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Table A-1
Plantwide GHG Emission Summary
Formosa Plastic Corporation, Texas
LDPE Plant
March 2014

Name	EPN	GHG Mass Emissions ton/yr	CO_2e ton/yr
RTO 1 [1]	LD-022A/B	31,550	32,439
RTO 2 [1]	LD-023A/B		
Waste Gas to OL3 Elevated Flare [2]	OL3-FLR	21,933	22,253
Pellet Blending Silo 1	LD-014	4,818	20,409
Pellet Blending Silo 2	LD-015	4,818	20,409
Emergency Engine	LD-002	207	229
Natural Gas Piping Fugitives [4]	NG-FUG	20.9	506
LDPE Plant MSS Vessel Opening [4]	LD-MSS	0.01	0.08
	Total [3] =	**63,347**	**96,245**

Notes:
[1] Waste gas combustion can occur in either RTO. Unit-specific maximum emission rates shown here assume that 100% of annual waste gas is routed to each RTO.
[2] Includes MSS emissions from LDPE plant MSS degassing to Olefins 3 elevated flare.
[3] Total annual emissions account for 100% of waste gas combustion in either RTO unit. That is, RTO unit-specific annual emission rates are not additive.
[4] FPC TX Requests that No Emission Limit be established for this source.
Compliance will be assured with the design/work practice standard as specified in the permit.

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Table A-2
GHG Emission Calculations - Natural Gas Combustion
Formosa Plastic Corporation, Texas
LDPE Plant
March 2014

GHG Emissions Contribution From Natural Gas Combustion:

Source Type	Average Heat Input/unit (MMBtu/hr)	Number of units	Annual Operation hrs/yr	Annual Avg Heat input, each unit (MMBtu/yr)	Pollutant	Emission Factor (kg/MMBtu)[1]	Emissions per Unit: GHG Mass Emissions[2] (metric ton/yr)	Emissions per Unit: Global Warming Potential[3]	Emissions per Unit: CO_2e (metric ton/yr)	Emissions per Unit: CO_2e (tpy)
RTOs	18.0	2	8,760	157,680	CO_2	53.02	8,360.2	1	8,360.2	9,217.1
					CH_4	1.0E-03	0.16	25	3.9	4.3
					N_2O	1.0E-04	0.02	298	4.7	5.2
						Totals	**8,360**		**8,369**	**9,227**

Notes:

1. CH_4 and N_2O GHG factors based on Table C-2 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.
2. CO_2 emissions based on 40 CFR Part 98, Subpart C Equation C-1

CH_4 and N_2O Emissions from 40 CFR Part 98, Subpart C Equation C-8.

3. Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.

Sample Calculations, CO_2:

GHG Mass Emissions = 0.001 x 157680 (MMBtu/yr) x 53.02 (kg/MMBtu) = 8360.2 (metric ton/yr)

CO2e Emissions (from CO2) = 8360.2 (metric ton/yr) x 1 (GWP factor) = 8360.2 (metric ton/yr)

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Table A-3

GHG Emission Calculations - RTO Waste Gas Combustion

Formosa Plastic Corporation, Texas

LDPE Plant

March 2014

RTO Waste Gas Data:

Variable	Value	Units	Reference
Carbon content (annual avg)	0.0031	kg C/kg	Formosa design data
Molecular Weight (annual avg)	29.1	kg/kmol	Formosa design data

GHG Emissions from RTO Waste Gas Combustion:

Source Type	Annual Avg Waste gas flow rate (scf/yr)	Pollutant	GHG Mass Emissions[2] (metric ton/yr)	Global Warming Potential[3]	CO_2e (metric ton/yr)	CO_2e (tpy)
RTOs 1 & 2	5.26E+10	CO_2	2.02E+04	1	2.02E+04	2.23E+04
		CH_4	3.07E+01	25	7.68E+02	8.47E+02
		N_2O	2.02E-01	298	6.03E+01	6.65E+01
		Totals	**2.03E+04**		**2.11E+04**	**2.32E+04**

Notes:

1. CH_4 and N_2O GHG factors based on Table C-2 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.

2. CO_2 emissions based on 40 CFR Part 98, Subpart Y Equation Y-1a

CH_4 emissions based on 40 CFR Part 98, Subpart Y Equation Y-4

3. Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.

Sample Calculations, CO_2:

GHG Mass Emissions = 44/12 x 5.26E+10 (scf/yr) x 0.0031 (kg C/kg) x (29.1 (kg/mol) / 849.5 scf/kg-mole @ std cond.) x 0.001 x 0.98

= 2.02E+04 (metric ton/yr)

CO2e Emissions (from CO2) = 2.02E+04 (metric ton/yr) x 1 = 2.02E+04 (metric ton/yr)

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Table A-3A

GHG Emission Calculations - RTO Waste Gas Combustion

Formosa Plastic Corporation, Texas

LDPE Plant

March 2014

Waste Gas Composition to RTO

Compound	Molecular Weight (lb/lbmol)	Molar composition (Mole %) [1]	Component Mass per Lbmol Gas (lb)	Number of carbons	Component Carbon Mass (lbC/lbmol)	Carbon Mass (lbC/lbmol)	Carbon Content (lbC/lb)
Ethylene	28.05	0.10%	0.03	2	24	0.025	**0.0031**
Vinyl Acetate	86.09	0.13%	0.12	4	48	0.065	
Air	28.97	99.76%	28.90	0	0	0.000	
			MW = 29.05 lb/lbmol				

Notes:

[1] Composition is representative and may vary. Estimated composition used for emission calculation purposes only.

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Table A-4

GHG Emission Calculations - Elevated Flare Contributions (Olefins 3 Elevated Flare)

Formosa Plastic Corporation, Texas

LDPE Plant

March 2014

Flare Gas Data:

Variable	Value	Units	Reference
Carbon content (annual avg)	0.80	kg C/kg	Formosa design data
Molecular Weight (annual avg)	31.9	kg/kmol	Formosa design data

GHG Emissions from Flares:

Source Type	Annual Avg Flare gas flow rate (scf/yr)	Pollutant	GHG Mass Emissions[2] (metric ton/yr)	Global Warming Potential[3]	CO_2e (metric ton/yr)	CO_2e (tpy)
Elevated Flare	2.63E+07	CO_2	2.83E+03	1	2.83E+03	3.12E+03
		CH_4	8.53E+00	25	2.13E+02	2.35E+02
		N_2O	2.83E-02	298	8.42E+00	9.29E+00
		Totals	**2.84E+03**		**3.05E+03**	**3.36E+03**

Notes:

1. CH_4 and N_2O GHG factors based on Table C-2 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.

2. CO_2 emissions based on 40 CFR Part 98, Subpart Y Equation Y-1a

CH_4 emissions based on 40 CFR Part 98, Subpart Y Equation Y-4

3. Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.

Sample Calculations, CO_2:

GHG Mass Emissions = (44/12) x 2.63E+07 (scf/yr) x 0.8 (kg C/kg) x
(31.91 (kg/mol) / 849.5 (scf/kg-mole @ std cond.)) x 0.001 x 0.98
= 2.83E+03 (metric ton/yr)

CO2e Emissions (from CO2) = 2.83E+03 (metric ton/yr) x 1 = 2.83E+03 (metric ton/yr)

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Table A-4A
GHG Emission Calculations - Elevated Flare
Formosa Plastic Corporation, Texas
LDPE Plant
March 2014

Elevated Flare Gas Properties

Compound	Molecular Weight (lb/lbmol)	Molar Composition (mole %) [1]	Component Mass per Lbmol Gas (lb)	Number of carbons	Component Carbon Mass (lbC/lbmol)	Carbon Mass (lbC/lbmol)	Carbon Content (lbC/lb)
Propylene	42.08	2.40%	1.01	3	36	0.865	**0.80**
Ethylene	28.05	85.73%	24.05	2	24	20.575	
Ethane	30.07	3.10%	0.93	2	24	0.744	
Methane	16.04	1.77%	0.28	1	12	0.213	
Propionaldehyde	58.05	0.05%	0.03	3	36	0.020	
Vinyl Acetate	86.09	6.06%	5.21	4	48	2.907	
Carbon Dioxide	44.01	0.88%	0.39	1	12	0.106	

MW = 31.91
lb/lbmol

Note:
[1] Composition is representative and may vary. Estimated composition used for emission calculation purposes only.

Table A-5

GHG Emission Calculations - Pellet Blending Silo Vents

Formosa Plastic Corporation, Texas

LDPE Plant

March 2014

Pellet Blending Silo Vent Data:

Variable	Value	Units	Reference
Volumetric flow rate (annual avg), each silo	1,190,400	scf/hr	design specification
CO_2 Concentration	0.70	mol %	design specification
CH_4 Concentration	0.30	mol %	design specification
Maximum vent operating schedule	8,760	hours/yr	design specification

Constants:

Field	Value	Units
CO_2 Molecular Weight	44	kg/kgmol
CH_4 Molecular Weight	16	kg/kgmol
Molar Volume Conversion	849.50	scf/kg-mol
Conversion factor	0.001	metric ton/kg

CO_2 Emissions from Pellet Blending Silo Vents:

Source Type	Pollutant	GHG Mass Emissions[1] (metric ton/yr)	Global Warming Potential[2]	CO_2e (metric ton/yr)	CO_2e (tpy)
Pellet Blending Silo 1	CO_2	3,781	1	3,781	4,168
	CH_4	589	25	14,730	16,240
Pellet Blending Silo 2	CO_2	3,781	1	3,781	4,168
	CH_4	589	25	14,730	16,240
	Total =	**8,740**		**37,022**	**40,817**

Notes:

1. *CO_2 and CH_4 emissions based on 40 CFR Part 98, Subpart Y Equation Y-19*
2. *Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.*

Sample Calculations, CO_2:

GHG Mass Emissions = 1190400 (scf/hr) x (0.7 mol % / 100) x 8760 (hours/yr) x (44 kg/kgmol / 849.5 scf/kg-mol) x 0.001 metric ton/kg = 3781 (metric ton/yr)

CO2e Emissions (from CO2) = 3781 (metric ton/yr) x 1 = 3781 (metric ton/yr)

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Table A-6

GHG Emission Calculations - Emergency Engine

Formosa Plastic Corporation, Texas

LDPE Plant

March 2014

Diesel Engine Specifications:

Variable	Value	Units	Reference
Ann.Operating Schedule	100	hours/year	NSPS IIII Limitation
Power Rating	400	hp	design specification
Brake Specific Fuel Consumption	7,000	Btu/hp-hr	AP-42 average fuel consumption for diesel engine

GHG Emissions Contribution From Diesel Combustion In Emergency Engines:

EPN	Annual Heat Input (MMBtu/yr)	Pollutant	Emission Factor (kg/MMBtu)[1]	GHG Mass Emissions (metric ton/yr)	Global Warming Potential[2]	CO_2e (metric ton/yr)	CO_2e (tpy)
LD-002	2,800	CO_2	73.96	207.1	1	207.1	228.3
		CH_4	3.0E-03	0.0084	25	0.2	0.2
		N_2O	6.0E-04	0.0017	298	0.5	0.6
				207.10		**207.8**	**229.1**

Calculation Procedure (From 40 CFR 98 Subpart C, Equation C-1)

Annual Emission Rate = Annual Heat Input (Fuel) X Emission Factor (EF) X 0.001 (metric tons/kg)

Notes:

1. *GHG factors based on Tables C-1 and C-2 of 40 CFR 98 Mandatory Greenhouse Gas Reporting for diesel fuel (distillate fuel oil no. 2).*
2. *Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.*

Sample Calculations, CO_2:

GHG Mass Emissions = 2800 (MMBtu/yr) x 73.96 (kg/MMBtu) x 0.001 ton/kg = 207.1 (metric ton/yr)

CO2e Emissions (from CO2) = 207.1 (metric ton/yr) x 1 = 207.1 (metric ton/yr)

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Table A-7

GHG Emission Calculations - Fugitive Component Emissions

Formosa Plastic Corporation, Texas

LDPE Plant

March 2014

GHG Emissions Contribution From Fugitive Piping Components:

EPN	Source Type	Fluid State	Count	Emission Factor[1] scf/hr/comp	CO_2 Content (vol %)	CH_4 Content (vol %)	CO_2 (tpy)	Methane (tpy)	Total (tpy)
NG-FUG	Valves	Gas/Vapor	600	0.121	1.20%	96.6%	0.436	12.80	
	Flanges	Gas/Vapor	2400	0.017			0.245	7.19	
	Relief Valves	Gas/Vapor	5	0.193			5.80E-03	1.70E-01	
	Sampling Connections	Gas/Vapor	10	0.031			1.86E-03	5.46E-02	
	Compressors	Gas/Vapor	3	0.002			3.60E-05	1.06E-03	
GHG Mass-Based Emissions							0.689	20.2	***20.9***
Global Warming Potential[2]							1	25	
CO_2e Emissions							0.69	505.4	***506.1***

Notes:

1. Emission factors from Table W-1A of 40 CFR 98 Mandatory Greenhouse Gas Reporting

2. Global Warming Potential factors based on Table A-1 of 40 CFR 98 Mandatory Greenhouse Gas Reporting.

Example calculation:

600 valves	0.121 scf gas	0.012 scf CO2	lbmol	44.01 lb CO_2	8760 hr	ton	0.44	ton/yr
	hr * valve	scf gas	385 scf	lbmol	yr	2000 lb		