**NYC Public School xxxX New Addition**

Street address.

borough, NY xxxxx

**Assessment of Energy Performance for
Compliance with NYC SCA
Green School Guide**

Date

**Project Narrative**

XYZ, Inc. analyzed the energy performance of the New York City addition to Public School 19X. The Proposed Design is a 4 story, 50,000 ft2 addition to an existing school. The building includes classrooms, offices and support spaces. The energy model is based on the 100% CD drawing set dated January 27, 2017.

XYZ performed energy modeling for compliance with the NYC SCA Green School Guide System. NYC SCA GSG allows compliance using the Appendix G Method of ASHRAE/IESNA Standard 90.1-2010 (ASHRAE 90.1-10G). In addition, XYZ analyzed the performance of the Proposed Design in respect to New York City Local Law 86 (LL86). LL86 mandates 20% regulated energy cost savings[[1]](#footnote-1) for projects with more than $12 Million construction cost. Compliance with LL86 is demonstrated against the Energy Cost Budget Method of ASHRAE/IESNA Standard 90.1-2013 (ASHRAE 90.1-13).

The results are summarized in Table 1 below. The project achieves **32.3%** savings in energy costs compared to the GSG baseline. The project is in compliance with the minimum requirements of E4.1R –Minimum Energy Performance (E4.1R). The minimum energy cost reduction required to meet the prerequisite is 10% using ASHRAE 90.1-2010 PRM as a baseline.

In addition, the project achieves **23.9%** savings in regulated energy costs compared with the LL86 Baseline. The project is in compliance with the LL86 requirements.

The energy model was developed for the sole purpose for documenting compliance with the SCA GSG E4.1R requirements and should not be used for predicting the actual energy use of the building. Actual energy use and cost will be greater, since the modeling rules do not account for many real-life issues, such as quality of construction, equipment functionality, building operation and other factors. Please refer to the end of the report for details.

*Table 1 Energy Modeling Results for Proposed Design; GSG Baseline and energy efficiency measures (EEMs)*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Description** | **Annual Energy Cost** | **Energy Cost Savings**  | **% Energy Cost Savings** | **NYC SCA GSG Compliance** |
|
|
| SCA GSG Baseline:ASHRAE 90.1-2010 Appendix G  | $91,423 | - | - | - |
| Proposed Design | $61,932 | $29,491 | 32.3% | Yes |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Electric Use (kW)** | **Peak KW** | **Electric Cost** | **Gas Use (Therms)** | **Gas Cost** |
| SCA Baseline:ASHRAE 90.1-2010 Appendix G | 300,556 | 205 | $78,021 | 12,055 | $13,402 |
| Proposed Design | 219,180 | 144 | $55,324 | 5,943 | $6,608 |

*Table 2 Energy Modeling Results for Proposed Design; LL86 Baseline and energy efficiency measures (EEMs)*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Description** | **Annual Energy Cost** | **Annual Regulated Energy Costs** | **Regulated Energy Cost Savings** | **% Regulated Energy Cost Savings** | **LL86 Compliance** |
|
|
| NYC LL86 Baseline:ASHRAE 90.1-2013 ECB | $78,714 | $70,242 | - | - | - |
| Proposed Design | $61,932 | $53,460 | $16,782 | 23.9% | Yes |

|  |  |  |
| --- | --- | --- |
|  | **LL86 Baseline** | **Proposed Design** |
| Total Annual Electric Use (kWh) |  265,616  |  219,180  |
| Regulated Annual Electric Use (kWh) |  231,464  |  185,028  |
| Peak Total Demand (kW) |  161  |  144  |
| Peak Regulated Demand (kW) |  149  |  132  |
| Sum of Regulated Monthly Peak Demands (kW) |  1,210  |  1,007  |
| Total Gas Use (Therms) |  11,630  |  5,943  |
| Regulated/Heating Gas Use (Therms) |  10,887  |  5,200  |

***Details for Energy Simulation***

XYZ used the computer software DOE-2.2 to model the building design and evaluate energy efficiency measures. DOE-2.2 is a computer program for detailed energy use analysis of residential and commercial buildings. It was developed by Lawrence Berkeley Laboratories, in collaboration with the U.S. Department of Energy and other research groups. DOE-2.2 calculates the hour-by-hour energy use of a building based on information on the building’s location, construction, HVAC systems, central plant, occupancy, and operation.

The project is located in the Bronx, NY, which is in ASHRAE Climate Zone 4A per ASHRAE 90.1 Table B-1. The design conditions per ASHRAE 90.1 Table D-1 are wet bulb temperature of 73°F, HDD65 of 4,910 and CDD50 of 3,547. The analysis was based on climatic data for LaGuardia Airport in New York City, using a TMY3 bin weather file. The envelope of the SCA GSG Baseline is modeled to meet the requirements prescribed in Table 5.5-4 of ASHRAE 90.1-10.

The utility rates used for the SCA Baseline and the Proposed Design are based on LL86 energy rates for FY 2012 published by Mayor's Office of Environmental Coordination (MOEC). The electricity rate for NYPA Electric Public Schools consists of a demand charge of $30.64 /kW and energy charge of $0.0910/kWh. The natural gas rate for NYPA Gas, Firm-heating is $1.1117/therm.

**B Building Energy Efficiency Measures included in Current Design**

1. *Reduced Interior Lighting Power*

The Proposed Design interior lighting consists of LED fixtures. Based upon a count of the installed lights we have calculated that the current interior lighting design is 37% better than ASHRAE 90.1-2010 and 31% better than ASHRAE 90.1-2013 Table 9.6.1, using the space-by-space method.

1. *Variable Frequency Drives (Pumps & Fans)*

All secondary hot water pumps and fans are scheduled to be equipped with Variable Frequency Drives controls. VFD controls enable the motor’s rotational speed to follow the flow rates. In this way the motor’s power consumption will be less than standard damper configurations at partial load.

1. *Condensing Boilers*

Gas-fired condensing boilers are part of the Proposed Design allowing for significant energy savings relative to conventional boiler versions. The condensing boilers have 92% heating efficiency at when operating in condensing mode.

1. *Baseboard Heating*

The proposed design provides heating via baseboard radiators. This eliminates night cycle use of the rooftop units. This hydronic perimeter heating system of the Proposed Design also allows reducing the air supply to minimum ventilation requirements, thereby minimizing the fan use during winter occupied hours.

**C Fan power in the Baseline Model**

We took credit for MERV 13 filters on the supply, MERV 9 filters on the supply and outside air, sound attenuators on the supply, ducted return air flow, and the heat recovery unit pressure drop.

**D Side-by-Side Comparison between Proposed Design, SCA GSG Baseline, and LL86**

|  | Proposed Design | SCA GSG BaselineASHRAE 90.1-2010 App. G | LL86 Baseline ASHRAE 90.1-2013 ECBM |
| --- | --- | --- | --- |
| **Climate** | Bronx, NY- ASHRAE Climate Zone 4A | ASHRAE Climate Zone 4A | ASHRAE Climate Zone 4A |
| **Exterior Wall Construction** | Typical Brick Face * Face Brick
* Air Gap
* 3” thick rigid insulation (R-15)
* 6” CMU (8" for 1st Floor)
* Air Gap
* 5/8” Gypsum wall board
* U-factor = 0.056 Btu/(h-ft2-F)
 | Steel Framed Walls* U-factor = 0.064 Btu/(h-ft2-F)
 | Mass Walls* U-factor = 0.104 Btu/(h-ft2-F)
 |
| **Vertical Fenestration** | Vision Glass Area: 16% of Total Wall Area* Type: Fixed Aluminum Windows
* U-factorunit = 0.38 Btu/h-ft2-F
* Solar Heat Gain Coefficient = 0.39
* Visible Transmittance = 0.68
* Type: Operable Aluminum Windows
* U-factorunit = 0.45 Btu/h-ft2-F
* Solar Heat Gain Coefficient = 0.39
* Visible Transmittance = 0.68
* Type: Entrance Doors with >50% glazed area
* U-factorunit = 0.77 Btu/h-ft2-F
* Solar Heat Gain Coefficient = 0.39
* Visible Transmittance = 0.68
 | Vision Glass Area: 16% of Total Wall Area* Type: Metal Framing- All Other
* U-factorunit =0.55
* Solar Heat Gain Coefficient= 0.4
* Visible transmittance = 0.44
* Type: Entrance Doors with >50% glazed area
* U-factorunit = 0.85 Btu/h-ft2-F
* Solar Heat Gain Coefficient = 0.39
* Visible Transmittance = 0.44
 | Vision Glass Area: 16% of Total Wall Area* Type: Metal Framing, Fixed:
* U-factorunit =0.42
* Solar Heat Gain Coefficient= 0.4
* Visible transmittance = 44%
* Type: Metal Framing, Operable:
* U-factorunit =0.50
* Solar Heat Gain Coefficient= 0.4
* Visible transmittance = 0.44
* Type: Entrance Doors with >50% glazed area
* U-factorunit = 0.77 Btu/h-ft2-F
* Solar Heat Gain Coefficient = 0.39
* Visible Transmittance = 0.44
 |
| **Below-Grade Wall Construction** | Below-Grade Walls * R-10 insulation
* C-factor = 0.092 Btu/(h-ft2-F)
 | Below-Grade Walls* C-factor = 1.140 Btu/(h-ft2-F)
 | Below-Grade Walls* C-factor = 1.140 Btu/(h-ft2-F)
 |
| **Roof Construction** | Typical Roof Construction* 2” Stone paver
* 6” thick rigid insulation (R-30)
* 4” Roof slab
* U-factor = 0.032 Btu/(h-ft2-F)
 | Typical Roof Construction* 2” Stone paver
* R-20 Continuous Insulation
* 10” Roof slab
* U-factor = 0.048 Btu/(h-ft2-F)
 | Typical Roof Construction* 2” Stone paver
* R-30 Continuous Insulation
* 10” Roof slab
* U-factor = 0.032 Btu/(h-ft2-F)
 |
| **Opaque Doors** | Swinging Door* U-factor = 0.6 Btu/(h-ft2-F)
 | Swinging Door* U-factor = 0.7 Btu/(h-ft2-F)
 | Swinging Door* U-factor = 0.5 Btu/(h-ft2-F)
 |
| **Interior Lighting** |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Space Type | Area | Design | GSG Baseline | LL86 Baseline |
| ft2 | LPD [W/ft2] | Model LPD (with OS Credit) | LPD [W/ft2] | Model LPD (with OS Credit) | LPD [W/ft2] | Model LPD (with OS Credit) |
| Classroom/Lecture/Training | 14,498 | 0.73 | 0.66 | 1.24 | 1.12 | 1.24 | 1.12 |
| Conference/Meeting/Multipurpose | 790 | 0.71 | 0.64 | 1.23 | 1.11 | 1.23 | 1.11 |
| Corridor/Transition | 4,786 | 0.52 | 0.50 | 0.66 | 0.66 | 0.66 | 0.63 |
| Dining Area/Cafeteria | 4,380 | 0.43 | 0.40 | 1.31 | 1.31 | 0.65 | 0.65 |
| Electrical/Mechanical | 3,437 | 0.70 | 0.68 | 0.95 | 0.95 | 0.42 | 0.42 |
| Exam/Treatment Room | 151 | 1.39 | 1.39 | 1.66 | 1.66 | 1.66 | 1.66 |
| Food Preparation | 1,857 | 1.02 | 1.02 | 0.99 | 0.99 | 1.21 | 1.21 |
| Gymnasium/Exercise Center/Playing Area | 3,250 | 0.49 | 0.44 | 1.20 | 1.20 | 1.20 | 1.20 |
| Lobby | 2,187 | 0.77 | 0.77 | 0.90 | 0.90 | 0.90 | 0.90 |
| Locker Room | 216 | 0.46 | 0.41 | 0.75 | 0.68 | 0.75 | 0.68 |
| Office/Enclosed | 2,689 | 0.72 | 0.66 | 1.11 | 1.00 | 1.11 | 1.00 |
| Restrooms | 2,339 | 0.48 | 0.46 | 0.98 | 0.88 | 0.98 | 0.88 |
| Stairwell | 2,601 | 0.63 | 0.57 | 0.69 | 0.69 | 0.69 | 0.62 |
| Storage<50sf | 94 | 1.79 | 1.61 | 0.63 | 0.63 | 1.24 | 1.12 |
| Storage>50sf | 2,862 | 0.66 | 0.59 | 0.63 | 0.57 | 0.63 | 0.57 |
| Overall |  46,138  | 0.65 | 0.61 | 1.04 | 0.99 | 0.95 | 0.89 |

 |
| **Interior Lighting Controls** |

|  |  |  |  |
| --- | --- | --- | --- |
| Space Type | Design | GSG Baseline | LL86 Baseline |
| Total Wattage | OS Wattage | Modeled Wattage | Total Wattage | OS Wattage | Modeled Wattage | Total Wattage | OS Wattage | Modeled Wattage |
| Classroom/Lecture/Training |  10,626  |  10,626  |  9,563  |  17,977  |  17,977  |  16,180  |  17,977  |  17,977  |  16,180  |
| Conference/Meeting/Multipurpose |  558  |  558  |  502  |  972  |  972  |  875  |  972  |  972  |  875  |
| Corridor/Transition |  2,501  |  2,411  |  2,380  |  3,159  |  -  |  3,159  |  3,159  |  3,159  |  3,001  |
| Dining Area/Cafeteria |  1,890  |  1,386  |  1,751  |  5,738  |  -  |  5,738  |  2,847  |  -  |  2,847  |
| Electrical/Mechanical |  2,422  |  686  |  2,353  |  3,265  |  -  |  3,265  |  1,444  |  -  |  1,444  |
| Exam/Treatment Room |  210  |  -  |  210  |  251  |  -  |  251  |  251  |  -  |  251  |
| Food Preparation |  1,890  |  -  |  1,890  |  1,839  |  -  |  1,839  |  2,247  |  -  |  2,247  |
| Gymnasium/Exercise Center/Playing Area |  1,584  |  1,584  |  1,426  |  3,900  |  -  |  3,900  |  3,900  |  -  |  3,900  |
| Lobby |  1,677  |  -  |  1,677  |  1,969  |  -  |  1,969  |  1,969  |  -  |  1,969  |
| Locker Room |  99  |  99  |  89  |  162  |  162  |  146  |  162  |  162  |  146  |
| Office/Enclosed |  1,932  |  1,512  |  1,781  |  2,985  |  2,985  |  2,686  |  2,985  |  2,985  |  2,686  |
| Restrooms |  1,122  |  363  |  1,086  |  2,292  |  2,292  |  2,063  |  2,292  |  2,292  |  2,063  |
| Stairwell |  1,638  |  1,638  |  1,474  |  1,794  |  -  |  1,794  |  1,794  |  1,794  |  1,615  |
| Storage<50sf |  168  |  168  |  151  |  59  |  -  |  59  |  117  |  117  |  105  |
| Storage>50sf |  1,876  |  1,776  |  1,698  |  1,803  |  1,803  |  1,623  |  1,803  |  1,803  |  1,623  |

 |
| **Mandatory Lighting Controls** | Vacancy sensors (manual on/automatic off) in classrooms, storage rooms, enclosed offices, IDF rooms, staff restrooms, changing rooms, reading room.  | Vacancy sensors (manual on/automatic off) in all rooms are required per Section 9.4.1.2b ASHRAE 90.1-2010. | Vacancy sensors (manual on/automatic off) in all rooms are required per Section 9.4.1.1b,c ASHRAE 90.1 2013. |
| **Daylight Dimming** | Daylight dimming located in classrooms and offices.  | Daylight dimming controls as required by Section 9.4.1.5. | Daylight dimming controls as required by Section 9.4.1.1e |
| **Exterior Lighting** | Tradable- 0 kWNon-tradable- 216 kWTotal- 0.216 kW | Tradable- 0 kWNon-tradable- 0.216 kWBase site allowance- 0.600 kWTotal- 0.816 kW  | Tradable- 0 kWNon-tradable- 0.216 kWBase site allowance- 0.600 kWTotal- 0.816kW |
| **Elevators** | (2) elevators | (2) elevators | (2) elevators |
| **Equipment Power** |

|  |  |
| --- | --- |
| Space Type | Equip. Power Density |
| Electrical room | 0.8 W/ft2 |
| Classroom/Lecture/ Training | 0.7 W/ft2 |
| Library - Reading Area | 0.9 W/ft2 |
| Office-Enclosed | 0.7 W/ft2 |
| IDF | 0.8 W/ft2 |

 | Same as proposed design | Same as proposed design |
| **HVAC System Description** | (1) Variable volume air handling unit (AHU) supplies ventilation, heating and cooling to classrooms, offices and corridors. (1) AHU serves the kitchen and cafeteria. (1) AHU serves the gymnasium. Heating and cooling to these units is provided by a central boiler and chiller.Finned-tube radiation (FTR) provides additional heating to the classrooms and offices as required.Hot water unit heaters serve minimally heated spaces such as the stairs and vestibules. Electric unit heaters serve the mechanical room.Air-source heat pumps serve areas which may require cooling during unoccupied hours such as the IDF rooms and dry kitchen storage. | Main systems are System #5: Packaged rooftop VAV with reheat (PVAV), with those zones that fall under the exceptions to G3.1.1 modeled as PSZ-AC systems (System #3) per Tables G3.1.1A and B. Zones which are heated only are served by System 9- Heating and Ventilation | Main system is a System #4 – Packaged VAV with reheat provided by a central boiler. Zones served by the HW and electric unit heaters in the proposed case modeled as individual System #11 (Packaged Rooftop air conditioner with Fossil Fuel Furnace) and System #9 (packaged Rooftop Heat Pump) respectively. |
| **HVAC Systems: Classrooms, offices, toilets, corridors, reading and exercise rooms** | AHU-1 (RTU-CR1)* Variable volume
* Supply Flow, Primary 22,300 CFM
	+ Flow/Fan 11,150 CFM
* Outside Air Flow 13,400 CFM
* Return Flow 17,000 CFM
* Supply fan 34.4 kW
* Relief fan 16.0 kW
* Economizer with fixed drybulb controls with high-limit of t(OA) > 65°F
* Demand Controlled Ventilation

Cooling:* Chilled water, 30% glycol

Heating:* Preheat – HW coil, 30% glycol
* Perimeter – HW FTR
* Supplemental CUHs in toilets

Energy Recovery* 91% energy recovery effectiveness
 | Classroom Systems * One Unit per Floor
* System #5 - Packaged VAV with reheat
* Hot water reheat coils on VAV boxes
* DX cooling coil
* No economizer
* 50% energy recovery effectiveness
* Fan Power Credits: (RTU-12 & RTU-34)
* Enth. Wheel (RA) 0.1” (50% eff)
* Enth. Wheel (OA) 0.1” (50% eff)
* MERV 13 (SA) 0.90”
* Ducted Ret. (RA) 0.50”
* Sound Attenuator

(SA & RA) 0.15”RTU-CR1 (1ST Floor)* Supply Flow 2,482 CFM
* Outside Air Flow 1,358 CFM
* Minimum Flow 1,358 CFM
* Return Flow 90% of supply
* Total Fan Power 3.2 kW
* Cooling capacity 113 kBtu/h
* Cooling efficiency 11.0 EER

RTU-CR2 (2nd Floor)* Supply Flow 8,342 CFM
* Outside Air Flow 5,017 CFM
* Minimum Flow 5,017 CFM
* Return Flow 90% of supply
* Total Fan Power 10.9 kW
* Cooling capacity 382 kBtu/h
* Cooling efficiency 9.5 EER

RTU-CR3 (3rd Floor)* Supply Flow 8,338 CFM
* Outside Air Flow 5,219 CFM
* Minimum Flow 5,219 CFM
* Return Flow 90% of supply
* Total Fan Power 11.3 kW
* Cooling capacity 387 kBtu/h
* Cooling efficiency 9.5 EER

RTU-CR4 (4th Floor)* Supply Flow 3,085 CFM
* Outside Air Flow 1,806 CFM
* Minimum Flow 1,806 CFM
* Return Flow 90% of supply
* Total Fan Power 3.9 kW
* Cooling capacity 141 kBtu/h
* Cooling efficiency 10.8 EER
 | Classroom System* System #4: Packaged VAV with reheat
* Hot water reheat coils on VAV boxes
* DX cooling coil
* Economizer with fixed drybulb controls with high-limit of t(OA) > 65°F
* 50% energy recovery effectiveness
* Demand Controlled Ventilation
* Fan Power Credits: (RTU 1 -2)
* Enth. Wheel (RA) 0.1” (50% eff)
* Enth. Wheel (OA) 0.1” (50% eff)
* MERV 13 (SA) 0.90”
* Ducted Ret. (RA) 0.50”
* Sound Attenuator

(SA & RA) 0.15”RTU-CR1* Supply Flow 27,132 CFM
* Outside Air Flow 13,400 CFM
* Minimum Flow 9,952 CFM
* Return Flow 90% of supply
* Total Fan Power 54.9 kW
* Cool capacity 1,107 kBtu/h
* Cooling Efficiency 9.5 EER
 |
| **HVAC Systems: Kitchen/ Cafeteria** | AHU-2 (RTU-K/C-SYS)* Variable volume AHU
* Supply Flow 10,000 CFM
	+ Flow/Fan 5,000 CFM
* Outside Air Flow 6,000 CFM
* Return Flow 1,300 CFM
* KEF Flow 5,000 CFM
* Supply fan 12.9 kW
* Relief fan 1.1 kW
* Kitchen Exhaust fan 3.2 kW
* Economizer with fixed drybulb controls with high-limit of t(OA) > 65°F

Cooling:* CHW coil, 30% glycol

Heating:* HW coil, 30% glycol

Energy Recovery(none)  | Kitchen/Cafeteria System* System #3: Packaged Single Zone AC
* Constant volume
* Gas-fired furnace, 80% Et
* DX cooling coil
* No economizer
* Fan Power Credits: (AHU-2)
* MERV 13 (SA) 0.90”
* Ducted Ret. (RA) 0.50”
* Sound Attenuator (SA & RA) 0.15

RTU-K/C-SYS* Supply Flow 7,151 CFM
* Outside Air Flow 6,000 CFM
* Minimum Flow 7,151 CFM
* Return Flow 90% of supply
* Total Fan Power 7.2 kW
* Cooling capacity 238 kBtu/h
* Cooling efficiency 10.8 EER
 |  Kitchen/Cafeteria System* System #11: Packaged rooftop AC
* Constant volume, two-speed fan
* Gas-fired furnace, 80% Et
* DX cooling coil
* Economizer with fixed drybulb controls with high-limit of t(OA) > 65°F
* Fan Power Credits: (AHU-2)
* MERV 13 (SA) 0.90”
* Ducted Ret. (RA) 0.50”
* Sound Attenuator (SA & RA) 0.15”

RTU-K/C-SYS* Supply Flow 10,492 CFM
* Outside Air Flow 6,000 CFM
* Minimum Flow (2spd) 6,925 CFM
* Return Flow 90% of supply
* Total Fan Power 13.2 kW
* Cool capacity 456 kBtu/h
* Cooling Efficiency 9.8 EER
 |
| **HVAC Systems:** **Gym** | AHU-3 (GYM-SYS)* Variable volume
* Supply Flow, Primary 3,500 CFM
* Outside Air Flow 1,100 CFM
* Return Flow 3,300 CFM
* Supply fan 4.1 kW
* Relief fan 1.6 kW
* Economizer with fixed drybulb controls with high-limit of t(OA) > 65°F

Cooling:* Chilled water, 30% glycol

Heating:* Preheat – HW coil, 30% glycol
* Perimeter – HW FTR
* Supplemental CUHs in toilets

Energy Recovery* 91% energy recovery effectiveness
 | Gym System* System #3: Packaged Single Zone AC
* Constant volume
* Gas-fired furnace, 80% Et
* DX cooling coil
* No economizer
* 50% energy recovery effectiveness
* Fan Power Credits: (AHU-3)
* Enth. Wheel (RA) 0.1” (50% eff)
* Enth. Wheel (OA) 0.1” (50% eff)
* MERV 13 (SA) 0.90”
* Ducted Ret. (RA) 0.50”
* Sound Attenuator (SA & RA) 0.15

GYM-SYS* Supply Flow 6,503 CFM
* Outside Air Flow 1,100 CFM
* Minimum Flow 6,503 CFM
* Return Flow 90% of supply
* Total Fan Power 7.1 kW
* Cool capacity 274 kBtu/h
* Cooling Efficiency 9.8 EER
 | Gym System* System #11: Packaged rooftop AC
* Constant volume, two-speed fan
* Gas-fired furnace, 80% Et
* DX cooling coil
* Economizer with fixed drybulb controls with high-limit of t(OA) > 65°F
* 50% energy recovery effectiveness
* Fan Power Credits: (AHU-3)
* Enth. Wheel (RA) 0.1” (50% eff)
* Enth. Wheel (OA) 0.1” (50% eff)
* MERV 13 (SA) 0.90”
* Ducted Ret. (RA) 0.50”
* Sound Attenuator (SA & RA) 0.15

GYM-SYS* Supply Flow 3,991 CFM
* Outside Air Flow 1,100 CFM
* Minimum Flow (2spd) 2,634 CFM
* Return Flow 90% of supply
* Total Fan Power 5.7 kW
* Cool capacity 193 kBtu/h
* Cooling Efficiency 10.8 EER
 |
| **HVAC Systems: Air source heat pumps** | Air source heat pumps serve the EMR, kitchen storage & telecom rooms

|  |  |  |
| --- | --- | --- |
| Unit | Service | SEER  |
| AC-1 | Dry Storage | 17.0 |
| AC-2 | 4th fl. Tel. | 13.1 |
| AC-3 | 2nd fl. Tel. | 17.0 |
| AC-4 | 3rd fl. Tel. | 17.0 |
| AC-5 | EMR | 13.1 |

Heating via 8.0 HSPF heat pump in model (no heating demand). | System 3- PSZ

|  |  |  |
| --- | --- | --- |
| Unit | Service | SEER  |
| AC-1 | Dry Storage | 17.0 |
| AC-2 | 4th fl. Tel. | 13.1 |
| AC-3 | 2nd fl. Tel. | 17.0 |
| AC-4 | 3rd fl. Tel. | 17.0 |
| AC-5 | EMR | 13.1 |

Heating from 80% efficient furnaces (no heating demand). | System 9- Packaged Roof top heat pump (Split unit)

|  |  |  |
| --- | --- | --- |
| Unit | Service | SEER  |
| AC-1 | Dry Storage | 17.0 |
| AC-2 | 4th fl. Tel. | 13.1 |
| AC-3 | 2nd fl. Tel. | 17.0 |
| AC-4 | 3rd fl. Tel. | 17.0 |
| AC-5 | EMR | 13.1 |

Heating from 80% efficient furnaces (no heating demand). |
| **HVAC Systems, Hot water unit heaters** | HW unit heaters serve mechanical, vestibule and stairs.  | System 9- Heating & Ventilation Heating from 80% efficient furnaces | System 11- Packaged rooftop air conditioner. Heating from 80% efficient furnaces. No cooling provided. |
| **HVAC Systems, Electric Unit Heaters** | Electric unit heaters serve the cellar electric room.  | System 9- Heating & Ventilation Heating from electric furnaces | System 9- Packaged rooftop heat pump. No cooling provided. |
| **Boiler Plant** | Two (2) gas-fired condensing boilers* 1,620 MBH each (1,800 MBH input)
* 87% estimated modeled efficiency (SCA preference)
* 87.5% rated efficiency at 125F return water temperature
* 95% Thermal Efficiency & 95.1% Comb Efficiency at AHRI conditions.
 | Two (2) gas-fired boilers* 633 MBH (each)
* 80% thermal efficiency per Table 6.8.1F

Note that the gas-fired furnaces of the PSZ-AC units have additional heating capacity. | Two (2) gas-fired boilers* 1,082 MBH (each)
* 80% thermal efficiency per Table 6.8.1F

Note that the gas-fired furnaces of the RTU units have additional heating capacity. |
| **Chiller Plant** | One (1) 160.6-ton modular air-cooled chiller* (6) 25-ton (nominal) modules
* 10.2 EER
 |  No chillers (all DX cooling). | No chillers (all DX cooling). |
| **Pumps** | Primary Hot Water Pumps* 22.2 W/gpm
* Constant-speed (VFD for balancing only)

Secondary Hot Water Pump* 18.3 W/gpm
* Constant-speed (VFD for balancing only)

Chilled Water Pump* 18.6 W/gpm
* Constant-speed (VFD for balancing only)
 | Hot Water Pumps* 19 W/gpm
* Constant speed, rides pump curve.
 | Primary Hot Water Pumps* 22.2 W/gpm
* Pump rides the pump curve.

Secondary Hot Water Pump* 18.3 W/gpm
* Pump rides the pump curve.
 |
| **Equipment Sizing** | * Equipment capacities based on mechanical schedule (actual sizes)
 | * Equipment capacities based on temperature difference of 20°F between supply air temperature and the temperature set point in the space.
* Cooling equipment oversized for 15% and heating equipment oversized by 25%.
 | * Equipment capacities based on temperature difference of 20°F between supply air temperature and the temperature set point in the space.
* The equipment capacities are sized proportionally to the capacities in the Proposed Design based on sizing runs; i.e., the ratio between the capacities used in the annual simulations and the capacities determined by the sizing runs are the same as in the Proposed Design
 |
| **HVAC Summary** | Cooling Capacity* System Total = 1,816 MBH
* Chiller = 1,927 MBH
* Packaged units = 0.027 MBH
* Heat Pumps = 27.14

Heating Capacity* System Total = 1,576 MBH
* Boiler = 1,620 MBH
* Heat Pump = 0.0 MBH
* Electric = 0.028 MBH

Fan Power* VAV supply- 35,800 cfm
* VAV supply fan power – 51.4 kW
* VAV ret & exh fan power – 17.6 kW
* CV supply- 4,297 cfm
* CV fan power- 1.27kW
 | Cooling Capacity* System Total = 1,763 MBH
* Chiller = 0 MBH
* Packaged units = 1,736 MBH
* Heat Pumps = 27.14

Heating Capacity* System Total = 1,836 MBH
* Boiler = 1,266 MBH
* Furnace = 630 MBH
* Electric = 0.083 MBH

Fan Power* VAV supply- 23,088 cfm
* VAV supply fan power – 27.0 kW
* VAV return fan power –2.4 kW
* CV supply- 13,651 cfm
* CV fan power- 14.3 kW
 | Cooling Capacity* System Total = 1,988 MBH
* Chiller = 0 MBH
* Packaged units = 1,961 MBH
* Heat Pumps = 27.14

Heating Capacity* System Total = 1,815 MBH
* Boiler 1,927 MBH
* Furnace = 666 MBH
* Electric = 1.17 MBH

Fan Power* VAV supply- 27,132 cfm
* VAV supply fan power – 39.3 kW
* VAV return fan power – 15.6 kW
* CV supply- 14,483 cfm
* CV fan power- 18.9 kW
 |
| **Electric usage summary** |

|  |  |
| --- | --- |
| Month | Peak kW |
| January | 69 |
| February | 63 |
| March | 64 |
| April | 112 |
| May | 143 |
| June | 124 |
| July | 124 |
| August | 105 |
| September | 121 |
| October | 78 |
| November | 74 |
| December | 65 |

Annual electric consumption = 219,179 kWh |

|  |  |
| --- | --- |
| Month | Peak kW |
| January | 97 |
| February | 88 |
| March | 82 |
| April | 157 |
| May | 204 |
| June | 175 |
| July | 196 |
| August | 181 |
| September | 182 |
| October | 101 |
| November | 92 |
| December | 90 |

Annual electric consumption = 300,555 kWh |

|  |  |
| --- | --- |
| Month | Peak kW |
| January | 78 |
| February | 74 |
| March | 71 |
| April | 128 |
| May | 160 |
| June | 141 |
| July | 147 |
| August | 133 |
| September | 144 |
| October | 102 |
| November | 93 |
| December | 75 |

Annual electric consumption = 265,615 kWh |
| **Natural gas usage summary** | Annual gas consumption = 5,940 therms | Annual gas consumption = 12,050 therms | Annual gas consumption = 11,630 therms |

**Note:**

This report is developed for the purpose of calculating the energy performance per requirements ASHRAE 90.1-2010 Appendix G and ASHRAE 90.1-2010 Section 11. Actual energy use and cost will be greater, since the modeling rules do not account for many real-life issues, such as quality of construction, equipment functionality, building operation and other factors. Reasons include, but are not limited to the following:

* The ECBM Baseline assumes perfection, as noted in the bullets below, so the design model also must assume perfection:
	+ - * The HVAC equipment is manufactured per standards. The design of the HVAC systems is such that the each individual piece of equipment performs optimally. The installation is flawless, and the operation optimum.
			* Lighting and lighting controls are perfectly manufactured/installed and function as such.
			* The insulation is installed perfectly. There are no gaps and no rips caused by pipes and wiring. The windows are put in place with perfect caulking.
* Certain real-life effects are not included in the baseline calculations, and therefore are not included in the design calculations either. For instance, the three-dimensional heat loss effect that occurs at the roof parapet
* Occupant behavior is idealized
* Other effects, such as uncertainties in equipment (plug load) operation.

Please refer to the Informative Note in ASHRAE 90.1-2010 Section 11.1: “*The energy cost budget and the design energy cost calculations are applicable only for determining compliance with this standard. They are not predictions of actual energy consumption or costs of the proposed design after construction. Actual experience will differ from these calculations due to variations such as occupancy, building operation and maintenance, weather, energy use not covered by this standard, changes in energy rates between design of the building and occupancy, and precision of the calculation tool.*”

To fully comply with ASHRAE 90.1, Section 11 and/or Appendix G, the design must comply with all mandatory provisions of ASHRAE 90.1 Sections 5.4 (Building Envelope), 6.4 (HVAC Equipment), 7.4 (Service Water Heating), 8.4 (Power), 9.4 (Lighting) and 10.4 (Other Equipment). Compliance with these provisions is not part of XYZ’s energy analysis. Typically, this compliance is certified by the Architect (Section 5.4) and the HVAC Engineer (Sections 6.4, 7.4, 8.4, 9.4 and 10.4

1. Note: Regulated energy excludes the energy consumed by equipment that is typically plugged into receptacles: computers, printers, copiers, TVs, radios, electric clocks, etc. It also excludes energy used by elevators and escalators, cooking equipment and process equipment (such as industrial or laboratory equipment). [↑](#footnote-ref-1)