

Engineering Economic Analysis For Ashland Public Safety Building

Ashland, MA

April 10, 2020

Prepared for:



**The Town of Ashland
Massachusetts**



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Ashland Public Safety Building Engineering Economic Analysis

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EXECUTIVE SUMMARY

Section 1.0: Executive Summary

The Ashland Public Safety is a new building with an approximate area of 39,500 s.f. located in Ashland, MA. The new facility will house the police and fire department with a sallyport and apparatus bay for vehicles and is intended for 24 hour operation.

The goal of the mechanical lifecycle engineering economic analysis is to assess the performance of various mechanical systems in comparison to a baseline mechanical system.

Each option is compared to the baseline system to determine the lowest combined savings over a 30 year cycle to determine the most advantageous system considering electrical costs, gas costs, maintenance costs, and initial construction costs.

By comparison of each option to the baseline system, the option with the greatest total life-cycle savings is generally recommended. To further enhance controllability and overall system performance, additional options should be considered that will enhance year round temperature control and comfort at a possible marginal increase in capital cost.

Section 1.1: Mechanical System Analysis

1.1.A: Baseline Mechanical System – ASHRAE Baseline Hot Water Heating/DX Cooling Variable Air Volume Air Handling Unit System

- 22,000 CFM hot water heating/split system direct expansion cooling indoor air handling unit with total energy recovery wheel and hot gas reheat with terminal variable air volume boxes with hot water reheat coils with 80 ton air-cooled condensing unit serving the occupied areas
- Overhead fiberglass insulated supply and return air ductwork distribution system
- Limited use of hot water radiation and unit heaters
- Hot water unit heaters and radiant floor heating serving the apparatus bay and sallyport
- (2) 1,500 MBH standard-efficiency gas-fired condensing boilers
- Hot water primary pumping with variable frequency drives
- Direct digital controls throughout

1.1.B: Mechanical System Option One – High-Efficiency Hot Water Heating/Chilled Water Cooling Variable Air Volume Air Handling Unit System

- 22,000 CFM hot water heating/chilled water cooling indoor air handling unit with dual energy recovery wheels and terminal variable air volume boxes with hot water reheat coils and demand control ventilation serving the occupied areas
- Overhead fiberglass insulated supply and return air ductwork distribution system
- Limited use of hot water radiation and unit heaters

- Hot water unit heaters and radiant floor heating serving the apparatus bay and sallyport
- (2) 1,500 MBH high-efficiency gas-fired condensing boilers
- 80 ton high-efficiency air-cooled chiller plant
- Chilled and hot water primary pumping with variable frequency drives
- Direct digital controls throughout

1.1.C: Mechanical System Option Two – Induction Unit System with Hot Water Heating/Chilled Water Cooling Dedicated Outside Air Handling Unit

- Multiple four-pipe induction units
- 10,000 CFM 100% outside air hot water heating/chilled water cooling indoor air handling unit with dual energy recovery wheels and terminal variable air volume boxes with demand control ventilation providing ventilation to the induction units of the occupied areas
- Primary air ducted directly to induction units
- Overhead fiberglass insulated ventilation distribution system feeding each induction unit
- Limited use of hot water radiation and unit heaters
- Hot water unit heaters and radiant floor heating serving the apparatus bay and sallyport
- (2) 1,500 MBH high-efficiency gas-fired condensing boilers
- 80 ton high-efficiency air-cooled chiller plant
- Chilled and hot water primary pumping with variable frequency drives
- Direct digital controls throughout

1.1.D: Mechanical System Option Three – Variable Refrigerant Flow (VRF) Heat Pump System with Hot Water Heating/DX Cooling Dedicated Outside Air Handling Unit

- Split system variable refrigerant terminal heat pump units throughout the building
- Insulated refrigerant piping and condensate piping system
- Outdoor air cooled variable refrigerant heat pump condensing units (45 ton total capacity)
- 10,000 CFM 100% outside air hot water heating/split system direct expansion cooling indoor air handling unit total with total energy recovery wheel and hot gas reheat with terminal variable air volume boxes with demand control ventilation with 35 ton air-cooled condensing unit providing ventilation to the VRF units of the occupied areas
- Primary air ducted directly to VRF units
- Overhead fiberglass insulated ventilation distribution system feeding each VRF unit

- Limited use of hot water radiation and unit heaters
- Hot water unit heaters and radiant floor heating serving the apparatus bay and sallyport
- (2) 1,200 MBH high-efficiency gas-fired condensing boilers
- Hot water primary pumping with variable frequency drives
- Direct digital controls throughout

1.1.E: Mechanical System Option Four – High-Efficiency Geothermal Induction Unit System with Hot Water Heating/Chilled Water Cooling Dedicated Outside Air Handling Unit

- Multiple four-pipe induction units
- 10,000 CFM 100% outside air hot water heating/chilled water cooling indoor air handling unit with dual energy recovery wheels and terminal variable air volume boxes with demand control ventilation providing ventilation to the induction units of the occupied areas
- Primary air ducted directly to induction units
- Overhead fiberglass insulated ventilation distribution system feeding each induction unit
- Limited use of hot water radiation and unit heaters
- Hot water unit heaters and radiant floor heating serving the apparatus bay and sallyport
- (15) 675 deep geothermal closed loop quad wells (105 tons total capacity)
- 105 ton total capacity high-efficiency water-to-water source geothermal modular heat pump chiller/heater plant providing chilled and hot water throughout the building
- Chilled, condenser, geothermal well, and hot water primary pumping with variable frequency drives
- Direct digital controls throughout

Section 1.2: Mechanical System Analysis Conclusion

The variable air volume air handling unit system is selected as the baseline system since it is an ASHRAE Standard 90.1 baseline system that generally results in a low installed cost system. Unfortunately, the selection results in overall ownership costs that in some cases are higher when compared to the alternative systems primarily relating to the increased annual operating costs while also compromising the thermal comfort of the building. The option comparison of each alternative system to the baseline assesses the benefits of improved systems with potentially reduced combined operating costs and improved thermal comfort with the goal of selecting the system with the highest ownership savings over the 30 year study period.

Annual electrical and gas consumption is calculated thru the results of a thermal dynamic heat transfer analysis utilizing Department of Energy (DOE-2)/eQuest software with all architectural data provided by HKT Architects Inc.

Utility cost data for electricity and natural gas are based on utility rates derived from the existing building's utility bills provided by the owner. The rates are \$0.14/kWh for Electricity and \$1.17/therm for Natural Gas.

The building envelope consists of the following insulation values: The roof has R-30 continuous insulation and the walls have R-25 continuous insulation. Operable windows have a U-Value of 0.28 and a SHGC of 0.43. Fixed window assemblies have a U-Value of 0.28 and a SHGC of 0.56.

The "Building Life-Cycle" analysis was performed in BLCC v5.3-18 and includes future worth of each system option considered using the DOE rates for discount (2.6%), escalation (for each utility type based on region), inflation (2.0%), and interest (2.0%). The life cycle analysis program BLCC5 utilizes energy price escalation rates by the D.O.E. Energy Information Administration and the most recent FEMP discount rates.

Our observations of the Mechanical System Payback Summary suggests that Option Two, an Induction Unit System with Hot Water Heating/Chilled Water Cooling Dedicated Outside Air Handling Unit, represents the most cost effective system yielding an approximate \$247,798 savings over the 30 year study period with a 4 year payback.

Section 2.0: LEED Energy Savings Summary

To predict the anticipated energy cost savings percentage for LEED V4 EAc2 – Optimize Energy Performance, an updated energy model simulation has been performed comparing the design building to a baseline ASHRAE Standard 90.1-2010 building.

1. The ASHRAE Standard 90.1-2010 baseline building is as follows:

- Envelope:
 - Wall: R-13 + R-7.5 c.i.
 - Roof: R-20 c.i.
 - Underslab: R-10 c.i.
 - Operable Windows: 0.55 U-Value, 0.40 SHGC
 - Fixed Windows: 0.45 U-Value, 0.40 SHGC
- Mechanical System:
 - Hot water coil heating/direct expansion coil cooling VAV AHU systems with energy recovery wheels serving terminal VAV boxes with hot water reheat coils
 - (2) 80% efficient gas-fired hot water boilers
- Domestic Hot Water System:
 - 80% efficient gas-fired domestic hot water system
- Lighting System:
 - 0.96 w/s.f.

2. The design building with Mechanical System Option 2 is as follows:

- Envelope:
 - Wall: R-25 c.i.
 - Roof: R-30 c.i.
 - Underslab: R-10 c.i.
 - Operable Windows: 0.28 U-Value, 0.43 SHGC
 - Fixed Windows: 0.28 U-Value, 0.56 SHGC

- Mechanical System:
 - (Refer to System 2 description above)
- Domestic Hot Water System:
 - 94% efficient gas-fired domestic hot water system
- Lighting System:
 - 0.50 w/s.f.

Section 2.1: LEED Energy Savings Analysis Conclusion

A comparison of the Design Building against the ASHRAE Standard 90.1-2010 Baseline Building results in a projected energy cost savings of 23.4%.

Note:

The values indicated above are based on energy modelling performed for system comparison purposes only. Our office strongly recommends adding a 30% safety factor to the calculated values of this report for budgeting purposes to account for potential variances to the actual operation of the building. Per ASHRAE Standard 90.1:

Neither the proposed building performance nor the baseline building performance are predictions of actual energy consumption or costs for 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 procedure, changes in energy rates between design of the building and occupancy, and the precision of the calculation tool.



Ashland Public Safety - Mechanical System Payback Summary

Baseline	System	Gross Capital Investment*	Annual Elec. Cons. (kWh)	Annual Gas Cons. (MBTU)	Annual Electric Cost	Annual Gas Cost	Combined Utility Cost	Annual Utility \$/s.f.	Annual kBTU/s.f. (EUI)	Annual Maint. Cost	Combined Annual Expense	Combined Expense Savings**	Total Life-Cycle Savings***	Discounted Payback (Years)****
-	1. Hot water coil heating/dx cooling VAV AHU system with energy recovery wheel & air-cooled condensing unit serving terminal VAV boxes with hot water reheat coils 2. Standard efficiency gas-fired boiler plant	\$2,419,543	291,650	4,139.6	\$40,832	\$48,433	\$89,265	\$2.26	129.99	\$23,625	\$112,890	\$0	-	-

Option	System	Gross Capital Investment*	Annual Elec. Cons. (kWh)	Annual Gas Cons. (MBTU)	Annual Electric Cost	Annual Gas Cost	Combined Utility Cost	Annual Utility \$/s.f.	Annual kBTU/s.f. (EUI)	Annual Maint. Cost	Combined Annual Expense	Combined Expense Savings**	Total Life-Cycle Savings***	Discounted Payback (Years)****
1	1. Hot water coil heating/chilled water coil cooling VAV AHU system with energy recovery wheels serving terminal VAV boxes with hot water reheat coils 2. High efficiency gas-fired condensing boiler plant 3. High efficiency air-cooled chiller plant	\$2,488,543	293,210	3,473.8	\$41,049	\$40,644	\$81,693	\$2.07	113.27	\$23,625	\$105,318	\$7,572	\$163,050	9
2	1. Four-pipe chilled/hot water coil induction units 2. Hot water coil heating/chilled water coil cooling 100% O.A. VAV ventilating unit with energy recovery wheels 3. High efficiency gas-fired condensing boiler plant 4. High efficiency air-cooled chiller plant	\$2,458,413	280,270	3,495.8	\$39,238	\$40,900	\$80,138	\$2.03	112.71	\$23,300	\$103,438	\$9,452	\$247,798	4
3	1. Variable refrigerant flow (VRF) terminal evaporator units with air-cooled condensing units 2. Hot water coil heating/dx cooling 100% O.A. VAV ventilating unit with energy recovery wheel & air-cooled condensing unit 3. High efficiency gas-fired condensing boiler plant	\$2,419,255	306,310	3,204.1	\$42,883	\$36,527	\$79,410	\$2.01	107.58	\$31,700	\$111,110	\$1,780	\$53,216	Instant*****
4	1. Four-pipe chilled/hot water coil induction units 2. Hot water coil heating/chilled water coil cooling 100% O.A. VAV ventilating unit with energy recovery wheels 3. Geothermal wells with high efficiency water-to-water source heat pump chiller/heating plant	\$3,362,600	538,300	0.0	\$75,362	\$0	\$75,362	\$1.91	46.50	\$25,275	\$100,637	\$12,253	-\$526,779	Not Reached*****

* Gross capital investment based upon in-house cost estimate utilizing cost data from similar past projects and industry standard estimating references. Costs have been estimated for system comparison purposes only and do not necessarily incorporate all supplemental/independent HVAC system costs which would be required for all systems studied (i.e. kitchen exhaust, sallyport HVAC systems, overhead and profit).

** Combined expense savings is the difference between the combined annual expense of the baseline and system in comparison.

*** Total life-cycle savings is based on a 30 year study period.

**** Discounted payback years is based upon BLCC5 Life Cycle Analysis.

***** Discounted payback never reached within 30 year study period.

***** Discounted payback never reached because system is more efficient and/or less expensive than baseline system.

Note 1: All calculated values are for mechanical system comparison purposes only.



Ashland Public Safety - LEED Energy Savings Summary

Baseline	System	Annual Elec. Cons. (kWh)	Annual Gas Cons. (MBTU)	Annual Electric Cost	Annual Gas Cost	Combined Utility Cost	Annual Utility \$/s.f.	Annual kBTU/s.f. (EUI)	Combined Expense Savings*	Energy Cost Savings Percentage**
LEED Baseline	1. ASHRAE Standard 90.1-2010 Envelope (Wall Insulation R-13 + R-7.5 c.i., Roof Insulation R-20 c.i., Operable Windows 0.55 U-Value/0.40 SHGC, Fixed Windows 0.45 U-Value/0.40 SHGC) 2. ASHRAE Standard 90.1-2010 Mechanical Systems (System 5 - Packaged VAV w/ Reheat and 80% Eff. Hot-Water Boilers) 3. ASHRAE Standard 90.1-2010 Lighting Systems (0.96 w/s.f.) 4. ASHRAE Standard 90.1-2010 Domestic Hot Water Systems (80% Eff. Hot Water Heaters)	376,520	4,431.5	\$52,713	\$51,849	\$104,562	\$2.65	144.71	-	-

Option	System	Annual Elec. Cons. (kWh)	Annual Gas Cons. (MBTU)	Annual Electric Cost	Annual Gas Cost	Combined Utility Cost	Annual Utility \$/s.f.	Annual kBTU/s.f. (EUI)	Combined Expense Savings*	Energy Cost Savings Percentage**
Option 2	1. Design Mechanical Systems (Hot Water Heating/Chilled Water Cooling Variable Air Volume Induction Unit System) 2. Design Envelope Assemblies (Wall Insulation R-25 c.i., Roof Insulation R-30 c.i., Fixed Windows 0.28 U-Value/0.56 SHGC, Operable Windows 0.28 U-Value/0.43 SHGC) 3. Design High-Efficiency Lighting Systems (0.5 w/s.f.) 4. Design High-Efficiency Domestic Hot Water Systems (94% Eff. Hot Water Heaters)	280,270	3,495.8	\$39,238	\$40,900	\$80,138	\$2.03	112.71	\$24,424	23.4%

*Combined expense savings is the difference between the combined annual expense of the baseline and building in comparison.

**Energy savings percentage is the difference between the annual energy consumption of the baseline and building in comparison.

LIFE CYCLE ANALYSES

NIST BLCC 5.3-18: Comparative Analysis

Consistent with Federal Life Cycle Cost Methodology in OMB Circular A-94

Base Case: Baseline - VAV

Alternative: Option 1 - CHW/HHW VAV

General Information

File Name: C:\Program Files\BLCC 5.3-2018\projects\Ashland Public Safety.xml
Date of Study: Wed Apr 08 09:12:34 EDT 2020
Project Name: Ashland Public Safety
Project Location: Massachusetts
Analysis Type: OMB Analysis, Non-Energy Project
Analysis Purpose: Public Investment or Regulatory Analysis
Analyst: Keith Lane
Base Date: January 1, 2021
Service Date: January 1, 2021
Study Period: 30 years 0 months(January 1, 2021 through December 31, 2050)
Discount Rate: 2.6%
Discounting Convention: End-of-Year

Comparison of Present-Value Costs

PV Life-Cycle Cost

	Base Case	Alternative	Savings from Alternative
Initial Investment Costs:			
Capital Requirements as of Base Date	\$2,419,543	\$2,488,543	-\$69,000
Future Costs:			
Energy Consumption Costs	\$2,690,671	\$2,458,621	\$232,050
Energy Demand Charges	\$0	\$0	\$0
Energy Utility Rebates	\$0	\$0	\$0
Water Costs	\$0	\$0	\$0
Recurring and Non-Recurring OM&R Costs	\$648,009	\$648,009	\$0
Capital Replacements	\$0	\$0	\$0
Residual Value at End of Study Period	\$0	\$0	\$0
	-----	-----	-----
Subtotal (for Future Cost Items)	\$3,338,680	\$3,106,630	\$232,050
	-----	-----	-----
Total PV Life-Cycle Cost	\$5,758,223	\$5,595,173	\$163,050

Net Savings from Alternative Compared with Base Case

PV of Non-Investment Savings \$232,050

- Increased Total Investment \$69,000

Net Savings \$163,050

Savings-to-Investment Ratio (SIR)

SIR = 3.36

Adjusted Internal Rate of Return

AIRR = 6.83%

Payback Period

Estimated Years to Payback (from beginning of Service Period)

Simple Payback occurs in year 8

Discounted Payback occurs in year 9

Energy Savings Summary

Energy Savings Summary (in stated units)

Energy Type	-----Average Base Case	Annual Alternative	Consumption----- Savings	Life-Cycle Savings
Electricity	291,650.0 kWh	293,210.0 kWh	-1,560.0 kWh	-46,793.6 kWh
Natural Gas	41,396.0 Therm	34,738.0 Therm	6,658.0 Therm	199,712.7 Therm

Energy Savings Summary (in MBtu)

Energy Type	-----Average Base Case	Annual Alternative	Consumption----- Savings	Life-Cycle Savings
Electricity	995.2 MBtu	1,000.5 MBtu	-5.3 MBtu	-159.7 MBtu
Natural Gas	4,139.6 MBtu	3,473.8 MBtu	665.8 MBtu	19,971.3 MBtu

Emissions Reduction Summary

Energy Type	-----Average Base Case	Annual Alternative	Emissions----- Reduction	Life-Cycle Reduction
Electricity				
CO2	179,595.82 kg	180,556.46 kg	-960.64 kg	-28,815.13 kg
SO2	498.79 kg	501.46 kg	-2.67 kg	-80.03 kg
NOx	156.46 kg	157.30 kg	-0.84 kg	-25.10 kg
Natural Gas				
CO2	218,668.32 kg	183,498.41 kg	35,169.91 kg	1,054,952.92 kg
SO2	1,764.72 kg	1,480.89 kg	283.83 kg	8,513.80 kg
NOx	183.46 kg	54.98 kg	128.48 kg	3,853.80 kg

Total:

CO2	398,264.14 kg	364,054.87 kg	34,209.28 kg	1,026,137.78 kg
SO2	2,263.51 kg	1,982.35 kg	281.16 kg	8,433.77 kg
NOx	339.92 kg	212.28 kg	127.64 kg	3,828.70 kg

NIST BLCC 5.3-18: Comparative Analysis

Consistent with Federal Life Cycle Cost Methodology in OMB Circular A-94

Base Case: Baseline - VAV

Alternative: Option 2 - Induction Units

General Information

File Name: C:\Program Files\BLCC 5.3-2018\projects\Ashland Public Safety.xml
Date of Study: Wed Apr 08 09:13:13 EDT 2020
Project Name: Ashland Public Safety
Project Location: Massachusetts
Analysis Type: OMB Analysis, Non-Energy Project
Analysis Purpose: Public Investment or Regulatory Analysis
Analyst: Keith Lane
Base Date: January 1, 2021
Service Date: January 1, 2021
Study Period: 30 years 0 months(January 1, 2021 through December 31, 2050)
Discount Rate: 2.6%
Discounting Convention: End-of-Year

Comparison of Present-Value Costs

PV Life-Cycle Cost

	Base Case	Alternative	Savings from Alternative
Initial Investment Costs:			
Capital Requirements as of Base Date	\$2,419,543	\$2,458,413	-\$38,870
Future Costs:			
Energy Consumption Costs	\$2,690,671	\$2,412,917	\$277,754
Energy Demand Charges	\$0	\$0	\$0
Energy Utility Rebates	\$0	\$0	\$0
Water Costs	\$0	\$0	\$0
Recurring and Non-Recurring OM&R Costs	\$648,009	\$639,094	\$8,914
Capital Replacements	\$0	\$0	\$0
Residual Value at End of Study Period	\$0	\$0	\$0
	-----	-----	-----
Subtotal (for Future Cost Items)	\$3,338,680	\$3,052,011	\$286,668
	-----	-----	-----
Total PV Life-Cycle Cost	\$5,758,223	\$5,510,424	\$247,798

Net Savings from Alternative Compared with Base Case

PV of Non-Investment Savings \$286,668

- Increased Total Investment	\$38,870

Net Savings	\$247,798

Savings-to-Investment Ratio (SIR)

SIR = 7.38

Adjusted Internal Rate of Return

AIRR = 9.67%

Payback Period

Estimated Years to Payback (from beginning of Service Period)

Simple Payback occurs in year 4
 Discounted Payback occurs in year 4

Energy Savings Summary

Energy Savings Summary (in stated units)

Energy Type	-----Average Base Case	Annual Alternative	Consumption----- Savings	Life-Cycle Savings
Electricity	291,650.0 kWh	280,270.0 kWh	11,380.0 kWh	341,353.3 kWh
Natural Gas	41,396.0 Therm	34,958.0 Therm	6,438.0 Therm	193,113.6 Therm

Energy Savings Summary (in MBtu)

Energy Type	-----Average Base Case	Annual Alternative	Consumption----- Savings	Life-Cycle Savings
Electricity	995.2 MBtu	956.3 MBtu	38.8 MBtu	1,164.7 MBtu
Natural Gas	4,139.6 MBtu	3,495.8 MBtu	643.8 MBtu	19,311.4 MBtu

Emissions Reduction Summary

Energy Type	-----Average Base Case	Annual Alternative	Emissions----- Reduction	Life-Cycle Reduction
Electricity				
CO2	179,595.82 kg	172,588.11 kg	7,007.72 kg	210,202.71 kg
SO2	498.79 kg	479.33 kg	19.46 kg	583.79 kg
NOx	156.46 kg	150.36 kg	6.11 kg	183.13 kg
Natural Gas				
CO2	218,668.32 kg	184,660.52 kg	34,007.79 kg	1,020,094.15 kg
SO2	1,764.72 kg	1,490.27 kg	274.45 kg	8,232.48 kg
NOx	183.46 kg	55.33 kg	128.13 kg	3,843.36 kg

Total:

CO2	398,264.14 kg	357,248.63 kg	41,015.51 kg	1,230,296.86 kg
SO2	2,263.51 kg	1,969.60 kg	293.92 kg	8,816.28 kg
NOx	339.92 kg	205.69 kg	134.23 kg	4,026.49 kg

NIST BLCC 5.3-18: Comparative Analysis

Consistent with Federal Life Cycle Cost Methodology in OMB Circular A-94

Base Case: Baseline - VAV

Alternative: Option 3 - VRF Units

General Information

File Name: C:\Program Files\BLCC 5.3-2018\projects\Ashland Public Safety.xml
Date of Study: Wed Apr 08 09:13:59 EDT 2020
Project Name: Ashland Public Safety
Project Location: Massachusetts
Analysis Type: OMB Analysis, Non-Energy Project
Analysis Purpose: Public Investment or Regulatory Analysis
Analyst: Keith Lane
Base Date: January 1, 2021
Service Date: January 1, 2021
Study Period: 30 years 0 months(January 1, 2021 through December 31, 2050)
Discount Rate: 2.6%
Discounting Convention: End-of-Year

Comparison of Present-Value Costs

PV Life-Cycle Cost

	Base Case	Alternative	Savings from Alternative
Initial Investment Costs:			
Capital Requirements as of Base Date	\$2,419,543	\$2,419,255	\$288
Future Costs:			
Energy Consumption Costs	\$2,690,671	\$2,416,254	\$274,416
Energy Demand Charges	\$0	\$0	\$0
Energy Utility Rebates	\$0	\$0	\$0
Water Costs	\$0	\$0	\$0
Recurring and Non-Recurring OM&R Costs	\$648,009	\$869,498	-\$221,489
Capital Replacements	\$0	\$0	\$0
Residual Value at End of Study Period	\$0	\$0	\$0
	-----	-----	-----
Subtotal (for Future Cost Items)	\$3,338,680	\$3,285,752	\$52,928
	-----	-----	-----
Total PV Life-Cycle Cost	\$5,758,223	\$5,705,007	\$53,216

Net Savings from Alternative Compared with Base Case

PV of Non-Investment Savings \$52,928

- Increased Total Investment	-\$288

Net Savings	\$53,216

NOTE: Meaningful SIR, AIRR and Payback can not be computed unless incremental savings and total savings are both positive.

Energy Savings Summary

Energy Savings Summary (in stated units)

Energy Type	-----Average Base Case	Annual Alternative	Consumption----- Savings	Life-Cycle Savings
Electricity	291,650.0 kWh	306,310.0 kWh	-14,660.0 kWh	-439,739.8 kWh
Natural Gas	41,396.0 Therm	32,041.0 Therm	9,355.0 Therm	280,611.6 Therm

Energy Savings Summary (in MBtu)

Energy Type	-----Average Base Case	Annual Alternative	Consumption----- Savings	Life-Cycle Savings
Electricity	995.2 MBtu	1,045.2 MBtu	-50.0 MBtu	-1,500.5 MBtu
Natural Gas	4,139.6 MBtu	3,204.1 MBtu	935.5 MBtu	28,061.3 MBtu

Emissions Reduction Summary

Energy Type	-----Average Base Case	Annual Alternative	Emissions----- Reduction	Life-Cycle Reduction
Electricity				
CO2	179,595.82 kg	188,623.34 kg	-9,027.52 kg	-270,788.38 kg
SO2	498.79 kg	523.86 kg	-25.07 kg	-752.06 kg
NOx	156.46 kg	164.33 kg	-7.86 kg	-235.91 kg
Natural Gas				
CO2	218,668.32 kg	169,251.90 kg	49,416.42 kg	1,482,289.66 kg
SO2	1,764.72 kg	1,365.92 kg	398.81 kg	11,962.55 kg
NOx	183.46 kg	50.71 kg	132.75 kg	3,981.85 kg
Total:				
CO2	398,264.14 kg	357,875.24 kg	40,388.90 kg	1,211,501.28 kg
SO2	2,263.51 kg	1,889.78 kg	373.73 kg	11,210.49 kg
NOx	339.92 kg	215.04 kg	124.88 kg	3,745.94 kg

NIST BLCC 5.3-18: Comparative Analysis

Consistent with Federal Life Cycle Cost Methodology in OMB Circular A-94

Base Case: Baseline - VAV

Alternative: Option 4 - Geo. Induction

General Information

File Name:	C:\Program Files\BLCC 5.3-2018\projects\Ashland Public Safety.xml
Date of Study:	Thu Apr 09 15:51:04 EDT 2020
Project Name:	Ashland Public Safety
Project Location:	Massachusetts
Analysis Type:	OMB Analysis, Non-Energy Project
Analysis Purpose:	Public Investment or Regulatory Analysis
Analyst:	Keith Lane
Base Date:	January 1, 2021
Service Date:	January 1, 2021
Study Period:	30 years 0 months(January 1, 2021 through December 31, 2050)
Discount Rate:	2.6%
Discounting Convention:	End-of-Year

Comparison of Present-Value Costs

PV Life-Cycle Cost

	Base Case	Alternative	Savings from Alternative
Initial Investment Costs:			
Capital Requirements as of Base Date	\$2,419,543	\$3,362,600	-\$943,057
Future Costs:			
Energy Consumption Costs	\$2,690,671	\$2,229,135	\$461,536
Energy Demand Charges	\$0	\$0	\$0
Energy Utility Rebates	\$0	\$0	\$0
Water Costs	\$0	\$0	\$0
Recurring and Non-Recurring OM&R Costs	\$648,009	\$693,267	-\$45,258
Capital Replacements	\$0	\$0	\$0
Residual Value at End of Study Period	\$0	\$0	\$0
	-----	-----	-----
Subtotal (for Future Cost Items)	\$3,338,680	\$2,922,401	\$416,278
	-----	-----	-----
Total PV Life-Cycle Cost	\$5,758,223	\$6,285,001	-\$526,779

Net Savings from Alternative Compared with Base Case

PV of Non-Investment Savings \$416,278

- Increased Total Investment	\$943,057

Net Savings	-\$526,779

Savings-to-Investment Ratio (SIR)

SIR = 0.44

SIR is lower than 1.0; project alternative is not cost effective.

Adjusted Internal Rate of Return

AIRR = -0.16%

AIRR is lower than your discount rate; project alternative is not cost effective.

Payback Period

Estimated Years to Payback (from beginning of Service Period)

Simple Payback never reached during study period.

Discounted Payback never reached during study period.

Energy Savings Summary

Energy Savings Summary (in stated units)

Energy Type	-----Average Base Case	Annual Alternative	Consumption----- Savings	Life-Cycle Savings
Electricity	291,650.0 kWh	538,300.0 kWh	-246,650.0 kWh	-7,398,487.1 kWh
Natural Gas	41,396.0 Therm	0.0 Therm	41,396.0 Therm	1,241,710.0 Therm

Energy Savings Summary (in MBtu)

Energy Type	-----Average Base Case	Annual Alternative	Consumption----- Savings	Life-Cycle Savings
Electricity	995.2 MBtu	1,836.8 MBtu	-841.6 MBtu	-25,244.7 MBtu
Natural Gas	4,139.6 MBtu	0.0 MBtu	4,139.6 MBtu	124,171.5 MBtu

Emissions Reduction Summary

Energy Type	-----Average Base Case	Annual Alternative	Emissions----- Reduction	Life-Cycle Reduction
Electricity				
CO2	179,595.82 kg	331,480.99 kg	-151,885.17 kg	-4,555,931.35 kg
SO2	498.79 kg	920.62 kg	-421.83 kg	-12,653.14 kg
NOx	156.46 kg	288.78 kg	-132.32 kg	-3,969.09 kg
Natural Gas				

CO2	218,668.32 kg	0.00 kg	218,668.32 kg	6,559,151.53 kg
SO2	1,764.72 kg	0.00 kg	1,764.72 kg	52,934.42 kg
NOx	183.46 kg	0.00 kg	183.46 kg	5,503.08 kg
Total:				
CO2	398,264.14 kg	331,480.99 kg	66,783.15 kg	2,003,220.19 kg
SO2	2,263.51 kg	920.62 kg	1,342.89 kg	40,281.28 kg
NOx	339.92 kg	288.78 kg	51.14 kg	1,533.99 kg

COST ESTIMATES



GARCIA • GALUSKA • DESOUSA
Consulting Engineers Inc.

370 Faunce Corner Road, Dartmouth, MA 02747-1217

PROJECT: Ashland Public Safety

JOB NO: 787 008 00

CLIENT: HKT Architects Inc.

DATE: 4/8/20

BY: KL

Baseline - ASHRAE Split System DX Cooling/Hot Water Coil Heating VAV AHU System

ITEM OF WORK	NO.	UNIT PRICE	AREA FT ²	PRICE/S.F.	TOTAL
VAV's w/ hot water reheat coil	52	\$1,500			\$ 78,000.00
AHU-1 DX/HHW VAV w/ ERV, Hot Gas Reheat, & DCV	22,000 CFM	\$16/CFM			\$ 352,000.00
80 Ton Air-Cooled Condensing Unit	80 tons	\$1,350/ton			\$ 108,000.00
AHU Refrigerant Piping & Ins. (2 Circuits)					\$ 28,000.00
(2) 1,500 MBH Standard-Efficiency Gas-Fired Boilers including Accessories and Gas Piping	2	\$40,000			\$ 80,000.00
Hot Water Pumps w/ VFD's	2	\$7,500			\$ 15,000.00
Ductwork including Insulation, GRD's, Dampers, & General Exhaust Systems			39,500	\$18.00	\$ 711,000.00
Hot Water Piping & Ins. and Accessories (Including Supplemental Heating Units)			39,500	\$6.00	\$ 237,000.00
Controls			39,500	\$7.00	\$ 276,500.00
Testing And Balancing			39,500	\$0.70	\$ 27,650.00
Split System Ductless Cooling Units	7	\$7,500			\$ 52,500.00
Radiant Floor Heating Piping (Apparatus Bay & Sallyport)			12,000	\$8.00	\$ 96,000.00
Apparatus Bay Hot Water Unit Heaters	7	\$950			\$ 6,650.00
Sallyport Hot Water Unit Heaters	3	\$950			\$ 2,850.00
Cabinet Hot Water Unit Heaters	8	\$1,500			\$ 12,000.00
Hot Water Unit Heaters	14	\$950			\$ 13,300.00
Exhaust Fans (Misc. Areas)					\$ 7,500.00
HVAC General Conditions (as-builts, coordination, shop drawings, Cx support, Project Management)	15.00%	\$2,103,950			\$ 315,592.50
TOTAL					\$ 2,419,542.50
TOTAL (\$/FT²)					\$ 61.25

Cost estimates have been derived for system comparison purposes only. Estimates do not necessarily include HVAC systems and equipment that would typically be required for all system options studied; example: vehicle exhaust air systems, supplemental cooling systems for elevator machine rooms, tel/data rooms, etc. and radiation heating for unoccupied areas such as storage rooms, corridors, vestibules etc.



GARCIA • GALUSKA • DESOUSA
 Consulting Engineers Inc.

370 Faunce Corner Road, Dartmouth, MA 02747-1217

PROJECT: Ashland Public Safety

JOB NO: 787 008 00


CLIENT: HKT Architects Inc.

Option 1 - Chilled Water Coil Cooling/Hot Water Coil Heating VAV AHU System

DATE: 4/8/20 **BY: KL**

ITEM OF WORK	NO.	UNIT PRICE	AREA FT ²	PRICE/S.F.	TOTAL
VAV's w/ hot water reheat coil	52	\$1,500			\$ 78,000.00
AHU-1 CHW/HHW VAV w/ Dual Wheel ERV & DCV	22,000 CFM	\$17/CFM			\$ 374,000.00
80 Ton Air-Cooled Chiller Unit	80 tons	\$1,450/ton			\$ 116,000.00
AHU Chilled Water Piping & Ins.					\$ 25,000.00
Chilled Water Pumps w/ VFD's	2	\$6,500			\$ 13,000.00
(2) 1,500 MBH High-Efficiency Gas-Fired Condensing Boilers including Accessories and Gas Piping	2	\$50,000			\$ 100,000.00
Hot Water Pumps w/ VFD's	2	\$7,500			\$ 15,000.00
Ductwork including Insulation, GRD's, Dampers, & General Exhaust Systems			39,500	\$18.00	\$ 711,000.00
Hot Water Piping & Ins. and Accessories (Including Supplemental Heating Units)			39,500	\$6.00	\$ 237,000.00
Controls (Including Demand Ventilation Controls)			39,500	\$7.00	\$ 276,500.00
Testing And Balancing			39,500	\$0.70	\$ 27,650.00
Split System Ductless Cooling Units	7	\$7,500			\$ 52,500.00
Radiant Floor Heating Piping (Apparatus Bay & Sallyport)			12,000	\$8.00	\$ 96,000.00
Apparatus Bay Hot Water Unit Heaters	7	\$950			\$ 6,650.00
Sallyport Hot Water Unit Heaters	3	\$950			\$ 2,850.00
Cabinet Hot Water Unit Heaters	8	\$1,500			\$ 12,000.00
Hot Water Unit Heaters	14	\$950			\$ 13,300.00
Exhaust Fans (Misc. Areas)					\$ 7,500.00
HVAC General Conditions (as-builts, coordination, shop drawings, Cx support, Project Management)	15.00%	\$2,163,950			\$ 324,593
TOTAL					\$ 2,488,542.50
TOTAL (\$/FT²)					\$ 63.00

Cost estimates have been derived for system comparison purposes only. Estimates do not necessarily include HVAC systems and equipment that would typically be required for all system options studied; example: vehicle exhaust air systems, supplemental cooling systems for elevator machine rooms, tel/data rooms, etc. and radiation heating for unoccupied areas such as storage rooms, corridors, vestibules etc.

 GARCIA • GALUSKA • DESOUSA Consulting Engineers Inc. 370 Faunce Corner Road, Dartmouth, MA 02747-1217		PROJECT: Ashland Public Safety			
		JOB NO: 787 008 00			
		CLIENT: HKT Architects Inc.			
Option 2 - Induction Unit System		DATE: 4/7/20	BY: KL		
ITEM OF WORK	NO.	UNIT PRICE	AREA FT²	PRICE/S.F.	TOTAL
Induction Units	68	\$1,500			\$ 102,000.00
VAV's w/ Demand Ventilation Controls	46	\$1,200			\$ 55,200.00
VAV's w/ hot water reheat coil (Cell Block)	1	\$1,500			\$ 1,500.00
DOAS-1 CHW/HHW VAV w/ Dual Wheel ERV & DCV	10,000 CFM	\$17/CFM			\$ 170,000.00
80 Ton Air-Cooled Chiller Unit	80 tons	\$1,450/ton			\$ 116,000.00
AHU Chilled Water Piping & Ins.					\$ 25,000.00
Chilled Water Pumps w/ VFD's	2	\$6,500			\$ 13,000.00
(2) 1,500 MBH Standard-Efficiency Gas-Fired Boilers including Accessories and Gas Piping	2	\$50,000			\$ 100,000.00
Hot Water Pumps w/ VFD's	2	\$7,500			\$ 15,000.00
Ductwork including Insulation, GRD's, Dampers, & General Exhaust Systems			39,500	\$16.00	\$ 632,000.00
Hot Water Piping & Ins. and Accessories (Including Supplemental Heating Units)			39,500	\$6.25	\$ 246,875.00
Chilled Water Piping & Ins., Condensate, and Accessories			21,000	\$7.00	\$ 147,000.00
Controls			39,500	\$7.50	\$ 296,250.00
Testing And Balancing			39,500	\$0.75	\$ 29,625.00
Split System Ductless Cooling Units	7	\$7,500			\$ 52,500.00
Radiant Floor Heating Piping (Apparatus Bay & Sallyport)			12,000	\$8.00	\$ 96,000.00
Apparatus Bay Hot Water Unit Heaters	7	\$950			\$ 6,650.00
Sallyport Hot Water Unit Heaters	3	\$950			\$ 2,850.00
Cabinet Hot Water Unit Heaters	8	\$1,500			\$ 12,000.00
Hot Water Unit Heaters	14	\$950			\$ 13,300.00
Exhaust Fans (Misc. Areas)					\$ 5,000.00
HVAC General Conditions (as-builts, coordination, shop drawings, Cx support, Project Management)	15.00%	\$2,137,750			\$ 320,662.50
TOTAL					\$ 2,458,412.50
TOTAL (\$/FT²)					\$ 62.24

Cost estimates have been derived for system comparison purposes only. Estimates do not necessarily include HVAC systems and equipment that would typically be required for all system options studied; example: vehicle exhaust air systems, supplemental cooling systems for elevator machine rooms, tel/data rooms, etc. and radiation heating for unoccupied areas such as storage rooms, corridors, vestibules etc.



GARCIA • GALUSKA • DESOUSA
 Consulting Engineers Inc.
 370 Faunce Corner Road, Dartmouth, MA 02747-1217

PROJECT: Ashland Public Safety

JOB NO: 787 008 00

CLIENT: HKT Architects Inc.

DATE: 4/7/20

BY: KL

Option 3 - Variable Refrigerant Flow (VRF) Heat Pump System

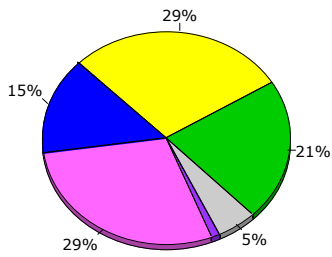
ITEM OF WORK	NO.	UNIT PRICE	AREA FT ²	PRICE/S.F.	TOTAL
Indoor VRF Evaporator Units	54	\$3,300			\$ 178,200.00
Outdoor Air Cooled VRF Condensing Units (45 Ton Total Capacity)	45 ton	\$1,500/ton			\$ 67,500.00
VAV's w/ Demand Ventilation Controls	46	\$1,200			\$ 55,200.00
VAV's w/ hot water reheat coil (Cell Block)	1	\$1,500			\$ 1,500.00
DOAS-1 DX/HHW VAV w/ w/ ERV, Hot Gas Reheat, & DCV	10,000 CFM	\$16/CFM			\$ 160,000.00
35 Ton Air-Cooled Condensing Unit	35 tons	\$1350/ton			\$ 47,250.00
AHU Refrigerant Piping & Ins.					\$ 28,000.00
(2) 1,200 MBH Standard-Efficiency Gas-Fired Boilers including Accessories and Gas Piping	2	\$45,000			\$ 90,000.00
Hot Water Pumps w/ VFD's	2	\$7,500			\$ 15,000.00
Ductwork including Insulation, GRD's, Dampers, & General Exhaust Systems			39,500	\$16.00	\$ 632,000.00
Hot Water Piping & Ins. and Accessories (Including Supplemental Heating Units)			39,500	\$5.00	\$ 197,500.00
Refrigeration Piping & Insulation and Condensate Piping & Pumps			21,000	\$7.00	\$ 147,000.00
Controls			39,500	\$7.00	\$ 276,500.00
Testing And Balancing			39,500	\$0.50	\$ 19,750.00
Split System Ductless Cooling Units	7	\$7,500			\$ 52,500.00
Radiant Floor Heating Piping (Apparatus Bay & Sallyport)			12,000	\$8.00	\$ 96,000.00
Apparatus Bay Hot Water Unit Heaters	7	\$950			\$ 6,650.00
Sallyport Hot Water Unit Heaters	3	\$950			\$ 2,850.00
Cabinet Hot Water Unit Heaters	8	\$1,500			\$ 12,000.00
Hot Water Unit Heaters	14	\$950			\$ 13,300.00
Exhaust Fans (Misc. Areas)					\$ 5,000.00
HVAC General Conditions (as-builts, coordination, shop drawings, Cx support, Project Management)	15.00%	\$2,103,700			\$ 315,555.00
TOTAL					\$ 2,419,255.00
TOTAL (\$/FT²)					\$ 61.25

Cost estimates have been derived for system comparison purposes only. Estimates do not necessarily include HVAC systems and equipment that would typically be required for all system options studied; example: vehicle exhaust air systems, supplemental cooling systems for elevator machine rooms, tel/data rooms, etc. and radiation heating for unoccupied areas such as storage rooms, corridors, vestibules etc.

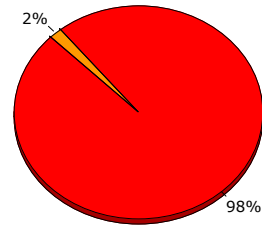
ENERGY PROFILES

Annual Energy Consumption by Enduse

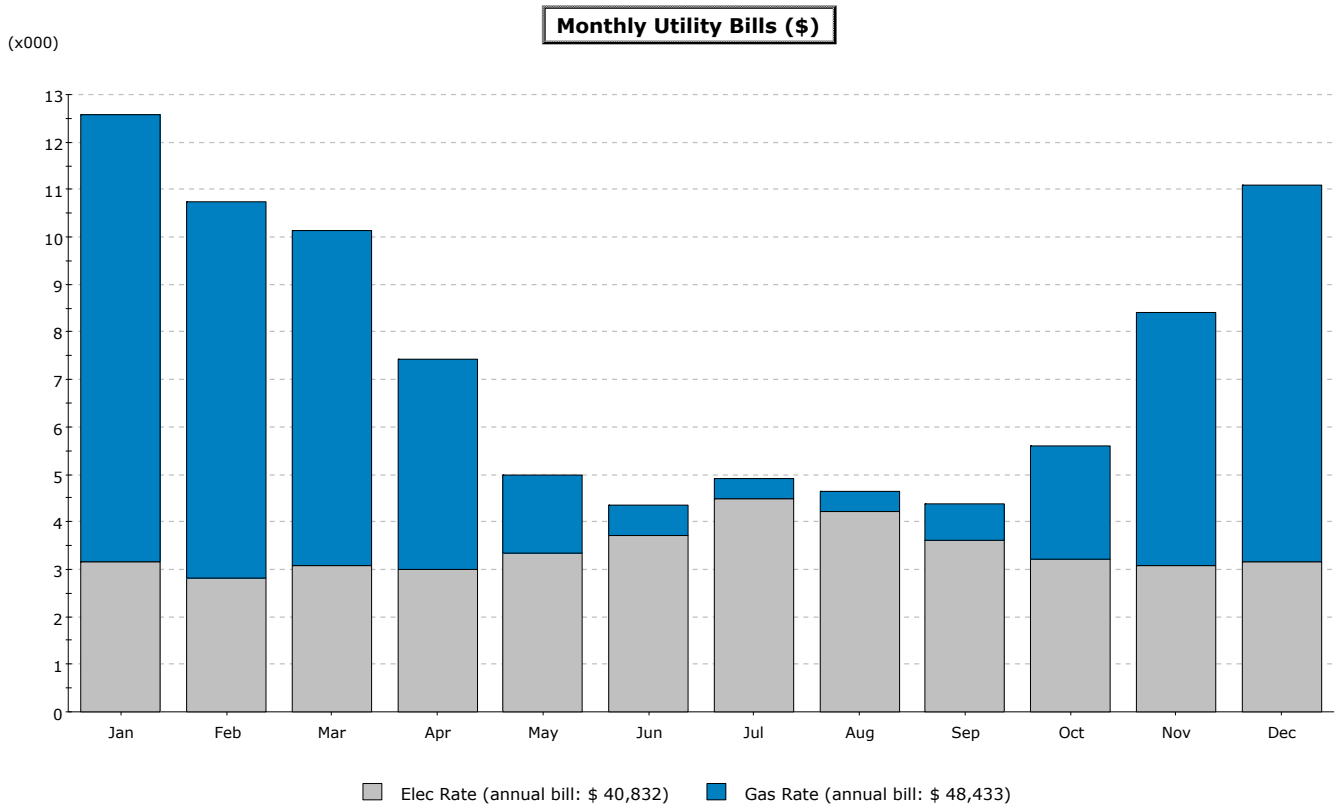
	Electricity kWh (x000)	Natural Gas MBtu	Steam Btu	Chilled Water Btu
Space Cool	43.51	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	-	4,067.3	-	-
HP Supp.	-	-	-	-
Hot Water	-	72.3	-	-
Vent. Fans	83.47	-	-	-
Pumps & Aux.	3.16	-	-	-
Ext. Usage	15.06	-	-	-
Misc. Equip.	62.32	-	-	-
Task Lights	-	-	-	-
Area Lights	84.15	-	-	-
Total	291.65	4,139.6	-	-



Electricity



Natural Gas

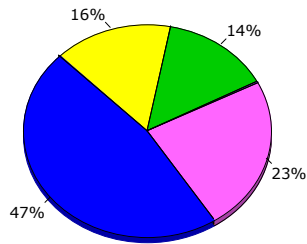


Total Annual Bill Across All Rates: \$ 89,265

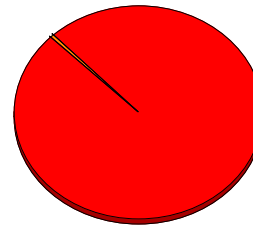
Annual Peak Demand by Enduse

	Electricity kW	Natural Gas Btu/h (x000)	Steam Btu/h	Chilled Water Btu/h
Space Cool	30.62	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	-	1,890.2	-	-
HP Supp.	-	-	-	-
Hot Water	-	8.7	-	-
Vent. Fans	15.23	-	-	-
Pumps & Aux.	0.15	-	-	-
Ext. Usage	-	-	-	-
Misc. Equip.	9.40	-	-	-
Task Lights	-	-	-	-
Area Lights	10.25	-	-	-
Total	65.65	1,898.8	-	-

- Area Lighting
- Exterior Usage
- Water Heating
- Refrigeration
- Task Lighting
- Pumps & Aux.
- Ht Pump Supp.
- Heat Rejection
- Misc. Equipment
- Ventilation Fans
- Space Heating
- Space Cooling



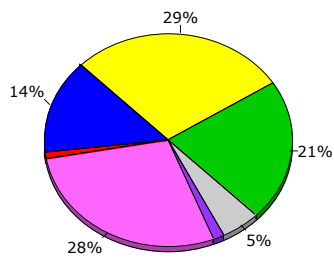
Electricity



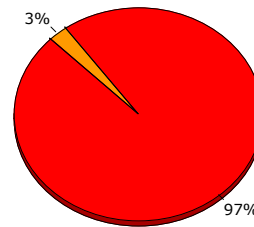
Natural Gas

Annual Energy Consumption by Enduse

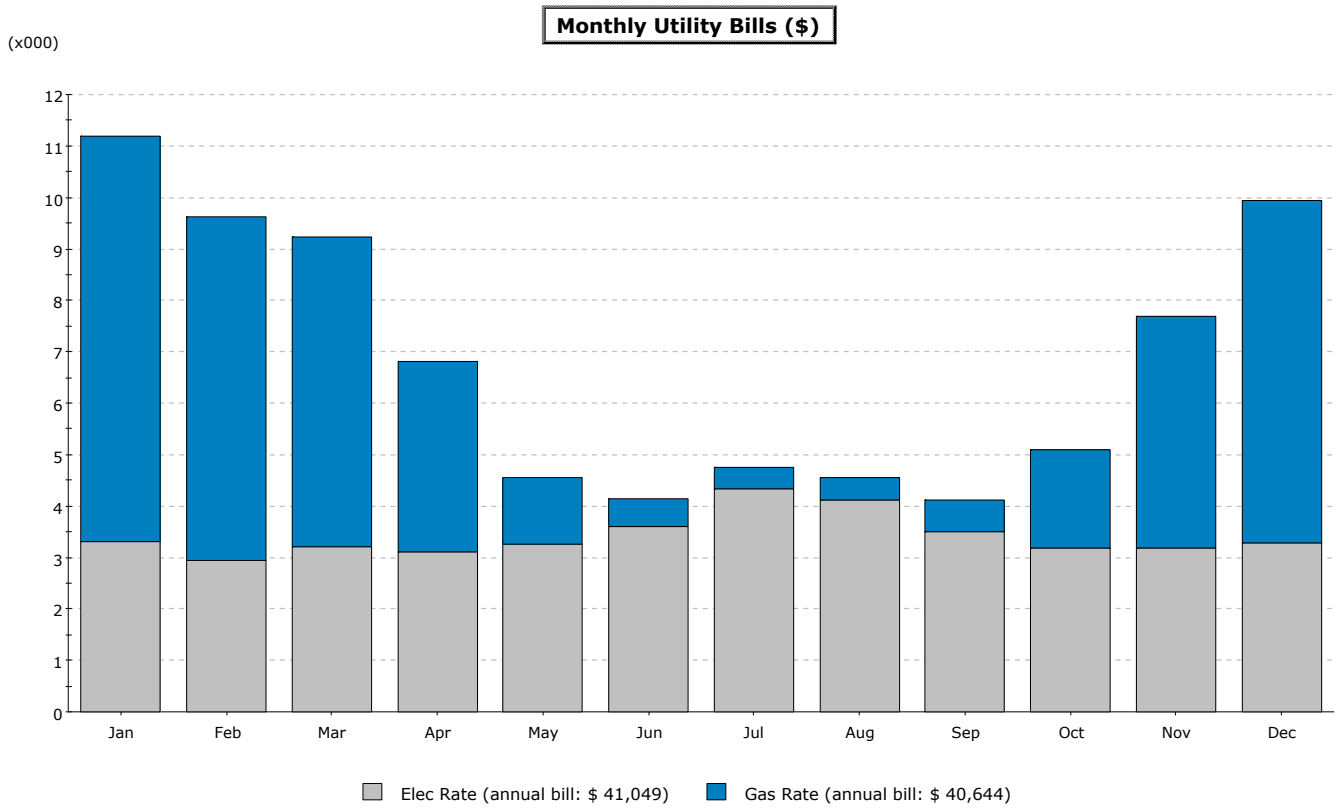
	Electricity kWh (x000)	Natural Gas MBtu	Steam Btu	Chilled Water Btu
Space Cool	42.27	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	3.18	3,381.9	-	-
HP Supp.	-	-	-	-
Hot Water	-	91.9	-	-
Vent. Fans	82.10	-	-	-
Pumps & Aux.	4.14	-	-	-
Ext. Usage	15.06	-	-	-
Misc. Equip.	62.32	-	-	-
Task Lights	-	-	-	-
Area Lights	84.15	-	-	-
Total	293.21	3,473.8	-	-



Electricity



Natural Gas

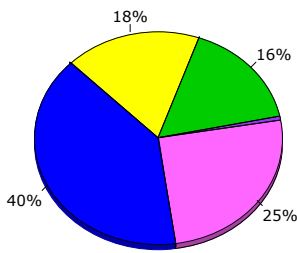


Total Annual Bill Across All Rates: \$ 81,693

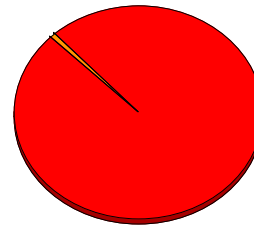
Annual Peak Demand by Enduse

	Electricity kW	Natural Gas Btu/h (x000)	Steam Btu/h	Chilled Water Btu/h
Space Cool	22.71	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	-	1,573.5	-	-
HP Supp.	-	-	-	-
Hot Water	-	11.1	-	-
Vent. Fans	14.41	-	-	-
Pumps & Aux.	0.28	-	-	-
Ext. Usage	-	-	-	-
Misc. Equip.	9.40	-	-	-
Task Lights	-	-	-	-
Area Lights	10.25	-	-	-
Total	57.05	1,584.7	-	-

- Area Lighting
- Exterior Usage
- Water Heating
- Refrigeration
- Task Lighting
- Pumps & Aux.
- Ht Pump Supp.
- Heat Rejection
- Misc. Equipment
- Ventilation Fans
- Space Heating
- Space Cooling



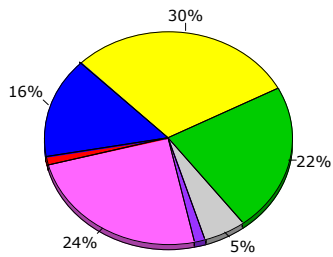
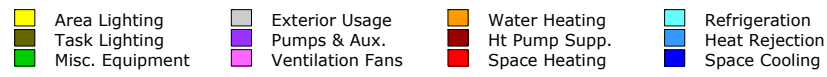
Electricity



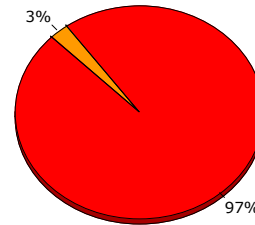
Natural Gas

Annual Energy Consumption by Enduse

	Electricity kWh (x000)	Natural Gas MBtu	Steam Btu	Chilled Water Btu
Space Cool	43.47	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	3.38	3,403.9	-	-
HP Supp.	-	-	-	-
Hot Water	-	91.9	-	-
Vent. Fans	67.92	-	-	-
Pumps & Aux.	3.98	-	-	-
Ext. Usage	15.06	-	-	-
Misc. Equip.	62.32	-	-	-
Task Lights	-	-	-	-
Area Lights	84.15	-	-	-
Total	280.27	3,495.8		



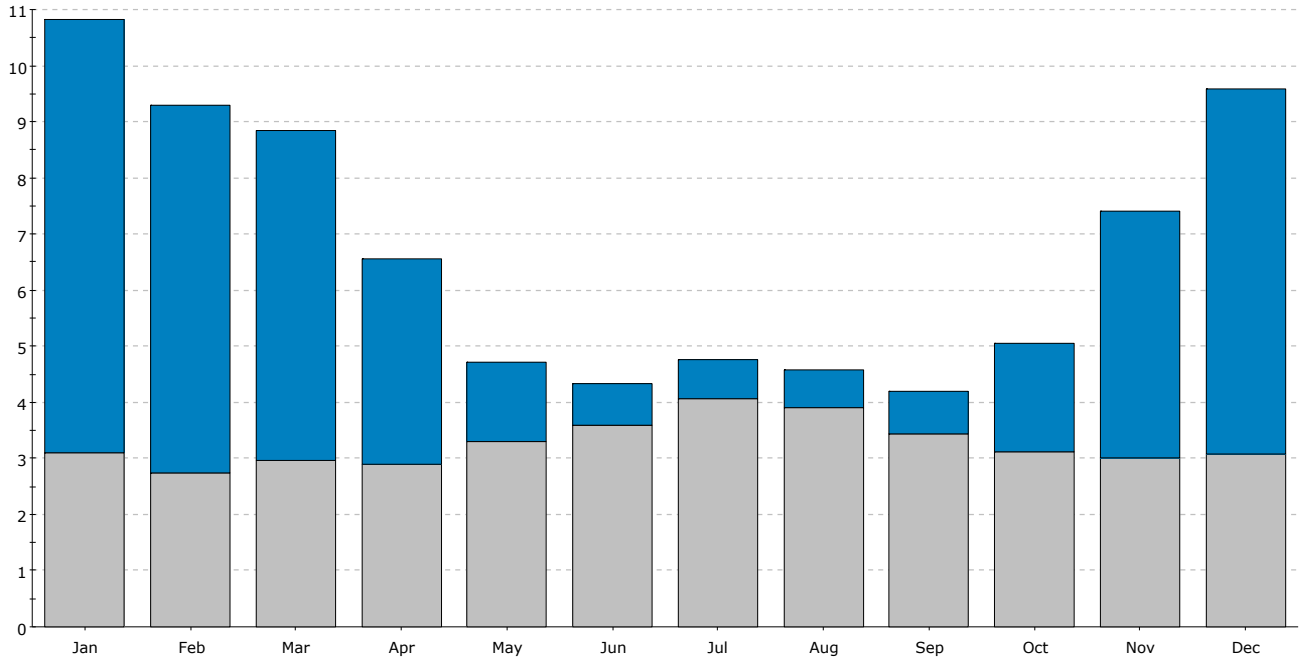
Electricity



Natural Gas

Monthly Utility Bills (\$)

(x000)



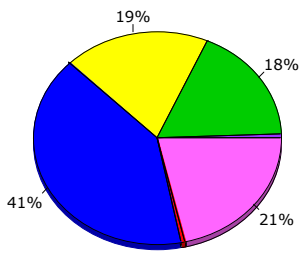
Elec Rate (annual bill: \$ 39,238)
 Gas Rate (annual bill: \$ 40,900)

Total Annual Bill Across All Rates: \$ 80,138

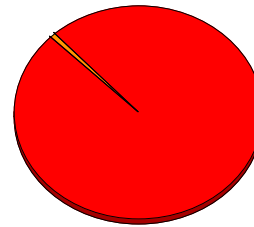
Annual Peak Demand by Enduse

	Electricity kW	Natural Gas Btu/h (x000)	Steam Btu/h	Chilled Water Btu/h
Space Cool	21.56	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	0.30	1,553.8	-	-
HP Supp.	-	-	-	-
Hot Water	-	11.1	-	-
Vent. Fans	11.26	-	-	-
Pumps & Aux.	0.28	-	-	-
Ext. Usage	-	-	-	-
Misc. Equip.	9.40	-	-	-
Task Lights	-	-	-	-
Area Lights	10.25	-	-	-
Total	53.05	1,564.9	-	-

Area Lighting	Exterior Usage	Water Heating	Refrigeration
Task Lighting	Pumps & Aux.	Ht Pump Supp.	Heat Rejection
Misc. Equipment	Ventilation Fans	Space Heating	Space Cooling



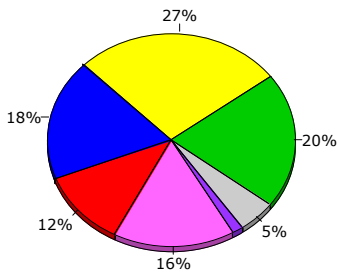
Electricity



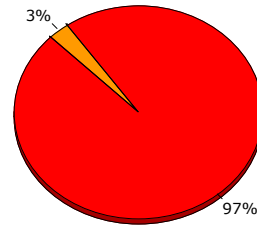
Natural Gas

Annual Energy Consumption by Enduse

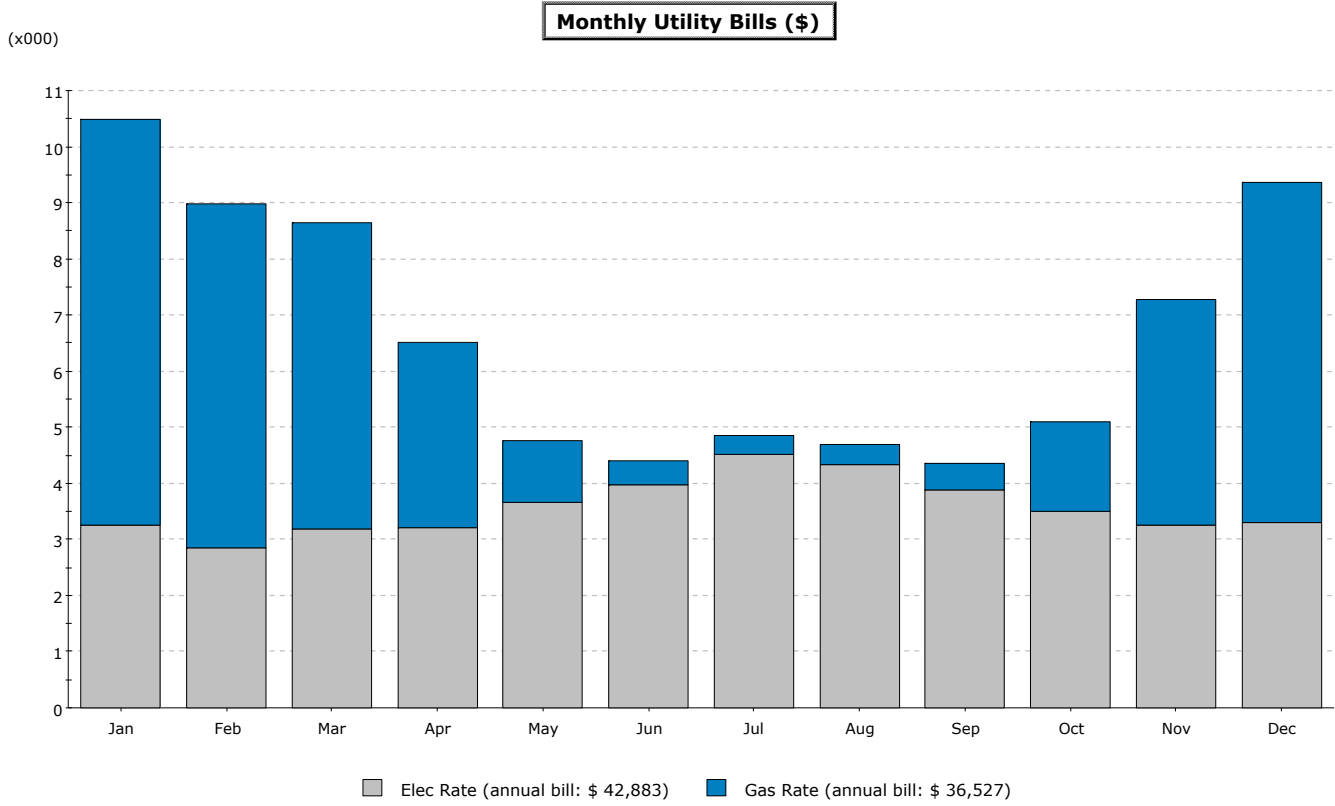
	Electricity kWh (x000)	Natural Gas MBtu	Steam Btu	Chilled Water Btu
Space Cool	56.67	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	35.54	3,112.3	-	-
HP Supp.	-	-	-	-
Hot Water	-	91.9	-	-
Vent. Fans	48.08	-	-	-
Pumps & Aux.	4.50	-	-	-
Ext. Usage	15.06	-	-	-
Misc. Equip.	62.32	-	-	-
Task Lights	-	-	-	-
Area Lights	84.15	-	-	-
Total	306.31	3,204.1	-	-



Electricity



Natural Gas

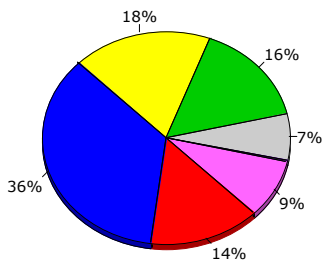


Total Annual Bill Across All Rates: \$ 79,410

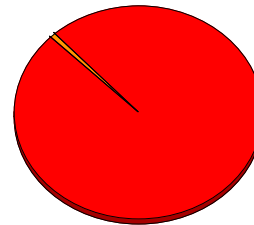
Annual Peak Demand by Enduse

	Electricity kW	Natural Gas Btu/h (x000)	Steam Btu/h	Chilled Water Btu/h
Space Cool	21.61	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	8.70	1,516.1	-	-
HP Supp.	-	-	-	-
Hot Water	-	11.1	-	-
Vent. Fans	5.30	-	-	-
Pumps & Aux.	0.16	-	-	-
Ext. Usage	4.25	-	-	-
Misc. Equip.	9.40	-	-	-
Task Lights	-	-	-	-
Area Lights	11.14	-	-	-
Total	60.56	1,527.2	-	-

- Area Lighting
- Exterior Usage
- Water Heating
- Refrigeration
- Task Lighting
- Pumps & Aux.
- Ht Pump Supp.
- Heat Rejection
- Misc. Equipment
- Ventilation Fans
- Space Heating
- Space Cooling



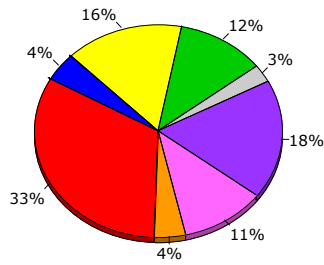
Electricity



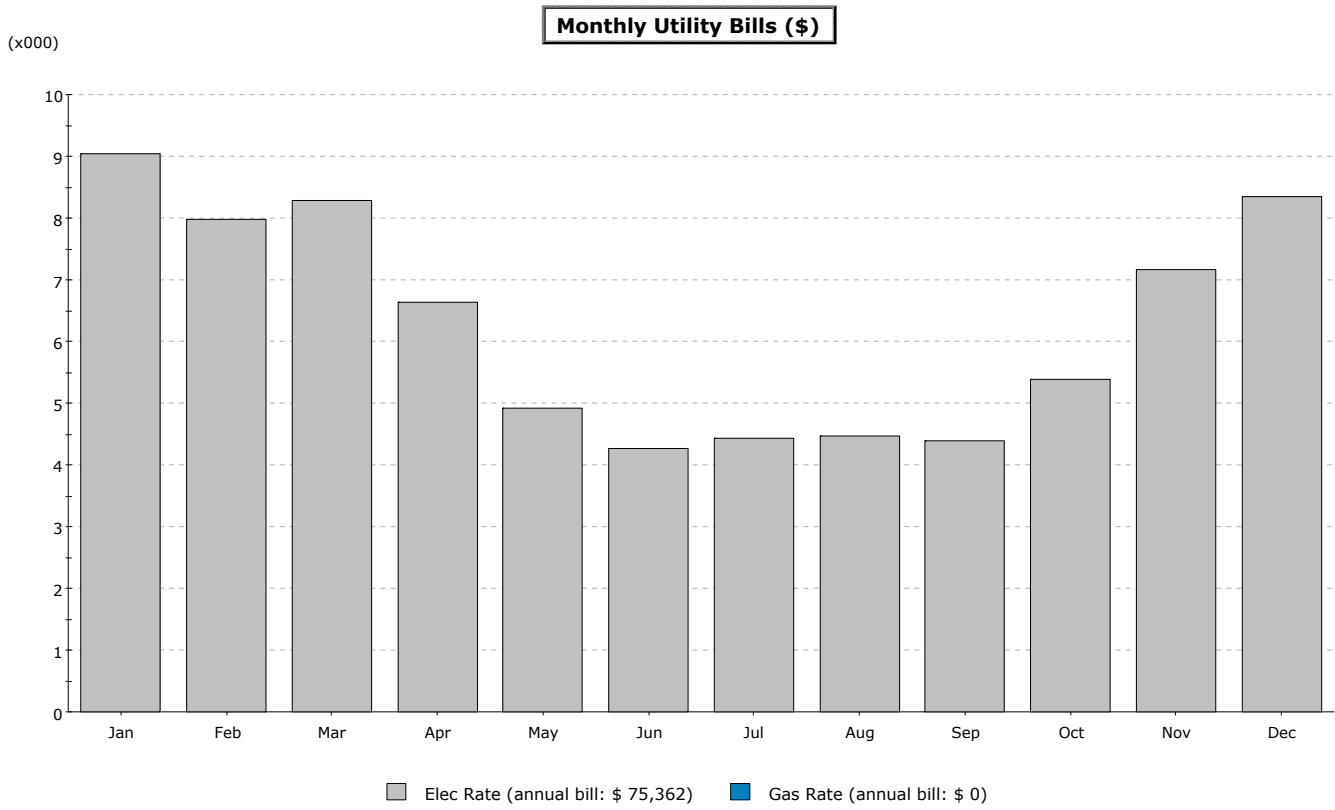
Natural Gas

Annual Energy Consumption by Enduse

	Electricity kWh (x000)	Natural Gas Btu	Steam Btu	Chilled Water Btu
Space Cool	23.66	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	176.02	-	-	-
HP Supp.	-	-	-	-
Hot Water	21.55	-	-	-
Vent. Fans	59.35	-	-	-
Pumps & Aux.	96.21	-	-	-
Ext. Usage	15.06	-	-	-
Misc. Equip.	62.32	-	-	-
Task Lights	-	-	-	-
Area Lights	84.15	-	-	-
Total	538.30	-	-	-



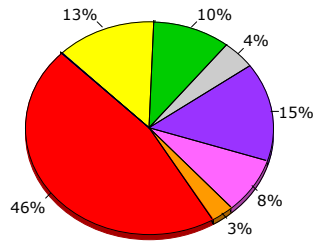
Electricity



Total Annual Bill Across All Rates: \$ 75,362

Annual Peak Demand by Enduse

	Electricity kW	Natural Gas Btu/h	Steam Btu/h	Chilled Water Btu/h
Space Cool	0.04	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	45.76	-	-	-
HP Supp.	-	-	-	-
Hot Water	2.89	-	-	-
Vent. Fans	8.32	-	-	-
Pumps & Aux.	14.75	-	-	-
Ext. Usage	4.25	-	-	-
Misc. Equip.	10.07	-	-	-
Task Lights	-	-	-	-
Area Lights	13.14	-	-	-
Total	99.22	-	-	-

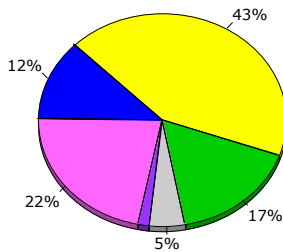


Electricity

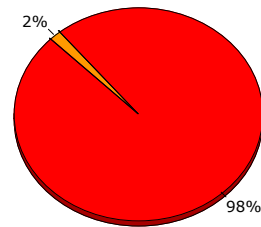
Annual Energy Consumption by Enduse

	Electricity kWh (x000)	Natural Gas MBtu	Steam Btu	Chilled Water Btu
Space Cool	46.87	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	-	4,359.3	-	-
HP Supp.	-	-	-	-
Hot Water	-	72.3	-	-
Vent. Fans	82.86	-	-	-
Pumps & Aux.	5.38	-	-	-
Ext. Usage	17.54	-	-	-
Misc. Equip.	62.32	-	-	-
Task Lights	-	-	-	-
Area Lights	161.56	-	-	-
Total	376.52	4,431.5	-	-

- | | | | |
|--|---|--|--|
| Area Lighting | Exterior Usage | Water Heating | Refrigeration |
| Task Lighting | Pumps & Aux. | Ht Pump Supp. | Heat Rejection |
| Misc. Equipment | Ventilation Fans | Space Heating | Space Cooling |



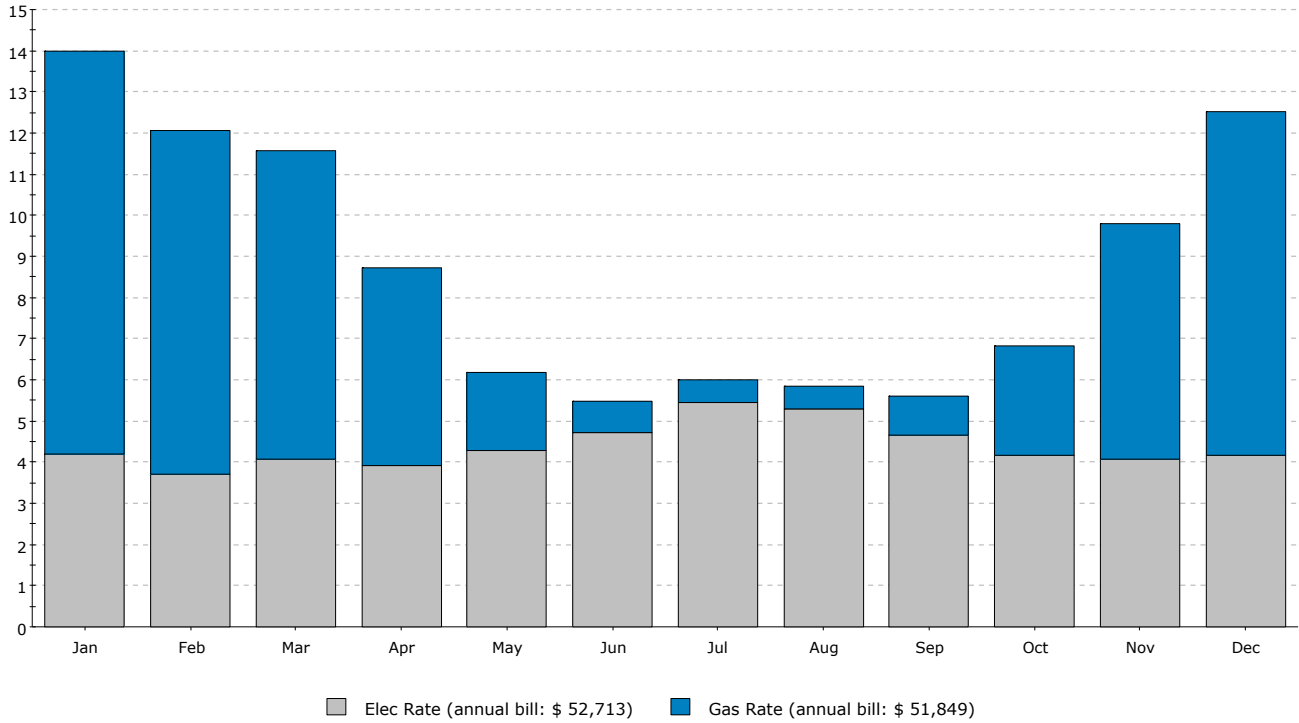
Electricity



Natural Gas

Monthly Utility Bills (\$)

(x000)

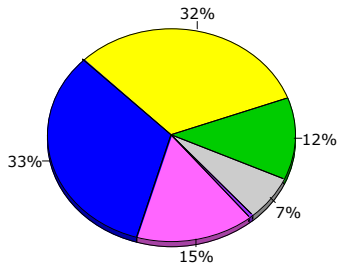


Total Annual Bill Across All Rates: \$ 104,562

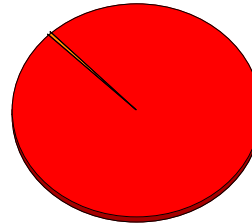
Annual Peak Demand by Enduse

	Electricity kW	Natural Gas Btu/h (x000)	Steam Btu/h	Chilled Water Btu/h
Space Cool	24.38	-	-	-
Heat Reject.	-	-	-	-
Refrigeration	-	-	-	-
Space Heat	-	1,982.7	-	-
HP Supp.	-	-	-	-
Hot Water	-	8.7	-	-
Vent. Fans	11.23	-	-	-
Pumps & Aux.	0.38	-	-	-
Ext. Usage	4.95	-	-	-
Misc. Equip.	9.08	-	-	-
Task Lights	-	-	-	-
Area Lights	23.58	-	-	-
Total	73.60	1,991.3	-	-

- | | | | |
|--|---|--|--|
| Area Lighting | Exterior Usage | Water Heating | Refrigeration |
| Task Lighting | Pumps & Aux. | Ht Pump Supp. | Heat Rejection |
| Misc. Equipment | Ventilation Fans | Space Heating | Space Cooling |



Electricity



Natural Gas