

Appendix D: High GWP Gas Emissions for Years 1990-2010 for Developed Countries

Appendix D summarizes high GWP gas emissions for developed countries from 1990 through 2010 in the following exhibits:

- Exhibit D-1: Total High GWP Gas Emissions from Developed Countries (MMTCO₂)
- Exhibit D-2: ODS Substitute Emissions 1990-2010 (MMTCO₂)
- Exhibit D-3: HFC-23 Fugitive Emissions 1990-2010 (MMTCO₂)
- Exhibit D-4: Aluminum PFC Emissions 1990-2010 (MMTCO₂)
- Exhibit D-5: SF₆ Emissions from Magnesium 1990-2010 (MMTCO₂)
- Exhibit D-6: SF₆ Emissions from Electric Utilities 1990-2010 (MMTCO₂)
- Exhibit D-7 Emissions from Semiconductor Production 1990-2010 (MMTCO₂)

Exhibit D-1: Total High GWP Gas Emissions from Developed Countries (MMTCO₂)

Developed Country	High GWP Gas Emissions (MMTCO ₂)				
	1990	1995	2000	2005	2010
Australia	6.2	4.5	5.5	9.7	10.8
Austria	0.6	0.3	0.7	1.4	2.1
Belgium	0.3	0.5	1.5	2.8	3.7
Bulgaria	0.0	0.0	0.1	0.4	0.8
Canada	13.6	10.8	12.8	20.5	26.7
Croatia	0.3	0.1	0.1	0.2	0.3
Czech Republic	0.0	0.0	0.3	1.1	2.0
Denmark	0.2	0.2	0.9	1.8	2.3
Estonia	0.0	0.0	0.0	0.0	0.0
Finland	0.3	0.4	0.6	1.1	1.4
France	10.7	11.2	13.9	19.4	25.2
Germany	8.3	6.9	16.8	30.6	43.4
Greece	1.0	1.4	2.0	2.3	2.5
Hungary	0.1	0.1	0.4	1.0	1.9
Iceland	0.2	0.1	0.4	1.3	2.0
Ireland	0.1	0.4	0.9	2.3	4.3
Italy	6.4	4.9	11.4	19.1	25.2
Japan	14.6	33.7	30.9	58.2	88.1
Latvia	-	-	0.3	0.9	1.7
Liechtenstein	-	-	-	-	-
Lithuania	-	-	0.2	0.8	1.5
Luxembourg	<0.05	<0.05	0.1	0.2	0.2
Monaco	0.0	0.0	0.0	0.0	0.0
Netherlands	9.4	5.4	7.4	9.8	11.3
New Zealand	1.3	0.7	0.8	0.9	1.1
Norway	6.1	3.8	5.1	8.1	14.4
Poland	0.2	0.1	0.4	1.1	2.0
Portugal	0.1	0.2	0.5	1.0	1.2
Romania	3.5	1.1	1.3	1.5	1.8
Russia	20.4	14.7	18.2	33.0	52.6
Slovakia	0.1	0.1	0.2	0.5	0.8
Slovenia	0.1	0.1	0.1	0.1	0.2
Spain	7.8	5.2	8.2	10.9	12.8
Sweden	1.0	1.0	1.3	2.2	3.4
Switzerland	0.4	0.3	0.4	0.9	1.6
Ukraine	1.1	1.3	0.9	1.5	2.3
UK	10.6	10.1	14.3	19.6	25.1
US	98.2	104.0	139.0	223.0	308.0
EU-15	57	48	81	124	164
Other Western Europe	7	4	6	10	18
Russia	20	15	18	33	53
Other Eastern Europe	5	3	4	9	15
AUS/NZ	7	5	6	11	12
Japan	15	34	31	58	88
Canada	14	11	13	21	27
US	98	104	139	223	308
Total	223	223	298	489	685

Note: Dashes indicate that emissions for the respective country were not analyzed.

Exhibit D-2: ODS Substitute Emissions 1990-2010 (MMTCO₂)

Developed Country	ODS Substitute Emissions (MMTCO ₂)				
	1990	1995	2000	2005	2010
Australia	-	0.7	1.9	3.8	5.2
Austria	-	0.1	0.4	0.8	1.1
Belgium	-	0.2	1.3	2.5	3.5
Bulgaria	-	0.0	0.1	0.4	0.8
Canada	-	1.0	3.3	7.3	10.7
Croatia	-	0.0	<0.05	0.1	0.2
Czech Republic	-	0.0	0.3	1.1	2.0
Denmark	-	0.1	0.8	1.7	2.3
Estonia	-	0.0	0.0	0.0	0.0
Finland	-	0.1	0.4	0.9	1.2
France	-	0.5	3.6	8.1	11.8
Germany	-	1.6	10.9	21.3	28.7
Greece	-	0.1	0.6	1.1	1.5
Hungary	-	0.0	0.3	1.0	1.9
Iceland	-	0.0	0.0	<0.05	0.1
Ireland	-	<0.05	0.3	0.6	0.8
Italy	-	1.1	7.3	14.2	19.1
Japan	-	9.6	10.6	22.3	37.3
Latvia	-	0.0	0.3	0.9	1.7
Liechtenstein	-	0.0	0.0	0.0	0.0
Lithuania	-	0.0	0.2	0.8	1.5
Luxembourg	-	0.0	0.1	0.1	0.2
Monaco	-	0.0	0.0	0.0	0.0
Netherlands	0.4	0.3	1.9	3.7	5.0
New Zealand	-	0.1	0.2	0.4	0.6
Norway	-	0.0	0.1	0.2	0.6
Poland	-	0.0	0.3	1.0	1.9
Portugal	-	0.1	0.4	0.9	1.2
Romania	-	0.0	0.1	0.3	0.7
Russia	-	0.0	6.0	20.9	40.8
Slovakia	-	0.0	0.1	0.4	0.7
Slovenia	-	0.0	<0.05	0.1	0.1
Spain	-	0.5	3.3	6.4	8.7
Sweden	-	0.1	0.4	1.0	1.4
Switzerland	-	0.0	0.2	0.6	1.1
Ukraine	-	0.0	0.3	0.9	1.7
UK	0.7	1.3	5.0	8.4	9.6
US	0.9	24.7	64.0	125.0	176.0
EU-15	1	6	37	72	96
Other Western Europe	-	0	0	1	2
Russia	-	0	6	21	41
Other Eastern Europe	-	0	2	7	13
AUS/NZ	-	1	2	4	6
Japan	-	10	11	22	37
Canada	-	1	3	7	11
US	1	25	64	125	176
Total	2	42	125	260	382

Note: Dashes indicate that emissions for the respective country were not analyzed.

Exhibit D-3: HFC-23 Fugitive Emissions 1990-2010 (MMTCO₂)

Developed Country	HFC-23 Fugitive Emissions (MMTCO ₂)				
	1990	1995	2000	2005	2010
Australia	0.7	0.4	-	-	-
Austria	-	-	-	-	-
Belgium	-	-	-	-	-
Bulgaria	-	-	-	-	-
Canada	1.1	0.2	0.2	0.1	0.1
Croatia	0.0	0.0	0.0	0.0	0.0
Czech Republic	-	-	-	-	-
Denmark	-	-	-	-	-
Estonia	-	-	-	-	-
Finland	-	-	-	-	-
France	7.0	7.5	7.0	5.8	4.6
Germany	3.1	1.7	1.9	1.6	1.3
Greece	0.5	1.0	1.2	1.0	0.8
Hungary	-	-	-	-	-
Iceland	-	-	-	-	-
Ireland	-	-	-	-	-
Italy	2.2	1.2	1.6	1.3	1.0
Japan	11.2	17.0	12.4	16.8	19.5
Latvia	-	-	-	-	-
Liechtenstein	0.0	0.0	0.0	0.0	0.0
Lithuania	-	-	-	-	-
Luxembourg	-	-	-	-	-
Monaco	0.0	0.0	0.0	0.0	0.0
Netherlands	3.3	2.2	2.5	2.1	1.6
New Zealand	-	-	-	-	-
Norway	-	-	-	-	-
Poland	-	-	-	-	-
Portugal	-	-	-	-	-
Romania	-	-	-	-	-
Russia	5.1	1.6	0.6	0.5	0.5
Slovakia	-	0.0	0.0	0.0	0.0
Slovenia	0.0	-	-	-	-
Spain	2.6	1.9	2.3	1.9	1.5
Sweden	-	-	-	-	-
Switzerland	-	-	-	-	-
Ukraine	-	-	-	-	-
UK	8.2	7.0	6.0	4.9	3.9
US	34.8	27.1	30.2	27.1	20.9
EU-15	27	22	22	19	15
Other Western Europe	0	0	0	0	0
Russia	5	2	1	1	0
Other Eastern Europe	0	0	0	0	0
AUS/NZ	1	0	-	-	-
Japan	11	17	12	17	20
Canada	1	0	0	0	0
US	35	27	30	27	21
Total	80	69	66	63	56

Note: Dashes indicate that emissions for the respective country were not analyzed.

Exhibit D-4: Aluminum PFC Emissions 1990-2010 (MMTCO₂)

Developed Country	Aluminum PFC Emissions (MMTCO ₂)				
	1990	1995	2000	2005	2010
Australia	4.7	2.7	3.2	3.5	3.1
Austria	0.4	0.0	0.0	0.0	0.0
Belgium	-	-	-	-	-
Bulgaria	-	-	-	-	-
Canada	8.0	5.7	6.0	6.6	6.1
Croatia	0.3	0.1	0.1	0.1	0.1
Czech Republic	-	-	-	-	-
Denmark	-	-	-	-	-
Estonia	-	-	-	-	-
Finland	-	-	-	-	-
France	1.6	0.9	1.0	1.0	1.0
Germany	2.2	0.7	0.7	0.8	0.8
Greece	0.3	0.2	0.2	0.2	0.2
Hungary	0.1	0.1	0.1	0.1	<0.05
Iceland	0.2	0.1	0.1	0.1	0.3
Ireland	-	-	-	-	-
Italy	2.8	1.4	1.4	1.4	1.4
Japan	<0.05	<0.05	0.1	0.1	0.1
Latvia	-	-	-	-	-
Liechtenstein	-	-	-	-	-
Lithuania	-	-	-	-	-
Luxembourg	-	-	-	-	-
Monaco	-	-	-	-	-
Netherlands	5.3	2.5	2.6	2.6	2.6
New Zealand	1.1	0.5	0.6	0.5	0.4
Norway	2.5	1.4	1.3	1.2	1.2
Poland	0.2	0.1	0.1	0.1	<0.05
Portugal	-	-	-	-	-
Romania	3.5	1.1	1.1	1.2	1.1
Russia	15.4	10.0	9.8	9.5	8.7
Slovakia	0.1	0.1	0.1	0.1	0.1
Slovenia	0.1	0.1	0.1	0.1	0.1
Spain	4.4	2.1	2.1	2.2	2.1
Sweden	0.3	0.2	0.1	0.1	0.1
Switzerland	0.1	<0.05	<0.05	<0.05	<0.05
Ukraine	0.4	0.3	0.3	0.3	0.2
UK	0.7	0.4	0.2	0.1	0.1
US	19.3	11.2	9.7	10.2	10.4
EU-15	18	8	8	8	8
Other Western Europe	3	2	1	1	2
Russia	15	10	10	10	9
Other Eastern Europe	5	2	2	2	2
AUS/NZ	6	3	4	4	4
Japan	0	0	0	0	0
Canada	8	6	6	7	6
US	19	11	10	10	10
Total	74	42	41	42	40

Note: Dashes indicate that emissions for the respective country were not analyzed.

Exhibit D-5: SF₆ Emissions from Magnesium 1990-2010 (MMTCO₂)

Developed Country	SF ₆ Emissions from Magnesium (MMTCO ₂)				
	1990	1995	2000	2005	2010
Australia	-	-	-	2.0	2.1
Austria	-	-	-	-	-
Belgium	-	-	-	-	-
Bulgaria	-	-	-	-	-
Canada	2.1	2.1	2.3	5.3	8.6
Croatia	-	-	-	-	-
Czech Republic	-	-	-	-	-
Denmark	-	-	-	-	-
Estonia	-	-	-	-	-
Finland	-	-	-	-	-
France	0.4	0.4	0.6	0.9	1.6
Germany	-	0.2	0.4	0.8	1.6
Greece	-	-	-	-	-
Hungary	-	-	-	-	-
Iceland	-	-	0.2	1.1	1.6
Ireland	-	-	-	-	-
Italy	0.1	-	-	-	-
Japan	0.3	0.5	1.0	2.0	4.0
Latvia	-	-	-	-	-
Liechtenstein	-	-	-	-	-
Lithuania	-	-	-	-	-
Luxembourg	-	-	-	-	-
Monaco	-	-	-	-	-
Netherlands	-	-	-	0.6	0.6
New Zealand	-	-	-	-	-
Norway	3.1	2.0	3.5	6.5	12.5
Poland	-	-	-	-	-
Portugal	-	-	-	-	-
Romania	-	-	-	-	-
Russia	-	-	-	-	-
Slovakia	-	-	-	-	-
Slovenia	-	-	-	-	-
Spain	-	-	-	-	-
Sweden	-	0.2	0.4	0.8	1.6
Switzerland	-	-	-	-	-
Ukraine	0.6	0.3	<0.05	<0.05	<0.05
UK	0.5	0.6	0.8	0.8	0.8
US	5.5	5.5	6.8	11.3	20.3
EU-15	1	1	2	4	6
Other Western Europe	3	2	4	8	14
Russia	-	-	-	-	-
Other Eastern Europe	1	0	0	0	0
AUS/NZ	-	-	-	2	2
Japan	0	0	1	2	4
Canada	2	2	2	5	9
US	6	6	7	11	20
Total	13	12	16	32	55

Note: Dashes indicate that emissions for the respective country were not analyzed.

Exhibit D-6: SF₆ Emissions from Electric Utilities 1990-2010 (MMTCO₂)

Developed Country	SF ₆ Emissions from Electric Utilities (MMTCO ₂)				
	1990	1995	2000	2005	2010
Australia	0.7	0.6	0.4	0.4	0.3
Austria	0.2	0.2	0.1	0.1	0.1
Belgium	0.3	0.3	0.2	0.2	0.1
Bulgaria	-	-	-	-	-
Canada	2.3	2.0	1.1	1.1	1.0
Croatia	-	-	-	-	-
Czech Republic	-	-	-	-	-
Denmark	0.2	0.1	0.1	0.1	0.1
Estonia	-	-	-	-	-
Finland	0.3	0.3	0.2	0.2	0.2
France	1.7	1.5	0.9	0.9	0.8
Germany	2.6	2.0	1.1	1.1	1.0
Greece	0.2	0.2	0.1	0.1	0.1
Hungary	-	-	-	-	-
Iceland	<0.05	<0.05	<0.05	<0.05	<0.05
Ireland	0.1	0.1	<0.05	<0.05	<0.05
Italy	1.2	1.0	0.6	0.6	0.5
Japan	1.8	1.4	0.5	2.5	4.5
Latvia	-	-	-	-	-
Liechtenstein	-	-	-	-	-
Lithuania	-	-	-	-	-
Luxembourg	<0.05	<0.05	<0.05	<0.05	<0.05
Monaco	-	-	-	-	-
Netherlands	0.4	0.3	0.2	0.2	0.2
New Zealand	0.2	0.1	0.1	0.1	0.1
Norway	0.5	0.4	0.2	0.2	0.2
Poland	-	-	-	-	-
Portugal	0.1	0.1	0.1	0.1	0.1
Romania	-	-	-	-	-
Russia	0.0	3.1	1.6	1.4	1.4
Slovakia	-	-	-	-	-
Slovenia	-	-	-	-	-
Spain	0.7	0.6	0.4	0.4	0.3
Sweden	0.7	0.6	0.3	0.2	0.2
Switzerland	0.3	0.2	0.1	0.1	0.1
Ukraine	0.0	0.7	0.3	0.3	0.3
UK	0.2	0.2	0.3	0.3	0.4
US	34.8	29.5	17.3	16.6	16.1
EU-15	9	8	4	4	4
Other Western Europe	1	1	0	0	0
Russia	<0.05	3	2	1	1
Other Eastern Europe	0	1	0	0	0
AUS/NZ	1	1	0	0	0
Japan	2	1	1	3	5
Canada	2	2	1	1	1
US	35	30	17	17	16
Total	50	46	26	27	28

Note: Dashes indicate that emissions for the respective country were not analyzed.

Exhibit D-7: Emissions from Semiconductor Production 1990-2010 (MMTCO₂)

Developed Country	Emissions from Semiconductor Production (MMTCO ₂)				
	1990	1995	2000	2005	2010
Australia	<0.05	<0.05	<0.05	<0.05	<0.05
Austria	<0.05	0.1	0.2	0.5	0.9
Belgium	<0.05	<0.05	<0.05	0.1	0.2
Bulgaria	-	-	-	-	-
Canada	<0.05	<0.05	<0.05	0.1	0.3
Croatia	-	-	-	-	-
Czech Republic	-	-	-	-	-
Denmark	-	-	-	-	-
Estonia	-	-	-	-	-
Finland	-	-	-	-	-
France	0.1	0.4	1.0	2.8	5.5
Germany	0.3	0.8	1.8	5.1	10.2
Greece	-	-	-	-	-
Hungary	<0.05	<0.05	<0.05	<0.05	<0.05
Iceland	-	-	-	-	-
Ireland	<0.05	0.3	0.6	1.7	3.4
Italy	0.1	0.2	0.6	1.6	3.2
Japan	1.3	5.2	6.3	14.5	22.7
Latvia	-	-	-	-	-
Liechtenstein	-	-	-	-	-
Lithuania	-	-	-	-	-
Luxembourg	-	-	-	-	-
Monaco	-	-	-	-	-
Netherlands	0.1	0.1	0.2	0.7	1.3
New Zealand	-	-	-	-	-
Norway	-	-	-	-	-
Poland	-	-	-	-	-
Portugal	-	-	-	-	-
Romania	-	-	-	-	-
Russia	<0.05	0.1	0.2	0.6	1.2
Slovakia	-	-	-	-	-
Slovenia	-	-	-	-	-
Spain	<0.05	<0.05	<0.05	0.1	0.2
Sweden	<0.05	<0.05	<0.05	0.1	0.1
Switzerland	<0.05	<0.05	0.1	0.2	0.4
Ukraine	-	-	-	-	-
UK	0.4	0.7	2.1	5.1	10.3
US	2.9	5.5	11.3	32.0	64.2
EU-15	1	2	6	15	35
Other Western Europe	<0.05	<0.05	0	0	0
Russia	<0.05	0	0	1	1
Other Eastern Europe	<0.05	<0.05	<0.05	<0.05	<0.05
AUS/NZ	<0.05	<0.05	<0.05	<0.05	<0.05
Japan	1	5	6	15	23
Canada	<0.05	<0.05	0	0	0
US	3	6	11	32	64
Total	5	13	24	65	124

Note: Dashes indicate that emissions for the respective country were not analyzed.