

A8.2 Worksheets for the industrial processes sector

Module **2004 Industrial Processes (New Zealand)**
Worksheet **NZ 2a**
Sheet **CO2 emissions**

Source category	Production Quantity (t)	CO2 emissions (Gg)	CO2 emis factor (t/t)
Total industrial processes		3,444.36	
Cement ¹	1,216,191.00	484.77	0.40
Lime ¹	167,407.34	122.08	0.73
Hydrogen ¹	27,185.07	175.43	6.45
Urea ¹	262,274.00	378.27	1.44
Iron and steel ¹	890,352.00	1,731.51	1.94
Aluminium ¹	350,299.00	552.29	1.58

1 Production and emissions data provided by industry and reported in Ministry of Economic Development (2005)

Module 2004 Industrial process (New Zealand)
Worksheet NZ 2b
Sheet Non-CO₂ emissions

Source Categories	ACTIVITY DATA		Emission Estimates					Aggregate Emission Factor										
	A Production Quantity (kt)	B Full Mass of Pollutants (Gg Tonnes x 1000)	C Tonne of pollutant per tonne of product (t/t)															
			CO	CH4	N2O	NOx	NMVOc	SO2	CO	CH4	N2O	NOx	NMVOc	SO2				
A Iron and Steel																		
Steel	C	0.9779			0.9615					C				C				C
B Non-Ferrous Metals																		
NZ Aluminium Smelters	347.0	38.2			0.7		6.9		0.11000					0.00215				0.02000
C Inorganic Chemicals (excepting solvent use)																		
Sulphuric Acid (Ballance and Ravensdown)	500.7						1.74											0.00348
Superphosphate (Ballance and Ravensdown)	1584.3						0.81											0.00084
Urea (Ballance)	263.0																	
Ammonia (Ballance)	151.2																	
D Organic Chemicals																		
Formaldehyde (Orica Adhesives and Dynea)	56.61	0.0000	0.0000				0.0849		0.00000	0.00000							0.00150	
Methanol (Methanex)	1087.8	0.1088	2.1756			0.9790	5.4390		0.00010	0.00200				0.00090			0.00500	
E Non-Metallic Mineral Products																		
Cement	985.6		0.0000		0.0000		0.6415		0.0000					0.0000				0.00065
Lime	165.3						0.0797											0.00048
Asphalt Roofing	0.3	0.0000					0.0007		0.000010									0.00240
Road Paving	156.6	0.0055			0.0132		2.8188	0.0188	0.000035					0.000084		0.01800		0.000120
Glass	C						0.6313	0.1705							C			C
F Other (ISIC)																		
Paper and Pulp (chemical processes)	724.0	0.0000			0.0000		0.3982	0.0746	0.00000					0.00000		0.00055		0.00010
Paper and Pulp (mechanical processes)	844.8						0.4647										0.00055	
Panel Products (particleboard)	175.5						0.1492										0.00085	
Panel Products (fibreboard)	640.5						1.3451										0.00210	
Nitrous oxide use	0.16				0.1560								1.0000					
Food and drink production																		
Wine (million litres)	110.5						0.0884											0.00083
Beer (million litres)	312.9						0.1095											0.00035
Spirits (million litres)	8.3						0.0167											0.00215
Meat	1269.0						0.3807											0.00030
Fish	334.8						0.1004											0.00030
Poultry	147.3						0.0442											0.00030
Sugar	227.8						2.2779											0.01000
Margarine and solid cooking fats	66.4						0.3986											0.00600
Cakes, biscuits and breakfast cereals	76.1						0.0761											0.00100
Bread	241.8						1.9344											0.00800
Animal feed	848.5						0.8485											0.00100
Coffee roasting	6.2						0.0034											0.00055
	3649.68						6.2788											

Module 1990 - 2004 Consumption of halocarbons (New Zealand)
Worksheet Supplementary 2.F. Aerosol 1 of 2
Sheet HFCs from aerosols (based on equation 3.35¹)

Year	Quantity HFC-134a contained in aerosol products sold in year t (tonnes) ^a	Emission factor	Quantity HFC-134a contained in aerosol products sold in year t-1 (tonnes)	Emission of HFC-134a (tonnes)
1992	0.0	0.5	0.0	0.0
1993	0.0	0.5	0.0	0.0
1994	0.0	0.5	0.0	0.0
1995	0.0	0.5	0.0	0.0
1996	2.5	0.5	0.0	1.3
1997	5.9	0.5	2.5	4.2
1998	9.1	0.5	5.9	7.5
1999	12.1	0.5	9.1	10.6
2000	16.1	0.5	12.1	14.1
2001	16.9	0.5	16.1	16.5
2002	17.1	0.5	16.9	17.0
2003	17.1	0.5	17.1	17.1
2004	17.3	0.5	17.1	17.2

- IPCC (2001) Equation 3.35
- Only HFC used in aerosols is HFC-134a

Module 1990 - 2004 Consumption of halocarbons (New Zealand)
Worksheet Supplementary 2.F. Aerosols 2 of 2
Sheet Imports and domestic production of aerosols

Year of import	Aerosol imports		Domestic loading HFC	Aerosol exports		Total HFC contained in products in NZ (tonnes)
	Number of Units	HFC ^a (tonnes)		HFC ^b	HFC ^c (tonnes)	
1992	3,300,000	0.0	0.0	0.0	0.0	0.0
1993	4,000,000	0.0	0.0	0.0	0.0	0.0
1994	5,400,000	0.0	0.0	0.0	0.0	0.0
1995	8,700,000	0.0	0.0	0.0	0.0	0.0
1996	13,100,000	2.2	3.0	2.7	2.5	2.5
1997	16,800,000	5.6	3.0	2.7	5.9	5.9
1998	17,400,000	8.8	3.0	2.7	9.1	9.1
1999	17,500,000	11.8	3.0	2.7	12.1	12.1
2000	18,848,536	15.8	3.0	2.7	16.1	16.1
2001	19,773,731	16.6	3.0	2.7	16.9	16.9
2002	20,000,000	16.8	3.0	2.7	17.1	17.1
2003	20,000,000	16.8	3.0	2.7	17.1	17.1
2004	20,000,000	16.8	4.5	4.1	17.3	17.3

- Assumes average propellant charge = 84 grams, 1.0±0.5% of all imported aerosols contain HFCs from 2000 with a gradual phase-in from 1996-2000.
- Based on the statement that 90% of this product is exported.

Module 1990 - 2004 Consumption of halocarbons (New Zealand)
Worksheet Supplementary 2.F. MDIs 1 of 1
Sheet HFCs from metered dose inhalers

Year ¹	Estimated no. of doses (millions)	Proportion of HFC-134a doses	Emission of HFC-134a (tonnes) ²
1995	500.0	1%	0.4
1996	500.0	5%	1.9
1997	500.0	5%	1.9
1998	500.0	5%	1.9
1999	497.2	8%	2.8
2000	477.4	9%	3.3
2001	485.2	39%	14.0
2002	486.3	68%	25.0
2003	474.8	73%	26.1
2004	469.4	76%	26.7

- HFC-134a not used in MDIs before 1995
- Only HFC used in MDIs is HFC-134a; average 0.075 gram per dose

Module 1990 - 2004 Consumption of halocarbons (New Zealand)
Worksheet Supplementary 2.F. Fire protection 1 of 1
Sheet Annual emissions from the fire protection industry

Year ¹	Total HFC-227a installed		Emission rate	Emissions of HFC-227a (tonnes)
	Streaming (tonnes)	Portable (tonnes)		
1994	1.6	0	0.015	0.02
1995	3.2	0	0.015	0.05
1996	4.8	0	0.015	0.07
1997	6.4	0	0.015	0.10
1998	8.0	0	0.015	0.12
1999	10.2	0	0.015	0.15
2000	11.4	0	0.015	0.17
2001	12.6	0	0.015	0.19
2002	17.0	0	0.015	0.26
2003	19.4	0	0.015	0.29
2004	21.2	0	0.015	0.32

- No evidence for use of HFC-227a in fire protection industry before 1994

Module 1990 - 2004 Consumption of halocarbons (New Zealand)
Worksheet Supplementary 2.F. Foam blowing 1 of 1
Sheet Annual emissions from the foam blowing industry

Year ¹	HFC usage ² (tonnes)	Emission rate	Emission rate	Emissions of HFC (tonnes)
		first year	later years	
2000	0.5	0.100	0.045	0.05
2001	0.5	0.100	0.045	0.07
2002	0.5	0.100	0.045	0.10
2003	0.5	0.100	0.045	0.12
2004	1.5	0.100	0.045	0.24
2005	1.5	0.100	0.045	0.31

- Assumed no use of HFC in foam blowing industry before 2000
- HFC-134a from 2000-2003 and HFC-245fa/365mfc from 2004-2005.

Module 1990 - 2004 Consumption of halocarbons (New Zealand)
 Worksheet Supplementary 2.F. RAC 1 of 4
 Sheet Stationary Refrigeration and Air Conditioning - annual sales of refrigerant (input to Box 3.4 equation)

Year	Domestically manufactured chemical (tonnes)	Imported bulk chemical (tonnes)	Exported bulk chemical (tonnes)	Chemical in imported equipment (tonnes)	Chemical in exported equipment (tonnes)	Annual sales (tonnes)
1990	0	0.0	0	0	0.0	0.0
1991	0	0.0	0	0	0.0	0.0
1992	0	2.0	0	0.1	0.8	1.3
1993	0	6.0	0	0.2	3.0	3.2
1994	0	51.2	0	2.3	7.2	46.3
1995	0	111.2	0	7.8	18.6	100.4
1996	0	159.8	0	9.3	19.8	149.3
1997	0	61.4	0	10.3	20.5	51.2
1998	0	197.5	0	9.4	21.2	185.6
1999	0	145.5	0	12.5	22.4	135.6
2000	0	124.1	0	11.1	24.3	110.9
2001	0	186.9	0	12.1	25.5	173.4
2002	0	231.7	0	14.4	25.6	220.5
2003	0	298.0	0	20.7	27.5	291.1
2004	0	222.3	0	35.7	30.8	227.2

1. IPCC (2001) Box 3.4 equation

Module 1990 - 2004 Consumption of halocarbons (New Zealand)
 Worksheet Supplementary 2.F. RAC 2 of 4
 Sheet Stationary Refrigeration and Air Conditioning - total charge of new equipment (input to Box 3.4 equation)

Year	Chemical to charge domestically manufactured + imported equipment (tonnes) 2	Chemical contained in factory charged imported equipment (tonnes)	Chemical contained in factory charged exported eqpmnt (tonnes)	Total charge of new equipment (tonnes)
1990	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0
1992	1.2	0.1	0.8	0.5
1993	2.4	0.2	3.0	-0.4
1994	8.6	2.3	7.2	3.7
1995	20.0	7.8	18.6	9.2
1996	25.0	9.3	19.8	14.5
1997	30.0	10.3	20.5	19.8
1998	28.1	9.4	21.2	16.2
1999	37.0	12.5	22.4	27.1
2000	31.3	11.1	24.3	18.1
2001	28.7	12.1	25.5	15.2
2002	28.0	14.4	25.6	16.8
2003	36.5	20.7	27.5	29.7
2004	45.4	35.7	30.8	50.2

1. IPCC (2001) Box 3.4 equation

2. Can not distinguish chemical to charge domestically manufactured and imported non-factory charged equipment.

Module 1990 - 2004 Consumption of halocarbons (New Zealand)
 Worksheet Supplementary 2.F. RAC 3 of 4
 Sheet All HFC and PFC emissions from stationary refrigeration

Year	Annual sales of new refrigerant (tonnes)	Total charge of new equipment (tonnes)	Emissions from retiring NZ eqpt. (tonnes)	Amount of intentional destruction (tonnes)	Emissions ² (tonnes)
1990	0.0	0.0	0.0	0	0.0
1991	0.0	0.0	0.0	0	0.0
1992	1.3	0.5	0.0	0	0.8
1993	3.2	-0.4	0.0	0	3.6
1994	46.3	3.7	0.0	0	42.6
1995	100.4	9.2	0.0	0	91.2
1996	149.3	14.5	0.0	0	134.8
1997	51.2	19.8	0.0	0	31.4
1998	185.6	16.2	0.0	0	169.4
1999	135.6	27.1	0.0	0	108.5
2000	110.9	18.1	0.0	0.1	92.6
2001	173.4	15.2	0.0	0.3	157.9
2002	220.5	16.8	0.1	0.4	203.4
2003	291.1	29.7	0.3	0.7	261.0
2004	227.2	50.2	1.1	1.1	177.0

1. IPCC (2001) equation 3.40

2. The methodology produces a negative number for 1992, thus 0 has been entered for this year.

Module 1990 - 2004 Consumption of halocarbons (New Zealand)
Worksheet Supplementary 2.F. MAC 1 of 4
Sheet Mobile air conditioning Equation 3.45¹ (input to equation 3.44¹)

Year ²	Total virgin HFC-134a ³ in first-fill MAC systems (tonnes)	Emission factor	First-fill emissions HFC-134a (tonnes)
1994	2.9	0.005	0.015
1995	10.8	0.005	0.054
1996	15.8	0.005	0.079
1997	11.0	0.005	0.055
1998	8.2	0.005	0.041
1999	6.9	0.005	0.035
2000	5.5	0.005	0.028
2001	4.6	0.005	0.023
2002	2.9	0.005	0.014
2003	3.3	0.005	0.017
2004	1.9	0.005	0.009

1. IPCC (2001) Equations 3.44 and 3.45
2. No use recorded before 1994
3. HFC-134a the only HFC used in MAC

Module 1990 - 2004 Consumption of halocarbons (New Zealand)
Worksheet Supplementary 2.F. MAC 2 of 4
Sheet Mobile air conditioning Equation 3.46¹ (input to equation 3.44¹)

Year ²	Total annual ¹ HFC in first-fill MAC systems					Total (tonnes)	Operation emissions HFC-134a (tonnes)
	virgin HFC-134a ³ (tonnes)	Buses (tonnes)	Trucks (tonnes)	Cars/vans (tonnes)	Cars/vans (new) (tonnes)		
1994	5.0	0.2	1.0	1.7	0.0	2.9	2.1
1995	15.0	0.2	3.3	6.9	0.3	10.8	4.2
1996	30.0	0.3	3.3	10.2	2.0	15.8	14.2
1997	40.0	0.3	2.8	6.5	1.4	11.0	29.0
1998	50.0	0.2	2.3	5.0	0.8	8.2	41.8
1999	52.0	0.3	2.5	3.9	0.2	6.9	45.1
2000	54.0	0.3	2.6	2.4	0.2	5.5	48.5
2001	56.0	0.3	2.7	1.3	0.3	4.6	51.4
2002	58.0	0.4	1.9	0.4	0.2	2.9	55.1
2003	60.0	0.4	1.9	0.4	0.6	3.3	56.7
2004	62.0	0.3	1.1	0.4	0.1	1.9	60.1

1. IPCC (2001) Equations 3.44 and 3.45
2. No use recorded before 1994
3. This model of MAC refrigerant use approximately follows the highly variable quantities provided by suppliers.

Module 1990 - 2004 Consumption of halocarbons (New Zealand)
Worksheet Supplementary 2.F. MAC 3 of 4 (IPCC (2001) equation 3.47)
Sheet HFC-134a emissions from mobile air conditioning (equation 3.44¹)

Year	Annual scrap rate of vehicles with MAC using HFC-134a	Number of vehicles with MAC using HFC-134a	Average HFC-134a charge per vehicle (kg)	Destruction (tonnes)	Disposal emissions (tonnes)
1994	0.000	90,780	0.86	0	0.04
1995	0.012	200,564	0.81	0	1.98
1996	0.017	318,586	0.80	0	4.38
1997	0.032	446,168	0.81	0	11.40
1998	0.022	580,065	0.79	0	9.98
1999	0.017	755,133	0.78	0	9.77
2000	0.020	925,705	0.77	0	14.00
2001	0.023	1,101,395	0.77	0	19.34
2002	0.024	1,290,412	0.77	0	23.76
2003	0.022	1,506,253	0.76	0	25.14
2004	0.024	1,722,148	0.76	0	30.94

1. IPCC (2001) Equations 3.44 and 3.47

Module 1990 - 2004 Consumption of halocarbons (New Zealand)
Worksheet Supplementary 2.F. MAC 4 of 4
Sheet HFC-134a emissions from mobile air conditioning (equation 3.44¹)

Year ²	First-fill emissions (tonnes)	Operation emissions (tonnes)	Disposal emissions ³ (tonnes)	Intentional destruction (tonnes)	Annual emissions of HFC-134a (tonnes)
1994	0.015	2.1	0.04	0	2.1
1995	0.054	4.2	1.98	0	6.3
1996	0.079	14.2	4.38	0	18.7
1997	0.055	29.0	11.40	0	40.5
1998	0.041	41.8	9.98	0	51.8
1999	0.035	45.1	9.77	0	54.9
2000	0.028	48.5	14.00	0	62.5
2001	0.023	51.4	19.34	0	70.8
2002	0.014	55.1	23.76	0	78.9
2003	0.017	56.7	25.14	0	81.8
2004	0.009	60.1	30.94	0	91.1

1. IPCC (2001) Equation 3.44
2. No use recorded before 1994
3. Calculated using IPCC (2001) equation 3.47



Module 1990 - 2004 Consumption of halocarbons (New Zealand)
Worksheet Supplementary 2.F. RAC 4 of 4
Sheet All HFC and PFC emissions from stationary refrigeration¹

Year	Bulk emissions (tonnes)	HFC-32 (tonnes)	HFC-125 (tonnes)	HFC-134a ² (tonnes)	HFC-143a (tonnes)	HFC-152a (tonnes)	PFC-218 (tonnes)
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1992	0.8	0.0	0.0	0.8	0.0	0.0	0.0
1993	3.6	0.0	0.0	3.6	0.0	0.0	0.0
1994	42.6	0.0	1.2	40.7	0.4	0.4	0.0
1995	91.2	0.4	0.5	80.5	7.9	1.2	0.8
1996	134.8	0.0	6.7	115.8	7.1	0.4	4.8
1997	31.4	0.0	10.5	11.0	9.3	0.2	0.3
1998	169.4	0.0	9.5	142.1	9.4	0.4	8.0
1999	108.5	7.4	10.4	77.9	11.0	1.7	0.0
2000	92.6	0.0	4.1	82.1	6.4	0.0	0.0
2001	157.9	3.4	27.6	99.9	26.1	0.9	0.0
2002	203.4	3.0	47.6	99.8	51.8	0.0	1.1
2003	261.0	5.0	53.9	140.1	60.2	0.0	1.8
2004	177.0	6.2	49.5	71.6	48.7	0.0	1.0

1. Calculated as bulk imports - exported in eqpt - charge for new NZ eqpt - destruction + eqpt retirement

2. HFC-134a calculated by difference after detailed consideration of other gases.

Module 1990 - 2004 Emissions of Sulphur Hexafluoride (New Zealand)

Worksheet

Sheet SF₆ from Electrical Equipment and Other Sources (based on equations 3.13, 3.17, 3.18 and 3.22)

Year	Potential SF ₆ Emissions (kg) ¹	Emissions from Electrical Equipment (kg) ²	Emissions from Other Sources ⁴ (kg) ³	Actual SF ₆ Emissions (kg)
1990	2030	396	120	516
1991	2256	409	131	540
1992	1393	423	147	570
1993	2026	435	153	588
1994	1842	448	155	603
1995	1566	466	162	628
1996	2240	485	134	619
1997	2354	505	135	640
1998	1952	439	148	587
1999	1851	414	138	552
2000	1753	499	11	510
2001	1535	501	14	514
2002	2523	536	14	550
2003	1939	722	11	733
2004	1901	888	11	899

1. IPCC (2001) Equation 3.18
2. IPCC (2001) Equation 3.13 (Tier 3c) for the few utilities with detailed data and Equation 3.17 (Tier 2b) for others.
3. IPCC (2001) Equation 3.22
4. SF₆ use in magnesium casting ceased in 1998