APPENDIX C

ASSUMPTIONS AND CALCULATIONS

PAR 1110.2 Emissions Calculations

ENGINES AND FUEL USAGE

___Emission calculations are based on engines and fuel use data reported in 2005 engine survey plus data added for unreported diesels that are or may be affected by PAR1110.2.
___Results for the survey engines are scaled up to represent the full population found in a search of AQMD permitting data base (all active permits and open applications for stationary, non-emergency engines). Scaling factors depend on category--RECLAIM, non-RECLAIM, biogas, diesel (see "Scale Factors" worksheet).

SCALING FACTORS

Biogas engines:	Represented in Calc's =	54	Number found in BCAT search =	66	Factor =	0.818
RECLAIM nat gas engines:	Represented in Calc's =	90	Number found in BCAT search =	111	Factor =	0.811
Other nat gas engines:	Represented in Calc's =	481	Number found in BCAT search =	652	Factor =	0.738
Diesel engines:	Represented in Calc's =	30	Number found in BCAT search =	30	Factor =	1.000
		655		859		

NOx, CO and VOC CONCENTRATIONS (Note Concentrations Summary Table at end of this section):

Baseline Emissions

Biogas Engines

Baseline emissions are based on NOx limits, landfill gas VOC limits (40 ppm @ 15% O2 as methane), average VOC source test results for digester gas engines based on the survey data, and average CO source test results based on the survey data. In all cases except CEMS-monitored NOx, baseline emissions are assumed to be, on average, 10% above those limits or source test results.

Rich-Burn Engines

For non-RECLAIM and RECLAIM BACT engines with NOx CEMS, it is assumed that the NOx level is maintained on average at 80% of the NOx limit.
For RECLAIM Majors, it is assumed that the NOx level is at the apparent "limit", which was calculated from Annual Emissions Report data.
For most rich-burn engines, baseline NOx and CO emissions are based on NOx and CO limits multipled by factors that are based on AQMD compliance test results.
AQMD compliance tests showed that for engines without CEMS, the average ratio of measured NOx to the NOx limit is 5.19 for BACT engines (NOx limit in 8-23 range)
AQMD compliance tests showed that the average ratio of measured CO to the CO limit follows the relationship R-CO = 6.75 - .00306 x (L - 75),
For non-BACT engines in RECLAIM, many NOx limits are above the range of the AQMD compliance data (none tested in this category), and it is assumed that baseline NOx
Although compliance testing did not include VOC data, source test data reported in the engine survey showed that VOC levels tend to correspond to roughly the square root of

Lean-Burn Engines (Excluding Biogas Engines)

Non-BACT engines (all in RECLAIM): Non-CEMS NOx assumed to be at limit on average, and CO and VOC assumed 10% over source test results on average.
BACT, non-RECLAIM engines: non-CEMS NOx assumed 1.8 x the NOx limit based on AQMD compliance test results; CO and VOC assumed 10% above average
BACT RECLAIM engines (Snow Summit diesels, 50 ppm NOx limit, no CEMS): NOx, CO and VOC assumed to be 10% over limits on average.

Controlled Emissions (Step 1)

Step 1 is the increased monitoring requirements that take effect in 2007 - 2009.
Lean-burn engines: Expected to operate at BACT limits or, in absence of BACT limit, at average source test results.
Rich-burn engines that will have NOx/CO CEMS: it is assumed that both NOx and CO will be maintained on average at 80% of their respective limits.
Rich-burn engines subject to Inspection & Monitoring Plans: it is assumed that both NOx and CO will be, on average, no greater than 20% above their respective limits.

Controlled Emissions (Step 2)

Step 2 is reduction to NOx/CO/VOC = 11/250/30 ppm @ 15% O2, taking effect in 2010 - 2012.
Engines with BACT limits will be unaffected, and engines in RECLAIM will be unaffected regarding NOx.
Engines that will have NOx and/or CO CEMS: it is assumed that the monitored pollutant(s) will be maintained on average at 80% of their respective limits.
Engines subject to Inspection & Monitoring Plans:
Rich-burn: it is assumed that both NOx and CO will be, on average, no greater than 20% above their respective limits.

Lean-burn: it is assumed that both NOx and CO will be, on average, no greater than their respective limits.

Concentrations Summary Table:

	Baseline			Step 1			Step 2			
	NOx	CO	VOC	NOx	CO	VOC	NOx	CO	VOC	Fuel
Biogas >=1000	0.8 x L	1.1 x S/T	1.1 x S/T	same	S/T	S/T	0.8 x 11	250 or S/T	CO% or 30	Biogas
Biogas <1000, New CEMS	1.1 x L	1.1 x S/T	1.1 x S/T	0.8 x L	S/T	S/T	0.8 x 11	250 or S/T	CO% or 30	Biogas
Biogas <1000, I&M	1.1 x L	1.1 x S/T	1.1 x S/T	L	S/T	S/T	11	250 or S/T	CO% or 30	Biogas
Rich BACT RECL Major	0.8 x L	f(L)	f(CO)	same	f(L)-0.8	f(CO)	same	same	f(CO) or 30	NG
Rich BACT RECL Non-Major	f(L)	f(L)	f(CO)	same	f(L)-1.2	f(CO)	same	same	f(CO) or 30	NG
Rich Non-BACT RECL Major	L	f(L)	f(CO)	same	f(L)-0.8	f(CO)	same	0.8 x 250 or same	f(CO) or 30	NG
Rich Non-BACT RECL Non-Major	L	f(L)	f(CO)	same	f(L)-1.2	f(CO)	same	1.2 x 250 or same	f(CO) or 30	NG
Lean BACT RECLAIM Non-Major	1.1 x L	1.1 x L	1.1 x L	L	L	L	same	same	same or 30	Dsl
Lean Non-BACT RECLAIM Major	L	1.1 x S/T	1.1 x S/T	same	S/T	S/T	same	250 or S/T	CO% or 30	NG, Dsl
Lean Non-BACT RECLAIM Non-Major	L	1.1 x S/T	1.1 x S/T	same	S/T	S/T	same	250 or S/T	CO% or 30	NG, Dsl
Rich BACT >=1000	0.8 x L	f(L)	f(CO)	same	f(L)-0.8	f(CO)	0.8 x (11 or L)	0.8 x (250 or L)	f(CO) or 30	NG
Rich BACT <1000, New CEMS	f(L)	f(L)	f(CO)	0.8 x L	f(L)-0.8	f(CO)	0.8 x (11 or L)	0.8 x (250 or L)	f(CO) or 30	NG
Rich BACT <1000, I&M	f(L)	f(L)	f(CO)	1.2 x L	f(L)-1.2	f(CO)	1.2 x (11 or L)	1.2 x (250 or L)	f(CO) or 30	NG
Lean BACT >=1000	0.8 x L	1.1 x L	1.1 x L	same	L	L	same	same	same or 30	NG
Lean BACT <1000, New CEMS	1.8 x L	1.1 x L	1.1 x L	L	L	L	same	same	same or 30	NG
Lean BACT <1000, I&M	1.8 x L	1.1 x L	1.1 x L	L	L	L	same	same	same or 30	NG
Rich Non-BACT >=1000	0.8 x L	f(L)	f(CO)	same	f(L)-0.8	f(CO)	0.8 x 11	0.8 x 250	f(CO) or 30	NG
Rich Non-BACT <1000, New CEMS	f(L)	f(L)	f(CO)	0.8 x L	f(L)-0.8	f(CO)	0.8 x 11	0.8 x 250	f(CO) or 30	NG
Rich Non-BACT <1000, I&M	f(L)	f(L)	f(CO)	1.2 x L	f(L)-1.2	f(CO)	1.2 x 11	1.2 x 250	f(CO) or 30	NG

Notes: L = horsepower-weighted average NOx or CO limit for group or effective "limit" based on actual emissions for some RECLAIM majors; S/T = avg. source test result for group.
"CO% or S/T" means same percentage reduction as CO or the averaged source test results for the group, whichever lower.
f(L) = calculated ppm using factors derived from AQMD compliance test data (discussed above under "Baseline Emissions").
f(CO) = calculated VOC ppm using factors developed from source test data (discussed above under "Baseline Emissions")
F(L)-0.8 = calculated ppm using factors based on AQMD compliance data capped at 0.8 x L (discussed above under "Baseline Emissions")
F(L)-1.2 = calculated ppm using factors based on AQMD compliance data capped at 1.2 x L (discussed above under "Baseline Emissions")
"(X or Y)" means whichever lower.

NOx, CO, VOC TPY Calculations

Natural gas: NOx factor is based on 80 ppm NOx @ 3% O2 = 1 lb per MMBtu fuel input (as NO2). For CO, 80 ppm factor becomes 80 x 46 (mol-wt. NO2) / 28 (mol-wt. CO).
For VOC (as methane), 80 ppm factor becomes 80 x 46 / 16 (mol-wt. CH4)
Diesel: 80 ppm factor becomes 80 x 8710 (EPA Method 19 dry gas factor for natural gas) / 9190 (EPA Method 19 dry gas factor for diesel).
Biogas: divide concentration @ 15% O2 by 0.97 to correct for typical 50% CO2 in biogas (resulting in approx. 3% added flue gas volume at 15% O2).

SOx TPY Calculations

Natural gas - 1 grain per 100 scf nat gas (CPUC limit); digester gas - 40 ppm as H2S (R431.1); landfill gas - 150 ppm as H2S (R431.1). Assumed 50% methane in digester or landfill gas (biogas).

Diesel - 15 ppm sulfur in fuel.

PM2.5 TPY Calculations

Natural gas, rich-burn - .0194 lb/MMBtu (AP42); natural gas or biogas lean-burn - .00998 lb/MMBtu (AP42); diesel - 0.1 lb/MMBtu (AP42)

CO2 TPY Calculations

Natural gas or biogas: TPY CO2 = fuel input (Btu/Yr) /23,861 (Btu/lb CH4) / 16 (mol-wt. CH4) x 44 (mol-wt. CO2) / 2000 (lb/ton). Double for biogas (assuming 50% CO2 on average).
Diesel: TPY CO2 = fuel input (Btu/Yr) / 19,000 (Btu/lb) x .871 (typical wt.-fraction carbon in diesel) / 12 (mol-wt. carbon) x 44 (mol-wt. CO2) / 2000 (lb/ton)
Subtract TPY CO / 28 (mol-wt. CO) x 44 (mol-wt. CO2)

Usage of Urea (CO[NH2]2)

Baseline NOx (TPY) x (baseline conc. Limit - 11 (future concentration limit))/ baseline concentration limit / 46 (mol-wt. NO2) /2 (mols NOx reduced per mol urea) x 60 (mol-wt. urea) x 1.2 (20 percent excess urea - equivalent to approx. 5 ppm slip for avg. biogas engine NOx if all excess ammonia appears in flue gas)

CO2 from Urea (CO[NH2]2)

Baseline NOx (TPY) x (baseline conc. Limit - 11 (future concentration limit))/ baseline concentration limit / 46 (mol-wt. NO2) /2 (mols NOx reduced per mol urea) x 44 (mol-wt. CO2) x 1.2 (20 percent excess urea - equivalent to approx. 5 ppm slip for avg. biogas engine NOx if all excess ammonia appears in flue gas)

Effects of Three-Way Catalyst Upgrades and Installation of Oxidation Catalysts

It is assumed that three-way catalyst upgrades and new oxidation catalysts both add 1 In. H2O pressure drop to engine exhaust.
Added engine work (hp) = .0158 x cfm x In. H2O / 85% (typical blower efficiency) - from Babcock & Wilcox Useful Tables
cfm engine exhaust per hp =
rich-burn: 2545 Btu/hp-hr / 0.31 (typical engine effic.) / 1e6 x 8710 scfm per MMBtu @ 0% O2 (EPA Meth 19) x 1460 / 520 (temperature correction / 60 (min/hr)
lean-burn: above x 20.9/13.9 (corrects to 7% O2 in flue) x 1260/1460 (corrects gas vol. from 1000F to 800F)
Total catalyst weight per horsepower = 0.615 pound
It was assumed that the volume of the haul trucks would be 20 cubic yards.

CEMS Power Requirement

= 2.3 kW per CEMS (figure provided by CEMS vendor). For shared CEMS, power use is distributed among engines sharing that CEMS.

Effect of Possible Electrification of Non-Biogas Engines

Scenarios were selected based on cost calculations - engine categories for which the present-value of the net 10-yr cost of electrification is negative (less than cost of compliance), in order of most negative to least negative on a $/hp basis.
For generator engines, replacement motor power use = Btu/Yr fuel used by engine x engine efficiency x 0.97 generator efficiency /3413000 Btu/MWH.
For work engines, replacement motor power use = Btu/Yr fuel used by engine x engine efficiency / 0.97 motor efficiency / 3413000 Btu/MWH.
CO2 reduction = baseline CO2 emission less CO2 from fossil power plants producing required power to replace power or work produce by engine less CO2 from increased boiler fuel. Increased boiler fuel = baseline fuel to engine x (1-engine effic) x 0.5 / 0.8 (assumes half of engine waste heat was being utilized by facility and must be replaced by increased boiler fuel at 80% boiler efficiency. Increased boiler fuel also produces NOx (30 ppm@3%O2), CO (100 ppm), SOx (1 grn/100 scf as sulfur) and CO2 emissions.
Grid power replacing engine power or work assumed to be produced 80% by in-basin natural gas plants and 20% by increased power from renewable sources.
Avg. fossil plant effic assumed to be 36% based on USEPA Acid Rain web site. Nat gas consumpt = 3413000 / 0.36 x 0.8 Btu/MWH
Emissions from power plants, based on annual emission reporting x 0.8 (lb/MWH) >>>>>>>
NOx, SOx from power plants are capped by RECLAIM.
CO2 ton/MWH = 7.58e6 / 23861 / 16 x 44 / 2000 =
Backup hp needed:
For generator engine replaced, hp = original engine hp
For work engine replaced, hp = original engine hp / 0.97 (typical generator efficiency)
Diesel fuel usage (gal/yr) = backup generator hp x 52.4 hrs/yr typical operation x 2545 Btu/hp-hr / 0.335 / 137000 Btu/gal
Diesel engine operation of 50 hrs/yr is based on 50 hrs testing (max allowed per Rule 1470)

Diesel emissions assume engine meets USEPA Nonroad standards for 2010, ultra low-sulfur diesel, 87% carbon in fuel, 137,000 Btu/gal.
It was assumed that the average engine would weigh 14,000 pounds
It was assumed that engines would be tested for 0.5 hours.

Diesel Emissions

	g/hp-hr:				ton/gal:			
Diesel Emissions	NOx	CO	VOC	PM	NOx	CO	VOC	PM
Engine Size <50 hp	5.29888579	4.103	0.2961142	0.2238	1.05E-04	8.15E-05	5.88E-06	4.44E-06
Engine Size 50 to <100 hp	3.3206351	3.73	0.1855649	0.2984	6.59E-05	7.41E-05	3.69E-06	5.93E-06
Engine Size 100 to <175 hp	2.82607242	3.73	0.1579276	0.2238	5.61E-05	7.41E-05	3.14E-06	4.44E-06
Engine Size 175 to <300 hp	2.72511416	2.611	0.2588858	0.1492	5.41E-05	5.19E-05	5.14E-06	2.96E-06
Engine Size 300 to <750 hp	2.72511416	2.611	0.2588858	0.1492	5.41E-05	5.19E-05	5.14E-06	2.96E-06
Engine Size >=750 hp	4.28471795	2.611	0.4896821	0.1492	8.51E-05	5.19E-05	9.73E-06	2.96E-06

SOx based on .0015% sulfur in fuel, 7.1 lb/gal	ton/gal =	1.07E-07
CO2 based on 87 % carbon in fuel, 7.1 lb/gal	ton/gal =	1.13E-02

TIMING OF ENGINE CHANGES FOR CEQA ANALYSIS

(Most dates are after rule deadlines to be conservative and synchronize dates of multiple requirements closely spaced in time.)

1/1/2008	Biogas engines using efficiency correction factor (ECF) reduce natural gas usage to 10%.
	Non-biogas engines using ECF lose this benefit (lower NOx, VOC limits).
1/1/2009	Inspection & Monitoring begins, increased frequency of source testing now affecting majority of engines, air/fuel ratio controllers installed.
7/1/2009	CEMS and CO analyzers installed on engines >=500hp, not owned by public agencies.
7/1/2010	Limits drop to 11/250/30 (NOx/CO/VOC) for non-biogas engines >=500hp (except low-use engines).
	Biogas engines not using ECF reduce nat gas use to 10%.
	CEMS and CO analyzers installed on engines <500hp, not owned by public agencies and >=500 hp owned by public agencies.
7/1/2011	Limits drop to 11/250/30 (NOx/CO/VOC) for non-biogas engines <500hp (except low-use engines).
	CEMS and CO analyzers installed on engines <500hp owned by public agencies.
7/1/2012	Limits drop to 11/250/30 (NOx/CO/VOC) for biogas engines except those deferred in Alternative D..
7/1/2014	Limits drop to 11/250/30 (NOx/CO/VOC) for biogas engines deferred in Alternative D.

Electrification timing was based on timing of rule requirements that require significant capital investment:

1/1/2009	Engines requiring installation of air/fuel ratio controller
7/1/2009	Engines requiring CEMS
7/1/2010	Engines requiring CEMS, new catalyst or catalyst upgrading
7/1/2011	Engines requiring CEMS, new catalyst or catalyst upgrading

BIOGAS FACILITY ASSUMPTIONS

General:
Biogas construction is assumed to begin in 2011 after the technology assessment in 2010. Half of the construction is assumed to start in 2011 and the rest in 2012.
Biogas operational emissions are assumed to occur in 2012. Both construction and operations will occur in 2012. Some operation (catalyst replacement) will not begin until 2014, since it was assumed that catalysts are replaced every three years.
Electricity production by ICE is based on heat input / 3.413E6 Btu/MWH x engine effic x generator effic (0.97)
Compressor work produced by ICE is based on heat input / 2545 (Btu/hp-hr) x engine effic.
Emissions and electricity production from gas turbine or microturbine are based on heat input and factors below:

	Lbs/MM Btu			
	BOILER	GAS TURBINE	MICROTURBINE	ICE
NOx	0.03	0.084	0.012	0.127
CO	0.0041	0.139	0.047	0.644
VOC	0.0034	0.0048	0.012	0.041
PM	0.0092	0.023	0.0037	0.013
Electr Effic (HHV)		26%	23%	
MWH/MMBtu		0.0761793	0.0673894	

These emission factors are based on averages of source test data in AQMD files.
Gas turbine and microturbine electrical efficiencies are typical of equipment used for biogas applications.

SCR Option
Assumed pressure losses (In. H2O) = 3" through gas cleanup, 3" through SCR and 1" through CatOx
Reduction in engine output based on hp = .0158 x cfm x In. H2O / 85% efficiency Babcock & Wilcox, Useful Tables, blower equation)
Flue gas cfm/hp = 2545 Btu/hp-hr/0.31(effic)/1e6 x 8710 (USEPA Meth 19 dscfm/MMBtu @ 0% O2) x 20.9/13.9 (corrects to

Seven percent flue O2) x 1260/520 (corrects to 800F flue temp.) / 60 min/hr — Fract. Reduct. In Engine Effic. = 3.74E-03
Fuel cfm/hp = 2545/0.31/475 (typical Btu/scf biogas) /60 — Fract. Reduct. In Engine Effic. = 1.61E-04
Urea usage is based on 20% excess urea (5 ppm slip at 15% O2); theor. urea (mols) = 0.5 x mols NOx reduced. — 3.90E-03
Equivalent ammonia = urea x 34 / 60

Total catalyst weight per horsepower = 0.615 pound
It was assumed that the volume of the haul trucks would be 20 cubic yards.

Gas Turbine Option
Power production = gas turbine power
Shaft work = 0
Natural gas usage = same as baseline

Microturbine Option
Power production = microturbine power
Shaft work = 0
Natural gas usage = same as baseline

LNG Option
For conversion of biogas to liquified natural gas (LNG), it is assumed that 17.8% of biogas to the conversion process is used in a boiler to produce heat required by the process (based on Prometheus process data).
For conversion of digester gas to LNG, it is assumed that the replaced ICE was providing heat to the digester process equal to engine waste heat (heat input x (1 - engine effic)) x 0.5 (waste heat recovery factor) and that heat must now be providedby firing biogas in a boiler at 80% efficiency.
Emissions from boiler are based on factors in table above.
Power used by LNG production process = .0441 MWH per MMBtu LNG product (based on Prometheus process data).
The size of the LNG tank was estimated based on amount of LNG that could be produced over a period of five days based on the permit application for the Frank Bowerman Landfill LNG plant.
The transport trucks were assumed to have 10,000 gallon tanks days based on the permit application for the Frank Bowerman Landfill LNG plant.

Diesel/Natural Gas Usage by Emergency Backup Generator
Size of backup generator needed (HP): landfill case = none needed
Replacement of compressor with turbine: HP = ICE HP x (1 - turbine elec effic / (ICE effic x 0.97))
Elimination of compressor: HP = ICE HP / 0.97
Backup LNG power requirement: HP = LNG product MMBTU/yr x .0441 MWH/MMBTU / 8000 hrs/yr on line/ .000746 MW/HP / 0.97 (motor/generator effic)

It is assumed that 20% of backup capacity will be diesel and 80% will be natural gas (using the existing biogas engine).
Gal/Yr diesel fuel = HP x 52.4 (diesel engine hrs/yr) / 8000 (turbine or LNG plant on-line hrs/yr) x 3413000 (Btu/MWH) / 0.335 (typical diesel engine efficiency) / 137,000 (Btu/gal) x 0.2
Natural gas use for backup power (Btu/Yr) = gal/yr diesel x 137,000 / 0.2 x 0.8
Backup engine operation of 50 hrs/yr is based on 50 hrs testing (max allowed per Rule 1470)
It was assumed that engines would be tested for one hour on any given day.

Diesel Emissions	g/hp-hr: NOx	CO	VOC	PM	ton/gal: NOx	CO	VOC	PM
Engine Size <50 hp	5.30	4.10	0.30	0.224	1.12E-04	8.68E-05	6.26E-06	4.74E-06
Engine Size 50 to <75 hp	3.3206351	3.73	0.1855649	0.2984	7.03E-05	7.89E-05	3.93E-06	6.32E-06
Engine Size 75 to <175 hp	2.8260724	3.73	0.1579276	0.2238	5.98E-05	7.89E-05	3.34E-06	4.74E-06
Engine Size 175 to <750 hp	2.7251142	2.611	0.2588858	0.1492	5.77E-05	5.53E-05	5.48E-06	3.16E-06
Engine Size >=750 hp	4.2847179	2.611	0.4896821	0.1492	9.07E-05	5.53E-05	1.04E-05	3.16E-06

SOx based on .0015% sulfur in fuel, 7.1 lb/gal	ton/gal =	1.07E-07
CO2 based on 87 % carbon in fuel, 7.1 lb/gal	ton/gal =	1.13E-02

Pretreatment Carbon Assumptions

The amount of carbon used at a facility was estimated from the amount of carbon used at Orange County Sanitation District Facility Number 1 (OCSD No. 1) by ratio the horsepower of the engines at OCSD No. 1.

The number of trips was estimated by the number of 6,800 pound vessels that need to be replaced.

It was assumed that all biogas facilities would need pre-treatment for add-on control and ICE alternative technology.

It was assumed that an equal number of trips would occur for both spent carbon removal and new carbon delivery.

Table C-1
Operational Emissions from Requirements of PAR 1110.2 Only (i.e, No Secondary Emissions)

Non-Biogas Engines

Year	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM-2.5, lb/day	CO2, ton/year
Baseline	7,336	44,688	1,611	87	741	680,612
2008	7,210	44,688	1,611	87	741	680,612
2009	5,056	14,192	1,065	87	741	689,358
2010	4,725	10,162	613	87	741	690,514
2011	4,388	7,305	566	87	741	691,333
2012	4,388	7,305	566	87	741	691,333
2014	4,388	7,305	566	87	741	691,333

Table C-1 (Continued)
Operational Emissions from Requirements of PAR 1110.2 Only (i.e, No Secondary Emissions)

Biogas Engines

Year	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM-2.5, lb/day	CO2, ton/year
Baseline	1,859	9,555	882	464	136	569,435
2008	~~1,781~~ 1,786	~~9,176~~ 9,209	~~846~~ 855	~~456~~ 457	~~130~~ 131	~~546,588~~ -
2009	~~1,765~~ 1,770	~~8,342~~ 8,375	~~769~~ 778	~~456~~ 457	~~130~~ 131	~~546,827~~
2010	~~1,722~~ 1,727	~~8,152~~ 8,185	~~753~~ 762	~~454~~ 455	~~128~~ 129	~~535,925~~ -
2011	~~1,714~~ 1,719	~~8,152~~ 8,185	~~753~~ 762	~~454~~ 455	~~128~~ 129	~~535,925~~

Biogas Engines – Addition of SCR or NOx Tech

Year	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM-2.5, lb/day	CO2, ton/year
2012	472	8,092	555	464	136	569,999
2014	472	8,092	555	464	136	569,999

Biogas Engines – Replacement with Gas Turbines

Year	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM-2.5, lb/day	CO2, ton/year
2012	5,536	9,205	632	551	1,056	1,260,768
2014	5,536	9,205	632	551	1,056	1,260,768

Biogas Engines – Replacement with Microturbines

Year	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM-2.5, lb/day	CO2, ton/year
2012	4,552	7,948	730	551	792	1,260,768
2014	4,552	7,948	730	551	792	1,260,768

Table C-1 (Concluded)
Operational Emissions from Requirements of PAR 1110.2 Only (i.e, No Secondary Emissions)

Biogas Engines – Replacement of Digester Gas ICE with Gas Turbines Landfill Gas ICE with LNG Plants

Year	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM-2.5, lb/day	CO2, ton/year
2012	4,901	8,090	598	224	883	1,122,319
2014	4,901	8,090	598	224	883	1,122,319

Biogas Engines – Replacement of Digester Gas ICE with Microturbines Landfill Gas ICE with LNG Plants

Year	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM-2.5, lb/day	CO2, ton/year
2012	4,497	7,574	638	224	775	1,122,319
2014	4,497	7,574	638	224	775	1,122,319

Table C-2A
Biogas Diesel Emergency Engine Emissions

Replace ICEs with Gas turbines - Diesel Emergency

Year	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM, lb/day	CO2, ton/year	Mitigated PM lb/day
2012	9.4	7.5	0.96	0.01	0.42	15.8	0.063

Replace ICEs with Microturbines - Diesel Emergency

Year	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM, lb/day	CO2, ton/year	Mitigated PM lb/day
2012	22.6	15.7	2.46	0.02	0.89	22.9	0.133

Replace ICEs LFG w LNG, DG w Turbines - Diesel Emergency

Year	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM, lb/day	CO2, ton/year	Mitigated PM lb/day
2012	9.4	7.5	0.96	0.01	0.42	15.8	0.063

Table C-2A (Concluded)
Biogas Diesel Emergency Engine Emissions

Replace ICEs LFG w LNG, DG w Microturbines - Diesel Emergency

Year	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM, lb/day	CO2, ton/year	Mitigated PM lb/day
2012	22.6	15.7	2.46	0.02	0.89	22.9	0.133

Notes:
Assumed that the emergency generators were needed to provide electricity to compensate for pressure drops caused by add-on control equipment or efficiency losses from the replacement of ICEs with alternative technologies (e.g., gas turbines, microturbines, etc.).
Assumed only digester gas facilities would need emergency generators.
Assumed only 20 percent of digester facilities would use diesel fueled emergency generators
Emission factors from USEPA Emission Standards for Nonroad diesel engines, 40CFR, Part 89 - Control of Emissions from New and In-Use Compression-Ignition Engines
50 hours of operation a year assumed pursuant to Rule 1470.
One hour of operation per test.
ARB has validated diesel particulate filters for stationary ICE as at least 85 percent efficient.

Table C-2B
Biogas Natural Gas Emergency Engine Emissions

Replace ICE with Gas turbines - NG emergency

Year	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM, lb/day	CO2, ton/year
2012	14.5	70.4	6.4	0.28	1.9	218

Replace ICE with Microturbines - NG emergency

Year	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM, lb/day	CO2, ton/year
2012	20.6	99.6	9.1	0.40	2.8	316

Replace ICE LFG w LNG, DG w Turbines - NG emergency

Year	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM, lb/day	CO2, ton/year
2012	14.5	70.4	6.4	0.28	1.9	218

Table C-2B (Concluded)
Biogas Natural Gas Emergency Engine Emissions

Replace ICE LFG w LNG, DG w Microturbines - NG emergency

Year	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM, lb/day	CO2, ton/year
2012	20.6	99.6	9.1	0.40	2.8	316

Notes:
Assumed only digester gas facilities would need emergency generators.
Assumed only 80 percent of digester facilities would use existing natural gas fueled engines as emergency generators.
Existing engine emissions used.
50 hours of operation a year assumed.
One hour of operation per test.

Table C-3
Biogas Power Plant Emissions

Install SCR - Power Plant Emissions - Daily

Year	CO, lb/day	VOC, lb/day	PM, lb/day	CO2, ton/year
2012	50.5	4.1	5.3	15.0

Replace with Microturbines - Power Plant Emissions - Daily

Year	CO, lb/day	VOC, lb/day	PM, lb/day	CO2, ton/year
2012	82.7	6.7	8.6	24.6

Replace LFG w LNG, DG w Turbines - Power Plant Emissions - Daily

Year	CO, lb/day	VOC, lb/day	PM, lb/day	CO2, ton/year
2012	292	23.5	30.5	86.9

Replace LFG w LNG, DG w Microturbines - Power Plant Emissions - Daily

Year	CO, lb/day	VOC, lb/day	PM, lb/day	CO2, ton/year
2012	305	24.6	31.9	90.9

Table C-4
Non-Biogas Effects of Replacing ICE with Electric Motors

Decreased Emissions from Engines

Year	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM, lb/day	CO2, ton/year	Diesel Backup Generator, HP	Diesel Backup Generator Fuel Use, Gal/Yr
2009	432	161	48.9	1.3	15.7	11,781	432	161
2010	856	1,328	137	8.8	50.7	67,378	856	1,328
2011	1,044	2,507	175	14.3	87.9	107,276	1,044	2,507

To determine impacts of electrification on CO2 and criteria pollutant emission, staff has calculated the reduction in engine emissions and the increase in emissions from electrical generation, from boilers that would have to provide thermal energy to replace the thermal energy from an engine in cogeneration use, and from any backup diesel generators installed. The following assumptions were used:

- Engine generator efficiency of 97 percent (engine mechanical output to electrical output).
- Electric motor efficiency of 97 percent.
- For cogeneration engines, 50 percent of the waste heat from the energy is recovered.
- Boiler efficiency of 80 percent.
- Grid power replacing engine power or work is supplied by modern natural gas power plants (80 percent) and by renewable energy sources (20 percent).
- Average power plant efficiency in the district is 36 percent high heating value (HHV) based on USEPA Acid Rain web site data for 2005.
- CO2 from natural gas combustion is 1,009 SCF at 68ºF per million Btu of fuel input (HHV), based on a stoichiometric calculation for methane.
- Boiler criteria pollutant emissions based on 30 ppmvd NOx, and 100 ppmvd CO, corrected to three percent O2.
- Twenty percent of facilities that electrify will install a backup diesel generator. Remainder will convert the natural gas engine to backup use (40 percent), or go without a backup (40 percent).
- Backup diesel efficiency is 33.5 percent HHV.
- Backup generator operated for 50 hours per year.
- Backup generator emissions based on USEPA Tier 3 emission standards for up to 750 bhp and Tier 2 over 750 bhp.
- Diesel fuel specifications are 137,000 Btu per gallon and 88 percent carbon by weight and ultralow sulfur (15 ppmw).
- CO2 reductions from the replacement of non-biogas ICEs with electric motors were assumed to occur over the lifetime of the electric motors (10 years).

Table C-4 (Continued)
Non-Biogas Effects of Replacing ICE with Electric Motors

Power Plant Emissions

Year	CO, lb/day	VOC, lb/day	PM, lb/day	CO2, ton/year
2009	12.2	1.0	1.3	7,272
2010	80.2	6.5	8.4	47,744
2011	126	10.2	26.4	75,098

Diesel Emergency Engine Emissions

Year	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM, lb/day	CO2, ton/year	Mitigated PM, lb/day
2009	10.2	6.8	1.14	0.01	0.39	37	0.058
2010	120	78.8	13.3	0.16	4.5	430	0.68
2011	159	118	16.9	0.24	6.6	1,258	0.99

Natural Gas Emergency Emissions

Year	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM, lb/day	CO2, ton/year
1/1/2009	11.2	5.4	2.0	0.035	0.24	35
7/1/2009	11.3	5.8	2.1	0.039	0.27	51
7/1/2010	55.2	134.1	28.9	0.50	3.4	590
7/1/2011	68.7	262	31.0	0.61	4.2	981

CO2 reduction = baseline CO2 emission less CO2 from fossil power plants producing required power to replace power or work produce by engine less CO2 from increased boiler fuel. Increased boiler fuel = baseline fuel to engine x (1-engine effic) x 0.5 / 0.8 (assumes half of engine waste heat was being utilized by facility and must be replaced by increased boiler fuel at 80% boiler efficiency. Increased boiler fuel also produces NOx (30 ppm@3%O2), CO (100 ppm), SOx (1 grn/100 scf as sulfur) and CO2 emissions.
Grid power replacing engine power or work assumed to be produced 80% by in-basin natural gas plants and 20% by increased power from renewable sources.
Avg. fossil plant effic assumed to be 36% based on USEPA Acid Rain web site. Nat gas consumpt = 3413000 / 0.36 x 0.8 Btu/MWH
Emissions from power plants, based on annual emission reporting x 0.8 (lb/MWH)
NOx, SOx from power plants are capped by RECLAIM.
CO2 ton/MWH = 7.58e6 / 23861 / 16 x 44 / 2000

Selected based on cost calculations - engine categories for which the present-value of the net 10-yr cost of electrification is negative (less than cost of compliance), in order of most negative to least negative on a $/hp basis.
There were 225 engines identified where it would be less to replace the engine with an electric motor than to comply with PAR 1110.2. Of the 225 engines, SCAQMD staff assumed that 75 percent of these engines (169 engines) would be replaced by facility operators.
It was assumed that 20 percent of the engines replaced would need diesel emergency generators, 40 percent of the engines replaced would need natural gas emergency generators, and 40 percent would not need emergency generators.

Table C–5
PAR 1110.2 Cost Effectiveness Calculations

	1	2	3	4	5	6	7	8	9
Fuel	BIOGAS	BIOGAS	BIOGAS	NATURAL GAS	NATURAL GAS	NATURAL GAS	NATURAL GAS	DIESEL	NATURAL GAS
RECLAIM?				RECLAIM	RECLAIM	RECLAIM	RECLAIM	RECLAIM	RECLAIM
BACT?				BACT	BACT	NON-BACT	NON-BACT	BACT	NON-BACT
Rich-Burn or Lean-Burn?				RICH	RICH	RICH	RICH	LEAN	LEAN
=>1000 HP or NOx-Major?	=>1000	<1000	<1000	MAJOR	NON-MAJOR	MAJOR	NON-MAJOR	NON-MAJOR	MAJOR
Need CEMS?		YES	NO						
Number of Engines (Survey Data)	41	7	6	1	16	1	36	6	25
Number of Engines (Total Population)	50	9	7	1	20	1	44	6	31
Average HP (Survey Data)	2,682	614	639	2,000	568	2,068	333	3,043	2,646
New CEMS (Total Population)		2.79							
Fuel Consumption, Btu/Yr (Total Population)	8.81E+12	3.63E+11	2.94E+11	1.31E+11	7.46E+11	1.36E+11	9.62E+11	1.11E+12	5.39E+12
Average NOx Limit, ppmvd @ 15% O2	43.3	38.1	38.1	9.0	15.9	13.8	130.0	50.0	149.4
Average CO Limit, ppmvd @ 15% O2	1225.8	1914.8	1914.8	60.0	98.8	260.2	2000.0	66.0	1896.2
Average VOC Limit, ppmvd @ 15% O2	106.8	245.0	245.0	26.0	106.3	132.0	250.0	22.0	247.9
Baseline NOx, ppmvd @ 15% O2	34.6	41.9	41.9	7.2	82.5	13.8	130.0	55.0	149.4
Baseline CO, ppmvd @ 15% O2	291.3	336.2	336.2	396.0	640.4	1557.9	1327.3	72.6	150.1
Baseline VOC, ppmvd @ 15% O2	47.5	51.5	51.5	18.5	23.5	43.4	40.1	24.2	135.0
Baseline NOx, TPY	596.4	29.7	24.1	1.8	116.7	3.6	237.2	122.1	1,526.3
Baseline CO, TPY	3,052.4	145.2	117.5	60.0	551.4	244.2	1,474.2	98.1	933.0
Baseline VOC, TPY	284.5	12.7	10.3	1.6	11.6	3.9	25.4	18.7	479.8
Controlled NOx (Step 1), ppmvd @ 15% O2	34.6	30.5	38.1	7.2	82.5	13.8	130.0	55.0	149.4
Controlled CO (Step 1), ppmvd @ 15% O2	264.8	305.6	305.6	27.7	58.1	115.8	819.6	66.0	136.4
Controlled VOC (Step 1), ppmvd @ 15% O2	43.2	46.8	46.8	4.9	7.1	11.8	31.5	22.0	122.8
Controlled NOx, TPY	596.4	21.6	21.9	1.8	116.7	3.6	237.2	122.1	1,526.3
Controlled CO, TPY	2,774.9	132.0	106.8	4.2	50.0	18.2	910.4	89.2	848.2
Controlled VOC, TPY	258.6	11.5	9.3	0.4	3.5	1.1	20.0	17.0	436.1
Step 1 (NOx+VOC+CO/7) Reduction, 10-Yr Tons	655	111	46	92	797	351	860	30	557
Controlled NOx (Step 2), ppmvd @ 15% O2	8.8	8.8	11.0	7.2	82.5	13.8	130.0	55.0	149.4
Controlled CO (Step 2), ppmvd @ 15% O2	200.0	250.0	250.0	27.7	58.1	115.8	300.0	66.0	136.4
Controlled VOC (Step 2), ppmvd @ 15% O2	30.0	30.0	30.0	4.9	7.1	11.8	19.1	22.0	30.0
Controlled NOx, TPY	151.5	6.2	6.3	1.8	116.7	3.6	237.2	122.1	1,526.3
Controlled CO, TPY	2,096.0	108.0	87.4	4.2	50.0	18.2	333.2	89.2	848.2
Controlled VOC, TPY	179.7	7.4	6.0	0.4	3.5	1.1	12.1	17.0	106.6
Step 2 (NOx+VOC+CO/7) Reduction, 10-Yr Tons	6,209	230	217	0	0	0	903	0	3,296

Table C-5 (Continued)
PAR 1110.2 Cost Effectiveness Calculations

	10	11	12	13	14	15	16	17	18
Fuel	DIESEL	NATURAL GAS	DIESEL	NATURAL GAS	NATURAL GAS	NATURAL GAS	NATURAL GAS	NATURAL GAS	NATURAL GAS
RECLAIM?	RECLAIM	RECLAIM	RECLAIM	NON-RECLAIM	NON-RECLAIM	NON-RECLAIM	NON-RECLAIM	NON-RECLAIM	NON-RECLAIM
BACT?	NON-BACT	NON-BACT	NON-BACT	BACT	BACT	BACT	BACT	BACT	BACT
Rich-Burn or Lean-Burn?	LEAN	LEAN	LEAN	RICH	RICH	RICH	LEAN	LEAN	LEAN
=>1000 HP or NOx-Major?	MAJOR	NON-MAJOR	NON-MAJOR	=>1000	<1000	<1000	=>1000	<1000	<1000
Need CEMS?					YES	NO		YES	NO
Number of Engines (Survey Data)	6	11	18	28	39	209	16	2	1
Number of Engines (Total Population)	6	14	18	38	53	283	22	3	1
Average HP (Survey Data)	2,213	519	478	1,674	716	286	2,144	880	898
New CEMS (Total Population)					18.13			1.36	
Fuel Consumption, Btu/Yr (Total Population)	8.07E+11	4.78E+11	5.23E+11	4.18E+12	2.49E+12	5.32E+12	3.10E+12	1.73E+11	5.90E+10
Average NOx Limit, ppmvd @ 15% O2	218.0	128.1	516.0	9.8	11.3	11.3	9.3	13.0	13.0
Average CO Limit, ppmvd @ 15% O2	2000.0	1743.9	2000.0	60.4	72.0	72.0	61.6	85.3	85.3
Average VOC Limit, ppmvd @ 15% O2	285.0	235.6	250.0	25.1	30.5	30.5	27.2	37.3	37.3
Baseline NOx, ppmvd @ 15% O2	218.0	128.1	516.0	7.8	58.6	58.6	7.4	23.4	23.4
Baseline CO, ppmvd @ 15% O2	10.8	188.4	221.4	398.6	472.6	472.6	67.8	93.8	93.8
Baseline VOC, ppmvd @ 15% O2	5.1	129.2	106.5	18.6	20.2	20.2	29.9	41.0	41.0
Baseline NOx, TPY	352.0	116.0	539.8	62.1	277.2	591.1	43.7	7.7	2.6
Baseline CO, TPY	10.6	103.8	141.0	1,921.9	1,359.4	2,899.4	242.3	18.8	6.4
Baseline VOC, TPY	2.8	40.7	38.7	51.2	33.2	70.9	61.1	4.7	1.6
Controlled NOx (Step 1), ppmvd @ 15% O2	218.0	128.1	516.0	7.8	9.0	13.6	7.4	13.0	13.0
Controlled CO (Step 1), ppmvd @ 15% O2	9.8	171.3	201.3	27.9	33.1	42.5	61.6	85.3	85.3
Controlled VOC (Step 1), ppmvd @ 15% O2	4.6	117.5	96.8	4.9	5.4	6.1	27.2	37.3	37.3
Controlled NOx, TPY	352.0	116.0	539.8	62.1	42.7	136.7	43.7	4.3	1.5
Controlled CO, TPY	9.6	94.4	128.2	134.3	95.3	260.8	220.3	17.1	5.8
Controlled VOC, TPY	2.6	37.0	35.2	13.5	8.8	21.3	55.6	4.3	1.5
Step 1 (NOx+VOC+CO/7) Reduction, 10-Yr Tons	4	50	54	2,930	4,395	8,810	87	41	14
Controlled NOx (Step 2), ppmvd @ 15% O2	218.0	128.1	516.0	7.8	9.0	13.6	7.4	13.0	13.0
Controlled CO (Step 2), ppmvd @ 15% O2	9.8	171.3	201.3	27.9	33.1	42.5	61.6	85.3	85.3
Controlled VOC (Step 2), ppmvd @ 15% O2	4.6	30.0	30.0	4.9	5.4	6.1	27.2	30.0	30.0
Controlled NOx, TPY	352.0	116.0	539.8	62.1	42.7	136.7	43.7	4.3	1.5
Controlled CO, TPY	9.6	94.4	128.2	134.3	95.3	260.8	220.3	17.1	5.8
Controlled VOC, TPY	2.6	9.4	10.9	13.5	8.8	21.3	55.6	3.4	1.2
Step 2 (NOx+VOC+CO/7) Reduction, 10-Yr Tons	0	276	243	0	0	0	0	8	3

Table C-5 (Continued)
PAR 1110.2 Cost Effectiveness Calculations

	19	20	21	
Fuel	NATURAL GAS	NATURAL GAS	NATURAL GAS	
RECLAIM?	NON-RECLAIM	NON-RECLAIM	NON-RECLAIM	
BACT?	NON-BACT	NON-BACT	NON-BACT	
Rich-Burn or Lean-Burn?	RICH	RICH	RICH	
=>1000 HP or NOx-Major?	=>1000	<1000	<1000	TOTALS
Need CEMS?		YES	NO	
Number of Engines (Survey Data)	5	15	166	655
Number of Engines (Total Population)	7	20	225	859
Average HP (Survey Data)	1,172	665	249	
New CEMS (Total Population)		5.87		28.15
Fuel Consumption, Btu/Yr (Total Population)	5.39E+11	8.74E+11	3.68E+12	4.015E+13
Average NOx Limit, ppmvd @ 15% O2	36.0	45.6	45.6	
Average CO Limit, ppmvd @ 15% O2	2000.0	1956.2	1956.2	
Average VOC Limit, ppmvd @ 15% O2	250.0	277.2	277.2	
Baseline NOx, ppmvd @ 15% O2	28.8	96.7	96.7	
Baseline CO, ppmvd @ 15% O2	1327.3	1560.4	1560.4	
Baseline VOC, ppmvd @ 15% O2	40.1	43.5	43.5	
Baseline NOx, TPY	29.4	160.1	674.5	5,514
Baseline CO, TPY	825.5	1,573.2	6,627.1	22,406
Baseline VOC, TPY	14.2	25.0	105.5	1,298
Controlled NOx (Step 1), ppmvd @ 15% O2	28.8	36.48	54.72	
Controlled CO (Step 1), ppmvd @ 15% O2	609.3	602.9	809.7	
Controlled VOC (Step 1), ppmvd @ 15% O2	27.2	27.0	31.3	
Controlled NOx, TPY	29.4	60.4	381.8	4,418
Controlled CO, TPY	378.9	607.8	3,438.8	10,325
Controlled VOC, TPY	9.6	15.6	76.0	1,038
Step 1 (NOx+VOC+CO/7) Reduction, 10-Yr Tons	684	2,471	7,777	30,816
Controlled NOx (Step 2), ppmvd @ 15% O2	8.8	8.8	13.2	
Controlled CO (Step 2), ppmvd @ 15% O2	200.0	200.0	300.0	
Controlled VOC (Step 2), ppmvd @ 15% O2	15.6	15.6	19.1	
Controlled NOx, TPY	9.0	14.6	92.1	3,586
Controlled CO, TPY	124.4	201.6	1,274.1	6,200
Controlled VOC, TPY	5.5	9.0	46.2	521
Step 2 (NOx+VOC+CO/7) Reduction, 10-Yr Tons	609	1,105	6,287	19,384

Table C-5 (Continued)
PAR 1110.2 Cost Effectiveness Calculations

	1	2	3	4	5	6	7	8	9
Fuel	BIOGAS	BIOGAS	BIOGAS	NATURAL GAS	NATURAL GAS	NATURAL GAS	NATURAL GAS	DIESEL	NATURAL GAS
RECLAIM?				RECLAIM	RECLAIM	RECLAIM	RECLAIM	RECLAIM	RECLAIM
BACT?				BACT	BACT	NON-BACT	NON-BACT	BACT	NON-BACT
Rich-Burn or Lean-Burn?				RICH	RICH	RICH	RICH	LEAN	LEAN
=>1000 HP or NOx-Major?	=>1000	<1000	<1000	MAJOR	NON-MAJOR	MAJOR	NON-MAJOR	NON-MAJOR	MAJOR
<u>Step 1 Eliminate Excess Emissions</u>									
Add CO Analyzer									
Initial Cost, $	0	0	0	19,000	0	19,000	0	0	0
Annual O&M Cost, $	0	0	0	0	0	0	0	0	0
New CEMS									
Initial Cost, $	0	699,492	0	0	0	0	0	0	0
Annual O&M Cost, $	0	190,885	0	0	0	0	0	0	0
Add AFRC									
Initial Cost, $	0	0	140,000	0	0	0	0	0	0
Annual O&M Cost, $	0	0	5,040	0	0	0	0	0	0
Incr Source Testing and I&M Program									
Initial Cost, $	171,443	30,860	24,002	0	68,577	0	150,870	20,573	106,295
Annual O&M Cost, $	313,348	56,403	73,269	0	306,939	0	675,266	37,602	194,276
Total Initial Cost, $	171,443	730,352	164,002	19,000	68,577	19,000	150,870	20,573	106,295
Total Annual O&M Cost, $	313,348	247,288	78,309	0	306,939	0	675,266	37,602	194,276
Present Value of 10-Yr Costs, $	2,816,101	2,817,463	824,928	19,000	2,659,144	19,000	5,850,118	337,932	1,745,983
Step 1 Cost Eff, $ per ton pollutants	**4,299**	**25,270**	**17,745**	**207**	**3,335**	**54**	**6,802**	**11,367**	**3,133**

Table C –5 (Continued)
PAR 1110.2 Cost Effectiveness Calculations

	10	11	12	13	14	15	16	17	18
Fuel	DIESEL	NATURAL GAS	DIESEL	NATURAL GAS	NATURAL GAS	NATURAL GAS	NATURAL GAS	NATURAL GAS	NATURAL GAS
RECLAIM?	RECLAIM	RECLAIM	RECLAIM	NON-RECLAIM	NON-RECLAIM	NON-RECLAIM	NON-RECLAIM	NON-RECLAIM	NON-RECLAIM
BACT?	NON-BACT	NON-BACT	NON-BACT	BACT	BACT	BACT	BACT	BACT	BACT
Rich-Burn or Lean-Burn?	LEAN	LEAN	LEAN	RICH	RICH	RICH	LEAN	LEAN	LEAN
=>1000 HP or NOx-Major?	MAJOR	NON-MAJOR	NON-MAJOR	=>1000	<1000	<1000	=>1000	<1000	<1000
Step 1 Eliminate Excess Emissions									
Add CO Analyzer									
Initial Cost, $	114,000	0	0	722,000	0	0	0	0	0
Annual O&M Cost, $	0	0	0	0	0	0	0	0	0
New CEMS									
Initial Cost, $	0	0	0	0	4,494,928	0	0	291,450	0
Annual O&M Cost, $	0	0	0	0	1,157,627	0	0	72,100	0
Add AFRC									
Initial Cost, $	0	280,000	360,000	0	0	0	0	0	20,000
Annual O&M Cost, $	0	10,080	12,960	0	0	0	0	0	720
Incr Source Testing and I&M Program									
Initial Cost, $		48,004	61,719	0	0	970,367	75,435	10,287	3,429
Annual O&M Cost, $		87,737	112,805	0	0	4,343,190	137,873	18,801	10,467
Total Initial Cost, $	114,000	328,004	421,719	722,000	4,494,928	970,367	75,435	301,736	23,429
Total Annual O&M Cost, $	0	97,817	125,765	0	1,157,627	4,343,190	137,873	90,901	11,187
Present Value of 10-Yr Costs, $	114,000	1,153,583	1,483,179	722,000	14,265,303	37,626,893	1,239,084	1,068,942	117,847
Step 1 Cost Eff, $ per ton pollutants	**28,795**	**22,847**	**27,703**	**246**	**3,246**	**4,271**	**14,236**	**26,137**	**8,471**

Table C-5 (Continued)
PAR 1110.2 Cost Effectiveness Calculations

	19	20	21	
Fuel	NATURAL GAS	NATURAL GAS	NATURAL GAS	
RECLAIM?	NON-RECLAIM	NON-RECLAIM	NON-RECLAIM	
BACT?	NON-BACT	NON-BACT	NON-BACT	
Rich-Burn or Lean-Burn?	RICH	RICH	RICH	
=>1000 HP or NOx-Major?	=>1000	<1000	<1000	TOTALS
Step 1 Eliminate Excess Emissions				
Add CO Analyzer				
Initial Cost, $	133,000	0	0	1,007,000
Annual O&M Cost, $	0	0	0	0
New CEMS				
Initial Cost, $	0	1,554,923	0	7,040,793
Annual O&M Cost, $	0	417,435	0	1,838,048
Add AFRC				
Initial Cost, $	0	0	0	800,000
Annual O&M Cost, $	0	0	0	28,800
Incr Source Testing and I&M Program				
Initial Cost, $	0	0	771,494	2,513,354
Annual O&M Cost, $	0	0	3,453,066	9,821,043
Total Initial Cost, $	133,000	1,554,923	771,494	11,361,147
Total Annual O&M Cost, $	0	417,435	3,453,066	11,687,891
Present Value of 10-Yr Costs, $	133,000	5,078,070	29,915,374	110,006,945
Step 1 Cost Eff, $ per ton pollutants	**194**	**2,055**	**3,847**	**3,570**

Table C-5 (Continued)
PAR 1110.2 Cost Effectiveness Calculations

	1	2	3	4	5	6	7	8	9
Fuel	BIOGAS	BIOGAS	BIOGAS	NATURAL GAS	NATURAL GAS	NATURAL GAS	NATURAL GAS	DIESEL	NATURAL GAS
RECLAIM?				RECLAIM	RECLAIM	RECLAIM	RECLAIM	RECLAIM	RECLAIM
BACT?				BACT	BACT	NON-BACT	NON-BACT	BACT	NON-BACT
Rich-Burn or Lean-Burn?				RICH	RICH	RICH	RICH	LEAN	LEAN
=>1000 HP or NOx-Major?	=>1000	<1000	<1000	MAJOR	NON-MAJOR	MAJOR	NON-MAJOR	NON-MAJOR	MAJOR
<u>Step 2: Reduce Emissions to NOx/CO/VOC = 11/250/30 ppm @ 15% O2</u>	Gas Cleanup System, SCR and Oxidation Catalyst	Gas Cleanup System, SCR and Oxidation Catalyst	Gas Cleanup System, SCR and Oxidation Catalyst				Upgrade Three-Way Catalyst		Install Oxidation Catalyst
Initial Cost, $	55,201,256	3,733,484	2,903,821				836,264		1,193,872
Annual O&M Cost, $	8,316,509	508,009	395,118				232,115		182,549
Present Value of 10-Yr Costs, $	125,392,596	8,021,083	6,238,620				2,795,312		2,734,583
Step 2 Cost Eff, $ per ton pollutants	**20,197**	**34,940**	**28,756**	**NA**	**NA**	**NA**	**3,094**	**NA**	**830**
Steps 1+ 2 Total Initial Cost, $	55,372,699	4,463,836	3,067,823	19,000	68,577	19,000	987,134	20,573	1,300,167
Steps 1+ 2 Total Annual O&M Cost, $	8,629,858	755,297	473,427	0	306,939	0	907,381	37,602	376,824
Present Value of 10-Yr Costs, $	128,208,697	10,838,546	7,063,548	19,000	2,659,144	19,000	8,645,429	337,932	4,480,565
Steps 1+2 Cost Eff, $ per ton pollutants	**18,679**	**31,778**	**26,813**	**207**	**3,335**	**54**	**4,902**	**11,367**	**1,163**
<u>Alternative Technology</u>				Electrify	Electrify	Electrify	Electrify	Electrify	Electrify
DG Engines (Survey)				0	7	1	5	6	1
DG Engines (Total Population)					9	1	6	6	1
DG Engines--Avg. HP					714	2068	690	3043	3000
Non-DG Engines (Total Population)				1	11		38		30
Non-DG Engines--Avg. HP				2000	454		275		2631
<u>DG Engines:</u>									
(NOx+VOC+CO/7) Reduction, 10-Yr Tons					1,140	415	1,327	1,515	772
Initial Cost, $					1,309,376	390,432	846,867	3,400,883	559,035
Annual O&M Cost, $					104,516	71,687	-37,953	569,812	-108,635
Present Value of 10-Yr Costs, $					2,191,492	995,473	526,547	8,210,095	-357,844

Table C-5 (Continued)
PAR 1110.2 Cost Effectiveness Calculations

	10	11	12	13	14	15	16	17	18
Fuel	DIESEL	NATURAL GAS	DIESEL	NATURAL GAS	NATURAL GAS	NATURAL GAS	NATURAL GAS	NATURAL GAS	NATURAL GAS
RECLAIM?	RECLAIM	RECLAIM	RECLAIM	NON-RECLAIM	NON-RECLAIM	NON-RECLAIM	NON-RECLAIM	NON-RECLAIM	NON-RECLAIM
BACT?	NON-BACT	NON-BACT	NON-BACT	BACT	BACT	BACT	BACT	BACT	BACT
Rich-Burn or Lean-Burn?	LEAN	LEAN	LEAN	RICH	RICH	RICH	LEAN	LEAN	LEAN
=>1000 HP or NOx-Major?	MAJOR	NON-MAJOR	NON-MAJOR	=>1000	<1000	<1000	=>1000	<1000	<1000
<u>Step 2: Reduce Emissions to NOx/CO/VOC = 11/250/30 ppm @ 15% O2</u>		Install Oxidation Catalyst	Install Oxidation Catalyst					Install Oxidation Catalyst	Install Oxidation Catalyst
Initial Cost, $		178,931	230,054					38,342	12,781
Annual O&M Cost, $		22,402	28,802					4,800	1,600
Present Value of 10-Yr Costs, $		368,003	473,147					78,858	26,286
Step 2 Cost Eff, $ per ton pollutants	**NA**	**1,335**	**1,946**	**NA**	**NA**	**NA**	**NA**	**9,446**	**9,257**
Steps 1+ 2 Total Initial Cost, $	114,000	506,935	651,774	722,000	4,494,928	970,367	75,435	340,079	36,210
Steps 1+ 2 Total Annual O&M Cost, $	0	120,219	154,568	0	1,157,627	4,343,190	137,873	95,702	12,787
Present Value of 10-Yr Costs, $	114,000	1,521,586	1,956,325	722,000	14,265,303	37,626,893	1,239,084	1,147,800	144,133
Steps 1+2 Cost Eff, $ per ton pollutants	**28,795**	**4,667**	**6,595**	**246**	**3,246**	**4,271**	**14,236**	**23,308**	**8,605**
<u>Alternative Technology</u>	Electrify	Electrify	Electrify	Electrify	Electrify	Electrify	Electrify	Electrify	Electrify
DG Engines (Survey)	6	6	6	18	16	105	16	0	1
DG Engines (Total Population)	6	7	6	25	22	142	22	0	1
DG Engines--Avg. HP	2213	368	853	1773	771	302	2144		898
Non-DG Engines (Total Population)		7	12	13	31	141		3	0
Non-DG Engines--Avg. HP		701	290	1497	677	270		880	
<u>DG Engines:</u>									
(NOx+VOC+CO/7) Reduction, 10-Yr Tons	3,539	580	3,555	2,522	2,189	5,533	1,210		48
Initial Cost, $	2,499,977	580,251	1,023,792	4,326,469	1,613,478	3,196,932	4,740,122		40,658
Annual O&M Cost, $	-916,897	-15,087	-1,046,832	1,867,548	521,385	2,530,364	1,987,838		52,050
Present Value of 10-Yr Costs, $	-5,238,633	452,916	-7,811,466	20,088,575	6,013,967	24,553,200	21,517,478		479,959

Table C-5 (Continued)
PAR 1110.2 Cost Effectiveness Calculations

	19	20	21	
Fuel	NATURAL GAS	NATURAL GAS	NATURAL GAS	
RECLAIM?	NON-RECLAIM	NON-RECLAIM	NON-RECLAIM	
BACT?	NON-BACT	NON-BACT	NON-BACT	
Rich-Burn or Lean-Burn?	RICH	RICH	RICH	
=>1000 HP or NOx-Major?	=>1000	<1000	<1000	TOTALS
<u>Step 2: Reduce Emissions to NOx/CO/VOC = 11/250/30 ppm @ 15% O2</u>	Upgrade Three-Way Catalyst	Upgrade Three-Way Catalyst	Upgrade Three-Way Catalyst	
Initial Cost, $	262,248	526,200	3,860,550	68,977,804
Annual O&M Cost, $	79,996	154,200	1,048,350	10,974,451
Present Value of 10-Yr Costs, $	937,414	1,827,648	12,708,624	161,602,173
Step 2 Cost Eff, $ per ton pollutants	**1,539**	**1,654**	**2,022**	**8,337**
Steps 1+ 2 Total Initial Cost, $	395,248	2,081,123	4,632,044	80,338,951
Steps 1+ 2 Total Annual O&M Cost, $	79,996	571,635	4,501,416	22,662,342
Present Value of 10-Yr Costs, $	1,070,414	6,905,718	42,623,998	271,609,118
Steps 1+2 Cost Eff, $ per ton pollutants	**828**	**1,931**	**3,031**	**5,410**
<u>Alternative Technology</u>	Electrify	Electrify	Electrify	
DG Engines (Survey)	5	3	14	
DG Engines (Total Population)	7	4	19	284
DG Engines--Avg. HP	1172	930	257	
Non-DG Engines (Total Population)		16	206	509
Non-DG Engines--Avg. HP		598	248	
<u>DG Engines:</u>				
(NOx+VOC+CO/7) Reduction, 10-Yr Tons	1,584	1,133	1,487	28,550
Initial Cost, $	744,245	350,598	430,130	26,053,243
Annual O&M Cost, $	344,681	219,008	287,903	6,431,390
Present Value of 10-Yr Costs, $	3,653,351	2,199,029	2,860,031	80,334,172

Table C-5 (Continued)
PAR 1110.2 Cost Effectiveness Calculations

	1	2	3	4	5	6	7	8	9
Fuel	BIOGAS	BIOGAS	BIOGAS	NATURAL GAS	NATURAL GAS	NATURAL GAS	NATURAL GAS	DIESEL	NATURAL GAS
RECLAIM?				RECLAIM	RECLAIM	RECLAIM	RECLAIM	RECLAIM	RECLAIM
BACT?				BACT	BACT	NON-BACT	NON-BACT	BACT	NON-BACT
Rich-Burn or Lean-Burn?				RICH	RICH	RICH	RICH	LEAN	LEAN
=>1000 HP or NOx-Major?	=>1000	<1000	<1000	MAJOR	NON-MAJOR	MAJOR	NON-MAJOR	NON-MAJOR	MAJOR
Electrify DG Eng's Cost Eff, $ per ton	**NA**	**NA**	**NA**	**NA**	**1,922**	**2,397**	**397**	**5,418**	**-464**
<u>Non-DG Engines:</u>									
(NOx+VOC+CO/7) Reduction, 10-Yr Tons				116	897		3,371		20,469
Initial Cost, $				458,019	1,684,405		4,437,908		17,418,616
Annual O&M Cost, $				9,429	-85,082		-442,620		-5,469,589
Present Value of 10-Yr Costs, $				537,601	966,316		702,199		-28,744,718
Electrify Non-DG Eng's Cost Eff, $ per ton	**NA**	**NA**	**NA**	**4,628**	**1,078**	**NA**	**208**	**NA**	**-1,404**
<u>Incremental Analysis (DG Engines):</u>									
Incremental (NOx+VOC+CO/7) Reduction, 10-Yr Tons					692	64	826	1,486	631
Incremental Present Value of 10-Yr Costs, $					994,877	976,473	-652,375	7,872,163	-502,378
Electrify DG Eng's Incremental Cost Eff, $ per ton	**NA**	**NA**	**NA**	**NA**	**1,438**	**15,254**	**-790**	**5,299**	**-797**
<u>Incremental Analysis (Non-DG Engines):</u>									
Incremental (NOx+VOC+CO/7) Reduction, 10-Yr Tons				25	548		2,108		16,757
Incremental Present Value of 10-Yr Costs, $				518,601	-496,213		-6,764,308		-33,080,749
Electrify Non-DG Incremental Cost Eff, $ per ton	**NA**	**NA**	**NA**	**21,089**	**-905**	**NA**	**-3,209**	**NA**	**-1,974**

Table C-5 (Continued)
PAR 1110.2 Cost Effectiveness Calculations

		10	11	12	13	14	15	16	17	18
Fuel		DIESEL	NATURAL GAS	DIESEL	NATURAL GAS	NATURAL GAS	NATURAL GAS	NATURAL GAS	NATURAL GAS	NATURAL GAS
RECLAIM?		RECLAIM	RECLAIM	RECLAIM	NON-RECLAIM	NON-RECLAIM	NON-RECLAIM	NON-RECLAIM	NON-RECLAIM	NON-RECLAIM
BACT?		NON-BACT	NON-BACT	NON-BACT	BACT	BACT	BACT	BACT	BACT	BACT
Rich-Burn or Lean-Burn?		LEAN	LEAN	LEAN	RICH	RICH	RICH	LEAN	LEAN	LEAN
=>1000 HP	or NOx-Major?	MAJOR	NON-MAJOR	NON-MAJOR	=>1000	<1000	<1000	=>1000	<1000	<1000
Electrify DG Eng's Cost Eff, $ per ton		**-1,480**	**780**	**-2,197**	**7,966**	**2,747**	**4,437**	**17,782**	**NA**	**10,053**
<u>Non-DG Engines:</u>										
(NOx+VOC+CO/7) Reduction, 10-Yr Tons			1,116	2,417	1,148	2,753	4,993		146	
Initial Cost, $			1,418,420	1,438,257	2,876,654	3,888,630	10,216,339		308,610	
Annual O&M Cost, $			-192,987	-827,642	169,588	539,101	975,075		66,719	
Present Value of 10-Yr Costs, $			-210,392	-5,547,039	4,307,976	8,438,646	18,445,971		871,722	
Electrify Non-DG Eng's Cost Eff, $ per ton		**NA**	**-189**	**-2,295**	**3,751**	**3,065**	**3,694**	**NA**	**5,972**	**NA**
<u>Incremental Analysis (DG Engines):</u>										
Incremental (NOx+VOC+CO/7) Reduction, 10-Yr Tons		3,536	468	3,378	486	225	866	1,123		31
Incremental Present Value of 10-Yr Costs, $		-5,352,633	-307,877	-8,463,575	19,613,575	92,520	5,673,275	20,278,394		335,827
Electrify DG Eng's Incremental Cost Eff, $ per ton		**-1,514**	**-658**	**-2,505**	**40,389**	**412**	**6,549**	**18,057**	**NA**	**10,836**
<u>Incremental Analysis (Non-DG Engines):</u>										
Incremental (NOx+VOC+CO/7) Reduction, 10-Yr Tons			902	2,297	255	323	850		97	
Incremental Present Value of 10-Yr Costs, $			-971,185	-6,851,256	4,060,976	94,790	-300,997		-276,078	
Electrify Non-DG Incremental Cost Eff, $ per ton		**NA**	**-1,077**	**-2,983**	**15,955**	**294**	**-354**	**NA**	**-2,854**	**NA**

Table C-5(Concluded)
PAR 1110.2 Cost Effectiveness Calculations

		19	20	21	
Fuel		NATURAL GAS	NATURAL GAS	NATURAL GAS	
RECLAIM?		NON-RECLAIM	NON-RECLAIM	NON-RECLAIM	
BACT?		NON-BACT	NON-BACT	NON-BACT	
Rich-Burn or Lean-Burn?		RICH	RICH	RICH	
=>1000 HP	or NOx-Major?	=>1000	<1000	<1000	TOTALS
Electrify DG Eng's Cost Eff, $ per ton		**2,307**	**1,941**	**1,923**	**2,814**
Non-DG Engines:					
(NOx+VOC+CO/7) Reduction, 10-Yr Tons			2,934	15,669	56,030
Initial Cost, $			1,915,837	14,931,788	60,993,484
Annual O&M Cost, $			245,313	1,309,040	-3,703,654
Present Value of 10-Yr Costs, $			3,986,276	25,980,081	29,734,641
Electrify Non-DG Eng's Cost Eff, $ per ton		**NA**	**1,358**	**1,658**	**531**
Incremental Analysis (DG Engines):					
Incremental (NOx+VOC+CO/7) Reduction, 10-Yr Tons		291	132	260	
Incremental Present Value of 10-Yr Costs, $		2,582,937	817,886	-739,329	
Electrify DG Eng's Incremental Cost Eff, $ per ton		**8,882**	**6,196**	**-2,839**	
Incremental Analysis (Non-DG Engines):					
Incremental (NOx+VOC+CO/7) Reduction, 10-Yr Tons			360	2,833	
Incremental Present Value of 10-Yr Costs, $			-1,538,299	-13,044,557	
Electrify Non-DG Incremental Cost Eff, $ per ton		**NA**	**-4,275**	**-4,605**	

PAR 1110.2 Cost Effectiveness Calculations - Preliminary Draft --Notes2

GENERAL:

Cost calculations assume 8000 hrs per year engine operation at full capacity and 31% engine efficiency (HHV).

Results of an engine survey were scaled up to represent total-population estimates based on a 73.5% response rate to the survey (based on number of engines).

Scaling Factors

Biogas engines:	Represented in Calc's =	54	Number found in BCAT search =	66	Factor =	0.818
RECLAIM nat gas engines:	Represented in Calc's =	90	Number found in BCAT search =	111	Factor =	0.811
Other nat gas engines:	Represented in Calc's =	481	Number found in BCAT search =	652	Factor =	0.738
Diesel engines:	Represented in Calc's =	30	Number found in BCAT search =	30	Factor =	1.000
		655		859		

The ten-year present-value calculation assumes a 4% real interest rate (prevailing interest rate less rate of inflation).

For purposes of these calculations, no distinction is made between engines fueled on natural gas, propane or field gas--all are included in "Natural Gas".

NOx, CO and VOC CONCENTRATIONS (Note Concentrations Summary Table at end of this section):

Baseline Emissions

Biogas Engines

Baseline emissions are based on horsepower-weighted averages of NOx limits, landfill gas VOC limits (40 ppm @ 15% O2 as methane), average VOC source test results for digester gas engines based on the survey data, and average CO source test results based on the survey data. In all cases except CEMS-monitored NOx, baseline emissions are assumed to be, on average, 10% above those limits or source test results.

Rich-Burn Engines

For non-RECLAIM and RECLAIM BACT engines with NOx CEMS, it is assumed that the NOx level is maintained on average at 80% of the NOx limit.

For RECLAIM Majors, it is assumed that the NOx level is at the apparent "limit", which was calculated from annual emissions reporting data.

For most rich-burn engines, baseline NOx and CO emissions are based on horsepower-weighted average NOx and CO limits multipled by factors that are based on AQMD compliance test results.

AQMD compliance tests showed that for engines without CEMS, the average ratio of measured NOx to the NOx limit is 5.19 for BACT engines (NOx limit in 8-23 range) and 2.12 for non-BACT engines (NOx limit in 36-59 range).

AQMD compliance tests showed that the average ratio of measured CO to the CO limit follows the relationship R-CO = 6.75 - .00306 x (L - 75),
where R-CO = ratio of measured CO to CO limit and L = CO limit, ppmvd @ 15% O2.
If measured CO were capped at 1.2 x L or 0.8 x L, the relationships would have been R-CO(1.2) = 0.590 - .000936 x (L - 75) or R-CO(0.8) = 0.460 - .000807 x (L - 75)

For non-BACT engines in RECLAIM, many NOx limits are above the range of the AQMD compliance data (none tested in this category), and it is assumed that baseline NOx for non-Major sources (no CEMS) in this group is maintained, on average, at the horsepower-weighted NOx limit.

Although compliance testing did not include VOC data, source test data reported in the engine survey showed that VOC levels tend to correspond to roughly the square root of the CO level. The following equations were developed (ppm-15% O2): for non-BACT engines VOC = 1.1 x sq rt (CO) and for BACT engines VOC = 0.93 x sq rt (CO).

Lean-Burn Engines (Excluding Biogas Engines)

Non-BACT engines (all in RECLAIM): Non-CEMS NOx assumed to be at limit on average, and CO and VOC assumed 10% over source test results on average.
For RECLAIM Majors, the NOx level is assumed to be maintained at the reported limit or apparent limit that was calculated based on annual emission reporting.

BACT, non-RECLAIM engines: non-CEMS NOx assumed 1.8 x the NOx limit based on AQMD compliance test results; CO and VOC assumed 10% above average source test results.

BACT RECLAIM engines (Snow Summit diesels, 50 ppm NOx limit, no CEMS): NOx, CO and VOC assumed to be 10% over limits on average.

Controlled Emissions (Step 1)

Step 1 is the increased monitoring requirements that take effect in 2008.

Lean-burn engines: Expected to operate at BACT limits or, in absence of BACT limit, at average source test results.

Rich-burn engines that will have NOx/CO CEMS: it is assumed that both NOx and CO will be maintained on average at 80% of their respective limits.

Rich-burn engines subject to Inspection & Monitoring Plans: it is assumed that both NOx and CO will be, on average, no greater than 20% above their respective limits.

Controlled Emissions (Step 2)

Step 2 is reduction to NOx/CO/VOC = 11/250/30 ppm @ 15% O2, taking effect in 2010 - 2012.

Engines with BACT limits will be unaffected, and engines in RECLAIM will be unaffected regarding NOx.

Engines that will have NOx and/or CO CEMS: it is assumed that the monitored pollutant(s) will be maintained on average at 80% of their respective limits.

Engines subject to Inspection & Monitoring Plans:

Rich-burn:

Lean-burn:

Concentrations Summary Table:

	Baseline			Step 1			Step 2			
	NOx	CO	VOC	NOx	CO	VOC	NOx	CO	VOC	Fuel
Biogas >=1000	0.8 x L	1.1 x S/T	1.1 x S/T	same	S/T	S/T	0.8 x 11	250 or S/T	CO% or 30	Biogas
Biogas <1000, New CEMS	1.1 x L	1.1 x S/T	1.1 x S/T	0.8 x L	S/T	S/T	0.8 x 11	250 or S/T	CO% or 30	Biogas
Biogas <1000, I&M	1.1 x L	1.1 x S/T	1.1 x S/T	L	S/T	S/T	11	250 or S/T	CO% or 30	Biogas
Rich BACT RECL Major	0.8 x L	f(L)	f(CO)	same	f(L)-0.8	f(CO)	same	same	f(CO) or 30	NG
Rich BACT RECL Non-Major	f(L)	f(L)	f(CO)	same	f(L)-1.2	f(CO)	same	same	f(CO) or 30	NG
Rich Non-BACT RECL Major	L	f(L)	f(CO)	same	f(L)-0.8	f(CO)	same	0.8 x 250 or same	f(CO) or 30	NG
Rich Non-BACT RECL Non-Major	L	f(L)	f(CO)	same	f(L)-1.2	f(CO)	same	1.2 x 250 or same	f(CO) or 30	NG
Lean BACT RECL Non-Major Dsl	1.1 x L	1.1 x L	1.1 x L	same	L	L	same	same	same or 30	Dsl
Lean Non-BACT RECL Major	L	1.1 x S/T	1.1 x S/T	same	S/T	S/T	same	250 or S/T	CO% or 30	NG
Lean Non-BACT RECL Major Dsl	L	1.1 x S/T	1.1 x S/T	same	S/T	S/T	same	250 or S/T	CO% or 30	Dsl
Lean Non-BACT RECL Non-Major	L	1.1 x S/T	1.1 x S/T	same	S/T	S/T	same	250 or S/T	CO% or 30	NG
Lean Non-BACT RECL Non-Maj Dsl	L	1.1 x S/T	1.1 x S/T	same	S/T	S/T	same	250 or S/T	CO% or 30	Dsl
Rich BACT >=1000	0.8 x L	f(L)	f(CO)	same	f(L)-0.8	f(CO)	0.8 x (11 or L)	0.8 x (250 or L)	f(CO) or 30	NG
Rich BACT <1000, New CEMS	f(L)	f(L)	f(CO)	0.8 x L	f(L)-0.8	f(CO)	0.8 x (11 or L)	0.8 x (250 or L)	f(CO) or 30	NG
Rich BACT <1000, I&M	f(L)	f(L)	f(CO)	1.2 x L	f(L)-1.2	f(CO)	1.2 x (11 or L)	1.2 x (250 or L)	f(CO) or 30	NG
Lean BACT >=1000	0.8 x L	1.1 x L	1.1 x L	same	L	L	same	same	same or 30	NG
Lean BACT <1000, New CEMS	1.8 x L	1.1 x L	1.1 x L	L	L	L	same	same	same or 30	NG
Lean BACT <1000, I&M	1.8 x L	1.1 x L	1.1 x L	L	L	L	same	same	same or 30	NG
Rich Non-BACT >=1000	0.8 x L	f(L)	f(CO)	same	f(L)-0.8	f(CO)	0.8 x 11	0.8 x 250	f(CO) or 30	NG
Rich Non-BACT <1000, New CEMS	f(L)	f(L)	f(CO)	0.8 x L	f(L)-0.8	f(CO)	0.8 x 11	0.8 x 250	f(CO) or 30	NG
Rich Non-BACT <1000, I&M	f(L)	f(L)	f(CO)	1.2 x L	f(L)-1.2	f(CO)	1.2 x 11	1.2 x 250	f(CO) or 30	NG

Notes:

NOx, CO, VOC TPY CALCULATIONS:

Natural gas: NOx factor is based on 80 ppm NOx @ 3% O2 = 1 lb per MMBtu fuel input (as NO2). For CO, 80 ppm factor becomes 80 x 46 (mol-wt. NO2) / 28 (mol-wt. CO). For VOC (as methane), 80 ppm factor becomes 80 x 46 / 16 (mol-wt. CH4)

Diesel: 80 ppm factor becomes 80 x 8710 (EPA Method 19 dry gas factor for natural gas) / 9190 (EPA Method 19 dry gas factor for diesel).

Biogas: 80 ppm factor becomes 80 x 0.97 to correct for typical 50% CO2 in biogas (resulting in approx. 3% added flue gas volume at 15% O2).

CONTROL COSTS:

Add CO analyzer to existing CEMS

The cost of a CO analyzer ($8,000 to $11,000) was obtained from a CEMS vendor. The cost of installation and reprogramming the DAS is estimated to be about $8000. The impact on span gas costs is expected to be minimal since CO can be added to the NOx span gases at little additional cost. The impact on RATA tests is expected to be minimal.

Total Est. Cost

Install New NOx-CO CEMS

The installed cost and annual cost of a NOx-CO CEMS were obtained from a vendor specializing in that equipment.

	Rich-Burn		Lean-Burn	
	Initial Costs, $	Annual Costs, $	Initial Costs, $	Annual Costs, $
CEMS--NOx/CO for rich-burn engines, NOx-only for lean-burn engines	86,000		78,000	
Switching Valve	5,000		5,000	
Data Aquisition System	25,000		25,000	
Installation	20,000		20,000	
Certification Testing	10,000		10,000	
Startup and Training	25,000		25,000	
Project Management	5,600		5,600	
AQMD Fees	4,000		4,000	
Span Gases		10,000		10,000
RATA		10,000		10,000
Maintenance		15,000		15,000
	180,600	35,000	172,600	35,000
Additional costs for sharing (per engine, AQMD estimates)				
Additional sampling system	15,000		15,000	
Additional installation	10,000		10,000	
Additional DAS programming	5,000		5,000	

Concluded

	Rich-Burn Initial Costs, $	Rich-Burn Annual Costs, $	Lean-Burn Initial Costs, $	Lean-Burn Annual Costs, $
Additional certification testing	5,000		5,000	
Additional span gases		2,500		2,500
Additional RATA		5,000		5,000
Additional Maintenance		7,500		7,500
	35,000	15,000	35,000	15,000

Install air/fuel ratio controller on a lean burn engine

The installed and operating cost of an air/fuel ratio controller was obtained from a vendor specializing in that equipment.

Installed Cost, $

Operating Cost quarterly changeout of O2 sensor(s)-two sensors @ $90, $/yr

Increased Source Testing and I&M Requirements for Non-CEMS Engines

	Initial Costs, $	Rich-burn	Lean-burn	Lean-burn RECLAIM or w NOx CEMS
Increase source test frequency from every 3 yrs to every 15 months (conservative, for case of highly utilized engine)		1,400	1,400	1,400
AQMD Protocol and Report Evaluation Fees ($278.57 x 2 every 15 mo.)		446	446	446
Source test protocol with every source test (engr labor: 8-hrs initially, then 1 hr every 15 mo., @ $55/hr)	440	28	28	28
I&M Plan (24 hrs engr @ $55)	1,320			
AQMD Plan Evaluation Fee	209			
Initial Parametric Test ($300 test + extra 6 hrs @ $70, 2 hrs engr @ $55, 8 hrs tech @ $35)	1,220			
Alarm ($100 to purchase ennunciator + 4 hrs tech @ $35 to install [AFRC assumed to have output for alarm])	240			
Emission Checks: most engines w/o NOx/CO CEMS--weekly/monthly--18 tests per year @ $300 per test		5,400	5,400	
Lean-burn engines in RECLAIM or with NOx CEMS--4 tests per year @ $300 per test				1,200
Daily inspections (0.25 hr tech time @ $35)		3,194	3,194	3,194
Repeat parametric test whenever O2 sensor is changed (quarterly)		4,880		
	3,429	15,347	10,467	6,267

Install fuel cleanup system, SCR system and oxidation catalyst on biogas-fired engine

	2682 hp		625 hp		Non-Biogas Engine 183 hp	
	Initial Costs, $	Annual Costs, $	Initial Costs, $	Annual Costs, $	Initial Costs, $	Annual Costs, $
Biogas cleanup (siloxane removal) system installed cost, $	353,782		115,926			
Sorbent disposal and replacement, $/yr		73,982		17,240		
Periodic sorbent test		10,000		10,000		
Selective catalytic reduction system installed cost, $	311,257		114,611		43,229	
Startup	10,549		10,549		10,549	
Contingency (10%)	31,126		11,461		4,323	
Total	352,932		136,622		58,101	
Replace catalyst every 3 years		51,876		19,102		7,205
Cost of urea @ $300/ton NH3, $/yr		732		171		50
Oxidation catalyst installed cost,$	29,279		10,562		6,431	
Replace catalyst every 3 years		4,880		1,760		1,072
Cost of parasitic load on engine, $/yr		4,031		939		275
Project management- 160 hrs @ $55	8,800		8,800		8,800	
AQMD application fee	2,300		2,300		2,300	
Performance test	4,000		4,000		4,000	
Annual maintenance cost @ 3% of original equipment cost, $/yr		20,830		7,233		1,490
	1,104,025	166,330	414,832	56,445	137,733	10,091

Installed cost and annual cost for a biogas cleanup system was obtained from a vendor specializing in that equipment.

Installed cost = $1,000,000 x (HP/10,413)^0.766; 850 scfm biogas uses 3400 lb/mo. sorbent @ $1.68/lb disposal and replacement cost plus $10k annual cost of periodic sorbent testing.

The SCR system costs were obtained from a vendor specializing in that equipment--see AQMD staff report

"Proposed Amended Best Available Control Technology (BACT) Guidelines, Part D- Non-Major Polluting Facilities, Regarding Emergency Compression-ignition (Diesel) Engines", April 2003, Appendix H (escalated to 2008 $ @ 3% per year).

The oxidation catalyst installed cost was obtained from a vendor specializing in that equipment.

Parasitic load is estimated to be 0.236% based on 3" H2O pressure loss through the fuel cleanup system and 3" H2O pressure loss through the SCR and oxidation catalysts. Cost is based on purchase of replacement power at $.0796/kWh.

Upgrade three-way catalyst to meet 11 ppm NOx		2068 hp	1172 hp	665 hp	568 hp	333 hp	249 hp
New catalyst (Installed) (vendor figure)		53,996	34,284	23,130	20,996	15,826	13,978
Project management (16 hrs @ $55)		880	880	880	880	880	880
AQMD application fee		2,300	2,300	2,300	2,300	2,300	2,300
Total		57,176	37,464	26,310	24,176	19,006	17,158
Annual O&M Cost	Replace catalyst every 3 years	17,999	11,428	7,710	6,999	5,275	4,659

Install oxidation catalyst to meet 30 ppm VOC and 250 ppm CO		3265 hp	341 hp
Oxidation catalyst (Installed) (vendor figure + 10% for modifications to ductwork)		35,332	9,601
Project management (16 hrs @ $55)		880	880
AQMD application fee		2,300	2,300
Total		38,512	12,781
Annual O&M Cost	Replace catalyst every 3 years	5,889	1,600

			CEMS Engine	
Eliminate DG engine or replace work engine with electric motor (1000 hp engine)	Remove (DG)	Replace (Non-DG)	Remove (DG)	Replace (Non-DG)
Engine removal (vendor figure) $5,000-$25,000 depends on accessibility	15,000	15,000		
Electric motor (www.automationdirect.com) $7100 @ 200hp, scale with capacity^0.73, includes 8% tax		22,988		
Motor controls and switchgear (AQMD estimate)		10,000		
Installation (vendor figure - about 2X removal cost)		30,000		
Backup generator @ $250/kW	180,905	180,905		
Project management (24 hrs to remove only, 56 hrs to remove and replace@ $55)	1,320	3,080		
	197,225	261,973		
Increased utility demand charge (SCE TOU-8 rate schedule--$194/kW-Yr), $/Yr	140,382	149,200	140,382	149,200
Cost of power (SCE TOU-8 rate schedule--$.0796/kWh ann. avg.), $/Yr	460,801	489,745	460,801	489,745
Avoided cost of fuel @ $0.81 per therm, source/RATA testing and CEMS maintenance, $/Yr	-461,867	-532,987	-478,867	-549,987
Maintenance cost differential--$.01 per hp-hr for ICE vs. negligible cost for motor, $/Yr	-80,000	-80,000	-80,000	-80,000
http://www.distributed-generation.com/Library/PLL%20AEIC.PDF	59,316	25,958	42,316	8,958

Power and fuel calculations assume 31% engine efficiency, 97% motor/generator efficiency, 8000 hrs per year operation.

Emissions from central power plant assumed to be 0.335 CO and .027 VOC (lb/MWh) based on annual emissions reporting. It is also assumed that 80% of marginal grid power is natural gas-based (state law requires grid power to be 20% from renewablr sources starting 2010).

Eliminate DG engine or replace work engine with electric motor (1000 hp engine) (Concluded)			CEMS Engine	
	Remove (DG)	Replace (Non-DG)	Remove (DG)	Replace (Non-DG)

It is assumed that removal of a natural gas distributed-generation engine increases boiler fuel by (1-0.31) x 0.5 / 0.8 x the engine fuel consumption (50% waste heat utilization, 80% boiler efficiency). Increased emissions from boiler are calculated at 30 ppm NOx and 100 ppm CO, both @ 3% O2 (.0375 and .076 lb/MMBtu, respectively).

Avoided source testing or RATA testing assumes testing triennially @ $3000 for non-CEMS engine and annual testing for CEMS engine.

Avoided CEMS maintenance is $15,000 annual cost.

Annual costs include credit for avoided permit and emission fees @ $955/yr permit fee (or $293 if <500 hp) and $200/ton NOx.

Costs include credits for emission reduction credits (ERC) @ $95,000 per TPY NOx (except in RECLAIM).

Costs for engines in RECLAIM include an annual credit for Reclaim Trading Credits (RTC) @ $4,000 per ton NOx.

Upgrade Biogas to PUC-Quality Pipeline Gas (Replacement of 4860 HP Engine)

	Landfill Gas (DG)	Digester Gas (DG)	Dig. Gas (Non-DG)
Installed Cost, $ (2008)	2,680,000	2,680,000	2,680,000
O&M Cost, $/yr (2008)	410,000	410,000	410,000
Value of PUC gas produced less gas needed for boilers (digester-DG case only), $/yr	1,598,400	760,050	1,598,400
Cost of power production foregone (landfill) or increased power purchase (digester), $/yr	1,026,904	1,026,904	
Cost of engine removal and motor installation, $			58,080
Cost of electric motors and backup generators, $			979,294
Cost of increased demand charge @ $194/kW-yr and purchased power @ $.0796/kWh, $/yr			3,105,273
ICE maintenance, $/yr	-388,800	-388,800	-388,800
CO emissions from increased grid power, tpy	4.36E+00	4.36E+00	4.60E+00
VOC emissions from increased grid power, tpy	3.52E-01	3.52E-01	3.71E-01
NOx emissions from thermal oxidizer, tpy	9.90E-01	9.90E-01	9.90E-01

In digester gas non-DG case, engines are being used to drive compressors. Electrification costs--see above, "replace work engine with electric motor".

Cost and technical information for a biogas upgrade plant were taken from "An Economic Evaluation of Carbon Molecular Sieve Membranes in Landfill Gas Applications", GC Environmental Inc., Media and Process Technology Inc., USC Dept. of Chemical Engineering, Copyright 1999-GC Environmental.

Basis: replacement of a 4860 hp biogas engine using 90,000 scfh biogas @ 45% methane, yielding 33.3 MMBtu/hr PUC gas and 6.6 MMBTU/hr waste gas to thermal oxidizer.

Value of PUC gas calculated at $0.6 per therm (recent wholesale price - US EIA data).

Value of power production foregone (landfill case) calculated at $.0365 per kWh (based on US EIA data for 1999 escalated to 2008 $ @ 3% inflation rate), and value of increased power

purchase (digester case) calculated at $.0796 per kWh. Value of avoided engine maintenance calculated at $.01 per hp-hr.

Power plant emissions based on power needed to compress biogas to 400 psi (554 kW) and to replace power produced by engines, @ 0.335 and .027 lb/MWh CO and VOC, resp., from central power plant (NOx capped by RECLAIM), 80% of marginal grid power produced by natural gas plants.

Thermal oxidizer NOx emission calculated based on 30 ppm NOx @ 3% O2.

Possible tax credit (IRS Section 29) not included in this analysis.

Fuel Cell Power Plant for Digester Gas

	Digester Gas (DG)	Dig. Gas (Non-DG)
Average Plant Size, HP	4396	652
ICE kW	3,181	472
Maximum Fuel Cell kW	4,230	627
Fuel Cell Plant Size, kW	4,200	600
Fuel Cell Output, kW	4,200	600
Installed Cost of Fuel Cell Power Plant @ $7000/kW, $	29,400,000	1,500,000
Maintenance (including restacks) @ $.04/kWh, $/yr	1,344,000	192,000
ICE maintenance @ $.01/hp-hr, $/yr	-351,680	-52,160
Cost of electrification, $		196,501
Cost of increased demand charge @ $194/kW-yr and purchased power @ $.0796/kWh, $/yr	-846,557	-81,888
Increased natural gas to boilers @ 50% waste heat utilization and 80% boiler efficiency, MMBtu/yr	16,240	
Cost of increased natural gas to boilers @ $0.81/therm, $/yr	131,547	
CO emissions from grid power increase, tpy	-1.43E-01	-1.38E-02
VOC emissions from grid power increase, tpy	-4.08E-02	-3.94E-03
NOx emissions from fuel cell @ .0017 lb/MWh, tpy	2.86E-02	4.08E-03
VOC emissions from fuel cell @ .007 lb/MWh, tpy	1.18E-01	1.68E-02
NOx emissions from increased boiler fuel @ 30 ppm @ 3% O2, tpy	3.05E-01	

In digester gas non-DG case, engines are being used to drive compressors. Electrification costs--see above, "replace work engine with electric motor".

Costs are for multiple Fuel Cell Energy DFC300MA 300-kW units--plant size based on 31% ICE efficiency, 97% generator efficiency and 40% fuel cell efficiency (average between restacks) (all HHV). Self-Generation Incentive Program provides $4.50 per Watt for new fuel cell biogas generation (applies to Non-DG case).

Plant size based on 31% ICE efficiency, 97% generator efficiency and 40% fuel cell efficiency (average between restacks) (all HHV).

Emissions from grid power are calculated at 0.335 lb/MWh CO and .027 lb/MWh VOC (NOx capped by RECLAIM) and 80% of marginal grid power produced from natural gas plants.

Fuel cell emissions are based on source test results on DFC300MA installation at Palmdale, CA.

Microturbine-Generator Biogas Power Plant

	Landfill Gas (DG)	Digester Gas (DG)	Dig. Gas (Non-DG)
Average Plant Size, HP	6,560	4,396	652
ICE kW	4,747	3,181	472
Maximum MTG kW	4,103	2,749	408
MTG Plant Size, kW	4,160	2,795	455
MTG Plant Output, kW	4,103	2,749	408
Installed Cost, $	8,699,466	7,594,551	455,092
Maintenance @ $.01/kWh, $/yr	328,214	219,943	32,621
ICE maintenance @ $.01/hp-hr, $/yr	-524,800	-351,680	-52,160
Cost of electrification, $			64,903
Cost of increased demand charge @ $194/kW-yr and purchased power @ $.088/kWh, $/yr	535,262	358,691	77,820
Increased natural gas to boilers @ 50% waste heat utilization and 80% boiler efficiency, MMBtu/yr		-9,022	
Cost of increased natural gas to boilers @ $0.81/therm, $/yr		-73,082	
CO emissions from grid power increase, tpy	6.91E-01	4.63E-01	6.86E-02
VOC emissions from grid power increase, tpy	5.57E-02	3.73E-02	5.53E-03
NOx emissions from MTGs @ 9 ppm @ 15% O2, tpy	7.27E+00	4.87E+00	7.23E-01
VOC emissions from MTGs @ 20 ppm @ 3% O2 (as hexane), tpy	1.12E+01	7.53E+00	1.12E+00
NOx emissions from increased boiler fuel @ 30 ppm @ 3% O2, tpy		-1.69E-01	

In digester gas non-DG case, engines are being used to drive compressors. Electrification costs--see above, "replace work engine with electric motor".

Costs are for multiple Capstone 65-kW microturbine-generators (MTGs), incl fuel kits and siloxane-removal skid.

Plant size based on 31% ICE efficiency, 97% generator efficiency and 26% MTG efficiency (all HHV).

MTG cost is $67,000 w/o heat exch. or $80,000 w/ heat exch (digester DG case). Self-Generation Incentive Program provides $1.30 per Watt of new kW (applies to non-DG case).

Installation cost is $35,800 per unit w/o waste heat recovery system, $57,000 per unit w/ waste heat recovery system ("AQMD Microturbine Generator Site Summary Report",

UCI Advanced Power & Energy Program, May 5, 2004) escalated to 2008 $ @ 3% inflation rate.

Cost of gas conditioning skid (information from vendor) is $550/kW @ 500 kW size, $300/kW @ 5 MW size.

Emissions from grid power are calculated at 0.335 lb/MWh CO and .027 lb/MWh VOC (NOx capped by RECLAIM) and 80% of marginal grid power from natural gas plants.

Solar Turbine Mercury 50 Digester Gas Power Plant

	ID 17301	ID 29110
Plant Size, HP	10,413	20,830
ICE kW	7,535	15,073
Maximum Gas Turbine, gross kW	8,641	17,286
Gas Turbine Plant Size, gross kW	9,000	18,000
Gas Turbine Plant Output, kW	8,400	16,800
Installed Cost @ $1200/kW, $	10,800,000	21,600,000
Maintenance @ $.01/kWh, $/yr	691,313	1,382,892
ICE maintenance @ $.01/hp-hr, $/yr	-833,040	-1,666,400
Cost of increased demand charge @ $194/kW-yr and purchased power @ $.0796/kWh, $/yr	-718,596	-1,434,788
Increased natural gas to boilers @ 50% waste heat utilization and 80% boiler efficiency, MMBtu/yr	-4,564	-9,390
Cost of increased natural gas to boilers @ $0.81/therm, $/yr	-36,965	-76,058
CO emissions from grid power increase, tpy	-9.27E-01	-1.85E+00
VOC emissions from grid power increase, tpy	-7.47E-02	-1.49E-01
NOx emissions from gas turbines @ 25 ppm @ 15% O2, tpy	4.25E+01	8.51E+01
VOC emissions from gas turbines @ 20 ppm @ 3% O2 (as hexane), tpy	2.72E+01	4.74E+01
NOx emissions from increased boiler fuel @ 30 ppm @ 3% O2, tpy	-8.56E-02	-1.76E-01

Costs are for multiple Mercury 50 4.2 MW (net) gas turbine-generators, incl fuel compressor (300 psi), sound enclosure, siloxane-removal skid and switchgear.
Plant size based on 31% ICE efficiency, 97% generator efficiency and 34.5% gas turbine-generator gross electrical efficiency (all HHV).
Emissions from grid power are calculated at 0.335 lb/MWh CO and .027 lb/MWh VOC (NOx capped by RECLAIM) and 80% of marginal grid power from natural gas plants.

Electrify Digester Gas-Fueled Compressor Engines

Engine Size, HP	652
Cost of electrification, $	196,501
Cost of increased demand charge @ $194/kW-yr and purchased power @ $.0796/kWh, $/yr	416,592
ICE maintenance @ $.01/hp-hr, $/yr	-52,160
CO emissions from grid power increase, tpy	5.38E-01
VOC emissions from grid power increase, tpy	4.33E-02
NOx emissions from flaring @ .06 lb/MMBtu, tpy	1.28E+00
VOC emissions from flaring @ 10 ppm @ 3% O2 (as methane), tpy	9.31E-02

Emissions from grid power are calculated at 0.335 lb/MWh CO and .027 lb/MWh VOC (NOx capped by RECLAIM) and 80% of marginal grid power from natural gas plants.
Flare emissions are based on NOx BACT and VOC source test data for biogas flares.

Table C-6
Affected Engines

Project - Engines	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Increased Source Testing	473					**473**
Inspection & Monitoring	473					**473**
Install Sampling Infrastructure	503					**503**
Install AFRC		34				**34**
Upgrade Three-Way Catalyst			26	50		**76**
Install Oxidation Catalyst			20	9		**29**
Install CEMS - Engine Count		9	28	32		**69**
Install CEMS - CEMS Count		4	10	10		**24**
Install CO Analyzer			34	14		**48**
Install Pretreatment, SCR, Ox Cat or ICE Alternative Technology					66	**66**
Electrified Engines		9	33	128		**170**

Table C-7
Affected Facilities

Project - Facilities	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Increased Source Testing	242					**242**
Inspection & Monitoring	242					**242**
Install Sampling Infrastructure	240					**240**
Install AFRC		16				**16**
Upgrade Three-Way Catalyst			15	30		**45**
Install Oxidation Catalyst			5	2		**7**
Install CEMS		4	10	10		**24**
Install CO Analyzer			15	5		**20**
Install Pretreatment, SCR, Ox Cat or ICE Alternative Technology					28	**28**
Facilities with Electrified Engines		4	13	88		**105**

Surveyed facilities are the number of facilities that were included in the surveys.
Total estimated facilities are the surveyed values scaled up to the total number of facilities in the district.
Facilities with electrified engines are the number of facilities that would replace existing non-biogas engines with electric motors instead of complying with PAR 1110.2.

Table C-8
2008 Vehicle Operational Emissions

Description	**Annual No of Trips[b]**	**Daily No of Trips[b]**	**One-way Distance[c], miles**	**NOx, lb/day**	**CO, lb/day**	**VOC, lb/day**	**SOx, lb/day**	**PM10, lb/day**	**PM2.5[d], lb/day**	**CO2, lb/year**
Source Test Related Trips	242	3	30	8.5	2.6	0.67	0.0071	0.42	0.40	61,303
Total				8.5	2.6	0.67	0.0071	0.42	0.40	61,303

Table C-9
2009 Vehicle Operational Emissions

Description	**Annual No of Trips[b]**	**Daily No of Trips[b]**	**One-way Distance[c], miles**	**NOx, lb/day**	**CO, lb/day**	**VOC, lb/day**	**SOx, lb/day**	**PM10, lb/day**	**PM2.5[d], lb/day**	**CO2, lb/year**
Source Test Related Trips	120	1	30	2.83	0.87	0.22	0.002	0.14	0.13	30,398
Diesel Delivery	9	1	30	2.8	0.87	0.22	0.0024	0.14	0.13	2,280
Total				5.7	1.74	0.45	0.005	0.28	0.27	32,678

Table C-10
2010 Vehicle Operational Emissions

Description	Annual No of Trips[b]	Daily No of Trips[b]	One-way Distance[c], miles	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5[d], lb/day	CO2, lb/year
Spent Catalyst Haul Truck	26	2	178	33.59	10.30	2.66	0.028	1.64	1.58	39,079
New Catalyst Delivery Truck	46	3	30	8.49	2.60	0.67	0.007	0.42	0.40	11,653
Source Test Related Trips	121	2	30	5.66	1.74	0.45	0.005	0.28	0.27	30,652
Diesel Delivery	45	1	30	2.83	0.87	0.22	0.002	0.14	0.13	11,399
Total				50.6	15.5	4.0	0.042	2.5	2.4	92,783

Table C-11
2011 Vehicle Operational Emissions

SCR

Description	Annual No of Trips[b]	Daily No of Trips[b]	One-way Distance[c], miles	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5[d], lb/day	CO2, lb/year
Spent Catalyst Haul Truck	30	2	178	33.59	10.30	2.66	0.028	1.64	1.58	45,091
New Catalyst Delivery Truck	46	3	30	8.49	2.60	0.67	0.007	0.42	0.40	11,653
Spent Carbon Haul Truck	92	1	30	2.83	0.87	0.22	0.002	0.14	0.13	23,305
New Carbon Delivery Truck	92	1	30	2.83	0.87	0.22	0.002	0.14	0.13	23,305
Source Test Related Trips	121	2	30	5.66	1.74	0.45	0.005	0.28	0.27	30,652
Ammonia Delivery	19	1	30	2.83	0.87	0.22	0.002	0.14	0.13	4,813
Diesel Delivery	170	2	30	5.66	1.74	0.45	0.005	0.28	0.27	43,064
Total				61.9	19.0	4.9	0.1	126.0	125.9	181,883.8

Gas Turbine

Table C-11 (Continued)
2011 Vehicle Operational Emissions

Description	**Annual No of Trips[b]**	**Daily No of Trips[b]**	**One-way Distance[c], miles**	**NOx, lb/day**	**CO, lb/day**	**VOC, lb/day**	**SOx, lb/day**	**PM10, lb/day**	**PM2.5[d], lb/day**	**CO2, lb/year**
Spent Catalyst Haul Truck	30	2	178	33.6	10.3	2.7	0.028	1.6	1.6	225,664
New Catalyst Delivery Truck	46	3	30	8.5	2.6	0.7	0.007	0.4	0.4	7,883
Spent Carbon Haul Truck	92	1	30	2.8	0.9	0.2	0.002	0.1	0.1	23,305
New Carbon Delivery Truck	92	1	30	2.8	0.9	0.2	0.002	0.1	0.1	23,305
Source Test Related Trips	121	1	30	2.8	0.9	0.2	0.002	0.1	0.1	29,132
Diesel Delivery	170	1	30	2.8	0.9	0.2	0.002	0.1	0.1	5,573
Total				53.3	16.5	4.2	0.043	2.4	2.4	314,862

Microturbine

Description	**Annual No of Trips[b]**	**Daily No of Trips[b]**	**One-way Distance[c], miles**	**NOx, lb/day**	**CO, lb/day**	**VOC, lb/day**	**SOx, lb/day**	**PM10, lb/day**	**PM2.5[d], lb/day**	**CO2, lb/year**
Spent Catalyst Haul Truck	150	2	178	33.6	10.3	2.7	0.028	1.64	1.6	225,664
New Catalyst Delivery Truck	46	3	30	8.5	2.6	0.7	0.007	0.42	0.4	7,883
Spent Carbon Haul Truck	92	1	30	2.8	0.9	0.2	0.002	0.14	0.1	23,305
New Carbon Delivery Truck	92	1	30	2.8	0.9	0.2	0.002	0.14	0.1	23,305
Source Test Related Trips	121	1	30	2.8	0.9	0.2	0.002	0.14	0.1	29,132
Diesel Delivery	170	1	30	2.8	0.9	0.2	0.002	0.14	0.1	5,573
Total				53.3	16.5	4.2	0.043	2.6	2.4	314,862

Table C-11 (Concluded)
2011 Vehicle Operational Emissions

Gas Turbine/LNG

Description	Annual No of Trips[b]	Daily No of Trips[b]	One-way Distance[c], miles	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5[d], lb/day	CO2, lb/year
Spent Catalyst Haul Truck	150	2	178	33.6	10.3	2.66	0.028	1.6	1.6	225,664
New Catalyst Delivery Truck	31	3	30	8.5	2.6	0.67	0.007	0.42	0.4	7,883
Spent Carbon Haul Truck	92	1	30	2.8	0.9	0.22	0.002	0.14	0.1	23,305
New Carbon Delivery Truck	92	1	30	2.8	0.9	0.22	0.002	0.14	0.1	23,305
Source Test Related Trips	121	2	30	5.7	1.7	0.448	0.005	0.28	0.27	30,652
Diesel Delivery	170	2	30	5.7	1.7	0.448	0.005	0.28	0.27	43,064
LNG Haul Truck	1,360	12	40	45.3	13.9	3.6	0.038	2.2	2.1	459,354
Total				104.4	32.0	8.2	0.09	5.1	4.9	813,228

Microturbine LNG

Description	Annual No of Trips[b]	Daily No of Trips[b]	One-way Distance[c], miles	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5[d], lb/day	CO2, lb/year
Spent Catalyst Haul Truck	150	2	178	33.6	10.3	2.7	0.0282	1.6	1.58	225,664
New Catalyst Delivery Truck	31	3	30	8.5	2.60	0.67	0.0071	0.42	0.40	7,883
Spent Carbon Haul Truck	92	1	30	2.8	0.87	0.22	0.0024	0.14	0.13	23,305
New Carbon Delivery Truck	92	1	30	2.8	0.87	0.22	0.0024	0.14	0.13	23,305
Source Test Related Trips	121	2	30	5.7	1.74	0.45	0.0048	0.28	0.27	30,652
Diesel Delivery	170	2	30	5.7	1.74	0.45	0.0048	0.28	0.27	43,064
LNG Haul Truck	1,360	12	40	45.3	13.9	3.6	0.0380	2.22	2.14	459,354
Total				104.4	32.0	8.2	0.088	5.1	4.9	813,228

There are three possible Class I disposal sites in California: Kettleman City (178 miles from Los Angeles), Buttonwillow (133 miles from Los Angeles), and Westmorland (192 miles from Los Angeles). The intermediate distance, 178 miles per one-way trip, was chosen for this analysis.

Table C-12
2012 Vehicle Operational Emissions

SCR

Description	Annual No of Trips[b]	Daily No of Trips[b]	One-way Distance[c], miles	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5[d], lb/day	CO2, lb/year
Spent Catalyst Haul Truck	123	3	178	50.4	15.45	3.98	0.042	2.47	2.38	185,411
New Catalyst Delivery Truck	183	3	30	8.49	2.60	0.67	0.007	0.42	0.40	46,269
Spent Carbon Haul Truck	184	2	30	5.66	1.74	0.45	0.005	0.28	0.27	46,611
New Carbon Delivery Truck	184	2	30	5.66	1.74	0.45	0.005	0.28	0.27	46,611
Source Test Related Trips	121	2	30	5.66	1.74	0.45	0.005	0.28	0.27	30,652
Ammonia Delivery	38	1	30	2.83	0.87	0.22	0.002	0.14	0.13	9,626
Diesel Delivery	178	2	30	5.66	1.74	0.45	0.005	0.28	0.27	45,091
Total				84	26	6.7	0.071	127	127	410,270

Gas Turbine

Description	Annual No of Trips[b]	Daily No of Trips[b]	One-way Distance[c], miles	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5[d], lb/day	CO2, lb/year
Spent Catalyst Haul Truck	123	3	178	50.4	15.4	4.0	0.042	2.5	2.4	185,411
New Catalyst Delivery Truck	123	3	30	8.5	2.6	0.7	0.007	0.4	0.4	31,249
Spent Carbon Haul Truck	184	2	30	5.7	1.7	0.4	0.005	0.3	0.3	46,611
New Carbon Delivery Truck	184	2	30	5.7	1.7	0.4	0.005	0.3	0.3	46,611
Source Test Related Trips	121	2	30	5.7	1.7	0.4	0.005	0.3	0.3	30,652
Diesel Delivery	178	2	30	5.7	1.7	0.4	0.005	0.3	0.3	45,091
Total				82	25	6.4	0.068	4.0	3.8	385,625

Table C-12 (Continued)
2012 Vehicle Operational Emissions

Microturbine

Description	Annual No of Trips[b]	Daily No of Trips[b]	One-way Distance[c], miles	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5[d], lb/day	CO2, lb/year
Spent Catalyst Haul Truck	123	3	178	50.4	15.4	4.0	0.042	2.47	2.4	185,411
New Catalyst Delivery Truck	123	3	30	8.5	2.6	0.7	0.007	0.42	0.4	31,249
Spent Carbon Haul Truck	184	2	30	5.7	1.7	0.4	0.005	0.28	0.3	46,611
New Carbon Delivery Truck	184	2	30	5.7	1.7	0.4	0.005	0.28	0.3	46,611
Source Test Related Trips	121	2	30	5.7	1.7	0.4	0.005	0.28	0.3	30,652
Diesel Delivery	178	2	30	5.7	1.7	0.4	0.005	0.28	0.3	45,091
Total				82	25	6.4	0.068	4.0	3.8	385,625

Gas Turbine/LNG

Description	Annual No of Trips[b]	Daily No of Trips[b]	One-way Distance[c], miles	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5[d], lb/day	CO2, lb/year
Spent Catalyst Haul Truck	123	3	178	50.4	15.4	3.98	0.042	2.47	2.4	185,411
New Catalyst Delivery Truck	123	3	30	8.5	2.6	0.67	0.0071	0.42	0.4	31,249
Spent Carbon Haul Truck	184	2	30	5.7	1.7	0.45	0.0048	0.28	0.3	46,611
New Carbon Delivery Truck	184	2	30	5.7	1.7	0.45	0.0048	0.28	0.3	46,611
Source Test Related Trips	121	2	30	5.7	1.7	0.448	0.0048	0.28	0.27	30,652
Diesel Delivery	178	2	30	5.7	1.7	0.448	0.0048	0.28	0.27	45,091
LNG Haul Truck	1,943	17	40	64.2	19.7	5.1	0.054	3.1	3.0	656,113
Total				146	44.7	11.5	0.12	7.1	6.9	1,041,738

Table C-12 (Concluded)
2012 Vehicle Operational Emissions

Microturbine/LNG

Description	Annual No of Trips[b]	Daily No of Trips[b]	One-way Distance[c], miles	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5[d], lb/day	CO2, lb/year
Spent Catalyst Haul Truck	123	3	178	50.4	15.4	4.0	0.042	2.5	2.38	185,411
New Catalyst Delivery Truck	123	3	30	8.5	2.60	0.67	0.0071	0.42	0.40	31,249
Spent Carbon Haul Truck	184	2	30	5.7	1.74	0.45	0.0048	0.28	0.27	46,611
New Carbon Delivery Truck	184	2	30	5.7	1.74	0.45	0.0048	0.28	0.27	46,611
Source Test Related Trips	121	2	30	5.7	1.74	0.45	0.0048	0.28	0.27	30,652
Diesel Delivery	178	2	30	5.7	1.74	0.45	0.0048	0.28	0.27	45,091
LNG Haul Truck	1,943	17	40	64.2	19.7	5.1	0.054	3.1	3.0	656,113
Total				146	44.7	11.5	0.12	7.1	6.9	1,041,738

There are three possible Class I disposal sites in California: Kettleman City (178 miles from Los Angeles), Buttonwillow (133 miles from Los Angeles), and Westmorland (192 miles from Los Angeles). The intermediate distance, 178 miles per one-way trip, was chosen for this analysis.

Table C-13
2014 Vehicle Operational Emissions

SCR

Description	Annual No of Trips[b]	Daily No of Trips[b]	One-way Distance[c], miles	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5[d], lb/day	CO2, lb/year
Spent Catalyst Haul Truck	163	6	178	101	30.9	7.97	0.085	4.9	4.8	244,822
New Catalyst Delivery Truck	163	6	30	17.0	5.2	1.34	0.014	0.83	0.80	41,262
Spent Carbon Haul Truck	184	2	30	5.7	1.7	0.45	0.005	0.28	0.27	46,611
New Carbon Delivery Truck	184	2	30	5.7	1.7	0.45	0.005	0.28	0.27	46,611
Source Test Related Trips	121	2	30	5.7	1.74	0.45	0.005	0.28	0.27	30,652
Ammonia Delivery	38	1	30	2.8	0.87	0.22	0.002	0.14	0.13	9,626
Diesel Delivery	178	2	30	5.7	1.7	0.45	0.005	0.28	0.27	45,091
Total				143	44	11	0.120	130	130	464,675

Table C-13 (Continued)
2014 Vehicle Operational Emissions

Gas Turbine

Description	Annual No of Trips[b]	Daily No of Trips[b]	One-way Distance[c], miles	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5[d], lb/day	CO2, lb/year
Spent Catalyst Haul Truck	123	6	178	101	30.9	8.0	0.085	4.9	4.8	185,411
New Catalyst Delivery Truck	123	6	30	17.0	5.2	1.3	0.014	0.8	0.8	31,249
Spent Carbon Haul Truck	184	2	30	5.7	1.7	0.4	0.005	0.3	0.3	46,611
New Carbon Delivery Truck	184	2	30	5.7	1.7	0.4	0.005	0.3	0.3	46,611
Source Test Related Trips	121	2	30	5.7	1.7	0.4	0.005	0.3	0.3	30,652
Diesel Delivery	178	2	30	5.7	1.7	0.4	0.005	0.3	0.3	45,091
Total				140	43.0	11	0.12	6.9	6.6	385,625

Microturbine

Description	Annual No of Trips[b]	Daily No of Trips[b]	One-way Distance[c], miles	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5[d], lb/day	CO2, lb/year
Spent Catalyst Haul Truck	123	6	178	101	30.9	8.0	0.085	4.9	4.8	185,411
New Catalyst Delivery Truck	123	6	30	17.0	5.2	1.3	0.014	0.83	0.80	31,249
Spent Carbon Haul Truck	184	2	30	5.7	1.7	0.4	0.005	0.28	0.27	46,611
New Carbon Delivery Truck	184	2	30	5.7	1.7	0.4	0.005	0.28	0.27	46,611
Source Test Related Trips	121	2	30	5.7	1.7	0.4	0.005	0.28	0.27	30,652
Diesel Delivery	178	2	30	5.7	1.7	0.4	0.005	0.28	0.27	45,091
Total				140	43.0	11.1	0.118	6.9	6.6	385,625

Table C-13 (Continued)
2014 Vehicle Operational Emissions

Gas Turbine/LNG

Description	Annual No of Trips[b]	Daily No of Trips[b]	One-way Distance[c], miles	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5[d], lb/day	CO2, lb/year
Spent Catalyst Haul Truck	123	6	178	101	30.9	7.97	0.085	4.93	4.8	185,411
New Catalyst Delivery Truck	123	6	30	17.0	5.2	1.34	0.014	0.83	0.80	31,249
Spent Carbon Haul Truck	184	2	30	5.7	1.7	0.45	0.005	0.28	0.27	46,611
New Carbon Delivery Truck	184	2	30	5.7	1.7	0.45	0.005	0.28	0.27	46,611
Source Test Related Trips	121	2	30	5.7	1.7	0.448	0.005	0.28	0.27	30,652
Diesel Delivery	178	2	30	5.7	1.7	0.448	0.005	0.28	0.27	45,091
LNG Haul Truck	3,885	33	40	125	38.2	9.8	0.105	6.10	5.9	1,312,227
Total				265	81.2	20.9	0.22	13.0	12.5	1,697,851

Table C-13 (Concluded)
2014 Vehicle Operational Emissions

Microturbine/LNG

Description	Annual No of Trips[b]	Daily No of Trips[b]	One-way Distance[c], miles	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5[d], lb/day	CO2, lb/year
Spent Catalyst Haul Truck	123	6	178	101	30.9	8.0	0.085	4.9	4.8	185,411
New Catalyst Delivery Truck	123	6	30	17.0	5.21	1.34	0.014	0.83	0.80	31,249
Spent Carbon Haul Truck	184	2	30	5.7	1.74	0.45	0.005	0.28	0.27	46,611
New Carbon Delivery Truck	184	2	30	5.7	1.74	0.45	0.005	0.28	0.27	46,611
Source Test Related Trips	121	2	30	5.7	1.74	0.45	0.005	0.28	0.27	30,652
Diesel Delivery	178	2	30	5.7	1.74	0.45	0.005	0.28	0.27	45,091
LNG Haul Truck	3,885	33	40	125	38.2	9.8	0.105	6.1	5.9	1,312,227
Total				265	81.2	20.9	0.222	13.0	12.5	1,697,851

There are three possible Class I disposal sites in California: Kettleman City (178 miles from Los Angeles), Buttonwillow (133 miles from Los Angeles), and Westmorland (192 miles from Los Angeles). The intermediate distance, 178 miles per one-way trip, was chosen for this analysis.

Table C-14
Summary of Operational Emissions

SCR - Total Operational Emissions

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	CO2, ton/year
2005 Baseline	9,195	54,243	2,493	551	877	875	1,250,047
2008	~~8,999~~ 9,004	~~53,867~~ 53,900	~~2,458~~ 2,467	~~544~~ 545	~~872~~ 873	~~870~~ 871	1,227,230
2009	~~6,410~~ 6,415	~~22,399~~ 22,432	~~1,790~~ 1,799	~~543~~ 544	~~858~~ 859	~~856~~ 857	1,231,763
2010	~~5,823~~ 5,828	~~17,295~~ 17,328	~~1,281~~ 1,290	~~534~~ 535	~~837~~ 838	~~835~~ 836	1,207,871
2011	~~5,345~~ 5,350	~~13,475~~ 13,508	~~1,207~~ 1,216	~~528~~ 529	~~821~~ 822	~~819~~ 820	1,196,652
2012	4,125	13,423	1,011	538	830	829	1,231,595
2014	4,184	13,441	1,015	538	833	831	1,231,622

Table C-14 (Continued)
Summary of Operational Emissions

Gas Turbines - Total Operational Emissions

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	CO2, ton/year
2005 Baseline	9,195	54,243	2,493	551	877	875	1,250,047
2008	~~8,999~~ 9,004	~~53,867~~ 53,900	~~2,458~~ 2,467	~~544~~ 545	~~872~~ 873	~~870~~ 871	1,227,230
2009	~~6,410~~ 6,415	~~22,399~~ 22,432	~~1,790~~ 1,799	~~543~~ 544	~~858~~ 859	~~856~~ 857	1,231,763
2010	~~5,823~~ 5,828	~~17,295~~ 17,328	~~1,281~~ 1,290	~~534~~ 535	~~837~~ 838	~~835~~ 836	1,207,871
2011	~~5,339~~ 5,344	~~13,473~~ 13,506	~~1,206~~ 1,215	~~528~~ 529	~~821~~ 822	~~819~~ 820	1,196,720
2012	4,825	7,357	533	538	1,016	1,014	1,231,271
2014	4,884	7,375	537	538	1,019	1,017	1,231,271

Microturbines - Total Operational Emissions

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	CO2, ton/year
2005 Baseline	9,195	54,243	2,493	551	877	875	1,250,047
2008	~~8,999~~ 9,004	~~53,867~~ 53,900	~~2,458~~ 2,467	~~544~~ 545	~~872~~ 873	~~870~~ 871	1,227,230
2009	~~6,410~~ 6,415	~~22,399~~ 22,432	~~1,790~~ 1,799	~~543~~ 544	~~858~~ 859	~~856~~ 857	1,231,763
2010	~~5,823~~ 5,828	~~17,295~~ 17,328	~~1,281~~ 1,290	~~534~~ 535	~~837~~ 838	~~835~~ 836	1,207,871
2011	~~5,339~~ 5,344	~~13,473~~ 13,506	~~1,206~~ 1,215	~~528~~ 529	~~821~~ 822	~~819~~ 820	1,196,720
2012	3,860	6,169	638	538	757	756	1,231,385
2014	3,919	6,187	643	538	760	758	1,231,385

Table C-14 (Concluded)
Summary of Operational Emissions

Gas Turbines/LNG - Total Operational Emissions

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	CO2, ton/year
2005 Baseline	9,195	54,243	2,493	551	877	875	1,250,047
2008	~~8,999~~ 9,004	~~53,867~~ 53,900	~~2,458~~ 2,467	~~544~~ 545	~~872~~ 873	~~870~~ 871	1,227,230
2009	~~6,440~~ 6,445	~~23,215~~ 23,248	~~1,814~~ 1,823	~~543~~ 544	~~860~~ 861	~~858~~ 859	1,232,969
2010	~~5,823~~ 5,828	~~17,295~~ 17,328	~~1,281~~ 1,290	~~534~~ 535	~~837~~ 838	~~835~~ 836	1,207,871
2011	~~5,390~~ 5,395	~~13,489~~ 13,522	~~1,210~~ 1,219	~~528~~ 529	~~823~~ 824	~~821~~ 822	1,196,970
2012	4,254	6,503	523	211	872	870	1,093,223
2014	4,373	6,540	533	211	878	876	1,093,551

Microturbines/LNG - Total Operational Emissions

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	CO2, ton/year
2005 Baseline	9,195	54,243	2,493	551	877	875	1,250,047
2008	~~8,999~~ 9,004	~~53,867~~ 53,900	~~2,458~~ 2,467	~~544~~ 545	~~872~~ 873	~~870~~ 871	1,227,230
2009	~~6,410~~ 6,415	~~22,399~~ 22,432	~~1,790~~ 1,799	~~543~~ 544	~~858~~ 859	~~856~~ 857	1,231,763
2010	~~5,823~~ 5,828	~~17,295~~ 17,328	~~1,281~~ 1,290	~~534~~ 535	~~837~~ 838	~~835~~ 836	1,207,871
2011	~~5,390~~ 5,395	~~13,489~~ 13,522	~~1,210~~ 1,219	~~528~~ 529	~~823~~ 824	~~821~~ 822	1,196,970
2012	3,870	6,038	569	211	767	765	1,093,331
2014	3,989	6,075	578	211	773	771	1,093,659

Table C-15
Construction of an LNG Plant – Grading

Construction Activity			
Three Acre Site	Grading	130,000	Square Feet[a]

Site Preparation Schedule -	6	days[a]	
Equipment Type[a,b]	**No. of Equipment**	**hr/day**	**Crew Size**
Scrapers	1	8.0	5
Graders	1	8.0	
Tractors/Loaders/Backhoes	1	7.0	

Construction Equipment Emission Factors						
	CO	**NOx**	**PM10**	**VOC**	**SOx**	**CO2**
Equipment Type[c]	lb/hr	lb/hr	lb/hr			
Scrapers	1.525	3.399	0.147	0.368	0.003	262.5
Graders	0.671	1.720	0.089	0.206	0.001	132.7
Tractors/Loaders/Backhoes	0.414	0.830	0.064	0.131	0.001	66.8

Fugitive Dust Clearing Parameters - Scraping						
Silt Content[d]	**Mean Vehicle Weight[e]**	**Vehicle Miles Traveled[f]**				
	ton					
6.9	88.73	0.43				

Fugitive Dust Stockpiling Parameters						
Silt Content[d]	**Precipitation Days[g]**	**Mean Wind Speed Percent[h]**	**TSP Fraction**	**Area[i] (acres)**		
6.9	10	100	0.5	0.11		

Table C-15 (Continued)
Construction of an LNG Plant – Grading

Fugitive Dust Material Handling

Aerodynamic Particle Size Multiplier[j]	Mean Wind Speed[k]	Moisture Content[f]	Dirt Handled[a]	Dirt Handled[l]
	mph		cy	lb/day
0.35	10	7.9	778	324,167

Construction Vehicle (Mobile Source) Emission Factors

	CO	NOx	PM10	VOC	SOx	CO2
	lb/mile	lb/mile	lb/mile	lb/mile	lb/mile	lb/mile
Heavy-Duty Truck[m]	0.01446237	0.04718166	0.00230900	0.00372949	0.00003962	4.221844935
Passenger Vehicle	0.01155158	0.00121328	0.00008447	0.00118234	0.00001078	1.106722361

Construction Worker Number of Trips and Trip Length

Vehicle	No. of One-Way Trips/Day	One WayTrip Length (miles)
Haul Truck[n]	5	30
Water Truck[o]	3	4.2
Worker Vehicles	5	10

Incremental Increase in Onsite Combustion Emissions from Construction Equipment

Equation: Emission Factor (lb/hr) x No. of Equipment x Work Day (hr/day) = Onsite Construction Emissions (lb/day)

	CO	NOx	PM10	VOC	SOx	CO2
Equipment Type	lb/day	lb/day	lb/day	lb/day	lb/day	lb/day
Scrapers	12.20	27.19	1.17	2.94	0.02	2100.0
Graders	5.37	13.76	0.71	1.64	0.01	1061.9
Tractors/Loaders/Backhoes	2.90	5.81	0.45	0.91	0.01	467.6
Total	**20.5**	**46.8**	**2.3**	**5.5**	**0.04**	**3629.6**

Table C-15 (Continued)
Construction of an LNG Plant – Grading

Incremental Increase in Fugitive Dust Emissions from Construction Operations

Equations:

Scraping[p]: PM10 Emissions (lb/day) = 1.5 x (silt content/12)$^{0.9}$ x (mean vehicle weight)$^{0.45}$ x VMT x (1 - control efficiency)

Storage Piles[q]: PM10 Emissions (lb/day) = 1.7 x (silt content/1.5) x ((365-precipitation days)/235) x wind speed percent/15 x TSP fraction x Area) x (1 - control efficiency)

Material Handling[r]: PM10 Emissions (lb/day) = (0.0032 x aerodynamic particle size multiplier x (wind speed (mph)/5)$^{1.3}$/(moisture content/2)$^{1.4}$ x dirt handled (lb/day)/2,000 (lb/ton) (1 - control efficiency)

Description	Control Efficiency %	PM10[s] lb/day
Scraping	68	0.58
Storage Piles	68	1.39
Material Handling	68	0.02
Total		**1.99**

Incremental Increase in Onsite Combustion Emissions from Onroad Mobile Vehicles

Equation: Emission Factor (lb/mile) x No. of One-Way Trips/Day x 2 x Trip length (mile) = Mobile Emissions (lb/day)

Vehicle	CO lb/day	NOx lb/day	PM10 lb/day	VOC lb/day	SOx lb/day	CO2 lb/day
Haul Truck	4.34	14.2	0.69	1.12	0.01	1,267
Water Truck	0.36	1.19	0.06	0.09	0	106
Worker Vehicles	1.16	0.12	0.01	0.12	0	111
Total	**5.86**	**15.46**	**0.76**	**1.33**	**0.01**	**1,484**

Table C- 15 (Continued)
Construction of an LNG Plant – Grading

Total Incremental Localized Emissions from Construction Activities

Sources	**CO** lb/day	**NOx** lb/day	**PM10** lb/day	**VOC** lb/day	**SOx** lb/day	**CO2** lb/day
Daily Emissions	**26.3**	**62.2**	**5.1**	**6.8**	**0.1**	**5,113**
Annual Emissions	**158.0**	**373.4**	**30.5**	**41.0**	**0.3**	**30,679**

Combustion and Fugitive Summary	**PM2.5 Fraction**[t]	**PM10** lb/day	**PM2.5** lb/day	**Percentage Contribution**
Combustion (Offroad)	0.92	2.3	2.1	65.0%
Combustion (Onroad)	0.96	0.76	0.74	22.3%
Fugitive	0.21	2	0.4	12.7%
Daily Emissions		**5.1**	**3.3**	
Annual Emissions		**30.5**	**19.8**	

Notes:

a) SCAQMD, estimated from survey data, Sept 2004

b) Equipment name must match CARB Off-Road Model (see Off-Road Model EF worksheet) equipment name for sheet to look up EFs automatically.

c) SCAB values provided by the ARB, May 2007. Assumed equipment is diesel fueled.

d) USEPA, AP-42, July 1998, Table 11.9-3 Typical Values for Correction Factors Applicable to the Predictive Emission Factor Equations

e) Mean vehicle weight (120,460 pound empty with a 75,000 pound capacity) estimated from 631G Model Scraper Caterpillar Performance Handbook, Edition 33. Scraper in the same horsepower range (450-490 hp) as the composite ARB emission factors.

f) Caterpillar G31G has a 11.5 foot wide blade, with an assumed 2 foot overlap (9.5 foot wide). Vehicle miles traveled (VMT) = (130,000 sq ft/9.5 foot x mile/5,280 ft)/6 days = 0.43 miles

g) Table A9-9-E2, SCAQMD CEQA Air Quality Handbook, 1993

h) Mean wind speed percent - percent of time mean wind speed exceeds 12 mph. At least one meteorological site recorded wind speeds greater than 12 mph over a 24-hour period in 1981.

i) Assumed storage piles are 0.11 acres in size

j) USEPA, AP-42, Jan 1995, Section 13.2.4 Aggregate Handling and Storage Piles, p 13.2.4-3 Aerodynamic particle size multiplier for < 10 µm

k) Mean wind speed - maximum of daily average wind speeds reported in 1981 meteorological data.

l) Assuming 778 cubic yards of dirt handled [(778 cyd x 2,500 lb/cyd)/ days = 324,167 lb/day]

m) CARB, EMFAC2007 (version 2.3) Burden Model, Winter 2007, 75 F, 40% RH: EF, lb/yr = (EF, ton/yr x 2,000 lb/ton)/VMT

Table C-15 (Concluded)
Construction of an LNG Plant – Grading

n) Assumed 30 cubic yd truck capacity for 778 cyd of dirt [(778 cy x truck/30 cy)/6 days = 5 one-way truck trips/day]. Assumed haul truck travels 0.1 miles through facility. Multiple trucks may be used.
o) Assumed six foot wide water truck traverses over 130,000 square feet of disturbed area
p) USEPA, AP-42, July 1998, Equation 1b and Table 13.2.2-2, AP-42, December 2003. Also see comment g of Table 11.9-1
q) USEPA, AP-42, Jan 1995, Section 13.2.4 Aggregate Handling and Storage Piles, Equation 1
r) USEPA, Fugitive Dust Background Document and Technical Information Document for Best Available Control Measures, Sept 1992, EPA-450/2-92-004, Equation 2-12
s) Includes watering at least three times a day per Rule 403 (68% control efficiency).
t) ARB's CEIDARS database PM2.5 fractions - construction dust category for fugitive and diesel vehicle exhaust category for combustion.

Table C-16
Construction of an LNG Plant – Paving

	Construction Activity
Three Acre Site	Architectural Coating and Asphalt Paving of Parking Lot

Construction Schedule - **10** **days**[a]

Equipment Type[a,b]	No. of Equipment	hr/day	Crew Size
Pavers	1	8.00	8
Paving Equipment	1	8.00	
Rollers	2	8.00	
Cement and Mortar Mixers	1	3.00	
Tractors/Loaders/Backhoes	1	8.00	

Construction Equipment Combustion Emission Factors

	CO	NOx	PM10	VOC	SOx	CO2
Equipment Type[c]	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr
Pavers	0.600	1.129	0.080	0.206	0.001	77.9
Paving Equipment	0.469	1.033	0.071	0.156	0.001	69.0
Rollers	0.442	0.907	0.063	0.141	0.001	67.1
Cement and Mortar Mixers	0.046	0.069	0.005	0.012	0.000	7.2
Tractors/Loaders/Backhoes	0.414	0.830	0.064	0.131	0.001	66.8

Construction Vehicle (Mobile Source) Emission Factors

	CO	NOx	PM10	VOC	SOx	CO2
	lb/mile	lb/mile	lb/mile	lb/mile	lb/mile	lb/mile
Heavy-Duty Truck[d]	0.01446237	0.04718166	0.00230900	0.00372949	0.00003962	4.221844935

Table C-16 (Continued)
Construction of an LNG Plant – Paving

Construction Worker Number of Trips and Trip Length

Vehicle	**No. of One-Way Trips/Day**	**Trip Length (miles)**
Delivery Truck[e]	9	20
Water Truck[f]	3	4.5

Incremental Increase in Onsite Combustion Emissions from Construction Equipment

Equation: Emission Factor (lb/hr) x No. of Equipment x Work Day (hr/day) = Onsite Construction Emissions (lb/day)

Equipment Type	**CO** lb/day	**NOx** lb/day	**PM10** lb/day	**VOC** lb/day	**SOx** lb/day	**CO2** lb/day
Pavers	4.80	9.03	0.64	1.65	0.01	623.49
Paving Equipment	3.75	8.27	0.57	1.24	0.01	551.62
Rollers	7.07	14.52	1.01	2.26	0.01	1,072.88
Cement and Mortar Mixers	0.14	0.21	0.01	0.04	0.00	21.74
Tractors/Loaders/Backhoes	3.31	6.64	0.51	1.05	0.01	534.46
Total	**19.1**	**38.7**	**2.7**	**6.2**	**0.0**	**2,804.19**

Incremental Increase in Onsite Combustion Emissions from Onroad Mobile Vehicles

Equation: Emission Factor (lb/mile) x No. of One-Way Trips/Day x 2 x Trip length (mile) = Mobile Emissions (lb/day)

Vehicle	**CO** lb/day	**NOx** lb/day	**PM10** lb/day	**VOC** lb/day	**SOx** lb/day	**CO2** lb/day
Delivery Truck	5.21	16.99	0.831	1.343	0.014	1519.864
Water Truck	0.39	1.27	0.06	0.1	0	113.99
Total	**5.60**	**18.26**	**0.89**	**1.44**	**0.01**	**1633.85**

Table C-16 (Concluded)
Construction of an LNG Plant – Paving

Total Incremental Combustion Emissions from Construction Activities	CO	NOx	PM10	VOC	SOx	CO2
Sources	lb/day	lb/day	lb/day	lb/day	lb/day	lb/day
Daily Emissions	**24.7**	**56.9**	**3.6**	**7.7**	**0.1**	**4,438**
Annual Emissions	**246.7**	**569.3**	**36.3**	**76.8**	**0.540**	**44,380**

Combustion and Fugitive Summary	PM2.5 Fraction[g]	PM10	PM2.5
		lb/day	lb/day
Combustion (Offroad)	0.92	2.7	2.5
Combustion (Onroad)	0.96	0.89	0.86
Fugitive	0.21	0	0.0
Daily Emissions		**3.6**	**3.4**
Annual Emissions		**36.3**	**33.8**

Notes:

a) SCAQMD, estimated from survey data, Sept 2004

b) Equipment name must match CARB Off-Road Model (see Off-Road Model EF worksheet) equipment name for sheet to look up EFs automatically.

c) SCAB values provided by the ARB, May 2007. Assumed equipment is diesel fueled.

d) CARB, EMFAC2007 (version 2.3) Burden Model, Winter 2007, 75 F, 40% RH: EF, lb/yr = (EF, ton/yr x 2,000 lb/ton)/VMT

e) Assumed haul truck travels 0.1 miles through facility

f) Assumed six foot wide water truck traverses over 140,000 square feet of disturbed area

t) ARB's CEIDARS database PM2.5 fractions - construction dust category for fugitive and diesel vehicle exhaust category for combustion.

Table C-17
Construction of an LNG Plant – Structure Construction

Construction Activity
Internal Combustion Engine and Equipment Installation

Construction Schedule	95	**days**[a]	
Equipment Type[a,b]	**No. of Equipment**	**hr/day**	**Crew Size**
Cranes	2	7.0	15
Rubber Tired Loaders	2	7.0	
Forklifts	2	7.0	
Welder	3	7.0	
Generator Sets	3	7.0	

Construction Equipment Combustion Emission Factors

	CO	**NOx**	**PM10**	**VOC**	**SOx**	**CO2**
Equipment Type[c]	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr
Cranes	0.637	1.695	0.075	0.188	0.001	128.7
Rubber Tired Loaders	0.555	1.382	0.077	0.173	0.001	108.6
Forklifts	0.250	0.643	0.035	0.086	0.001	54.4

Construction Vehicle (Mobile Source) Emission Factors

	CO	**NOx**	**PM10**	**VOC**	**SOx**	**CO2**
	lb/mile	lb/mile	lb/mile	lb/mile	lb/mile	lb/mile
Heavy-Duty Truck[d]	0.01446237	0.04718166	0.00230900	0.00372949	0.00003962	4.222
Passenger Vehicle	0.01155158	0.00121328	0.00008447	0.00118234	0.00001078	1.107

Table C-17 (Continued)
Construction of an LNG Plant – Structure Construction (Continued)

Number of Trips and Trip Length

Vehicle	**No. of One-Way Trips/Day**	**One Way Trip Length (miles)**
Haul Trucks[e]	4	20
Worker Vehicles	15	10

Incremental Increase in Onsite Idling Emissions from Onroad Mobile Vehicles

Equation: Emission Factor (lb/hr) x No. of Equipment x Work Day (hr/day) = Onsite Construction Emissions (lb/day)

	CO	**NOx**	**PM10**	**VOC**	**SOx**	**CO2**
Equipment Type	lb/day	lb/day	lb/day	lb/day	lb/day	lb/day
Cranes	8.91	23.73	1.06	2.63	0.019	1801.428
Rubber Tired Loaders	7.77	19.35	1.08	2.42	0.017	1520.591
Forklifts	3.49	9.00	0.48	1.21	0.008	761.541
Welder	0.00	0.00	0.00	0.00	0.000	0.000
Generator Sets	0.00	0.00	0.00	0.00	0.000	0.000
Total	**20.18**	**52.08**	**2.62**	**6.26**	**0.045**	**4,084**

Incremental Increase in Onsite Combustion Emissions from Onroad Mobile Vehicles

Equation: Emission Factor (lb/mile) x No. of One-Way Trips/Day x 2 x Trip length (mile) = Mobile Emissions (lb/day)

	CO	**NOx**	**PM10**	**VOC**	**SOx**	**CO2**
Vehicle	lb/day	lb/day	lb/day	lb/day	lb/day	lb/day
Flatbed Trucks	2.314	7.549	0.3694	0.5967	0.0063	675.4952
Worker Vehicles	3.465	0.364	0.0253	0.3547	0.0032	332.0167
Total	**5.78**	**7.91**	**0.39**	**0.95**	**0.01**	**1,008**

Table C-17 (Concluded)
Construction of an LNG Plant – Structure Construction (Continued)

Total Incremental Combustion Emissions from Construction Activities

Sources	CO lb/day	NOx lb/day	PM10 lb/day	VOC lb/day	SOx lb/day	CO2 lb/day
Daily Emissions	**26.0**	**60.0**	**3.01**	**7.21**	**0.05**	**5,091**
Annual Emissions	**2,466**	**5,699**	**286**	**685**	**5.1**	**483,652**

Combustion and Fugitive Summary	PM2.5 Fraction[f]	PM10 lb/day	PM2.5 lb/day
Combustion, Offroad	0.92	2.6	2.4
Combustion, Onroad	0.964	0.4	0.38
Daily Emissions		**3.0**	**2.8**
Annual Emissions		**286.0**	**264.8**

Notes:

a) SCAQMD, staff estimation

b) Equipment name must match CARB Off-Road Model (see Off-Road Model EF worksheet) equipment name for sheet to look up EFs automatically.

c) SCAB values provided by the ARB, June 2007. Assumed equipment is diesel fueled.

d) CARB, EMFAC2002 as summarized on SCAQMD website at http://www.aqmd.gov/ceqa/handbook/onroad/onroadHHDT05_25.xls

e) Assumed haul truck travels 20 miles one-way

f) ARB's CEIDARS database PM2.5 fractions - construction dust category for offroad and onroad diesel vehicle exhaust category for combustion.

Table C-18
Construction of Control Equipment or Replacement of an ICE – Paving

		Construction Activity
		Concrete Paving
Construction Schedule -	**1**	**days**[a]

Equipment Type[a,b]	**No. of Equipment**	**hr/day**	**Crew Size**
Pavers	1	4.00	8
Paving Equipment	1	4.00	
Rollers	1	2.00	
Cement and Mortar Mixers	1	3.00	
Tractors/Loaders/Backhoes	1	4.00	

Construction Equipment Combustion Emission Factors

	CO	**NOx**	**PM10**	**VOC**	**SOx**	**CO2**
Equipment Type[c]	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr
Pavers	0.600	1.129	0.080	0.206	0.001	77.9
Paving Equipment	0.469	1.033	0.071	0.156	0.001	69.0
Rollers	0.442	0.907	0.063	0.141	0.001	67.1
Cement and Mortar Mixers	0.046	0.069	0.005	0.012	0.000	7.2
Tractors/Loaders/Backhoes	0.414	0.830	0.064	0.131	0.001	66.8

Construction Vehicle (Mobile Source) Emission Factors

	CO	**NOx**	**PM10**	**VOC**	**SOx**	**CO2**
	lb/mile	lb/mile	lb/mile	lb/mile	lb/mile	lb/mile
Heavy-Duty Truck[d]	0.01446237	0.04718166	0.00230900	0.00372949	0.00003962	4.221844935

Table C-18 (Continued)
Construction of Control Equipment or Replacement of an ICE – Paving

Construction Worker Number of Trips and Trip Length

Vehicle	No. of One-Way Trips/Day	Trip Length (miles)
Delivery Truck[e]	2	20
Water Truck[f]	3	4.5

Incremental Increase in Onsite Combustion Emissions from Construction Equipment

Equation: Emission Factor (lb/hr) x No. of Equipment x Work Day (hr/day) = Onsite Construction Emissions (lb/day)

Equipment Type	CO lb/day	NOx lb/day	PM10 lb/day	VOC lb/day	SOx lb/day	CO2 lb/day
Pavers	2.40	4.52	0.32	0.82	0.0036	311.74
Paving Equipment	1.88	4.13	0.28	0.62	0.0032	275.81
Rollers	0.88	1.81	0.13	0.28	0.0015	134.11
Cement and Mortar Mixers	0.14	0.21	0.01	0.04	0.0003	21.74
Tractors/Loaders/Backhoes	1.66	3.32	0.26	0.52	0.0031	267.23
Total	**7.0**	**14.0**	**1.0**	**2.3**	**0.012**	**1,010.63**

Incremental Increase in Onsite Combustion Emissions from Onroad Mobile Vehicles

Equation: Emission Factor (lb/mile) x No. of One-Way Trips/Day x 2 x Trip length (mile) = Mobile Emissions (lb/day)

Vehicle	CO lb/day	NOx lb/day	PM10 lb/day	VOC lb/day	SOx lb/day	CO2 lb/day
Delivery Truck	1.16	3.78	0.185	0.298	0.00317	337.7
Water Truck	0.39	1.27	0.062	0.10	0.001	114.0
Total	**1.55**	**5.05**	**0.25**	**0.40**	**0.0042**	**451.7**

Table C-18 (Concluded)
Construction of Control Equipment or Replacement of an ICE – Paving

Total Incremental Combustion Emissions from Construction Activities

Sources	CO lb/day	NOx lb/day	PM10 lb/day	VOC lb/day	SOx lb/day	CO2 lb/day
Daily Emissions	**8.5**	**19.0**	**1.2**	**2.7**	**0.0160**	**1,462**
Annual Emissions	**8.5**	**19.0**	**1.2**	**2.7**	**0.0160**	**1,462**

Combustion and Fugitive Summary	PM2.5 Fraction[g]	PM10 lb/day	PM2.5 lb/day
Combustion (Offroad)	0.92	1.0	0.9
Combustion (Onroad)	0.96	0.25	0.24
Fugitive	0.21	0	0.0
Daily Emissions		**1.2**	**1.2**
Annual Emissions		**1.2**	**1.2**

Notes:

a) SCAQMD, estimated from survey data, Sept 2004

b) Equipment name must match CARB Off-Road Model (see Off-Road Model EF worksheet) equipment name for sheet to look up EFs automatically.

c) SCAB values provided by the ARB, May 2007. Assumed equipment is diesel fueled.

d) CARB, EMFAC2007 (version 2.3) Burden Model, Winter 2007, 75 F, 40% RH: EF, lb/yr = (EF, ton/yr x 2,000 lb/ton)/VMT

e) Assumed haul truck travels 0.1 miles through facility

f) Assumed six foot wide water truck traverses over 140,000 square feet of disturbed area

g) ARB's CEIDARS database PM2.5 fractions - construction dust category for fugitive and diesel vehicle exhaust category for combustion.

Table C-19
Construction of Control Equipment or Replacement of an ICE – Equipment

Construction Activity
Internal Combustion Engine and Equipment Installation

Construction Schedule	2 days		
Equipment Type[a,b]	**No. of Equipment**	**hr/day**	**Crew Size**
Cranes	1	7.0	11
Rubber Tired Loaders	2	7.0	
Forklifts	3	7.0	
Welder	1	7.0	
Generator Sets	1	7.0	

Construction Equipment Combustion Emission Factors

	CO	**NOx**	**PM10**	**VOC**	**SOx**	**CO2**
Equipment Type[c]	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr
Cranes	0.637	1.695	0.075	0.188	0.001	128.7
Rubber Tired Loaders	0.555	1.382	0.077	0.173	0.001	108.6
Forklifts	0.250	0.643	0.035	0.086	0.001	54.4

Construction Vehicle (Mobile Source) Emission Factors

	CO	**NOx**	**PM10**	**VOC**	**SOx**	**CO2**
	lb/mile	lb/mile	lb/mile	lb/mile	lb/mile	lb/mile
Heavy-Duty Truck[d]	0.01446237	0.04718166	0.00230900	0.00372949	0.00003962	4.221844935
Passenger Vehicle	0.01155158	0.00121328	0.00008447	0.00118234	0.00001078	1.106722361

Table C-19 (Continued)
Construction of Control Equipment or Replacement of an ICE – Equipment

Number of Trips and Trip Length

Vehicle	No. of One-Way Trips/Day	One Way Trip Length (miles)
Haul Trucks[e]	4	20
Worker Vehicles	11	10

Incremental Increase in Onsite Idling Emissions from Onroad Mobile Vehicles

Equation: Emission Factor (lb/hr) x No. of Equipment x Work Day (hr/day) = Onsite Construction Emissions (lb/day)

Equipment Type	CO lb/day	NOx lb/day	PM10 lb/day	VOC lb/day	SOx lb/day	CO2 lb/day
Cranes	4.46	11.86	0.53	1.32	0.010	901
Rubber Tired Loaders	7.77	19.35	1.08	2.42	0.017	1,521
Forklifts	5.24	13.50	0.73	1.81	0.013	1,142
Welder	0.00	0.00	0.00	0.00	0.000	0
Generator Sets	0.00	0.00	0.00	0.00	0.000	0
Total	**17.47**	**44.72**	**2.33**	**5.55**	**0.039**	**3,564**

Incremental Increase in Onsite Combustion Emissions from Onroad Mobile Vehicles

Equation: Emission Factor (lb/mile) x No. of One-Way Trips/Day x 2 x Trip length (mile) = Mobile Emissions (lb/day)

Vehicle	CO lb/day	NOx lb/day	PM10 lb/day	VOC lb/day	SOx lb/day	CO2 lb/day
Flatbed Trucks	2.314	7.549	0.3694	0.5967	0.0063	675
Worker Vehicles	2.541	0.267	0.0186	0.2601	0.0024	243
Total	**4.86**	**7.82**	**0.39**	**0.86**	**0.01**	**919**

Table C-19 (Concluded)
Construction of Control Equipment or Replacement of an ICE – Equipment

Total Incremental Combustion Emissions from Construction Activities

Sources	CO lb/day	NOx lb/day	PM10 lb/day	VOC lb/day	SOx lb/day	CO2 lb/day
Daily Emissions	**22.3**	**52.5**	**2.7**	**6.4**	**0.048**	**4,483**
Annual Emissions	**44.6**	**105**	**5.4**	**13**	**0.096**	**8,965**

Combustion and Fugitive Summary	**PM2.5 Fraction**[f]	**PM10** lb/day	**PM2.5** lb/day
Combustion, Offroad	0.92	2.3	2.1
Combustion, Onroad	0.964	0.4	0.37
Total, lb/project		**2.7**	**2.5**
		5.4	**5.0**

Notes:

a) SCAQMD, staff estimation

b) Equipment name must match CARB Off-Road Model (see Off-Road Model EF worksheet) equipment name for sheet to look up EFs automatically.

c) SCAB values provided by the ARB, May 2007. Assumed equipment is diesel fueled.

d) CARB, EMFAC2002 as summarized on SCAQMD website at http://www.aqmd.gov/ceqa/handbook/onroad/onroadHHDT05_25.xls

e) Assumed haul truck travels 20 miles one-way

f) ARB's CEIDARS database PM2.5 fractions - construction dust category for offroad and onroad diesel vehicle exhaust category for combustion.

Table C-20
Construction of Infrastructure or CEMS

Construction Activity
Internal Combustion Engine and Equipment Installation

Construction Schedule 2 days

Equipment Type[a,b]	**No. of Equipment**	**hr/day**	**Crew Size**
Cranes	1	4.0	8
Rubber Tired Loaders	1	4.0	
Forklifts	1	4.0	
Welder	1	7.0	
Generator Sets	1	7.0	

Construction Equipment Combustion Emission Factors

	CO	**NOx**	**PM10**	**VOC**	**SOx**	**CO2**
Equipment Type[c]	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr
Cranes	0.637	1.695	0.075	0.188	0.001	128.7
Rubber Tired Loaders	0.555	1.382	0.077	0.173	0.001	108.6
Forklifts	0.250	0.643	0.035	0.086	0.001	54.4
Welders	0.234	0.319	0.030	0.092	0.000	25.6
Generator Sets	0.355	0.725	0.045	0.113	0.001	61.0

Construction Vehicle (Mobile Source) Emission Factors

	CO	**NOx**	**PM10**	**VOC**	**SOx**	**CO2**
	lb/mile	lb/mile	lb/mile			lb/mile
Heavy-Duty Truck[d]	0.01446237	0.04718166	0.00230900	0.00372949	0.00003962	4.221844935
Passenger Vehicle	0.01155158	0.00121328	0.00008447	0.00118234	0.00001078	1.106722361

Table C-20 (Continued)
Construction of Infrastructure or CEMS

Number of Trips and Trip Length

Vehicle	No. of One-Way Trips/Day	One Way Trip Length (miles)
Haul Trucks[e]	4	20
Worker Vehicles	8	10

Incremental Increase in Onsite Idling Emissions from Onroad Mobile Vehicles

Equation: Emission Factor (lb/hr) x No. of Equipment x Work Day (hr/day) = Onsite Construction Emissions (lb/day)

	CO	**NOx**	**PM10**	**VOC**	**SOx**	**CO2**
Equipment Type	lb/day	lb/day	lb/day	lb/day	lb/day	lb/day
Cranes	2.55	6.78	0.30	0.75	0.0	515
Rubber Tired Loaders	2.22	5.53	0.31	0.69	0.0	434
Forklifts	1.00	2.57	0.14	0.34	0.0	218
Welder	1.64	2.23	0.21	0.64	0.0	179
Generator Sets	2.48	5.07	0.31	0.79	0.0	427
Total	**9.88**	**22.19**	**1.27**	**3.22**	**0.0**	**1,773**

Incremental Increase in Onsite Combustion Emissions from Onroad Mobile Vehicles

Equation: Emission Factor (lb/mile) x No. of One-Way Trips/Day x 2 x Trip length (mile) = Mobile Emissions (lb/day)

	CO	**NOx**	**PM10**	**VOC**	**SOx**	**CO**
Vehicle	lb/day	lb/day	lb/day	lb/day	lb/day	lb/day
Flatbed Trucks	2.314	7.549	0.3694	0.5967	0.0063	675
Worker Vehicles	1.848	0.194	0.0135	0.1892	0.0017	177
Total	**4.16**	**7.74**	**0.38**	**0.79**	**0.01**	**853**

Table C-20 (Concluded)
Construction of Infrastructure or CEMS

Total Incremental Combustion Emissions from Construction Activities

Sources	CO lb/day	NOx lb/day	PM10 lb/day	VOC lb/day	SOx lb/day	CO2 lb/day
Daily Emissions	14.0	29.9	1.7	4.0	0.028	2,625
Annual Emissions	28.1	59.9	3.3	8.0	0.056	5,251

Combustion and Fugitive Summary	PM2.5 Fraction[f]	PM10 lb/day	PM2.5 lb/day
Combustion, Offroad	0.92	1.3	1.2
Combustion, Onroad	0.964	0.4	0.37
Daily Emissions		**1.7**	**1.5**
Annual Emissions		**3.3**	**3.1**

Notes:

a) SCAQMD, staff estimation

b) Equipment name must match CARB Off-Road Model (see Off-Road Model EF worksheet) equipment name for sheet to look up EFs automatically.

c) SCAB values provided by the ARB, May 2007. Assumed equipment is diesel fueled.

d) CARB, EMFAC2002 as summarized on SCAQMD website at http://www.aqmd.gov/ceqa/handbook/onroad/onroadHHDT05_25.xls

e) Assumed haul truck travels 20 miles one-way

f) ARB's CEIDARS database PM2.5 fractions - contruction dust category for offroad and onroad diesel vehicle exhaust category for combustion.

Table C-21
Construction Miscellaneous

Construction Activity
Internal Combustion Engine and Equipment Installation

Construction Schedule	1 day		
Equipment Type[a,b]	**No. of Equipment**	**hr/day**	**Crew Size**
Forklifts	1	4.0	4

Construction Equipment Combustion Emission Factors

	CO	**NOx**	**PM10**	**VOC**	**SOx**	**CO2**
Equipment Type[c]	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr
Forklifts	0.250	0.643	0.035	0.086	0.001	54.4

Construction Vehicle (Mobile Source) Emission Factors

	CO	**NOx**	**PM10**	**VOC**	**SOx**	**CO2**
	lb/mile	lb/mile	lb/mile	lb/mile	lb/mile	lb/mile
Heavy-Duty Truck[d]	0.01446237	0.04718166	0.00230900	0.00372949	0.00003962	4.221844935
Passenger Vehicle	0.01155158	0.00121328	0.00008447	0.00118234	0.00001078	1.106722361

On-Site Number of Trips and Trip Length

Vehicle	**No. of One-Way Trips/Day**	**One Way Trip Length (miles)**
Haul Trucks[e]	2	20
Worker Vehicles	4	10

Table C-21 (Continued)
Construction Miscellaneous

Incremental Increase in Onsite Idling Emissions from Onroad Mobile Vehicles

Equation: Emission Factor (lb/hr) x No. of Equipment x Work Day (hr/day) = Onsite Construction Emissions (lb/day)

	CO	NOx	PM10	VOC	SOx	CO2
Equipment Type	lb/day	lb/day	lb/day	lb/day	lb/day	lb/day
Forklifts	1.00	2.57	0.14	0.34	0.002	218
Total	**1.00**	**2.57**	**0.14**	**0.34**	**0.002**	**218**

Incremental Increase in Onsite Combustion Emissions from Onroad Mobile Vehicles

Equation: Emission Factor (lb/mile) x No. of One-Way Trips/Day x 2 x Trip length (mile) = Mobile Emissions (lb/day)

	CO	NOx	PM10	VOC	SOx	CO2
Vehicle	lb/day	lb/day	lb/day	lb/day	lb/day	lb/day
Flatbed Trucks	1.157	3.775	0.1847	0.2984	0.0032	338
Worker Vehicles	0.924	0.097	0.0068	0.0946	0.0009	89
Total	**2.08**	**3.87**	**0.19**	**0.39**	**0.00**	**426**

Total Incremental Combustion Emissions from Construction Activities

	CO	NOx	PM10	VOC	SOx	CO2
Sources	lb/day	lb/day	lb/day	lb/day	lb/day	lb/day
Daily Emissions	**3.1**	**6.4**	**0.3**	**0.7**	**0.007**	**644**
Annual Emissions	**3.1**	**6.4**	**0.33**	**0.74**	**0.007**	**644**

Combustion and Fugitive Summary	**PM2.5 Fraction**[f]	**PM10**	**PM2.5**
		lb/day	lb/day
Combustion, Offroad	0.92	0.1	0.1
Combustion, Onroad	0.964	0.2	0.18
Daily Emissions		**0.33**	**0.31**
Annual Emissions		**0.33**	**0.31**

Table C-21 (Concluded)
Construction Miscellaneous

Notes:

a) SCAQMD, staff estimation

b) Equipment name must match CARB Off-Road Model (see Off-Road Model EF worksheet) equipment name for sheet to look up EFs automatically.

c) SCAB values provided by the ARB, May 2007. Assumed equipment is diesel fueled.

d) CARB, EMFAC2002 as summarized on SCAQMD website at http://www.aqmd.gov/ceqa/handbook/onroad/onroadHHDT05_25.xls

e) Assumed haul truck travels 20 miles one-way

f) ARB's CEIDARS database PM2.5 fractions - construction dust category for offroad and onroad diesel vehicle exhaust category for combustion.

Table C-22
Offroad Emission Factors 2007

Equipment	CO lb/hr	NOx lb/hr	PM lb/hr	ROG lb/hr	SOX lb/hr	CO2 lb/hr	Fuel Use, gal/hr
Aerial Lifts	0.2253	0.4026	0.0279	0.0781	0.0004	34.7	
Air Compressors	0.3872	0.8302	0.0579	0.1285	0.0007	63.6	
Bore/Drill Rigs	0.5388	1.4734	0.0648	0.1457	0.0017	165.0	
Cement and Mortar Mixers	0.0455	0.0693	0.0050	0.0120	0.0001	7.2	0.33
Concrete/Industrial Saws	0.4487	0.7639	0.0640	0.1561	0.0007	58.5	
Cranes	0.6365	1.6948	0.0755	0.1882	0.0014	128.7	9.82
Crawler Tractors	0.7090	1.6218	0.0988	0.2180	0.0013	114.0	
Crushing/Proc. Equipment	0.7817	1.6553	0.1048	0.2499	0.0015	132.3	
Dumpers/Tenders	0.0383	0.0709	0.0049	0.0137	0.0001	7.6	
Excavators	0.5977	1.4225	0.0776	0.1816	0.0013	119.6	
Forklifts	0.2495	0.6430	0.0346	0.0861	0.0006	54.4	2.48
Generator Sets	0.3549	0.7249	0.0446	0.1130	0.0007	61.0	2.79
Graders	0.6712	1.7198	0.0886	0.2055	0.0015	132.7	6.06
Off-Highway Tractors	0.9270	2.2742	0.1107	0.2692	0.0017	151.5	
Off-Highway Trucks	0.9133	2.9144	0.1056	0.2881	0.0027	260.1	
Other Construction Equipment	0.4749	1.2411	0.0539	0.1311	0.0013	122.8	
Other General Industrial Equipmen	0.6987	1.9012	0.0850	0.2111	0.0016	152.2	
Other Material Handling Equipment	0.6298	1.8362	0.0819	0.2038	0.0015	141.2	
Pavers	0.6000	1.1291	0.0799	0.2062	0.0009	77.9	3.59
Paving Equipment	0.4693	1.0333	0.0708	0.1556	0.0008	69.0	3.16
Plate Compactors	0.0263	0.0351	0.0025	0.0054	0.0001	4.3	
Pressure Washers	0.0705	0.1079	0.0081	0.0235	0.0001	9.4	
Pumps	0.3243	0.6224	0.0439	0.1090	0.0006	49.6	
Rollers	0.4419	0.9073	0.0629	0.1410	0.0008	67.1	3.07
Rough Terrain Forklifts	0.4928	0.9631	0.0800	0.1576	0.0008	70.3	
Rubber Tired Dozers	1.6950	3.4143	0.1474	0.3789	0.0025	239.1	
Rubber Tired Loaders	0.5552	1.3821	0.0768	0.1730	0.0012	108.6	5.06
Scrapers	1.5249	3.3991	0.1465	0.3677	0.0027	262.5	10.74
Signal Boards	0.0972	0.1806	0.0115	0.0254	0.0002	16.7	
Skid Steer Loaders	0.2735	0.3375	0.0326	0.0981	0.0004	30.3	
Surfacing Equipment	0.7654	1.8498	0.0712	0.1864	0.0017	166.0	
Sweepers/Scrubbers	0.5672	1.0277	0.0819	0.1963	0.0009	78.5	
Tractors/Loaders/Backhoes	0.4142	0.8303	0.0639	0.1307	0.0008	66.8	3.41
Trenchers	0.5171	0.8578	0.0714	0.1942	0.0007	58.7	
Welders	0.2336	0.3191	0.0297	0.0917	0.0003	25.6	

SCAB values provided by the ARB, May 2007. Assumed equipment is diesel fueled.

Table C-23
2008 Construction Emissions

SCR

Description	**Annual No of Facilities**	**Daily No of Facilities**	**CO, lb/day**	**NOx, lb/day**	**PM10, lb/day**	**VOC, lb/day**	**SOx, lb/day**	**PM2.5, lb/day**	**CO2, lb/year**
Infrastructure	240	3	42.1	89.8	5.0	12.0	0.083	4.6	1,260,225
Total	240	3	**42.1**	**89.8**	**5.0**	**12.0**	0.083	**4.6**	**1,260,225**

Table C-24
2009 Construction Emissions

Description	**Annual No of Facilities**	**Daily No of Facilities**	**CO, lb/day**	**NOx, lb/day**	**PM10, lb/day**	**VOC, lb/day**	**SOx, lb/day**	**PM2.5, lb/day**	**CO2, lb/year**
CEMS	4	1	14.0	29.9	1.7	4.0	0.028	1.5	21,004
AFRC and CO analyzer	16	1	3.1	6.4	0.3	0.7	0.007	0.31	10,302
Electric Motor	4	1	22.3	52.5	2.7	6.4	0.048	2.5	41710
Total	24	3	**39.5**	**88.9**	**4.7**	**11.1**	**0.082**	**4.4**	**73,016**

Table C-25
2010 Construction Emissions

Description	**Annual No of Facilities**	**Daily No of Facilities**	**CO, lb/day**	**NOx, lb/day**	**PM10, lb/day**	**VOC, lb/day**	**SOx, lb/day**	**PM2.5, lb/day**	**CO2, lb/year**
Ox Cat or Update	20	1	22.3	52.5	2.7	6.4	0.048	2.5	208,551
CEMS	10	1	14.0	29.9	1.7	4.0	0.028	1.5	52,509
AFRC and CO analyzer	15	1	3.1	6.4	0.3	0.7	0.007	0.3	9,658
Electric Motor	13	1	22.3	52.5	2.7	6.4	0.048	2.5	135,558
Total	58	4	**61.8**	**141**	**7.4**	**17.6**	**0.130**	**6.9**	**406,277**

Table C-26
2011 Construction Emissions

SCR

Description	Annual No of Facilities	Daily No of Facilities	CO, lb/day	NOx, lb/day	PM10, lb/day	VOC, lb/day	SOx, lb/day	PM2.5, lb/day	CO2, lb/year
SCR	14	1	22.3	52.5	2.7	6.4	0.048	2.5	145,986
Ox Cat or Update	32	1	22.3	52.5	2.7	6.4	0.048	2.5	333,682
CEMS	10	1	14.0	29.9	1.7	4.0	0.028	1.5	52,509
CO Analyzer	5	1	3.1	6.4	0.33	0.74	0.007	0.31	3,219
Electric Motor	88	2	44.6	105	5.4	13	0.096	5.0	917,624
Total	149	6	**106**	**247**	**12.9**	**30.4**	**0.23**	**11.9**	**1,453,020**

Gas Turbine or Microturbine

Description	Annual No of Facilities	Daily No of Facilities	CO, lb/day	NOx, lb/day	PM10, lb/day	VOC, lb/day	SOx, lb/day	PM2.5, lb/day	CO2, lb/year
Gas Turbine or Microturbine	14	1	22.3	52.5	2.7	6.4	0.05	2.5	145,986
Ox Cat or Update	32	1	22.3	52.5	2.7	6.4	0.05	2.5	333,682
CEMS	10	1	14.0	29.9	1.7	4.0	0.03	1.5	52,509
CO Analyzer	5	1	3.1	6.4	0.33	0.74	0.01	0.31	3,219
Electric Motor	88	2	45	105	5.4	12.8	0.10	5.0	917,624
Total	149	6	**106.4**	**246.5**	**12.9**	**30.4**	**0.23**	**11.9**	**1,453,020**

Gas Turbine or Microturbine and LNG Plant

Description	Annual No of Facilities	Daily No of Facilities	CO, lb/day	NOx, lb/day	PM10, lb/day	VOC, lb/day	SOx, lb/day	PM2.5, lb/day	CO2, lb/year
LNG Plant	6	7	184	436	35.6	54	0.38	24	3,352,270
Gas Turbine or Microturbine	8	1	22.3	52.5	2.7	6.4	0.048	2.5	83,420
Ox Cat or Update	32	1	22.3	52.5	2.7	6.4	0.048	2.5	333,682
CEMS	10	1	14.0	29.9	1.7	4.0	0.028	1.5	52,509
CO Analyzer	5	1	3.1	6.4	0.33	0.74	0.007	0.31	3,219
Electric Motor	88	2	44.6	105	5.4	12.8	0.10	5.0	917,624
Total	149	13	**291**	**682**	**48.4**	**84.1**	**0.60**	**35.6**	**4,742,725**

Table C-27
2012 Construction Emissions

SCR

Description	Annual No of Facilities	Daily No of Facilities	CO, lb/day	NOx, lb/day	PM10, lb/day	VOC, lb/day	SOx, lb/day	PM2.5, lb/day	CO2, lb/year
SCR	14	1	22.3	52.5	2.7	6.4	0.048	2.5	145,986
Total	14	1	**22.3**	**52.5**	**2.7**	**6.4**	**0.048**	**2.5**	**145,986**

Gas Turbine or Microturbine

Description	Annual No of Facilities	Daily No of Facilities	CO, lb/day	NOx, lb/day	PM10, lb/day	VOC, lb/day	SOx, lb/day	PM2.5, lb/day	CO2, lb/year
Gas Turbine or Microturbine	14	1	22.3	52.5	2.7	6.4	0.048	2.5	145,986
Total	14	1	**22.3**	**52.5**	**2.7**	**6.4**	**0.048**	**2.5**	**145,986**

Gas Turbine or Microturbine and LNG Plant

Description	Annual No of Facilities	Daily No of Facilities	CO, lb/day	NOx, lb/day	PM10, lb/day	VOC, lb/day	SOx, lb/day	PM2.5, lb/day	CO2, lb/year
LNG Plant	6	7	184	436	35.6	53.8	0.38	23.7	3,352,270
Gas Turbine or Microturbine	8	1	22.3	52.5	2.7	6.4	0.048	2.5	83,420
Total	14	8	**207**	**488**	**38.3**	**60.2**	**0.43**	**26.2**	**3,435,691**

Table C-28
2008 Construction Vehicle Travel

Description	Annual No of Facilities	Daily No of Facilities	Daily HHD Distance, mile/day	Daily Worker, mile/day	Total HHD Distance, mile/ project	Total Worker, mile/ project	Daily HHD Distance, mile/day	Daily Worker, mile/day	Total HHD Distance, mile/ project	Total Worker, mile/ project
Infrastructure	240	3	160	160	320	320	480	480	76,800	76,800
Total	240	3	160	160	320	320	480	480	76,800	76,800

Table C-29
2009 Construction Vehicle Travel

Description	Annual No of Facilities	Daily No of Facilities	Daily HHD Distance, mile/day	Daily Worker, mile/day	Total HHD Distance, mile/ project	Total Worker, mile/ project	Daily HHD Distance, mile/day	Daily Worker, mile/day	Total HHD Distance, mile/ project	Total Worker, mile/ project
CEMS	4	1	160	160	320	320	160	160	1,280	1,280
AFRC and CO analyzer	16	1	80	80	80	80	80	80	1,280	1,280
Electric Motor	4	1	160	220	400	27	160	220	1,600	108
Total	24	3	880	1060	1920	801	400	460	4,160	2,668

Table C-30
2010 Construction Vehicle Travel

Description	Annual No of Facilities	Daily No of Facilities	Daily HHD Distance, mile/day	Daily Worker, mile/day	Total HHD Distance, mile/ project	Total Worker, mile/ project	Daily HHD Distance, mile/day	Daily Worker, mile/day	Total HHD Distance, mile/ project	Total Worker, mile/ project
Ox Cat or Update	20	1	160	220	400	27	160	220	3200	4400
CEMS	10	1	160	160	320	320	160	160	1600	1600
AFRC and CO analyzer	15	1	80	80	80	80	80	80	1200	1200
Electric Motor	13	1	160	220	400	27	160	220	2080	2860
Total	58	4	880	1,060	1,920	801	560	680	8,080	10,060

Table C-31
2011 Construction Vehicle Travel

SCR

Description	Annual No of Facilities	Daily No of Facilities	Daily HHD Distance, mile/day	Daily Worker, mile/day	Total HHD Distance, mile/ project	Total Worker, mile/ project	Daily HHD Distance, mile/day	Daily Worker, mile/day	Total HHD Distance, mile/ project	Total Worker, mile/ project
SCR	14	1	160	220	400	27	160	220	5,600	378
Ox Cat or Update	32	1	160	220	400	27	160	220	12,800	864
CEMS	10	1	160	160	320	320	160	160	3,200	3,200
CO Analyzer	5	1	80	80	80	80	80	80	400	400
Electric Motor	88	2	160	220	400	27	320	440	35,200	2,376
Total	149	6	720	900	1600	481	880	1120	57,200	7,218

Gas Turbine or Microturbine

Description	Annual No of Facilities	Daily No of Facilities	Daily HHD Distance, mile/day	Daily Worker, mile/day	Total HHD Distance, mile/ project	Total Worker, mile/ project	Daily HHD Distance, mile/day	Daily Worker, mile/day	Total HHD Distance, mile/ project	Total Worker, mile/ project
Gas Turbine or Microturbine	15	1	160	220	400	27	160	220	6,000	405
Ox Cat or Update	15	1	160	220	400	27	160	220	6,000	405
CEMS	2	1	160	160	320	320	160	160	640	640
Electric Motor	118	2	160	220	400	27	320	440	47,200	3,186
Total	150	5	640	820	1,520	401	800	1,040	59,840	4,636

Table C-31 (Concluded)
2011 Construction Vehicle Travel

Gas Turbine or Microturbine and LNG Plant

Description	Annual No of Facilities	Daily No of Facilities	Daily HHD Distance, mile/day	Daily Worker, mile/day	Total HHD Distance, mile/ project	Total Worker, mile/ project	Daily HHD Distance, mile/day	Daily Worker, mile/day	Total HHD Distance, mile/ project	Total Worker, mile/ project
LNG Plant	6	7	547	300	18,800	270	3,830	2,100	112,800	1,620
Gas Turbine or Microturbine	8	1	160	220	400	27	160	220	3,200	216
Ox Cat or Update	32	1	160	220	400	27	160	220	12,800	864
CEMS	10	1	160	160	320	320	160	160	3,200	3,200
CO Analyzer	5	1	80	80	80	80	80	80	400	400
Electric Motor	88	2	160	220	400	27	320	440	35,200	2,376
Total	149	13	1267.2	1200	20400	751	4710.4	3220	167,600	8,676

Table C-32
2012 Construction Vehicle Travel

SCR

Description	Annual No of Facilities	Daily No of Facilities	Daily HHD Distance, mile/day	Daily Worker, mile/day	Total HHD Distance, mile/ project	Total Worker, mile/ project	Daily HHD Distance, mile/day	Daily Worker, mile/day	Total HHD Distance, mile/ project	Total Worker, mile/ project
SCR	14	1	160	220	400	27	160	220	5,600	378
Total	14	1	160	220	400	27	160	220	5600	378

Gas Turbine or Microturbine

Description	Annual No of Facilities	Daily No of Facilities	Daily HHD Distance, mile/day	Daily Worker, mile/day	Total HHD Distance, mile/ project	Total Worker, mile/ project	Daily HHD Distance, mile/day	Daily Worker, mile/day	Total HHD Distance, mile/ project	Total Worker, mile/ project
Gas Turbine or Microturbine	14	1	160	220	400	27	160	220	5,600	378
Total	14	1	160	220	400	27	160	220	5600	378

Table C-32 (Concluded)
2012 Construction Vehicle Travel

Gas Turbine or Microturbine and LNG Plant

Description	Annual No of Facilities	Daily No of Facilities	Daily HHD Distance, mile/day	Daily Worker, mile/day	Total HHD Distance, mile/ project	Total Worker, mile/ project	Daily HHD Distance, mile/day	Daily Worker, mile/day	Total HHD Distance, mile/ project	Total Worker, mile/ project
LNG Plant	6	7	547	300	18,800	270	3,830	2,100	112,800	1,620
Gas Turbine or Microturbine	8	1	160	220	15,280	27	160	220	122,240	216
Total	14	8	707.2	520	34080	297	3990.4	2320	235040	1836

Table C-33
EMFAC2007 Emission Factors for 2007

Description	NOx, lb/mile	CO, lb/mile	VOC, lb/mile	SOx, lb/mile	PM10, lb/mile	CO2, lb/mile
Heavy-Duty Truck[a]	0.04718	0.01446	0.00373	0.00004	0.00231	4.222

CARB, EMFAC2002 as summarized on SCAQMD website at http://www.aqmd.gov/ceqa/handbook/onroad/onroadHHDT05_25.xls

Table C-34
Summary of Construction Emissions

SCR-Construction

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5, lb/day	CO2, ton/year
2008	89.8	42.1	12.0	0.08	5.0	4.6	630
2009	88.9	39.5	11.1	0.08	4.7	4.4	36.5
2010	141.4	61.8	17.6	0.13	7.4	6.9	203
2011	247	106	30.4	0.23	12.9	11.9	727
2012	52.5	22.3	6.4	0.05	2.7	2.5	73.0

Table C-34 (Concluded)
Summary of Construction Emissions

Gas Turbines or Microturbines - Construction

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5, lb/day	CO2, ton/year
2008	89.8	42.1	12.0	0.08	5.0	4.6	630
2009	88.9	39.5	11.1	0.08	4.7	4.4	36.5
2010	141.4	61.8	17.6	0.13	7.4	6.9	203
2011	247	106	30.4	0.23	12.9	11.9	727
2012	52.5	22.3	6.4	0.05	2.7	2.5	73.0

Gas Turbines/LNG - Construction

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5, lb/day	CO2, ton/year
2008	89.8	42.1	12.0	0.08	5.0	4.6	630
2009	88.9	39.5	11.1	0.08	4.7	4.4	36.5
2010	141.4	61.8	17.6	0.13	7.4	6.9	203
2011	682	291	84.1	0.60	48.4	35.6	2,371
2012	488	206.6	60.2	0.43	38.3	26.2	1,718

Table C-35
Summary of Total Proposed Project Emissions

SCR - Total

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
2008	~~9,089~~ 9,094	~~53,909~~ 53,942	~~2,470~~ 2,479	~~544~~ 545	~~877~~ 878	~~875~~ 876	~~1,227,861~~
2009	~~6,410~~ 6,415	~~22,399~~ 22,432	~~1,790~~ 1,799	~~543~~ 544	~~858~~ 859	~~856~~ 857	~~1,231,763~~
2010	~~5,964~~ 5,969	~~17,357~~ 17,390	~~1,298~~ 1,307	~~534~~ 535	~~844~~ 845	~~842~~ 843	~~1,208,074~~
2011	~~5,591~~ 5,596	~~13,581~~ 13,614	~~1,237~~ 1,246	~~529~~ 530	~~834~~ 835	~~831~~ 832	~~1,197,378~~
2012	4,178	13,445	1,017	538	833	831	~~1,231,668~~
2014	4,184	13,441	1,015	538	833	831	~~1,231,622~~

Gas Turbines - Total

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
2008	~~9,089~~ 9,094	~~53,909~~ 53,942	~~2,470~~ 2,479	~~544~~ 545	~~877~~ 878	~~875~~ 876	~~1,227,861~~
2009	~~6,410~~ 6,415	~~22,399~~ 22,432	~~1,790~~ 1,799	~~543~~ 544	~~858~~ 859	~~856~~ 857	~~1,231,763~~
2010	~~5,964~~ 5,969	~~17,357~~ 17,390	~~1,298~~ 1,307	~~534~~ 535	~~844~~ 845	~~842~~ 843	~~1,208,074~~
2011	~~5,586~~ 5,591	~~13,579~~ 13,612	~~1,237~~ 1,246	~~529~~ 530	~~833~~ 834	~~831~~ 832	~~1,197,447~~
2012	4,878	7,380	539	538	1,019	1,017	~~1,231,344~~
2014	4,884	7,375	537	538	1,019	1,017	~~1,231,271~~

Table C-35 (Continued)
Summary of Total Proposed Project Emissions

Microturbines - Total

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
2008	~~9,089~~ 9,094	~~53,909~~ 53,942	~~2,470~~ 2,479	~~544~~ 545	~~877~~ 878	~~875~~ 876	~~1,227,861~~
2009	~~6,410~~ 6,415	~~22,399~~ 22,432	~~1,790~~ 1,799	~~543~~ 544	~~858~~ 859	~~856~~ 857	~~1,231,763~~
2010	~~5,964~~ 5,969	~~17,357~~ 17,390	~~1,298~~ 1,307	~~534~~ 535	~~844~~ 845	~~842~~ 843	~~1,208,074~~
2011	~~5,586~~ 5,591	~~13,579~~ 13,612	~~1,237~~ 1,246	~~529~~ 530	~~833~~ 834	~~831~~ 832	~~1,197,447~~
2012	3,913	6,192	644	538	760	758	~~1,231,458~~
2014	3,919	6,187	643	538	760	758	~~1,231,385~~

Gas Turbines/LNG - Total

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
2008	~~9,089~~ 9,094	~~53,909~~ 53,942	~~2,470~~ 2,479	~~544~~ 545	~~877~~ 878	~~875~~ 876	~~1,227,861~~
2009	~~6,410~~ 6,415	~~22,399~~ 22,432	~~1,790~~ 1,799	~~543~~ 544	~~858~~ 859	~~856~~ 857	~~1,231,763~~
2010	~~5,964~~ 5,969	~~17,357~~ 17,390	~~1,298~~ 1,307	~~534~~ 535	~~844~~ 845	~~842~~ 843	~~1,208,074~~
2011	~~6,072~~ 6,077	~~13,779~~ 13,812	~~1,295~~ 1,304	~~529~~ 530	~~872~~ 873	~~857~~ 858	~~1,199,341~~
2012	4,742	6,710	584	211	911	896	~~1,094,941~~
2014	4,373	6,540	533	211	878	876	~~1,093,551~~

Table C-35 (Concluded)
Summary of Total Proposed Project Emissions

Microturbines/LNG - Total

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
2008	~~9,089~~ 9,094	~~53,909~~ 53,942	~~2,470~~ 2,479	~~544~~ 545	~~877~~ 878	~~875~~ 876	~~1,227,861~~
2009	~~6,410~~ 6,415	~~22,399~~ 22,432	~~1,790~~ 1,799	~~543~~ 544	~~858~~ 859	~~856~~ 857	~~1,231,763~~
2010	~~5,964~~ 5,969	~~17,357~~ 17,390	~~1,298~~ 1,307	~~534~~ 535	~~844~~ 845	~~842~~ 843	~~1,208,074~~
2011	~~6,072~~ 6,077	~~13,779~~ 13,812	~~1,295~~ 1,304	~~529~~ 530	~~872~~ 873	~~857~~ 858	~~1,199,341~~
2012	4,358	6,245	629	211	805	791	~~1,095,049~~
2014	3,989	6,075	578	211	773	771	~~1,093,659~~

Table C-36
Summary of Emissions and Emission Reductions from PAR 1110.2

SCR - Total Compared to Baseline

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	CO2, ton/year
2008	~~(106)~~ (100)	~~(334)~~ (301)	~~(23)~~ (14)	~~(7.4)~~ (6.8)	~~0.1~~ 1.0	~~0.4~~ 0.7	~~(22,186)~~
2009	~~(3,231)~~ (3,225)	~~(36,886)~~ (36,853)	~~(1,195)~~ (1,186)	~~(17)~~ (17)	~~(33)~~ (32)	~~(33)~~ (32)	~~(41,973)~~
2010	~~(3,231)~~ (3,225)	~~(36,886)~~ (36,853)	~~(1,195)~~ (1,186)	~~(17)~~ (17)	~~(33)~~ (32)	~~(33)~~ (32)	~~(41,973)~~
2011	~~(3,603)~~ (3,598)	~~(40,662)~~ (40,629)	~~(1,256)~~ (1,247)	~~(23)~~ (22)	~~(43)~~ (42)	~~(44)~~ (43)	~~(52,669)~~
2012	(5,017)	(40,798)	(1,476)	(13)	(44)	(44)	~~(18,379)~~
2014	(5,011)	(40,802)	(1,477)	(13)	(44)	(44)	~~(18,425)~~

Table C-36 (Continued)
Summary of Emissions and Emission Reductions from PAR 1110.2

Gas Turbines - Total Compared to Baseline

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
2008	~~(106)~~	~~(334)~~	~~(23)~~	~~(7.5)~~	~~0.1~~	~~0.4~~	~~(22,186)~~
	(100)	(301)	(14)	(6.8)	1.0	0.7	
2009	~~(3,231)~~	~~(36,886)~~	~~(1,194)~~	~~(18)~~	~~(33)~~	~~(33)~~	~~(41,973)~~
	(3,225)	(36,853)	(1,186)	(17)	(32)	(32)	
2010	~~(3,231)~~	~~(36,886)~~	~~(1,195)~~	~~(18)~~	~~(33)~~	~~(33)~~	~~(41,973)~~
	(3,225)	(36,853)	(1,186)	(17)	(32)	(32)	
2011	~~(3,609)~~	~~(40,664)~~	~~(1,256)~~	~~(23)~~	~~(43)~~	~~(44)~~	~~(52,600)~~
	(3,603)	(40,631)	(1,247)	(22)	(43)	(43)	
2012	(4,317)	(46,863)	(1,954)	(13)	142	142	~~(18,703)~~
2014	(4,311)	(46,868)	(1,955)	(13)	142	142	~~(18,776)~~

Microturbines - Total Compared to Baseline

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
2008	~~(106)~~	~~(334)~~	~~(22)~~	~~(7.5)~~	~~(0.1)~~	~~0.4~~	~~(22,186)~~
	(100)	(301)	(14)	(6.9)	0.8	0.4	
2009	~~(3,231)~~	~~(36,886)~~	~~(1,194)~~	~~(18)~~	~~(33)~~	~~(33)~~	~~(41,973)~~
	(3,225)	(36,853)	(1,186)	(17)	(32)	(32)	
2010	~~(3,231)~~	~~(36,886)~~	~~(1,194)~~	~~(18)~~	~~(33)~~	~~(33)~~	~~(41,973)~~
	(3,225)	(36,853)	(1,186)	(17)	(32)	(32)	
2011	~~(3,609)~~	~~(40,664)~~	~~(1,256)~~	~~(23)~~	~~(43)~~	~~(44)~~	~~(52,600)~~
	(3,603)	(40,631)	(1,247)	(22)	(43)	(43)	
2012	(5,282)	(48,051)	(1,848)	(13)	(117)	(117)	~~(18,589)~~
2014	(5,275)	(48,056)	(1,850)	(13)	(117)	(117)	~~(18,662)~~

Table C-36 (Concluded)
Summary of Emissions and Emission Reductions from PAR 1110.2

Gas Turbines/LNG - Total Compared to Baseline

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
2008	~~(106)~~	~~(334)~~	~~(22)~~	~~(7.5)~~	~~(0.1)~~	~~0.4~~	~~(22,186)~~
	(100)	(301)	(14)	(6.9)	0.8	0.4	
2009	~~(3,231)~~	~~(36,886)~~	~~(1,194)~~	~~(18)~~	~~(33)~~	~~(33)~~	~~(41,973)~~
	(3,225)	(36,853)	(1,186)	(17)	(32)	(32)	
2010	~~(3,231)~~	~~(36,886)~~	~~(1,195)~~	~~(17)~~	~~(33)~~	~~(33)~~	~~(41,973)~~
	(3,225)	(36,853)	(1,186)	(17)	(32)	(32)	
2011	~~(3,123)~~	~~(40,464)~~	~~(1,198)~~	~~(22)~~	~~(5)~~	~~(18)~~	~~(50,706)~~
	(3,117)	(40,431)	(1,189)	(22)	(4)	(17)	
2012	(4,453)	(47,533)	(1,909)	(340)	33.7	21.3	~~(155,106)~~
2014	(4,821)	(47,703)	(1,960)	(340)	1.2	0.75	~~(156,496)~~

Microturbines/LNG - Total Compared to Baseline

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
2008	~~(106)~~	~~(334)~~	~~(22)~~	~~(7.5)~~	~~(0.1)~~	~~0.4~~	~~(22,186)~~
	(100)	(301)	(14)	(6.9)	0.8	0.4	
2009	~~(3,231)~~	~~(36,886)~~	~~(1,194)~~	~~(18)~~	~~(33)~~	~~(33)~~	~~(41,973)~~
	(3,225)	(36,853)	(1,186)	(17)	(32)	(32)	
2010	~~(3,231)~~	~~(36,886)~~	~~(1,195)~~	~~(17)~~	~~(33)~~	~~(33)~~	~~(41,973)~~
	(3,225)	(36,853)	(1,186)	(17)	(32)	(32)	
2011	~~(3,123)~~	~~(40,464)~~	~~(1,198)~~	~~(22)~~	~~(5)~~	~~(18)~~	~~(50,706)~~
	(3,117)	(40,431)	(1,189)	(22)	(4)	(17)	
2012	(4,837)	(47,998)	(1,864)	(340)	(72)	(84)	~~(154,998)~~
2014	(5,205)	(48,168)	(1,914)	(340)	(104)	(104)	~~(156,387)~~

Table C-37
Estimation of the Number of Electric Motor Replacements of Non-Biogas Engines Required for PAR 1110.2 to Be Carbon Neutral

SCR - Carbon Neutral Calculation

Description	Proposed Project CO2, ton/year	No Electrification CO2, ton/year	Reduction in CO2 from Electrification	Average CO2 Savings per Motor	Average No of Motor to Stay Carbon Neutral
Baseline					
2008	(22,186)	(22,186)	0		
2009	(41,973)	(23,358)	18,614		
2010	(41,973)	(23,358)	18,614		
2011	(52,669)	(21,974)	30,695		
2012	(18,379)	11,559	29,938		
2014	(18,425)	11,513	29,938		
2013-2018	(110,549)	69,081	179,630		
10 year total	(265,542)	11,950	277,492	1,642	8

Gas Turbines - Carbon Neutral Calculation

Description	Proposed Project CO2, ton/year	No Electrification CO2, ton/year	Reduction in CO2 from Electrification	Avg CO2 Savings per Motor	Avg No of Motor to Stay Carbon Neutral
Baseline					
2008	(22,186)	(22,181)	5		
2009	121,080	(23,358)	18,614		
2010	(41,973)	(23,358)	18,614		
2011	(52,600)	(21,905)	30,695		
2012	(18,703)	11,236	29,938		
2014	(18,776)	11,163	29,938		
2013-2018	(112,654)	66,976	179,630		
10 year total	(104,849)	9,591	114,439	677	15

Table C-37 (Continued)
Estimation of the Number of Electric Motor Replacements of Non-Biogas Engines Required for PAR 1110.2 to Be Carbon Neutral

Microturbines - Carbon Neutral Calculation

Description	Proposed Project CO_2, ton/year	No Electrification CO_2, ton/year	Reduction in CO_2 from Electrification	Average CO_2 Savings per Motor	Average No of Motor to Stay Carbon Neutral
Baseline					
2008	(22,186)	(22,181)	5		
2009	(41,973)	(23,358)	18,614		
2010	(41,973)	(23,358)	18,614		
2011	(52,600)	(21,905)	30,695		
2012	(18,589)	11,350	29,938		
2014	(18,662)	11,277	29,938		
2013-2018	(111,970)	67,660	179,630		
10 year total	(267,103)	10,389	277,492	1,642	7

Gas Turbines/LNG - Carbon Neutral Calculation

Description	Proposed Project CO_2, ton/year	No Electrification CO_2, ton/year	Reduction in CO_2 from Electrification	Avg CO_2 Savings per Motor	Avg No of Motor to Stay Carbon Neutral
Baseline					
2008	(22,186)	(22,181)	5		
2009	(41,973)	(23,358)	18,614		
2010	(41,973)	(23,358)	18,614		
2011	(50,706)	(20,011)	30,695		
2012	(155,106)	(125,168)	29,938		
2014	(156,496)	(126,558)	29,938		
2013-2018	(938,975)	(759,345)	179,630		
10 year total	(1,228,732)	(951,240)	277,492	1,642	0

Table C-37 (Concluded)
Estimation of the Number of Electric Motor Replacements of Non-Biogas Engines Required for PAR 1110.2 to Be Carbon Neutral

Microturbines/LNG - Carbon Neutral Calculation

Description	Proposed Project CO2, ton/year	No Electrification CO2, ton/year	Reduction in CO2 from Electrification	Avg CO2 Savings per Motor	Avg No of Motor to Stay Carbon Neutral
Baseline					
2008	(22,186)	(22,181)	5		
2009	(41,973)	(23,358)	18,614		
2010	(41,973)	(23,358)	18,614		
2011	(50,706)	(20,011)	30,695		
2012	(154,998)	(125,059)	29,938		
2014	(156,387)	(126,449)	29,938		
2013-2018	(938,325)	(758,695)	179,630		
10 year total	(1,227,973)	(950,481)	277,492	1,642	0

Project CO2 emissions begin with the adoption of the rule.
Electric engines would be installed between 2009 and 2011. Electric motor useful life was assumed to be 10 years. The electric motor useful life was assumed to start in 2009. CO2 emissions were not estimated for 2013. The emissions for 2013 are assumed to be equivalent to 2014. This is conservative because in 2013 the catalyst disposal and replacement would not start until 2014, which adds diesel haul truck emissions.

Table C-38
Summary of the Number of Electric Motor Replacements of Non-Biogas Engines Required for PAR 1110.2 to Be Carbon Neutral

Description	Proposed Project CO2, ton/year	No Electrification CO2, ton/year	Reduction in CO2 from Electrification	Average CO2 Savings per Motor	Average No of Motor to Stay Carbon Neutral
SCR	(270,810)	11,981	282,791	1,673	8
Replace ICE with Gas Turbine	(104,849)	9,591	114,439	677	15
Replace ICE Microturbine	(267,103)	10,389	277,492	1,642	7
Replace LFG w LNG, DG w Turbines	(1,228,732)	(951,240)	277,492	1,642	0
Replace LFG w LNG, DG w Microturbines	(1,227,973)	(950,481)	277,492	1,642	0

SCAQMD staff estimates that there are 225 non-biogas engines where replacing the non-biogas engines with electric motors would cost less than complying with PAR 1110.2.
The proposed project assumes that 75 percent of existing non-biogas ICEs (169) would be replaced with electrification where cost would be lower than complying with PAR 1110.2.

Table C-39
Adverse Electricity Impacts from Differences in Efficiency Between ICE Alternatives and LNG Reliance on the Power Grid

Description	Electricity Production, MWH/yr	Electricity Consumption, MWH/yr	Total Electricity, MWH/yr	Electricity Change from Baseline, MWH/yr
2005 Baseline (ICE)	437,214		437,214	
SCR	435,509		435,509	1,706
Gas Turbines	380,053		380,053	57,161
Microturbines	336,201		336,201	101,013
Gas Turbines/LNG	155,746	104,694	51,052	386,162
Microturbines/LNG	137,706	104,694	33,081	404,133

ICEs, gas turbines, and microturbines generate electricity.
LNG plants would not generate electricity, but would require energy from the power grid.

Table C-40
Adverse Electricity Impacts

Description	Non-Biogas and Biogas CEMS and Controllers, MWH/Yr	Non-Biogas Electrification, MWH/Yr	Electricity Production, MWH/yr	Electricity Totals, MWH/yr	Electricity Change from Baseline, MWH/yr
2005 Baseline			437,214	437,214	0
SCR	(567)	(171,827)	435,509	263,114	(174,100)
Gas Turbines	(567)	(171,827)	380,053	207,659	(229,556)
Micro Turbines	(567)	(171,827)	336,201	163,807	(273,408)
Gas Turbines/LNG	(567)	(171,827)	51,052	(121,342)	(558,557)
Microturbines/LNG	(567)	(171,827)	33,081	(139,313)	(576,527)

Negative values are presented in parenthesis. Negative electricity values represent consumption, positive values represent production.

Table C-41
Adverse Natural Gas Impacts from Reduction of Natural Gas Usage to 10 Percent

Year	Baseline Natural Gas Usage, MMBtu/ year	2008 Natural Gas Reduction, MMBtu/ year	2010 Natural Gas Reduction, MMBtu/ year
2008	4,061,047	162,928	77,761
2010	4,964,605	199,179	95,063

Table C-42
Diesel Fuel Use from Truck Trips Associated with PAR 1110.2

Natural Gas Reduction from ICE Replacement with Electric Motors, MMBtu/year	Power Plants, MMBtu/year	Emergency ICE, MMBtu/year	Electrification Natural Gas Consumption, MMBtu/year
(1,854,358)	1,303,214	2,283	(548,862)

Values in parenthesis are negative. Reduction in natural gas use is negative, consumption is positive

Table C-43
Adverse Natural Gas Impacts

Description	Catalyst Pressure Drop Consumption, MMBtu/yr	Non-biogas Electrification Natural Gas Consumption, MMBtu/yr	Biogas Emergency Engines Natural Gas, MMBtu/yr	Power Plant Natural Gas, MMBtu/Yr	Biogas Natural Gas Consumption, MMBtu/yr	Non-biogas Natural Gas Consumption, MMBtu/yr	Natural Gas Total, MMBtu/yr	Natural Gas Change from Baseline, MMBtu/yr
Baseline					512,787	10,501,630	11,014,417	
SCR	2,713	(548,862)		1,751	512,787	10,501,630	10,470,019	(544,398)
Gas Turbines	2,713	(548,862)	3,318	68,793	512,787	10,501,630	10,540,378	(474,039)
Micro Turbines	2,713	(548,862)	5,023	112,645	512,787	10,501,630	10,585,936	(428,481)
Gas Turbines/LNG	2,713	(548,862)	3,318	397,794	456,430	10,501,630	10,813,022	(201,395)
Microturbines/LNG	2,713	(548,862)	5,023	415,764	456,430	10,501,630	10,832,698	(181,719)

Values in parenthesis are negative. Reduction in natural gas use is negative, consumption is positive

Table C-44
Diesel Fuel Use from Truck Trips Associated with Non-biogas and the SCR Biogas Compliance Option

Year	Daily HHD Consumption Construction, gal/day	Diesel Construction Equipment, gal/day	Daily HHD Consumption Operational gal/day	Non-Biogas Emergency Engines, gal/day	Daily Consumption, gal/day
2008	24	267	9	0	300
2009	20	279	6	65	370
2010	28	373	54	760	1,214
2011	44	653	63	1,111	1,871
2012	8	141	86	1,111	1,346
2014	0	0	149	1,111	1,260
Max	44	653	149	1,111	1,957

HHDT = Heavy – heavy- duty truck

Table C-45
Diesel Fuel Use from Truck Trips Associated with Non-biogas and the Gas Turbine Biogas Compliance Option

Year	Daily HHD Consumption Construction, gal/day	Diesel Construction Equipment, gal/day	Daily HHD Consumption Operational gal/day	Non-Biogas Emergency Engines, gal/day	Non-Biogas Emergency Engines, gal/day	Daily Consumption, gal/day
2008	24	267	9	0	0	300
2009	20	367	6	65	0	458
2010	28	373	54	760	0	1,214
2011	44	653	57	1,111	0	1,865
2012	8	141	86	1,111	0	1,346
2014	0	0	149	1,111	140	1,399
Max	44	653	149	1,111	140	1,865

HHDT = Heavy – heavy- duty truck

Table C-46
Diesel Fuel Use from Truck Trips Associated with Non-biogas and the Microturbine Biogas Compliance Option

Year	Daily HHD Consumption Construction, gal/day	Diesel Construction Equipment, gal/day	Daily HHD Consumption Operational gal/day	Non-Biogas Emergency Engines, gal/day	Non-Biogas Emergency Engines, gal/day	Daily Consumption, gal/day
2008	24.0	267	9.0	0	0	300
2009	20.0	367	6.0	65	0	458
2010	28.0	373	53.6	760	0	1,214
2011	44.0	653	56.6	1,111	0	1,865
2012	8.0	141	86.4	1,111	0	1,346
2014	0.0	0	149	1,111	202	148.8
Max	44	653	149	1,111	202	1,865

HHDT = Heavy – heavy- duty truck

Table C-47
Diesel Fuel Use from Truck Trips Associated with Non-biogas and the LNG and Gas Turbine Biogas Compliance Option

Year	Daily HHD Consumption Construction, gal/day	Diesel Construction Equipment, gal/day	Daily HHD Consumption Operational gal/day	Non-Biogas Emergency Engines, gal/day	Non-Biogas Emergency Engines, gal/day	Daily Consumption, gal/day
2008	24	267	9	0	0	300
2009	20	279	6	65	0	370
2010	28	373	54	760	0	1,214
2011	236	1,761	111	1,111	0	3,218
2012	200	1,249	154	1,111	0	2,714
2014	0	0	281	1,111	140	1,531
Max	236	1,761	281	1,111	140	3,218

HHDT = Heavy – heavy- duty truck

Table C-48
Diesel Fuel Use from Truck Trips Associated with Non-biogas and the LNG and Microturbine Biogas Compliance Option

Year	Daily HHD Consumption Construction, gal/day	Diesel Construction Equipment, gal/day	Daily HHD Consumption Operational gal/day	Non-Biogas Emergency Engines, gal/day	Non-Biogas Emergency Engines, gal/day	Daily Consumption, gal/day
2008	24.0	267	9.0	0	0	300
2009	20.0	279	6.0	65	0	370
2010	28.0	373	53.6	760	0	1,214
2011	236	1,761	111	1,111	0	3,218
2012	200	1,249	154	1,111	0	2,714
2014	0.0	0	281	1,111	202	1,593
Max	236	1,761	281	1,111	202	3,218

HHDT = Heavy – heavy- duty truck

Table C-49
Summary of Energy Effects Non-Biogas Effects

Natural Gas Consumption, MMBtu/Yr	Electricity Consumption, MWH/Yr	Diesel Fuel Consumption, Gal/Yr
(551,144,402,851)	172,394	55,536

Table C-50
Summary PAR 1110.2 Energy Effects Compared to Baseline

Description	Natural Gas Consumption, MMBtu/yr	Electricity Production, MWH/yr	Shaft Work Produced, Hp-Hrs/yr	Diesel Fuel Consumption, gal/yr	LNG Production, MMBtu/yr
SCR	(544,398)	174,100	(59,006)	31,152	
Gas Turbines	(474,039)	229,556	(15,123,937)	38,128	
Micro Turbines	(428,481)	273,408	(15,123,937)	41,241	
Gas Turbines/LNG	(201,395)	558,557	(15,123,937)	38,128	2,374,019
Microturbines/LNG	(181,719)	576,527	(15,123,937)	57,364	2,374,019

Table C-51
Example ISCST3 File for Ammonia Slip Emissions

```
**
****************************************
**
** ISCST3 Input Produced by:
** ISC-AERMOD View Ver. 5.6.0
** Lakes Environmental Software Inc.
** Date: 8/14/2007
**
****************************************
**
**
****************************************
** ISCST3 Control Pathway
****************************************
**
**
CO STARTING
   TITLEONE
   TITLETWO
   MODELOPT CONC  URBAN NOCALM
   AVERTIME 1 PERIOD
   POLLUTID OTHER
   TERRHGTS ELEV
   RUNORNOT RUN
CO FINISHED
**
****************************************
** ISCST3 Source Pathway
****************************************
**
**
SO STARTING
   ELEVUNIT FEET
** Source Location **
** Source ID - Type - X Coord. - Y Coord. **
   LOCATION S008 POINT 412935.000 3728400.900 23.000
   LOCATION S009 POINT 412942.100 3728391.300 23.000
** Source Parameters **
   SRCPARAM S008 1 18.902 533.150 17.88100 0.762
   SRCPARAM S009 1 18.902 533.150 17.88100 0.762
```

Table C-51 (Continued)
Example ISCST3 File for Ammonia Slip Emissions

```
** Building Downwash **
   BUILDHGT S008      14.20   14.20   14.20   14.20   14.20   14.20
   BUILDHGT S008      14.20   14.20   14.20   14.20   14.20   14.20
   BUILDHGT S008      14.20   14.20   14.20   14.20   14.20   14.20
   BUILDHGT S008      14.20   14.20   14.20   14.20   14.20   14.20
   BUILDHGT S008      14.20   14.20   14.20   14.20   14.20   14.20
   BUILDHGT S008      14.20   14.20   14.20   14.20   14.20   14.20

   BUILDHGT S009      14.20   14.20   14.20   14.20   14.20   14.20
   BUILDHGT S009      14.20   14.20   14.20   14.20   14.20   14.20
   BUILDHGT S009      14.20   14.20   14.20   14.20   14.20   14.20
   BUILDHGT S009      14.20   14.20   14.20   14.20   14.20   14.20
   BUILDHGT S009      14.20   14.20   14.20   14.20   14.20   14.20
   BUILDHGT S009      14.20   14.20   14.20   14.20   14.20   14.20

   BUILDWID S008      52.26   49.64   45.77   42.62   38.96   40.98
   BUILDWID S008      44.94   47.54   48.70   48.38   49.33   49.07
   BUILDWID S008      47.31   45.00   46.81   50.53   52.72   53.30
   BUILDWID S008      52.26   49.64   45.77   42.62   38.96   40.98
   BUILDWID S008      44.94   47.54   48.70   48.38   49.33   49.07
   BUILDWID S008      47.31   45.00   46.81   50.53   52.72   53.30

   BUILDWID S009      52.26   49.64   45.77   42.62   38.96   40.98
   BUILDWID S009      44.94   47.54   48.70   48.38   49.33   49.07
   BUILDWID S009      47.31   45.00   46.81   50.53   52.72   53.30
   BUILDWID S009      52.26   49.64   45.77   42.62   38.96   40.98
   BUILDWID S009      44.94   47.54   48.70   48.38   49.33   49.07
   BUILDWID S009      47.31   45.00   46.81   50.53   52.72   53.30



   SRCGROUP S008 S008
   SRCGROUP S009 S009
   SRCGROUP ALL
SO FINISHED
**
****************************************
** ISCST3 Receptor Pathway
****************************************
**
**
RE STARTING
   ELEVUNIT FEET
** DESCRREC "" ""
   DISCCART    412572.90   3727853.70   19.70
   DISCCART    412622.90   3727853.70   19.70
   DISCCART    412672.90   3727853.70   19.70

**The receptor list is abbreviated for space.  A full list of the receptors is available upon request.

RE FINISHED
**
****************************************
** ISCST3 Meteorology Pathway
****************************************
```

Table C-51 (Concluded)
Example ISCST3 File for Ammonia Slip Emissions

```
**
**
ME STARTING
   INPUTFIL C:\metdata\COSMESA.ASC
   ANEMHGHT 10 METERS
   SURFDATA 53126 1981
   UAIRDATA 91919 1981
ME FINISHED
**
****************************************
** ISCST3 Output Pathway
****************************************
**
**
OU STARTING
   RECTABLE ALLAVE 1ST
   RECTABLE 1 1ST
** Auto-Generated Plotfiles
** Plotfile Path: C:\Lakes\ISC-AERMODView\Projects\2007\PAR1110_2\OCSD1.IS\
   PLOTFILE 1 ALL 1ST OCSD1.IS\01H1GALL.PLT
   PLOTFILE PERIOD ALL OCSD1.IS\PE00GALL.PLT
OU FINISHED
```

Table C-52
Summary of Diesel Exhaust Emissions from Biogas Emergency Engines

Facility ID No.	Diesel PM, ton/year
29110	0.0186142
17301	0.0078784
9961	0.0022837
9163	0.0020946
001703	0.0019239
135216	0.0012418
3866	0.0011543
13088	0.000726
13433	0.0007106
11301	0.0006434
019159	0.0004719
1179	0.00026

Table C- 53
Summary of Diesel Exhaust Emissions from Non-Biogas Emergency Engines

Facility ID No.	Engine HP	TPY PM
Facility 1	31430	0.2467415
Facility 2	13272	0.0851537
Facility 3	12185	0.0782137
Facility 4	11191	0.0510922
Facility 5	3804	0.0323925
Facility 6	2425	0.0206498
Facility 7	1800	0.0153277
Facility 8	1760	0.0149871
Facility 9	2045	0.0146039
Facility 10	1580	0.0134543
Facility 11	1575	0.0134117
Facility 12	1535	0.0111551
Facility 13	2917	0.0100481
Facility 14	6813	0.0096309
Facility 15	1110	0.0094521
Facility 16	1055	0.0089837
Facility 17	1054	0.0089752
Facility 18	1008	0.0085835
Facility 19	1580	0.0084302
Facility 20	954	0.0081237
Facility 21	853	0.0072636
Facility 22	840	0.0071529
Facility 23	825	0.0070252
Facility 24	800	0.0068123
Facility 25	2875	0.0057479
Facility 26	2400	0.0057479
Facility 27	594	0.0050581
Facility 28	594	0.0050581
Facility 29	592	0.0050411
Facility 30	581	0.0049474
Facility 31	798	0.0048197
Facility 32	558	0.0047516
Facility 33	780	0.004726
Facility 34	545	0.0046409
Facility 35	512	0.0043599
Facility 36	500	0.0042577
Facility 37	500	0.0042577
Facility 38	468	0.0039852
Facility 39	460	0.0039171
Facility 40	740	0.0036616
Facility 41	567	0.0036616
Facility 42	427	0.0036361

Table C- 53 (Continued)
Summary of Diesel Exhaust Emissions from Non-Biogas Emergency Engines

Facility ID No.	Engine HP	TPY PM
Facility 43	412	0.0035083
Facility 44	400	0.0034061
Facility 45	400	0.0034061
Facility 46	395	0.0033636
Facility 47	395	0.0033636
Facility 48	395	0.0033636
Facility 49	880	0.003321
Facility 50	1161	0.0031507
Facility 51	369	0.0031422
Facility 52	348	0.0029633
Facility 53	755	0.0028101
Facility 54	330	0.0028101
Facility 55	330	0.0028101
Facility 56	3711	0.0027845
Facility 57	459	0.0026738
Facility 58	314	0.0026738
Facility 59	300	0.0025546
Facility 60	300	0.0025546
Facility 61	283	0.0024099
Facility 62	270	0.0022992
Facility 63	530	0.0022566
Facility 64	250	0.0021288
Facility 65	230	0.0019585
Facility 66	400	0.0017031
Facility 67	186	0.0015839
Facility 68	180	0.0015328
Facility 69	180	0.0015328
Facility 70	175	0.0014902
Facility 71	145	0.0012347
Facility 72	145	0.0012347
Facility 73	145	0.0012347
Facility 74	778	0.0012177
Facility 75	140	0.0011922
Facility 76	121	0.0010304
Facility 77	100	0.0008515
Facility 78	465	0.000843
Facility 79	94	0.0008004

Table C- 54
Summary of Ammonia Slip Emission

Facility ID No.	Ammonia Slip, ton/year	19% Ammonia Use, gal/year	Urea Use, gal/yr
Facility 1	0.13	1,065	298
Facility 2	0.13	1,052	294
Facility 3	0.45	3,598	1,007
Facility 4	0.78	6,194	1,734
Facility 5	0.62	4,939	1,383
Facility 6	0.38	3,034	849
Facility 7	0.42	3,352	938
Facility 8	1.68	13,324	3,730
Facility 9	3.38	26,869	7,521
Facility 10	0.67	5,337	1,494
Facility 11	0.33	2,603	729
Facility 12	1.77	14,067	3,938
Facility 13	1.66	13,152	3,681
Facility 14	0.64	5,108	1,430
Facility 15	0.09	748	209
Facility 16	0.34	2,732	765
Facility 17	1.39	11,026	3,086
Facility 18	0.81	6,444	1,804
Facility 19	0.34	2,667	747
Facility 20	0.04	308	86
Facility 21	0.06	455	127
Facility 22	0.16	1,237	346
Facility 23	2.08	16,540	4,630

Facilities listed in Table C-53 are not necessarily the same as in Table C-54.

Table C-55
Health Risk Calculations from Biogas Emergency Engines

Biogas Emergency Engine Carcinogenic Health Risk

Facility	No of Emerg ICEs	Single Unit Emissions, lb/yr	Facility DPM Emissions, ton/yr	Facility DPM Emissions, g/s	Cancer Potency Factor, (mg/kg-day)$^{-1}$	Daily Breathing Rate, L/kg-day	Exposure Frequency, day/year	Exposure Duration, year	Averaging Time, day	Modeled Conc, (ug/m3)/(g/s)	Carcinogenic Health Risk	Mitigated Carcinogenic Health Risk
Facility A	4	9	0.0186142	5.35E-04	1.10	302.00	350.00	70.00	2.56E+04	19.977	3.41E-06	5.11E-07
Facility B	2	8	0.0078784	2.27E-04	1.10	302.00	350.00	70.00	2.56E+04	5.49	3.96E-07	5.945E-08

Carcinogenic Health Risk = [DPM Emissions, g/s x Cancer Potency Factor, (mg/kg-day)$^{-1}$ x Daily Breathing Rate, L/kg-day x Exposure Frequency, hr/yr x Exposure Duration, yr x Modeled Conc., (ug/m3)/(g/s)]/(Averaging Time, day x 1,000,000 ug/mg)

Biogas Emergency Engine Chronic Non Carcinogenic Health Risk

Facility	No of Emergency ICEs	Single Unit Emissions, lb/yr	Facility DPM Emissions, ton/yr	Facility DPM Emissions, g/s	Reference Exposure Level, ug/m3	Modeled Conc, (ug/m3)/(g/s)	Chronic Hazard Index
Facility A	4	9	0.0186142	5.35E-04	5.00E+00	19.977	0.0021
Facility B	2	8	0.0078784	2.27E-04	5.00E+00	5.49	0.00025

Chronic Hazard Index = [Modeled Conc., (ug/m3)/(g/s)]/(Reference Exposure Level, ug/m3)
DPM target organ – Respiratory

Table C-56
Health Risk Calculations from Non-Biogas Emergency Engines

Non-Biogas Emergency Engine Carcinogenic Health Risk

Facility	Combined Facilty Engine Power,[a] bhp	Existing Engine Size,[b] bhp	Diesel Engine Replacement Size,[c] bhp	Number of Diesel Engines[d]	Receptor Distance,[e] m	ARB Single Engine Carcinogenic Health Risk[f] (millions)	Residential Carcinogenic Health Risk[g] (millions)	Worker Carcinogenic Health Risk[h] (millions)	MICR[i]	Mitigated MICR[j]	Chronic Hazard Index[k]
Facility C	28,976	five 5000, two 738	2,600	11	50	4	44.6	8.92	8.9		0.034
Facility D	10,000	five 2000	2,600	4	1,000	1	3.8	0.77	3.8		0.003
Facility E	11,175	3200, 3000, five 995	2,600	4	300	2	8.6	1.72	1.7		0.007
Facility F	6,000	three 2000	2,600, 750	two 2600, 750	40	4, 10	18.0	3.60	18.0	4.5	0.014
Facility G	3,804	six 634	2,600, 1,500	2,600, 1,500	30	12	12.0	2.40	2.4		0.009

a) Combined facility engine power - the sum of the bhp of the engines at a single facility
b) Existing engine size, bhp from survey information
c) Diesel engine replacement size was based on sizes available in the ARB "Hot Spots" Stationary Diesel Engine Screening Risk Assessment Tables (http://www.arb.ca.gov/ab2588/diesel/diesel.htm)
d) Number of engines is the number of ARB modeled engines that would be required to match the combined facility engine power. The largest stationary diesel emergency engine are around 3,000 bhp.
e) Receptor distances approximated from aerial photos on Google maps (www.maps.google.com)
f) Carcinogenic health risk associated with receptor distance and health risk in ARB diesel engine HRA tables for a single engine operating 50 hours per year.
g) Carcinogenic risk scaled to number of engines.
h) Worker carcinogenic health risk estimated by dividing residential heath risk by a factor of five.
i) The maximum exposed individual (residential or worker) based on information found in Google maps and Metrobot (http://streets.metrogbot.com)
j) ARB has validated diesel particulate filters for stationary ICE as at least 85 percent efficient.
k) Chronic HI = (residential carcinogenic health risk x AT)/(REF x CP x DBR x EF x ED), where AT = 25,550 days, diesel REF = 5 ug/m3, CP 1.1 mg/kg-day, DBR = 302 L/kg-day, EF = 350 days/year , ED = 70 years

Table C-57
ARB's Diesel Exhaust PM Risk (Potential Cancer Cases in a Million) for 750 BHP Engines

EF = 0.15 g/bhp-hr										
Downwind Distance (m)										
20	30	40	**50**	70	100	200	400	800	1200	1600
2	2	2	2	2	1	0	0	0	0	0
4	4	4	4	3	2	1	0	0	0	0
6	6	6	6	5	3	1	0	0	0	0
8	8	8	8	7	4	1	0	0	0	0
10	10	10	10	8	5	2	0	0	0	0
20	20	20	20	16	11	3	1	0	0	0
30	30	30	30	25	16	5	1	0	0	0
40	40	40	40	33	21	7	2	0	0	0
61	61	61	61	49	32	10	3	1	0	0
81	81	81	81	66	42	13	3	1	0	0
101	101	101	101	82	53	17	4	1	0	0
202	202	202	202	164	106	33	8	2	1	1

ARB "Hot Spots" Stationary Diesel Engine Screening Risk Assessment Tables (http://www.arb.ca.gov/ab2588/diesel/diesel.htm)

Table C-58
ARB's Diesel Exhaust PM Risk (Potential Cancer Cases in a Million) for 1,500 BHP Engines

EF = 0.15 g/bhp-hr														
Downwind Distance (m)														
20	30	40	50	60	70	80	90	100	200	300	400	800	1200	1600
2	2	2	2	2	2	2	2	1	1	0	0	0	0	0
3	3	3	3	3	3	3	3	3	2	1	0	0	0	0
5	5	5	5	5	5	5	5	4	2	1	1	0	0	0
6	6	6	6	6	6	6	6	6	3	2	1	0	0	0
8	8	8	8	8	8	8	8	7	4	2	1	0	0	0
15	15	15	15	15	15	15	15	15	8	4	2	1	0	0
23	23	23	23	23	23	23	23	22	12	6	4	1	0	0
30	30	30	30	30	30	30	30	30	16	8	5	1	1	0
45	45	45	45	45	45	45	45	45	24	12	7	2	1	1
60	60	60	60	60	60	60	60	60	31	16	10	2	1	1
75	75	75	75	75	75	75	75	75	39	20	12	3	1	1
151	151	151	151	151	151	151	151	150	78	41	24	6	3	2

ARB "Hot Spots" Stationary Diesel Engine Screening Risk Assessment Tables (http://www.arb.ca.gov/ab2588/diesel/diesel.htm)

Table C-59
ARB's Diesel Exhaust PM Risk (Potential Cancer Cases in a Million) for 2,600 BHP Engines

EF = 0.15 g/bhp-hr											
Downwind Distance (m)											
50	80	100	120	**150**	175	200	280	370	400	800	1600
1	1	1	1	1	1	1	1	0	0	0	0
2	2	2	2	2	2	2	1	1	1	0	0
3	3	3	3	3	3	3	2	1	1	0	0
4	4	4	4	4	4	3	2	2	1	0	0
4	4	4	4	4	4	4	3	2	2	1	0
9	9	9	9	9	9	8	6	4	4	1	0
13	13	13	13	13	13	12	9	6	5	2	1
18	18	18	18	18	17	16	12	8	7	2	1
26	26	26	26	26	26	25	18	12	11	3	1
35	35	35	35	35	35	33	24	16	14	4	1
44	44	44	44	44	44	41	30	20	18	5	2
88	88	88	88	88	87	82	59	40	36	10	3

ARB "Hot Spots" Stationary Diesel Engine Screening Risk Assessment Tables (http://www.arb.ca.gov/ab2588/diesel/diesel.htm)

Table C-60
Health Risk Calculations from Biogas SCR Ammonia Slip

Chronic Non-Carcinogenic Health Risk

Facility ID	No of Engines	Single Unit Emissions, lb/yr	Facility NH3 Emissions, ton/yr	X/Q, (ug/m3)/ (tons/yr)	Met Factor	Muti-Pathway Factor	Reference Exposure Level, ug/m3	Chronic Hazard Index
Facility A	5	2,255	5.637	49.68	0.69	1	2.00E+02	0.97

Chronic Hazard Index = (Facility DPM Emissions, ton/yr x X/Q, (ug/m3)/ (tons/yr) x Met Factor x Multi-Pathway Factor)/(Reference Exposure Level, ug/m3)

Acute Non-Carcinogenic Health Risk

Facility	No of Engines	Single Unit Emissions, lb/yr	Facility NH3 Emissions, lb/hr	X/Q, (ug/m3)/ (lb/hr)	Reference Exposure Level, ug/m3	Acute Hazard Index
Facility A	5	2,255	1.29	1000	3.20E+03	0.40

Acute Hazard Index = (Facility DPM Emissions, lb/hr x X/Q, (ug/m3)/ (lb/hr) x Met Factor x Multi-Pathway Factor)/(Reference Exposure Level, ug/m3)

Table C-61
LNG Calculations

Facility ID No.	Total LNG, MMBtu/year	Total LNG, gal/yr	LNG, gal/wk	LNG, gal/dy	LNG, cf/day	LNG, lb/day	LNG, lb/five days	LNG, gal/5 days
Facility 1	7,409	83,242	1,601	228	30	0	0	1,140
Facility 2	11,785	132,411	2,546	363	48	1,285	6,426	1,814
Facility 3	71,546	803,888	15,459	2,202	294	7,802	39,011	11,012
Facility 4	58,214	654,085	12,579	1,792	240	6,348	31,741	8,960
Facility 5	26,222	294,630	5,666	807	108	2,860	14,298	4,036
Facility 6	22,991	258,324	4,968	708	95	2,507	12,536	3,539
Facility 7	24,931	280,127	5,387	767	103	2,719	13,594	3,837
Facility 8	150,052	1,685,975	32,423	4,619	617	16,363	81,817	23,096
Facility 9	280,256	3,148,948	60,557	8,627	1,153	30,562	152,812	43,136
Facility 10	119,352	1,341,034	25,789	3,674	491	13,016	65,078	18,370
Facility 11	60,486	679,619	13,070	1,862	249	6,596	32,980	9,310
Facility 12	419,715	4,715,897	90,690	12,920	1,727	45,770	228,852	64,601
Facility 13	251,532	2,826,202	54,350	7,743	1,035	27,430	137,150	38,715
Facility 14	114,236	1,283,547	24,684	3,517	470	12,458	62,288	17,583
Facility 15	8,525	95,784	1,842	262	35	930	4,648	1,312
Facility 16	51,845	582,530	11,203	1,596	213	5,654	28,269	7,980
Facility 17	304,962	3,426,539	65,895	9,388	1,255	33,257	166,283	46,939
Facility 18	178,374	2,004,202	38,542	5,491	734	19,452	97,260	27,455
Facility 19	9,548	107,278	2,063	294	39	1,041	5,206	1,470
Facility 20	3,527	39,624	762	109	15	385	1,923	543
Facility 21	4,018	45,149	868	124	17	438	2,191	618
Facility 22	13,393	150,485	2,894	412	55	1,461	7,303	2,061
Facility 23	369,900	4,156,180	79,927	11,387	1,522	40,338	201,691	56,934
Total	2,562,817	28,712,460	552,163	78,664	10,516	278,671	1,393,355	393,321

89,000 Btu/gal
Facilities listed in Table C-61 are not necessarily the same as in Tables C-53 and C-54.

Table C-62
Health Risk Calculations from LNG Truck Delivery

Carcinogenic Health Risk

Facility DPM Emissions, ton/yr	X/Q, (ug/m3)/(tons /yr)	Met Factor	Annual Conc, Adjustment Factor	Daily Breathing Rate, L/kg-day	Exposure Value Factor	Muti-Pathway Factor	Cancer Potency Factor, , $(mg/kg\text{-}day)^{-1}$	Carcinogenic Health Risk
2.09E-06	2.98	1	1	302	0.96	1	1.1	1.99E-09

MICR = Cancer Potency Factor, $(mg/kg\text{-}day)^{-1}$ x Facility DPM Emissions, ton/year x X/Q, (g/m3)/(tons/yr)x Annual Conc, Adjustment Factor x Met Factor x Daily Breathing Rate, L/kg-day x Exposure Value Factor x Muti-Pathway Factor]/ (1,000,000 ug/mg)

Chronic Non-Carcinogenic Health Risk

Facility DPM Emissions, ton/yr	Facility, lb/hr	X/Q, (ug/m3)/ (tons/yr)	Met Factor	Reference Exposure Level, ug/m3	Met Factor	Chronic Hazard Index
2.09E-06	2.17E-04	41.45	1	5.00E+00	1	1.80E-03

Chronic Hazard Index = (Facility DPM Emissions, ton/yr x X/Q, (ug/m3)/ (tons/yr) x Met Factor x Multi-Pathway Factor)/(Reference Exposure Level, ug/m3)

Table C-63
Example RMP*COMP Input File for a Bermed Ammonia Storage Tank

RMP*Comp Ver. 1.07
Results of Consequence Analysis

Chemical: Ammonia (water solution) 20%
CAS #: 7664-41-7
Category: Toxic Liquid
Scenario: Worst-case
Quantity Released: 5500 gallons
Liquid Temperature: 25 C

Mitigation Measures:
Diked area: 267 square feet
Dike height: 3 feet

Release Rate to Outside Air: 5.61 pounds per minute
Topography: Rural surroundings (terrain generally flat and unobstructed)
Toxic Endpoint: 0.14 mg/L; basis: ERPG-2
Estimated Distance to Toxic Endpoint: 0.1 miles (0.2 kilometers)

--------Assumptions About This Scenario---------
Wind Speed: 1.5 meters/second (3.4 miles/hour)
Stability Class: F
Air Temperature: 77 degrees F (25 degrees C)

--

Table C-64
Example RMP*COMP Input File for a Bermed LNG Storage Tank

RMP*Comp Ver. 1.07
Results of Consequence Analysis

Chemical: Methane
CAS #: 74-82-8
Category: Flammable Gas
Scenario: Worst-case
Liquefied by refrigeration
Quantity Released: 71000 gallons
Release Type: Vapor Cloud Explosion
Mitigation Measures:
Diked area: 3480 square feet
Dike height: 3 feet

Release Rate to Outside Air: 731 pounds per minute
Quantity Evaporated in 10 Minutes: 7310 pounds
Estimated Distance to 1 psi overpressure: .2 miles (.3 kilometers)

Table C-64 (Concluded)
Example RMP*COMP Input File for a Bermed LNG Storage Tank

--------Assumptions About This Scenario---------
Wind Speed: 1.5 meters/second (3.4 miles/hour)
Stability Class: F
Air Temperature: 77 degrees F (25 degrees C)

Table C-65
Example RMP*COMP Input File for Delivery Truck

RMP*Comp Ver. 1.07
Results of Consequence Analysis

Chemical: Methane
CAS #: 74-82-8
Category: Flammable Gas
Scenario: Worst-case
Liquefied by refrigeration
Quantity Released: 10000 gallons
Release Type: Vapor Cloud Explosion
Mitigation Measures: NONE
Estimated Distance to 1 psi overpressure: .3 miles (.4 kilometers)

--------Assumptions About This Scenario---------
Wind Speed: 1.5 meters/second (3.4 miles/hour)
Stability Class: F
Air Temperature: 77 degrees F (25 degrees C)

Table C-66
Example RMP*COMP Input File for Delivery Truck Pool Fire

RMP*Comp Ver. 1.07
Results of Consequence Analysis

Chemical: Methane
CAS #: 74-82-8
Category: Flammable Gas
Scenario: Alternative
Liquefied by refrigeration
Release Duration: 1 minutes
Release Type: Pool Fire
Release Rate: 6000 gallons per min
Mitigation Measures: NONE
Topography: Rural surroundings (terrain generally flat and unobstructed)
Estimated Distance to Heat Radiation Endpoint (5 kilowatts/square meter): .2 miles (.3 kilometers)

Table C-66 (Concluded)
Example RMP*COMP Input File for Delivery Truck Pool Fire

--------Assumptions About This Scenario---------
Wind Speed: 3 meters/second (6.7 miles/hour)
Stability Class: D
Air Temperature: 77 degrees F (25 degrees C)

Table C-67
Example RMP*COMP Input File for Delivery Boiling Liquid Expanding Vapor Explosion

RMP*Comp Ver. 1.07
Results of Consequence Analysis

Chemical: Methane
CAS #: 74-82-8
Category: Flammable Gas
Scenario: Alternative
Liquefied by refrigeration
Release Type: BLEVE
Quantity in Fireball: 10000 gallons
Estimated Distance at which exposure may cause second-degree burns: .3 miles (.4 kilometers)

--------Assumptions About This Scenario---------
Wind Speed: 3 meters/second (6.7 miles/hour)
Stability Class: D
Air Temperature: 77 degrees F (25 degrees C)

Table C-68
LNG or NH3 Hypothetical* Accidental Release Impacts to Airports and Airfields

Airports	**Estimated NH3 Tank Size (gal)**	**Estimated LNG Tank Size (gal)**	**Distance to Airport (mile)**	**Distance to Toxic Endpoint (mile)**	**Significant for NH3**	**Distance to 1 psi overpressure, (mile)**	**Significant for LNG**
Riverside Municipal	5,500	4,500	0.51	0.01	No	0.06	No
Ontario International	5,500	10,000	0.92	0.01	No	0.08	No
San Bernardino International	5,500	11,000	0.52	0.01	No	0.09	No
Whiteman, LA County	5,500	71,000	1.45	0.01	No	0.2	No
Rialto Municipal	5,500	8,000	0.49	0.01	No	0.08	No
Ontario International	5,500	8,000	1.58	0.01	No	0.08	No
Chino Airport	5,500	1,500	0.32	0.01	No	0.04	No
Burbank	5,500	52,000	1.18	0.01	No	0.1	No
Whiteman, LA County	5,500	21,000	1.97	0.01	No	0.1	No

Note: Biogas facilities will either install add-on control and potential have NH3 adverse impacts or replace ICEs with LNG plants but not both. Therefore the adverse impacts would not overlap from the same facility. No biogas facility is within two miles of another.
*None of these facilities have indicated their compliance option.

Table C-69
LNG or NH3 Hypothetical* Accidental Release Impacts to Schools

Name of School	**Estimated NH3 Tank Size (gal)**	**Estimated LNG Tank Size (gal)**	**Distance to School (mile)**	**Distance to Toxic Endpoint (mile)**	**Significant for NH3**	**Distance to 1 psi overpressure, (mile)**	**Significant for LNG**
St. Edward the Confessor Parish	5,500	2,000	0.39	0.01	No	0.05	No
Capo Beach Calvary Schools			0.41	0.01	No	0.05	No
El Potrero Elementary	5,500	600	0.36	0.01	No	0.08	No

Note: Biogas facilities will either install add-on control and potential have NH3 adverse impacts or replace ICEs with LNG plants but not both. Therefore the adverse impacts would not overlap from the same facility. No biogas facility is within two miles of another.
*None of these facilities have indicated their compliance option.

Table C-70
LNG or NH3 Hypothetical* Accidental Release Impacts to Other Non-Residential Sensitive Receptors

Name of Sensitive Receptor	Estimated NH3 Tank Size (gal)	Estimated LNG Tank Size (gal)	Distance to School (mile)	Distance to Toxic Endpoint (mile)	Significant for NH3	Distance to 1 psi overpressure, (mile)	Significant for LNG
Childtime Children's Ctr	5,500	4,500	0.31	0.01	No	0.06	No

Note: Biogas facilities will either install add-on control and potential have NH3 adverse impacts or replace ICEs with LNG plants but not both. Therefore the adverse impacts would not overlap from the same facility. No biogas facility is within two miles of another.
*None of these facilities have indicated their compliance option.

Table C-71
Solid Waste Adverse Impacts

Upgrade Three-Way Catalyst	Install Cat Ox	Engines that May Be Electrified	Biogas Engines that May Be Replaced	SCR	Non-Biogas Electric Engine, lb	Biogas Electric Engine, lb	New Cat Ox, lb	New Cat Ox Number of Trucks Required	Upgrade Cat Ox, lb	Upgrade Number of Trucks Required	Carbon,, lb	Carbon No of Trucks Required	SCR, lb	SCR Number of Trucks Required
217	114	225	66	66	1,888,014	924,205	90,669	156	28,540	214	231,281	148	72,175	119

Solid and Hazardous Waste Disposed (in tons)

Description	Total	Upgrade	New Cat	SCR
Solid Waste	1,522			
Hazardous Waste Disposed		14.3	45.3	36.1

Table C-72
Alternative B Total Construction Criteria Emissions

SCR-Construction

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	CO2, ton/year
2008	89.8	42.1	12.0	0.08	5.0	4.6	630
2009	88.9	39.5	11.1	0.08	4.7	4.4	36.5
2010	141.4	61.8	17.6	0.13	7.4	6.9	203
2011	247	106	30.4	0.23	12.9	11.9	727
2012	52.5	22.3	6.4	0.05	2.7	2.5	73.0

Gas Turbines - Construction

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	CO2, ton/year
2008	89.8	42.1	12.0	0.08	5.0	4.6	630
2009	88.9	39.5	11.1	0.08	4.7	4.4	36.5
2010	141.4	61.8	17.6	0.13	7.4	6.9	203
2011	247	106	30.4	0.23	12.9	11.9	727
2012	52.5	22.3	6.4	0.05	2.7	2.5	73.0

Microturbines - Construction

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	CO2, ton/year
2008	89.8	42.1	12.0	0.08	5.0	4.6	630
2009	88.9	39.5	11.1	0.08	4.7	4.4	36.5
2010	141.4	61.8	17.6	0.13	7.4	6.9	203
2011	247	106	30.4	0.23	12.9	11.9	727
2012	52.5	22.3	6.4	0.05	2.7	2.5	73.0

Gas Turbines/LNG - Construction

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	CO2, ton/year
2008	89.8	42.1	12.0	0.08	5.0	4.6	630
2009	88.9	39.5	11.1	0.08	4.7	4.4	36.5
2010	141.4	61.8	17.6	0.13	7.4	6.9	203
2011	682	291	84.1	0.60	48.4	35.6	2,371
2012	488	206.6	60.2	0.43	38.3	26.2	1,718

Table C-72 (Concluded)
Alternative B Total Construction Criteria Emissions

Microturbines/LNG - Construction

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	CO2, ton/year
2008	90	42.1	12.0	0.08	5.0	4.6	630
2009	88.9	39.5	11.1	0.08	4.7	4.4	36.5
2010	141.4	61.8	17.6	0.13	7.4	6.9	203
2011	682	291	84.1	0.60	48.4	35.6	2,371
2012	488	206.6	60.2	0.43	38.3	26.2	1,718

Table C-73
Alternative B Total Operational Criteria Emissions

SCR - Total Operational Emissions

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
Baseline	9,195	54,243	2,493	551	877	875	~~1,250,047~~
2008	~~8,999~~ 9,004	~~53,867~~ 53,900	~~2,458~~ 2,467	~~544~~ 545	~~872~~ 873	~~870~~ 871	~~1,227,230~~ -
2009	~~6,410~~ 6,415	~~22,399~~ 22,432	~~1,790~~ 1,799	~~543~~ 544	~~858~~ 859	~~856~~ 857	~~1,231,763~~ -
2010	~~5,862~~ 5,867	~~17,323~~ 17,356	~~1,280~~ 1,289	~~534~~ 535	~~837~~ 838	~~835~~ 836	~~1,208,248~~ -
2011	~~5,349~~ 5,354	~~13,511~~ 13,544	~~1,209~~ 1,218	~~528~~ 529	~~821~~ 822	~~819~~ 820	~~1,196,641~~ -
2012	4,129	13,459	1,013	538	830	829	~~1,231,572~~
2014	4,188	13,477	1,018	538	833	831	~~1,231,599~~

Gas Turbines - Total Operational Emissions

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
Baseline	9,195	54,243	2,493	551	877	875	~~1,250,047~~
2008	~~8,999~~ 9,004	~~53,867~~ 53,900	~~2,458~~ 2,467	~~544~~ 545	~~872~~ 873	~~870~~ 871	~~1,227,230~~ -
2009	~~6,410~~ 6,415	~~22,399~~ 22,432	~~1,790~~ 1,799	~~543~~ 544	~~858~~ 859	~~856~~ 857	~~1,231,763~~ -
2010	~~5,862~~ 5,867	~~17,323~~ 17,356	~~1,280~~ 1,289	~~534~~ 535	~~837~~ 838	~~835~~ 836	~~1,208,248~~ -
2011	~~5,343~~ 5,348	~~13,509~~ 13,542	~~1,209~~ 1,218	~~528~~ 529	~~821~~ 822	~~819~~ 820	~~1,196,710~~ -
2012	4,829	7,394	535	538	1,016	1,014	~~1,231,248~~
2014	4,888	7,412	540	538	1,019	1,017	~~1,231,248~~

Table C-73 (Contined)
Alternative B Total Operational Criteria Emissions

Microturbines - Total Operational Emissions

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
Baseline	9,195	54,243	2,493	551	877	875	~~1,250,047~~
2008	~~8,999~~	~~53,867~~	~~2,458~~	~~544~~	~~872~~	~~870~~	~~1,227,230~~
	9,004	53,900	2,467	545	873	871	-
2009	~~6,410~~	~~22,399~~	~~1,790~~	~~543~~	~~858~~	~~856~~	~~1,231,763~~
	6,415	22,432	1,799	544	859	857	-
2010	~~5,862~~	~~17,323~~	~~1,280~~	~~534~~	~~837~~	~~835~~	~~1,208,248~~
	5,867	17,356	1,289	535	838	836	-
2011	~~5,343~~	~~13,509~~	~~1,209~~	~~528~~	~~821~~	~~819~~	~~1,196,710~~
	5,348	13,542	1,218	529	822	820	-
2012	3,864	6,206	641	538	757	756	~~1,231,362~~
2014	3,923	6,224	645	538	760	758	~~1,231,362~~

Gas Turbines/LNG - Total Operational Emissions

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
Baseline	9,195	54,243	2,493	551	877	875	~~1,250,047~~
2008	~~8,999~~	~~53,867~~	~~2,458~~	~~544~~	~~872~~	~~870~~	~~1,227,230~~
	9,004	53,900	2,467	545	873	871	-
2009	~~6,440~~	~~23,215~~	~~1,814~~	~~543~~	~~860~~	~~858~~	~~1,232,969~~
	6,445	23,248	1,823	544	861	859	-
2010	~~5,862~~	~~17,323~~	~~1,280~~	~~534~~	~~837~~	~~835~~	~~1,208,248~~
	5,867	17,356	1,289	535	838	836	-
2011	~~5,394~~	~~13,525~~	~~1,213~~	~~528~~	~~823~~	~~821~~	~~1,196,943~~
	5,399	13,558	1,222	529	824	822	-
2012	4,258	6,539	526	211	872	870	~~1,093,200~~
2014	4,377	6,576	535	211	878	876	~~1,093,528~~

Table C-73 (Concluded)
Alternative B Total Operational Criteria Emissions

Microturbines/LNG - Total Operational Emissions

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
Baseline	9,195	54,243	2,493	551	877	875	~~1,250,047~~
2008	~~8,999~~ 9,004	~~53,867~~ 53,900	~~2,458~~ 2,467	~~544~~ 545	~~872~~ 873	~~870~~ 871	~~1,227,230~~ -
2009	~~6,410~~ 6,415	~~22,399~~ 22,432	~~1,790~~ 1,799	~~543~~ 544	~~858~~ 859	~~856~~ 857	~~1,231,763~~ -
2010	~~5,862~~ 5,867	~~17,323~~ 17,356	~~1,280~~ 1,289	~~534~~ 535	~~837~~ 838	~~835~~ 836	~~1,208,248~~ -
2011	~~5,394~~ 5,399	~~13,525~~ 13,558	~~1,213~~ 1,222	~~528~~ 529	~~823~~ 824	~~821~~ 822	~~1,196,943~~ -
2012	3,874	6,075	572	211	767	765	~~1,093,308~~
2014	3,993	6,111	581	211	773	771	~~1,093,637~~

Table C-74
Alternative B Total Criteria Emissions

SCR - Total

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	CO2, ton/year
2008	~~9,089~~	~~53,909~~	~~2,470~~	~~543.9~~	~~876.8~~	~~874.7~~	~~1,227,861~~
	9,094	53,942	2,479	545	878	876	
2009	~~6,410~~	~~22,399~~	~~1,790~~	~~543~~	~~858~~	~~856~~	~~1,231,763~~
	6,415	22,432	1,799	544	859	857	
2010	~~6,004~~	~~17,385~~	~~1,297~~	~~534~~	~~844~~	~~842~~	~~1,208,451~~
	6,009	17,418	1,306	535	845	843	
2011	~~5,595~~	~~13,617~~	~~1,240~~	~~529~~	~~834~~	~~831~~	~~1,197,367~~
-	5,600	13,650	1,249	530	835	832	
2012	4,181	13,481	1,020	538	833	831	1,231,645
2014	4,188	13,477	1,018	538	833	831	1,231,599

Table C-74 (Continued)
Alternative B Total Criteria Emissions

Gas Turbines - Total

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
2008	~~9,089~~ 9,094	~~53,909~~ 53,942	~~2,470~~ 2,479	~~543.9~~ 545	~~876.8~~ 878	~~874.7~~ 876	~~1,227,861~~
2009	~~6,410~~ 6,415	~~22,399~~ 22,432	~~1,790~~ 1,799	~~543~~ 544	~~858~~ 859	~~856~~ 857	~~1,231,763~~
2010	~~6,004~~ 6,009	~~17,385~~ 17,418	~~1,297~~ 1,306	~~534~~ 535	~~844~~ 845	~~842~~ 843	~~1,208,451~~
2011	~~5,589~~ 5,594	~~13,616~~ 13,649	~~1,239~~ 1,248	~~529~~ 530	~~833~~ 834	~~831~~ 832	~~1,197,436~~
2012	4,882	7,416	542	538	1,019	1,017	~~1,231,321~~
2014	4,888	7,412	540	538	1,019	1,017	~~1,231,248~~

Microturbines - Total

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
2008	~~9,089~~ 9,094	~~53,909~~ 53,942	~~2,470~~ 2,479	~~543.9~~ 545	~~876.8~~ 878	~~874.7~~ 876	~~1,227,861~~
2009	~~6,410~~ 6,415	~~22,399~~ 22,432	~~1,790~~ 1,799	~~543~~ 544	~~858~~ 859	~~856~~ 857	~~1,231,763~~
2010	~~6,004~~ 6,009	~~17,385~~ 17,418	~~1,297~~ 1,306	~~534~~ 535	~~844~~ 845	~~842~~ 843	~~1,208,451~~
2011	~~5,589~~ 5,594	~~13,616~~ 13,649	~~1,239~~ 1,248	~~529~~ 530	~~833~~ 834	~~831~~ 832	~~1,197,436~~
2012	3,917	6,228	647	538	760	758	~~1,231,435~~
2014	3,923	6,224	645	538	760	758	~~1,231,362~~

Gas Turbines/LNG - Total

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
2008	~~9,089~~ 9,094	~~53,909~~ 53,942	~~2,470~~ 2,479	~~543.9~~ 545	~~876.8~~ 878	~~874.7~~ 876	~~1,227,861~~
2009	~~6,410~~ 6,415	~~22,399~~ 22,432	~~1,790~~ 1,799	~~543~~ 544	~~858~~ 859	~~856~~ 857	~~1,231,763~~
2010	~~6,004~~ 6,009	~~17,385~~ 17,418	~~1,297~~ 1,306	~~534~~ 535	~~844~~ 845	~~842~~ 843	~~1,208,451~~
2011	~~6,076~~ 6,081	~~13,816~~ 13,849	~~1,297~~ 1,306	~~529~~ 530	~~872~~ 873	~~857~~ 858	~~1,199,314~~
2012	4,746	6,746	586	211	911	896	~~1,094,918~~
2014	4,377	6,576	535	211	878	876	~~1,093,528~~

Table C-74 (Concluded)
Alternative B Total Criteria Emissions

Microturbines/LNG - Total

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
2008	~~9,089~~ 9,094	~~53,909~~ 53,942	~~2,470~~ 2,479	~~543.9~~ 545	~~876.8~~ 878	~~874.7~~ 876	~~1,231,763~~
2009	~~6,410~~ 6,415	~~22,399~~ 22,432	~~1,790~~ 1,799	~~543~~ 544	~~858~~ 859	~~856~~ 857	~~1,208,451~~
2010	~~6,004~~ 6,009	~~17,385~~ 17,418	~~1,297~~ 1,306	~~534~~ 535	~~844~~ 845	~~842~~ 843	~~1,199,314~~
2011	~~6,076~~ 6,081	~~13,816~~ 13,849	~~1,297~~ 1,306	~~529~~ 530	~~872~~ 873	~~857~~ 858	~~1,199,314~~
2012	4,362	6,281	632	211	805	791	~~1,095,026~~
2014	3,993	6,111	581	211	773	771	~~1,093,637~~

Table C-75
Alternative B Total Compared to Baseline

SCR - Total Compared to Baseline

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
2008	~~(106)~~ (100)	~~(334)~~ (301)	~~(22)~~ (14)	~~(7.5)~~ (6.9)	~~(0.1)~~ 0.8	~~0.4~~ 0.4	~~(22,186)~~
2009	~~(3,191)~~ (3,185)	~~(36,858)~~ (36,825)	~~(1,196)~~ (1,187)	~~(17)~~ (17)	~~(33)~~ (32)	~~(33)~~ (32)	~~(41,596)~~
2010	~~(3,191)~~ (3,185)	~~(36,858)~~ (36,825)	~~(1,196)~~ (1,187)	~~(17)~~ (17)	~~(33)~~ (32)	~~(33)~~ (32)	~~(41,596)~~
2011	~~(3,600)~~ (3,594)	~~(40,626)~~ (40,593)	~~(1,253)~~ (1,244)	~~(23)~~ (22)	~~(43)~~ (42)	~~(44)~~ (43)	~~(52,679)~~
2012	(5,013)	(40,762)	(1,473)	(13)	(44)	(44)	~~(18,402)~~
2014	(5,007)	(40,766)	(1,475)	(13)	(44)	(44)	~~(18,448)~~

Table C-75 (Continued)
Alternative B Total Compared to Baseline

Gas Turbines - Total Compared to Baseline

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
2008	~~(106)~~ (100)	~~(334)~~ (301)	~~(22)~~ (14)	~~(7.5)~~ (6.9)	~~(0.1)~~ 0.8	~~0.4~~ 0.4	~~(22,186)~~
2009	~~(3,191)~~ (3,185)	~~(36,858)~~ (36,825)	~~(1,196)~~ (1,187)	~~(17)~~ (17)	~~(33)~~ (32)	~~(33)~~ (32)	~~(41,596)~~
2010	~~(3,191)~~ (3,185)	~~(36,858)~~ (36,825)	~~(1,196)~~ (1,187)	~~(17)~~ (17)	~~(33)~~ (32)	~~(33)~~ (32)	~~(41,596)~~
2011	~~(3,605)~~ (3,600)	~~(40,627)~~ (40,594)	~~(1,253)~~ (1,245)	~~(23)~~ (22)	~~(43)~~ (43)	~~(44)~~ (43)	~~(52,610~~
2012	(4,313)	(46,827)	(1,951)	(13)	142	142	~~(18,725)~~
2014	(4,307)	(46,831)	(1,953)	(13)	142	142	~~(18,798)~~

Microturbines - Total Compared to Baseline

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	CO2, ton/year
2008	~~(106)~~ (100)	~~(334)~~ (301)	~~(22)~~ (14)	~~(7.5)~~ (6.9)	~~(0.1)~~ 0.8	~~0.4~~ 0.4	(22,186)
2009	~~(3,191)~~ (3,185)	~~(36,858)~~ (36,825)	~~(1,196)~~ (1,187)	~~(17)~~ (17)	~~(33)~~ (32)	~~(33)~~ (32)	(41,596)
2010	~~(3,191)~~ (3,185)	~~(36,858)~~ (36,825)	~~(1,196)~~ (1,187)	~~(17)~~ (17)	~~(33)~~ (32)	~~(33)~~ (32)	(41,596)
2011	~~(3,605)~~ (3,600)	~~(40,627)~~ (40,594)	~~(1,254)~~ (1,245)	~~(23)~~ (22)	~~(43)~~ (43)	~~(44)~~ (43)	(52,610)
2012	(5,278)	(48,015)	(1,846)	(13)	(117)	(117)	(18,611)
2014	(5,272)	(48,019)	(1,848)	(13)	(117)	(117)	(18,684)

Gas Turbines/LNG - Total Compared to Baseline

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
2008	~~(106)~~ (100)	~~(334)~~ (301)	~~(22)~~ (14)	~~(7.5)~~ (6.9)	~~(0.1)~~ 0.8	~~0.4~~ 0.4	~~(22,186)~~
2009	~~(3,191)~~ (3,185)	~~(36,858)~~ (36,825)	~~(1,196)~~ (1,187)	~~(17)~~ (17)	~~(33)~~ (32)	~~(33)~~ (32)	~~(41,596)~~
2010	~~(3,191)~~ (3,185)	~~(36,858)~~ (36,825)	~~(1,196)~~ (1,187)	~~(17)~~ (17)	~~(33)~~ (32)	~~(33)~~ (32)	~~(41,596)~~
2011	~~(3,119)~~ (3,113)	~~(40,427)~~ (40,394)	~~(1,196)~~ (1,187)	~~(22)~~ (22)	~~(5)~~ (4)	~~(18)~~ (17)	~~(50,732)~~
2012	(4,449)	(47,497)	(1,907)	(340)	33.6	21.28	~~(155,129)~~
2014	(4,818)	(47,667)	(1,957)	(340)	1.2	0.73	~~(156,519)~~

Table C-75 (Concluded)
Alternative B Total Compared to Baseline

Microturbines/LNG - Total Compared to Baseline

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
2008	~~(106)~~ (100)	~~(334)~~ (301)	~~(22)~~ (14)	~~(7.5)~~ (6.9)	~~(0.1)~~ 0.8	~~0.4~~ 0.4	~~(22,186)~~
2009	~~(3,191)~~ (3,185)	~~(36,858)~~ (36,825)	~~(1,196)~~ (1,187)	~~(17)~~ (17)	~~(33)~~ (32)	~~(33)~~ (32)	~~(41,596~~
2010	~~(3,191)~~ (3,185)	~~(36,858)~~ (36,825)	~~(1,196)~~ (1,187)	~~(17)~~ (17)	~~(33)~~ (32)	~~(33)~~ (32)	~~(41,596~~
2011	~~(3,119)~~ (3,113)	~~(40,427)~~ (40,394)	~~(1,196)~~ (1,187)	~~(22)~~ (22)	~~(5)~~ (4)	~~(18)~~ (17)	~~(50,732)~~
2012	(4,833)	(47,962)	(1,861)	(340)	(72)	(84)	~~(155,020)~~
2014	(5,202)	(48,132)	(1,912)	(340)	(104)	(104)	~~(156,410)~~

Table C-76
Estimation of the Number of Electric Motor Replacements of Non-Biogas Engines Required for Alternative B to Be Carbon Neutral

SCR - Carbon Neutral Calculation

Description	Proposed Project CO2, ton/year	No Electrification CO2, ton/year	Reduction in CO2 from Electrification	Average CO2 Savings per Motor	Average No of Motor to Stay Carbon Neutral
Baseline					
2008	(22,186)	(22,186)	0		
2009	(41,596)	(23,363)	18,233		
2010	(41,596)	(23,363)	18,233		
2011	(52,679)	(22,016)	30,663		
2012	(18,402)	11,505	29,907		
2014	(18,448)	11,459	29,907		
2013-2018	(110,686)	68,753	179,439		
10 year total	(264,959)	11,516	276,475	1,636	8

Table C-76 (Continued)
Estimation of the Number of Electric Motor Replacements of Non-Biogas Engines Required for Alternative B to Be Carbon Neutral

Gas Turbines – Carbon Neutral Calculation

Description	Proposed Project CO2, ton/year	No Electrification CO2, ton/year	Reduction in CO2 from Electrification	Average CO2 Savings per Motor	Average No of Motor to Stay Carbon Neutral
Baseline					
2008	(22,186)	(22,186)	0		
2009	121,080	(23,363)	18,233		
2010	(41,596)	(23,363)	18,233		
2011	(52,610)	(21,947)	30,663		
2012	(18,725)	11,181	29,907		
2014	(18,798)	11,108	29,907		
2013-2018	(112,790)	66,649	179,439		
10 year total	(104,642)	9,157	113,799	673	14

Microturbines – Carbon Neutral Calculation

Description	Proposed Project CO2, ton/year	No Electrification CO2, ton/year	Reduction in CO2 from Electrification	Average CO2 Savings per Motor	Average No of Motor to Stay Carbon Neutral
Baseline					
2008	(22,186)	(22,186)	0		
2009	(41,596)	(23,363)	18,233		
2010	(41,596)	(23,363)	18,233		
2011	(52,610)	(21,947)	30,663		
2012	(18,611)	11,295	29,907		
2014	(18,684)	11,222	29,907		
2013-2018	(112,106)	67,333	179,439		
10 year total	(266,520)	9,955	276,475	1,636	7

Table C-76 (Concluded)
Estimation of the Number of Electric Motor Replacements of Non-Biogas Engines Required for Alternative B to Be Carbon Neutral

Gas Turbines/LNG - Carbon Neutral Calculation

Description	Proposed Project CO2, ton/year	No Electrification CO2, ton/year	Reduction in CO2 from Electrification	Average CO2 Savings per Motor	Average No of Motor to Stay Carbon Neutral
Baseline					
2008	(22,186)	(22,186)	0		
2009	(41,596)	(23,363)	18,233		
2010	(41,596)	(23,363)	18,233		
2011	(50,732)	(20,069)	30,663		
2012	(155,129)	(125,222)	29,907		
2014	(156,519)	(126,612)	29,907		
2013-2018	(939,112)	(759,672)	179,439		
10 year total	(1,228,165)	(951,690)	276,475	1,636	0

Microturbines/LNG - Carbon Neutral Calculation

Description	Proposed Project CO2, ton/year	No Electrification CO2, ton/year	Reduction in CO2 from Electrification	Average CO2 Savings per Motor	Average No of Motor to Stay Carbon Neutral
Baseline					
2008	(22,186)	(22,186)	0		
2009	(41,596)	(23,363)	18,233		
2010	(41,596)	(23,363)	18,233		
2011	(50,732)	(20,069)	30,663		
2012	(155,020)	(125,114)	29,907		
2014	(156,410)	(126,504)	29,907		
2013-2018	(938,462)	(759,022)	179,439		
10 year total	(1,227,406)	(950,932)	276,475	1,636	0

Table C-77
Summary of the Number of Electric Motor Replacements of Non-Biogas Engines Required for Alternative B to Be Carbon Neutral

Description	Proposed Project CO_2, ton/year	No Electrification CO_2, ton/year	Reduction in CO_2 from Electrification	Average CO_2 Savings per Motor	Average No of Motor to Stay Carbon Neutral
SCR	(264,959)	11,516	276,475	1,636	8
Replace ICE with Gas Turbine	(104,642)	9,157	113,799	673	14
Replace ICE Microturbine	(266,520)	9,955	276,475	1,636	7
Replace LFG w LNG, DG w Turbines	(1,228,165)	(951,690)	276,475	1,636	0
Replace LFG w LNG, DG w Microturbines	(1,227,406)	(950,932)	276,475	1,636	0

Table C-78
Summary of Alternative B Energy Effects Compared to Baseline

Description	Natural Gas Consumption, MMBtu/yr	Electricity Consumption, MWH/yr	Shaft Work Produced, Hp-Hrs/yr	Diesel Fuel Consumption, gal/yr	LNG Production, MMBtu/yr
SCR	(544,398)	174,100	(59,006)	31,152	
Gas Turbines	(474,039)	229,556	(15,123,937)	38,128	
Micro Turbines	(428,481)	273,408	(15,123,937)	41,241	
Gas Turbines/LNG	(201,395)	558,557	(15,123,937)	38,128	2,374,019
Microturbines/LNG	(181,719)	576,527	(15,123,937)	57,364	2,374,019

Table C-79
Number of Engines Affected by Alternative C

Engines	**2008**	**2009**	**2010**	**2011**	**Total**
Begin Increased Source Testing	473				**473**
Begin Inspection & Monitoring	473				**473**
Install Sampling Infrastructure	503				**503**
Install AFRC		34			**34**
Install CEMS - Engine Count		9	28	32	**69**
Install CEMS - CEMS Count		4	10	10	**24**
Install CO Analyzer			34	14	**48**

Table C-80
Number of Facilities Affected by Alternative C

Facilities	2008	2009	2010	2011	Total
Begin Increased Source Testing	242				**242**
Begin Inspection & Monitoring	242				**242**
Install Sampling Infrastructure	240				**240**
Install AFRC		16			**16**
Install CEMS		4	10	10	**24**
Install CO Analyzer			15	5	**20**

Table C-81
Alternative C Total Construction Emissions

Description	**NOx, lb/day**	**CO, lb/day**	**VOC, lb/day**	**SOx, lb/day**	**PM10, lb/day**	**PM2.5 lb/day**	**CO2, ton/year**
2008	119.7	56.2	16.0	0.11	6.6	6.1	790
2009	36.4	17.1	4.7	0.03	2.0	1.8	19.2
2010	36.4	17.1	4.7	0.03	2.0	1.8	31
2011	36	17	4.7	0.03	2.0	1.8	33

Table C-82
Alternative C Total Criteria Operational Emissions

Description	**NOx, lb/day**	**CO, lb/day**	**VOC, lb/day**	**SOx, lb/day**	**PM10, lb/day**	**PM2.5 lb/day**	**CO2, ton/year**
2005 Baseline	9,195	54,243	2,493	551	877	875	~~1,250,047~~
2008	~~9,032~~ 9,035	~~54,030~~ 54,048	~~2,473~~ 2,478	~~547~~ 547	~~874~~ 874	~~872~~ 872	~~1,237,072~~
2009	~~6,853~~ 6,856	~~22,683~~ 22,701	~~1,848~~ 1,853	~~547~~ 547	~~874~~ 874	~~872~~ 872	~~1,246,022~~
2010	~~6,828~~ 6,831	~~22,216~~ 22,234	~~1,514~~ 1,519	~~545~~ 545	~~872~~ 872	~~871~~ 871	~~1,238,771~~
2011	~~6,784~~ 6,787	~~21,972~~ 21,990	~~1,512~~ 1,517	~~545~~ 545	~~872~~ 872	~~871~~ 871	~~1,238,841~~

Table C-83
Alternative C Total Criteria Emissions

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO_2, ton/year~~
2008	~~9,152~~ 9,155	~~54,086~~ 54,104	~~2,489~~ 2,494	~~547~~ 547	~~880.8~~ 881.3	~~878.6~~ 879.1	~~1,237,862~~
2009	~~6,853~~ 6,856	~~22,683~~ 22,701	~~1,848~~ 1,853	~~547~~ 547	~~874.0~~ 874.5	~~872.0~~ 872.5	~~1,246,022~~
2010	~~6,864~~ 6,867	~~22,233~~ 22,251	~~1,519~~ 1,524	~~545~~ 545	~~874.0~~ 874.5	~~872.0~~ 872.5	~~1,238,803~~
2011	~~6,820~~ 6,823	~~21,989~~ 22,007	~~1,517~~ 1,522	~~545~~ 545	~~874.0~~ 874.5	~~872.0~~ 872.5	~~1,238,875~~

Table C-84
Alternative C Total Compared to Baseline

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO_2, ton/year~~
2008	~~(43)~~ (40)	~~(157)~~ (139)	~~(3)~~ 1	~~(5)~~ (4)	~~3.9~~ 4.4	~~3.4~~ 3.9	~~(12,184)~~
2009	~~(2,331)~~ (2,339)	~~(32,010)~~ (31,542)	~~(974)~~ (640)	~~(6)~~ (4)	~~(3)~~ (2.4)	~~(3)~~ (2.7)	~~(11,244)~~
2010	~~(2,331)~~ (2,328)	~~(32,010)~~ (31,992)	~~(974)~~ (969)	~~(6)~~ (6)	~~(3)~~ (2.4)	~~(3)~~ (2.7)	~~(11,244)~~
2011	~~(2,375)~~ (2,372)	~~(32,254)~~ (32,236)	~~(976)~~ (971)	~~(6)~~ (6)	~~(3)~~ (2.4)	~~(3)~~ (2.7)	~~(11,172)~~

Table C-85
Summary of Alternative C Energy Effects Compared Baseline

Natural Gas Consumption, MMBtu/yr	Electricity Consumption, MWH/yr	Diesel Fuel Consumption, gal/yr
0	2,273	32,528

Table C-86
Alternative D Total Construction Emissions

SCR - Construction

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	CO2, ton/year
2008	89.8	42.1	12.0	0.08	5.0	4.6	630
2009	88.9	39.5	11.1	0.08	4.7	4.4	36.5
2010	141.4	61.8	17.6	0.13	7.4	6.9	203
2011	247	106	30.4	0.23	12.9	11.9	727
2012	52.5	22.3	6.4	0.05	2.7	2.5	73.0

Gas Turbines - Construction

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	CO2, ton/year
2008	89.8	42.1	12.0	0.08	5.0	4.6	630
2009	88.9	39.5	11.1	0.08	4.7	4.4	36.5
2010	141.4	61.8	17.6	0.13	7.4	6.9	203
2011	247	106	30.4	0.23	12.9	11.9	727
2012	52.5	22.3	6.4	0.05	2.7	2.5	73.0

Microturbines - Construction

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	CO2, ton/year
2008	89.8	42.1	12.0	0.08	5.0	4.6	630
2009	88.9	39.5	11.1	0.08	4.7	4.4	36.5
2010	141.4	61.8	17.6	0.13	7.4	6.9	203
2011	247	106	30.4	0.23	12.9	11.9	727
2012	52.5	22.3	6.4	0.05	2.7	2.5	73.0

Gas Turbines/LNG - Construction

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	CO2, ton/year
2008	89.8	42.1	12.0	0.08	5.0	4.6	630
2009	88.9	39.5	11.1	0.08	4.7	4.4	36.5
2010	141.4	61.8	17.6	0.13	7.4	6.9	203
2011	682	291	84.1	0.60	48.4	35.6	2,371
2012	488	206.6	60.2	0.43	38.3	26.2	1,718

Table C-86 (Concluded)
Alternative D Total Construction Emissions

Microturbines/LNG - Construction

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	CO2, ton/year
2008	90	42.1	12.0	0.08	5.0	4.6	630
2009	88.9	39.5	11.1	0.08	4.7	4.4	36.5
2010	141.4	61.8	17.6	0.13	7.4	6.9	203
2011	682	291	84.1	0.60	48.4	35.6	2,371
2012	488	206.6	60.2	0.43	38.3	26.2	1,718

Table C-87
Alternative D Total Criteria Operational Emissions

SCR - Total Operational Emissions

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
2005 Baseline	9,195	54,243	2,493	551	877	875	~~1,250,047~~
2008	~~8,999~~ 9,004	~~53,867~~ 53,900	~~2,458~~ 2,467	~~544~~ 545	~~872~~ 873	~~870~~ 871	~~1,227,230~~
2009	~~6,410~~ 6,415	~~22,399~~ 22,432	~~1,790~~ 1,799	~~543~~ 544	~~858~~ 859	~~856~~ 857	~~1,231,763~~
2010	~~5,823~~ 5,828	~~15,757~~ 15,790	~~1,250~~ 1,259	~~534~~ 535	~~837~~ 838	~~835~~ 836	~~1,208,312~~
2011	~~5,345~~ 5,350	~~11,627~~ 11,660	~~1,169~~ 1,178	~~528~~ 529	~~821~~ 822	~~819~~ 820	~~1,197,181~~
2012	4,125	5,748	627	538	830	829	1233796
2014	4,184	5,766	632	538	833	831	1233823

Table C-87Continued)
Alternative D Total Criteria Operational Emissions

Gas Turbines - Total Operational Emissions

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
2005 Baseline	9,195	54,243	2,493	551	877	875	~~1,250,047~~
2008	~~8,999~~ 9,004	~~53,867~~ 53,900	~~2,458~~ 2,467	~~544~~ 545	~~872~~ 873	~~870~~ 871	~~1,227,230~~
2009	~~6,410~~ 6,415	~~22,399~~ 22,432	~~1,790~~ 1,799	~~543~~ 544	~~858~~ 859	~~856~~ 857	~~1,231,763~~
2010	~~5,823~~ 5,828	~~15,757~~ 15,790	~~1,250~~ 1,259	~~534~~ 535	~~837~~ 838	~~835~~ 836	~~1,208,312~~
2011	~~5,339~~ 5,344	~~11,625~~ 11,658	~~1,169~~ 1,178	~~528~~ 529	~~821~~ 822	~~819~~ 820	~~1,197,250~~
2012	4,825	5,509	495	538	1016	1014	~~1,231,801~~
2014	4,884	5,527	500	538	1019	1017	~~1,231,801~~

Microturbines - Total Operational Emissions

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
2005 Baseline	9,195	54,243	2,493	551	877	875	~~1,250,047~~
2008	~~8,999~~ 9,004	~~53,867~~ 53,900	~~2,458~~ 2,467	~~544~~ 545	~~872~~ 873	~~870~~ 871	~~1,227,230~~
2009	~~6,410~~ 6,415	~~22,399~~ 22,432	~~1,790~~ 1,799	~~543~~ 544	~~858~~ 859	~~856~~ 857	~~1,231,763~~
2010	~~5,823~~ 5,828	~~15,757~~ 15,790	~~1,250~~ 1,259	~~534~~ 535	~~837~~ 838	~~835~~ 836	~~1,208,312~~
2011	~~5,339~~ 5,344	~~11,625~~ 11,658	~~1,169~~ 1,178	~~528~~ 529	~~821~~ 822	~~819~~ 820	~~1,197,250~~
2012	3,860	4,321	600	538	757	756	~~1,231,915~~

Table C-87 (Concluded)
Alternative D Total Criteria Operational Emissions

Gas Turbines/LNG - Total Operational Emissions

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
2005 Baseline	9,195	54,243	2,493	551	877	875	~~1,250,047~~
2008	~~8,999~~ 9,004	~~53,867~~ 53,900	~~2,458~~ 2,467	~~544~~ 545	~~872~~ 873	~~870~~ 871	~~1,227,230~~
2009	~~6,440~~ 6,445	~~23,215~~ 23,248	~~1,814~~ 1,823	~~543~~ 544	~~860~~ 861	~~858~~ 859	~~1,232,969~~
2010	~~5,823~~ 5,828	~~15,757~~ 15,790	~~1,250~~ 1,259	~~534~~ 535	~~837~~ 838	~~835~~ 836	~~1,208,312~~
2011	~~5,390~~ 5,395	~~11,640~~ 11,673	~~1,173~~ 1,182	~~528~~ 529	~~823~~ 824	~~821~~ 822	~~1,197,500~~
2012	4,254	4,655	486	211	872	870	~~1,093,753~~
2014	4,373	4,692	495	211	878	876	~~1,094,081~~

Microturbines/LNG - Total Operational Emissions

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
2005 Baseline	9,195	54,243	2,493	551	877	875	~~1,250,047~~
2008	~~8,999~~ 9,004	~~53,867~~ 53,900	~~2,458~~ 2,467	~~544~~ 545	~~872~~ 873	~~870~~ 871	~~1,227,230~~
2009	~~6,410~~ 6,415	~~22,399~~ 22,432	~~1,790~~ 1,799	~~543~~ 544	~~858~~ 859	~~856~~ 857	~~1,231,763~~
2010	~~5,823~~ 5,828	~~15,757~~ 15,790	~~1,250~~ 1,259	~~534~~ 535	~~837~~ 838	~~835~~ 836	~~1,208,312~~
2011	~~5,390~~ 5,395	~~11,640~~ 11,673	~~1,173~~ 1,182	~~528~~ 529	~~823~~ 824	~~821~~ 822	~~1,197,500~~
2012	3,870	4,190	531	211	767	765	~~1,093,861~~
2014	3,989	4,227	541	211	773	771	~~1,094,189~~

Table C-88
Alternative D Total Criteria Emissions

SCR - Total

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
2008	~~9,089~~ 9,094	~~53,909~~ 53,942	~~2,470~~ 2,479	~~543.9~~ 545	~~876.8~~ 878	~~874.7~~ 876	~~1,227,861~~
2009	~~6,410~~ 6,415	~~22,399~~ 22,432	~~1,790~~ 1,799	~~543~~ 544	~~858~~ 859	~~856~~ 857	~~1,231,763~~
2010	~~5,964~~ 5,969	~~15,818~~ 15,851	~~1,267~~ 1,276	~~534~~ 535	~~844~~ 845	~~842~~ 843	~~1,208,515~~
2011	~~5,591~~ 5,596	~~11,733~~ 11,766	~~1,200~~ 1,209	~~529~~ 530	~~834~~ 835	~~831~~ 832	~~1,197,908~~
2012	~~4,178~~	~~5,770~~	~~634~~	~~538~~	~~833~~	~~831~~	~~1,233,869~~
	5,420	11,657	1,177	528	825	823	
2014	~~4,184~~	~~5,766~~	~~632~~	~~538~~	~~833~~	~~831~~	~~1,233,823~~
	3,706	3,504	425	74	697	696	
2015	3,712	3,500	423	74	697	696	

Gas Turbines - Total

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
2008	~~9,089~~ 9,094	~~53,909~~ 53,942	~~2,470~~ 2,479	~~543.9~~ 545	~~876.8~~ 878	~~874.7~~ 876	~~1,227,861~~
2009	~~6,410~~ 6,415	~~22,399~~ 22,432	~~1,790~~ 1,799	~~543~~ 544	~~858~~ 859	~~856~~ 857	~~1,231,763~~
2010	~~5,964~~ 5,969	~~15,818~~ 15,851	~~1,267~~ 1,276	~~534~~ 535	~~844~~ 845	~~842~~ 843	~~1,208,515~~
2011	~~5,586~~ 5,591	~~11,731~~ 11,764	~~1,199~~ 1,208	~~529~~ 530	~~833~~ 834	~~831~~ 832	~~1,197,977~~
2012	5,444	11,784	1,189	529	832	830	~~1,231,874~~
2014	4,878	5,532	502	538	1,019	1,017	~~1,231,801~~
2015	4,884	5,527	500	538	1,019	1,017	

Table C-88 (Continued)
Alternative D Total Criteria Emissions

Microturbines - Total

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
2008	~~9,089~~ 9,094	~~53,909~~ 53,942	~~2,470~~ 2,479	~~543.9~~ 545	~~876.8~~ 878	~~874.7~~ 876	~~1,227,861~~
2009	~~6,410~~ 6,415	~~22,399~~ 22,432	~~1,790~~ 1,799	~~543~~ 544	~~858~~ 859	~~856~~ 857	~~1,231,763~~
2010	~~5,964~~ 5,969	~~15,818~~ 15,851	~~1,267~~ 1,276	~~534~~ 535	~~844~~ 845	~~842~~ 843	~~1,208,515~~
2011	~~5,586~~ 5,591	~~11,731~~ 11,764	~~1,199~~ 1,208	~~529~~ 530	~~833~~ 834	~~831~~ 832	~~1,197,977~~
2012	5,463	11,854	1,196	529	837	835	~~1,231,988~~
2014	3,913	4,344	607	538	760	758	~~1,231,915~~
2015	3,919	4,339	605	538	760	758	

Gas Turbines/LNG - Total

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
2008	~~9,089~~ 9,094	~~53,909~~ 53,942	~~2,470~~ 2,479	~~543.9~~ 545	~~876.8~~ 878	~~874.7~~ 876	~~1,227,861~~
2009	~~6,410~~ 6,415	~~22,399~~ 22,432	~~1,790~~ 1,799	~~543~~ 544	~~858~~ 859	~~856~~ 857	~~1,231,763~~
2010	~~5,964~~ 5,969	~~15,818~~ 15,851	~~1,267~~ 1,276	~~534~~ 535	~~844~~ 845	~~842~~ 843	~~1,208,515~~
2011	~~6,072~~ 6,077	~~11,931~~ 11,964	~~1,257~~ 1,266	~~529~~ 530	~~872~~ 873	~~857~~ 858	~~1,199,871~~
2012	5,944	12,230	1,267	529	896	882	~~1,095,471~~
2014	4,742	4,862	546	211	911	896	~~1,094,081~~
2015	4,373	4,692	495	211	878	876	

Table C-88 (Concluded)
Alternative D Total Criteria Emissions

Microturbines/LNG - Total

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
2008	~~9,089~~ 9,094	~~53,909~~ 53,942	~~2,470~~ 2,479	~~543.9~~ 545	~~876.8~~ 878	~~874.7~~ 876	~~1,227,861~~
2009	~~6,410~~ 6,415	~~22,399~~ 22,432	~~1,790~~ 1,799	~~543~~ 544	~~858~~ 859	~~856~~ 857	~~1,231,763~~
2010	~~5,964~~ 5,969	~~15,818~~ 15,851	~~1,267~~ 1,276	~~534~~ 535	~~844~~ 845	~~842~~ 843	~~1,208,515~~
2011	~~6,072~~ 6,077	~~11,931~~ 11,964	~~1,257~~ 1,266	~~529~~ 530	~~872~~ 873	~~857~~ 858	~~1,199,871~~
2012	5,963	12,280	1,272	529	899	885	~~1,095,579~~
2014	4,206	3,707	483	75	736	722	~~1,094,189~~
2015	3,837	3,537	433	74	703	702	

Table C-89
Alternative D Total Compared to Baseline

SCR - Total Compared to Baseline

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
2008	~~(106)~~ (100)	~~(334)~~ (301)	~~(22)~~ (14)	~~(7.5)~~ (6.9)	~~(0.1)~~ 0.8	~~0.4~~ 0.4	~~(22,186)~~
2009	~~(3,231)~~ (3,225)	~~(38,425)~~ (38,392)	~~(1,226)~~ (1,217)	~~(18)~~ (17)	~~(33)~~ (32)	~~(33)~~ (32)	~~(41,531)~~
2010	~~(3,231)~~ (3,225)	~~(38,425)~~ (38,392)	~~(1,226)~~ (1,217)	~~(18)~~ (17)	~~(33)~~ (32)	~~(33)~~ (32)	~~(41,531)~~
2011	~~(3,603)~~ (3,598)	~~(42,510)~~ (42,477)	~~(1,293)~~ (1,284)	~~(23)~~ (22)	~~(43)~~ (42)	~~(44)~~ (43)	~~(52,139)~~
2012	~~(5,017)~~	~~(48,473)~~	~~(1,859)~~	~~(13)~~	~~(44)~~	~~(44)~~	~~(16,178)~~
	(3,775)	(42,586)	(1,315)	(23)	(52)	(52)	
2014	~~(5,011)~~	~~(48,477)~~	~~(1,861)~~	~~(13)~~	~~(44)~~	~~(44)~~	~~(16,224)~~
	(5,489)	(50,739)	(2,068)	(477)	(180)	(180)	
2015	(5,483)	(50,743)	(2,070)	(477)	(179)	(179)	

Table C-89 (Continued)
Alternative D Total Compared to Baseline

Gas Turbines - Total Compared to Baseline

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
2008	~~(106)~~ (100)	~~(334)~~ (301)	~~(23)~~ (14)	~~(7.5)~~ (6.9)	~~(0.1)~~ 0.8	~~0.4~~ 0.4	~~(22,186)~~
2009	~~(3,231)~~ (3,225)	~~(38,425)~~ (38,392)	~~(1,194)~~ (1,217)	~~(18)~~ (17)	~~(33)~~ (32)	~~(33)~~ (32)	~~(41,531)~~
2010	~~(3,231)~~ (3,225)	~~(38,425)~~ (38,392)	~~(1,226)~~ (1,217)	~~(18)~~ (17)	~~(33)~~ (32)	~~(33)~~ (32)	~~(41,531)~~
2011	~~(3,609)~~ (3,603)	~~(42,512)~~ (42,479)	~~(1,294)~~ (1,285)	~~(23)~~ (22)	~~(43)~~ (43)	~~(44)~~ (43)	~~(52,070)~~
2012	(3,751)	(42,459)	(1,304)	(23)	(44)	(45)	
2014	(4,317)	(48,711)	(1,991)	(13)	142	142	~~(18,173)~~
2015	(4,311)	(48,716)	(1,993)	(13)	142	142	~~(18,246)~~

Microturbines - Total Compared to Baseline

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
2008	~~(106)~~ (100)	~~(334)~~ (301)	~~(22)~~ (14)	~~(7.5)~~ (6.9)	~~(0.1)~~ 0.8	~~0.4~~ 0.4	~~(22,186)~~
2009	~~(3,231)~~ (3,225)	~~(38,425)~~ (38,392)	~~(1,226)~~ (1,217)	~~(18)~~ (17)	~~(33)~~ (32)	~~(33)~~ (32)	~~(41,531)~~
2010	~~(3,231)~~ (3,225)	~~(38,425)~~ (38,392)	~~(1,226)~~ (1,217)	~~(18)~~ (17)	~~(33)~~ (32)	~~(33)~~ (32)	~~(41,531)~~
2011	~~(3,609)~~ (3,603)	~~(42,512)~~ (42,479)	~~(1,294)~~ (1,285)	~~(23)~~ (22)	~~(43)~~ (43)	~~(44)~~ (43)	~~(52,070)~~
2012	~~(5,282)~~	~~(49,899)~~	~~(1,886)~~	~~(13)~~	~~(117)~~	~~(117)~~	~~(18,059)~~
	(3,732)	(49,389)	(1,297)	(22)	(40)	(40)	
2014	~~(5,275)~~	~~(49,904)~~	~~(1,888)~~	~~(13)~~	~~(117)~~	~~(117)~~	~~(18,132)~~
	(5,282)	(49,899)	(1,886)	(13)	(117)	(117)	
2015	(5,275)	(49,904)	(1,888)	(13)	(117)	(117)	

Table C-89 (Concluded)
Alternative D Total Compared to Baseline

Gas Turbines/LNG - Total Compared to Baseline

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
2008	~~(106)~~ (100)	~~(334)~~ (301)	~~(22)~~ (14)	~~(7.5)~~ (6.9)	~~(0.1)~~ 0.8	~~0.4~~ 0.4	~~(22,186)~~
2009	~~(3,231)~~ (3,225)	~~(38,425)~~ (38,392)	~~(1,226)~~ (1,217)	~~(18)~~ (17)	~~(33)~~ (32)	~~(33)~~ (32)	~~(41,531)~~
2010	~~(3,231)~~ (3,225)	~~(38,425)~~ (38,392)	~~(1,226)~~ (1,217)	~~(18)~~ (17)	~~(33)~~ (32)	~~(33)~~ (32)	~~(41,531)~~
2011	~~(3,123)~~ (3,117)	~~(42,312)~~ (42,279)	~~(1,236)~~ (1,227)	~~(22)~~ (22)	~~(5)~~ (4)	~~(18)~~ (17)	~~(50,176)~~
2012	~~(4,453)~~	~~(49,381)~~	~~(1,947)~~	~~(340)~~	~~33.7~~	~~21.30~~	~~(154,576)~~
	(3,251)	(42,013)	(1,226)	(22)	19.6	7.24	
2014	~~(4,821)~~	~~(49,551)~~	~~(1,998)~~	~~(340)~~	~~1.2~~	~~0.75~~	~~(155,966)~~
	(4,453)	(49,381)	(1,947)	(340)	33.7	21.30	
2015	(4,821)	(49,551)	(1,998)	(340)	1.2	0.75	

Microturbines/LNG - Total Compared to Baseline

Description	NOx, lb/day	CO, lb/day	VOC, lb/day	SOx, lb/day	PM10, lb/day	PM2.5 lb/day	~~CO2, ton/year~~
2008	~~(106)~~ (100)	~~(334)~~ (301)	~~(22)~~ (14)	~~(7.5)~~ (6.9)	~~(0.1)~~ 0.8	~~0.4~~ 0.4	~~(22,186)~~
2009	~~(3,231)~~ (3,225)	~~(38,425)~~ (38,392)	~~(1,226)~~ (1,217)	~~(18)~~ (17)	~~(33)~~ (32)	~~(33)~~ (32)	~~(41,531)~~
2010	~~(3,231)~~ (3,225)	~~(38,425)~~ (38,392)	~~(1,226)~~ (1,217)	~~(18)~~ (17)	~~(33)~~ (32)	~~(33)~~ (32)	~~(41,531)~~
2011	~~(3,123)~~ (3,117)	~~(42,312)~~ (42,279)	~~(1,236)~~ (1,227)	~~(22)~~ (22)	~~(5)~~ (4)	~~(18)~~ (17)	~~(50,176)~~
2012	~~(4,837)~~	~~(49,846)~~	~~(1,901)~~	~~(340)~~	~~(72)~~	~~(84)~~	~~(154,468)~~
	(3,232)	(41,963)	(1,220)	(22)	22	10	
2014	~~(5,205)~~	~~(50,016)~~	~~(1,952)~~	~~(340)~~	~~(104)~~	~~(104)~~	~~(155,857)~~
	(4,989)	(50,536)	(2,009)	(477)	(141)	(153)	
2015	(5,358)	(50,706)	(2,060)	(477)	(173)	(174)	

Table C-90
Estimation of the Number of Electric Motor Replacements of Non-Biogas Engines Required for Alternative D to Be Carbon Neutral

SCR - Carbon Neutral Calculation

Description	Proposed Project CO_2, ton/year	No Electrification CO_2, ton/year	Reduction in CO_2 from Electrification	Average CO_2 Savings per Motor	Average No of Motor to Stay Carbon Neutral
Baseline					
2008	(22,186)	(22,186)	0		
2009	(41,531)	(22,713)	18,819		
2010	(41,531)	(22,713)	18,819		
2011	(52,139)	(21,001)	31,138		
2012	(16,178)	14,203	30,381		
2014	(16,224)	14,157	30,381		
2013-2018	(97,344)	84,943	182,287		
10 year total	(248,723)	32,719	281,443	1,665	20

Gas Turbines – Carbon Neutral Calculation

Description	Proposed Project CO_2, ton/year	No Electrification CO_2, ton/year	Reduction in CO_2 from Electrification	Average CO_2 Savings per Motor	Average No of Motor to Stay Carbon Neutral
Baseline					
2008	(22,186)	(22,186)	0		
2009	121,080	(22,713)	18,819		
2010	(41,531)	(22,713)	18,819		
2011	(52,070)	(20,932)	31,138		
2012	(18,173)	12,208	30,381		
2014	(18,246)	12,135	30,381		
2013-2018	(109,474)	72,813	182,287		
10 year total	(100,168)	18,664	118,831	703	27

Table C-90 (Continued)
Estimation of the Number of Electric Motor Replacements of Non-Biogas Engines Required for Alternative D to Be Carbon Neutral

Microturbines - Carbon Neutral Calculation

Description	Proposed Project CO2, ton/year	No Electrification CO2, ton/year	Reduction in CO2 from Electrification	Average CO2 Savings per Motor	Average No of Motor to Stay Carbon Neutral
Baseline					
2008	(22,186)	(22,186)	0		
2009	(41,531)	(22,713)	18,819		
2010	(41,531)	(22,713)	18,819		
2011	(52,070)	(20,932)	31,138		
2012	(18,059)	12,322	30,381		
2014	(18,132)	12,249	30,381		
2013-2018	(108,790)	73,497	182,287		
10 year total	(261,981)	19,462	281,443	1,665	12

Gas Turbines/LNG - Carbon Neutral Calculation

Description	Proposed Project CO2, ton/year	No Electrification CO2, ton/year	Reduction in CO2 from Electrification	Average CO2 Savings per Motor	Average No of Motor to Stay Carbon Neutral
Baseline					
2008	(22,186)	(22,186)	0		
2009	(41,531)	(22,713)	18,819		
2010	(41,531)	(22,713)	18,819		
2011	(50,176)	(19,038)	31,138		
2012	(154,576)	(124,195)	30,381		
2014	(155,966)	(125,585)	30,381		
2013-2018	(935,795)	(753,508)	182,287		
10 year total	(1,223,610)	(942,167)	281,443	1,665	0

Table C-90 (Concluded)
Estimation of the Number of Electric Motor Replacements of Non-Biogas Engines Required for Alternative D to Be Carbon Neutral

Microturbines/LNG - Carbon Neutral Calculation

Description	Proposed Project CO_2, ton/year	No Electrification CO_2, ton/year	Reduction in CO_2 from Electrification	Average CO_2 Savings per Motor	Average No of Motor to Stay Carbon Neutral
Baseline					
2008	(22,186)	(22,186)	0		
2009	(41,531)	(22,713)	18,819		
2010	(41,531)	(22,713)	18,819		
2011	(50,176)	(19,038)	31,138		
2012	(154,468)	(124,087)	30,381		
2014	(155,857)	(125,476)	30,381		
2013-2018	(935,145)	(752,858)	182,287		
10 year total	(1,222,851)	(941,408)	281,443	1,665	0

Table C-91
Summary of the Number of Electric Motor Replacements of Non-Biogas Engines Required for Alternative D to Be Carbon Neutral

Description	Proposed Project CO_2, ton/year	No Electrification CO_2, ton/year	Reduction in CO_2 from Electrification	Average CO_2 Savings per Motor	Average No of Motor to Stay Carbon Neutral
SCR	(248,723)	32,719	281,443	1,665	20
Replace ICE with Gas Turbine	(100,168)	18,664	118,831	703	27
Replace ICE Microturbine	(261,981)	19,462	281,443	1,665	12
Replace LFG w LNG, DG w Turbines	(1,223,610)	(942,167)	281,443	1,665	0
Replace LFG w LNG, DG w Microturbines	(1,222,851)	(941,408)	281,443	1,665	0

Table C-92
Summary of Alternative D Energy Effects Compared to Baseline

Description	Natural Gas Consumption, MMBtu/yr	Electricity Consumption, MWH/yr	Shaft Work Produced, Hp-Hrs/yr	Diesel Fuel Consumption, gal/yr	LNG Production, MMBtu/yr
SCR	(547,111)	174,100	(59,006)	31,152	
Gas Turbines	(476,752)	229,556	(15,123,937)	38,128	
Micro Turbines	(431,194)	273,408	(15,123,937)	41,241	
Gas Turbines/LNG	(204,108)	558,557	(15,123,937)	38,128	2,374,019
Microturbines/LNG	(184,431)	576,527	(15,123,937)	57,364	2,374,019

Table C-93
Exception for ICEs That Heat Digester Gas Calculations for Proposed Project, Alternative B and Alternative D

Assumptions

- Two 574 bhp engines and one stand-by engine
- 2006 fuel use:
  - 5.34×10^{10} Btu/year of digester gas
  - 2.24×10^{10} Btu/year of natural gas

  Therefore, 7.52×10^{10} Btu/year (8.65 MMBtu/hour) total fuel use
- 35 percent heat recovery by boiler
- 31 percent engine efficiency
- 80 percent boiler efficiency
- Engine CO and VOC emission factors are based on source test.
- Engine SOx emission factor is based on 1 grain sulfur per 1000 std cubic feet natural gas (PUC maximum allowable).
- Engine PM10 emission factor from AP-42.
- Boiler CO emission factors based on 50 ppm at three percent oxygen (typical for a firetube boiler).
- Boiler VOC and PM emission factors are from AP-42.

Estimated Full Load Fuel Use
(574 bhp x 2,545)/(0.31 engine efficiency) = 4.71 MMBtu/hour

Average Load
(8.65 MMBtu/hour)/(2 engines x 4.71 MMBtu/hour) = 91.8 percent

Estimated Heat Recovery
8.65 MMBtu/hour x 0.35 heat recovery = 3.0 MMBtu/hour

Fuel Use with 10 Percent Natural Gas
(5.34×10^{10} Btu/year x 10/9)/(8,760 hour/year) = 6.77 MMBtu/hour ~ 72 percent load

Estimated Heat Recovery
6.77 MMBtu/hour x 0.35 heat recovery = 2.37 MMBtu/hour

Reduced Heat Recovery
3.0 MMBtu/hour – 2.37 MMBtu/hour = 0.63 MMBtu/hour

Stand-by Boiler Size:
(0.63 MMBtu/hour)/(0.80 boiler efficiency) = 0.79 MMBtu/hour

Reduced Engine Fuel Use
8.65 MMBtu/hour - 6.77 MMBtu/hour = 1.88 MMBtu/hr

Annual ICE Emissions from Using More Than 10 Percent Natural Gas
1.88 MMBtu/hour x 720 hour/year x 0.12 lb NOx/MMBtu = 162 lb NOx /year
1.88 MMBtu/hour x 720 hour/year x 0.728 lb CO/MMBtu = 985 lb CO/year
1.88 MMBtu/hour x 720 hour/year x 0.196 lb VOC/MMBtu = 265 lb VOC/year
1.88 MMBtu/hour x 720hour/year x 0.0134 lb SOx/MMBtu = 18.1 lb SOx/year
1.88 MMBtu/hour x 720 hour/year x 0.0194 lb PM10/MMBtu = 26.3 lb PM10/year
26.3 lb PM/year x 0.998 lb PM2.5/lb PM10 = 26.2 lb PM2.5/year
1.88 MMBtu/hour x 720 hour/year x 115 lb CO2/MMBtu = 155,664 lb CO2/year

Daily ICE Emissions from Using More Than 10 Percent Natural Gas
1.88 MMBtu/hour x 24 hour/day x 0.12 lb NOx/MMBtu = 5.4 lb NOx /day
1.88 MMBtu/hour x 24 hour/day x 0.728 lb CO/MMBtu = 32.8 lb CO/day
1.88 MMBtu/hour x 24 hour/day x 0.196 lb VOC/MMBtu = 8.8 lb VOC/day
1.88 MMBtu/hour x 720hour/day x 0.0134 lb SOx/MMBtu = 0.60 lb SOx/day
1.88 MMBtu/hour x 24 hour/day x 0.0194 lb PM10/MMBtu = 0.88 lb PM10/day
26.3 lb PM/day x 0.998 lb PM2.5/lb PM10 = 0.88 lb PM2.5/day

Summary of Exception for Natural Gas for ICEs That Heat Digester Gas

Description	**NOx Emissions, lb/day**	**CO Emissions, lb/day**	**VOC Emissions, lb/day**	**SOx Emissions, lb/day**	**PM10 Emissions, lb/day**	**PM2.5 Emissions, lb/day**
ICE	5.41	32.85	8.8	0.6	0.88	0.87

Proposed Project

Description	**NOx Emissions, lb/day**	**CO Emissions, lb/day**	**VOC Emissions, lb/day**	**SOx Emissions, lb/day**	**PM10 Emissions, lb/day**	**PM2.5 Emissions, lb/day**
ICE Exception	5.4	32.8	8.8	0.60	0.88	0.87
Significance Threshold	55	550	75	150	150	55
Significant or Substantial Increase?	No	No	No	No	No	No

Alternative B

Description	**NOx Emissions, lb/day**	**CO Emissions, lb/day**	**VOC Emissions, lb/day**	**SOx Emissions, lb/day**	**PM10 Emissions, lb/day**	**PM2.5 Emissions, lb/day**
ICE Exception	5.4	32.8	8.8	0.60	0.88	0.87
Significance Threshold	55	550	75	150	150	55
Significant or Substantial Increase?	No	No	No	No	No	No

Alternative D

Description	**NOx Emissions, lb/day**	**CO Emissions, lb/day**	**VOC Emissions, lb/day**	**SOx Emissions, lb/day**	**PM10 Emissions, lb/day**	**PM2.5 Emissions, lb/day**
Worst-Case						
ICE Exception	5.41	32.85	8.84	0.60	0.88	0.87
Significance Threshold	55	550	75	150	150	55
Significant or Substantial Increase?	No	No	No	No	No	No

Table C-93
Exception for ICEs That Heat Digester Gas Calculations for Alternative C

Assumptions

- Two 574 bhp engines and one stand-by engine
- 2006 fuel use:
  - 5.34×10^{10} Btu/year of digester gas
  - 2.24×10^{10} Btu/year of natural gas

  Therefore, 7.52×10^{10} Btu/year (8.65 MMBtu/hour) total fuel use
- 35 percent heat recovery by boiler
- 31 percent engine efficiency
- 80 percent boiler efficiency
- Engine CO and VOC emission factors are based on source test.
- Engine SOx emission factor is based on 1 grain sulfur per 1000 std cubic feet natural gas (PUC maximum allowable).
- Engine PM10 emission factor from AP-42.
- Boiler CO emission factors based on 50 ppm at three percent oxygen (typical for a firetube boiler).
- Boiler VOC and PM emission factors are from AP-42.

Estimated Full Load Fuel Use
(574 bhp x 2,545)/(0.31 engine efficiency) = 4.71 MMBtu/hour

Average Load
(8.65 MMBtu/hour)/(2 engines x 4.71 MMBtu/hour) = 91.8 percent

Estimated Heat Recovery
8.65 MMBtu/hour x 0.35 heat recovery = 3.0 MMBtu/hour

Fuel Use with 10 Percent Natural Gas
(5.34 x 10^{10} Btu/year x 10/9)/(8,760 hour/year) = 6.77 MMBtu/hour ~ 72 percent load

Estimated Heat Recovery
6.77 MMBtu/hour x 0.35 heat recovery = 2.37 MMBtu/hour

Reduced Heat Recovery
3.0 MMBtu/hour – 2.37 MMBtu/hour = 0.63 MMBtu/hour

Stand-by Boiler Size:
(0.63 MMBtu/hour)/(0.80 boiler efficiency) = 0.79 MMBtu/hour

Reduced Engine Fuel Use
8.65 MMBtu/hour - 6.77 MMBtu/hour = 1.88 MMBtu/hr

Annual ICE Emissions from Using More Than 25 Percent Natural Gas
1.03 MMBtu/hour x 720 hour/year x 0.12 lb NOx/MMBtu = 89 lb NOx /year
1.03 MMBtu/hour x 720 hour/year x 0.728 lb CO/MMBtu = 540 lb CO/year
1.03 MMBtu/hour x 720 hour/year x 0.196 lb VOC/MMBtu = 145 lb VOC/year
1.03 MMBtu/hour x 720hour/year x 0.0134 lb SOx/MMBtu = 9.9 lb SOx/year
1.03 MMBtu/hour x 720 hour/year x 0.0194 lb PM10/MMBtu = 14.4 lb PM10/year
14.4 lb PM/year x 0.998 lb PM2.5/lb PM10 = 14.4 lb PM2.5/year
1.03 MMBtu/hour x 720 hour/year x 115 lb CO2/MMBtu = 85,295 lb CO2/year

Daily ICE Emissions from Using More Than 25 Percent Natural Gas
1.03 MMBtu/hour x 24 hour/day x 0.12 lb NOx/MMBtu = 3.0 lb NOx /day
1.03 MMBtu/hour x 24 hour/day x 0.728 lb CO/MMBtu = 18.0 lb CO/day
1.03 MMBtu/hour x 24 hour/day x 0.196 lb VOC/MMBtu = 4.8 lb VOC/day
1.03 MMBtu/hour x 720hour/day x 0.0134 lb SOx/MMBtu = 0.33 lb SOx/day
0.33 MMBtu/hour x 24 hour/day x 0.0194 lb PM10/MMBtu = 0.48 lb PM10/day
26.3 lb PM/day x 0.998 lb PM2.5/lb PM10 = 0.48 lb PM2.5/day

Summary of Exception for Natural Gas for ICEs That Heat Digester Gas

Description	**NOx Emissions, lb/day**	**CO Emissions, lb/day**	**VOC Emissions, lb/day**	**SOx Emissions, lb/day**	**PM10 Emissions, lb/day**	**PM2.5 Emissions, lb/day**
ICE	3.0	18.0	4.8	0.39	0.48	0.48

Alternative C

Description	**NOx Emissions, lb/day**	**CO Emissions, lb/day**	**VOC Emissions, lb/day**	**SOx Emissions, lb/day**	**PM10 Emissions, lb/day**	**PM2.5 Emissions, lb/day**
ICE Exception	3.0	18.0	4.8	0.39	0.48	0.48
Significance Threshold	55	550	75	150	150	55
Significant or Substantial Increase?	No	No	No	No	No	No