PENNSTATE

New York Police Academy

College Point, New York

Technical Report 2:

Energy Consumption, Emissions & Economic Analysis

Prepared for: Professor William Bahnfleth, PhD, PE

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Mechanical Option
Senior Thesis 2010- 2011

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Executive Summary

This report is intended to summarize information regarding the energy consumption of the New York Police Academy's East Campus. The NYPA is divided into an East and West Campus. The East campus houses the office and classroom space for the Academy, while the West Campus houses the central utility plant and physical training facilities. The East Campus and West Campus are physically two separate buildings, connected only by an enclosed walkway. Due to the size of the entire NYPA (nearly 1,000,000 SF) only the East Campus was chosen to be modeled for energy consumption (nearly 400,000 SF).

An energy model was developed using Trane TRACE 700 software. The information calculated from this energy model serves as the foundation for the analysis of this report. Unfortunately, the actual energy model for this building was not accessible from the team of engineers who have been working on the project. Therefore, a thorough comparison of my energy model with the model of the actual engineers was not possible. Nonetheless, this report provides an overview of the steps taken and assumption made for my energy model simulation.

After designing and running an energy simulation, the calculated loads were then used to perform an economic and emissions analysis for the NYPA's East Campus. Overall, the calculated peek cooling load of the East Campus is 1,235.5 tons and the peak heating load is 10,104.2 MBh. The electricity consumption of the building was determined to be 5,634,061 kWh/yr and the natural gas consumption was calculated as 5,530,679 kBtu/yr. Using the Department of Energy's utility costs averages for New York, the annual utility costs of the building were calculated to be \$971,429 which boils down to \$2.59/ ft^2 /yr. This building is not yet constructed and is scheduled to be completed at the end of 2013. Thus, actual utility costs of the building are not available for comparison.

Mechanical Systems Overview:

The air conditioning needs of the building will be met by 63 chilled water Air Handling Units (AHUs). The capacity of the AHUs range from 3,000 CFM to 30,000 CFM. The 63 Air Handling Units will be housed in different sections of the campus. 18 AHUs will reside in the Central Plant, 26 AHUs will reside in the West Campus, the final 19 AHUs will be located in the East Campus. Indoor air quality needs will also be addressed with precautions such as a no smoking policy, indoor CO_2 sensors, and appropriate placement of air intakes that will limit outdoor contaminants entering the building.

There are three water tube boilers that are located in the central plant that will be responsible for introducing the hot water for the entire campus. Along with the boilers there will be (8) 1350 ton chillers that will supply all the cold water needs of the Academy. The central plant serves both the East and West Campus. The capacity of the central plant has been oversized both for redundancy and the intent for future expansion of the New York Police Academy.

Building Load Estimation

The New York Police Academy is divided into an East and West Campus. The East campus houses the office and classroom space for the Academy, while the West Campus houses the central utility plant and physical training facilities. The East Campus and West Campus are physically two separate buildings, connected only by an enclosed walkway. Due to the size of the entire NYPA (nearly 1,000,000 SF) only the East Campus was chosen to be modeled.

In order to estimate the NYPA's load and energy consumption, Trane TRACE 700 was used. The Trane TRACE 700 is a program designed to estimate the energy load of a building and is also useful for performing an economic analysis for the energy consumption of a building. TRACE 700 uses a full 8760 hours-per-year analysis and provides a detailed summary of the estimated loads of the building.

Block Load Analysis

A block load analysis was performed for the energy analysis of NYPA's East Campus. The East Campus consists of eight floors. Each floor was divided into zones based on orientation and occupancy use. In total, the building was designated into 52 different zones. A room by room analysis for this size project was deemed unnecessary for this report because of the size of this

building. By grouping similar spaces into larger zones it will allow for easier analysis and provide a similar level of accuracy.

Below is a summary of some useful information that was gathered and imported into TRACE 700 for the analysis. It summarizes information such as weather input, zone designation, power loads, and construction types.

1.0 Design Load Information:

Location Information

The New York Police Academy will be constructed in College Point, Queens. Its location is 1.5 miles East of LaGuardia airport. Thus, the weather information provided for New York's LaGuardia airport will be used and should provide a high level of accuracy to the actual weather conditions of the NYPA.

Table 1.1: Location Information: College Point, Queens

ASHRAE Handbook of Fundamentals

Station	Latitude	Longitude	Elevation	Heating DB (99.6%)	Cooling DB 0.4%	Cooling MCWB 0.4%	Evaporation WB 0.4%	Evaporation MCDB 0.4%	Dehumid. DP 0.4%	Dehumid HR 0.4%	Dehumid MCDB 0.4%
New York, LaGuardia Aprt	40.78N	73.88W	30	12.6	92.2	74.4	77.2	87.2	74.3	185.5	81.0

Information	Input
Air Density	0.0760 lb/ft^3
Air Specific Heat	0.244 Btu/lb •°F
Density-Specific Heat Product	1.1147 Btu/h •cfm °•F
Latent Heat Factor	4906.9 Btu •min/h• ft^3
Enthalpy Factor	4.5604 lb•min/hr • ft^3
Summer Design Dry Bulb	89°F
Summer Design Wet Bulb	73°F
Winter Design Dry Bulb	15°F
Summer/Winter Clearness Number	0.85°F
Summer/Winter Ground Reflectance	0.20°F
Carbon Dioxide Level	400 ppm

Building Area and Zones

As stated previously, in order to effectively analyze the building it was unnecessary to model each room in TRACE 700. Therefore, each floor was divided into smaller zones based on proximity, occupancy and orientation. In total the eight stories of the East Campus building was designated into 52 different zones, each floor ranging from five to seven zones. The East Campus consists of four different types of spaces which include classroom spaces, office spaces, mechanical rooms, and lobby/corridors. These different spaces were used as a templates to model each zone.

Below is an example of how Level 3 was designated into separate zones for analysis. All other zones can be found in Appendix A.

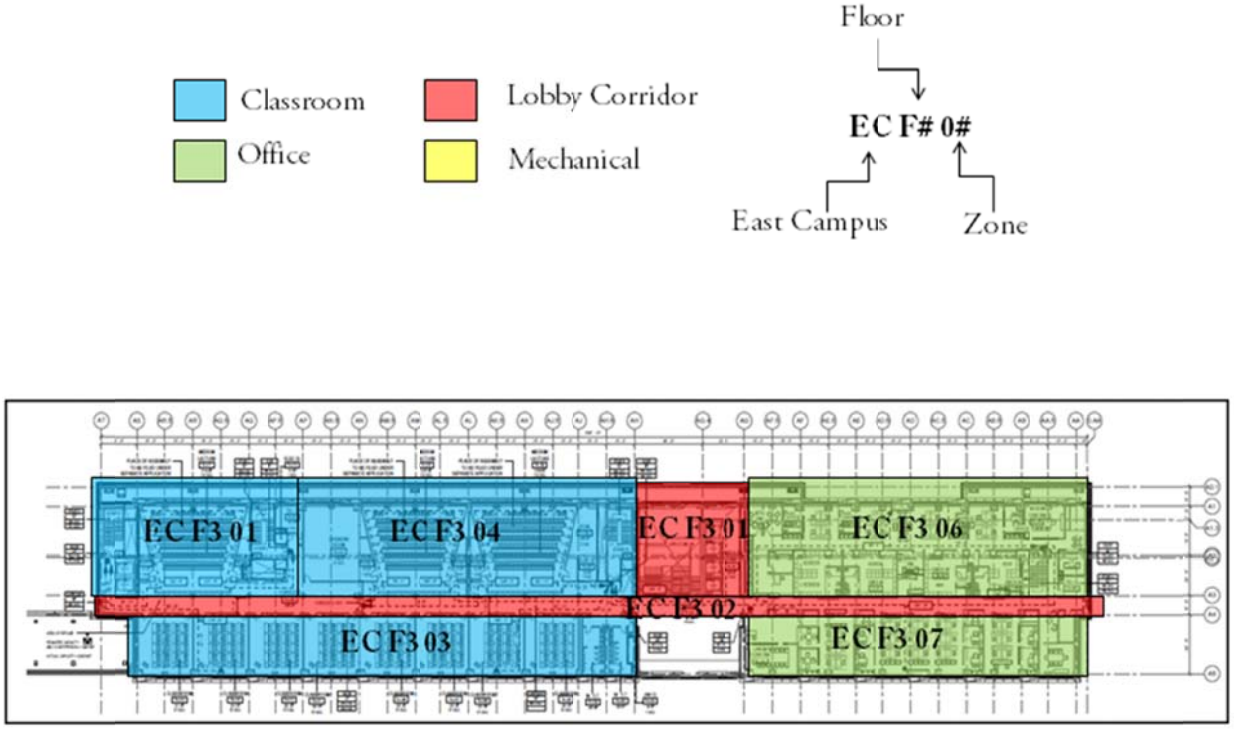


Figure 1.1: New York Police Academy Energy Simulation Zones (Floor 3)

Miscellaneous Internal Loads

All equipment and lighting loads were modeled on a watts per square foot (w/sf) basis. Lighting fixtures and office equipment schedules have not yet been released for this project at this time. Therefore, it was determined to input each space with a typical equipment and lighting load based on the occupancy. Below is a summary of the modeled equipment loads, lighting loads and occupant loads.

Table 1.2: Internal Load Densities

Space	Lighting Load	Equipment Load	Occupant Load	Sensible Load	Latent Load
Classroom	1.0 w/sf	0.22 w/sf	20 ft^2/occ	250 Btu/hr	200 Btu/hr
Office	1.0 w/sf	0.5 w/sf	143 ft^2/occ	250 Btu/hr	200 Btu/hr
Mechanical Room	0.8 w/sf	2.0 w/sf	400 ft^2/occ	275 Btu/hr	200 Btu/hr
Lobby Corridor	0.8 w/sf	0.25 w/sf	50 ft^2/occ	250 Btu/hr	200 Btu/hr

Outdoor Ventilation Rates

Outdoor air ventilation rates for the New York Police Academy were not available for the NYPA's East Campus. However, the ventilation rates were calculated using ASHRAE Standard 62.1-2007 Ventilation Rate Procedure and a summary of the calculated ventilation rates can be found in the previous technical report (Technical Report 1: ASHRAE Standard 62.1 & 90.1 Compliance Analysis) also see Appendix B.2.

Wall Construction

Below is a summary of the construction values that were used for the energy simulation of the New York Police Academy. The East Campus of the academy is composed of 4" concrete slabs, the exterior walls are to be built with aluminum paneling and insulation, the interior walls were modeled as ¾" standard gypsum board framing. The u-factors and shading coefficient for the windows of the East Campus were input it correlation to the glazing specifications (Spec 08 44 13-1).

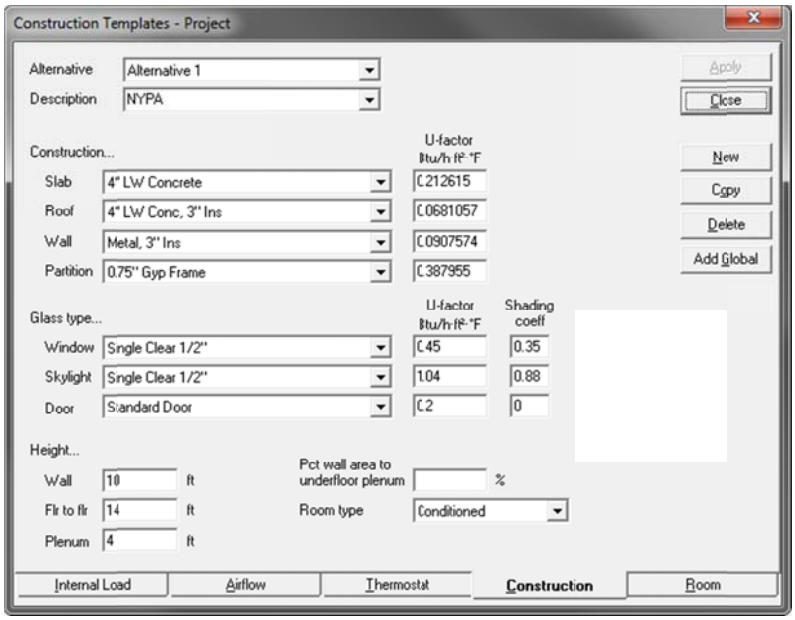


Figure 1.2: New York Police Academy Construction Template

Equipment Information

Air Handling Unit, electric water chillers, hot water boiler, circulating pump, and cooling tower schedules can be found in Appendix B. These schedules dictate information regarding the types and specifications of equipment used for the mechanical building systems. Please note that these equipment schedules to not represent the equipment solely for the East Campus. These equipment schedules represent equipment for the entire campus as well as equipment that will be used for future expansion.

2.0 Energy Analysis Results

After running the simulation for the building, some of the useful information that the program was able to determine was the annual electricity consumption, annual natural gas consumption, the peak cooling loads and the peak heating loads. The consumption and loads were based upon the site location, room types, occupancy, scheduled use, equipment efficiency and several other variables that were input into TRACE 700.

The simulation was able to determine that the total electricity consumption was 5,634,061 kWh and the total natural gas consumption was 5,530,679 kBtu. Also the peak cooling load was 1235.5 tons and the peak heating load was 10,104.2 MBh. Below is a summary of the energy

consumption and peak loads of the New York Police Academy's East Campus as simulated by TRACE 700. Actual designed document loads have not been made available, so comparison from actual design data and simulated data is not possible at this time.

Energy Consumption and Peak Loads Summary

Table 2.1: Electricity Consumption

Source	Electricity Consumption [kWh]	Total Building Electricity
Primary Heating	10,176 (does not include gas consumption)	22.5%
Primary Cooling	1,787,982	24.7%
Auxiliary	9,964	.1%
Lighting	2,986,304	41.2%
Receptacle	839,635	11.6%
Totals	5,634,031	100%

Table 2.2: Natural Gas Consumption

Primary Heating	Natural Gas Consumption[kBtu]
Natural Gas Boilers	5,530,679

Table 2.3: Water Consumption

Primary Cooling	Water Consumption (1000 gallons)
Cooling Equipment	7,233

Table 2.4: Heating and Cooling Load

	Tons	ft^2/ton	MBh	Btu/hr ft^2
Cooling Load	1235.5	303.84	14826.4	39.49
Heating Load	-	-	-10,104.2	-26.92

Table 2.5: Ventilation Results

	[cfm]	[cfm/ft^2]
Outside Airflow	98,265	0.26
Cooling Airflow	234,422	.62
Heating Airflow	73,890	.20
Return Airflow	270,912	.72
Exhaust Airflow	134,754	.36

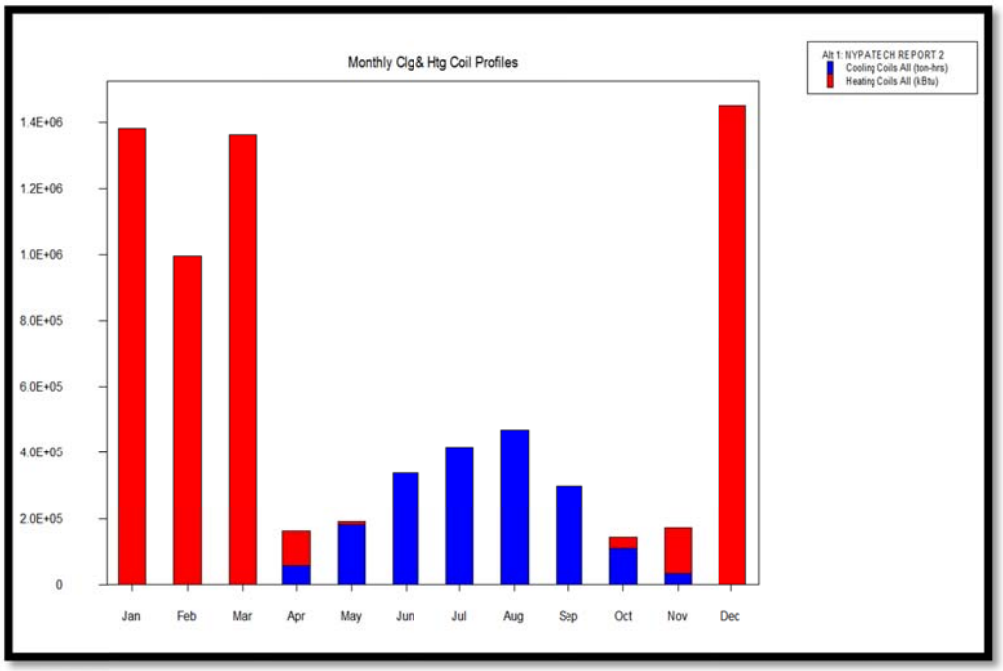


Figure 2.1: Monthly Cooling and Heating Coil Profiles

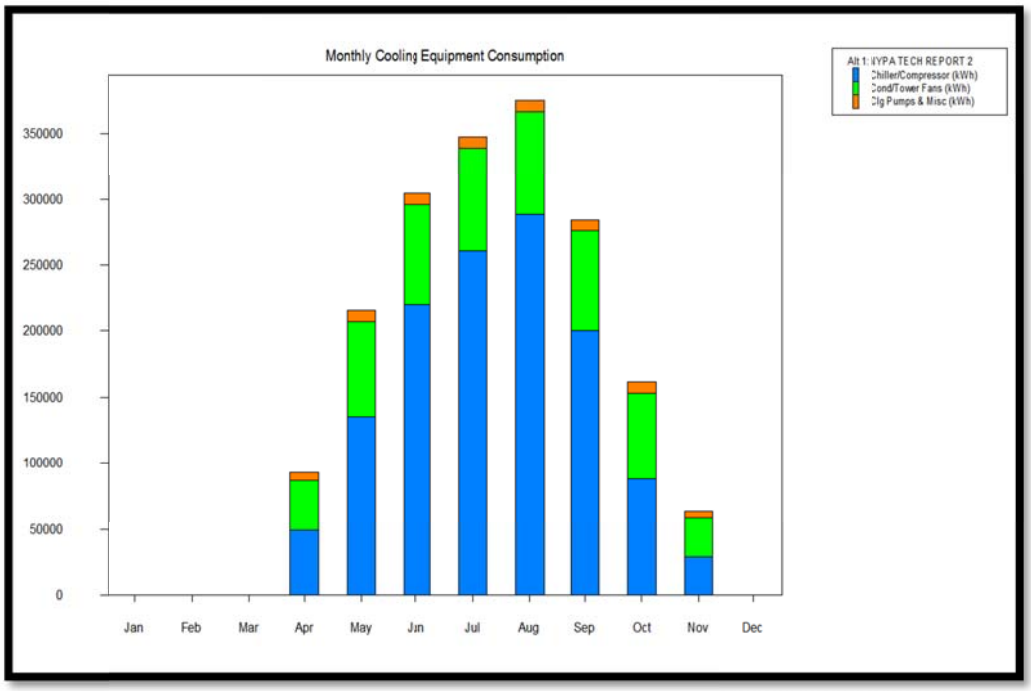


Figure 2.2: Monthly Cooling Equipment Consumption

Electrical Loads

As stated previously, there is limited information available in regards to what assumptions were made by the engineers when calculating the total loads of the building. The closest information available for the electrical loads is the total nominal kW for the East Campus. A discrepancy between the electrical loads I have calculated using TRACE 700 and the electrical loads provided are the units. The construction documents have provided the electrical load on a kW basis where as a TRACE 700 has calculated on a kWh basis. In order to convert the construction documents kW loads to kWh a schedule would need to be provided on when these electrical loads would be running.

Hypothetically, if it was assumed that electrical loads were to run 9 hours a day Monday-Friday then the construction documents would yield an electrical load of 5,891,292 kWh which is 4.6% greater than the TRACE 700 simulation. Nonetheless, it is a broad assumption to assume all electrical loads run specifically at 9 hours a day Monday- Friday. However, this broad assumption proves that the TRACE 700 model is comparable to the construction documents.

Also in order to effectively compare the construction documents with the TRACE 700 simulation, the percentage of total energy use for each category was compared with the construction documents. This analysis can be seen below. Overall, the HVAC load was responsible for almost an identical amount of electricity consumption (% of total), however the lighting and receptacle loads varied by +/- 14% of total electricity consumption.

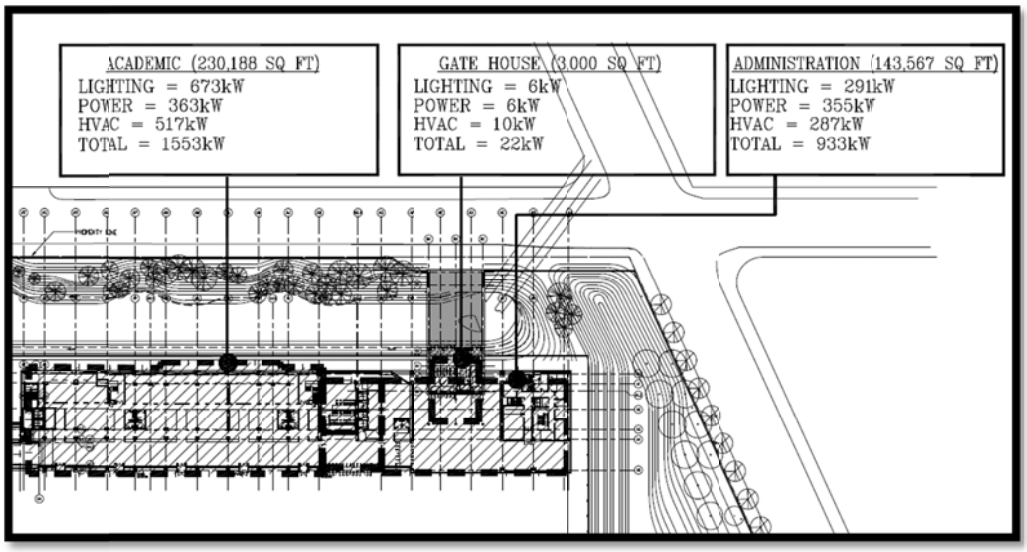


Figure 2.3: Electric Consumption NYPA East Campus

Table 2.6: Electrical Load from Construction Documents (kW)

East Campus	Electrical Load	Percentage of Total
Lighting	970 kW	39%
Power	724 kW	29%
HVAC	814 kW	32%
Total	2508 kW	100%

Table 2.7: Electrical Load Calculated with TRACE 700 Simulation

East Campus	Electrical Load	Percentage of Total
Lighting	2,986,304 kWh	53%
Receptacles	839,635 kWh	15%
HVAC	1,798,158 kWh	32%
Total	5,634,061 kWh	100%

Table 2.8: Electrical Load Comparison Construction Documents vs TRACE 700 Simulation

East Campus	Construction Documents	TRACE 700 Simulation	Difference
Lighting	39%	53%	-14%
Receptacles	29%	15%	14%
HVAC	32%	32%	0%

3.0 Economic Analysis Results

Energy Costs

In order to accurately verify the energy cost per square foot of a building it is useful to have both the typical utility rates charged to a building as well the actual energy consumption of a building. This report has been written prior to the construction of the New York Police Academy thus assumptions had to be made. Assumptions made include the cost per kWh of electricity and the cost of natural gas. These prices were gathered from the United States Department of Energy's: Energy Information Administration. New York State has one of the highest prices for electricity and natural gas in the United States. It was assumed that the price per kWh was .1611 $/kWh and the price for natural gas was $11.858/1000 ft^3 of natural gas. The electricity price was assumed to be an average commercial electricity rate for New York State in the year 2010 and the natural gas price was an annual average from 2004-2010. See appendix for the Energy Information Administration's tables.

Table 3.1: Electric Utility Costs

Source	Energy Cost	Electricity Consumption [kWh/yr]	Utility Price [$ /yr]	Utility Price [$/ ft^2 • yr]
Primary Heating	$.1611 /kWh	10,176	$1,639.35	$.0043/ ft^2 • yr
Primary Cooling	$.1611 /kWh	1,787,982	$288,043.90	$.767/ ft^2 • yr
Auxiliary	$.1611 /kWh	9,964	$16,05.20	$.0043/ ft^2 • yr
Lighting	$.1611 /kWh	2,986,304	$481,093.57	$1.28/ ft^2 • yr
Receptacle	$.1611 /kWh	839,635	$135,265.20	$0.36/ ft^2 • yr
Totals	$.1611 /kWh	5,634,031	$907,642.39	$2.42/ ft^2 • yr

Table 3.2: NYPA East Campus Total Utility Costs

Energy Cost	Energy Consumption	Building Size (East Campus Only)	Utility Price/ $ft^2 \cdot yr$
$.1611 /kWh	5,634,061 kWh/yr	375,405 ft^2	$2.42 / $ft^2 \cdot yr$
$11.858/1000 ft^3 NG	5,530,679 kBtu/yr	375,405 ft^2	$.1699/ $ft^2 \cdot yr$
		Total Utility Cost:	**$2.59/ $ft^2 \cdot yr$**
		Annual Cost:	**$971,428/yr**

*High Heating Value for Natural Gas was used $1ft^3$=1028 Btu in accordance with specification of boiler.

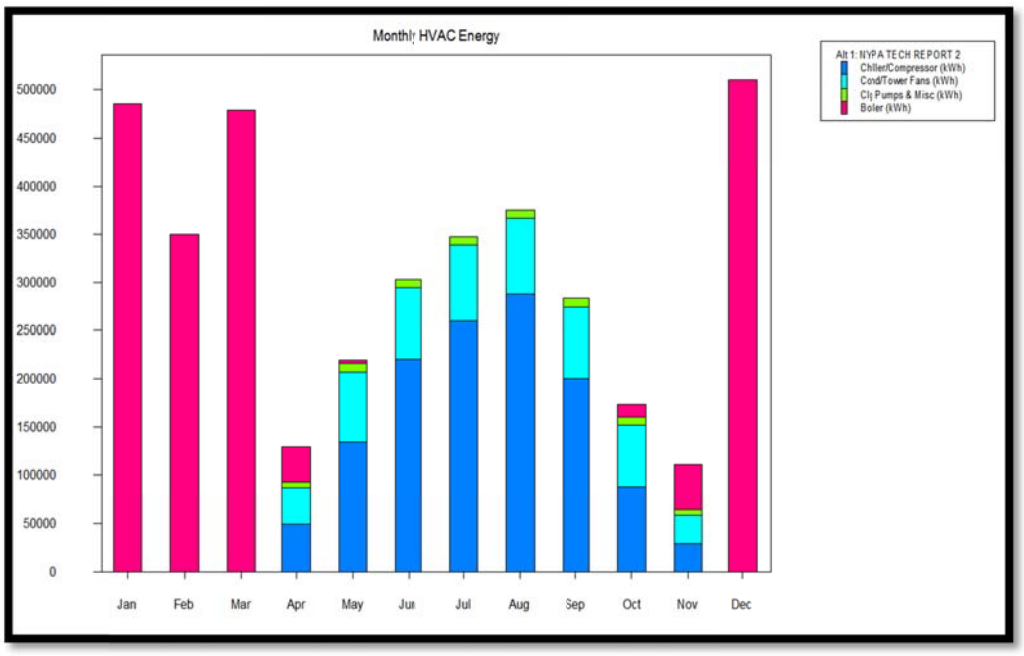


Figure 3.1: Monthly HVAC Energy

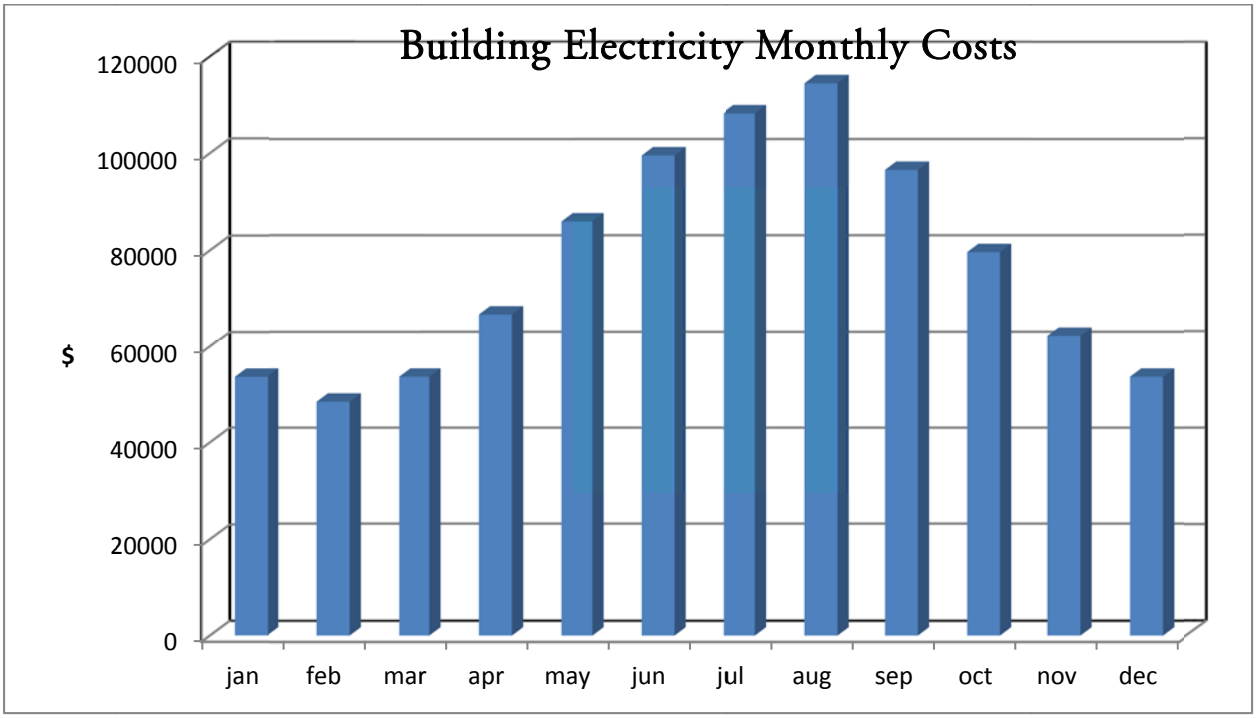


Figure 3.2: Building Electricity Monthly Costs

Emissions Analysis Results

The use of electricity in buildings can contribute pollutants into the atmosphere. Pollutant emissions for the East Campus of the New York Police Academy have been calculated using information from the National Renewable Energy Laboratory (NREL). *The Source Energy and Emissions Factors for Energy use in Buildings Table* was used from the NREL. This table allows for calculating source emissions depending on the amount of electricity consumed by a building and the location of the building. Below you can find a summary of the amount of pollutants the East Campus of the NYPA is responsible for.

Table 3.3:Emissions Analysis

Pollutant	[lb/kWh]	[kWh/yr]	[lbs of Pollutant/yr]
CO_{2e}	1.03	5,634,061	5,803,082.83
CO_2	0.961	5,634,061	5,414,332.62
CH_4	0.00259	5,634,061	14,592.22
$N0_2$	0.00000168	5,634,061	9.47
$N0_x$	0.00172	5,634,061	9,690.58
$S0_x$	0.00623	5,634,061	35,100.20

CO	0.00175	5,634,061	9,859.61
TNMOC	0.0000638	5,634,061	359.45
Lead	5.59E-08	5,634,061	0.31
Mercury	3.99E-08	5,634,061	0.22
PM10	0.0000687	5,634,061	387.06
Solid Waste	0.0618	5,634,061	348,184.97

Table 3.4: Natural Gas Boiler CO^2 Emissions

Primary Heating Source	Natural Gas Derive CO_2 Emissions [lbs CO_2/year]	Electricity Derived CO_2 Emissions [lbs CO_2/year]	Total CO_2 Emissions [lbs CO_2/year]
Natural Gas Boilers	**647,089**	**4,062**	**651,151**

References:

ASHRAE. (2009). *Handbook of Fundamentals.* Atlanta, GA: American Society of Heating Refrigeration and Air Conditioning Engineers, Inc.

Turner Construction Company. *New York Police Academy Construction Documents*. New York, New York. (2010)

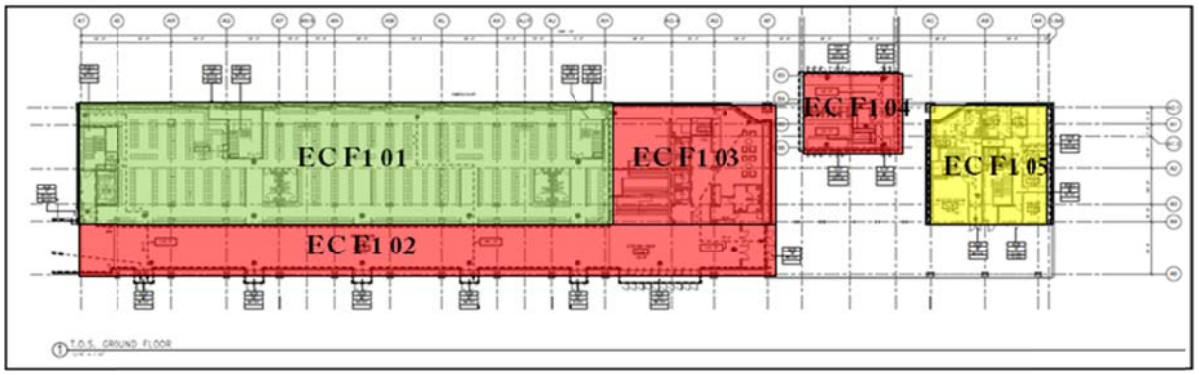
Turner Construction Company. *New York Police Academy Specifications*. New York, New York. (2010)

"U.S Energy Information Adminstration: *Independednt Statistcs Analysisis"* Accessed October 15, 2010. <http://www.eia.doe.gov/cneaf/electricity/epa/epa_sum.html>

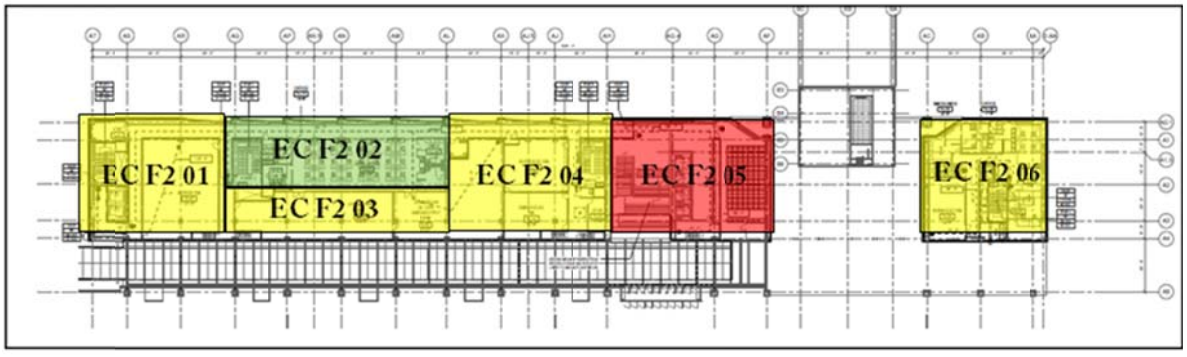
Appendices:

Appendix A: Building Zone Information

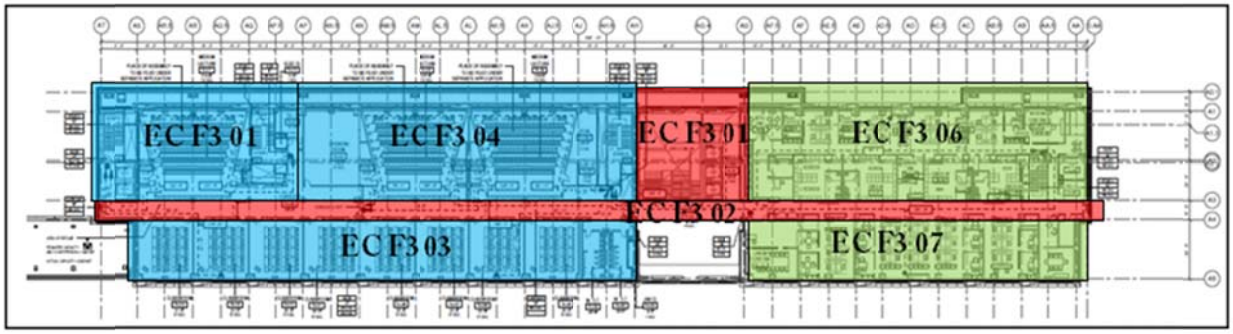
Floor 1 Zones



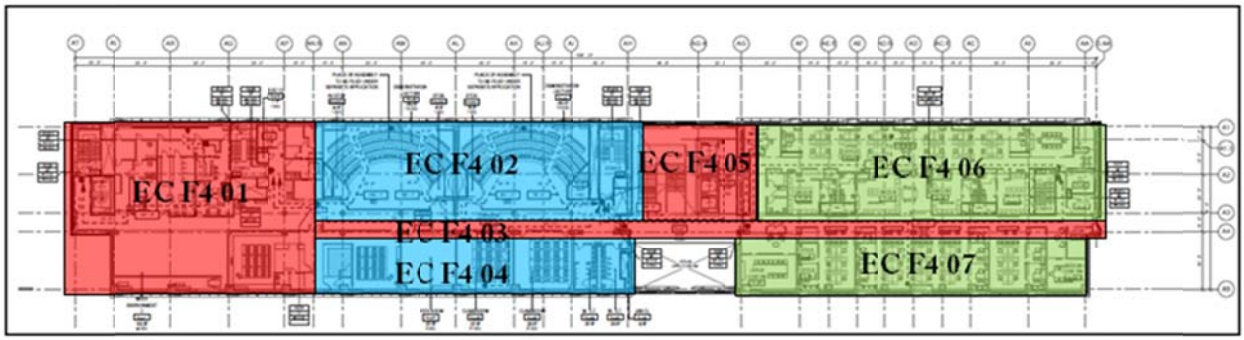
Floor 2 Zones



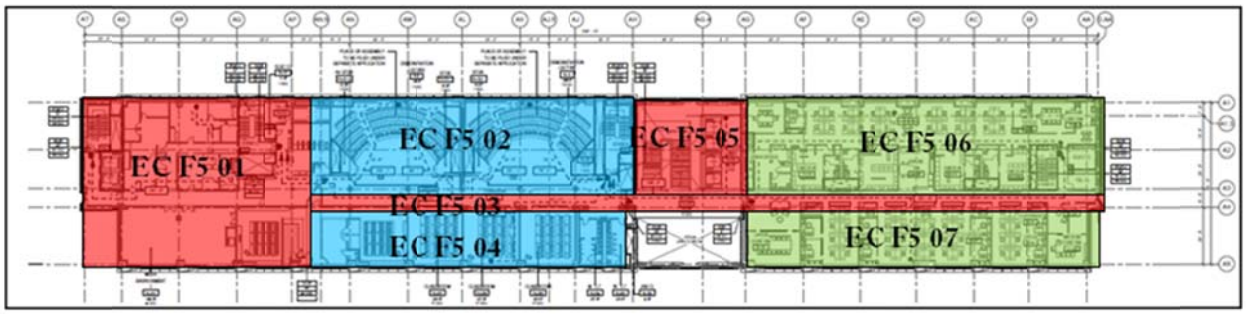
Floor 3 Zones



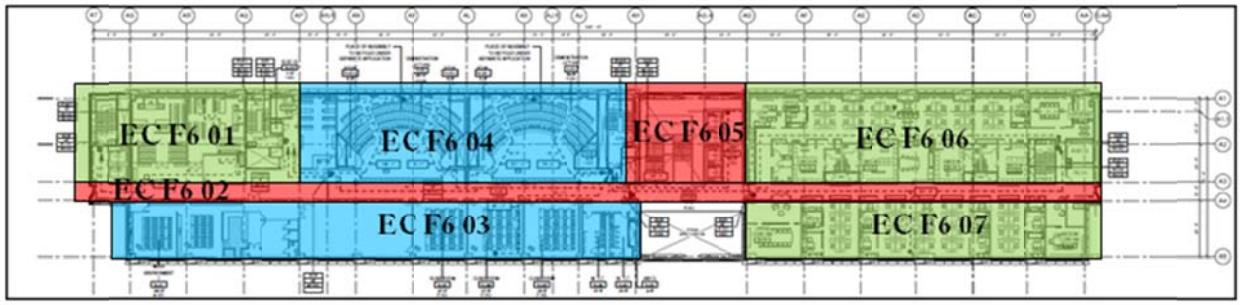
Floor 4 Zones



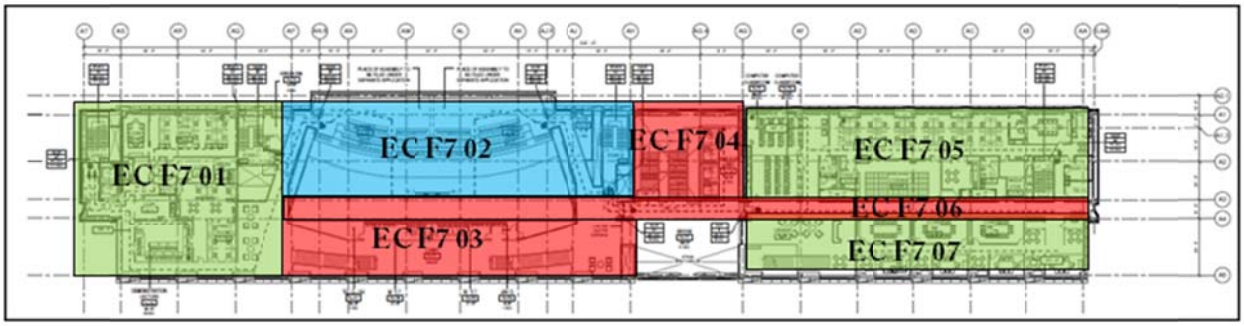
Floor 5 Zones



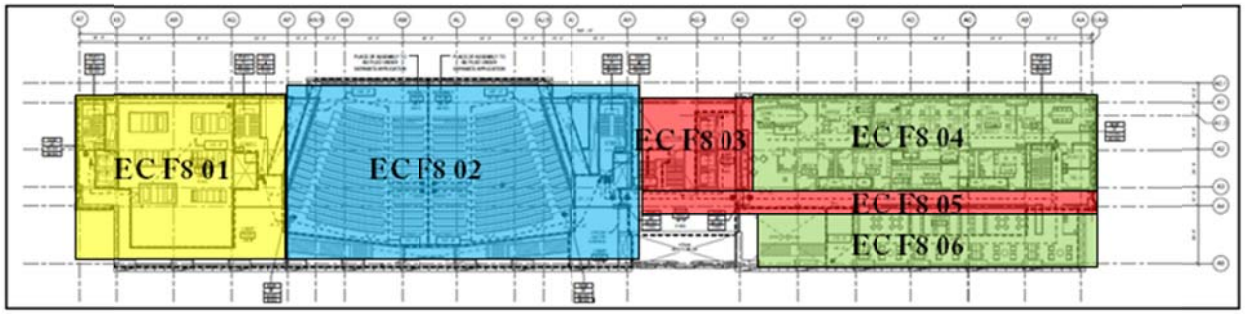
Floor 6 Zones



Floor 7 Zones



Floor 8 Zones



Appendix B.1: Equipment Information

Note: Boiler Schedule, Electric Water Chiller Schedule and Cooling Tower Chiller represent equipment for both the East and West Campus of the New York Police Academy.

Hot Water Boiler Schedule

HOT WATER BOILER LOW NOx (UNILUX AS STANDARD)

DESIGNATION	SERVICE	LOCATION	BOILER H.P.	NET OUTPUT (MBH)	PASS ARRANGEMENT	DESIGN PRESSURE (PSIG)	RELIEF VALVE SET POINT (PSIG)	EFFICIENCY AT RATED LOAD (%)	HOT WATER DATA: FLOW RATE (USGPM) 40% DT/DT	HOT WATER DATA: ENT. TEMP (DEGREES F)	HOT WATER DATA: LVG. TEMP (DEGREES F)	HOT WATER DATA: WATER PRESSURE DROP (PSI)	GAS BURNER DATA: GAS TYPE	GAS BURNER DATA: GAS CONTROL METHOD (VFT)	GAS BURNER DATA: FIRING AT RATED LOAD (CFH)	GAS BURNER DATA: GAS INLET PRESSURE AT BURNER (PSIG)	DRAFT BLOWER DATA: FLUE GAS OUTLET SIZE (IN.)	DRAFT BLOWER DATA: MOTOR HP	VOLTS/PHASE	MODEL NUMBER	OPERATING WEIGHT (LBS)	ELECTRICAL POWER: NORMAL POWER	ELECTRICAL POWER: EMERGENCY POWER	UNIT/ MOC/ LOOSE MOUNTED STARTER	STARTER PROVIDED BY	STARTER TYPE	VARIABLE SPEED	REMARKS
B-311-3-1	HOT WATER	CENTRAL PLANT 3RD FLOOR	750	25110	5	250	180	84.0	2010	165	190	<5.0	NG	1000	30000	10	30	30	460/3	SF2900H-1-250/250	38,000	YES	YES	UNIT	MECH	VFD	YES	DUAL FUEL
B-311-3-2	HOT WATER	CENTRAL PLANT 3RD FLOOR	750	25110	5	250	180	84.0	2010	165	190	<5.0	NG	1000	30000	10	30	30	460/3	SF2900H-1-250/250	38,000	YES	YES	UNIT	MECH	VFD	YES	DUAL FUEL
B-311-3-3	HOT WATER	CENTRAL PLANT 3RD FLOOR	750	25110	5	250	180	84.0	2010	165	190	<5.0	NG	1000	30000	10	30	30	460/3	SF2900H-1-250/250	38,000	YES	NO	UNIT	MECH	VFD	YES	DUAL FUEL
B-311-3-4	HOT WATER	CENTRAL PLANT 3RD FLOOR	750	25110	5	250	180	84.0	2010	165	190	<5.0	NG	1000	30000	10	30	30	460/3	SF2900H-1-250/250	38,000	YES	NO	UNIT	MECH	VFD	YES	DUAL FUEL (FUTURE)
B-311-3-5	HOT WATER	CENTRAL PLANT 3RD FLOOR	750	25110	5	250	180	84.0	2010	165	190	<5.0	NG	1000	30000	10	30	30	460/3	SF2900H-1-250/250	38,000	YES	NO	UNIT	MECH	VFD	YES	DUAL FUEL (FUTURE)

•LOW NOx ON GAS FIRING < 30 PPM

ITEMS GROSS INPUT, TOTAL HEATING SURFACE, FURNACE VOLUME, AIR QUALITY AND VIBRATION ISOLATION REMOVED FROM SCHEDULE

Electric Water Chiller Schedule

ELECTRIC WATER CHILLER (YORK 'YD" AS STANDARD)

DESIGNATION	SERVICE	LOCATION	NOMINAL TONS	EVAPORATOR SIDE: CHILLED WATER FLOW RATE (GPM)	EVAPORATOR SIDE: ENT. WATER TEMPERATURE (DEGREES F)	EVAPORATOR SIDE: LVG. WATER TEMPERATURE (DEGREES F)	EVAPORATOR SIDE: CHILLED WATER PRESS. DROP (FT. OF WATER)	EVAPORATOR SIDE: NUMBER OF PASSES	EVAPORATOR SIDE: FOULING FACTOR	CONDENSER SIDE: COND. WATER FLOW RATE (GPM)	CONDENSER SIDE: ENT. WATER TEMPERATURE (DEGREES F)	CONDENSER SIDE: LVG. WATER TEMPERATURE (DEGREES F)	CONDENSER SIDE: COND. WATER PRESS. DROP (FT. OF WATER)	CONDENSER SIDE: NUMBER OF PASSES	CONDENSER SIDE: FOULING FACTOR	COMPRESSOR ELECTRIC DATA: NUMBER OF COMPRESSORS	COMPRESSOR ELECTRIC DATA: KW (EACH MOTOR)	COMPRESSOR ELECTRIC DATA: SHAFT HP EACH MOTOR	COMPRESSOR ELECTRIC DATA: KW TOTAL	COMPRESSOR ELECTRIC DATA: UNIT KW /TON	COMPRESSOR ELECTRIC DATA: UNIT MPLV	COMPRESSOR ELECTRIC DATA: FLA (EACH MOTOR)	COMPRESSOR ELECTRIC DATA: LRA (EACH MOTOR)	COMPRESSOR ELECTRIC DATA: MARGIN AMPS	COMPRESSOR ELECTRIC DATA: VOLTS /PHASE	OIL PUMP ELECTRIC DATA: FLA	OIL PUMP ELECTRIC DATA: VOLTS /PHASE	OPERATING WEIGHT (LBS)
CH-311-3-1	CHILLED WATER	CENTRAL PLANT 3RD FLOOR	1350	2625	58	42	14	2	0.00010	2700	85	100	12	2	0.00025	1	826	1023	826	0.612	0.38	1152	7014	1165	480/3	-	460/3	63,293
CH-311-3-2	CHILLED WATER	CENTRAL PLANT 3RD FLOOR	1350	2625	58	42	14	2	0.00010	2700	85	100	12	2	0.00025	1	826	1023	826	0.612	0.38	1152	7014	1165	480/3	-	460/3	63,293
CH-311-3-3	CHILLED WATER	CENTRAL PLANT 3RD FLOOR	1350	2625	58	42	14	2	0.00010	2700	85	100	12	2	0.00025	1	826	1023	826	0.612	0.38	1152	7014	1165	480/3	-	460/3	63,293
CH-311-3-4	CHILLED WATER	CENTRAL PLANT 3RD FLOOR	1350	2625	58	42	14	2	0.00010	2700	85	100	12	2	0.00025	1	826	1023	826	0.612	0.38	1152	7014	1165	480/3	-	460/3	63,293
CH-311-3-5	CHILLED WATER	CENTRAL PLANT 3RD FLOOR	1350	2625	58	42	14	2	0.00010	2700	85	100	12	2	0.00025	1	826	1023	826	0.612	0.38	1152	7014	1165	480/3	-	460/3	63,293
CH-311-3-6	CHILLED WATER	CENTRAL PLANT 3RD FLOOR	1350	2625	58	42	14	2	0.00010	2700	85	100	12	2	0.00025	1	826	1023	826	0.612	0.38	1152	7014	1165	480/3	-	460/3	63,293

•TWO CHILLER WILL BE UNDER ENERGY POWER BUT ONLY ONE WILL RUN.

Cooling Tower Schedule

COOLING TOWERS (MARLEY AS STD)

DESIGNATION	LOCATION	TYPE	TOTAL FLOW RATE (GPM)	ENT. WATER TEMPERATURE (DEGREES F)	LVG. WATER TEMPERATURE (DEGREES F)	AMBIENT AIR TEMP (DEGREES F. W.B.)	GPM PER CELL	NUMBER OF CELLS	FAN MOTOR DATA: NUMBER OF FAN MOTORS	FAN MOTOR DATA: HP PER FAN MOTOR	FAN MOTOR DATA: RPM	FAN MOTOR DATA: VOLTS/PHASE	MODEL NUMBER	OPERATING WEIGHT W/O STEEL SUPPORT	BASIN HEATER KW, & KW	VIBRATION ISOLATION: SPECIFICATION TYPE	VIBRATION ISOLATION: STATIC DEFLECTION (INCHES)	ELECTRICAL POWER: NORMAL POWER	ELECTRICAL POWER: EMERGENCY POWER	VARIABLE SPEED	UNIT / MOC / LOOSE MOUNTED STARTER	STARTER PROVIDED BY	STARTER TYPE
CT-311-R-1	ROOF LEVEL	INDUCED DRAFT COUNTER FLOW	2700	100	85	78	2700	1	1	60	1800	460/3	NC8414VAN1	53,070	24	-	-	YES	YES	YES	LOOSE	MECH	VFD
CT-311-R-2	ROOF LEVEL	INDUCED DRAFT COUNTER FLOW	2700	100	85	78	2700	1	1	60	1800	460/3	NC8414VAN1	53,070	24	-	-	YES	YES	YES	LOOSE	MECH	VFD
CT-311-R-3	ROOF LEVEL	INDUCED DRAFT COUNTER FLOW	2700	100	85	78	2700	1	1	60	1800	460/3	NC8414VAN1	53,070	24	-	-	YES	NO	YES	LOOSE	MECH	VFD
CT-311-R-4	ROOF LEVEL	INDUCED DRAFT COUNTER FLOW	2700	100	85	78	2700	1	1	60	1800	460/3	NC8414VAN1	53,070	24	-	-	YES	NO	YES	LOOSE	MECH	VFD
CT-311-R-5	ROOF LEVEL	INDUCED DRAFT COUNTER FLOW	2700	100	85	78	2700	1	1	60	1800	460/3	NC8414VAN1	53,070	24	-	-	YES	NO	YES	LOOSE	MECH	VFD
CT-311-R-6	ROOF LEVEL	INDUCED DRAFT COUNTER FLOW	2700	100	85	78	2700	1	1	60	1800	460/3	NC8414VAN1	53,070	24	-	-	YES	NO	YES	LOOSE	MECH	VFD
CT-311-R-7	ROOF LEVEL	INDUCED DRAFT COUNTER FLOW	2700	100	85	78	2700	1	1	60	1800	460/3	NC8414VAN1	53,070	24	-	-	YES	NO	YES	LOOSE	MECH	VFD

•TWO COOLING TOWERS WILL BE UNDER ENERGY POWER BUT ONLY ONE WILL RUN.

AHU Circulating Pumps

AHU HEATING COIL CIRCULATING PUMPS

DESIGNATION	SERVICE	LOCATION	FLOW RATE (GPM)	TOTAL PUMP HEAD (FT. OF WATER)	STATIC HEAD (FT. OF WATER)	CASING PRESSURE (PSIG)	MINIMUM PUMP EFFICIENCY (%)	MOTOR DATA				MODEL NUMBER	PUMP TYPE	MANUFACTURER	VIBRATION ISOLATION		REMARKS	DRAWING NO.
								BRAKE HP	MINIMUM MOTOR HP	RPM	VOLTS/PHASE				SPECIFICATION TYPE	STATIC DEFLECTION (INCHES)		
CP-111-B-1	AHU-111-B-1	8TH FLOOR MER	54.5	20	-	150	62.27	.47	.75	1800	460/3	B&G 2AA SERIES 90	IN-LINE	BELL & GOSSETT	-	-	-	-
CP-111-B-2	AHU-111-B-2	8TH FLOOR MER	65.2	20	-	150	63.5	.54	.75	1800	460/3	B&G 2AA SERIES 90	IN-LINE	BELL & GOSSETT	-	-	-	-
CP-111-B-3	AHU-111-B-3	8TH FLOOR MER	108.3	20	-	150	68.18	.8	1.1	1800	460/3	B&G 2x2x5 1/4 SERIES 60	IN-LINE	BELL & GOSSETT	-	-	-	-
CP-111-B-4	AHU-111-B-4	8TH FLOOR MER	81.8	20	-	150	65.53	.64	.75	1800	460/3	B&G 2AA SERIES 90	IN-LINE	BELL & GOSSETT	-	-	-	-
CP-111-B-5	AHU-111-B-5	8TH FLOOR MER	140.2	20	-	150	62.81	1.17	1.5	1800	460/3	B&G 3x3x7.5 SERIES 80	IN-LINE	BELL & GOSSETT	-	-	-	-
CP-111-B-6	AHU-111-B-6	8TH FLOOR MER	140.2	20	-	150	62.81	1.17	1.5	1800	460/3	B&G 3x3x7.5 SERIES 80	IN-LINE	BELL & GOSSETT	-	-	-	-
CP-111-PH-1	AHU-111-PH-1	WEST PENTHOUSE MER	140.2	20	-	150	62.81	1.17	1.5	1800	460/3	B&G 3x3x7.5 SERIES 80	IN-LINE	BELL & GOSSETT	-	-	-	-
CP-111-PH-2	AHU-111-PH-2	WEST PENTHOUSE MER	140.2	20	-	150	62.81	1.17	1.5	1800	460/3	B&G 3x3x7.5 SERIES 80	IN-LINE	BELL & GOSSETT	-	-	-	-
CP-111-PH-3	AHU-111-PH-3	WEST PENTHOUSE MER	140.2	20	-	150	62.81	1.17	1.5	1800	460/3	B&G 3x3x7.5 SERIES 80	IN-LINE	BELL & GOSSETT	-	-	-	-
CP-111-PH-4	AHU-111-PH-4	WEST PENTHOUSE MER	68.2	20	-	150	64.86	.55	.75	1800	460/3	B&G 2AA SERIES 90	IN-LINE	BELL & GOSSETT	-	-	-	-
CP-111-PH-5	AHU-111-PH-5	WEST PENTHOUSE MER	68.2	20	-	150	64.86	.55	.75	1800	460/3	B&G 2AA SERIES 90	IN-LINE	BELL & GOSSETT	-	-	-	-
CP-111-PH-6	AHU-111-PH-6	WEST PENTHOUSE MER	118.3	20	-	150	67.48	.89	1.1	1800	460/3	B&G 2x2x5 1/4 SERIES 60	IN-LINE	BELL & GOSSETT	-	-	-	-
CP-131-PH-1	AHU-131-PH-1	EAST PENTHOUSE MER	118.3	20	-	150	67.48	.89	1.1	1800	460/3	B&G 2x2x5 1/4 SERIES 60	IN-LINE	BELL & GOSSETT	-	-	-	-
CP-131-PH-2	AHU-131-PH-2	EAST PENTHOUSE MER	108.3	20	-	150	68.18	.8	1.1	1800	460/3	B&G 2x2x5 1/4 SERIES 60	IN-LINE	BELL & GOSSETT	-	-	-	-
CP-131-PH-3	AHU-131-PH-3	EAST PENTHOUSE MER	108.3	20	-	150	68.18	.8	1.1	1800	460/3	B&G 2x2x5 1/4 SERIES 60	IN-LINE	BELL & GOSSETT	-	-	-	-
CP-131-PH-4	AHU-131-PH-4	EAST PENTHOUSE MER	108.3	20	-	150	68.18	.8	1.1	1800	460/3	B&G 2x2x5 1/4 SERIES 60	IN-LINE	BELL & GOSSETT	-	-	-	-
CP-131-PH-5	AHU-131-PH-5	EAST PENTHOUSE MER	108.3	20	-	150	68.18	.8	1.1	1800	460/3	B&G 2x2x5 1/4 SERIES 60	IN-LINE	BELL & GOSSETT	-	-	-	-
CP-131-PH-6	AHU-131-PH-6	EAST PENTHOUSE MER	83.4	20	-	150	65.53	.64	.75	1800	460/3	B&G 2AA SERIES 90	IN-LINE	BELL & GOSSETT	-	-	-	-
CP-131-PH-7	AHU-131-PH-7	EAST PENTHOUSE MER	83.4	20	-	150	65.53	.64	.75	1800	460/3	B&G 2AA SERIES 90	IN-LINE	BELL & GOSSETT	-	-	-	-

East Campus AHU Schedule

FACTORY ASSEMBLED HVAC SYSTEMS – (CHILLED WATER)

DESIGNATION	SERVICE	LOCATION	TOTAL AIR QUALITY (CFM)	OUTSIDE AIR QUALITY (CFM)	FILTER: SPECIFICATION TYPE	FILTER: MINIMUM % EFFICIENCY	FILTER: AIR FRICTION (IN. OF WATER) INITIAL	FILTER: AIR FRICTION (IN. OF WATER) REPLACE	FILTER: TOTAL FACE AREA (SQ. FT.)	COOLING COIL AIR SIDE: ENT. TEMP. DRY BULB (DEGREES F)	COOLING COIL AIR SIDE: ENT. TEMP. WET BULB (DEGREES F)	COOLING COIL AIR SIDE: LVG. TEMP. DRY BULB (DEGREES F)	COOLING COIL AIR SIDE: LVG. TEMP. WET BULB (DEGREES F)	COOLING COIL AIR SIDE: MAXIMUM AIR FRICTION (IN. OF WATER)	COOLING COIL WATER SIDE: FLOW RATE (GPM)	COOLING COIL WATER SIDE: ENT. TEMP. (DEGREES F)	COOLING COIL WATER SIDE: LVG. TEMP. (DEGREES F)	COOLING COIL WATER SIDE: MAXIMUM PRESS. DROP (FT. OF WATER)	COOLING COIL: TOTAL COOLING CAPACITY (MBH)	COOLING COIL: SENSIBLE COOLING CAPACITY (MBH)	COOLING COIL: NUMBER OF SECTIONS	COOLING COIL: FACE AREA (SQ. FT.)	COOLING COIL: FACE VELOCITY (FPM)	COOLING COIL: SERIES SURFACE (FPI) AND ROWS	HEATING COIL: TOTAL HEATING CAPACITY (MBH)	HEATING COIL: HEATING COIL TYPE	HEATING COIL AIR SIDE: ENT. TEMP. DRY BULB (DEGREES F)	HEATING COIL AIR SIDE: LVG TEMP. DRY BULB (DEGREES F)	HEATING COIL AIR SIDE: MAXIMUM AIR FRICTION (IN. OF WATER)	HEATING COIL WATER SIDE: FLOW RATE (GPM)	HEATING COIL WATER SIDE: ENT. TEMP. (DEGREES F)	HEATING COIL WATER SIDE: LVG. TEMP. (DEGREES F)	HEATING COIL WATER SIDE: MAXIMUM PRESS. DROP (FT. OF WATER)	HEATING COIL: NUMBER OF SECTIONS	HEATING COIL: FACE AREA (SQ. FT.)	HEATING COIL: FACE VELOCITY (FPM)	HEATING COIL: SERIES SURFACE (FPI) AND ROWS
AHU-111-B-1	2ND FLOOR OFFICE	8TH FLOOR MER	15,000	2,550 / 15,000	-	-	.25	1.0	-	77.4	64.5	49.7	49.5	0.83	88.9	42	56	12.66	624.6	442.2	2	30	500.0	8-8	1004.5	-	0	53.6	0.11	82.8	190	165	10.07	2	30.1	498.3	1-10
AHU-111-B-2	7 FL. ADMIN OFFICE	8TH FLOOR MER	7,500	1,300 / 7,500	-	-	.25	1.0	-	78.3	65.3	50.1	49.9	0.76	46.1	42	56	6.16	323.9	224.9	2	16	468.8	8-8	498.9	-	0	53.2	0.10	41.1	190	165	0.82	2	16	468.8	1-10
AHU-111-B-3	PEDESTRIAN WALKWAY	8TH FLOOR MER	29,500	5,000 / 29,500	-	-	.25	1.0	-	77.4	64.5	50.2	49.9	0.75	170.2	42	56	8.11	1196	856.1	2	63	468.3	6-8	2024.4	-	0	54.9	0.10	138.8	190	160	6.63	2	54	468.3	1-10
AHU-111-B-4	LOCKERS	8TH FLOOR MER	15,000	2,550 / 15,000	-	-	.25	1.0	-	76.0	63.4	51.7	51.1	0.54	122.3	42	56	12.86	859.0	649.1	2	54	463.0	8-8	992.3	-	0	52.9	0.08	81.8	190	165	3.12	2	35	428.6	1-9
AHU-111-B-5	CLASSROOM	8TH FLOOR MER	30,000	10,800 / 30,000	-	-	.25	1.0	-	83.0	69.1	50.5	50.2	0.80	234	42	56	14.74	1645.2	1030.7	2	63	476.2	8-8	2043.6	-	0	54.5	0.10	140.2	190	160	6.75	2	63	476.2	1-10
AHU-111-B-6	CLASSROOM	8TH FLOOR MER	30,000	10,800 / 30,000	-	-	.25	1.0	-	83.0	69.1	50.5	50.2	0.80	234	42	56	14.74	1645.2	1030.7	2	63	476.2	8-8	2043.6	-	0	54.5	0.10	140.2	190	160	6.75	2	63	476.2	1-10
AHU-111-PH-1	CORRIDOR	WEST PENTHOUSE MER	30,000	5,100 / 30,000	-	-	.25	1.0	-	85.0	70.8	52.0	51.8	0.80	243.3	42	56	10.7	1710.0	1041.8	2	63	476.2	8-8	2043.6	-	0	54.5	0.10	140.2	190	160	6.75	2	63	476.2	1-10
AHU-111-PH-2	CLASSROOM	WEST PENTHOUSE MER	30,000	12,200 / 30,000	-	-	.25	1.0	-	85.0	70.8	52.0	51.8	0.80	243.3	42	56	10.7	1710.0	1041.8	2	63	476.2	8-8	2043.6	-	0	54.5	0.10	140.2	190	160	6.75	2	63	476.2	1-10
AHU-111-PH-3	CLASSROOM	WEST PENTHOUSE MER	30,000	12,200 / 30,000	-	-	.25	1.0	-	77.6	64.7	50.3	50.0	0.77	174.9	42	56	8.53	1228.7	873.6	2	63	476.2	8-8	2043.6	-	0	54.5	0.10	140.2	190	160	6.75	2	63	476.2	1-10
AHU-111-PH-4	AUDITORIUM	WEST PENTHOUSE MER	15,000	4,800 / 15,000	-	-	.25	1.0	-	88.5	73.7	51.3	51.1	0.88	147.6	42	56	11.79	1036.6	583.8	2	30	500	8-8	829.4	-	0	53.5	0.11	82.7	190	165	2.90	2	30	500	1-10
AHU-111-PH-5	AUDITORIUM	WEST PENTHOUSE MER	15,000	4,800 / 15,000	-	-	.25	1.0	-	88.5	73.7	51.03	51.1	0.88	147.6	42	56	11.79	1036.6	583.8	2	30	500	8-8	829.4	-	0	53.5	0.11	82.7	190	165	2.90	2	30	500	1-10
AHU-111-PH-6	ATRIUM	WEST PENTHOUSE MER	25,000	6,400 / 25,000	-	-	.25	1.0	-	82.3	68.6	50.3	50.1	0.77	190	42	56	11.40	1336.5	845.0	2	54	463.0	8-8	1724.2	-	0	55.2	0.10	118.3	190	160	5.0	2	54	463	1-10
AHU-131-PH-1	ATRIUM	EAST PENTHOUSE MER	25,000	6,400 / 25,000	-	-	.25	1.0	-	82.3	68.6	50.3	50.1	0.77	190	42	56	11.40	1336.5	845.0	-	54	463.0	8-8	1724.2	-	0	55.2	0.10	118.3	190	160	5.0	2	54	463	1-10
AHU-131-PH-2	ADMIN. OFFICE	EAST PENTHOUSE MER	25,000	6,400 / 25,000	-	-	.25	1.0	-	79.0	65.8	50.2	50.0	0.75	158.4	42	56	8.13	1113.3	764.8	2	54	463.0	8-8	1578	-	0	50.5	0.09	108.3	190	160	4.94	2	54	463	1-9
AHU-131-PH-3	ADMIN. OFFICE	EAST PENTHOUSE MER	25,000	6,400 / 25,000	-	-	.25	1.0	-	79.0	65.8	50.2	50.0	0.75	158.4	42	56	8.13	1113.3	764.8	2	54	463.0	8-8	1578	-	0	50.5	0.09	108.3	190	160	4.94	2	54	463	1-9
AHU-131-PH-4	ADMIN. OFFICE	EAST PENTHOUSE MER	25,000	6,400 / 25,000	-	-	.25	1.0	-	79.0	65.8	50.2	50.0	0.75	158.4	42	56	8.13	1113.3	764.8	2	54	463.0	8-8	1578	-	0	50.5	0.09	108.3	190	160	4.94	2	54	463	1-9
AHU-131-PH-5	ADMIN. OFFICE	EAST PENTHOUSE MER	25,000	6,400 / 25,000	-	-	.25	1.0	-	79.0	65.8	50.2	50.0	0.75	158.4	42	56	8.13	1113.3	764.8	2	54	463.0	8-8	1578	-	0	50.5	0.09	108.3	190	160	4.94	2	54	463	1-9
AHU-131-PH-6	LIBRARY	EAST PENTHOUSE MER	16,000	6,000 / 16,000	-	-	.25	1.0	-	82.0	68.5	50.1	50.0	0.65	125.5	42	56	5.92	882.8	556.0	2	40	412.5	8-8	1013.3	-	0	49.1	0.06	83.4	190	165	10.04	2	40.1	411.4	1-8
AHU-131-PH-7	LIBRARY	EAST PENTHOUSE MER	16,000	6,000 / 16,000	-	-	.25	1.0	-	82.0	68.5	50.1	50.0	0.65	125.5	42	56	5.92	882.8	556.0	2	40	412.5	8-8	1013.3	-	0	49.1	0.06	83.4	190	165	10.04	2	40.1	411.4	1-8
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Appendix B.2:East Campus Ventilation Rate Procedure Calculations

Space Description			Az	Rp	Ra	Occupant Load	Occupants	Rp* Pz	Ra*Az	Vbz	Ez	Voz	Zp	Srvc.	Air Flow
Level	Space Type	ASHRAE Category	ft^2	Cfm /occ	cfm/ ft^2	Occ/ 100sf	Occ.	cfm	cfm	cfm		cfm	%	-	cfm
East G	Office	Office Space	18951	5	6%	5	94.755	473.775	1137	1610.8	1	1610.8	N/a	N/a	N/a
East G	Atrium Lobby	Lobbies	22187	5	6%	150	3328.05	16640.25	1331	17971	1	17971	N/a	N/a	N/a
East G	North Entrance	Lobbies	2475	5	6%	150	371.25	1856.25	148.5	2004.8	1	2004.8	N/a	N/a	N/a
East G	East Entrance	Lobbies	4454	5	6%	150	668.1	3340.5	267.2	3607.7	1	3607.7	N/a	N/a	N/a
East 2	Server/ Electrical Rooms (RA-207)	Equipment Rooms	14650	0	6%	0	0	0	879	879	1	879	N/a	N/a	N/a
East 2	Offices (RA-217)	Office Space	4200	5	6%	5	21	105	252	357	1	357	N/a	N/a	N/a
East 2	Passenger Elevator Lobby (RA-231)	Lobbies	1512	5	6%	150	226.8	1134	90.72	1224.7	1	1224.7	N/a	N/a	N/a
East 2	East Offices (RA-235)	Office Space	4454	5	6%	5	22.27	111.35	267.2	378.59	1	378.59	N/a	N/a	N/a
East 3	Medium Lecture (RA-317)	Classroom (age 9 Plus)	7700	10	12%	35	269.5	2695	924	3619	1	3619	N/a	N/a	N/a
East 3	Medium Lecture (RA-323)	Classroom (age 9 Plus)	8250	10	12%	35	288.75	2887.5	990	3877.5	1	3877.5	N/a	N/a	N/a
East 3	Corridor (RA-309)	Corridors	4288	0	6%	0	0	0	257.3	257.28	1	257.28	N/a	N/a	N/a
East 3	Classroom (RA-314)	Classroom (age 9 Plus)	3704	10	12%	35	129.64	1296.4	444.5	1740.9	1	1740.9	N/a	N/a	N/a
East 3	Classroom (RA-308)	Classroom (age 9 Plus)	4229	10	12%	35	148.015	1480.15	507.5	1987.6	1	1987.6	N/a	N/a	N/a

East 3	Passenger Elevator Lobby (RA-331)	Lobbies	395	5	6%	150	59.25	296.25	23.7	319.95	1	319.95	N/a	N/a	N/a
East 3	Large Conference North (RA-334)	Office Space	8359	5	6%	5	41.795	208.975	501.5	710.52	1	710.52	N/a	N/a	N/a
East 3	Large Conference South (RA-372)	Office Space	7430	5	6%	5	37.15	185.75	445.8	631.55	1	631.55	N/a	N/a	N/a
East 4	Medium Lecture (RA-421)	Classroom (age 9 Plus)	7700	10	12%	35	269.5	2695	924	3619	1	3619	N/a	N/a	N/a
East 4	Medium Lecture (RA-423)	Classroom (age 9 Plus)	8250	10	12%	35	288.75	2887.5	990	3877.5	1	3877.5	N/a	N/a	N/a
East 4	Corridor (RA-401)	Corridors	4288	0	6%	0	0	0	257.3	257.28	1	257.28	N/a	N/a	N/a
East 4	Classroom (RA-411)	Classroom (age 9 Plus)	3704	5	6%	5	18.52	92.6	222.2	314.84	1	314.84	N/a	N/a	N/a
East 4	Classroom (RA-407)	Classroom (age 9 Plus)	4229	5	6%	5	21.145	105.725	253.7	359.47	1	359.47	N/a	N/a	N/a
East 4	Passenger Elevator Lobby (RA-428)	Lobbies	395	5	6%	150	59.25	296.25	23.7	319.95	1	319.95	N/a	N/a	N/a
East 4	Large Conference North (RA-433)	Office Space	8359	5	6%	5	41.795	208.975	501.5	710.52	1	710.52	N/a	N/a	N/a
East 4	Large Conference South (RA-465)	Office Space	7430	5	6%	5	37.15	185.75	445.8	631.55	1	631.55	N/a	N/a	N/a
East 5	Medium Lecture (RA-517)	Classroom (age 9 Plus)	7700	10	12%	35	269.5	2695	924	3619	1	3619	N/a	N/a	N/a
East 5	Medium Lecture (RA-522)	Classroom (age 9 Plus)	8250	10	12%	35	288.75	2887.5	990	3877.5	1	3877.5	N/a	N/a	N/a
East 5	Corridor (RA-501)	Corridors	4288	0	6%	0	0	0	257.3	257.28	1	257.28	N/a	N/a	N/a
East 5	Classroom (RA-512)	Classroom (age 9 Plus)	3704	10	12%	35	129.64	1296.4	444.5	1740.9	1	1740.9	N/a	N/a	N/a
East 5	Classroom (RA-507)	Classroom (age 9 Plus)	4229	10	12%	35	148.015	1480.15	507.5	1987.6	1	1987.6	N/a	N/a	N/a
East 5	Passenger Elevator Lobby (RA-526)	Lobbies	395	5	6%	150	59.25	296.25	23.7	319.95	1	319.95	N/a	N/a	N/a
East 5	Large Conference North (RA-533)	Office Space	8359	5	6%	5	41.795	208.975	501.5	710.52	1	710.52	N/a	N/a	N/a
East 5	Large Conference South (RA-563)	Office Space	7430	5	6%	5	37.15	185.75	445.8	631.55	1	631.55	N/a	N/a	N/a
East 6	Medium Lecture (RA-618)	Classroom (age 9 Plus)	7700	10	12%	35	269.5	2695	924	3619	1	3619	N/a	N/a	N/a
East 6	Medium Lecture (RA-623)	Classroom (age 9 Plus)	8250	10	12%	35	288.75	2887.5	990	3877.5	1	3877.5	N/a	N/a	N/a
East 6	Corridor (RA-601)	Corridors	4288	0	6%	0	0	0	257.3	257.28	1	257.28	N/a	N/a	N/a
East 6	Classroom (RA-611)	Classroom (age 9 Plus)	3704	10	12%	35	129.64	1296.4	444.5	1740.9	1	1740.9	N/a	N/a	N/a
East 6	Classroom (RA-607)	Classroom (age 9 Plus)	4229	10	12%	35	148.015	1480.15	507.5	1987.6	1	1987.6	N/a	N/a	N/a
East 6	Passenger Elevator Lobby (RA-627)	Lobbies	395	5	6%	150	59.25	296.25	23.7	319.95	1	319.95	N/a	N/a	N/a
East 6	Large Conference North (RA-632)	Office Space	8359	10	12%	35	292.565	2925.65	1003	3928.7	1	3928.7	N/a	N/a	N/a
East 6	Large Conference South (RA-664)	Office Space	7430	10	12%	35	260.05	2600.5	891.6	3492.1	1	3492.1	N/a	N/a	N/a
East 7	Demonstration Lecture (RA-709)	Classroom (age 9 Plus)	7000	10	12%	35	245	2450	840	3290	1	3290	N/a	N/a	N/a
East 7	Lobby (RA-701)	Lobbies	6334	5	6%	150	950.1	4750.5	380	5130.5	1	5130.5	N/a	N/a	N/a
East 7	Assembly (RA-808)	Multi Use Assembly	5873	7.5	6%	100	587.3	4404.75	352.4	4757.1	1	4757.1	N/a	N/a	N/a
East 7	Passenger Elevator Lobby (RA-728)	Lobbies	895	5	6%	150	134.25	671.25	53.7	724.95	1	724.95	N/a	N/a	N/a
East 7	Computer Classrooms (RA-731)	Computer Lab	12074	10	12%	25	301.85	3018.5	1449	4467.4	1	4467.4	N/a	N/a	N/a
East 7	Library (RA-758)	Library	5573	5	12%	10	55.73	278.65	668.8	947.41	1	947.41	N/a	N/a	N/a
East 8	Mechanical Room (RA-806)	Equipment Rooms	7000	0	6%	0	0	0	420	420	1	420	N/a	N/a	N/a
East 8	Lobby (RA-802)	Lobbies	6334	5	6%	150	950.1	4750.5	380	5130.5	1	5130.5	N/a	N/a	N/a
East 8	Passenger Elevator Lobby (RA-813)	Lobbies	895	5	6%	150	134.25	671.25	53.7	724.95	1	724.95	N/a	N/a	N/a
East 8	Conference Rooms (RA-816)	Office Space	12074	5	6%	5	60.37	301.85	724.4	1026.3	1	1026.3	N/a	N/a	N/a
East 8	Library (RA-833)	Library	5573	5	12%	10	55.73	278.65	668.8	947.41	1	947.41	N/a	N/a	N/a

Appendix C: Utility Cost Information

Average Retail Price of Electricity (DOE)

Table 5.6.B. Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, by State, Year-to-Date through July 2010 and 2009
(Cents per kilowatthour)

Census Division and State	Residential		Commercial[1]		Industrial[1]		Transportation[1]		All Sectors	
	2010	2009	2010	2009	2010	2009	2010	2009	2010	2009
New England	**15.5**	**17.86**	**14.87**	**16.44**	**12.76**	**12.06**	**8.81**	**8.58**	**15**	**15.93**
Connecticut	1935	20.37	16.54	16.89	14.78	16.51	12.17	12.06	17.52	18.28
Maine	1544	15.48	12.38	12.82	9.19	10.23	--	--	12.62	13.12
Massachusetts	1526	17.71	14.99	18.25	13.34	11.39	6.96	6.72	14.54	15.87
New Hampshire	1598	16.54	13.99	15.31	12.6	14.08	--	--	14.57	15.61
Rhode Island	1582	16.13	13	13.75	13.51	12.72	13.37	--	14.19	14.47
Vermont	1534	14.78	13.32	12.78	9.38	9.27	--	--	13.08	12.67
Middle Atlantic	**1567**	**14.78**	**13.86**	**13.36**	**8.56**	**8.34**	**13.12**	**13**	**13.57**	**12.97**
New Jersey	1639	16.44	13.99	14.6	11.68	11.33	13.83	14.3	14.68	14.92
New York	1855	17.52	16.11	15.09	9.71	10.09	14.71	14.42	16.35	15.44
Pennsylvania	1271	11.55	10.14	9.56	7.66	7.25	7.75	7.77	10.34	9.61

Average Natural Gas Price (DOE)

Natural Gas Prices

(Dollars per Thousand Cubic Feet, except where noted)

Area: New York Period: Annual

Download Series History Definitions, Sources & Notes

Show Data By: Data Series / Area	2004	2005	2006	2007	2008	2009	View History
Wellhead Price	6.98	7.78	7.13	8.85	8.94		1967-2008
Imports Price	6.44	9.11	7.50	7.43	9.36		1989-2008
Exports Price	6.99	--	--	12.07	--		1999-2008
Pipeline and Distribution Use Price	--	--					1967-2005
Citygate Price	6.36	8.22	9.22	9.02	10.07	7.35	1984-2009
Residential Price	12.50	14.89	15.35	15.73	16.75	15.08	1967-2009
Percentage of Total Residential Deliveries	100.00	100.00	100.00	100.00	100.00		1989-2008
Commercial Price	10.11	11.80	11.91	11.82	12.86	10.90	1967-2009
Percentage of Total Commercial Deliveries	100.0	100.0	100.0	100.0	100.0	100.0	1990-2009
Industrial Price	8.05	10.76	10.56	11.43	12.30	10.82	1997-2009
Percentage of Total Industrial Deliveries	10.7	14.7	11.7	12.3	11.4	9.9	1997-2009
Vehicle Fuel Price	8.45	11.52	13.10	13.45	18.55		1990-2008
Electric Power Price	6.65	9.24	7.75	8.09	10.85	5.24	1997-2009

- = No Data Reported; -- = Not Applicable; NA = Not Available; W = Withheld to avoid disclosure of individual company data.

Notes: Prices are in nominal dollars. Gas volumes delivered for use as vehicle fuel are included in the State annual totals through 2008 but not in the State monthly components. Through 2001, electric power price data are for regulated electric utilities only; beginning in 2002, data also include nonregulated members of the electric power sector. See Definitions, Sources, and Notes link above for more information on this table.

Release Date: 9/29/2010
Next Release Date: 10/29/2010

CO2 Emissions from Natural Gas Consumed by Boilers			
Fuel Type	**CO2 Emissions Factor [lbs CO2/KBTU]**	**Boiler Energy Consumption [KBTU/Yr}**	**CO2 Emissions [lbs CO2/year]**
Natural Gas	**0.12**	**5,530,679**	**647,089**

CO2 Emissions from Electricity Consumed by Boilers			
Fuel Type	**CO2 Emissions Factor [lbs CO2/kWh]**	**Primary Heating Energy Consumption [kWh/Yr}**	**CO2 Emissions [lbs CO2/year]**
Natural Gas	**0.40**	**10,176**	**4,062**

Primary Heating Source	Natural Gas Derive CO2 Emissions [lbs CO2/year]	Electricity Derived CO2 Emissions [lbs CO2/year]	Total CO2 Emissions [lbs CO2/year]
Natural Gas Boiler	**647,089**	**4,062**	**651,151**

Appendix D: Emission Rates

Emission Factors for Delieverd Electricity by State

Table B-10 (page 2) Total Emission Factors for Delivered Electricity by State (lb of pollutant per kWh of electricity)

Pollutant (lb)	MT	NC	ND	NE	NH	NJ	NM	NV	NY	OH	OK	OR	PA
CO_{2e}	1.99E+00	1.47E+00	2.68E+00	1.81E+00	8.60E-01	9.31E-01	2.43E+00	1.88E+00	1.03E+00	2.20E+00	2.08E+00	4.85E-01	1.55E+00
CO_2	1.87E+00	1.41E+00	2.61E+00	1.71E+00	8.05E-01	8.61E-01	2.29E+00	1.76E+00	9.61E-01	2.10E+00	1.93E+00	4.40E-01	1.48E+00
CH_4	4.17E-03	2.37E-03	2.41E-03	3.70E-03	2.19E-03	2.79E-03	5.38E-03	4.81E-03	2.59E-03	3.71E-03	5.67E-03	1.83E-03	2.70E-03
N_2O	5.29E-05	3.11E-05	5.92E-05	4.94E-05	1.53E-05	1.76E-05	6.50E-05	3.75E-05	1.68E-05	4.73E-05	5.09E-05	1.04E-05	3.22E-05
NO_x	3.33E-03	2.83E-03	3.71E-03	3.09E-03	1.44E-03	1.32E-03	4.00E-03	2.89E-03	1.72E-03	4.14E-03	3.02E-03	5.21E-04	2.91E-03
SO_x	5.88E-03	3.26E-03	1.00E-02	4.79E-03	5.47E-03	6.34E-03	7.30E-03	1.21E-02	6.23E-03	1.19E-02	8.88E-03	3.03E-03	8.88E-03
CO	7.40E-04	4.31E-04	1.07E-03	6.09E-04	1.13E-03	6.69E-04	8.66E-04	7.39E-04	1.75E-03	6.38E-04	8.67E-04	2.72E-04	6.01E-04
TNMOC	6.02E-05	5.25E-05	5.34E-05	5.23E-05	8.62E-05	6.92E-05	7.27E-05	6.23E-05	6.38E-05	5.41E-05	8.01E-05	3.90E-05	5.46E-05
Lead	1.99E-07	1.16E-07	4.23E-07	1.87E-07	4.57E-08	4.27E-08	2.37E-07	1.09E-07	5.59E-08	1.76E-07	1.61E-07	2.05E-08	1.17E-07
Mercury	4.08E-08	2.40E-08	7.52E-08	3.73E-08	2.60E-08	1.44E-08	4.75E-08	2.27E-08	3.99E-08	3.59E-08	3.27E-08	4.59E-09	2.70E-08
PM10	1.14E-04	6.55E-05	3.03E-04	1.01E-04	5.47E-05	5.14E-05	1.36E-04	8.97E-05	6.87E-05	9.87E-05	1.16E-04	2.87E-05	7.14E-05
Solid Waste	3.01E-01	1.78E-01	3.33E-01	2.88E-01	5.65E-02	6.23E-02	3.65E-01	1.68E-01	6.18E-02	2.71E-01	2.49E-01	3.25E-02	1.73E-01

Pollutant (lb)	RI	SC	SD	TN	TX	UT	VA	VT	WA	WI	WV	WY	
CO_{2e}	1.18E+00	1.00E+00	1.45E+00	1.46E+00	1.99E+00	2.62E+00	1.40E+00	1.88E-02	4.11E-01	2.03E+00	2.41E+00	2.67E+00	
CO_2	1.04E+00	9.57E-01	1.36E+00	1.40E+00	1.85E+00	2.51E+00	1.33E+00	1.78E-02	3.82E-01	1.92E+00	2.31E+00	2.52E+00	
CH_4	5.65E-03	1.72E-03	3.02E-03	2.43E-03	5.80E-03	4.21E-03	2.52E-03	2.25E-05	1.13E-03	4.13E-03	3.85E-03	5.42E-03	
N_2O	2.04E-05	2.12E-05	3.91E-05	3.28E-05	4.37E-05	5.53E-05	2.81E-05	1.70E-06	1.05E-05	5.32E-05	5.08E-05	7.30E-05	
NO_x	7.91E-04	1.90E-03	2.45E-03	2.77E-03	2.42E-03	5.00E-03	2.67E-03	1.38E-04	6.13E-04	3.51E-03	4.62E-03	4.58E-03	
SO_x	9.90E-03	5.73E-03	3.97E-03	7.32E-03	1.05E-02	1.47E-02	8.04E-03	1.13E-04	1.70E-03	6.60E-03	1.35E-02	7.05E-03	
CO	8.52E-04	3.22E-04	5.26E-04	4.14E-04	9.77E-04	6.89E-04	9.74E-04	5.90E-05	1.80E-04	7.13E-04	6.50E-04	9.00E-04	
TNMOC	9.92E-05	4.89E-05	4.12E-05	4.17E-05	8.22E-05	5.78E-05	8.77E-05	1.02E-04	3.74E-05	8.26E-05	5.26E-05	7.43E-05	
Lead	6.87E-09	7.66E-08	1.47E-07	1.24E-07	1.49E-07	2.08E-07	1.02E-07	6.33E-10	3.21E-08	1.97E-07	1.92E-07	2.77E-07	
Mercury	4.09E-09	1.62E-08	3.01E-08	2.50E-08	2.96E-08	4.15E-08	3.24E-08	1.03E-09	6.62E-09	4.01E-08	3.87E-08	5.54E-08	
PM10	7.02E-05	4.61E-05	8.12E-05	6.75E-05	1.37E-04	1.14E-04	7.25E-05	7.67E-06	2.46E-05	1.11E-04	1.05E-04	1.49E-04	
Solid Waste	1.31E-02	1.17E-01	2.26E-01	1.91E-01	1.82E-01	3.20E-01	1.47E-01	2.83E-04	4.96E-02	3.03E-01	2.95E-01	4.26E-01	

Table from the National Renewable Energy Laboratory: Source Energy and Emission Factors for Energy use in Buildings.