

Preparing a Process Industry Greenhouse Gas Emission Inventory

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Elements of an Inventory

Boundaries

Scope

Calculations/Tools

Reporting

Certification

Calculations/Tools

California Climate Action Registry

www.climateregistry.org/protocols/grp

www.climateregistry.org/protocols/cp

U.S. Dept. of Energy/ EIA

www.eia.doe.gov/oiaf/1605/frntvrgg.html

www.eia.doe.gov/oiaf/1605/techassist.html

Pew Center

www.pewclimate.org/global-warming-in-depth/all_reports/inventory_issues/

World Business Council for
Sustainable Development/
World Resources Institute
www.ghgprotocol.org/standard/index.htm
www.ghgprotocol.org/standard/tools.htm

Cement Industry Tool

- Input materials-based
- Product-based

Production

Data being brought up from bottom of spreadsheet

Currently operating at 65% of 1990's level

Fuel/Power Consumption

Get electricity CO₂ data from your supplier

Emissions

Direct from raw materials and EF

Direct from kiln fuels and EF

Direct from other than kiln fuels and EF

Performance Indicators

Components of CO₂ released

Specific CO₂ per tone clinker, product

Credits for indirect savings

Fuel details

Developed from purchase records

Issue: how do you classify some fuels

Fuel heating value

From plant/vendor measurements

Emission Factors (EF)

kgCO₂/GJ from WBCSD-WRI or IPCC
default values

Fuel Consumption

Calculated and transferred to top

CO₂ Emissions

Calculated and transferred to top

Report

Confirm baseline year

Report trends

Identify sources of data (copies in notebook)

Unaccounted for less than 5%

Use of same factors for purchased
intermediate to avoid outsourcing
games

Specific CO₂ emissions per tonne of product

OVERVIEW

This greenhouse gases emissions inventory for the Hadrian, Inc. Albany plant reports on all sources of greenhouse gases emissions at the plant, including fuels, processing minerals in the kiln, and operation of equipment, vehicles and the office. As is commonly estimated for a cement plant, approximately half of the emissions come from fuels and half comes from calcination of carbonates in the kiln.

Cement plants are unusual among modern industrial plants in that a large share of the CO₂ emissions come from the chemical changes to input materials. Another large portion of the CO₂ comes from the fossil fuels required to produce the product, which is the more common situation. Because there are two major sources of CO₂, the emissions from cement plants are very significant. The possibilities for reducing CO₂ emissions may be correspondingly large. The description of the specific sources of CO₂ at the Albany plant will be discussed in more detail below.

The use of 1990 as a baseline year appears to be a defensible choice. It was possible to develop an inventory for continuous years from 1990 through 2002. Because there are no significant sources of other greenhouse gases at the plant, this inventory includes only emissions of carbon dioxide (CO₂). The specific net emissions of CO₂ per tonne (i.e., a metric ton) of cement product ranged from a high of 949 kilograms per tonne of product in 1990 to a low of 830 kg/t in 2002. There has been a trend down from 2000 to 2002, due both to a reduction in specific net emissions from calcination and from kiln fuels. The drop in emissions from calcination is attributed to an increased use of slag as a cement additive to reduce clinker in the product.

This inventory has nearly complete data for each year from 1990 to 2002, which provides a valid picture of the changes in various sources of CO₂ between 1990 and 2002. There are sufficient data to make this inventory valid for each year, based on the California Climate Action Registry standard, which requires that less than 5% of the emissions in any given year be unknown because of missing data.

This inventory can provide information that will assist in planning for additional steps to reduce emissions.

INVENTORY FORMAT AND DATA

Emissions calculations spreadsheets were built from the World Business Council for Sustainable Development (WBCSD) - World Resources Institute (WRI) Protocol for cement plants, version 1.6, dated September 2001. Methods for treating missing data were based upon the approach of the California Climate Action Registry (CCAR). Several numerical constants which were not supplied by the WRI spreadsheet were taken from the Intergovernmental Panel on Climate Change (IPCC) publications.

The data for the inventory came from plant records provided by plant personnel. A special effort was made to use annual data from the plant for the net caloric values of fuels used to heat the kilns, rather than standard values. However, the WBCSD-WRI default value for CO₂ emissions due to calcination in the kiln was used rather than working up a value from the local materials chemistry. The default value takes into account the typically small CO₂ emissions from magnesium carbonate as well as the much larger emissions from calcium carbonate. The WBCSD-WRI default values for tonnes of CO₂ per GJ of energy for various fuels were also used.

The WBCSD-WRI spreadsheet proved to be a very useful tool because it provides a worksheet format that begins with the basic plant operating data and proceeds to estimates of gross CO₂ emissions, net CO₂ emissions, and specific CO₂ emissions per tonne of clinker and per tonne of cementitious product. The Albany plant will find this a useful format for future use. A blank copy of the spreadsheet is provided along with the completed electronic copies of spreadsheets accompanying this report.

INVENTORY BOUNDARIES, PLANT DESCRIPTION

The approach to inventory boundaries was based on the CCAR recommended procedures. Plant staff determined the inventory should be limited to activities within the plant. This is suitable given the absence of any activities outside the plant that are under the management control of plant personnel. The plant staff do not manage or operate quarries or other sources of raw materials and do not manage vehicle fleets operating outside the plant.

The WBCSD-WRI protocol requires that all "direct" emissions of CO₂ be included. Direct emissions are those arising from equipment and processes under the direct control of plant staff. These activities include the production of clinker, various grinding, crushing and packaging of product, and the lighting and heating of the building space and hot water.

Two "indirect" sources of CO₂ emissions are also required in the WBCSD-WRI inventory. Indirect emissions result from activities at other locations not under the control of plant management. One indirect source is the CO₂ produced elsewhere to make clinker that is subsequently imported into the plant and incorporated into product. The amount of clinker imported annually into the Albany plant between 1990 and 2002 varied from 0 to more than 100,000 tons.

The other indirect source of CO₂ is from electricity generating plants that use fossil fuels. To the extent that Basin Power (the local electric utility) purchases power from these generators, indirect CO₂ is a source of emissions for the plant. However, since Hadrian makes a substantial "green power" purchase from Basin Power, which gets its "green power" from wind turbines, the amount of CO₂ associated with the electricity purchase is very small.

The basis for estimating the CO₂ emissions from purchased clinker is the emissions from the Albany plant per tonne of clinker it produces. The result is that the plants' CO₂ emissions are the same whether the Albany plant produces clinker, or purchases it.

PLANT PRACTICES

The Albany plant uses the wet process, which requires more fossil fuel to produce a ton of clinker than does the dry process. On the other hand, there are several Albany plant practices that directly reduce emissions of CO₂.

The WBCSD-WRI protocol distinguishes between "gross CO₂ emissions" and "net CO₂ emissions". The difference is that net emissions exclude a portion of the emissions from the "alternative" fuels used in the kiln. The portion excluded represents the CO₂ emissions associated with disposal of the waste, such as decay and release of methane and CO₂. However in the absence of data available for the amount of credit that should be given for avoiding waste disposal, the WBCSD-WRI protocol provides a default assumption of 100% credit of the waste fuel CO₂.

The Albany plant has used significant amounts of waste fossil fuels during the inventory period, including tire-derived fuel and waste oils. The CO₂ emissions from these waste fossil fuels are not counted in the "net" emissions for the plant because the default provides for 100% credit. The use of these waste fuels reduces the CO₂ emissions counted in the net inventory for kiln heating.

The second and more important practice that has reduced emissions is the use of slag as an additive to displace clinker in cement products. As a consequence, less clinker must be produced for each tonne of cement product and the emissions associated with clinker production are reduced correspondingly. The discussion below will demonstrate the value of this practice.

REPORTING

The WBCSD-WRI Protocol distinguishes between total plant emissions, and "specific emissions". The term "specific emissions" means emissions per unit of production. The two types of specific emissions used in the protocol are:

- (specific) emissions of CO₂ per tonne of clinker produced
- (specific) emissions of CO₂ per tonne of cement product produced

The correct measure of the plant's performance is the total CO₂ emissions per year. Total CO₂ emissions will continue to rise in future years because of increased production and in spite of improved plant practices. Specific emissions identify gains from improved plant practices.

Total CO₂ emissions from the plant for a given year varies directly with the amount of product. Dividing the total emissions for the year by the tonnes of clinker produced, or by

the tonne of cement product produced, gives the average amount of CO₂ per tonne, or specific CO₂ emissions. Comparisons of specific emissions indicate whether the plant is reducing emissions independent of how many tonnes of product are produced. This comparison is the one that should be used to evaluate the effect of changes in practices upon CO₂ emissions.

However, it is not yet clear how others will judge the plant's performance, on the total CO₂ emissions per year or specific emissions. The choice of a baseline year, and estimates of future emissions of CO₂ from the plant, must take into account the alternative measures that may be selected and the probability that plant production levels will rise along with total CO₂ emissions because of increased production and in spite of improved plant practices.

CONCLUSIONS

The various sources of CO₂ included in the inventory boundaries do not change significantly over the period from 1990 to 2002. Neither do the relative amounts from each source. Fluctuations in the amount of clinker produced clearly have an impact on the total emissions each year, but not much impact on the relative amounts of each source of CO₂. Table I shows the sources and the percentages of each source for three years: 1990, 1996, and 2002.

Table I. Relative Trend in Sources of CO₂ Emissions Over Ten Years

SOURCE OF CO ₂	YEAR					
	1990		1996		2002	
	Tonnes	%	Tonnes	%	Tonnes	%
Calcination of carbonates	209,000	47%	211,000	52%	131,000	54%
Conventional fossil fuels	172,000	39%	152,000	37%	94,100	39%
Purchased clinker	27,800	6.3%	0	0%	3,440	1.4%
Waste fossil fuels (AFR)	23,700	5.4%	38,900	9.6%	11,700	4.8%
Purchased electricity	6,980	1.6%	3,060	0.8%	1,600	0.6%
Equipment & vehicles	414	< .1%	419	< .1%	226	< .1%
CKD sold	247	< .1%	498	< .1%	41	< .1%
Space & water heat	160	< .1%	134	< .1%	156	< .1%

If we look at annual specific CO₂ emissions per tonne of cement product produced, we see that there has been a significant change over the period from 1999 to 2002, with a reduction of approximately –13%.

Data for the past three years clearly shows a decline in CO₂ emissions per ton of cement product due to calcination. This drop is coincident with the increased use of slag as a cement additive to reduce clinker content in cement products. The decline in the net CO₂ emissions per tonne of clinker shows a drop of approximately 4% in 2000, 2001 and 2002, compared to the prior years.

Date of latest update

Sept 05, 2001

INFORMATION

LAST CORRECTION 5/15 2030 pm

General Plant Information		1990	1996	2002
1	Plant	Albany	Albany	Albany
2	Company	Hadrian	Hadrian	Hadrian
3	Country	U.S.	U.S.	U.S.
4	Continent	N.A.	N.A.	N.A.
5	"Kyoto" Region (Annex 1 oder non-Annex 1)	Annex 1	Annex 1	Annex 1
6	Kiln types	Wet	Wet	Wet
7	Shares owned by Company	100%	100%	100%

Inventory Boundaries: Coverage of Main Process Steps		1990	1996	2002
7a	Raw material supply (quarrying, mining, crushing)	[yes, no or partly]	No	No
7b	Preparation of raw materials, fuels and additives	[yes, no or partly]	No	No
7c	Kiln operation (pyro-processing)	[yes, no or partly]	Partly	Partly
7d	Cement grinding, blending	[yes, no or partly]	Yes	Yes
7e	On-site (internal) transport	[yes, no or partly]	Yes	Yes
7f	Off-site transport with company-owned fleets	[yes, no or partly]	No	No
7g	On-site power generation	[yes, no or partly]	No	No
7h	(add other processes as appropriate)	[yes, no or partly]	N/A	N/A

Clinker and Cement Production		1990	1996	2002
Clinker:				
8	Clinker production	[t/yr]	397,973	402,786
9	Clinker bought or imported	[t/yr]	27,259	0
10	Clinker sold	[t/yr]	0	0
10a	Change in clinker stocks	[t/yr]	0	0
11	Total clinker consumed	[t/yr]	425,232	402,786

Mineral components (MIC) used to produce blended cements (dry weight):		1990	1996	2002
12	Gypsum (LF - includes synthetic gypsum)	[t/yr]	24,627	21,510
13	Limestone	[t/yr]	0	128
14	Slag	[t/yr]	0	0
15	Fly ash (for blending)	[t/yr]	2,753	4,136
16	Puzzolana	[t/yr]	0	0
17	Blending Dust	[t/yr]	0	0
18	Total MIC consumed for blending	[t/yr]	27,380	25,774
	"s" lime		257	266

Mineral components (MIC) used as cement substitutes (direct additions to concrete; dry weight):		1990	1996	2002
19a	MIC consumed for production of pure slag cement (dry weight)	[t/yr]	0	0
19b	Fly ash and puzzolana (direct sales, dry weight)	[t/yr]	0	0
19	Total pure MIC products used as cement substitutes	[t/yr]	0	0

Production totals:		1990	1996	2002
20	Total Portland + Blended cements	[t/yr]	452,612	428,560
21	Total cements + substitutes: Portland, Blended, Slag	[t/yr]	452,612	428,560
21a	Total cementitious products	[t/yr]	425,353	428,560

IMPORTED CLINKER NOT COUNTED IN THIS SPREADSHEET, ALTHOUGH IT DOES INCREASE ELECTRICITY USE

Dust Production		1990	1996	2002
22	Bypass dust discarded	[t/yr]	0	0
23	CKD sold or discarded	[t/yr]	35,628	71,900
24	Calcination rate of CKD	[%]	2	2

Kiln Fuel Consumption (Aggregate)		1990	1996	2002
25	Total heat consumption of kilns	[TJ/yr]	2,237	2,024
26	Fossil fuels	[TJ/yr]	1,956	1,556
27	Alternative fuels (fossil-based, non-biomass)	[TJ/yr]	281	468
28	Biomass fuels	[TJ/yr]	0	0
29	Waste water	[t/yr]	0	0

Non-Kiln Fuel Consumption		1990	1996	2002
30	Equipment and on-site vehicles	[TJ/yr]	6	6
31a	Room heating / cooling	[TJ/yr]	3	2
31b	Drying of raw materials	[TJ/yr]	0	0
31c	On-site power generation	[TJ/yr]	0	0
32	Total non-kiln fuel consumption	[TJ/yr]	9	8

Power Consumption		1990	1996	2002
33a	from on-site power generation	[MWh/yr]	0	0
33b	CO2 per power unit produced on-site	[kg CO2/MWh]	0	0
33c	from external power generation	[MWh/yr]	67,129	59,739
33d	CO2 per power unit produced externally	[kg CO2/MWh]	104,000	51,200
33	Total plant power consumption	[MWh/yr]	67,129	59,739

Waste Heat Exports		1990	1996	2002	
34	Waste heat supplied to external consumers	[GJ/yr]	0	0	3

CO2 EMISSIONS

Direct CO2 Emissions

CO2 from Raw Materials		1990	1996	2002	
35	Calcination emission factor, corrected for CaO- and MgO imports	[kg CO2/ t cli]	525	525	525
36	CO2 from raw meal converted to clinker	[t CO2/yr] *	208,936	211,463	130,706
37	CO2 from bypass dust discarded	[t CO2/yr]	0	0	0
38	CO2 from CKD sold or discarded	[t CO2/yr] *	247	498	41
39	Total CO2 from raw materials	[t CO2/yr]	209,183	211,961	130,747

CO2 from Kiln Fuels		1990	1996	2002	
40	CO2 from conventional fossil fuels	[t CO2/yr] *	179,592	151,465	99,561
41	CO2 from alternative fossil fuels (fossil wastes)	[t CO2/yr] *	23,730	38,887	11,652
43	Total CO2 from fossil-based kiln fuels	[t CO2/yr]	203,322	190,352	111,213

CO2 from Non-Kiln Fuels		1990	1996	2002	
44	CO2 from equipment and on-site vehicles	[t CO2/yr] *	414	419	226
45a	CO2 from room heating / cooling	[t CO2/yr] *	168	140	155
45b	CO2 from drying of raw materials	[t CO2/yr]	0	0	0
45c	CO2 from on-site power generation	[t CO2/yr]	0	0	0
46	Total CO2 from non-kiln fuels	[t CO2/yr]	582	560	382

Total Direct CO2 Emissions		1990	1996	2002	
48	Total direct CO2: all sources	[t CO2/yr]	413,087	402,873	242,342

Indirect CO2 Emissions (Main Sources)

		1990	1996	2002	
49a	CO2 from external power generation	[t CO2/yr] *	6,981	3,059	1,595
49b	CO2 from purchased clinker	[t CO2/yr] *	28,294	0	0
49c	Total indirect CO2 (main sources)	[t CO2/yr]	35,276	3,059	1,595

Direct CO2 from Biomass Fuels (Memo Item)

		1990	1996	2002	
50	CO2 from combustion of biomass fuels (kiln and non-kiln)	[t CO2/yr]	0	0	0

PERFORMANCE INDICATORS

Gross CO2 Emissions (= total direct CO2; all sources)		1990	1996	2002	
59	Absolute gross CO2	[t CO2/yr]	413,087	402,873	242,342
59a	calcination component	[t CO2/yr]	209,183	211,961	130,747
59b	fuel component	[t CO2/yr]	203,904	190,912	111,595
60	Specific gross CO2 per tonne of clinker produced	[kg CO2/t cli]	1,038	1,000	973
62	tonne of cementitious product	[kg CO2/t cem prod]	971	940	872
62a	calcination component	[kg CO2/t cem prod]	492	495	470
62b	fuel component	[kg CO2/ cem prod]	479	445	401

Credits for Indirect GHG Savings		1990	1996	2002	
65a	Credits for indirect savings through alternative fuels (waste fuels)	[t CO2/yr]	23,730	38,887	11,652
65b	Source of credits	[--]			

NOTE: TIM ESTIMATED AVOIDED LANDFILL methane and added by hand to line 65a

Net CO2 Emissions (= gross CO2 minus credits for indirect savings)		1990	1996	2002	
71	Absolute net CO2	[t CO2/yr]	389,357	363,985	230,690
71a	calcination component	[t CO2/yr]	209,183	211,961	130,747
71b	fuel component	[t CO2/yr]	180,174	152,024	99,943
73	Specific net CO2 per tonne of clinker produced	[kg CO2/t cli]	978	904	927
74	tonne of cementitious product	[kg CO2/t cem prod]	915	849	830
74a	calcination component	[kg CO2/ cem prod]	492	495	470
74b	fuel component	[kg CO2/ cem prod]	424	355	360
77	Improvement rate - net CO2 per tonne of cementitious product	[% relative to base yr]	0.0	-7.2	-9.3
78	calcination component	[% relative to base yr]	0.0	0.6	-4.4
79	fuel component (fossil-based)	[% relative to base yr]	0.0	-16.3	-15.1

Specific CO2 from Indirect and Biomass Sources		1990	1996	2002	
82	Specific indirect CO2 (power generation and clinker purchased)	[kg CO2/t cem prod]	83	7	6
83	Specific CO2 from biomass fuels (Memo Item)	[kg CO2/t cem prod]	0	0	0

General Performance Indicators		1990	1996	2002	
91	Net clinker sales / net clinker consumption	[%]	-6.4	0.0	0.0
92	Clinker/cement factor in cements	[%]	94.0	94.0	89.7

93	Specific heat consumption of clinker production	[MJ/t cli]	5,621	5,026	4,697
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94	Fossil fuel rate	[%]	87.5	76.9	87.5
95	Alternative fossil fuel rate (fossil wastes)	[%]	12.5	23.1	12.5
96	Biomass fuel rate	[%]	0.0	0.0	0.0
97	Specific power consumption	[kWh/t cement]	148.3	139.4	163.7

KILN FUELS - DETAILED INFORMATION

Kiln Fuel Consumption in tonnes per year			1990	1996	2002
101	Fossil fuels				
102	coal + anthracite + waste coal + coal/petcoke mix	[t/yr]	30,861.00	29,150	23,694
103	petrol coke	[t/yr]	28,925.00	26,666	18,632
104	(ultra) heavy fuel(TB OIL, off-spec oil)	[t/yr]	0.00	0	0
105	diesel oil (OIL, LIGHT OIL)	[t/yr]	3,981.00	533	1,132
106	natural gas	[t/yr]	4,490.00	347	386
107	shale	[t/yr]	0	0	0
108	Alternative fossil fuels (fossil wastes)				
109	waste oil	[t/yr]	1,388	6,842	5,826
110	tyres	[t/yr]	7,307.00	8,231	0
111	plastics	[t/yr]			
112	solvents	[t/yr]			
113	impregnated saw dust	[t/yr]			
114	other fossil based wastes	[t/yr]			
115	Biomass fuels				
116	dried sewage sludge	[t/yr]			
117	wood, non impregnated saw dust	[t/yr]			
118	paper, carton	[t/yr]			
119	animal meal	[t/yr]			
120	agricultural, organic, diaper waste, charcoal	[t/yr]			
121	Waste water	[t/yr]	0	0	0

Fuel Heating Values and CO2 Emission Factors			1990	1996	2002
130	kg CO2/GJ fuel name				
131	Fossil fuels				
132	96 coal + anthracite + waste coal + coal/petcoke mix	[GJ/t]	22.4	25.46	21.20
133	100 petrol coke	[GJ/t]	31.6	29.19	27.00
134	77.4 (ultra) heavy fuel(TB OIL,OFF-SPEC OIL)	[GJ/t]	0.00	0.00	0.00
135	74.1 diesel oil (OIL, LIGHT OIL)	[GJ/t]	29.84	39.00	0.00
136	56.1 natural gas	[GJ/t]	51.70	43.10	47.70
137	107 shale	[GJ/t]	0.00	0.00	0.00
138	Alternative fossil fuels (fossil wastes)				
139	80 waste oil	[GJ/t]	18.50	26.50	25.00
140	85 tyres	[GJ/t]	34.9	34.85	36.00
141	75 plastics	[GJ/t]			
142	75 solvents	[GJ/t]			
143	75 impregnated saw dust	[GJ/t]			
144	80 other fossil based wastes	[GJ/t]			
145	Biomass fuels				
146	110 sewage sludge	[GJ/t]			
147	110 wood, non impregnated saw dust	[GJ/t]			
148	110 paper, carton	[GJ/t]			
149	110 animal meal	[GJ/t]			
150	110 agricultural, organic, diaper waste, charcoal	[GJ/t]			
151	Waste water	[GJ/t]	0	0	0

Kiln Fuel Consumption in terajoules (TJ) per year			1990	1996	2002
161	Fossil fuels	[TJ/yr]	1,956	1,556	1,024
162	coal + anthracite + waste coal + coal/petcoke mix	[TJ/yr]	691	742	502
163	petrol coke	[TJ/yr]	914	778	503
164	(ultra) heavy fuel	[TJ/yr]	0	0	0
165	diesel oil	[TJ/yr]	119	21	0
166	natural gas	[TJ/yr]	232	15	18
167	shale	[TJ/yr]	0	0	0
168	Alternative fossil fuels (fossil wastes)	[TJ/yr]	281	468	146
169	waste oil	[TJ/yr]	26	181	146
170	tyres	[TJ/yr]	255	287	0
171	plastics	[TJ/yr]	0	0	0
172	solvents	[TJ/yr]	0	0	0
173	impregnated saw dust	[TJ/yr]	0	0	0
174	other fossil based wastes	[TJ/yr]	0	0	0
175	Biomass fuels	[TJ/yr]	0	0	0
176	sewage sludge	[TJ/yr]	0	0	0
177	wood, non impregnated saw dust	[TJ/yr]	0	0	0
178	paper, carton	[TJ/yr]	0	0	0
179	animal meal	[TJ/yr]	0	0	0
180	agricultural, organic, diaper waste, charcoal	[TJ/yr]	0	0	0
181	Waste water	[TJ/yr]	0	0	0

CO2 Emissions from Kiln Fuels			1990	1996	2002
211	Fossil fuels - total emissions	[t CO2/yr]	179,592	151,465	99,561
212	coal + anthracite + waste coal + coal/petcoke mix	[t CO2/yr]	66,363	71,247	48,222
213	petrol coke	[t CO2/yr]	91,403	77,838	50,306
214	(ultra) heavy fuel	[t CO2/yr]	0	0	0
215	diesel oil	[t CO2/yr]	8,803	1,540	0
216	natural gas	[t CO2/yr]	13,023	839	1,033
217	shale	[t CO2/yr]	0	0	0
218	Alternative fossil fuels - total emissions	[t CO2/yr]	23,730	38,887	11,652
219	waste oil	[t CO2/yr]	2,054	14,505	11,652
220	waste tyres	[t CO2/yr]	21,676	24,382	0
221	plastics	[t CO2/yr]	0	0	0
222	solvents	[t CO2/yr]	0	0	0
223	impregnated saw dust	[t CO2/yr]	0	0	0
224	other fossil based wastes	[t CO2/yr]	0	0	0
225	Biomass fuels - total emissions	[t CO2/yr]	0	0	0
226	sewage sludge	[t CO2/yr]	0	0	0
227	wood, non impregnated saw dust	[t CO2/yr]	0	0	0
228	paper, carton	[t CO2/yr]	0	0	0
229	animal meal	[t CO2/yr]	0	0	0
230	agricultural, organic, diaper waste, charcoal	[t CO2/yr]	0	0	0
231	Waste water	[t CO2/yr]	0	0	0

NON-KILN FUELS - DETAILED INFORMATION

Non-Kiln Fuel Consumption in tonnes per year			1990	1996	2002
301	Equipment and On-Site Vehicles		0		
301a	diesel oil	[t/yr]	100	101	54.9
301b	gasoline	[t/yr]	30	31	16.2
302	Room Heating and Cooling		0		
302a	diesel oil	[t/yr]	0		
302b	natural gas	[t/yr]	58	58	58
303	Drying of raw materials		0		
303a	coal + anthracite + waste coal + coal/petcoke mix	[t/yr]	0		
303b	petrol coke	[t/yr]	0		
303c	(ultra) heavy fuel	[t/yr]	0		
303d	diesel oil	[t/yr]	0		
303e	natural gas	[t/yr]	0		
303f	shale	[t/yr]	0		
304	On-site power generation		0		
304a	coal + anthracite + waste coal + coal/petcoke mix	[t/yr]	0		
304b	(ultra) heavy fuel	[t/yr]	0		
304c	diesel oil	[t/yr]	0		
304d	natural gas	[t/yr]	0		
304e	biomass fuels	[t/yr]	0		

Fuel Heating Values and CO2 Emission Factors			1990	1996	2002
310	kg CO2/GJ fuel name				
311	Equipment and On-Site Vehicles				
311a	74.1 diesel oil	[GJ/t]	43.33	43.33	43.33
311b	69.2 gasoline	[GJ/t]	44.80	44.80	44.80
312	Room Heating and Cooling				
312a	74.1 diesel oil	[GJ/t]	0.00	0.00	0.00
312b	56.1 natural gas	[GJ/t]	51.70	43.10	47.70
313	Drying of raw materials				
313a	96 coal + anthracite + waste coal + coal/petcoke mix	[GJ/t]	0.00	0.00	0.00
313b	100 petrol coke	[GJ/t]	0.00	0.00	0.00
313c	77.4 (ultra) heavy fuel	[GJ/t]	0.00	0.00	0.00
313d	74.1 diesel oil	[GJ/t]	0.00	0.00	0.00
313e	56.1 natural gas	[GJ/t]	0.00	0.00	0.00
313f	107 shale	[GJ/t]	0.00	0.00	0.00
314	On-site power generation		0.00	0.00	0.00
314a	96 coal + anthracite + waste coal + coal/petcoke mix	[GJ/t]	0.00	0.00	0.00
314b	77.4 (ultra) heavy fuel	[GJ/t]	0.00	0.00	0.00
314c	74.1 diesel oil	[GJ/t]	0.00	0.00	0.00
314d	56.1 natural gas	[GJ/t]	0.00	0.00	0.00
314e	110 biomass fuels	[GJ/t]	0.00	0.00	0.00

Non-Kiln Fuel Consumption in terajoules (TJ) per year			1990	1996	2002
321	Equipment and On-Site Vehicles	[TJ/yr]	5.7	5.8	3.1
321a	diesel oil	[TJ/yr]	4.3	4.4	2.4
321b	gasoline	[TJ/yr]	1.4	1.4	0.7
322	Room Heating and Cooling	[TJ/yr]	2.9986	2.4998	2.7666
322a	diesel oil	[TJ/yr]	0	0	0
322b	natural gas	[TJ/yr]	2.9986	2.4998	2.7666
323	Drying of raw materials	[TJ/yr]	0	0	0

323a	coal + anthracite + waste coal + coal/petcoke mix	[TJ/yr]	0	0	0
323b	petrol coke	[TJ/yr]	0	0	0
323c	(ultra) heavy fuel	[TJ/yr]	0	0	0
323d	diesel oil	[TJ/yr]	0	0	0
323e	natural gas	[TJ/yr]	0	0	0
323f	shale	[TJ/yr]	0	0	0
324	On-site power generation	[TJ/yr]	0	0	0
324a	coal + anthracite + waste coal + coal/petcoke mix	[TJ/yr]	0	0	0
324b	(ultra) heavy fuel	[TJ/yr]	0	0	0
324c	diesel oil	[TJ/yr]	0	0	0
324d	natural gas	[TJ/yr]	0	0	0
324e	biomass fuels	[TJ/yr]	0	0	0

CO2 Emissions from Non-Kiln fuels			1990	1996	2002
331	Equipment and On-Site Vehicles	[t CO2/yr]	413.7	419.5	226.5
331a	diesel oil	[t CO2/yr]	319.8	324.3	176.3
331b	gasoline	[t CO2/yr]	93.9	95.2	50.2
332	Room Heating and Cooling	[t CO2/yr]	168.22146	140.23878	155.20626
332a	diesel oil	[t CO2/yr]	0	0	0
332b	natural gas	[t CO2/yr]	168.22146	140.23878	155.20626
333	Drying of raw materials	[t CO2/yr]	0	0	0
333a	coal + anthracite + waste coal + coal/petcoke mix	[t CO2/yr]	0	0	0
333b	petrol coke	[t CO2/yr]	0	0	0
333c	(ultra) heavy fuel	[t CO2/yr]	0	0	0
333d	diesel oil	[t CO2/yr]	0	0	0
333e	natural gas	[t CO2/yr]	0	0	0
333f	shale	[t CO2/yr]	0	0	0
334	On-site power generation (excl. biomass fuels)	[t CO2/yr]	0	0	0
334a	coal + anthracite + waste coal + coal/petcoke mix	[t CO2/yr]	0	0	0
334b	(ultra) heavy fuel	[t CO2/yr]	0	0	0
334c	diesel oil	[t CO2/yr]	0	0	0
334d	natural gas	[t CO2/yr]	0	0	0
334e	biomass fuels (memo item)	[t CO2/yr]	0	0	0