

Module **2003 Industrial process (New Zealand)**
Worksheet **NZ 2a**
Sheet **CO₂ emissions**

Source category	Production Quantity (t)	CO ₂ emissions (Gg)	CO ₂ emis factor (t/t)
Total industrial processes		3,470	
Cement ¹	1,239,580	527.47	0.43
Lime ¹	152,180	111.36	0.73
Hydrogen ¹	28,303	184.35	6.51
Urea ¹	269,428	387.92	1.44
Iron and steel ¹	845,328	1,716.80	2.03
Aluminium ¹	333,653	542.14	1.62

1 Production and emissions data provided by industry and reported in Ministry of Economic Development (2004):

Module
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Sheet

2003 Industrial Processes (New Zealand)

CH₄ and CO emissions-ammonia/urea production

Year	Urea production kt	Ammonia production kt	CH ₄ EF t/t	CH ₄ emissions Gg	CO EF t/t	CO emissions Gg
1990	171.08	97.52	7.00E-03	0.68	5.00E-06	4.88E-04
1991	171.01	97.48	7.00E-03	0.68	5.00E-06	4.87E-04
1992	146.96	83.77	7.00E-03	0.59	5.00E-06	4.19E-04
1993	165.14	94.13	7.00E-03	0.66	5.00E-06	4.71E-04
1994	172.22	98.17	7.00E-03	0.69	5.00E-06	4.91E-04
1995	170.68	97.29	7.00E-03	0.68	5.00E-06	4.86E-04
1996	145.35	82.85	7.00E-03	0.58	5.00E-06	4.14E-04
1997	167.74	95.61	7.00E-03	0.67	5.00E-06	4.78E-04
1998	200.93	114.53	7.00E-03	0.80	5.00E-06	5.73E-04
1999	230.60	131.44	7.00E-03	0.92	5.00E-06	6.57E-04
2000	227.24	129.53	7.00E-03	0.91	5.00E-06	6.48E-04
2001	250.55	142.81	7.00E-03	1.00	5.00E-06	7.14E-04
2002	234.30	133.55	7.00E-03	0.93	5.00E-06	6.68E-04
2003	269.43	153.57	7.00E-03	1.08	5.00E-06	7.68E-04

Source Categories	ACTIVITY DATA	Emission Estimates										Aggregate Emission Factor									
	A Production Quantity (kt)	B										C									
		Full Mass of Pollutants										Tonne of pollutant per tonne of product									
		(Gg) Tonnes x 1000										(t/t)									
	CO	CH4	N2O	NOx	NM/OC	HFC	PFC	SF6	SO2	CO	CH4	N2O	NOx	NM/OC	HFC	PFC	SF6	SO2			
A Iron and Steel																					
Pacific Steel	217.0			0.0127									0.000003	0.00006							
NZ Steel	628.0	0.2355		0.9420					0.7222				0.000375	0.00150					0.001150		
B Non-Ferrous Metals																					
NZ Aluminium Smelters	333.6	36.7		0.7172					6.5060				0.11000	0.00215					0.01950		
C Inorganic Chemicals (excepting solvent use)																					
Sulphuric Acid (Ballance and Ravensdown)	541.6								2.35										0.00434		
Superphosphate (Ballance and Ravensdown)	1719.4								1.62										0.00094		
Urea (Ballance)	269.4																				
Ammonia (Ballance)	153.6	0.0008	0.1075										0.000005	0.00070							
D Organic Chemicals																					
Formaldehyde (Orica Adhesives and Dynea)	52.1	0.0000	0.0000		0.2912								0.00000	0.00000					0.00559		
Methanol (Methanex)	967.7	0.0968	1.9354	0.8709	4.8385								0.00010	0.00200	0.00090	0.00500					
E Non-Metallic Mineral Products																					
Cement	1050.8			0.0000					1.0266				0.0000	0.0000					0.00098		
Lime	161.7								0.1803										0.00111		
Asphalt Roofing	0.1	0.0000			0.0002								0.000010		0.00245						
Road Paving	105.0	0.0037		0.0088	2.5200				0.0126				0.000035	0.000084	0.02400				0.000120		
Glass	114.8				0.5166										0.00450						
F Other (ISIC)																					
Paper and Pulp (chemical processes)	623.4	1.0723		0.9663	0.3429				0.0642				0.00172	0.00155	0.00055				0.00010		
Paper and Pulp (mechanical processes)	795.2				0.4374										0.00055						
Panel Products (particleboard)	197.9				0.0257										0.00013						
Panel Products (fibreboard)	871.2				0.9583										0.00110						
Food and drink production																					
Wine (million litres)	68.0				0.0544										0.000833						
Beer (million litres)	313.0				0.1096										0.000350						
Spirits (million litres)	8.7				0.0173										0.002151						
Meat	1255.6				0.3767										0.000300						
Fish	297.1				0.0891										0.000300						
Poultry	142.9				0.0429										0.000300						
Sugar	228.6				2.2860										0.010000						
Margarine and solid cooking fats	0.0				0.0000										0.010000						
Cakes, biscuits and breakfast cereals	44.6				0.0446										0.001000						
Bread	260.0				2.0800										0.008000						
Animal feed	797.0				0.7970										0.001000						
Coffee roasting	5.6				0.0031										0.000550						
TOTAL		38.11	2.04	0.00	3.52	15.83	0.00	0.00	0.00	12.48											

Note: Use of halocarbons and SF6 covered in separate tables

Module 1990 - 2003 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) ²	Emission factor	Quantity HFC-134a contained in aerosol products sold in year t-1 (tonnes)	Emission of HFC-134a (tonnes)
1992	2.8	0.5	0.0	1.4
1993	3.4	0.5	2.8	3.1
1994	5.3	0.5	3.4	4.4
1995	13.0	0.5	5.3	9.2
1996	17.5	0.5	13.0	15.2
1997	20.6	0.5	17.5	19.0
1998	20.1	0.5	20.6	20.4
1999	19.1	0.5	20.1	19.6
2000	21.1	0.5	19.1	20.1
2001	22.0	0.5	21.1	21.6
2002	22.8	0.5	22.0	22.4
2003	23.6	0.5	22.8	23.2

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

Module 1990 - 2003 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 (tonnes)	Total HFC contained in products (tonnes)
	Number of Units	HFC ¹ (tonnes)		
1992	3,300,000	2.8	0.0	2.8
1993	4,000,000	3.4	0.0	3.4
1994	5,400,000	4.5	0.8	5.3
1995	8,700,000	7.3	5.7	13.0
1996	13,100,000	11.0	6.5	17.5
1997	16,800,000	14.1	6.5	20.6
1998	17,400,000	14.6	5.5	20.1
1999	17,500,000	14.7	4.4	19.1
2000	18,848,536	15.8	5.3	21.1
2001	19,773,731	16.6	5.4	22.0
2002	20,000,000	16.8	6.0	22.8
2003	21,000,000	17.6	6.0	23.6

1. Assumes average propellant charge = 84 grams, 1.0±0.5% of all imported aerosols contain HFCs

Module 1990 - 2003 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	526.4	7%	2.8
2000	510.1	9%	3.3
2001	835.4	39%	24.4
2002	716.4	73%	39.1
2003	634.7	66%	31.3

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

Module 1990 - 2003 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

1. Use of HFC-227a in fire protection industry not occurring before 1994

Module 1990 - 2003 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-134a usage (tonnes)	Emission rate first year	Emission rate later years	Emissions of HFC-134a (tonnes)
2000	1.5	0.100	0.045	0.15
2001	1.5	0.100	0.045	0.22
2002	1.5	0.100	0.045	0.29
2003	1.5	0.100	0.045	0.35

1. Assumed no use of HFC-134a in foam blowing industry before 2000

Module 1990 - 2003 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	0.0	0	3.9	0.3	3.6
1993	0	6.0	0	6.4	2.0	10.4
1994	0	53.0	0	6.8	10.5	49.3
1995	0	105.4	0	8.4	16.6	97.2
1996	0	152.3	0	10.6	15.9	147.0
1997	0	88.5	0	10.5	14.9	84.1
1998	0	192.9	0	9.9	16.8	186.0
1999	0	170.1	0	12.6	17.8	165.0
2000	0	134.0	0	11.9	19.0	126.9
2001	0	184.9	0	11.5	18.9	177.5
2002	0	257.2	0	15.5	19.6	253.1
2003	0	300.2	0	17.2	20.7	296.8

1. IPCC (2001) Box 3.4 equation

Module 1990 - 2002 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 equipment (tonnes)	Total charge of new equipment (tonnes)
1990	0.0	0	0.0	0.0
1991	0.0	0	0.0	0.0
1992	0.0	3.7	0.3	3.4
1993	4.7	6.4	2.0	9.1
1994	36.5	6.8	10.5	32.8
1995	71.2	8.4	16.6	63.0
1996	98.0	10.6	15.9	92.7
1997	62.1	10.5	14.9	57.7
1998	122.1	9.9	16.8	115.2
1999	110.3	12.6	17.8	105.1
2000	94.1	11.9	19.0	87.0
2001	140.4	11.5	18.9	133.1
2002	168.4	15.5	19.6	164.3
2003	194.8	17.2	20.7	191.4

1. IPCC (2001) Box 3.4 equation

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

Module 1990 - 2003 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 equipment (tonnes)	Amount of intentional destruction (tonnes)	Emissions ² (tonnes)
1990	0.0	0.0	0	0	0.0
1991	0.0	0.0	0	0	0.0
1992	3.4	3.4	0	0	0.0
1993	10.0	9.1	0	0	0.9
1994	46.1	32.8	0	0	13.3
1995	92.0	63.0	0	0	29.0
1996	140.0	92.7	0	0	47.3
1997	81.6	57.7	0	0	23.9
1998	177.7	115.2	0	0	62.5
1999	158.7	105.1	0	0	53.6
2000	126.9	87.0	0	0	39.9
2001	177.5	133.1	0	0	44.5
2002	253.1	164.3	0.8	0	89.6
2003	296.8	191.4	2.6	0	108.0

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 - 2003 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	Emission factor	First-fill emissions HFC-134a (tonnes)
	(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

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 - 2003 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 virgin HFC-134a (tonnes)	Annual virgin HFC in first-fill MAC systems					Operation emissions HFC-134a (tonnes)
		Buses	Trucks	Cars/vans	Cars/vans (new)	Total	
		(tonnes)	(tonnes)	(tonnes)	(tonnes)	(tonnes)	
1994	3.2	0.2	1.0	1.7	0.0	2.9	0.3
1995	20.8	0.2	3.3	6.9	0.3	10.8	10.0
1996	37.5	0.3	3.3	10.2	2.0	15.8	21.7
1997	12.9	0.3	2.8	6.5	1.4	11.0	1.9
1998	54.6	0.2	2.3	5.0	0.8	8.2	46.3
1999	27.4	0.3	2.5	3.9	0.2	6.9	20.5
2000	44.1	0.3	2.6	2.4	0.2	5.5	38.5
2001	46.3	0.3	2.7	1.3	0.3	4.6	41.7
2002	62.1	0.4	1.9	0.4	0.2	2.9	59.3
2003	48.6	0.4	1.9	0.4	0.6	3.3	45.3

1. IPCC (2001) Equations 3.44 and 3.45
2. No use recorded before 1994

Module 1990 - 2002 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	Disposal emissions
				(tonnes)	(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

1. IPCC (2001) Equations 3.44 and 3.47

Module 1990 - 2002 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	Operation emissions	Disposal emissions ³	Intentional destruction	Annual emissions of HFC-134a
	(tonnes)	(tonnes)	(tonnes)	(tonnes)	(tonnes)
1994	0.015	0.3	0.04	0	0.3
1995	0.054	10.0	1.98	0	12.1
1996	0.079	21.7	4.38	0	26.2
1997	0.055	1.9	11.40	0	13.3
1998	0.041	46.3	9.98	0	56.3
1999	0.035	20.5	9.77	0	30.3
2000	0.028	38.5	14.00	0	52.5
2001	0.023	41.7	19.34	0	61.1
2002	0.014	59.3	23.76	0	83.0
2003	0.017	45.3	25.14	0	70.4

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

Module 1990 - 2003 Consumption of halocarbons (New Zealand)
 Worksheet Supplementary 2.F. RAC 4 of 4
 Sheet All HFC and PFC emissions from stationary refrigeration

Year	Bulk emissions (tonnes)	HFC-32 (tonnes)	HFC-125 (tonnes)	HFC-134a (tonnes)	HFC-143a (tonnes)	HFC-152 (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	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1993	1.1	0.0	0.0	1.1	0.0	0.0	0.0
1994	14.6	0.0	1.2	11.3	0.4	0.4	0.0
1995	31.1	0.4	0.5	18.2	7.9	1.2	0.8
1996	50.1	0.0	6.7	28.3	7.1	0.4	4.8
1997	24.8	0.0	10.5	3.6	9.3	0.2	0.3
1998	65.8	0.0	9.5	35.2	9.4	0.4	8.0
1999	57.8	7.4	10.4	23.0	11.0	1.7	0.0
2000	39.9	0.0	4.1	29.3	6.4	0.0	0.0
2001	44.5	0.1	12.8	16.6	14.9	0.0	0.0
2002	89.6	0.9	19.4	47.4	21.6	0.0	0.4
2003	108.0	1.8	23.6	55.3	26.6	0.0	0.6

Module 1990 - 2003 Emissions of Sulphur Hexafluoride (New Zealand)
 Worksheet
 Sheet SF₆ from Electrical Equipment and Other Sources (based on equations 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	489	11	500
2001	1483	490	14	504
2002	2014	526	14	540
2003	2182	507	11	518

1. IPCC (2001) Equation 3.18
2. IPCC (2001) Equation 3.17
3. IPCC (2001) Equation 3.22