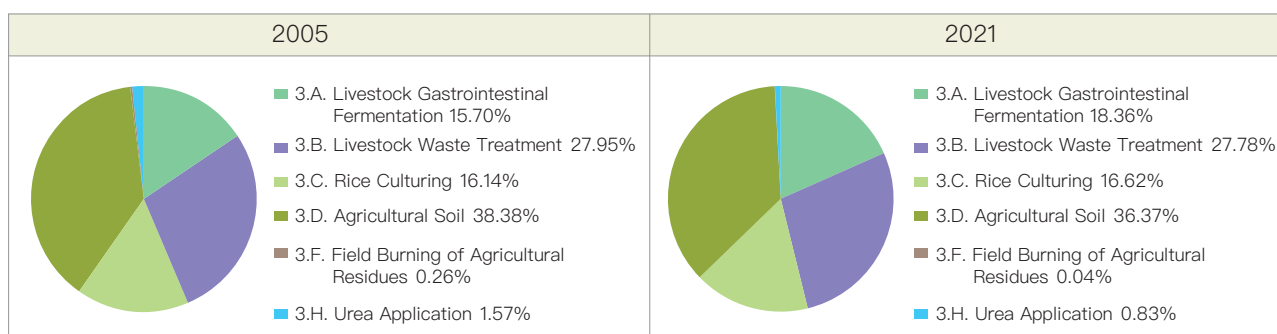


Figure ES3.6 Percentage of Greenhouse Gas Emissions by Agriculture Sectors in Taiwan in (a) 2005 and (b) 2021.



Table ES3.5 1990–2021 Changes in Carbon Sequestration by LULUCF Sector in Taiwan

(Unit: Kilotons of Carbon Dioxide Equivalents)

| GHG Emission Sources and Sinks                          |   | 1990               | 1991               | 1992    | 1993    | 1994    | 1995    | 1996    | 1997    | 1998               | 1999    | 2000    |
|---|---|--------------------|--------------------|---------|---------|---------|---------|---------|---------|--------------------|---------|---------|
| 4.A.1 Forests<br>Maintaining Forests                    | Biomass Carbon Sequestration<br>( $\Delta$ CO <sub>2g</sub> ) | -23,902            | -23,902            | -23,741 | -23,580 | -23,418 | -23,257 | -23,095 | -22,934 | -22,772            | -22,611 | -22,449 |
|   | Biomass Carbon Emissions<br>( $\Delta$ CO <sub>2a</sub> )     | 607.25             | 2,503 <sup>1</sup> | 333     | 216     | 190     | 202     | 559     | 266     | 326                | 401     | 389     |
| 4.A.2 Other Lands<br>Turned to Forests                  | Biomass Carbon Sequestration<br>( $\Delta$ CO <sub>2g</sub> ) | -91                | -91                | -136    | -182    | -230    | -285    | -315    | -392    | -440               | -553    | -656    |
| Total Carbon Sequestration ( $\Delta$ CO <sub>2</sub> ) |   | -23,386            | -21,490            | -23,544 | -23,546 | -23,459 | -23,340 | -22,851 | -23,060 | -22,887            | -22,764 | -22,717 |
| GHG Emission Sources and Sinks                          |   | 2001               | 2002               | 2003    | 2004    | 2005    | 2006    | 2007    | 2008    | 2009               | 2010    | 2011    |
| 4.A.1 Forests<br>Maintaining Forests                    | Biomass Carbon Sequestration<br>( $\Delta$ CO <sub>2g</sub> ) | -22,288            | -22,127            | -21,965 | -21,804 | -21,642 | -21,481 | -21,319 | -21,158 | -20,997            | -20,889 | -20,907 |
|   | Biomass Carbon Emissions<br>( $\Delta$ CO <sub>2a</sub> )     | 1,112 <sup>2</sup> | 167                | 227     | 243     | 369     | 251     | 308     | 199     | 2,753 <sup>3</sup> | 218     | 140     |
| 4.A.2 Other Lands<br>Turned to Forests                  | Biomass Carbon Sequestration<br>( $\Delta$ CO <sub>2g</sub> ) | -673               | -747               | -886    | -981    | -1,016  | -1,029  | -1,062  | -1,123  | -1,145             | -1,218  | -1,181  |
| Total Carbon Sequestration ( $\Delta$ CO <sub>2</sub> ) |   | -21,850            | -22,707            | -22,624 | -22,542 | -22,290 | -22,259 | -22,074 | -22,082 | -19,388            | -21,889 | -21,947 |
| GHG Emission Sources and Sinks                          |   | 2012               | 2013               | 2014    | 2015    | 2016    | 2017    | 2018    | 2019    | 2020               | 2021    |         |
| 4.A.1 Forests<br>Maintaining Forests                    | Biomass Carbon Sequestration<br>( $\Delta$ CO <sub>2g</sub> ) | -20,932            | -20,970            | -21,004 | -21,040 | -21,068 | -21,105 | -21,148 | -21,202 | -21,271            | -21,318 |         |
|   | Biomass Carbon Emissions<br>( $\Delta$ CO <sub>2a</sub> )     | 145                | 135                | 197     | 189     | 153     | 107     | 83      | 116     | 90                 | 121     |         |
| 4.A.2 Other Lands<br>Turned to Forests                  | Biomass Carbon Sequestration<br>( $\Delta$ CO <sub>2g</sub> ) | -1,173             | -1,139             | -1,079  | -1,049  | -1,011  | -963    | -918    | -831    | -724               | -654    |         |
| Total Carbon Sequestration ( $\Delta$ CO <sub>2</sub> ) |   | -21,960            | -21,974            | -21,886 | -21,900 | -21,926 | -21,961 | -21,984 | -21,917 | -21,905            | -21,850 |         |

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.

emissions from the waste sector in 2021 were grown by 2.92%. Among the waste sector's emissions in 2021, greenhouse gas emissions from 5.D "wastewater treatment and discharge" accounted for 58.84%, followed by greenhouse gas emissions from 5.A "solid waste disposal", accounting for 20.30%, greenhouse gas emissions from 5.C "waste incineration and opening burning", accounting for 18.99%, greenhouse gas emissions from 5.B "waste biological disposal", accounting for 1.87%, as shown in Figure ES3.7.

#### ES.4 Other Information

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

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

Table ES3.6 1990–2021 Greenhouse Gas Emissions in Taiwan by Waste Sector

(Unit: Kilotons of Carbon Dioxide Equivalents)

| GHG Emission Sources and Sinks   | 1990         | 1991         | 1992         | 1993         | 1994         | 1995          | 1996          | 1997          | 1998          | 1999          | 2000          |
|--|--------------|--------------|--------------|--------------|--------------|---------------|---------------|---------------|---------------|---------------|---------------|
| <b>Total CO<sub>2</sub> Emission</b><br>(5.C Incineration and Open Burning of Waste) | 20           | 8            | 65           | 63           | 110          | 398           | 387           | 105           | 117           | 65            | 259           |
| <b>Total CH<sub>4</sub> Emission</b>   | 7,257        | 7,416        | 7,455        | 7,839        | 8,595        | 9,277         | 9,675         | 9,803         | 9,933         | 10,098        | 9,457         |
| 5.A Solid Waste Disposal   | 5,833        | 5,919        | 5,930        | 6,325        | 7,063        | 7,721         | 8,082         | 8,215         | 8,376         | 8,608         | 8,030         |
| 5.B Solid Waste Biological Disposal  | 11           | 0.5          | 0.8          | 0.5          | 0.1          | 0.6           | 0.3           | 1.4           | 0.05          | 1.9           | 0.3           |
| 5.D Wastewater Treatment and Discharge   | 1,412        | 1,497        | 1,525        | 1,514        | 1,532        | 1,555         | 1,593         | 1,587         | 1,557         | 1,488         | 1,427         |
| <b>Total N<sub>2</sub>O Emission</b>   | 296          | 285          | 298          | 311          | 313          | 334           | 337           | 337           | 321           | 329           | 331           |
| 5.B Solid Waste Biological Disposal  | 10           | 0.5          | 0.7          | 0.4          | 0.1          | 0.6           | 0.2           | 1.3           | 0.05          | 1.7           | 0.2           |
| 5.C Waste Burn   | 1.1          | 0.4          | 4            | 3            | 6            | 18            | 19            | 4             | 6             | 3             | 8             |
| 5.D Wastewater Treatment and Discharge   | 285          | 284          | 294          | 307          | 307          | 316           | 318           | 332           | 315           | 324           | 322           |
| <b>Total Emission from Waste Sector</b>  | <b>7,573</b> | <b>7,709</b> | <b>7,818</b> | <b>8,214</b> | <b>9,018</b> | <b>10,009</b> | <b>10,399</b> | <b>10,245</b> | <b>10,370</b> | <b>10,493</b> | <b>10,047</b> |
| GHG Emission Sources and Sinks   | 2001         | 2002         | 2003         | 2004         | 2005         | 2006          | 2007          | 2008          | 2009          | 2010          | 2011          |
| <b>Total CO<sub>2</sub> Emission</b><br>(5.C Incineration and Open Burning of Waste) | 540          | 612          | 418          | 512          | 348          | 470           | 562           | 443           | 154           | 208           | 149           |
| <b>Total CH<sub>4</sub> Emission</b>   | 8,726        | 8,235        | 7,767        | 7,171        | 6,631        | 6,042         | 5,553         | 4,972         | 4,420         | 3,913         | 3,523         |
| 5.A Solid Waste Disposal   | 7,311        | 6,830        | 6,322        | 5,777        | 5,231        | 4,666         | 4,144         | 3,608         | 3,072         | 2,601         | 2,226         |
| 5.B Solid Waste Biological Disposal  | 0.02         | 0.4          | 2            | 7            | 10           | 11            | 14            | 16            | 18            | 21            | 26            |
| 5.D Wastewater Treatment and Discharge   | 1,416        | 1,404        | 1,443        | 1,387        | 1,391        | 1,365         | 1,395         | 1,348         | 1,330         | 1,290         | 1,271         |
| <b>Total N<sub>2</sub>O Emission</b>   | 340          | 348          | 353          | 343          | 350          | 318           | 328           | 300           | 295           | 302           | 314           |
| 5.B Solid Waste Biological Disposal  | 0.02         | 0.3          | 2            | 6            | 9            | 10            | 13            | 15            | 16            | 19            | 23            |
| 5.C Waste Burn   | 30           | 26           | 24           | 23           | 27           | 30            | 30            | 21            | 9             | 11            | 9             |
| 5.D Wastewater Treatment and Discharge   | 310          | 321          | 327          | 314          | 314          | 278           | 285           | 265           | 270           | 273           | 282           |
| <b>Total Emission from Waste Sector</b>  | <b>9,606</b> | <b>9,195</b> | <b>8,538</b> | <b>8,026</b> | <b>7,329</b> | <b>6,830</b>  | <b>6,443</b>  | <b>5,715</b>  | <b>4,868</b>  | <b>4,423</b>  | <b>3,986</b>  |
| GHG Emission Sources and Sinks   | 2012         | 2013         | 2014         | 2015         | 2016         | 2017          | 2018          | 2019          | 2020          | 2021          |               |
| <b>Total CO<sub>2</sub> Emission</b><br>(5.C Incineration and Open Burning of Waste) | 149          | 153          | 146          | 103          | 132          | 129           | 159           | 214           | 297           | 499           |               |
| <b>Total CH<sub>4</sub> Emission</b>   | 3,194        | 2,849        | 2,647        | 2,442        | 2,342        | 2,228         | 2,211         | 2,091         | 1,925         | 1,808         |               |
| 5.A Solid Waste Disposal   | 1,890        | 1,598        | 1,351        | 1,141        | 970          | 835           | 723           | 645           | 596           | 544           |               |
| 5.B Solid Waste Biological Disposal  | 24           | 23           | 20           | 20           | 20           | 20            | 23            | 25            | 26            | 26            |               |
| 5.D Wastewater Treatment and Discharge   | 1,279        | 1,228        | 1,275        | 1,281        | 1,352        | 1,373         | 1,465         | 1,421         | 1,303         | 1,238         |               |
| <b>Total N<sub>2</sub>O Emission</b>   | 313          | 323          | 332          | 342          | 330          | 377           | 368           | 388           | 382           | 372           |               |
| 5.B Solid Waste Biological Disposal  | 22           | 20           | 18           | 18           | 18           | 18            | 21            | 22            | 23            | 24            |               |
| 5.C Waste Burn   | 9            | 9            | 9            | 6            | 7            | 7             | 7             | 8             | 9             | 10            |               |
| 5.D Wastewater Treatment and Discharge   | 282          | 294          | 305          | 318          | 306          | 352           | 340           | 358           | 349           | 339           |               |
| <b>Total Emission from Waste Sector</b>  | <b>3,655</b> | <b>3,325</b> | <b>3,125</b> | <b>2,886</b> | <b>2,804</b> | <b>2,734</b>  | <b>2,738</b>  | <b>2,693</b>  | <b>2,603</b>  | <b>2,679</b>  |               |

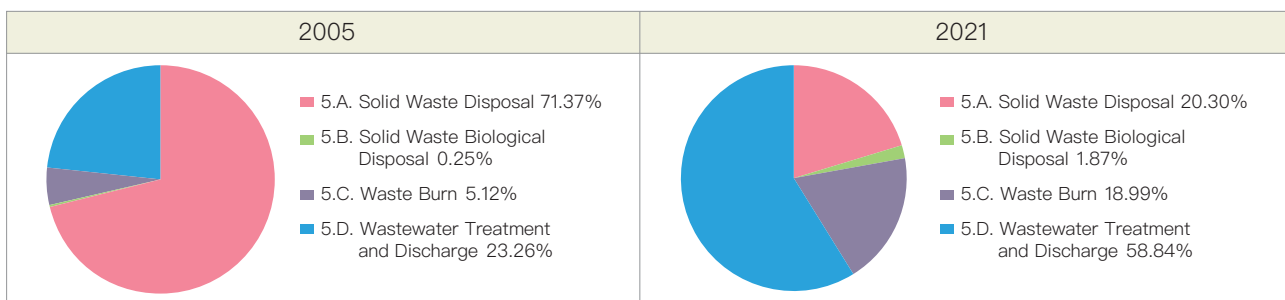


Figure ES3.7 Percentage of Greenhouse Gas Emissions by Waste Sectors in Taiwan in (a) 2005 and (b) 2021.

# 2023 TAIWAN REPUBLIC OF CHINA NATIONAL GREENHOUSE GAS INVENTORY REPORT Report Summary



Environmental Protection Administration  
Executive Yuan, R.O.C. (TAIWAN)