

Technical Support Document – Section 202 Greenhouse Gas Emissions

Roadmap to Annex

This Annex describes greenhouse gas emissions information from Section 202 source categories. The Annex provides an overview of the Section 202 source categories, beginning with a description of how the emissions data from the *Inventory of U.S. Greenhouse Gas Emissions and Sinks* map to these source categories. Then, relevant emissions data are presented by gas (CO₂, CH₄, N₂O, HFCs,) and comparisons are made between U.S. greenhouse gas emissions from the respective source category and other domestic and global emissions data. Within the discussion of each gas, greenhouse gas emissions are expressed as a share of:

- As a share of total global aggregated emissions of the 6 greenhouse gases included in the definition of “air pollution”;
- As a share of total aggregated U.S. emissions of these greenhouse gases;
- As a share of aggregated U.S. greenhouse gas emissions for existing motor vehicles and engines;
- As a share of global emissions of that individual greenhouse gas; and
- As a share of total U.S. emissions of that individual greenhouse gas, including comparisons to the magnitude of emissions of that gas from other non-transport related source categories.

(1) Overview of Section 202 source categories

To support the Administrator’s assessment of what greenhouse gases “cause or contribute” to the air pollution that endangers, EPA has analyzed historical greenhouse gas emissions data for motor vehicles and motor vehicle engines in the U.S. from 1990 to 2006 (the most recent year for which official EPA estimates are available). The motor vehicles and motor vehicle engines addressed include:

- Passenger cars
- Light-duty trucks
- Motorcycles
- Buses
- Medium/heavy-duty trucks
- Cooling¹

The source of the emissions data is the *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006 (U.S.EPA #430-R-08-005* (hereinafter “U.S. Inventory”). The *U.S. Inventory* is organized around the source classification scheme put forth by the Intergovernmental Panel Climate on Climate Change, in which emissions from motor vehicles and motor vehicle engines are reported within two different sectors: Energy and Industrial Processes. Table TSD-A.1 describes the correspondence between Section 202 greenhouse gas emission source categories and IPCC source categories:

Table TSD-A.1 – Source categories included under Section 202

Section 202 Source	IPCC Sector	IPCC Source Category	Greenhouse Gases
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¹ Greenhouse gas emissions result from the use of HFCs in cooling systems designed for passenger comfort, as well as auxiliary systems for refrigeration.

Category			
Passenger Cars	Energy	1A3b (i) Cars	CO ₂ , CH ₄ , N ₂ O
Light-Duty Trucks	Energy	1A3b (ii) Light-duty trucks	CO ₂ , CH ₄ , N ₂ O
Motorcycles	Energy	1A3b (iv) Motorcycles	CO ₂ , CH ₄ , N ₂ O
Buses	Energy	1A3b (iii) Heavy-duty trucks and buses	CO ₂ , CH ₄ , N ₂ O
Medium/Heavy-Duty Trucks	Energy	1A3b (iii) Heavy-duty trucks and buses	CO ₂ , CH ₄ , N ₂ O
Cooling (all transportation sources)	Industrial Processes	2F1 Refrigeration and Air Conditioning Equipment	Hydrofluorocarbons (HFCs)

Greenhouse gas emissions from aviation, pipelines, railways, and marine transport (not for cooling/refrigeration) are included in the IPCC Energy Sector under 1A3 but are not included within the Section 202 definition.

(2) Greenhouse gas emissions from Section 202 source categories (CO₂, CH₄, N₂O, and HFCs)

Table TSD-A.2 presents estimates of historical emissions of all greenhouse gases (CO₂, CH₄, N₂O, and HFCs) from Section 202 source categories from 1990-2006, in carbon dioxide equivalent units (Tg CO₂e).² Passenger cars (39 percent), light-duty trucks (32 percent), and medium/heavy-duty trucks (24 percent) emitted the largest shares of greenhouse gas emissions in 2006, followed by cooling (4.2 percent), buses (0.68 percent) and motorcycles (0.11 percent). From 1990 to 2006, greenhouse gas emissions from Section 202 source categories grew by 35 percent due, in part, to increased demand for travel and the stagnation of fuel efficiency across the U.S. vehicle fleet. Since the 1970s, the number of highway vehicles registered in the U.S. has increased faster than the overall population, according to the Federal Highway Administration (FHWA). Likewise, the number of miles driven (up 41 percent from 1990 to 2006) and the gallons of gasoline consumed each year in the U.S. have trended upward since the 1980s, according to the FHWA and Energy Information Administration, respectively.³ These increases in motor vehicle usage are the result of a confluence of factors including population growth, economic growth, urban sprawl, generally low fuel prices, and increasing popularity of sport utility vehicles and other light-duty trucks that tend to have lower fuel efficiency.

Table TSD-A.2 – Greenhouse gas emissions from Section 202 source categories – All Gases (Tg CO₂e)

Section 202 Sources	1990	1995	2000	2001	2002	2003	2004	2005	2006
Passenger Cars	656.9	633.9	670.3	673.1	686.5	664.4	660.7	677.3	651.2
Light-Duty Trucks	336.2	428.6	489.5	492.7	502.6	536.2	556.9	516.3	528.2
Motorcycles	1.8	1.8	1.9	1.7	1.7	1.7	1.8	1.6	1.9
Buses	8.3	9.1	10.9	10.0	9.7	10.5	14.7	11.8	12.1
Medium/Heavy-Duty Trucks	228.8	272.4	342.9	342.0	356.2	352.6	365.4	393.2	402.5
Cooling (all trans. sources)	0.0	18.6	52.6	57.2	61.1	64.4	67.8	69.7	69.5
Total	1231.9	1364.4	1568.1	1576.8	1617.9	1629.7	1667.4	1670.0	1665.4

² A Tg is one teragram, or one million metric tons.

³ Gasoline consumption declined from 2005-2006.

Between 1990 and 2006, greenhouse gas emissions from passenger cars decreased 0.9 percent, while emissions from light-duty trucks increased 57 percent, largely due to the increased use of sport-utility vehicles and other light-duty trucks. Meanwhile, greenhouse gas emissions from heavy-duty trucks increased 76 percent, reflecting the increased volume of total freight movement and an increasing share transported by trucks. In 1990 there were no hydrofluorocarbons (HFCs) used in vehicle cooling systems. HFCs were gradually introduced into motor vehicle air conditioning and refrigerating systems during the 1990s as chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) started to phase out of production as required under the Montreal Protocol and Title VI of the Clean Air Act.

Table TSD-A.3 presents estimates of total greenhouse gas emissions from Section 202 source categories by gas, in CO₂ equivalent units. In 2006, the CO₂ made up the largest share of emissions (94 percent), followed by HFCs (4.2 percent), N₂O (1.8 percent) and CH₄ (0.11 percent). Since 1990, the share of HFCs has increased (from zero in 1990), whereas the share of the other gases have correspondingly decreased⁴. Methane and N₂O emissions have decreased in absolute terms since 1990.

Table TSD-A.3 - Greenhouse gas emissions from Section 202 source categories by gas (Tg CO₂e)

Section 202 Sources	1990	1995	2000	2001	2002	2003	2004	2005	2006
CO ₂	1187.3	1291.9	1463.8	1470.5	1512.0	1524.2	1561.4	1565.6	1564.6
<i>Share of Sec 202 GHGs</i>	96%	95%	93%	93%	93%	94%	94%	94%	94%
CH ₄	4.2	3.8	2.9	2.8	2.4	2.2	2.1	1.9	1.8
<i>Share of Sec 202 GHGs</i>	0.34%	0.28%	0.18%	0.18%	0.15%	0.14%	0.13%	0.12%	0.11%
N ₂ O	40.4	50.1	48.8	46.4	42.3	38.9	36.1	32.7	29.5
<i>Share of Sec 202 GHGs</i>	3.3%	3.7%	3.1%	2.9%	2.6%	2.4%	2.2%	2.0%	1.8%
HFCs	0.0	18.6	52.6	57.2	61.1	64.4	67.8	69.7	69.5
<i>Share of Sec 202 GHGs</i>	0.0%	1.4%	3.4%	3.6%	3.8%	4.0%	4.1%	4.2%	4.2%
Total GHGs	1231.9	1364.4	1568.1	1576.8	1617.9	1629.7	1667.4	1670.0	1665.4

Table TSD-A.4 presents estimates of greenhouse gas emissions from Section 202 source categories alongside total U.S. emissions. The table also presents emissions from the electricity generation and industrial sectors for comparison. In 1990, Section 202 source categories emitted 20 percent of total U.S. emissions, behind the electricity generation sector (30 percent) and the industrial sector (24 percent). By 2006, Section 202 source categories collectively were the second largest sector with 24 percent of total U.S. emissions.

Table TSD-A.4 – Sectoral comparison to total U.S. greenhouse gas emissions – all gases (Tg CO₂e)

U.S. Emissions	1990	1995	2000	2001	2002	2003	2004	2005	2006
Section 202 GHG emissions	1231.9	1364.4	1568.1	1576.8	1617.9	1629.7	1667.4	1670.0	1665.4
<i>Share of U.S. (%)</i>	20%	21%	22%	22%	23%	23%	23%	23%	24%

⁴ Estimates of HFC emissions included in Tables TSD-A.3 and A.15 - 17 include a small share of emissions resulting from sources not included under Section 202 (e.g., nonroad and agricultural vehicles). As the majority of air conditioning and cooling systems are related to road transport, the effect of this overestimate is expected to be negligible. See U.S. Inventory (www.epa.gov/climatechange/emissions), Chapter 4.

Electricity Sector emissions	1859.1	1989.7	2328.9	2290.9	2300.4	2329.4	2363.4	2430.0	2377.8
<i>Share of U.S. (%)</i>	30%	31%	33%	33%	33%	33%	33%	34%	34%
Industrial Sector emissions	1460.3	1478.0	1432.9	1384.3	1384.9	1375.5	1388.9	1354.3	1371.5
<i>Share of U.S. (%)</i>	24%	23%	20%	20%	20%	20%	20%	19%	19%
Total U.S. GHG emissions	6148.3	6494.0	7032.6	6921.3	6981.2	6998.2	7078.0	7129.9	7054.2

Table TSD-A.5 compares estimates of total greenhouse gas emissions from Section 202 source categories to all U.S. greenhouse gas emissions, global greenhouse emissions from the transport sector (as defined by IPCC), and total global greenhouse gas emissions from all source categories for the year 2000.⁵ Section 202 greenhouse gas emissions are a significantly larger share of global transport greenhouse gas emissions (30 percent) than the corresponding share of all U.S. greenhouse gas emissions to the global total (22 percent), reflecting the relative size of the transport sector in the U.S. compared to the global average. Section 202 greenhouse gas emissions were 4.3 percent of total global emissions in 2000. The global transport sector was 14 percent of all global emissions in 2000.

Table TSD-A.5 – Comparison of Section 202 source emissions to global greenhouse gas emissions – all gases (Tg CO₂e)

U.S. and Global Emissions	2000	Sec 202 Share
All U.S. GHG emissions	7,033	22%
Global transport GHG emissions	5,315	30%
All global GHG emissions	36,728	4.3%

(a) Carbon dioxide emissions from Section 202 source categories

Carbon dioxide is emitted from motor vehicles and motor vehicle engines during the fossil fuel combustion process. During combustion, the carbon (C) stored in the fuels is oxidized and emitted as CO₂ and smaller amounts of other carbon compounds.

As the dominant greenhouse gas emitted from motor vehicles and motor vehicle engines (94 percent of total emissions in 2006), CO₂ emission trends in Table TSD-A.6 mirror those of the greenhouse gas emissions total. Carbon dioxide emissions grew by 32 percent between 1990 and 2006. Most of this growth occurred as a result of increased CO₂ emissions from light-duty trucks (60.5 percent) and medium/heavy-duty trucks (76 percent). Emissions from passenger cars did not grow over the same time period.

⁵ The year 2000 is the most recent year for which comprehensive greenhouse gas emissions data are available for all gases, all countries, and all sources. Global estimates are ‘gross’ emissions estimates and do not include removals of greenhouse gas emissions from the atmosphere by terrestrial sinks (i.e., forests and other biomass). Global data come from the World Resources Institute’s Climate Analysis Indicators Tool, which contains national data submitted by Parties to the UNFCCC, and other independent and peer-reviewed datasets (e.g., International Energy Agency).

Table TSD-A.6 – CO₂ emissions from Section 202 source categories (Tg CO₂)

Sec. 202 Source Categories	1990	1995	2000	2001	2002	2003	2004	2005	2006
Passenger Cars	628.8	604.9	643.5	647.9	662.6	642.1	640.0	658.4	634.5
Light-Duty Trucks	320.7	405.0	466.0	470.3	483.2	518.8	540.8	501.9	514.9
Motorcycles	1.7	1.8	1.8	1.7	1.7	1.6	1.7	1.6	1.9
Buses	8.3	9.0	10.9	10.0	9.6	10.5	14.7	11.8	12.1
Medium/Heavy-Duty Trucks	227.8	271.2	341.5	340.6	354.8	351.2	364.1	391.9	401.3
Cooling (all trans. Sources)	na	na	na	na	na	na	na	na	na
Total	1187.3	1291.9	1463.8	1470.5	1512.0	1524.2	1561.4	1565.6	1564.6

Table TSD-A.7 presents estimates of CO₂ emissions from Section 202 source categories alongside total U.S. CO₂ emissions. The table also presents emissions from the electricity generation and industrial sectors for comparison. In 1990, Section 202 source categories emitted 23 percent of total U.S. CO₂ emissions, behind the electricity generation sector (36 percent), and ahead of the industrial sector (19 percent). By 2006, Section 202 source categories collectively remained the second largest sector with 26 percent of total U.S. CO₂ emissions.

Table TSD-A.7 - Sectoral comparison to total U.S. CO₂ emissions (Tg CO₂)

U.S. CO₂ Emissions	1990	1995	2000	2001	2002	2003	2004	2005	2006
Section 202 CO ₂ emissions	1187.3	1291.9	1463.8	1470.5	1512.0	1524.2	1561.4	1565.6	1564.6
<i>Share of U.S. CO₂ (%)</i>	23%	24%	25%	25%	26%	26%	26%	26%	26%
Electricity Sector CO ₂	1829.7	1964.6	2310.8	2273.0	2283.0	2313.2	2346.2	2412.3	2360.3
<i>Share of U.S. CO₂ (%)</i>	36%	36%	39%	39%	39%	39%	39%	40%	39%
Industrial Sector CO ₂	947.5	977.3	967.3	943.2	943.0	948.4	974.7	965.3	984.1
<i>Share of U.S. CO₂ (%)</i>	19%	18%	16%	16%	16%	16%	16%	16%	16%
Total U.S. CO₂ emissions	5068.5	5394.2	5939.7	5846.2	5908.6	5952.7	6038.2	6074.3	5983.1

Table TSD-A.8 compares estimates of total CO₂ emissions from Section 202 source categories to total U.S. emissions, global greenhouse emissions from the transport sector (as defined by IPCC), and total global greenhouse gas emissions from all source categories for the year 2000. Section 202 CO₂ emissions are a significantly larger share of global transport greenhouse gas emissions (28 percent) than the corresponding share of all U.S. CO₂ emissions to the global total (21 percent), reflecting the relative size of the transport sector in the U.S. compared to the global average. Section 202 CO₂ emissions were 4.0 percent of total global greenhouse gas emissions in 2000.

Table TSD-A.8 – Comparison of Section 202 CO₂ to U.S. and global greenhouse gas emissions (Tg CO₂e)

U.S. and Global Emissions	2000	Sec 202 CO₂ Share
All U.S. GHG emissions	7,032.6	21%
All global CO ₂ emissions	30,689.5	4.8%
Global transport GHG emissions	5,315.2	28%
All global GHG emissions	36,727.9	4.0%

(b) Methane emissions from Section 202 source categories

Methane emissions from motor vehicles are a function of the CH₄ content of the motor fuel, the amount of hydrocarbons passing uncombusted through the engine, and any post-combustion control of hydrocarbon emissions (such as catalytic converters).

Table TSD-A.9 shows estimates of the trend in CH₄ emissions from Section 202 source categories since 1990, presented in carbon dioxide equivalents. The combustion of gasoline in passenger cars and light-duty trucks was responsible for the majority (92 percent) of the CH₄ emitted from Section 202 source categories. From 1990 to 2006, CH₄ emissions decreased by 58 percent.

Table TSD-A.9 – CH₄ emissions from Section 202 source categories (Tg CO₂e)

202 Sources	1990	1995	2000	2001	2002	2003	2004	2005	2006
Passenger Cars	2.6	2.1	1.6	1.5	1.4	1.3	1.2	1.1	1.0
Light-Duty Trucks	1.4	1.4	1.1	1.1	0.9	0.8	0.7	0.7	0.7
Motorcycles	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Buses	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Medium/Heavy-Duty Trucks	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Cooling (all trans. sources)	na	na	na	na	na	na	na	na	na
Total	4.2	3.8	2.9	2.8	2.4	2.2	2.1	1.9	1.8

Table TSD-A.10 presents CH₄ emissions estimates from Section 202 source categories alongside total U.S. CH₄ emissions. The table also presents CH₄ emissions from landfills and natural gas systems for comparison. In 2006, Section 202 source categories emitted 0.32 percent of total U.S. CH₄ emissions; landfills (23 percent) and natural gas systems (18 percent) represented a significantly larger share. Overall, total CH₄ emissions decreased by 8 percent (51 Tg or 0.7 percent of U.S. emissions) from 1990 to 2006, in part due to efforts to reduce emissions at individual sources such as landfills and coal mines.

Table TSD-A.10 - Sectoral comparison to total U.S. CH₄ emissions (Tg CO₂e)

U.S. CH₄ Emissions	1990	1995	2000	2001	2002	2003	2004	2005	2006
Section 202 CH ₄ emissions	4.2	3.8	2.9	2.8	2.4	2.2	2.1	1.9	1.8
<i>Share of U.S. CH₄ (%)</i>	<i>0.70%</i>	<i>0.64%</i>	<i>0.50%</i>	<i>0.50%</i>	<i>0.43%</i>	<i>0.40%</i>	<i>0.38%</i>	<i>0.36%</i>	<i>0.32%</i>
Landfill CH ₄ emissions	149.6	144.0	120.8	117.6	120.1	125.6	122.6	123.7	125.7
<i>Share of U.S. CH₄ (%)</i>	<i>25%</i>	<i>24%</i>	<i>21%</i>	<i>21%</i>	<i>21%</i>	<i>22%</i>	<i>22%</i>	<i>23%</i>	<i>23%</i>
Natural Gas CH ₄ emissions	124.7	128.1	126.5	125.3	124.9	123.3	114.0	102.5	102.4
<i>Share of U.S. CH₄ (%)</i>	<i>21%</i>	<i>21%</i>	<i>22%</i>	<i>22%</i>	<i>22%</i>	<i>22%</i>	<i>21%</i>	<i>19%</i>	<i>18%</i>
Total U.S. CH₄ emissions	606.1	598.9	574.3	558.8	563.5	559.4	545.6	539.7	555.3

Table TSD-A.11 compares total CH₄ emissions estimates from Section 202 source categories to U.S. greenhouse gas emissions, global greenhouse emissions from the transport sector (as defined by IPCC), and to total global greenhouse gas emissions from all source categories for the year 2000. Section 202 CH₄ emissions are a significantly smaller share of U.S., global transport, and global emissions in comparison to Section 202 CO₂ emissions.

Table TSD-A.11 – Comparison of Section 202 CH₄ emissions to U.S. and global greenhouse gas emissions (Tg CO₂e)

U.S. and Global Emissions	2000	Sec 202 CH ₄ Share
All U.S. GHG emissions	7,032.6	0.04%
All global CH ₄ emissions	5,854.9	0.05%
Global transport GHG emissions	5,315.2	0.05%
All global GHG emissions	36,727.9	0.01%

(c) Nitrous oxide emissions from Section 202 source categories

Nitrous oxide (N₂O) is a product of the reaction that occurs between nitrogen and oxygen during fuel combustion. Nitrous oxide (and nitrogen oxide (NO_x)) emissions from motor vehicles and motor vehicle engines are closely related to fuel characteristics, air-fuel mixes, combustion temperatures, and the use of pollution control equipment. For example, some types of catalytic converters installed to reduce motor vehicle NO_x, CO, and hydrocarbon emissions can promote the formation of N₂O.

Table TSD-A.12 shows the trend in N₂O emissions estimates from Section 202 source categories since 1990, presented in carbon dioxide equivalents. Section 202 emissions of N₂O decreased by 27 percent from 1990 to 2006. Earlier-generation control technologies initially resulted in higher N₂O emissions, causing a 24 percent increase in N₂O emissions from motor vehicles between 1990 and 1995. Improvements in later-generation emission control technologies have reduced N₂O output, resulting in a 41 percent decrease in N₂O emissions from 1995 to 2006. Overall, N₂O emissions were predominantly from gasoline-fueled passenger cars (49 percent) and light-duty trucks (40 percent) in 2006.

Table TSD-A.12 – N₂O emissions from Section 202 source categories (Tg CO₂e)

202 Sources	1990	1995	2000	2001	2002	2003	2004	2005	2006
Passenger Cars	25.4	26.9	25.2	23.8	22.5	21.0	19.5	17.8	15.6
Light-Duty Trucks	14.1	22.1	22.4	21.3	18.5	16.6	15.3	13.7	12.7
Motorcycles	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Buses	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Medium/Heavy-Duty Trucks	0.8	1.0	1.2	1.2	1.3	1.3	1.3	1.2	1.1
Cooling (all trans. Sources)	na	na	na	na	na	na	na	na	na
Total	40.4	50.1	48.8	46.4	42.3	38.9	36.1	32.7	29.5

Table TSD-A.13 presents N₂O emissions estimates from Section 202 source categories alongside total U.S. N₂O emissions. The table also presents N₂O emissions from agricultural soil management, and nitric acid production, for comparison. In 2006, Section 202 source categories emitted 8.0 percent of total U.S. N₂O emissions, making it the second largest source category. By far the largest source category in the U.S. is agricultural soil management, representing 72 percent of total N₂O emissions in 2006. The third largest source in 2005 was nitric acid production (4.3 percent).

Table TSD-A.13 - Sectoral comparison to total U.S. N₂O emissions (Tg CO₂e)

U.S. N ₂ O Emissions	1990	1995	2000	2001	2002	2003	2004	2005	2006
Section 202 N ₂ O emissions	40.4	50.1	48.8	46.4	42.3	38.9	36.1	32.7	29.5
<i>Share of U.S. N₂O (%)</i>	<i>10.5%</i>	<i>12.7%</i>	<i>12.7%</i>	<i>11.8%</i>	<i>11.3%</i>	<i>10.9%</i>	<i>10.2%</i>	<i>8.8%</i>	<i>8.0%</i>
Agricultural Soil N ₂ O emissions	269.4	264.8	262.1	277.0	262.0	247.3	246.9	265.2	265.0
<i>Share of U.S. N₂O (%)</i>	<i>70%</i>	<i>67%</i>	<i>68%</i>	<i>71%</i>	<i>70%</i>	<i>69%</i>	<i>70%</i>	<i>72%</i>	<i>72%</i>
Nitric Acid N ₂ O emissions	17.0	18.9	18.6	15.1	16.4	15.4	15.2	15.8	15.6
<i>Share of U.S. N₂O (%)</i>	<i>4.4%</i>	<i>4.8%</i>	<i>4.8%</i>	<i>3.8%</i>	<i>4.3%</i>	<i>4.3%</i>	<i>4.3%</i>	<i>4.3%</i>	<i>4.3%</i>
Total U.S. N ₂ O emissions	383.4	395.6	385.9	392.9	376.1	356.6	353.5	370.1	367.9

Table TSD-A.14 compares total N₂O emissions estimates from Section 202 source categories to U.S. greenhouse gas emissions, global greenhouse emissions from the transport sector (as defined by IPCC), and to total global greenhouse gas emissions from all source categories, for the year 2000. Section 202 N₂O emissions are 1.6 percent of global transport emissions and 0.13 percent of all global greenhouse gas emissions.

Table TSD-A.14 – Comparison of Section 202 N₂O emissions to U.S. and global greenhouse gas emissions (Tg CO₂e)

U.S. and Global Emissions	2000	Sec 202 N ₂ O Share
All US GHG emissions	7,032.6	0.69%
All global N ₂ O emission	3,113.8	1.6%
Global transport GHG emissions	5,315.2	0.92%
All global GHG emissions	36,727.9	0.13%

(d) HFC emissions from Section 202 source categories

HFCs (a term which encompasses a group of eleven related compounds) are progressively replacing CFCs and HCFCs in Section 202 cooling and refrigeration systems as they are being phased out under the Montreal Protocol and Title VI of the Clean Air Act.⁶ For example, HFC-134a has become a replacement for CFC-12 in mobile air conditioning systems. A number of HFC blends, containing multiple compounds, have also been introduced. The emissions pathway can be complex, with mobile source HFCs being emitted to the atmosphere during charging of cooling and refrigeration systems, during operation, and during decommissioning/disposal.

Table TSD-A.15 shows the trend in HFC emissions estimates from Section 202 source categories since 1990, presented in carbon dioxide equivalents. The estimates presented are for all Section 202 source categories together due to the fact that the *U.S. Inventory* does not disaggregate data by vehicle mode. HFCs were not used in motor vehicles in 1990, but by 2006 emissions had increased to 69.5 Tg CO₂e. From 1995 to 2006, HFC emission increased by 274%.

Table TSD-A.15 – HFC emissions from Section 202 source categories (Tg CO₂e)

202 HFC Sources	1990	1995	2000	2001	2002	2003	2004	2005	2006
Cooling & refrigerated transport	0.000	18.6	52.6	57.2	61.1	64.4	67.8	69.7	69.5

⁶ 2006 IPCC Guidelines, Volume 3, Chapter 7. Page 43.

Table TSD-A.16 presents HFC emissions estimates from Section 202 source categories alongside total U.S. HFC emissions. The table also presents HFC emissions from HCFC-22 production, and all other end-use applications of substitutes for ozone depleting substances (ODS substitutes), for comparison. In 2006, Section 202 source categories emitted 56 percent of total U.S. HFC emissions, making it the largest source category. Other applications of ODS substitutes (including foam blowing, fire protection, aerosol propellants, solvents, and other applications) accounted for 33 percent. HCFC-22 chemical production results in by-product releases of HFC-23, which accounted for over 99 percent of HFC emissions in 1990, but declined by 2006 and now represents 11 percent.

Table TSD-A.16 - Sectoral comparison to total U.S. HFC emissions (Tg CO₂e)

U.S. HFC Emissions	1990	1995	2000	2001	2002	2003	2004	2005	2006
Section 202 HFC emissions	0.0	18.6	52.6	57.2	61.1	64.4	67.8	69.7	69.5
<i>Share of U.S. HFC (%)</i>	<i>0%</i>	<i>30%</i>	<i>53%</i>	<i>58%</i>	<i>57%</i>	<i>62%</i>	<i>58%</i>	<i>57%</i>	<i>56%</i>
HCFC-22 Production	36.4	33.0	28.6	19.7	21.1	12.3	17.2	15.8	13.8
<i>Share of U.S. HFC (%)</i>	<i>99%</i>	<i>53%</i>	<i>29%</i>	<i>20%</i>	<i>20%</i>	<i>12%</i>	<i>15%</i>	<i>13%</i>	<i>11%</i>
Other ODS Substitutes	0.5	10.3	18.9	21.0	24.1	27.7	31.5	35.9	41.2
<i>Share of U.S. HFC (%)</i>	<i>1%</i>	<i>17%</i>	<i>19%</i>	<i>21%</i>	<i>23%</i>	<i>27%</i>	<i>27%</i>	<i>30%</i>	<i>33%</i>
Total U.S. HFC emissions	36.9	61.8	100.1	97.9	106.3	104.5	116.6	121.4	124.5

Table TSD-A.17 compares total HFC emissions estimates from Section 202 source categories to U.S. greenhouse gas emissions, global greenhouse emissions from the transport sector (as defined by IPCC), and to total global greenhouse gas emissions from all source categories, for the year 2000. Section 202 HFC emissions are 1 percent of global transport emissions and 0.14 percent of all global greenhouse gas emissions.

Table TSD-A.17 – Comparison of Section 202 HFC emission to U.S. and global greenhouse gas emissions (Tg CO₂e)

U.S. and Global Emissions	2000	Sec 202 HFC Share
All U.S. GHG emissions	7,032.6	0.75%
All global HFC emission	259.2	20%
Global transport GHG emissions	5,315.2	0.99%
All global GHG emissions	36,727.9	0.14%

(e) PFC and SF₆ emissions

Perfluorocarbons (PFCs) are not emitted from motor vehicles or motor vehicle engines in the U.S. The main sources of PFC emissions in the U.S. are aluminum smelting and semiconductor manufacturing.

Similarly, sulfur hexafluoride (SF₆) is not emitted from motor vehicles or motor vehicle engines in the United States. The main sources of SF₆ emissions in the United States are electrical transmission and distribution systems, and primary magnesium smelting.