

Synthetic Minor Operating Permit Application Evaluation Report
University of California, Berkeley
Application #23526 - Site (Plant) #59

Background:

University of California, Berkeley, Plant #59, owns and operates 3 permitted boilers and about 50 permitted generators on site to provide heating and emergency power to the facility. UC Berkeley has converted to a Synthetic Minor Plant on 12/14/04, and the plant has accepted federally enforceable permit terms that ensure the plant is classified as a Synthetic Minor Facility under the District’s Regulation 2, Rule 6, Major Facility Review, and the permit terms ensure the plant is not subject to the permitting requirements of Title V of the Federal Clean Air Act and 40 CFR 70.

As of July 1, 2011, an existing facility that is not previously subject to title V and has a Greenhouse Gas (GHG) Potential to Emit (PTE) over 100,000 TPY CO₂e (carbon dioxide equivalent) is subject to Title V of the Federal Clean Air Act and 40 CFR 70.

UC Berkeley submitted this application on 7/1/2011 to the District to incorporate a federally enforceable permit condition of 90,000 tons/yr of GHG into the existing Synthetic Minor Operation Permit Condition. Synthetic Minor permit must have practically enforceable limits and conditions that ensure that emissions never exceed major facility thresholds. The permit may also contain limits and conditions that have been established pursuant to other BAAQMD rules and regulation but do not contribute the synthetic minor limits.

The facility is current operating 3 permitted natural gas fired boilers, 41 permitted diesel fired engines, 7 permitted natural gas fired engines, and 1 propane fired engine. In addition, UC Berkeley also owns and operates numerous exempt boilers and other exempt combustion sources throughout the campus.

Emissions calculations & discussion

To obtain a synthetic minor permit, a facility must have federally enforceable emission limits that keep the potential to emit below 95 tons per year of any regulated air pollutant, below 9 tons per year of any single HAP, below 23 tons per year of any combination of HAPs, and below 90,000 tons per year of CO₂ equivalent (CO₂e).

For this application, only CO₂ equivalent emissions are needed since calculations for other regulated air pollutant and HAP were performed in the previous Synthetic Minor Applications and found in compliance.

Calculation Basis:

The emissions factors for Greenhouse Gases, such as carbon dioxide, methane, and nitrous oxide are based on Table C-1 and Table C-2 of 40 CFR 98 Greenhouse gas reporting. CO₂ equivalent emission is the sum of the emissions of each type Greenhouse gas multiplied with the global warming potential per Table A-1 of 40 CFR 98.

Table 1: Emissions Factors and Global Warming Potential

	Diesel	Natural Gas	LPG	Global Warming Potential
CO ₂	73.96 kg/mmBtu	53.02 kg/mmBtu	61.46 kg/mmBtu	1
Methane (CH ₄)	0.003 kg/mmBtu	0.001 kg/mmBtu	0.003 kg/mmBtu	21
Nitrous Oxide (N ₂ O)	0.0006kg/mmBtu	0.0001kg/mmBtu	0.0006kg/mmBtu	310

Note: Heat content for diesel is 0.138 mmBtu/gallon, for natural gas is 1.028 mmBtu/scf, for Propane is 0.091 mmBtu/gal (source: 40 CFR 98)

Potential to Emit:

To calculate Potential to Emit, numerous assumptions are made. For S-2, S-3, and S-4 boilers, we assume 24 hours per day, 365 days per year of operation. Emergency Generators are assumed to operate at most 500 hours per year. All sources are assumed to be operated at their maximum rated capacity.

Table 2: Potential to Emit of Greenhouse Gas

Sources	Fuel Use (MMBTU/yr)	CO ₂ (kg/yr)	CH ₄ (kg/yr)	N ₂ O (kg/yr)	CO ₂ Equivalent (kg/yr)	CO ₂ Equivalent (ton/yr)
Boilers	3565320.00	189033266.40	3565.32	356.53	189218663.04	208115.56
Diesel Engines	91578.53	6773147.71	4.96	0.99	6773559.18	7450.02
Natural Gas Engines	2640.05	142858.19	2.45	0.25	142986.51	157.27
Total	3659538.58	195949272.30	3572.73	357.77	196135208.72	215,722.84

From the calculation, CO₂e Potential to Emit from Plant 59 is about 216 thousand tons per year which exceeded 100,000 tpy CO₂ equivalent emissions.

Actual Emissions:

The actual emissions are based on the reported actual fuel usage from the plant in the last permit renewal and the facility's utility records.

**Table 3-A: Actual Emissions of Greenhouse Gases
 Based on Reported Annual Usage for Permitted Sources**

Sources	Fuel Use (MMBTU/yr)	CO ₂ (kg/yr)	CH ₄ (kg/yr)	N ₂ O (kg/yr)	CO ₂ Equivalent (kg/yr)	CO ₂ Equivalent (ton/yr)
Boilers	1109.32	58815.98	1.11	0.11	58873.67	64.75
Diesel Engines	1652.49	122217.93	4.96	0.99	122629.40	134.88
Natural Gas Engines	75.01	4113.10	0.10	0.01	4119.07	4.53
Total	2836.81	185147.01	6.16	1.12	185622.14	204.16

**Table 3-B: Actual Emissions of Greenhouse Gases
 Based on Campus-wide Natural Gas and Diesel Fuel Usage (includes exempt sources)**

Sources	Fuel Use (MMBTU/yr)	CO ₂ (kg/yr)	CH ₄ (kg/yr)	N ₂ O (kg/yr)	CO ₂ Equivalent (kg/yr)	CO ₂ Equivalent (ton/yr)
Natural Gas Engines	217820	11548816	217	21.8	11560143	12,743
Diesel	1652.49	122217.93	4.96	0.99	122629.40	134.88
Total						12,877.88

The actual Greenhouse gas emissions calculated are below 90,000 ton/yr, so the plant currently meets the Synthetic Minor Operation Permit requirements per Regulation 2-6.

Statement of Compliance:

This facility is in compliance with the necessary requirements in Regulation 2, Rule 6 to obtain a synthetic minor permit. UC Berkeley (Plant #59) has accepted federally enforceable permit conditions including emission limits that will keep its annual emissions within 90 tons per year of any regulated air pollutant, 9 tons of any hazardous air pollutant, and 23 tons of any combination of hazardous air pollutants in the previous SMOP applications. To establish compliance, daily records, monthly totals of Greenhouse Gas emission as well as the total fuel usage throughout the campus shall be maintained and a 12 month rolling average calculated each month, in addition to the existing record keeping requirements for criteria pollutants and HAPs.

Permit Conditions

University of California, Berkeley, Site #A59, has a synthetic minor operating permit. This operating permit covers all sources existing at this facility as of permit issuance.

The following conditions establish the permit terms that ensure this plant is classified as a Synthetic Minor Facility under District Regulation 2, Rule 6 - Major Facility Review and ensure it is not subject to the permitting requirements of Title V of the Federal Clean Air Act as amended in 1990 and 40 CFR Part 70. All applications submitted by the applicant and all modifications to the plant's equipment after issuance of the synthetic minor permit must be evaluated to ensure that the facility cannot exceed the synthetic minor general limits below, and that sufficient monitoring, record keeping, and reporting requirements are imposed to ensure enforceability of the limits.

Any revision to a condition establishing this plant's status as a Synthetic Minor Facility or any new permit term that would limit emissions of a new or modified source for the purpose of maintaining the facility as a Synthetic Minor must undergo the procedures specified by Rule 2-6, Section 423. The basis for the synthetic minor conditions is an emission limit for regulated air pollutants of less than 95 tons per year, an emission limit for a single hazardous air pollutant of less than 9 tons per year, an emission limit for a combination of hazardous air pollutants of less than 23 tons per year, and an emission limit for greenhouse gas, expressed as CO₂ equivalent, of less than 900,000 tons per year.

Asterisks denote permit conditions that are part of this permit but do not contribute to establishing the synthetic minor limits. The facility must comply with all conditions, regardless of asterisks. The following conditions do not negate the applicability of any District, state or federal requirements.

Synthetic Minor Operating Condition for Plant #59, UC Berkeley, Condition #21880

UC Berkeley, Plant #59, has a synthetic minor operating permit. This operating permit covers all sources ([permitted, registered, and exempt](#)) at the facility.

The following conditions establish the federally enforceable permit terms that ensure this plant is classified as a Synthetic Minor Facility under District Regulation 2, Rule 6, Major Facility Review; and ensure it is not subject to the permitting requirements of Title V of the Federal Clean Air Act as amended in 1990, and 40 CFR Part 70. All applications submitted by the applicant and all modifications to the plant's equipment after issuance of the synthetic minor permit must be evaluated to ensure that the facility will not exceed the synthetic minor general limits below, and that sufficient monitoring, recordkeeping, and reporting requirements are imposed to ensure enforceability of the limits.

Any revision to a condition establishing this plant's status as a Synthetic Minor Facility or any new permit term that would limit emissions of a new or modified source for the purpose of maintaining the facility as a synthetic minor, must undergo the procedures pursuant to Regulation 2, Rule 6, section 423. The basis for the synthetic minor conditions is an emission limit for regulated air pollutants of less than 95 tons per year, an emission limit for a single hazardous air pollutant of less than 9 tons per year, and an emission limit for a combination of hazardous air pollutants of less than 23 tons per year.

Synthetic Minor Conditions:

1. The owner/operator of UC Berkeley shall not emit more than 9 tons of any single hazardous air pollutant (HAP) or 23 tons of any combination of HAPs in any consecutive 12-month period. (basis: ~~Synthetic Minor~~[Regulation 2-6-423.2.1](#))
2. The owner/operator shall not emit more than 95 tons of any regulated air pollutant into the atmosphere during any consecutive 12-month period. (basis: [Regulation 2-6-423.2.1](#)~~Synthetic Minor~~)
3. [The owner/operator shall not emit more than 90,000 tons of greenhouse gases on a carbon dioxide equivalent basis \(CO₂e\) into the atmosphere during any consecutive 12-month period.](#) (basis: [Regulation 2-6-423.2.2](#))
4. Boilers:
 - a. In addition to the times of operation allowed in Permit Condition 14330, boilers S-2, 3, and 4 may also run for a period of up to four hours prior to expected winter operations for the purpose of ensuring boiler operational reliability and to test for their CO emissions. This will start the 168-hour clock for CO monitoring.
 - b. Within each 168 hours of operation at each boiler, the owner/operator shall monitor the boiler's CO readings. The 168-hour clock will restart at the end of each test.
 - c. The owner/operator shall maintain records of the CO monitoring data.
 - d. All records must be kept on site and made available for District inspection for at least 5 years.
 - e. The owner/operator shall use each CO reading to ensure that the CO emission factor is 0.084 lb/mmbtu or less if burning natural gas and 0.036 lb/mmbtu or less when burning fuel oil. If the reading exceeds these values then the higher value shall be used in the monthly calculations for the following month or months, until the next 168 hr reading is performed.
 - f. If the CO emission exceeds the 400 ppmv (0.29 lb/mmbtu) limit in BAAQMD Regulation 9-7, the exceedance shall be considered a violation and shall be reported to the Director of Enforcement within 10 days of the reading.(basis: [Regulation 2-6-423.2.3](#)~~Synthetic Minor~~ and recordkeeping)
5. Stationary Emergency Diesel Engine Generators:
 - a. The owner/operator shall ensure each stationary emergency diesel engine generator will for no more than their respective permitted hours in maintenance mode.
 - b. The owner/operator shall record and maintain the number of hours of operation and the hp rating for each generator on a monthly basis and whether the engine operation is maintenance or production.
 - c. Fuel oil sulfur content shall not exceed 0.5% by weight.
 - d. All records must be kept on site and made available for District inspection for at least 5 years.(basis: [Regulation 2-6-423.2.3](#)~~Synthetic Minor~~ and recordkeeping)
6. Plant Wide Coating Operations:
 - a. The total amount of non-water based coating used at Source 100, miscellaneous painting operations, shall not exceed 80 gallons during any consecutive twelve-month period. The total amount of water based coating used at Source 100 shall not exceed 250 gallons during any consecutive twelve-month period. All coating usage must meet the requirements of the Districts Regulation 8 coatings rules.
 - b. The net amount of cleanup and surface preparation solvent used at Source 100 shall not exceed 10 gallons during any consecutive twelve-month period. The net amount of organic thinner used at Source 100 shall not exceed 10 gallons during any consecutive twelve-month period.

- c. The owner/operator shall maintain the following records in a District-approved log:
- 1) Net clean-up solvent used at Source 100, in gallons/day
 - 2) Total surface preparation solvent used at Source 100, in gallons/day
 - 3) Cumulative monthly totals of above daily usage rates, in gallons/month
 - 4) All applicable coating and thinner usages as specified in Regulation 8 rules. These records shall be kept on site and made available for District inspection for a period of 5 years from the date on which a record is made.

(basis: cumulative increase and recordkeeping)

7. The owner/operator shall calculate and maintain records on a monthly basis of each regulated air pollutant emitted into the atmosphere for all sources at the facility. Each regulated air pollutant must be totaled on a consecutive twelve-month period to ensure compliance with part #2 of this condition. The following factors shall be used:

- a. Boilers

The owner/operator shall use the AP-42 emission factors for the following pollutants, *except for the Regulation 9-7 limit for NO_x

AP-42 Factors for burning natural Gas Pollutant Emission Factor(lb/MM Btu)

CO	Higher of 0.084 or measured value from previous CO reading conducted every 168 hours
*NO _x	0.036
POC	0.0055

AP-42 Factors for burning fuel oil Pollutant Emission Factor(lb/MM Btu)

CO	0.036
*NO _x	0.048
POC	0.0025

- b. For Engines S-129,128,126,125,124,123,122,121,120,119,118,117,116,115,114,113,112,111,110, 64
- 1) Records of operation for each source shall be totaled monthly to determine emissions of NO_x and CO. Records shall be retained on site and made available for inspection by District personnel for a period of 5 years from the date on which a record is made.
 - 2) Monthly NO_x and CO emissions shall be calculated using the following emission factors:
NO_x- 0.031 lb/hp-hr, CO- 0.0067 lb/hp-hr
- c. For Engines S-109,108, 107, 106, 105
- 1) Records of operation for each source shall be totaled monthly to determine emissions of NO_x and CO. Records shall be retained on site and made available for inspection by District personnel for a period of 5 years from the date on which a record is made
 - 2) Monthly NO_x and CO emissions shall be calculated using the following emission factors:
NO_x- 0.024 lb/hp-hr, CO- 0.0055 lb/hp-hr.
- d. For Engines S-133, 132, 131, 130, 65, 63, 62,
- 1) Records of operation for each source shall be totaled monthly to determine emissions of NO_x and CO. Records shall be retained on site and made available for inspection by District personnel for a period of 5 years from the date on which a record is made.
 - 2) Monthly NO_x and CO emissions shall be calculated using the following emission factors:
NO_x- 0.015 lb/hp-hr, CO- 0.0019 lb/hp-hr.

- e. For Engines S-140, 139, 138, 137, 136, 135,134
 - 1) Records of operation for each source shall be totaled monthly to determine emissions of NOx and CO. Records shall be retained on site and made available for inspection by District personnel for a period of 5 years from the date on which a record is made.
 - 2) Monthly NOx and CO emissions shall be calculated using the following emission factors:
NOx- 0.002 lb/hp-hr, CO- 0.0014 lb/hp-hr.

- f. For Engines S-143, 142, 141
 - 1) Records of operation for each source shall be totaled monthly to determine emissions of NOx and CO. Records shall be retained on site and made available for inspection by District personnel for a period of 5 years from the date on which a record is made.
 - 2) Monthly NOx and CO emissions shall be calculated using the following emission factors:
NOx- 0.0113 lb/hp-hr, CO- 0.0015 lb/hp-hr.

- g. For Engine S-144
 - 1) Records of operation for each source shall be totaled monthly to determine emissions of NOx and CO. Records shall be retained on site and made available for inspection by District personnel for a period of 5 years from the date on which a record is made.
 - 2) Monthly NOx and CO emissions shall be calculated using the following emission factors:
NOx- 0.0128 lb/hp-hr, CO- 0.0013 lb/hp-hr.

- h. Other Internal Combustion Engines permitted after 2004 In the absence of actual source test data or District approved emission factors, the owner/operator shall use the AP-42 emission factors for the following pollutants:
Pollutant Emission Factor(lb/hp-hr)
CO 0.00668
NOx 0.031
POC 0.0027

- i. Surface Coating and Solvent Cleaning
For surface coatings and cold cleaner solvents, the owner/operator shall use the manufacturers' chemical speciation data or the MSDS information to calculate VOC.
| (basis: [Regulation 2-6-423.2.3 Synthetic Minor](#) and recordkeeping)

- 8. The owner/operator shall calculate and maintain records on a monthly basis of the quantity of each hazardous air pollutant (HAP) emitted into the atmosphere from all sources at the facility. The HAPs must be totaled on a consecutive twelve-month period to ensure compliance with part #1. In the absence of actual source test data or District approved emissions factors, the owner/operator shall use the California Air Resources Board CATEF database emission factors or AP-42 factors for the following pollutants.

| a. Boilers burning natural ~~Gas-gas~~ (CATEF)
Pollutant Emission Factor(lb/MM cf)
Benzene 0.00215
Acetaldehyde 0.00847
Formaldehyde 0.0696
| Benzaldehyde 0.0157

- b. Boilers burning fuel oil (CATEF)
Pollutant Emission Factor(lb/1000 gallons)
Benzene 0.00262
Formaldehyde 0.0533
Hexane 0.00126
Toluene 0.00143
Xylene 0.00155
- c. Diesel Firing Internal Combustion Engines (AP-42)
Pollutant Emission Factor (lb/mmBtu/hr)
Benzene 0.00000876
Toluene 0.00000384
Xylene 0.00000267
- d. For surface coatings and cold cleaner solvents, the owner/operator shall use the manufacturers chemical speciation data or the MSDS information to calculate HAPs.

(basis: Regulation 2-6-423.2.3 Synthetic Minor and recordkeeping)

9. The owner/operator shall calculate and maintain records on a monthly basis of the quantity of greenhouse gases (expressed as CO₂e) emitted into the atmosphere from all permitted and exempt combustion sources at the facility. The CO₂e must be totaled on a consecutive twelve-month period to ensure compliance with part #3.

a. CO₂e emission factor for sources fired with natural gas:

- 1) 117.0 lb/MMBtu, Or
- 2) 11.7 lb/therm

b. CO₂e emission factor for sources fired with diesel:

- 1) 163.6 lb/MMBtu, Or
- 2) 22.58 lb/gallon

c. CO₂e emission factor for sources fired with LPG

- 1) 13.28 lb/gallon

If other fuel types besides diesel and natural gas are used, the Permit Holder shall use the emission factors for the fuel types in question from 40 CFR part 98.

If fuel usage and engine load are not measured but run time is recorded, the Permit Holder shall assume that the engine is operated at full load and maximum fuel use rate during its entire run time.

(basis: Regulation 2-6-423.3)

9-10. The owner/operator shall keep records of other unpermitted, temporary, or portable sources (except emissions from non-road engines as defined by 40 CFR 89) if the total emissions from these sources exceed 2 tons per year of any single regulated air pollutant or 400 pounds per year of a combination of hazardous air pollutants.

(basis: Regulation 2-6-423.3 Synthetic Minor and recordkeeping)

11. The owner/operator shall maintain records of the facility wide fossil fuel usage for all permitted and exempt combustion sources. The owner/operator may satisfy the record keeping requirement for utility natural gas by maintaining the usage records from utility service providers.

(basis: Regulation 2-6-423.3 and recordkeeping)

~~10.12.~~ The Owner/Operator shall prepare an annual emissions report. The report shall contain the following items for the year ending Feb 28:

- a. Total HAP emissions for the year.
- b. Emissions of each HAP for the year
- c. Total NOx, CO, and VOC emissions.
- d. Usage of fuel oil and natural gas at boilers
- e. Usage of fuel at engines
- f. Any regulated air pollutant required by part 7 of this condition
- g. This report shall be submitted to the Director of Compliance and Enforcement by February 28 of each year.

(basis: [Regulation 2-6-423.3 Synthetic Minor](#) and recordkeeping)

~~11.13.~~ The owner/operator shall report non-compliance with any of the above conditions in writing to the Director of Compliance and Enforcement within 10 calendar days of discovery of non-compliance. Enforcement within 10 calendar days of discovery of non-compliance.

(basis: Compliance Reporting)

6/26/2012 _____
 Date

Signed by Yu Zhang Liu
 Yu Zhang Liu
 Temporary Air Quality Engineer

h:\pub_data\titlev\synmin\evals\23526e.doc
 attachment: CO₂e Calculation

Appendix A Emission Inventory - Potential to Emit									
Sources	Type	Fuel	Usage	Unit	HHV (MMBTU)	CO ₂ (kg)	CH ₄ (kg)	N ₂ O (kg)	CO ₂ Equivalent (kg)
2	Boiler	NG	1.20E+07	Therms	1.20E+06	6.36E+07	1200.12	1.20E+02	6.37E+07
3	Boiler	NG	1.18E+07	Therms	1.18E+06	6.27E+07	1182.60	1.18E+02	6.28E+07
4	Boiler	NG	1.18E+07	Therms	1.18E+06	6.27E+07	1182.60	1.18E+02	6.28E+07
62	Diesel Generator	Diesel	2.40E+04	Gal	3.31E+03	2.45E+05	0.07	1.34E-02	2.45E+05
63	Diesel Generator	Diesel	1.80E+04	Gal	2.48E+03	1.84E+05	0.16	3.12E-02	1.84E+05
64	Diesel Generator	Diesel	2.95E+03	Gal	4.07E+02	3.01E+04	0.02	3.90E-03	3.01E+04
65	Diesel Generator	Diesel	2.75E+04	Gal	3.80E+03	2.81E+05	0.09	1.76E-02	2.81E+05
105	Diesel Generator	Diesel	3.00E+03	Gal	4.14E+02	3.06E+04	0.25	5.02E-02	3.06E+04
106	Diesel Generator	Diesel	3.00E+03	Gal	4.14E+02	3.06E+04	0.23	4.59E-02	3.06E+04
107	Diesel Generator	Diesel	2.93E+04	Gal	4.04E+03	2.99E+05	0.01	2.85E-03	2.99E+05
108	Diesel Generator	Diesel	2.93E+04	Gal	4.04E+03	2.99E+05	0.18	3.67E-02	2.99E+05
109	Diesel Generator	Diesel	2.44E+04	Gal	3.37E+03	2.49E+05	0.13	2.65E-02	2.49E+05
110	Diesel Generator	Diesel	1.46E+04	Gal	2.02E+03	1.49E+05	0.11	2.18E-02	1.49E+05

Appendix A Emission Inventory - Potential to Emit									
Sources	Type	Fuel	Usage	Unit	HHV (MMBTU)	CO ₂ (kg)	CH ₄ (kg)	N ₂ O (kg)	CO ₂ Equivalent (kg)
	Generator								
111	Diesel Generator	Diesel	1.40E+04	Gal	1.93E+03	1.43E+05	0.09	1.84E-02	1.43E+05
112	Diesel Generator	Diesel	1.22E+04	Gal	1.68E+03	1.24E+05	0.03	6.03E-03	1.24E+05
113	Diesel Generator	Diesel	1.22E+04	Gal	1.68E+03	1.24E+05	0.03	6.03E-03	1.24E+05
114	Diesel Generator	Diesel	1.22E+04	Gal	1.68E+03	1.24E+05	0.03	6.03E-03	1.24E+05
115	Diesel Generator	Diesel	1.22E+04	Gal	1.68E+03	1.24E+05	0.03	6.03E-03	1.24E+05
116	Diesel Generator	Diesel	1.22E+04	Gal	1.68E+03	1.24E+05	0.07	1.40E-02	1.24E+05
117	Diesel Generator	Diesel	1.22E+04	Gal	1.68E+03	1.24E+05	0.08	1.55E-02	1.24E+05
118	Diesel Generator	Diesel	1.22E+04	Gal	1.68E+03	1.24E+05	0.08	1.68E-02	1.24E+05
120	Diesel Generator	Diesel	6.14E+03	Gal	8.47E+02	6.27E+04	0.08	1.63E-02	6.27E+04
121	Diesel Generator	Diesel	6.11E+03	Gal	8.43E+02	6.23E+04	0.00	9.54E-04	6.23E+04
122	Diesel Generator	Diesel	6.11E+03	Gal	8.43E+02	6.23E+04	0.04	8.58E-03	6.23E+04
123	Diesel Generator	Diesel	6.11E+03	Gal	8.43E+02	6.23E+04	0.04	7.87E-03	6.23E+04
124	Diesel Generator	Diesel	6.11E+03	Gal	8.43E+02	6.23E+04	0.04	7.55E-03	6.23E+04
125	Diesel Generator	Diesel	6.11E+03	Gal	8.43E+02	6.23E+04	0.04	7.34E-03	6.23E+04
126	Diesel Generator	Diesel	3.89E+03	Gal	5.37E+02	3.97E+04	0.03	6.71E-03	3.97E+04
128	Diesel Generator	Diesel	2.44E+03	Gal	3.36E+02	2.49E+04	0.04	7.51E-03	2.49E+04
129	Diesel Generator	Diesel	2.44E+03	Gal	3.36E+02	2.49E+04	0.02	3.90E-03	2.49E+04
130	Diesel Generator	Diesel	7.00E+03	Gal	9.66E+02	7.14E+04	0.15	2.94E-02	7.15E+04
131	Diesel Generator	Diesel	3.00E+03	Gal	4.14E+02	3.06E+04	0.02	3.44E-03	3.06E+04
132	Diesel Generator	Diesel	3.00E+03	Gal	4.14E+02	3.06E+04	0.02	3.15E-03	3.06E+04
133	Diesel Generator	Diesel	2.50E+04	Gal	3.45E+03	2.55E+05	0.10	1.94E-02	2.55E+05
134	Natural Gas Generator	NG	5.36E+03	Therms	5.36E+02	2.84E+04	0.54	5.36E-02	2.84E+04
135	Natural Gas Generator	NG	4.10E+03	Therms	4.10E+02	2.17E+04	0.41	4.10E-02	2.17E+04
136	Natural Gas Generator	NG	3.47E+03	Therms	3.47E+02	1.84E+04	0.35	3.47E-02	1.84E+04
137	Natural Gas Generator	NG	2.52E+03	Therms	2.52E+02	1.34E+04	0.25	2.52E-02	1.34E+04
138	Natural Gas Generator	NG	2.84E+03	Therms	2.84E+02	1.50E+04	0.28	2.84E-02	1.50E+04
139	Natural Gas Generator	NG	2.84E+03	Therms	2.84E+02	1.50E+04	0.28	2.84E-02	1.50E+04
140	Propane Generator	Propane	2.45E+03	Gal	2.23E+02	1.47E+04	0.03	6.32E-03	1.47E+04
141	Diesel Generator	Diesel	7.50E+03	Gal	1.04E+03	7.65E+04	0.04	8.93E-03	7.66E+04
142	Diesel Generator	Diesel	9.40E+03	Gal	1.30E+03	9.59E+04	0.03	6.03E-03	9.59E+04

Appendix A Emission Inventory - Potential to Emit									
Sources	Type	Fuel	Usage	Unit	HHV (MMBTU)	CO ₂ (kg)	CH ₄ (kg)	N ₂ O (kg)	CO ₂ Equivalent (kg)
143	Diesel Generator	Diesel	9.40E+03	Gal	1.30E+03	9.59E+04	0.03	6.03E-03	9.59E+04
144	Diesel Generator	Diesel	6.87E+04	Gal	9.48E+03	7.01E+05	1.13	2.26E-01	7.01E+05
145	Diesel Generator	Diesel	6.80E+04	Gal	9.38E+03	6.94E+05	1.06	2.11E-01	6.94E+05
146	Diesel Generator	Diesel	1.80E+04	Gal	2.48E+03	1.83E+05	0.13	2.53E-02	1.83E+05
148	Diesel Generator	Diesel	5.25E+04	Gal	7.25E+03	5.36E+05	0.11	2.20E-02	5.36E+05
149	Diesel Generator	Diesel	6.50E+04	Gal	8.97E+03	6.63E+05	0.00	0.00E+00	6.63E+05
150	Diesel Generator	Diesel	6.50E+03	Gal	8.97E+02	6.63E+04	0.12	2.48E-02	6.64E+04
151	Natural Gas Generator	NG	3.07E+03	Therms	3.07E+02	1.63E+04	0.31	3.07E-02	1.63E+04
	Sources	HHV	CO2 (kg)	CH4(kg)	N2O (kg)	CO2 Equivalent (kg)	CO2 Equivalent(ton)		
	Boilers	3.57E+06	1.89E+08	3.57E+03	3.57E+02	1.89E+08	2.08E+05		
	Diesel Engines	9.16E+04	6.77E+06	4.96E+00	9.91E-01	6.77E+06	7.45E+03		
	Natural Gas Engines	2.64E+03	1.43E+05	2.45E+00	2.48E-01	1.43E+05	1.57E+02		
	Total	3.66E+06	1.96E+08	3.57E+03	3.58E+02	1.96E+08	2.16E+05		

Appendix B Emission Inventory – Annual Renewal Data									
Sources	Type	Fuel	Usage	Unit	HHV (MMBTU)	CO ₂ (kg)	CH ₄ (kg)	N ₂ O (kg)	CO ₂ Equivalence (kg)
2	Boiler	NG	6138.13	Therms	613.81	32544.37	0.61	0.06	32576.28
3	Boiler	NG	1765.60	Therms	176.56	9361.22	0.18	0.02	9370.40
4	Boiler	NG	3189.44	Therms	318.94	16910.39	0.32	0.03	16926.98
62	Diesel Generator	Diesel	162.07	Gal	22.37	1654.16	0.07	0.01	1659.73
63	Diesel Generator	Diesel	376.53	Gal	51.96	3843.05	0.16	0.03	3855.98
64	Diesel Generator	Diesel	47.08	Gal	6.50	480.52	0.02	0.00	482.14
65	Diesel Generator	Diesel	212.25	Gal	29.29	2166.33	0.09	0.02	2173.62
105	Diesel Generator	Diesel	606.17	Gal	83.65	6186.86	0.25	0.05	6207.69
106	Diesel Generator	Diesel	554.50	Gal	76.52	5659.49	0.23	0.05	5678.55
107	Diesel Generator	Diesel	34.43	Gal	4.75	351.41	0.01	0.00	352.59
108	Diesel Generator	Diesel	443.30	Gal	61.18	4524.53	0.18	0.04	4539.77
109	Diesel Generator	Diesel	320.39	Gal	44.21	3270.05	0.13	0.03	3281.06
110	Diesel Generator	Diesel	263.47	Gal	36.36	2689.10	0.11	0.02	2698.15
111	Diesel Generator	Diesel	222.64	Gal	30.72	2272.37	0.09	0.02	2280.02
112	Diesel Generator	Diesel	72.86	Gal	10.05	743.64	0.03	0.01	746.15

Appendix B Emission Inventory – Annual Renewal Data									
Sources	Type	Fuel	Usage	Unit	HHV (MMBTU)	CO ₂ (kg)	CH ₄ (kg)	N ₂ O (kg)	CO ₂ Equivalence (kg)
113	Diesel Generator	Diesel	72.86	Gal	10.05	743.64	0.03	0.01	746.15
114	Diesel Generator	Diesel	72.86	Gal	10.05	743.64	0.03	0.01	746.15
115	Diesel Generator	Diesel	72.86	Gal	10.05	743.64	0.03	0.01	746.15
116	Diesel Generator	Diesel	169.00	Gal	23.32	1724.90	0.07	0.01	1730.70
117	Diesel Generator	Diesel	187.67	Gal	25.90	1915.45	0.08	0.02	1921.90
118	Diesel Generator	Diesel	202.39	Gal	27.93	2065.69	0.08	0.02	2072.64
120	Diesel Generator	Diesel	197.26	Gal	27.22	2013.33	0.08	0.02	2020.11
121	Diesel Generator	Diesel	11.52	Gal	1.59	117.58	0.00	0.00	117.97
122	Diesel Generator	Diesel	103.67	Gal	14.31	1058.11	0.04	0.01	1061.67
123	Diesel Generator	Diesel	95.03	Gal	13.11	969.92	0.04	0.01	973.19
124	Diesel Generator	Diesel	91.19	Gal	12.58	930.73	0.04	0.01	933.86
125	Diesel Generator	Diesel	88.62	Gal	12.23	904.50	0.04	0.01	907.54
126	Diesel Generator	Diesel	81.03	Gal	11.18	827.03	0.03	0.01	829.82
128	Diesel Generator	Diesel	90.70	Gal	12.52	925.73	0.04	0.01	928.84
129	Diesel Generator	Diesel	47.08	Gal	6.50	480.52	0.02	0.00	482.14
130	Diesel Generator	Diesel	355.01	Gal	48.99	3623.40	0.15	0.03	3635.60
131	Diesel Generator	Diesel	41.54	Gal	5.73	423.98	0.02	0.00	425.40
132	Diesel Generator	Diesel	38.08	Gal	5.26	388.66	0.02	0.00	389.97
133	Diesel Generator	Diesel	233.99	Gal	32.29	2388.21	0.10	0.02	2396.25
134	Natural Gas Generator	NG	128.70	Therms	12.87	682.37	0.01	0.00	683.04
135	Natural Gas Generator	NG	70.20	Therms	7.02	372.20	0.01	0.00	372.57
136	Natural Gas Generator	NG	119.60	Therms	11.96	634.12	0.01	0.00	634.74
137	Natural Gas Generator	NG	59.80	Therms	5.98	317.06	0.01	0.00	317.37
138	Natural Gas Generator	NG	126.10	Therms	12.61	668.58	0.01	0.00	669.24
139	Natural Gas Generator	NG	140.40	Therms	14.04	744.40	0.01	0.00	745.13
140	Propane Generator	Propane	115.70	Gal	10.53	694.37	0.03	0.01	696.99
141	Diesel Generator	Diesel	107.86	Gal	14.88	1100.87	0.04	0.01	1104.58
142	Diesel Generator	Diesel	72.86	Gal	10.05	743.66	0.03	0.01	746.16
143	Diesel Generator	Diesel	72.86	Gal	10.05	743.66	0.03	0.01	746.16
144	Diesel Generator	Diesel	2732.86	Gal	377.13	27892.88	1.13	0.23	27986.79
145	Diesel Generator	Diesel	2548.78	Gal	351.73	26014.07	1.06	0.21	26101.65

Appendix B Emission Inventory – Annual Renewal Data									
Sources	Type	Fuel	Usage	Unit	HHV (MMBTU)	CO ₂ (kg)	CH ₄ (kg)	N ₂ O (kg)	CO ₂ Equivalence (kg)
	Generator								
146	Diesel Generator	Diesel	305.27	Gal	42.13	3115.73	0.13	0.03	3126.22
148	Diesel Generator	Diesel	266.00	Gal	36.71	2714.92	0.11	0.02	2724.06
149	Diesel Generator	Diesel	0.00	Gal	0.00	0.00	0.00	0.00	0.00
150	Diesel Generator	Diesel	300.00	Gal	41.40	3061.94	0.12	0.02	3072.25
151	Natural Gas Generator	NG	0.00	Therms	0.00	0.00	0.00	0.00	0.00
	Sources	HHV	CO2 (kg)	CH4(kg)	N2O (kg)	CO2 Equivalent (kg)	CO2 Equivalent(ton)		
	Boilers	1109.32	58815.98	1.11	0.11	58873.67	64.75		
	Diesel Engines	1652.49	122217.93	4.96	0.99	122629.40	134.88		
	Natural Gas Engines	75.01	4113.10	0.10	0.01	4119.07	4.53		
	Total	2836.81	185147.01	6.16	1.12	185622.14	204.16		

Appendix C: Campus Natural Gas Usage including exempts			
Gas (therms) - Year 2011	Totals Nat Gas	Total Nat Gas To Report - Central Campus & Directly Adjacent; Campus Housing including Clark Kerr	Units
Main Campus/Off-Campus Berkeley	454,670	454,670	therms
Off-Campus Housing	1,319,228	1,319,228	therms
Richmond Field Station	166,117		therms
Off-Campus-outside Berkeley	404,302	404,302	therms
TOTAL	2,344,317	2,178,200	therms
Heat Content	234431.70	217820.00	MMBTU/yr
CO₂	12429568.73	11548816.40	kg/yr
CH₄	234.43	217.82	kg/yr
N₂O	23.44	21.78	kg/yr
Total CO2e	12441759.18	11560143.04	kg/yr
	13714.46	12742.66	Ton/yr