ENERGY ASSESSMENT

PREPARED FOR THE:

CITY OF SEVEN HILLS, OHIO

November 12, 2013

Rev 2

PREPARED BY:

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EXECUTIVE SUMMARY

In 2012, the City of Seven Hills implemented several energy conservation measures that were identified and funded through the Cuyahoga County Energy Efficiency and Conservation Block Grant (EECBG) Sub-Grant Program. The County has a new program in place to assist municipalities with implementation of energy upgrade projects. The Cleveland/Cuyahoga County Pilot Program, Retrofits for Energy Efficiency Works (RENEW) provides financing and technical assistance solutions for energy efficiency projects in municipal buildings. The program is a joint effort of Emerald Cities Cleveland, Cuyahoga County's Planning Commission, the Cleveland-Cuyahoga County Port Authority, and Public Finance & Energy Advisors, LLC. This program requires an updated energy assessment of City owned facilities. The cost for this Energy Assessment can be included in Cuyahoga County's RENEW financing program. Osborn Engineering was requested by the City of Seven Hills to conduct an energy assessment and identify energy savings opportunities that are eligible under the RENEW program.

In 2011, the City of Seven Hills paid approximately **$360,493** in utility costs for the City Hall, Recreation Center, Service Garage, and Fire Department facilities totaling 94,793 gross square feet (gsf). Implementation of all ECMs shown in the table below results in an estimated annual energy savings of **$123,465** with a total project cost of **$1,603,311**. The simple payback period for implementation of all ECMs is **13.0** years and does not account for utility rebates (by COSE). The estimated total project cost includes general conditions (10%), design contingency (0%); architectural / engineering fees (8%) and construction contingency (10%).

Factoring in the energy audit fee of $20,705 and an energy guarantee cost of $48,099, the overall program cost is estimated to be $1,672,116 which increases the simple payback period to 13.54 years. Based on an annual operational and utility inflation rate of 3%, the return on investment of implementing all ECMS is 8.1%. The return on investment ignores debt service and assumes that the project is paid from general funds. Factoring in debt service at a 4.5% finance rate over 15 years, the project has a positive cash flow of $11,283 in year 1 and an overall cumulative positive cashflow of $739,654 over the 15-year term.

ECM #	ECM DESCRIPTION	Rough Order of Magnitude (ROM) First Cost	Annual Savings				Metrics		
			Electricity	Natural Gas	Total Energy	Utility Cost Savings	Expected Useful life	Simple Payback Period (SPP)	Cumulative SPP
			kWh	*NG MCF*	*MMBtu*	*$*	*Years*	*Years*	*Years*
2012	2012 ECMs & Rate Negotiations	$0	205,117	-616	84	$64,993	-----	INSTANT	Instant
13 - 1	City Hall - BAS Upgrades to RTU-1-3 and Smart Meters	$15,000	38,568	147	283	$4,679	15	3.2	0.2
13 - 2	City Hall - Lighting Retrofit	$18,339	66,100	0	226	$6,213	15	3.0	0.4
13 - 3	Rec Center - Pool Heater Replacement	$30,114	0	802	826	$5,753	25	5.2	0.8
13 - 4	Rec Center - Lighting Retrofit	$64,112	76,677	0	262	$7,208	15	8.9	1.4
13 - 5	Service Garage - Lighting Retrofit	$7,404	8,201	0	28	$771	15	9.6	1.5
13 - 6	Fire Department - Lighting Retrofit	$8,059	7,862	0	27	$739	15	10.9	1.6
13 -7	City Hall - Boiler Replacement with OA Reset	$65,042	1,427	639	663	$4,715	25	13.8	2.2
13 - 8	City Hall - Replace Domestic Water Heater	$6,633	0	55	57	$397	20	16.7	2.2
13 - 9	Service Garage - Roof Replacement	$65,510	27,961	0	95	$2,628	30	24.9	2.9
13- 10	Fire Department - Furnace Replacement	$7,392	0	27	28	$197	20	37.6	2.9
13 - 11	City Hall - Roof Replacement	$416,528	49,667	800	993	$10,406	30	40.0	6.5
13 - 12	Fire Department - Condensing Unit Upgrade	$24,130	4,966	0	17	$467	20	51.7	6.7
13 - 13	Rec Center - Natatorium DHU & Lighting Replacement and Smart Meters	$875,048	106,062	604	984	$14,299	25	61.2	13.0
Total		**$1,603,311**	**592,609**	**2,458**	**4,573**	**$123,465**	**28.9**	**13.0**	

SCOPE OF WORK

Osborn Engineering was requested by the City of Seven Hills to conduct an ASHRAE Level II energy audit and identify energy savings opportunities that are eligible under the RENEW program. The Cleveland/Cuyahoga County Pilot Program, Retrofits for Energy Efficiency Works (RENEW) provides financing and technical assistance solutions for energy efficiency projects in municipal buildings. The program is a joint effort of Emerald Cities Cleveland, Cuyahoga County's Planning Commission, the Cleveland-Cuyahoga County Port Authority, and Public Finance & Energy Advisors, LLC. This program requires an updated energy assessment of City owned facilities.

The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) defines a Level I Energy Audit as a preliminary analysis that involves a brief building survey accompanied by an operator; analysis of utility bills and historical energy use to identify potential cost saving opportunities including low cost / no cost measures and potential capital improvements for further study as part of a Level II or III Energy Audit. A Level II audit includes a breakdown of energy use as well as a more detailed building survey and energy analysis. A Level II analysis identifies and provides the savings and cost analysis of all practical measures that meet the owner's constraints and economic criteria, along with a discussion of any effects on operation and maintenance procedures. It also lists potential capital-intensive improvements that require more thorough data collection and analysis, along with an initial judgment of potential cost savings.

The following are not addressed in this report:

- Detailed building assessment
- Detailed HVACR assessment
- Detailed electrical load study
- Detailed structural load study
- Detailed code / life safety analysis
- Detailed construction cost estimates
- Utility rebate applications (by COSE)

The assessment services were limited to a visual survey of existing conditions and exclude both nondestructive and destructive testing. However, this type of inspection does not clearly reveal all defects and requires certain engineering assumptions be made to establish condition. These assumptions cannot always be verified without extensive testing, some of which can be destructive. Therefore, this evaluation is not to be considered a guarantee of the exact condition, life and total extent of potential repairs of the facilities inspected.

Please note, all energy cost savings and construction costs are estimates and actual savings and costs may vary and will be affected by future usage, maintenance and weather.

METHODOLOGY

Work was completed for this project in a series of phases including the following:

- Data Collection and Preliminary Opportunity Analysis
  - Kickoff Meeting / Data Collection
  - Field Investigation
  - Preliminary Opportunity Analysis
- Analysis and Documentation
  - Baseline
  - Energy Savings Projects
  - Documentation
- Validation / Justification
- Program Development

Data Collection and Preliminary Opportunity Analysis

Kickoff Meeting / Data Collection

Osborn Engineering met with the appropriate personnel with the City of Seven Hills to coordinate scheduling progress and review meetings with key project team members and stakeholders. The kickoff meeting introduced the team and process, established goals, collected valuable input and provided an understanding of the priorities and needs of the city. Additionally, initial data requests, access issues and schedules were coordinated. Initial data requests included:

- Equipment inventories
- Maintenance history
- Recent energy studies
- Historical energy data
- Capital and master plans
- Building drawings
- Protocol for access to buildings
- Protocol for access to Building Automation Systems (BAS)

Field Investigation

Collectively, the team performed field audits with particular attention to building envelope, mechanical, electrical and control systems to identify potential energy efficiency projects. During the audits the team observed and noted the operational and usage characteristics of each facility to identify low-cost / no-cost and behavioral based opportunities. The field data was collected and a narrative description of the existing conditions was developed to provide the basis for energy calculations, analysis and a consistent record of baseline data for future use.

Preliminary Opportunity Analysis

Utility data was tabulated (January 2008 through August 2013) and buildings were benchmarked to compare their usage to similar buildings in order to help target opportunities and to prioritize field investigation. Drawings and past studies were reviewed to confirm their level of accuracy compared to data collected during walkthroughs of the buildings. Subsequent to the field investigation, Osborn Engineering issued to Seven Hills a list of potential energy conservation measures (ECMs) along with any critical system deficiencies.

Analysis and documentation

Baseline

During the analysis phase, the previously compiled field data was analyzed to develop projects that are consistent with the City's goals and objectives. In order to estimate energy savings, the first step was to determine a facility's baseline energy consumption. The baseline energy consumption served as a reference point to compare the effect of proposed ECMs to test their individual and combined effects on utility consumption and cost. The baseline energy consumption accounted for ECMs implemented by the City in 2012.

Energy Savings Projects

Our team utilized either Trane Trace 700 energy simulation software based analysis, a data based algorithm analysis, or a combination of both to independently establish the baseline energy model as well as to analyze the energy savings potential of various energy conservation measures (ECMs). Most of the HVAC and building envelope ECMs were analyzed utilizing Trane Trace 700 while the lighting was analyzed utilizing a data based algorithm analysis. Once the initial analysis was complete, our team compared the results of each of the independent analyses and reconciled any discrepancies through further investigation and analysis. Potential energy savings opportunities were evaluated in a holistic manner that leveraged synergies between various ECMs while assuring that savings from multiple ECMs are appropriately modeled without "double counting" savings. Follow up walkthroughs of specific buildings and interviews with maintenance and engineering staff were performed in order to reconcile discrepancies in the baseline model with actual utility data.

Energy savings calculations were based on a combination of actual and assumed data. Specific assumptions can be found in the Energy Analysis section of this report. The following general assumptions were made:

- HVAC calculations were all based on interviews with maintenance staff.
- Interior lighting operating hours were assumed based on the operating hours of the HVAC systems, as well as interviews with maintenance staff.
- All cost estimates include material and labor costs assuming outside contractors will be used the complete the work.
- Soft costs such as general conditions, design fees and contingencies were included in cost estimates.
- Annual savings estimates include energy savings only and do not include maintenance savings.
- All utility savings calculations were based on the rates in the table below.

Utility	Rate
Electricity ($/kWh)	$0.096
Natural Gas ($/MCF)	$7.192
Water ($/kgal)	$6.746
Sewer ($/kgal)	$6.416

Documentation

During the documentation phase, the previously compiled data was put into a report including the following:

- Executive Summary
- Scope of Work
- Methodology
- Utility Summary
- Past/Planned Energy Conservation Measures
- Energy Analysis
- Energy Conservation Measures Not Recommended
- Other Recommendations
- Funding
- Project Cost Estimate

Validation

Osborn Engineering maintained an open issues log of items requiring additional field investigation throughout the project. Utilizing this log, Osborn Engineering performed additional field verification, took measurements and interviewed maintenance personnel. This information was utilized to update baselines, demand profiles, cost estimates and findings.

Justification

In order to develop actionable and sustainable programs, it is critical to tie the program to the core mission of the City, provide economic justification and integrate the goals and objectives of the City.

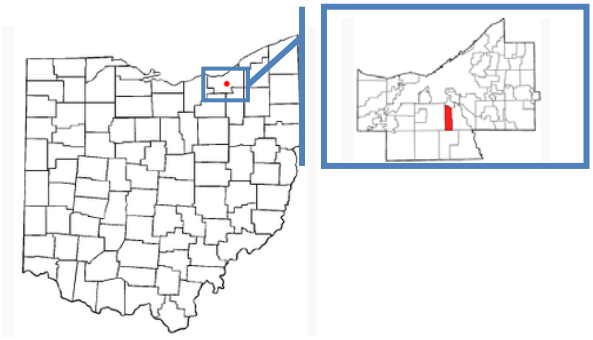
Osborn Engineering provided economic justification in the form of itemized ECM summary tables, simple payback period, cash flow analysis and return on investment.

Program Development

The Energy Assessment provides facility energy profiles; energy programs ranked by simple payback period, prioritized and coordinated with the City's capital needs. Based on feedback from the City, Osborn Engineering refined the recommended programs, developed phasing plans, detailed cost estimates and identified potential funding sources.

UTILITY SUMMARY

The City of Seven Hills sits on 5.0 square miles of land in the central portion of Cuyahoga County, Ohio. As of the 2010 Census there are about 11,800 people residing in the City. Seven Hills offers full service of police and fire departments, as well as a Recreation Center completed in 2001.



The following table lists the major buildings that are owned and operated by Seven Hills. Please note that the utility costs and consumptions in the table only account for the buildings listed and do not include the Calvin Park Rec Hall and energy-consuming entities such as exterior lighting, traffic signals and parks.

The City Hall building, Recreation Center, and Fire Station utilize both electricity and natural gas. The Service Garage is an all electric building and uses electricity for heating. The total 2012 utility cost was $238,038 for these four buildings. The Illuminating Company, a subsidiary of FirstEnergy Corporation, provides electric service and electricity is purchased through GDF Suez Energy Resources NA, a competitive energy supplier. The City of Seven Hills is charged a basic consumption fee ($/kWh) at low rates through GDF Suez and for additional customer and distribution charges through the Illuminating Company. Dominion East Ohio Gas Company is the natural gas service provider. The City of Cleveland provides water and the Northeast Ohio Regional Sewer District (NEORSD) provides sewer service to all buildings.

ADDRESS	BUILDING NAME	AREA (gsf)	2012 kBtu Consumption	SITE EUI (kBtu/gsf)	2012 Utility Expense	Cost/ gsf
7325 Summitview Dr.	City Hall & Police	32,525	3,201,103	98	$47,318	$1.46
7777 Summitview Dr.	Recreation Center	46,852	10,215,229	218	$160,886	$3.43
7359 Broadview Rd.	Service Garage	4,833	469,153	97	$14,959	$3.10
7195 Broadview Rd.	Fire Station	10,583	807,635	76	$14,875	$1.41
Total		**94,793**	**14,693,120**		**$238,038**	**$2.51**

Energy Use Index (EUI) is a measure of the intensity of a facility's energy use in terms of total energy consumption from all sources per square foot per year (kBtu/ft2). It is often used to compare the energy consumption of facilities that have similar functions and is a good indicator of the energy efficiency of a facility in relative terms. The U.S. Department of Energy (DOE) has developed a series of benchmark models to help establish a EUI representation of different building types in different geographic areas. The table below identifies various building type EUI's and cost/gsf data for reference. Benchmark data was taken from the Energy Information Administration's (EIA) Commercial Building Energy Consumption Survey (CBECS) database, specifically for the building types shown below in the 5A climate region.

CBECS Benchmark Data in Climate Zone 5A		
Building Type	**Average EUI (kBtu/gsf)**	**Average Energy Cost/gsf**
Office - General*	128	$1.88
Recreation - Public*	142	$1.40
Vehicle Service*	87	$1.34
Fire/Police Station*	113	$1.60

*Source: HTTP://BUILDINGSDATABOOK.EREN.DOE.GOV/CBECS.ASPX

City Hall's EUI is 25% less than the average EUI for an office building. Considering that the police wing of the building operates continuously and should use more energy than a typical office building, City Hall is already a fairly energy-efficient building. The Recreation Center's EUI is considerably higher than the benchmark. However, it is possible that some of the buildings in the CBECS sample do not have natatoriums like this recreation center, which would make the sample appear more efficient. The Service Garage and Fire Station both have EUIs that are lower than the benchmark.

CITY HALL & POLICE

Monthly electricity and natural gas utility data for the City Hall and Police Station was compiled for the 4 year, 8 month period January 2009 thru August 2013. Water use data was compiled quarterly for the same period. Implementation of the ECMs recommended in 2011 was finalized in September 2012, making the partial 2013 utility data critical for analyzing the building's operational changes.

Consumption

SEVEN HILLS CITY HALL ANNUAL UTILITY CONSUMPTION								
Year	**Electricity kWh**	**Natural Gas mcf**	**CDD**	**HDD**	**Total Energy kbtu**	**Gross Floor Area gsf**	**Energy Use Intensity kbtu/gsf**	**Water mcf**
2009	320,320	2,009	657	5,864	3,162,408	32,525	97	**N/A
2010	314,560	1,957	1,136	5,604	3,088,886	32,525	95	47
2011	307,680	2,013	962	5,644	3,123,606	32,525	96	20
2012	302,560	2,106	1,066	5,057	3,201,103	32,525	98	16
*2013	204,800	1,662	739	3,775	2,410,844	32,525	74	8
Average	**311,280**	**2,021**	**955**	**5,542**	**3,144,001**	**32,525**	**97**	**28**

*2013 utility data was available for Jan-Aug only and was excluded from average

**Water data was not available for 2009

The City Hall's EUI remained similar over the past four years and eight months. According to City personnel, energy efficiency projects associated with the 2011 ECMs were completed by September 2012. An entire year's worth of utility data is not available yet for 2013, so it is difficult to determine the full effect of the ECMs on the annual energy utilization.

Cost and Rates

SEVEN HILLS CITY HALL ANNUAL UTILITY COST					
Year	**Electricity**	**Natural Gas**	**Water**	**Total Energy**	**Total Utility**
2009	$39,564	$23,154	**N/A	$62,718	$62,718
2010	$38,884	$19,711	$1,223	$58,595	$59,818
2011	$36,215	$19,513	$1,142	$55,729	$56,871
2012	$29,682	$16,290	$1,346	$45,972	$47,318
*2013	$19,507	$11,846	$685	$31,353	$32,038
Average	**$36,086**	**$19,667**	**$1,237**	**$55,753**	**$56,681**

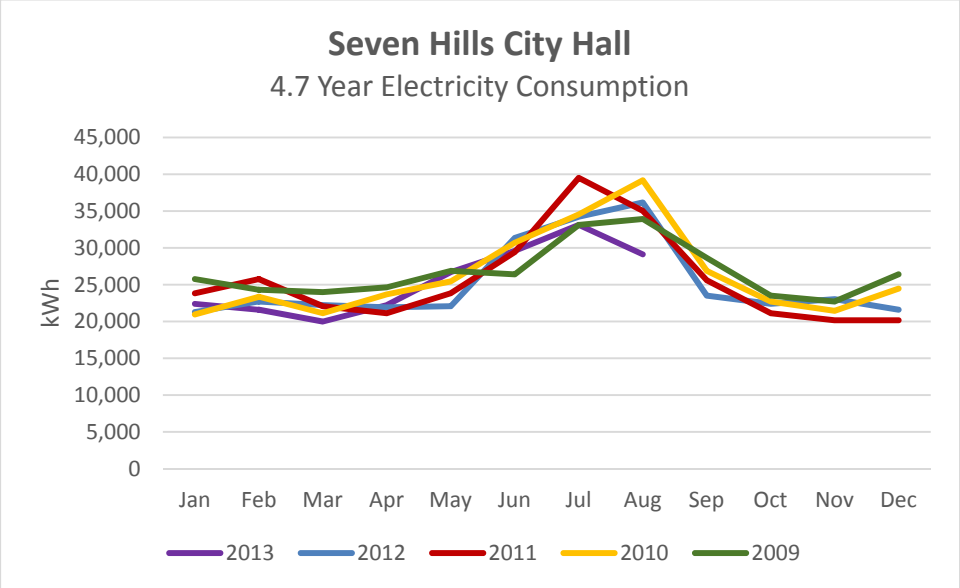
SEVEN HILLS CITY HALL ANNUAL UTILITY RATES					
Electricity $/kWh	**Nat Gas $/mcf**	**Water $/Mcf**	**Electricity / Natural Gas Ratio**	**Total Energy $/gsf**	**Total Utility $/gsf**
$0.124	$11.524	*N/A	3.14	$1.928	$1.928
$0.124	$10.073	$26.021	3.60	$1.802	$1.839
$0.118	$9.692	$57.100	3.56	$1.713	$1.749
$0.098	$7.737	$84.125	3.72	$1.413	$1.455
$0.095	$7.127	$90.162	3.92	$0.964	$0.985
$0.116	**$9.756**	**$55.749**	**3.50**	**$1.714**	**$1.743**

*2013 utility data was available for Jan-Aug only and was excluded from average
**Water data was not available for 2009

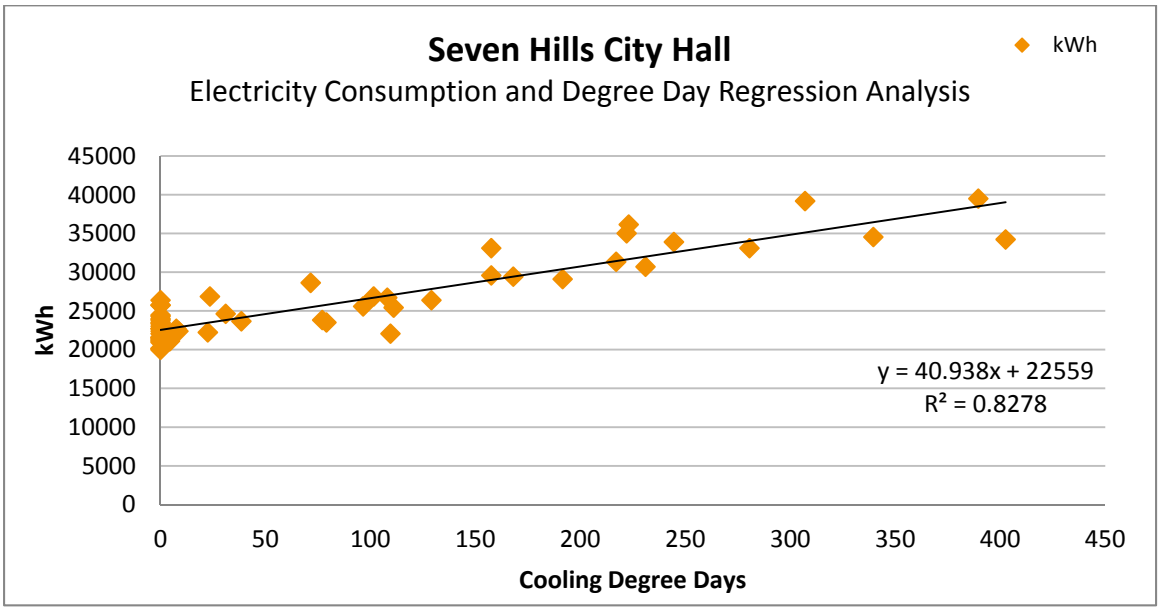
City Hall spent $45,972 on energy (electric and natural gas only) and $47,318 on all utilities (including water and sewer) in 2012. Even though the energy consumption remained relatively the same, the total energy cost was reduced 26.7% since 2009 due to lower electricity and natural gas rates. However, the water rate has increased significantly.

Electricity Use

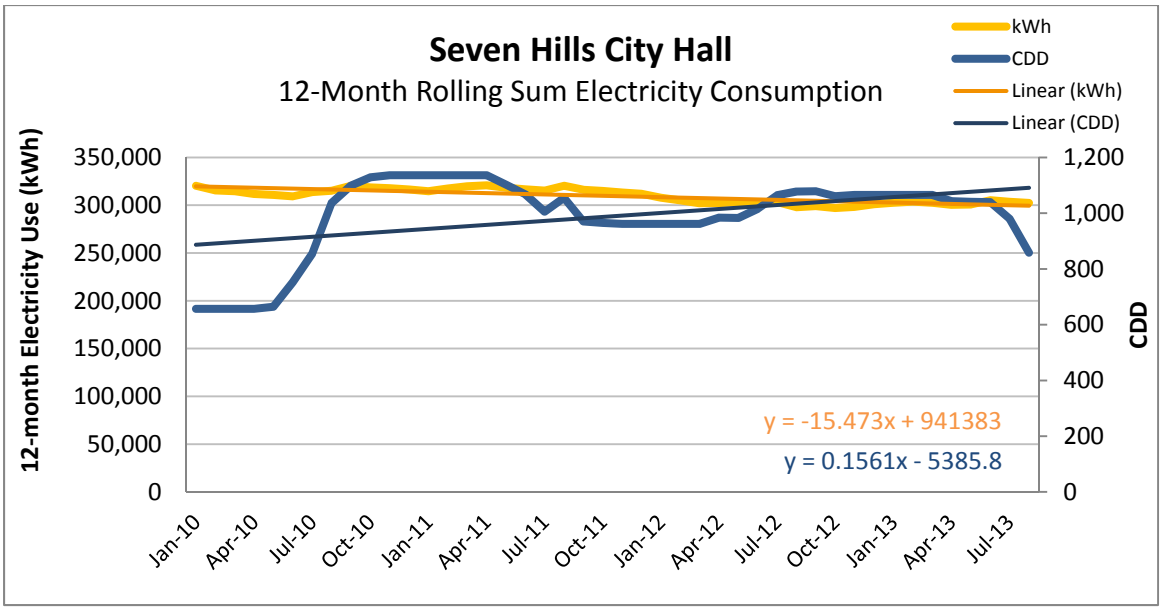
The graph below shows the monthly electricity consumption of the City Hall beginning in January 2009 and ending in August 2013. The electricity consumption varies throughout the year with increased usage in the summer, as expected. For the first 8 months of 2013, the electricity consumption has decreased about 5% below the four year average, indicating that the ECMs implemented in 2012 are starting to slightly reduce the building's electricity consumption. However, an electricity decrease of 40% was anticipated in the 2011 report, so the ECMs did not result in nearly as much energy savings as expected.



Typically, energy consumption is driven largely by weather patterns. The extent to which this is true for a facility can provide an indication as to the size of the opportunity and the manner in which to make energy saving improvements. One way to analyze the impact of weather on a facility's energy consumption is to correlate to an index called "degree days." These indices are calculated using a base temperature of 65 degrees Fahrenheit. Heating degree days (HDD) reflect the demand for energy needed to heat a facility. If the average outside air temperature is 31 degrees, the HDD index for that day is the difference between 65 and 31 degrees, or 34. Cooling degree days (CDD) are the opposite and reflect the demand to cool a facility. Typically, electricity is more affected by the cooling needs of a facility; the cooling degree day index can be used to analyze changes in electricity consumption. The chart below shows a regression analysis of electricity use and CDD since January 2009. The R2 value indicates the strength of the correlation between electricity use and CDD. The closer the R2 value is to 1, the stronger the correlation. The R2 value is 0.8278, indicating a strong correlation between electricity use and CDD.

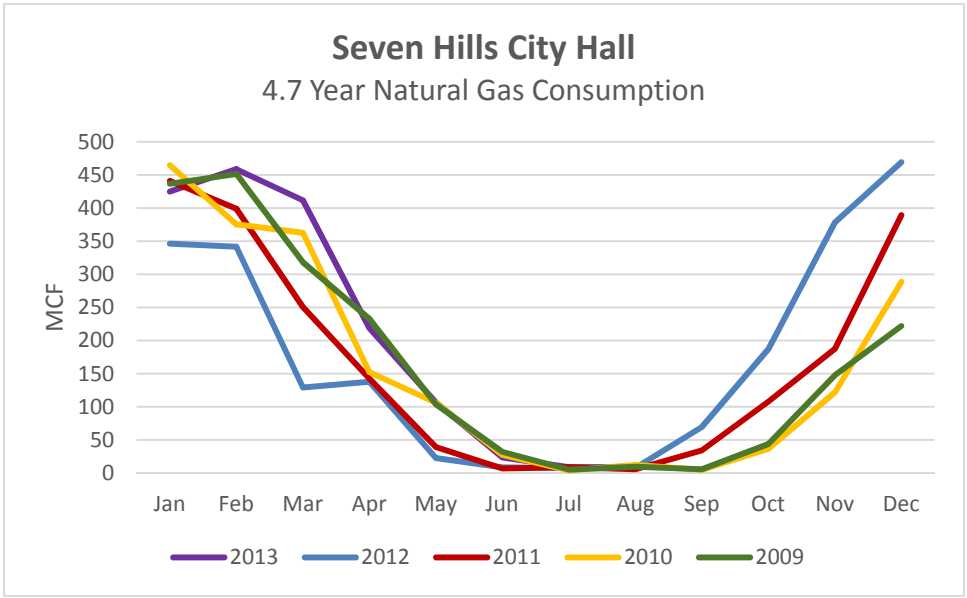


The graph below shows the 12-month rolling sum of electricity consumption compared to a 12-month rolling sum of cooling degree days. Each orange point on the graph below signifies the 12-month total electricity consumption for the 12 previous months. Each blue point on the graph below signifies the 12-month total cooling degree days for the 12 previous months. This trend was graphed for January 2010 through August 2013 to determine the relationship between weather patterns and electricity consumption. Since 2010, electricity consumption has decreased slightly; this is indicated by the negative slope of the trend line of electricity consumption. The trend line of cooling degree days has increased, indicating that there is an improvement in the building's efficiency since electricity consumption has decreased instead of increasing with cooling degree days.

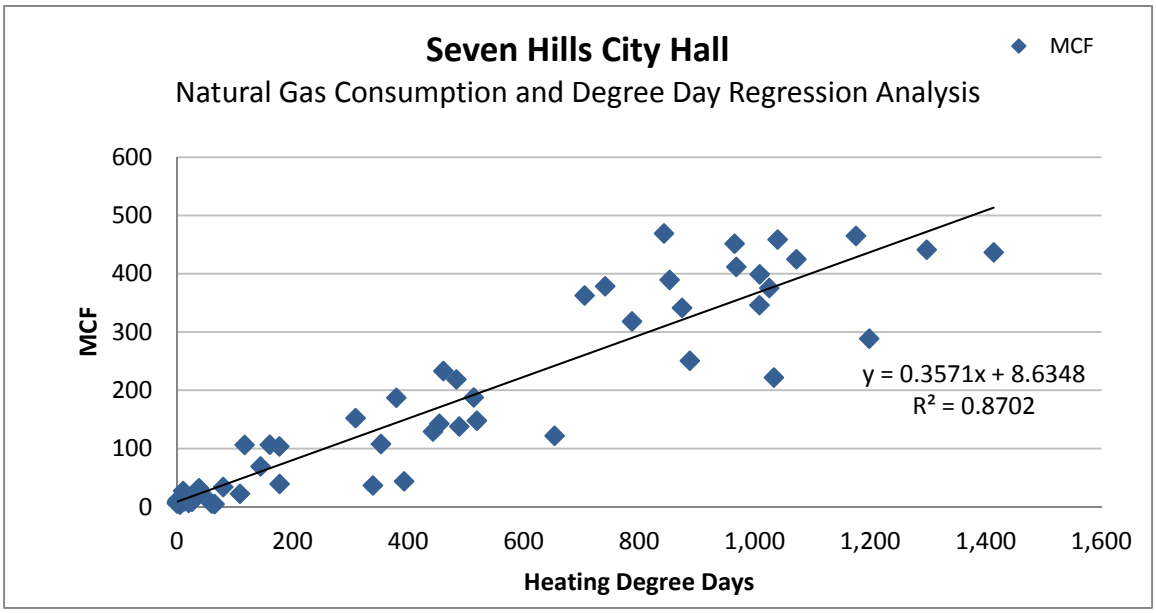


Natural Gas Use

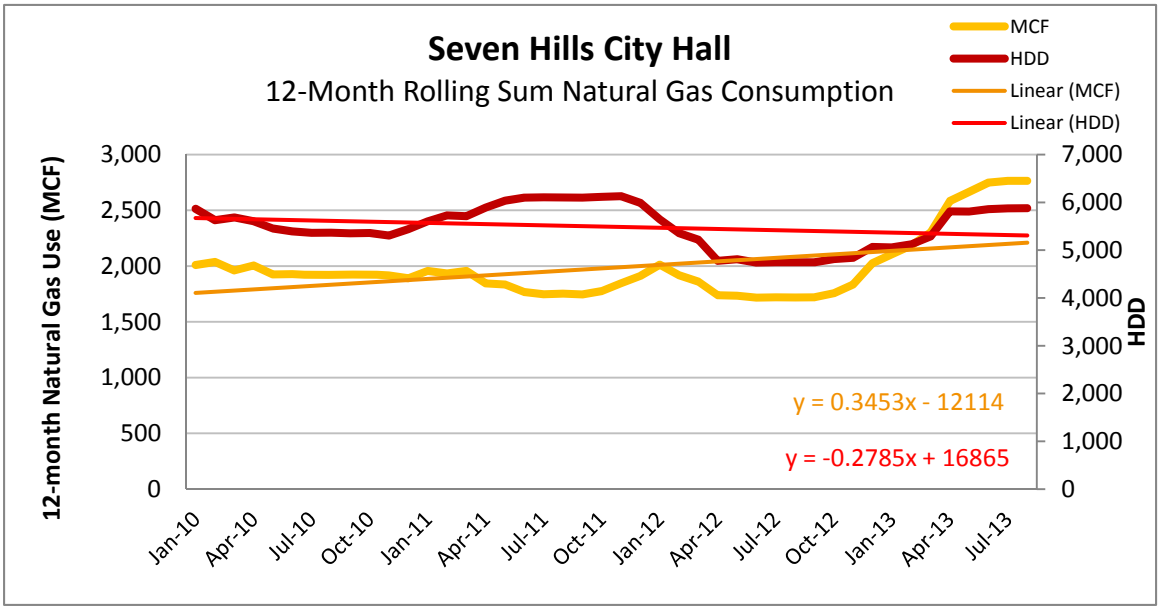
The following graph shows the monthly natural gas consumption starting in January 2009 and ending in August 2013. Natural gas consumption typically peaks around 450 MCF in the coldest month of the year and drops to nearly 0 MCF during the summer months. This is indicative of a low domestic hot water demand and good HVAC control practices to minimize use of natural gas in the summer. For the first 8 months of 2013, the natural gas consumption has increased slightly above the four year average. This is likely due to issues with the new controls sequence for the boilers, which was implemented in September 2012. The schedules and set points should be adjusted so that the boilers do not over-fire in the spring when minimal heating is needed.



Natural gas is used almost entirely for building heat; therefore, natural gas consumption should trend very closely with heating degree days. The chart below shows a regression analysis of natural gas use and HDD since January 2009. The R^2 value indicates the strength of the correlation between natural gas use and HDD. The closer the R^2 value is to 1, the stronger the correlation. The R^2 value is 0.8702, indicating a strong correlation between natural gas use and HDD.



Since 2009, natural gas consumption has increased despite the slight decrease in heating degree days. This is indicated by the positive slope of the natural gas usage and the slightly negative slope of heating degree days. The increased natural gas consumption is most likely a result of the aforementioned boiler controls issues and should decrease next year once the sequence is corrected



RECREATION CENTER

Monthly electricity and natural gas utility data for the Recreation Center was compiled for the 4 year, 8 month period January 2009 thru August 2013. Water use data was compiled quarterly for the same period. Implementation of the ECMs recommended in 2011 was finalized in September 2012, making the partial 2013 utility data critical for analyzing the building's operational changes.

Consumption

SEVEN HILLS RECREATION CENTER ANNUAL UTILITY CONSUMPTION								
Year	Electricity kWh	Natural Gas mcf	CDD	HDD	Total Energy kbtu	Gross Floor Area gsf	Energy Use Intensity kbtu/gsf	Water mcf
2009	1,170,880	5,231	657	5,864	9,382,870	46,852	200	227
2010	1,152,160	4,635	1,136	5,604	8,705,117	46,852	186	216
2011	1,215,120	6,015	962	5,644	10,341,748	46,852	221	245
2012	1,096,080	6,287	1,066	5,057	10,215,229	46,852	218	243
*2013	726,320	3,486	739	3,775	6,068,578	46,852	130	95
Average	**1,158,560**	**5,542**	**955**	**5,542**	**9,661,241**	**46,852**	**206**	**233**

*2013 utility data was available for Jan-Aug only and was excluded from average

The Recreation Center's EUI increased in 2011, likely due to an increase in utilization by members of the community. An entire year's worth of utility data is not available yet for 2013, so it is difficult to determine the full effect of the ECMs on the annual energy utilization. Looking at the first 8 months of 2013 utility data, it appears that the EUI is slightly decreasing from 2011/2012, which could be an indication of the ECMs successfully reducing the building's energy usage.

Cost and Rates

SEVEN HILLS RECREATION CENTER ANNUAL UTILITY COST					
Year	Electricity	Natural Gas	Water	Total Energy	Total Utility
2009	$134,679	$57,662	$10,712	$192,340	$203,052
2010	$139,676	$48,237	$11,851	$187,913	$199,764
2011	$129,578	$57,505	$13,604	$187,083	$200,687
2012	$103,270	$43,734	$13,882	$147,004	$160,886
*2013	$68,414	$24,531	$5,699	$92,945	$98,644
Average	**$126,801**	**$51,784**	**$12,512**	**$126,801**	**$191,097**

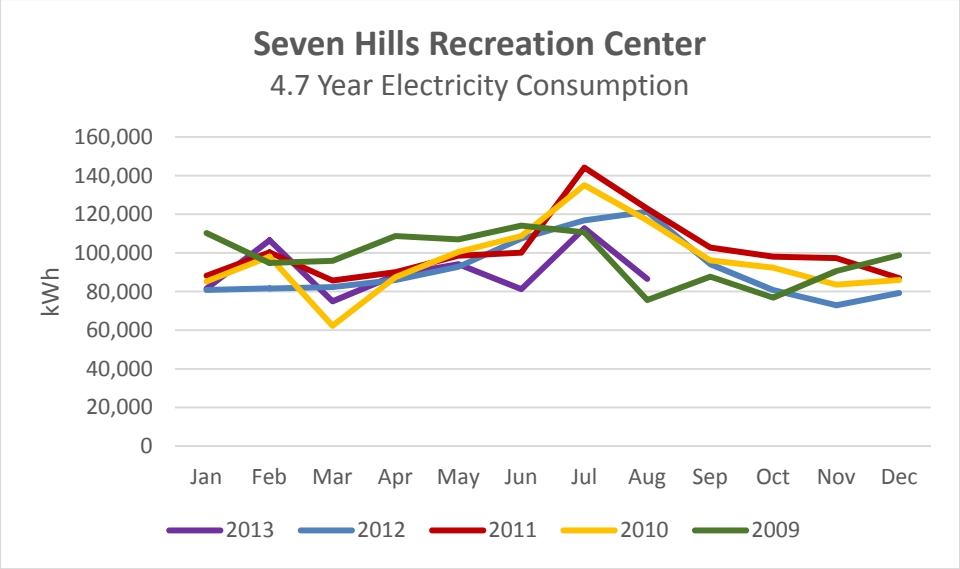
*2013 utility data was available for Jan-Aug only and was excluded from average

SEVEN HILLS RECREATION CENTER ANNUAL UTILITY RATES					
Electricity $/kWh	Nat Gas $/mcf	Water $/Mcf	Electricity / Natural Gas Ratio	Total Energy $/gsf	Total Utility $/gsf
$0.115	$11.023	$47.189	3.06	$4.105	$4.334
$0.121	$10.407	$54.866	3.41	$4.011	$4.264
$0.107	$9.560	$55.527	3.27	$3.993	$4.283
$0.094	$6.956	$57.128	3.97	$3.138	$3.434
$0.094	$7.037	$60.243	3.92	$1.984	$2.105
$0.109	**$9.487**	**$53.677**	**3.43**	**$2.706**	**$4.079**

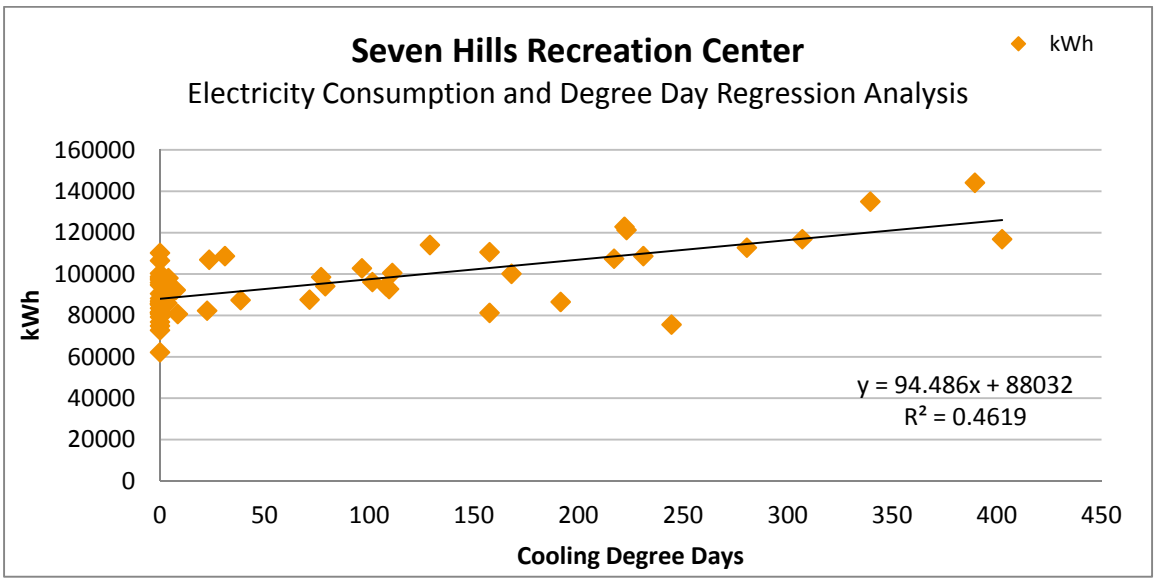
The Recreation Center spent $147,004 on energy (electricity and natural gas only) and $160,407 on all utilities (including water and sewer) in 2012. Even though the energy consumption increased slightly, the total energy cost was reduced 23.6% since 2009 due to lower electricity and natural gas rates.

Electricity Use

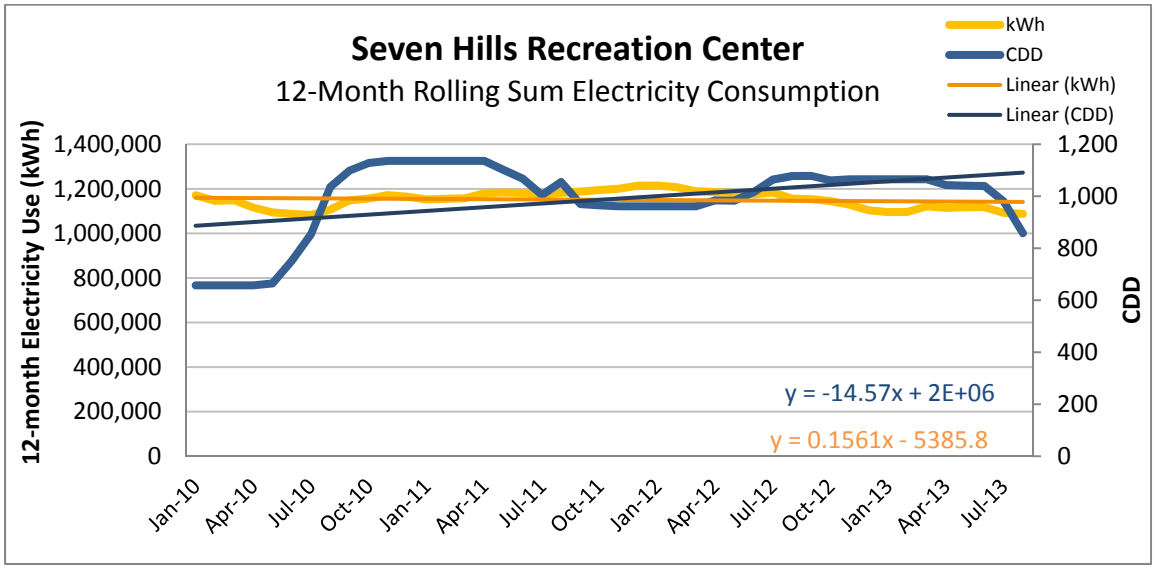
The graph below shows the monthly electricity consumption of the Recreation Center beginning in January 2009 and ending in August 2013. The electricity consumption varies throughout the year with increased usage in the summer, as expected. For the first 8 months of 2013, the electricity consumption has decreased about 9% below the four year average, indicating that the ECMs implemented in 2012 are starting to reduce the building's electricity consumption, about 4% more than anticipated.



The chart below shows a regression analysis of electricity use and CDD since January 2009. The R2 value indicates the strength of the correlation between electricity use and CDD. The closer the R2 value is to 1, the stronger the correlation. The R2 value is 0.4619, indicating a moderate correlation between electricity use and CDD. Since the Natatorium has cooling needs dependent upon the pool load, the cooling energy does not change significantly with the weather compared to an office building.

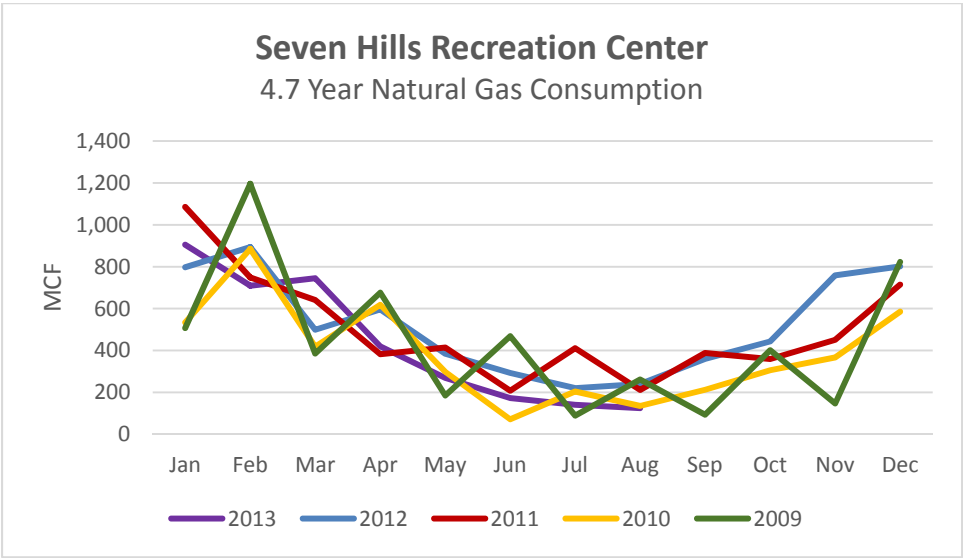


The graph below shows the 12-month rolling sum of electricity consumption compared to a 12-month rolling sum of cooling degree days. Since 2010, electricity consumption has decreased slightly; this is indicated by the negative slope of the trend line of electricity consumption. The trend line of cooling degree days has increased, indicating that there is an improvement in the building's efficiency since electricity consumption has decreased instead of increasing with cooling degree days.

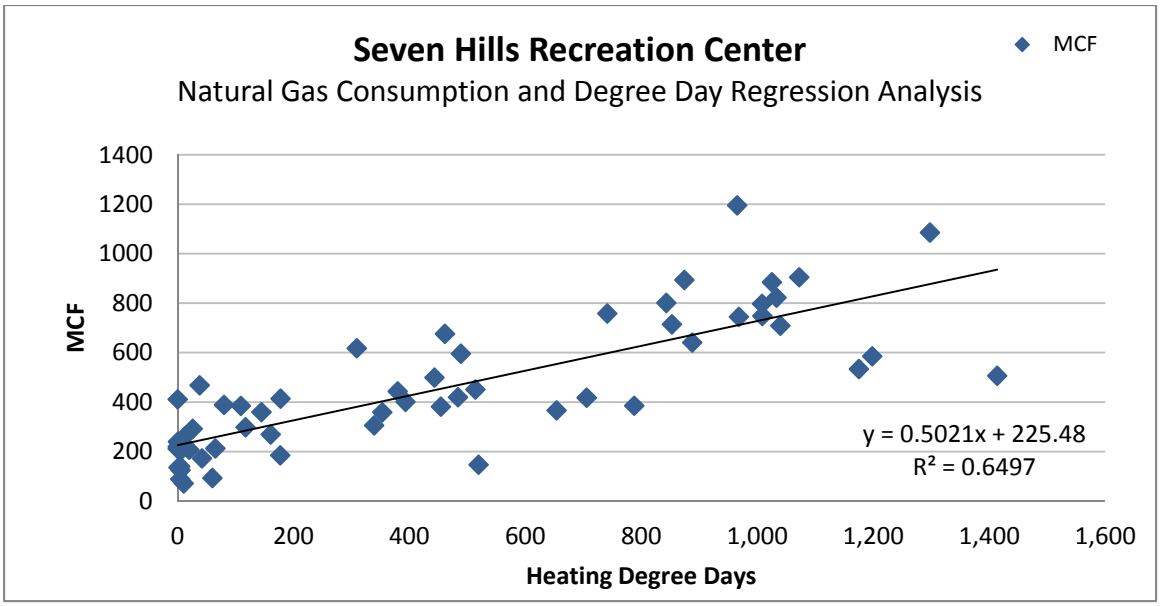


Natural Gas Use

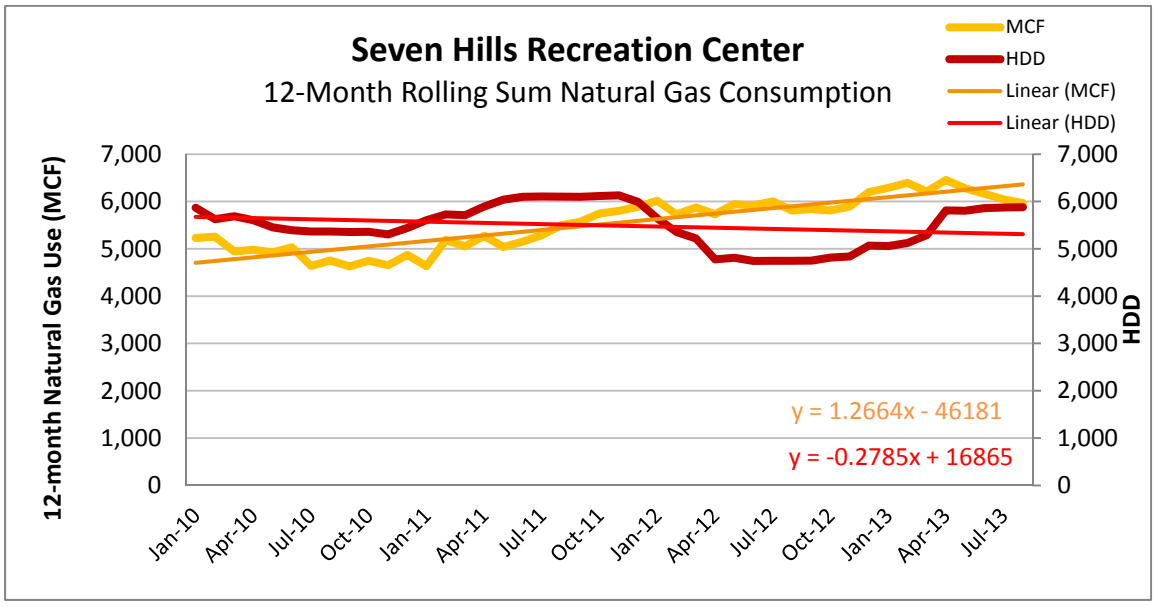
The following graph shows the monthly natural gas consumption starting in January 2009 and ending in August 2013. Natural gas consumption typically peaks around 800 MCF in the winter and decreases to 200 MCF in the summer. The natural gas use does not decrease significantly in the summer since the pool is heated year round. For the first 8 months of 2013, natural gas consumption has decreased in the summer but increased in the winter slightly above the four year average.



The chart below shows a regression analysis of natural gas use and HDD since January 2009. The R^2 value indicates the strength of the correlation between natural gas use and HDD. The closer the R^2 value is to 1, the stronger the correlation. The R^2 value is 0.6497, indicating a moderate correlation between natural gas use and HDD due to the heating needs of the pool.



Since 2009, natural gas consumption has increased slightly despite a minimal decrease in heating degree days. This is indicated by the positive slope of the natural gas use trend line and the negative slope of the heating degree trend line. This trend indicates that the building systems are operating less efficiently or that there is an increased heating demand due to increased occupant utilization.



SERVICE GARAGE

Monthly electricity utility data for the Service Garage was compiled for the 4 year, 8 month period January 2009 thru August 2013. Water use data was compiled quarterly for the same period. Implementation of the ECMs recommended in 2011 was finalized in September 2012, making the partial 2013 utility data critical for analyzing the building's operational changes.

Consumption

SEVEN HILLS SERVICE GARAGE ANNUAL UTILITY CONSUMPTION							
Year	Electricity kWh	CDD	HDD	Total Energy kbtu	Gross Floor Area gsf	Energy Use Intensity kbtu/gsf	Water mcf
2009	164,460	657	5,864	561,138	4,833	116	7
2010	143,754	1,136	5,604	490,489	4,833	101	12
2011	148,580	962	5,644	506,955	4,833	105	8
2012	137,501	1,066	5,057	469,153	4,833	97	7
*2013	88,213	739	3,775	300,983	4,833	62	3
Average	**148,574**	**955**	**5,542**	**506,934**	**4,833**	**105**	**9**

*2013 utility data was available for Jan-Aug only and was excluded from average

The Service Garage's EUI has been slightly decreasing over the last four years. An entire year's worth of utility data is not available yet for 2013, so it is difficult to determine the full effect of the ECMs on the annual energy utilization. Looking at the first 8 months of 2013 utility data, it appears that the EUI is continuing to decrease.

Cost and Rates

SEVEN HILLS SERVICE GARAGE ANNUAL UTILITY COST				
Year	Electricity	Water	Total Energy	Total Utility
2009	$20,705	$310	$20,705	$21,015
2010	$18,018	$553	$18,018	$18,571
2011	$17,998	$387	$17,998	$18,385
2012	$14,549	$410	$14,549	$14,959
*2013	$8,140	$147	$8,140	$8,287
Average	**$17,818**	**$415**	**$17,818**	**$18,233**

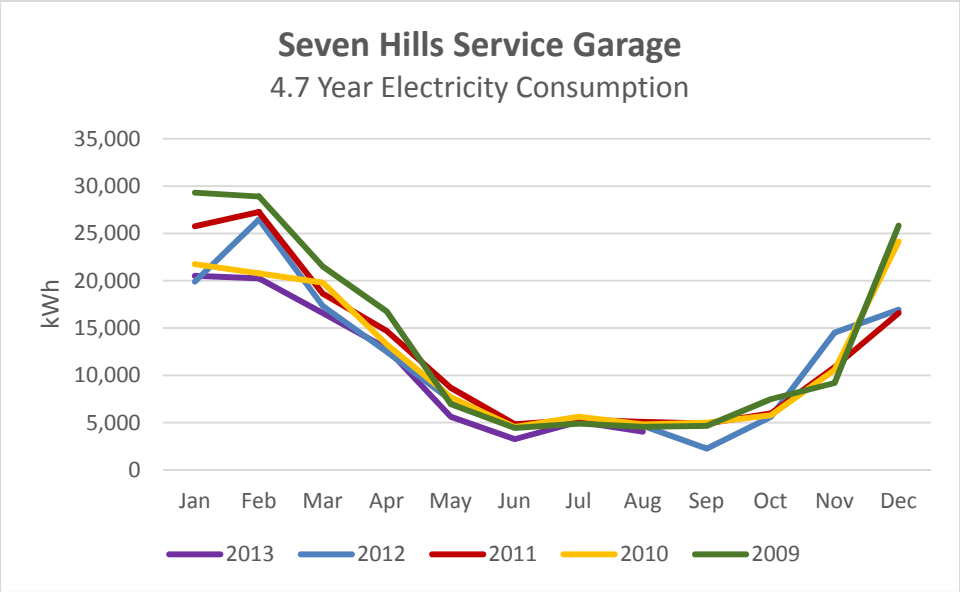
ANNUAL UTILITY RATES			
Electricity $/kWh	Water $/Mcf	Total Energy $/gsf	Total Utility $/gsf
$0.126	$44.286	$4.284	$4.348
$0.125	$46.083	$3.728	$3.842
$0.121	$48.375	$3.724	$3.804
$0.106	$58.571	$3.010	$3.095
$0.092	$47.335	$1.684	$1.715
$0.120	**$49.329**	**$3.687**	**$3.773**

*2013 utility data was available for Jan-Aug only and was excluded from average

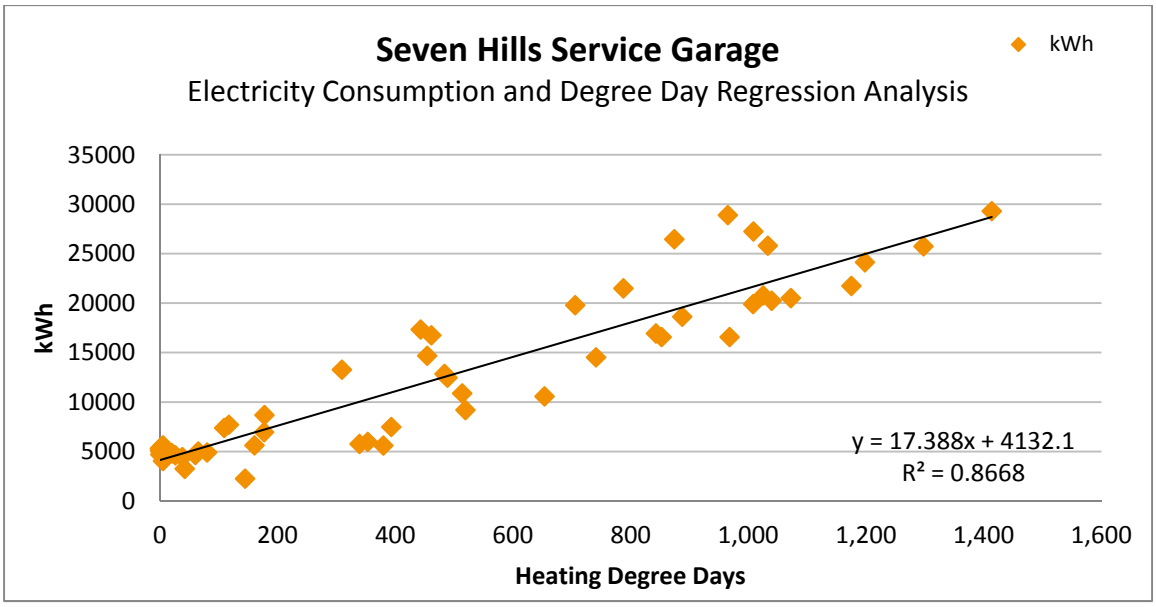
The Service Garage spent $14,549 on energy (electricity and natural gas only) and $14,959 on all utilities (including water and sewer) in 2012. Energy consumption has decreased 16.3% and energy cost has decreased 28.8% over the last four years.

Electricity Use

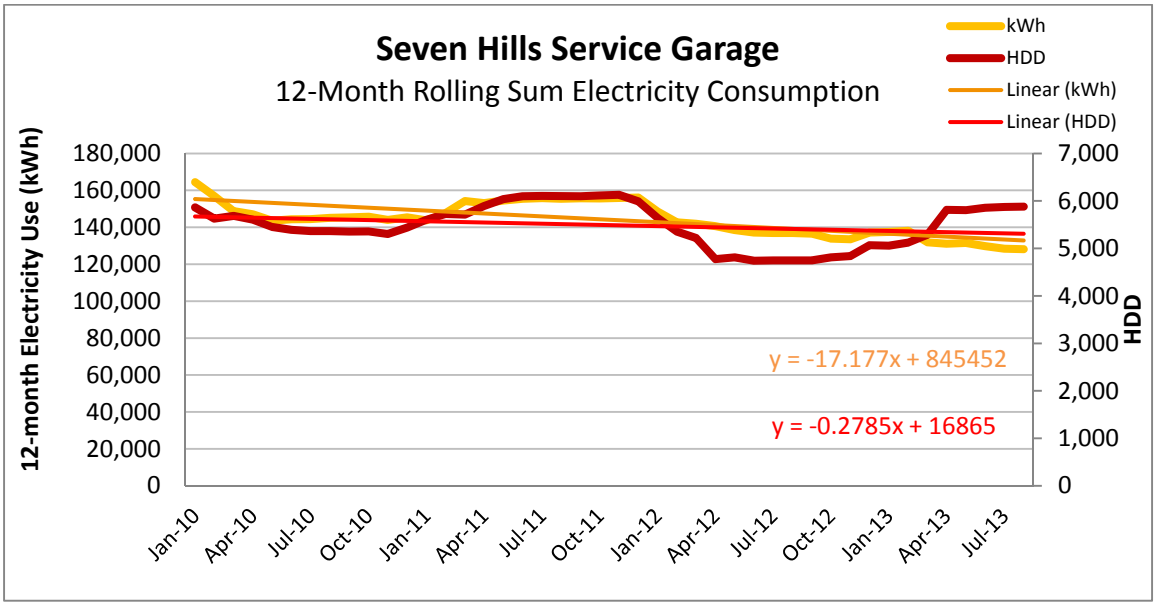
The graph below shows the monthly electricity consumption of the Service Garage beginning in January 2009 and ending in August 2013. The electricity consumption varies throughout the year with decreased usage in the summer since electricity is not needed for space heating. For the first 8 months of 2013, the electricity consumption has decreased about 17% below the four year average, indicating that the ECMs implemented in 2012 are starting to significantly reduce the building's electricity consumption.



The chart below shows a regression analysis of electricity use and HDD since January 2009. Heating degree days are analyzed with electricity instead of cooling degree days for the Service Garage since the building uses electricity for heating and there is no mechanical cooling. The R2 value indicates the strength of the correlation between electricity use and HDD. The closer the R2 value is to 1, the stronger the correlation. The R2 value is 0.8668, indicating a strong correlation between electricity use and CDD.



The graph below shows the 12-month rolling sum of electricity consumption compared to a 12-month rolling sum of heating degree days. This trend was graphed for January 2010 through August 2013 to determine the relationship between weather patterns and electricity consumption. Since 2010, electricity usage has decreased at a slightly faster rate than the heating degree days, indicating that the building efficiency is improving.



FIRE DEPARTMENT

Monthly electricity and natural gas utility data for the Fire Station was compiled for the 4 year, 8 month period January 2009 thru August 2013. Water use data was compiled quarterly for the same period. Implementation of the ECMs recommended in 2011 was finalized in September 2012, making the partial 2013 utility data critical for analyzing the building's operational changes.

Consumption

SEVEN HILLS FIRE DEPARTMENT ANNUAL UTILITY CONSUMPTION								
Year	Electricity kWh	Natural Gas mcf	CDD	HDD	Total Energy kbtu	Gross Floor Area gsf	Energy Use Intensity kbtu/gsf	Water mcf
2009	91,464	536	657	5,864	864,567	10,583	82	27
2010	90,855	543	1,136	5,604	868,875	10,583	82	32
2011	94,480	535	962	5,644	873,416	10,583	83	39
2012	94,400	471	1,066	5,057	807,635	10,583	76	33
*2013	56,000	370	739	3,775	571,966	10,583	54	17
Average	**92,800**	**521**	**955**	**5,542**	**853,623**	**10,583**	**81**	**33**

*2013 utility data was available for Jan-Aug only and was excluded from average

The Fire Department's EUI has remained similar over the last four years. An entire year's worth of utility data is not available yet for 2013, so it is difficult to determine the full effect of the ECMs on the annual energy utilization.

Cost and Rates

SEVEN HILLS FIRE DEPARTMENT ANNUAL UTILITY COST					
Year	Electricity	Natural Gas	Water	Total Energy	Total Utility
2009	$10,668	$6,238	$1,344	$16,906	$18,250
2010	$11,207	$5,574	$1,655	$16,780	$18,435
2011	$10,967	$5,256	$2,083	$16,223	$18,306
2012	$9,271	$3,720	$1,884	$12,991	$14,875
*2013	$4,800	$2,670	$1,006	$7,470	$8,476
Average	**$10,528**	**$5,197**	**$1,742**	**$10,528**	**$17,466**

SEVEN HILLS FIRE DEPARTMENT ANNUAL UTILITY RATES					
Electricity $/kWh	Nat Gas $/mcf	Water $/Mcf	Electricity / Natural Gas Ratio	Total Energy $/gsf	Total Utility $/gsf
$0.117	$11.629	$49.778	2.94	$1.597	$1.724
$0.123	$10.272	$51.719	3.52	$1.586	$1.742
$0.116	$9.825	$53.410	3.46	$1.533	$1.730
$0.098	$7.892	$57.091	3.65	$1.228	$1.406
$0.086	$7.219	$60.596	3.48	$0.706	$0.801
$0.114	**$9.904**	**$52.999**	**3.39**	**$0.995**	**$1.650**

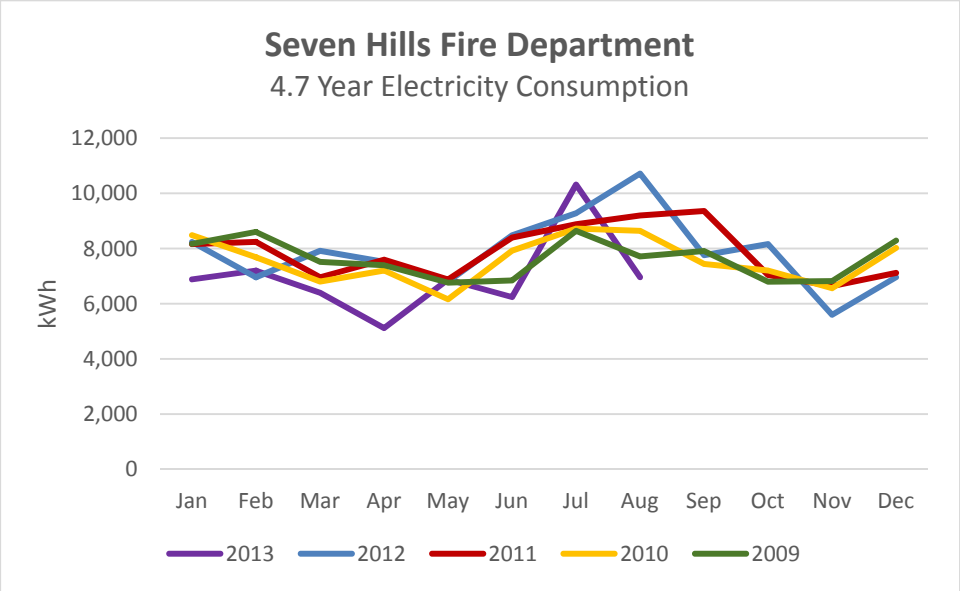
*2013 utility data was available for Jan-Aug only and was excluded from average

The Fire Department spent $12,991 on energy (electricity and gas only) and $14,875 on all utilities (including water and sewer) in 2012. Even though the energy consumption remained relatively the same, the total energy cost was reduced 18.5% since 2009 due to lower electricity and natural gas rates.

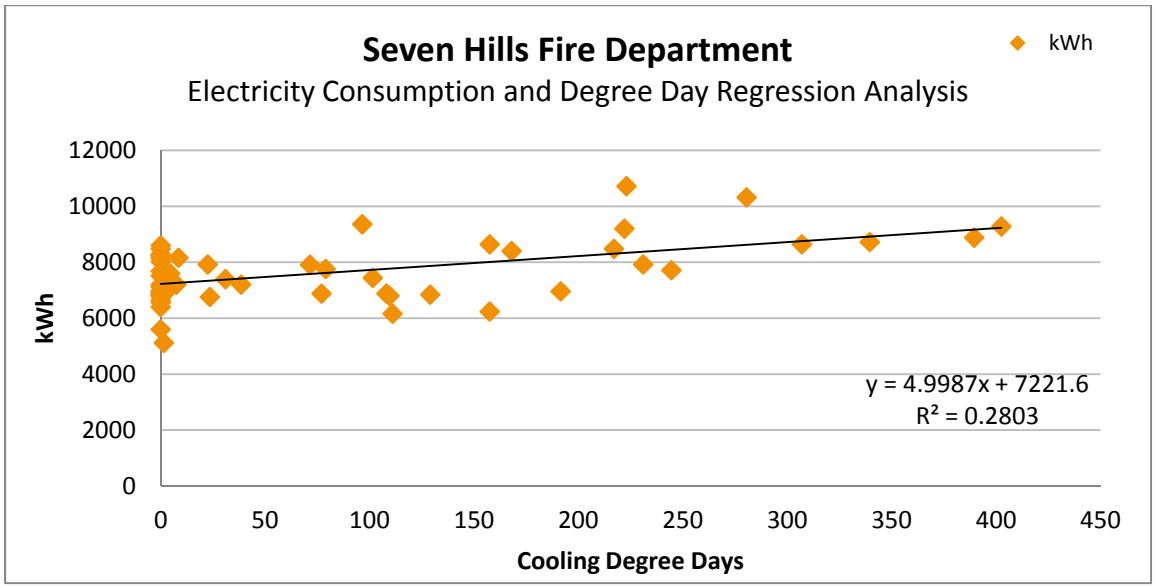
Electricity Use

The graph below shows the monthly electricity consumption of the Fire Station beginning in January 2009 and ending in August 2013. The electricity consumption varies throughout the year with increased

usage in the summer, as expected. For the first 8 months of 2013, the electricity consumption has decreased about 12% below the four year average, indicating that the ECMs implemented in 2012 are starting to reduce the building's electricity consumption.

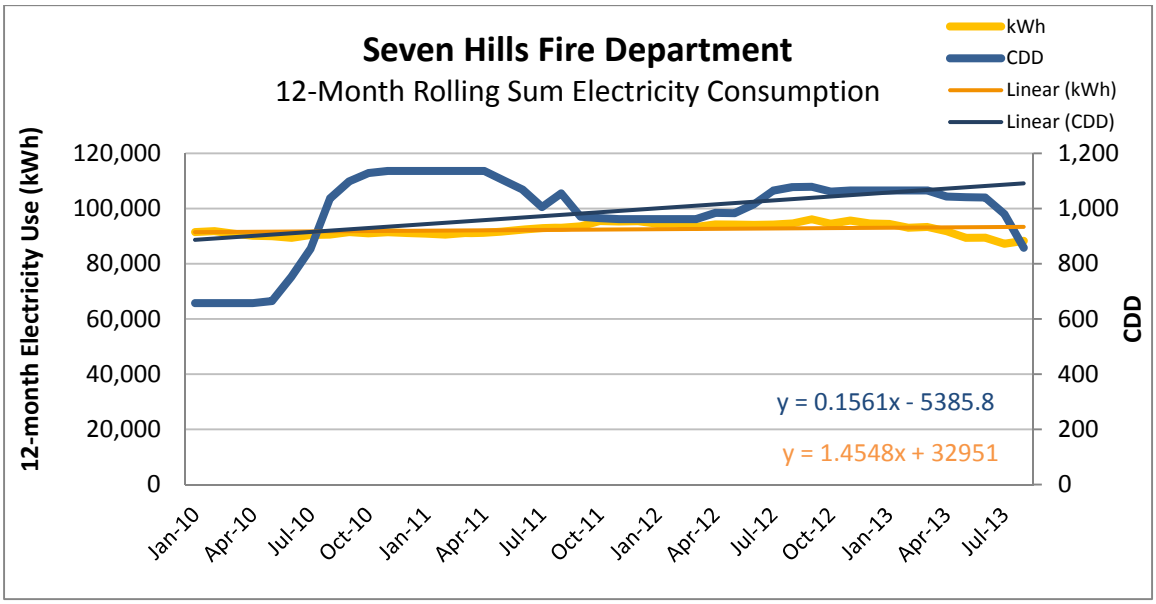


The chart below shows a regression analysis of electricity use and CDD since January 2009. The R2 value indicates the strength of the correlation between electricity use and CDD. The closer the R2 value is to 1, the stronger the correlation. The R2 value is 0.2803, indicating a weak correlation between electricity use and CDD. The building most likely uses more energy for non-weather dependent loads such as lighting and receptacles (computers, kitchen appliances, etc) than for cooling.



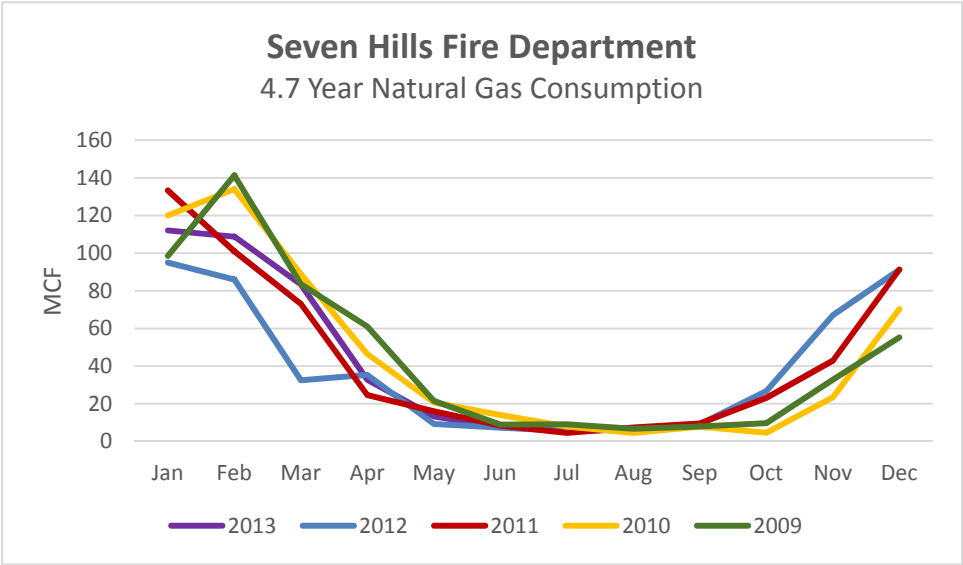
The graph below shows the 12-month rolling sum of electricity consumption compared to a 12-month rolling sum of cooling degree days. This trend was graphed for January 2010 through August 2013 to

determine the relationship between weather patterns and electricity consumption. Since 2010, electricity usage has remained relatively the same. The trend line of cooling degree days has increased, indicating that there is an improvement in the building's efficiency since electricity consumption has not increased with cooling degree days.

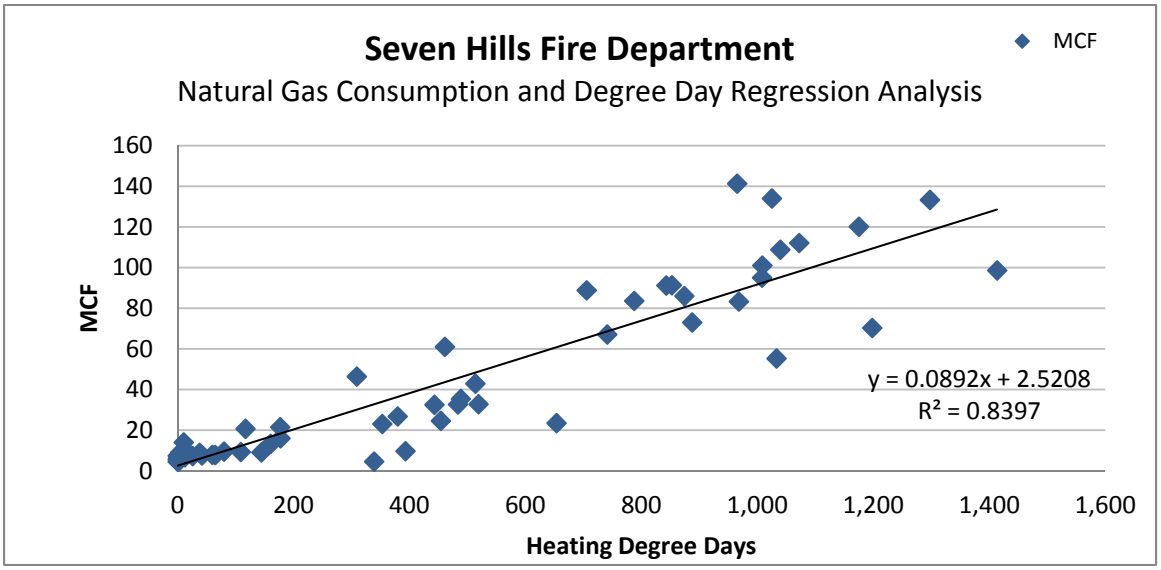


Natural Gas Use

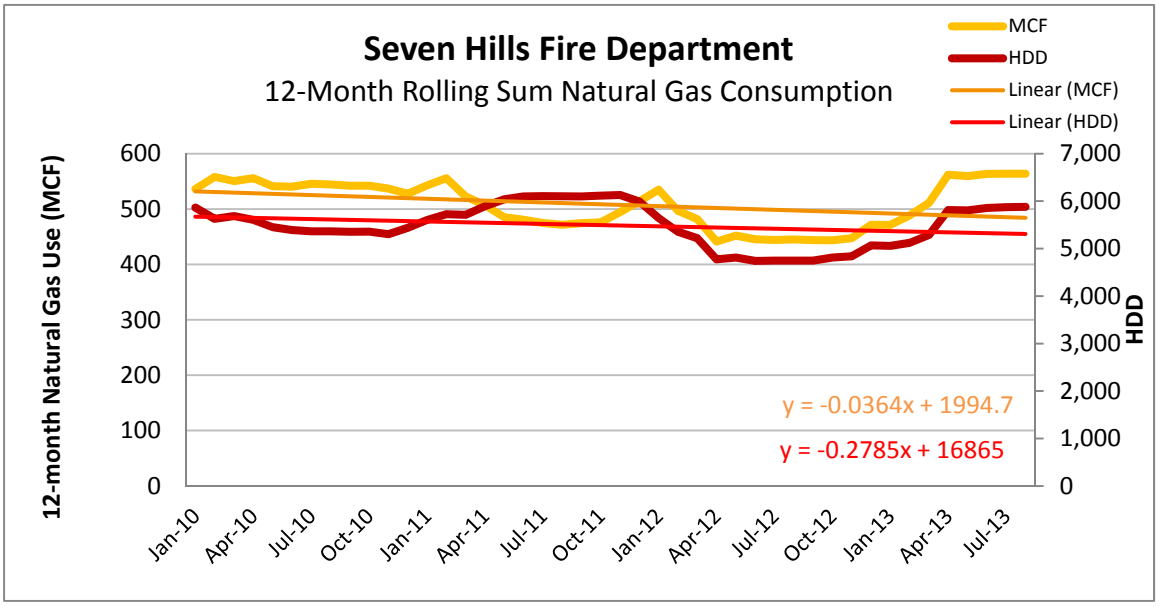
The following graph shows the monthly natural gas consumption starting in January 2009 and ending in August 2013. Natural gas consumption typically peaks around 120 MCF in the coldest month of the year and drops to nearly 0 MCF during the summer months. This is indicative of a low domestic hot water demand and good HVAC control practices to minimize use of natural gas in the summer. For the first 8 months of 2013, natural gas consumption has decreased about 8% below the four year average, indicating that the ECMs are starting to reduce the building's natural gas consumption.



The chart below shows a regression analysis of natural gas use and HDD since January 2009. The R^2 value indicates the strength of the correlation between natural gas use and HDD. The closer the R^2 value is to 1, the stronger the correlation. The R^2 value is 0.8397, indicating a strong correlation between natural gas use and HDD.



Since 2009, natural gas consumption has decreased along with the slight decrease in heating degree days. This is indicated by the negative slope of both the natural gas use and heating degree day trend lines. This indicates that the building is using less natural gas due to both lower heating demands and increased building efficiency.



PAST/PLANNED ENERGY CONSERVATION MEASURES

In 2012, the City of Seven Hills implemented multiple lighting and HVAC energy conservation measures (ECMs) as part of Cuyahoga County's energy upgrade program. Additional ECMs were also considered but have not been implemented yet. These ECMs were evaluated in this report for implementation now as part of the Retrofits for Energy Efficiency Works (RENEW) program.

The ECMs implemented in 2012, were identified and funded through the Cuyahoga County's Energy Efficiency and Conservation Block Grant (EECBG) Sub-Grant Program. In total the City was awarded $281,671 under this program with estimated annual energy savings of $45,971 per year. This work was completed in September 2012.

CITY HALL & POLICE ECMS

Prior to the 2012 upgrades, sections of the roof were replaced above the North entry hall and council chambers. However, a majority of the roof has not been replaced and is a source of leaks.

Lighting ECMs implemented in 2012 include retrofitting two hundred twenty-four (224) T12 fluorescent lighting fixtures with T8 fluorescent lamps and electronic ballasts, reducing the 4-lamp luminaires to 2-lamp. In addition to this, eleven (11) incandescent exit signs were replaced with LED exit signs and forty-nine (49) occupancy sensors were installed throughout offices, restrooms and common areas.

HVAC ECMs implemented in 2012 include boiler outside air reset, replacement of RTU-3 and conversion from a bypass variable air volume system utilizing a constant speed supply fan to a "true" variable air volume system utilizing a variable speed drive supply fan. RTU-3 (Model# TCD180F40CBB / Serial# 123210076D) is a Trane, packaged direct expansion (DX) rooftop unit with electric heat and was installed in August 2012. RTU-3 has a full economizing capability; utilizes R410a, a non-CFC/HCFC; and has two (2) independent circuits and CO2 based demand control. The VAV boxes are Krueger cooling only with perimeter hot water skin heat.

The existing boiler controls were modified so that the heating hot water temperature is reset from 180°F at 0°F outside air temperature to 140°F at 50°F outside air temperature.

A Niagara Tridium Building Automation System was installed to control RTU-3, the new VAV boxes and the boilers. The static pressure set point for RTU-3 supply fan speed is 1.50 in wc and the minimum outside air damper position is 20%. The VAV box minimum set points are very low to maximize energy efficiency. No schedules are currently set up for RTU-3 since the Police occupy the space 24/7.

Recommended ECMs that have not been implemented yet include:

- Optimization of RTU-1, serving the City Hall administration areas on the west end of the building: VAV retrofit with demand control ventilation, zone level HVAC setback and air-side economizing
- Optimization of RTU-2, serving community center and council chambers: demand control ventilation, zone level HVAC setback and air-side economizing.
- Replacing the remaining 300 watt incandescent lamps in the gym with 85 watt spiral compact fluorescent lamps.
- Installing occupancy sensors in additional areas of the building.

RECREATION CENTER ECMS

No ECMs were reportedly implemented prior to the 2012 upgrades since the building was less than ten years old.

Lighting ECMs implemented in 2012 include replacing (20) 400W metal halide fixtures in the gymnasium with 6-lamp T8 fluorescent fixtures with integral occupancy sensors and retrofitting 179 existing T8 luminaires. The 4-lamp T8 fixtures were retrofitted with 3-lamps and the 2-lamp T8 fixtures were retrofitted with 1-lamp. In addition to this, 48 occupancy sensors were installed throughout office, locker room and restroom areas. Further verification is needed to determine if all of these lighting upgrades were performed.

The daylight harvesting ECM for the track, community room and front vestibule areas was attempted unsuccessfully. The metal halide fixtures were slow at responding to the changes in daylight, so the rooms remained dark when clouds passed since the lights could not turn on fast enough. The daylight harvesting controls were disabled for these rooms.

HVAC ECMs implemented in 2012 include demand control ventilation sequences on the seven existing rooftop units, which serve the majority of the building, excluding the natatorium. In addition to this, the natatorium climate conditions were reset from 88°F water temperature and 88°F air temperature with 50-60% relative humidity to 84°F water temperature and 86°F air temperature with 50% relative humidity.

Recommended ECMs that have not been implemented yet include:

- Replacing the pool heater with high efficiency condensing heater. This ECM has been re-evaluated later in this report.
- Installing a building automation system to control the rooftop units and Dectron unit. This ECM had a very long payback and could not be justified based on energy savings alone.

SERVICE GARAGE ECMS

Prior to the 2012 upgrades, a waste oil heater was installed in the repair bay that provides free heat by utilizing waste oil instead of natural gas.

Lighting ECMs implemented in 2012 include retrofitting (60) T12 fluorescent luminaires with magnetic ballasts to T8 fixtures with electronic ballasts, and replacing ten (10) 400-watt metal halide lights in the garage bays with T8 fluorescent high bay luminaires. In addition to this, three incandescent exit signs were replaced with LED, five occupancy sensors were installed in the locker room, restroom and office areas, and the exterior high-intensity discharge (HID) lights were replaced with LED lights. During winter months when the garage bay doors are closed, mechanics in the building complained the lighting levels in the services bays were too low. Therefore, the city reinstalled the T8 fixtures to operate during colder weather periods. During warmer weather periods (late spring, summer and early fall) when the garage door bay doors are open, the LED lights are reportedly used.

HVAC ECMs implemented in 2012 include replacing two 15 year old standard efficiency electric domestic water heaters with new high efficiency heat pump units.

All of the ECMs identified in the 2012 energy assessment have been implemented.

FIRE STATION ECMS

No ECMs were reportedly implemented prior to the 2012 upgrades since the building went through a major renovation in 1998.

Lighting ECMs implemented in 2012 include retrofitting (164) T12 fluorescent luminaires with T8 lamps and electronic ballasts. The 4-lamp fixtures were reduced to 2-lamps or 3-lamps. In addition to this, occupancy sensors were installed in each of the four restrooms.

No HVAC ECMs have been implemented, but the following ECM was recommended in the 2012 energy assessment:

- Replace four standard efficiency (9 SEER) condensing units with new high efficiency (15 SEER) condensing units. This ECM has been re-evaluated later in this report.

OTHER CITY ECMS

HVAC ECMs implemented in 2012 at the Calvin Park Recreation Hall include shutting off the domestic hot water heater and converting the garage forced air heating system to infrared heat. According to city personnel, with the exception of a few garage bays used for equipment storage, this building is currently unoccupied and it was excluded from the scope of work from this assessment.

Ninety (90) traffic signals and nineteen (19) pedestrian crosswalk signals have been converted to LED.

ENERGY ANALYSIS

In 2011, the City of Seven Hills paid approximately **$360,493** in utility costs for the City Hall, Recreation Center, Service Garage, and Fire Department facilities totaling 94,793 gross square feet (gsf). Implementation of all ECMs shown in the table below results in an estimated annual energy savings of **$123,465** with a total project cost of **$1,603,311**. The simple payback period for implementation of all ECMs is **13.0** years and does not account for utility rebates (by COSE). The estimated total project cost includes general conditions (10%), design contingency (0%); architectural / engineering fees (8%) and construction contingency (10%).

ECMs 1-2 (shown in green) are no-cost or low-cost measures that should be considered in the near term. ECMs 3-7 (shown in yellow) are capital-investment projects with a simple payback period (SPP) of between 5 and 15 years. ECMs 8-9 (shown in orange) are capital-intensive projects that have SPPs of greater than 15 years and should be considered where synergies exist with other capital projects. ECMs 10-12 (shown in red) have a SPP of greater than 30 years should not be implemented based on energy savings alone.

ECM #	ECM DESCRIPTION	Rough Order of Magnitude (ROM) First Cost	Annual Savings				Metrics		
			Electricity	Natural Gas	Total Energy	Utility Cost Savings	Expected Useful life	Simple Payback Period (SPP)	Cumulative SPP
			kWh	*NG MCF*	*MMBtu*	*$*	*Years*	*Years*	*Years*
2012	2012 ECMs & Rate Negotiations	$0	205,117	-616	84	$64,993	-----	INSTANT	Instant
13 - 1	City Hall - BAS Upgrades to RTU-1-3 and Smart Meters	$15,000	38,568	147	283	$4,679	15	3.2	0.2
13 - 2	City Hall - Lighting Retrofit	$18,339	66,100	0	226	$6,213	15	3.0	0.4
13 - 3	Rec Center - Pool Heater Replacement	$30,114	0	802	826	$5,753	25	5.2	0.8
13 - 4	Rec Center - Lighting Retrofit	$64,112	76,677	0	262	$7,208	15	8.9	1.4
13 - 5	Service Garage - Lighting Retrofit	$7,404	8,201	0	28	$771	15	9.6	1.5
13 - 6	Fire Department - Lighting Retrofit	$8,059	7,862	0	27	$739	15	10.9	1.6
13 -7	City Hall - Boiler Replacement with OA Reset	$65,042	1,427	639	663	$4,715	25	13.8	2.2
13 - 8	City Hall - Replace Domestic Water Heater	$6,633	0	55	57	$397	20	16.7	2.2
13 - 9	Service Garage - Roof Replacement	$65,510	27,961	0	95	$2,628	30	24.9	2.9
13- 10	Fire Department - Furnace Replacement	$7,392	0	27	28	$197	20	37.6	2.9
13 - 11	City Hall - Roof Replacement	$416,528	49,667	800	993	$10,406	30	40.0	6.5
13 - 12	Fire Department - Condensing Unit Upgrade	$24,130	4,966	0	17	$467	20	51.7	6.7
13 - 13	Rec Center - Natatorium DHU & Lighting Replacement and Smart Meters	$875,048	106,062	604	984	$14,299	25	61.2	13.0
Total		**$1,603,311**	**592,609**	**2,458**	**4,573**	**$123,465**	**28.9**	**13.0**	

Factoring in the energy audit fee of $20,705 and an energy guarantee cost of $48,099, the overall program cost is estimated to be $1,672,116 which increases the simple payback period to 13.54 years. Based on an annual operational and utility inflation rate of 3%, the return on investment of implementing all ECMS is 8.1%. The return on investment ignores debt service and assumes that the project is paid from general funds. Factoring in debt service at a 4.5% finance rate over 15 years, the project has a positive cash flow of $11,283 in year 1 and an overall cumulative positive cashflow of $739,654 over the 15-year term.

+

Financial Analysis

Project Cost:		**$1,603,311**
Energy Assessment Fee		**$20,705**
Energy Guarantee	*3.00%*	**$48,099**
Total Program Cost		**$1,672,116**
Estimated Energy Savings		**$123,465**
Operational Savings*		**$35,000**
APR**		***4.50%***
Period - Length		***15***
Utility Inflation		***3.00%***
Operational Cost Inflation		***3.00%***

UTILITY RATES		
Electricity	$ 0.0940	$/kWh
Natural Gas	$ 98.465	$/mcf
Water	$ 6.746	$/kgal
Sewer	$ 6.416	$/kgal

Simple Payback Period	**13.54**
Return on Investment (ROI)	**8.1%**
Savings to Investment Ratio	**115.5%**
Total Debt Service Cost	**($604,429)**
Year 1 Cash Flow:	**$11,283**
Total Cumulative Cash Flow:	**$739,654**

Year	Energy Savings	Operational Savings	Annual Auditing Service Fee	Total Savings	*Annual Program Cost	Cash Flow (Savings-Cost)	Cumulative Cash Flow (Savings-Cost)
INSTALL				($1,603,311)			
1	$123,465	$35,000	$0	$158,466	-$147,183	$11,283	$11,283
2	$127,169	$36,050	$0	$163,221	-$147,183	$16,038	$27,321
3	$130,984	$37,132	$0	$168,118	-$147,183	$20,936	$48,257
4	$134,913	$38,245	$0	$173,163	-$147,183	$25,980	$74,237
5	$138,961	$39,393	$0	$178,359	-$147,183	$31,176	$105,413
6	$143,130	$40,575	$0	$183,710	-$147,183	$36,528	$141,941
7	$147,424	$41,792	$0	$189,222	-$147,183	$42,040	$183,980
8	$151,846	$43,046	$0	$194,900	-$147,183	$47,717	$231,697
9	$156,402	$44,337	$0	$200,748	-$147,183	$53,565	$285,262
10	$161,094	$45,667	$0	$206,771	-$147,183	$59,588	$344,850
11	$165,926	$47,037	$0	$212,975	-$147,183	$65,792	$410,642
12	$170,904	$48,448	$0	$219,364	-$147,183	$72,182	$482,824
13	$176,031	$49,902	$0	$225,946	-$147,183	$78,763	$561,587
14	$181,312	$51,399	$0	$232,725	-$147,183	$85,542	$647,129
15	$186.752	$52.941	$0	$239.707	-$147.183	$92.525	$739.654
Total	$2,296,313	$650,962	$0	$1,344,083	-$2,207,741	$739,654	

Note:

*** Operational Savings include average maintenance cost of $10,000 for existing Dectron Pool DHU over and above preventative maintenance plus another $25,000 in annual repair / replacement cost for the rooftop units and the natatorium roof due to capacity and performance issues with the existing Dectron Pool dehumidification unit.**

**** Annual payment cost is based on 12 equal monthly payments per year.**

ECM-1. CITY HALL – BAS UPGRADES TO RTU-1-3

RTU-1 serves the office areas outside of the Police in City Hall and is currently controlled by a programmable thermostat, by connecting RTU-1 to the Tridium BAS, a more aggressive set back could be employed. RTU-2 which serves Council Chambers is controlled by a non-programmable thermostat and is not set back, by connecting to the BAS this unit could be set back when City Hall is not occupied. RTU-3 has a CO2-based demand control capability that does not appear to be fully utilized given the minimum outside air damper position of 20%. RTU-3's static pressure set point of 1.50 in wc should be reduced from 1.5 in wc to 1.0 in wc to reduce fan energy. Lastly smart meters should be installed to provide real time utility data to ensure energy savings are being achieved and to aid in troubleshooting maintenance issues.

The following assumptions were made in order to estimate the energy savings:

- RTU-1 currently has summer and winter night set back temperatures of 75°F and 70°F, respectively.
- RTU-2 cycles with all loads and is not set back.
- RTU-1&2 can be set back to 80°F in the summer and 64°F in the winter.
- RTU-3 minimum outside air damper position is 20% which can be reduced to 10%.
- RTU-3 static pressure set point is 1.50 in wc which can be reduced to 1.0 in wc.

The BAS upgrades will achieve an estimated reduction of **38,568 kWh** per year in electricity **and 147 MCF** per year in natural gas; based on 2012 utility costs this is an estimated savings of **$4,769** per year.

The cost of performing this work is estimated at **$15,000**, which results in a simple payback of **3.2** years.

ECM-2. CITY HALL - LIGHTING RETROFIT

The City of Seven Hills replaced several interior lights at City Hall in 2012. There are some additional opportunities to reduce the energy consumed by lighting at City Hall including:

- Retrofit eighteen (18) 300W incandescent fixtures in the gym with 85W compact fluorescent lamps (2 of these fixtures have already been replaced by City staff).
- Retrofit eight (8) 100W incandescent fixtures with 26W compact fluorescent lamps.
- Retrofit fifty (50) T12 2x4 light fixtures to T8 lamps and electronic ballasts.
- Install occupancy sensors throughout the facility (utilize ceiling or high wall mounted sensors to minimize interference from furniture and other obstructions).

Implementation of this ECM will achieve an estimated reduction of **66,100 kWh** per year; based on 2012 utility costs, this is an estimated annual savings of **$6,213** per year. The cost of performing this work is estimated at **$18,339**, which results in a simple payback of **3.0 years**.

ECM-3. RECREATION CENTER – POOL HEATER REPLACEMENT

The existing pool heater is original to the building, approximately 12-years old; has been damaged by flame roll out and is not the most energy efficient. A new energy high efficiency condensing pool heater could be installed. High-efficiency condensing boilers feature advanced heat exchanger designs and the ability to extract heat from flue gases, which allow for efficiencies beyond 90%.

Water vapor (steam) is a by-product of the gas-fired combustion process and this vapor contains a significant amount of energy. For every pound of water vapor that is forced back into its liquid state, an estimated 1,000 BTUs of latent energy in the form of heat are released. This change of state from vapor to liquid is called "condensing" and occurs naturally when water vapor is cooled below its dew point (135°F). A condensing boiler takes advantage of this natural phenomenon by flowing cold water (<130°F) into the heat exchanger, thus causing condensing and releasing the latent heat. With about 12% of the input energy of a gas-fired boiler tied up as latent heat, this represents a significant energy-savings potential. It is important to note that in order for the water vapor in the flue gases to condense, the temperature of the flue gas must be reduced to below the water dew point of the flue gas. For this to occur, the return water temperature to the boiler must be below 140°F. If there are no heat exchange surfaces at the back of the boiler below this dew point, condensing will not occur, and this energy opportunity will be lost, even if the boiler claims to be a “condensing” boiler. Modern condensing boilers have energy efficiencies of 90 to 96%. New conventional non-condensing models have energy efficiencies of only 70 to 85%. Many boilers over 20 years old typically operate at only 60 to 70% efficiency, making them good candidates for upgrade or replacement. A number of natural-gas-fired condensing pool heaters are available.

The following assumptions were made in order to estimate the energy savings:

- Existing heating plant has an average thermal efficiency of 70%.
- New heating plant will have an average thermal efficiency of 95%.

Based on the assumptions above, replacing the existing standard efficiency pool heater with a new high-efficiency, condensing heater will achieve an estimated reduction of **802 MCF** per year in natural gas. Based on 2012 utility costs, this is an estimated annual savings of **$5,753** per year. The cost of performing this work is estimated at **$30,144**, which results in a simple payback of **5.2** years. The new pool heater will have an expected useful life of 20 years.

ECM-4. RECREATION CENTER - LIGHTING RETROFIT

The City of Seven Hills replaced several interior lights at the Recreation Center in 2012. There are some additional opportunities to reduce the energy consumed by lighting at the Recreation Center including:

- Replace thirty-one (31) 250 watt metal halide fixtures around track and fitness areas with 4 lamp 2x4 low bay fluorescent fixtures.
- Replace nine (9) existing 250W metal halide can downlights in the Main Lobby Area with 70W LED. This will also allow for the use of the existing daylighting control since LED lamps are instant on and dimmable.
- Replace eleven (11) exterior 100 watt metal halide bollards with LED fixtures.
- Replace twenty-seven (27) 400W metal halide "shoe box" style parking lot lights with LED fixtures. Reuse existing poles.

Implementation of this ECM will achieve an estimated reduction of **76,677 kWh** per year; based on 2012 utility costs, this is an estimated annual savings of **$7,208** per year. The cost of performing this work is estimated at **$64,112**, which results in a simple payback of **8.9 years**.

ECM-5. SERVICE GARAGE - LIGHTING RETROFIT

The City of Seven Hills replaced several interior and exterior lights at the Service Garage in 2012. There are some additional opportunities to reduce the energy consumed by lighting at the Service Garage including:

- Replace seven (7) 175W metal halide exterior lights with LED fixtures (Note: some of the exterior halogen, metal halide and high pressure sodium fixtures [e.g., salt storage building] were reportedly not working. If the City of Seven Hills decides to repair/replace these fixtures, it is recommended to replace these with LED fixtures.)
- Replace four (4) 250W post top metal halide flood lights with LED fixtures.

Performing the upgrade described above will achieve an estimated reduction of **8,201 kWh** per year; based on 2012 utility costs this is an estimated annual savings of **$771** per year.

The cost of performing this work is estimated at **$7,404**, which results in a simple payback of **9.6 years**.

ECM-6. FIRE DEPARTMENT - LIGHTING RETROFIT

The City of Seven Hills replaced several interior and exterior lights at the Fire Department in 2012. There are some additional opportunities to reduce the energy consumed by lighting at the Fire Department including:

- Retrofit three (3) incandescent fixtures with compact fluorescent lamps in the men's and women's restrooms.
- Replace eleven (11) "eye lid" style exterior wall packs utilizing 100 watt metal halide lamps with LED fixtures.
- Replace four (4) 250W post top metal halide flood lights with LED fixtures.

Implementation of this ECM will achieve an estimated reduction of **7,862 kWh** per year; based on 2012 utility costs, this is an estimated annual savings of **$739** per year. The cost of performing this work is estimated at **$8,059**, which results in a simple payback of **10.9 years**.

ECM-7. CITY HALL – BOILER REPLACEMENT

The existing heating plant at City Hall is inefficient and is past its expected service life. The boilers should be replaced with high-efficiency condensing boilers. High-efficiency condensing boilers feature advanced heat exchanger designs and the ability to extract heat from flue gases, which allow for efficiencies beyond 90%.

Water vapor (steam) is a by-product of the gas-fired combustion process and this vapor contains a significant amount of energy. For every pound of water vapor that is forced back into its liquid state, an estimated 1,000 BTUs of latent energy in the form of heat are released. This change of state from vapor to liquid is called "condensing" and occurs naturally when water vapor is cooled below its dew point (135°F). A condensing boiler takes advantage of this natural phenomenon by flowing cold water (<130°F) into the heat exchanger, thus causing condensing and releasing the latent heat. With about 12% of the input energy of a gas-fired boiler tied up as latent heat, this represents a significant energy-savings potential.

It is important to note that in order for the water vapor in the flue gases to condense, the temperature of the flue gas must be reduced to below the water dew point of the flue gas. For this to occur, the return water temperature to the boiler must be below 140°F. If there are no heat exchange surfaces at the back of the boiler below this dew point, condensing will not occur, and this energy opportunity will be lost, even if the boiler claims to be a "condensing" boiler.

Modern condensing boilers have energy efficiencies of 90 to 96%. New conventional non-condensing models have energy efficiencies of only 70 to 85%. Many boilers over 20 years old typically operate at only 60 to 70% efficiency, making them good candidates for upgrade or replacement. A number of natural-gas-fired condensing boilers are available.

The following assumptions were made in order to estimate the energy savings:

- Existing heating plant has 70% thermal efficiency.
- New heating plant will have an average thermal efficiency of 93%.
- Utilize the following reset schedule to ensure the boilers operate in the condensing mode: when outside air temperature is 20°F, the leaving boiler water temperature set point shall be 150°F and be rest proportionally to 130°F when outside air temperature is 40°F.

The following assumptions were made in order to estimate first cost:

- The existing heating hot water pumps and hydronic specialties such as air separator and expansion tank will be replaced.
- The new boilers will utilize direct vent combustion air.

The replacement of the existing boilers will achieve an estimated reduction of **1,427 kWh** in electricity and **639 MCF** in natural gas per year; based on 2012 utility costs this is an estimated savings of **$4,715** per year.

The cost of performing this work is estimated at **$65,042**, which results in a simple payback of **13.8**-years. This has a payback longer than 10-years; however, the existing boiler is nearing the end of its useful life of 25-years and may require replacement soon.

ECM-8. CITY HALL – DOMESTIC WATER HEATER REPLACEMENT

The existing domestic water heater at City Hall is inefficient and is nearing the end of its expected service life. The domestic water heater should be replaced with a high-efficiency condensing water heater. High-efficiency condensing water heaters feature advanced heat exchanger designs and the ability to extract heat from flue gases, which allow for efficiencies beyond 90%.

The following assumptions were made in order to estimate the energy savings:

- Existing domestic water heater has a thermal efficiency of 80%.
- New condensing water heater will have a thermal efficiency of 95%.

The replacement of the existing domestic hot water heater will achieve an estimated reduction of **55 MCF** per year in natural gas; based on 2012 utility costs this is an estimated savings of **$397** per year.

The cost of performing this work is estimated at **$6,633**, which results in a simple payback of **16.7** years. This has a payback longer than 10-years; however, the existing domestic water heater is at the end of its useful life of 15-years and will likely require replacement soon.

ECM-9. SERVICE GARAGE – REPLACE ROOF

The existing roof is in very poor condition and has issues with retaining water. Even though the dry roof has an R-value of 7.5, when the insulation is saturated with water, its R-value is reduced by approximately 70%. This results in a considerable amount of energy being wasted.

The following assumptions were made in order to estimate the energy savings:

- Existing roof has a saturation U-value of 0.444 Btuh-ft^2-°F (R-2.25 insulation).
- New roof will have a U-value of 0.045 Btuh-ft^2-°F (R-22 insulation).

The replacement of the existing roof will achieve an estimated reduction of **27,961 kWh** per year in electricity; based on 2012 utility costs this is an estimated savings of **$2,628** per year.

The cost of performing this work is estimated at **$65,510**, which results in a simple payback of **24.9** years. This has a payback longer than 10-years; however, the existing roof is in very poor condition.

ECM-10. FIRE DEPARTMENT – FURNACE REPLACEMENT

Two of the four existing furnaces, serving the lounge and dormitories in the Fire Station, have an efficiency of 80%. These units could be replaced with 95% efficient units. The other two furnaces serving the offices and training room have efficiencies of 93% and 95%, so it does not make sense to replace them.

Based on the assumption of an efficiency change from 80% to 95%, this ECM will achieve an estimated reduction of **27 MCF** per year; based on 2012 utility costs this is an estimated annual savings of **$197** per

year. The cost of performing this work is estimated at **$7,392** which results in a simple payback of **37.6 years.** The existing units are approximately 15 years old and are nearing the end of their expected service life.

ECM-11. CITY HALL – REPLACE ROOF

The existing roof, with the exception of the part above the Council Chambers that was replaced 5-7 years ago, is in poor condition. Several areas of buckling and damaged flashing and caulking were observed during the site visit. In addition, the roof should have more insulation to help conserve energy.

The following assumptions were made in order to estimate the energy savings:

- Existing roof has a U-value of 0.101 Btuh-ft^2-°F (R-8.5 insulation).
- New roof will have a U-value of 0.047 Btuh-ft^2-°F (R-20 insulation).

The replacement of the existing roof, except for the Council Chambers roof, will achieve an estimated reduction of **49,667 kWh** in electricity and **800 MCF** in natural gas per year; based on 2012 utility costs this is an estimated savings of **$10,524** per year.

The cost of performing this work is estimated at **$416,528**, which results in a simple payback of **40.0** years. This has a payback longer than 30-years; however, the existing roof is in poor condition and may require replacement soon.

ECM-12. FIRE DEPARTMENT – CONDENSING UNIT UPGRADE

The four existing condensing units for the Fire Station are assumed to have a seasonal energy efficiency ratio (SEER) of 10. These units could be replaced with high-efficient, 16 SEER, units for existing single phase units and 13 SEER units for three phase units. Based on the assumption of an SEER change of 10 to 13 / 16, this ECM will achieve an estimated reduction of **4,966 kWh** per year; based on 2012 utility costs this is an estimated annual savings of **$467** per year.

The cost of performing this work is estimated at **$24,130** which results in a simple payback of **51.7** years. Although this payback is longer than 10 years, this ECM should be considered for implementation given the age and condition of the existing condensing units. The existing units are approximately 15 years old and are nearing the end of their expected service life.

ECM-13. RECREATION CENTER – POOL DECTRON UNIT UPGRADE

The existing Dectron dehumidification and ventilation unit is undersized and in very poor condition. Prior to 2011, the pool water temperature was set to 88°F and the Natatorium air conditions set to 88°F at 50-60% relative humidity. After the 2011 energy assessment, the room conditions were reset to 84°F water temperature and 86°F air temperature at 55% relative humidity to save energy and let the dehumidification unit better handle the load. However, the Dectron unit is still significantly undersized even with the new space requirements. Taking into consideration all of the water surfaces, including the water feature and slide, we calculated the humidity load to be 500 lbs/hour. The installed Dectron unit has a dehumidification capacity of 300 lbs/hour, which is only 60% of the required capacity.

Currently one of the two compressors is non-functional, which has led to increased humidity loads and corrosion of both ferrous steel and stainless steel components in the Natatorium. High levels of trichloramines caused by incorrect pool chemistry have also contributed to the corrosion problem. Seven Hills has selected a consultant to perform a study of the pool chemistry under a separate contract and plans to convert to ultraviolet (UV) for pool water treatment in lieu of chlorine. In addition to this, the heat recovery system is not functioning, resulting in greater utilization of the pool heater and increased natural gas consumption.

The City of Seven Hills has spent on average over $10,000 per year in repair cost on the Dectron pool dehumidification unit. This is over and above basic preventative maintenance. In addition, the Natatorium roof was replaced in 2007 at a cost of $3 million. The natatorium roof was only 6 years old at the time and the normal life of a roof is 20-30 years.

We recommend replacing the Dectron unit with a new dehumidification unit sized to handle the room load. The unit will have an airside economizer and variable frequency drives on the supply and exhaust fans to save energy when full design airflow is not needed. In addition to this, the unit will have a functional heat recovery system for heating the pool. The supply and return air ductwork will need to be replaced and reconfigured to accommodate the increased supply air flow. The existing lights will need to be replaced in order to allow the duct modifications. Lastly smart meters should be installed to provide real time utility data to ensure energy savings are being achieved and to aid in troubleshooting maintenance issues.

Replacing the existing natatorium dehumidification unit a VAV unit and lighting will achieve an estimated reduction of **106,062 kWh** in electricity and **604 MCF** in natural gas per year. Based on 2012 utility costs, this is an estimated annual savings of **$14,299** per year. The cost of performing this work is estimated at **$875,048**, which results in a simple payback of **61.2** years. This has a payback longer than 10-years; however, the existing dehumidification unit is in poor condition and will likely require replacement soon. In addition, the lack of adequate dehumidification capacity is contributing to the corrosion of the rooftop units; metal surfaces in the pool area and the Dectron Unit itself. In 2007, the entire roof above the natatorium was replaced at a cost of $3 million and the City has been averaging over $10,000 in annual repair costs to the Dectron, over and above basic preventative maintenance costs.

ECMs NOT RECOMMENDED

Energy conservation measures were evaluated but not recommended include:

City Hall and Police:

- Optimization of RTU-1, serving the City Hall administration areas on the west end of the building: VAV retrofit with demand control ventilation, zone level HVAC setback and air-side economizing. This ECM had a very long payback (57 years)and cannot be justified based on energy savings alone
- Optimization of RTU-2, serving community center and council chambers: demand control ventilation, zone level HVAC setback and air-side economizing. This ECM had a very long payback (24 years) and cannot be justified based on energy savings alone
- The existing roof, with the exception of the part above the Council Chambers that was replaced 5-7 years ago, is in poor condition. Several areas of buckling and damaged flashing and caulking were observed during our site visits. In addition, the roof should have more insulation to help conserve energy. This ECM had a very long payback (39 years) which adversely affect the viability of the rest of the program (ECMs 1-12) and cannot be justified based on energy savings alone. We recommend that replacement of the roof be pursued under the Local Government Innovation Fund.

Compressed Natural Gas (CNG) Vehicles:

- Given the lack of filling stations and high upfront costs this ECM is not recommended at this time.
  - First cost to retrofit vehicles for CNG is approximately $7,000 to $8,000 per vehicle depending on the size of the tank. Tank size depends on size/weight of vehicle and how much it is driven each day/week. The tank itself is approx. 25-30% of the total fee; other costs include DOT certification, materials and labor. Conversion cost can be reduced by finding a used tank
  - An important factor for deciding which vehicle(s) to convert is age of vehicle. CNG tanks have 20 year lifespan – so it does not make sense to place it on an older vehicle – but the tank and conversion kit can be transferred to another vehicle when the existing vehicle dies.
  - Conversion takes about 1 week
  - Mileage rate is referred to as gasoline gallon equivalent (GGE) rather than miles per cubic feet of natural gas. A station at Hopkins Airport is currently selling CNG for $2.09/GGE, but in other parts of the U.S. where more stations are available, the cost can be as low as $1.70 to $1.80/GGE
  - It is important to have access to filling station (currently only 2 active in Cleveland – one at Hopkins Airport and one on E. 55th Street; others are in planning/development stages). Another option is to install a compressing unit and trunk line and connect it to the main natural gas line for an existing building. A hose with a disconnect would be connected to the trunk line and could be used to fill vehicles at night or when not in use at a slower rate (cost could be as low as $0.70 to 0.80/GGE). A challenge for the Service Garage where most of the City's vehicles are kept is that it is an all electric building.
  - Some Ford and Chrysler dealerships sell new CNG trucks which typically cost about $10,000 to 12,000 more than an equivalent gasoline powered truck.

OTHER RECOMMENDATIONS

Osborn has identified the following recommendations for which energy and cost savings calculations were not calculated. Implementing these recommendations will result in additional energy and cost savings for the City.

City Hall and Police:

- Perform tune-up on all HVAC equipment in the building to verify dampers are working properly, clean damaged fins, replace filters when applicable, clean coils, recalibrate thermostats, etc.
- Repair/replace vibrating exhaust fan on roof near RTU-1.

Recreation Center:

- Address pool chemistry issues causing elevated trichloramine levels.
- Perform tune-up on all HVAC equipment in the building to verify dampers are working properly, clean damaged fins, replace filters where applicable, clean coils, recalibrate thermostats, etc.
- Verify the proper operation of the carbon dioxide sensors installed in the return air duct work to the packaged rooftop units.
- Repair/replace damaged fiberglass insulation on the manifold (cold water inlet) associated with the three A.O. Smith water heaters in the mechanical room.
- Repair door frames, seals and thresholds including exterior door in mechanical room and the exterior door leading from the track to the lower roof.

Service Garage:

- Replace standard flush toilets and urinals in locker room/restroom with low flush models.

FUNDING

Potential sources of funding for the recommended energy conservation measures include:

- *Cleveland/Cuyahoga County Pilot Program, Retrofits for Energy Efficiency Works (RENEW):* This program is a joint effort of Emerald Cities Cleveland, Cuyahoga County's Planning Commission, the Cleveland-Cuyahoga County Port Authority, and Public Finance & Energy Advisors, LLC and provides financing and technical assistance solutions for energy efficiency in municipal buildings. This program requires an updated energy assessment of City owned facilities. The cost for this Energy Assessment can be included in Cuyahoga County's RENEW financing program. RENEW financing and technical assistance are available to public building owners outside of Cuyahoga County as well. RENEW Financing and Technical Assistance offers:

  - ✓ Projects that pay for themselves through guaranteed energy savings
  - ✓ Lease-purchase financing (subject to appropriation) through the Cleveland Cuyahoga Port Authority and/or other participating issuing authorities that is "off-balance sheet" and is not a factor in statutory debt limitations
  - ✓ No Debt Rating Agency impact as long as savings significantly exceed total costs
  - ✓ Low Tax-Exempt interest rates
  - ✓ Technical Assistance that provides "third party" measurement and verification of saving after installation

  For additional information and applications go to:

  HTTP://RENEWRETROFITS.COM/

- *Energy Savings Performance Contracting:* A mechanism to implement energy efficiency improvements with minimal up-front costs. It uses guaranteed savings from energy efficiency project outlined by energy service performance contractor (ESPC) to pay for the work over a period of time.

- *First Energy Incentive Program:* FirstEnergy, which owns the Illuminating Company, Ohio Edison and Toledo Edison, released its first phase of rebate programs on Monday, April 11, 2011. The Council of Smaller Business Enterprises (COSE) is administering the rebate application process for the RENEW program. For additional information and rebate applications go to:

  HTTP://WWW.COSE.ORG/MANAGE%20EXPENSES/ENERGY%20PROGRAMS/ENERGY%20EFFICIENCY%20PROGRAM/UTILITY%20REBATES/FIRST%20ENERGY%20REBATE%20AND%20INCENTIVES%20PROGRAMS.ASPX

  HTTP://ENERGYSAVEOH-BUSINESS.COM/INDEX.HTML

- *Local Government Innovation Fund (LGIF):* The Ohio Development Services Agency has a Local Government Innovation Fund (LGIF) which offers communities financial assistance to create more efficient and effective service delivery. Projects are expected to facilitate improved business environments and promote community attraction with their plan for efficiency, collaboration, or shared services. Communities will be able to save money and provide more effective services to their constituents with assistance from this program. The Local Government Innovation Program will award up to $50,000 in grant funds per feasibility study, up to $100,000 in loan assistance per entity for demonstration projects, and up to $500,000 in loan assistance for collaborative demonstration projects. Award amounts for applicants with collaborative partners are limited to $100,000 per applicant and $100,000 for each collaborative partner up to $500,000. Grant funds will be awarded semi-annually and loan funds will be awarded quarterly through a competitive and open selection process. Applications for Round 8 of the Local Government Innovation Fund are due December 2, 2013. For additional information and applications go to:

  HTTP://DEVELOPMENT.OHIO.GOV/CS/CS_LOCALGOVFUND.HTM

- *Ohio Air Quality Development Authority (OAQDA):* Under Ohio Revised Code Chapter 3706, OAQDA can issue low interest bonds to both public and private entities for any property, device, or equipment that promotes the reduction of emissions of air contaminants into the ambient air through improvements in the efficiency of energy utilization or energy conservation.

  HTTP://WWW.OHIOAIRQUALITY.ORG/OAQDA/ABOUT_OAQDA.ASP

ESTIMATED PROJECT COST

ESTIMATE WORKSHEET	ORIGINATING OFFICE: Cleveland	DATE SUBMITTED: 10/07/13	PROJECT NO.: J20130278	CONTRACT NO.:
	PROJECT AND CITY: City of Seven Hills RENEW Energy Audit Seven Hills Ohio		PURPOSE: Estimated Project Cost STUDY	
			ITEM: Summary by Sheet	

ESTIMATE VALID TO:	ESTIMATED BY:	Labor Rate:	DATE	SHEET NO. 1 OF 1
12/31/13	CLZ	$ 65.00	10/07/13	

DESCRIPTION OF WORK	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	MATERIAL PER UNIT	MATERIAL SUBTOTAL	LABOR PER UNIT	LABOR SUBTOTAL	SUBTOTALS	ECCA	EXTENDED
COST SUMMARY BY SHEET									
City Hall Hot Water Boilers			$32,005			$18,105	$50,110	$55,121	$65,042
City Hall Roof Replacement			$187,000			$133,900	$320,900	$352,990	$416,528
City Hall Domestic Water Heater			$3,875			$1,235	$5,110	$5,621	$6,633
Service Garage Roof Replacement			$29,800			$20,670	$50,470	$55,517	$65,510
Rec Center Pool Heaters			$16,700			$6,500	$23,200	$25,520	$30,114
Rec Center Pool DHU			$598,647			$75,504	$674,151	$741,566	$875,048
Fire Department A/C Units			$15,600			$2,990	$18,590	$20,449	$24,130
Fire Department Furnaces			$4,200			$1,495	$5,695	$6,265	$7,392
							$0	$0	$0
							$0	$0	$0
SUBTOTAL 1			$887,827			$260,399	$1,148,226	$1,263,048	$1,490,397
GENERAL CONDITIONS	*10%*						$114,823		
SUBTOTAL 2							$1,263,048		
ESCALATION TO MIDPOINT OF CONSTRUCTION	*0.00%*						$0		
SUBTOTAL 3							$1,263,048		
DESIGN CONTINGENCY	*0%*						$0		
ECCA (Estimated Construction Cost at Award)							$1,263,048		
ARCHITECTURAL FEES	*8%*						$101,044		
CONSTRUCTION CONTINGENCY	*10%*						$126,305		
CONSTRUCTION MANAGEMENT FEE	*0%*						$0		
TOTAL CONSTRUCTION COST							$ 1,490,397		

ESTIMATE WORKSHEET	ORIGINATING OFFICE: Cleveland	DATE SUBMITTED: 09/23/13	PROJECT NO.: J20130278	CONTRACT NO.:
	PROJECT AND CITY: City of Seven Hills **RENEW Energy Audit** Seven Hills Ohio		PURPOSE: Estimated Project Cost	STUDY
			ITEM: City Hall Hot Water Boilers	
ESTIMATE VALID TO: 12/31/13	ESTIMATED BY: CLZ	LABOR RATE: $65.00 /HR	DATE: 10/07/13	Page 1 of 1

DESCRIPTION OF WORK	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	MATERIAL PER UNIT	MATERIAL SUBTOTAL	LABOR OT (y/n)	LABOR PER UNIT	LABOR SUBTOTAL	SUBTOTALS	ECCA	EXTENDED
DEMOLTION				$ -	n	0	$ -	$ -	$ -	$ -
Remove Existing Boilers	2.0	ls	250.00	$ 500	n	260	$ 520.00	$ 1,020	$ 1,122	$ 1,324
				$ -	n	0	$ -	$ -	$ -	$ -
EQUIPMENT				$ -	n	0	$ -	$ -	$ -	$ -
Two (2) High Eff Condensing Boilers	900.0	mbh	12.00	$ 10,800	n	0	$ -	$ 10,800	$ 11,880	$ 14,018
Set Boilers	2.0	ea	100.00	$ 200.00	n	780	$ 1,560.00	$ 1,760	$ 1,936	$ 2,284
Hot Water Pumps	2.0	ea	2,500.00	$ 5,000.00	n	390	$ 780.00	$ 5,780	$ 6,358	$ 7,502
Air Separator	1.0	ea	1,000.00	$ 1,000.00	n	260	$ 260.00	$ 1,260	$ 1,386	$ 1,635
Expansion Tank & City Water Piping	1.0	ea	1,500.00	$ 1,500.00	n	1040	$ 1,040.00	$ 2,540	$ 2,794	$ 3,297
				$ -	n	0	$ -	$ -	$ -	$ -
CONNECTIONS / INSTALLATION				$ -	n	0	$ -	$ -	$ -	$ -
Manlift / Scaffolding	1.0	ls	500.00	$ 500.00	n	0	$ -	$ 500	$ 550	$ 649
Flue & Comb Air Piping	2.0	ea	500.00	$ 1,000.00	n	520	$ 1,040.00	$ 2,040	$ 2,244	$ 2,648
Gas Piping	2.0	ea	100.00	$ 200.00	n	260	$ 520.00	$ 720	$ 792	$ 935
Controls	2.0	ea	500.00	$ 1,000.00	n	260	$ 520.00	$ 1,520	$ 1,672	$ 1,973
				$ -	n	0	$ -	$ -	$ -	$ -
PIPING				$ -	n	0	$ -	$ -	$ -	$ -
3-Inch Sch 40 Steel Pipe	100.0	lft	19.50	$ 1,950.00	n	24	$ 2,418.00	$ 4,368	$ 4,805	$ 5,670
3-inch BW Steel Elbows	10	ea	29.00	$ 290.00	n	149	$ 1,485.90	$ 1,776	$ 1,953	$ 2,305
3-inch BW Steel Tees	4.0	ea	84.00	$ 336.00	n	260	$ 1,040.00	$ 1,376	$ 1,514	$ 1,786
3-inch Butterfly Valves	8.0	ea	96.50	$ 772.00	n	130	$ 1,040.00	$ 1,812	$ 1,993	$ 2,352
3-inch Strainers	2.0	ea	500.00	$ 1,000.00	n	297	$ 594.23	$ 1,594	$ 1,754	$ 2,069
3-inch Vibration Isolators	4.0	ea	65.00	$ 260.00	n	47	$ 189.02	$ 449	$ 494	$ 583
3-inch Circuit Setters	2.0	ea	770.00	$ 1,540.00	n	260	$ 520.00	$ 2,060	$ 2,266	$ 2,674
3-inch Check Valves	2.0	ea	540.00	$ 1,080.00	n	80	$ 160.03	$ 1,240	$ 1,364	$ 1,610
Boiler Drains	4.0	ea	10.00	$ 40.00	n	16	$ 65.00	$ 105	$ 116	$ 136
Air Vents	4.0	ea	100.00	$ 400.00	n	43	$ 173.42	$ 573	$ 631	$ 744
Thermometers	6.0	ea	75.00	$ 450.00	n	16	$ 97.50	$ 548	$ 602	$ 711
Pressure Gauges	4.0	ea	35.00	$ 140.00	n	16	$ 65.00	$ 205	$ 226	$ 266
Insulation	260.0	elft	1.41	$ 366.60	n	5	$ 1,352.00	$ 1,719	$ 1,890	$ 2,231
				$ -	n	0	$ -	$ -	$ -	$ -
ELECTRICAL				$ -	n	0	$ -	$ -	$ -	$ -
3 HP Feeder	100.0	lft	2.50	$ 250.00	n	10	$ 975.00	$ 1,225	$ 1,348	$ 1,590
3 HP Disconnect	2.0	ea	400.00	$ 800.00	n	260	$ 520.00	$ 1,320	$ 1,452	$ 1,713
3 HP Circuit Breaker	2.0	ea	215.00	$ 430.00	n	65	$ 130.00	$ 560	$ 616	$ 727
				$ -	n	0	$ -	$ -	$ -	$ -
Test / Check & Start Up	2.0	ea	50.00	$ 100.00	n	260	$ 520.00	$ 620	$ 682	$ 805
Balancing	2.0	ea	25.00	$ 50.00	n	130	$ 260.00	$ 310	$ 341	$ 402
Commissioning	2.0	ea	25.00	$ 50.00	n	130	$ 260.00	$ 310	$ 341	$ 402
				$ 32,005			**$ 18,105**	**$ 50,110**	**$ 55,121**	**$ 65,042**

ESTIMATE WORKSHEET	ORIGINATING OFFICE: Cleveland	DATE SUBMITTED: 10/07/13	PROJECT NO.: J20130278	CONTRACT NO.:
	PROJECT AND CITY: City of Seven Hills **RENEW Energy Audit** Seven Hills Ohio		PURPOSE: Estimated Project Cost	STUDY
			ITEM: City Hall Roof Replacement	
ESTIMATE VALID TO: 12/31/13	ESTIMATED BY: CLZ	LABOR RATE: $65.00 /HR	DATE: 10/07/13	Page 1 of 1

DESCRIPTION OF WORK	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	MATERIAL PER UNIT	MATERIAL SUBTOTAL	LABOR OT (y/n)	LABOR PER UNIT	LABOR SUBTOTAL	SUBTOTALS	ECCA	EXTENDED
DEMOLTION				$ -	n	0	$ -	$ -	$ -	$ -
Remove Existing Roof - 30,000 sf	1.0	ls	500.00	$ 500	n	19500	$ 19,500.00	$ 20,000	$ 22,000	$ 25,960
				$ -	n	0	$ -	$ -	$ -	$ -
NEW WORK				$ -	n	0	$ -	$ -	$ -	$ -
Patch Roof Deck	3000.0	sf	2.00	$ 6,000	n	3	$ 9,750.00	$ 15,750	$ 17,325	$ 20,444
Insulation - 3.5-inch polyiso	30000.0	sf	3.00	$ 90,000.00	n	1	$ 19,500.00	$ 109,500	$ 120,450	$ 142,131
EPDM Membrane	30000.0	sf	1.50	$ 45,000.00	n	2	$ 48,750.00	$ 93,750	$ 103,125	$ 121,688
Lift Existing HVAC Units	3.0	ls	2500.00	$ 7,500.00	n	2600	$ 7,800.00	$ 15,300	$ 16,830	$ 19,859
Flashing - Against Wall	2500.0	sf	10.00	$ 25,000.00	n	7	$ 16,250.00	$ 41,250	$ 45,375	$ 53,543
Flashing - Roof Edge	500.0	sf	10.00	$ 5,000.00	n	7	$ 3,250.00	$ 8,250	$ 9,075	$ 10,709
Flashing - Roof Curbs	200.0	sf	10.00	$ 2,000.00	n	7	$ 1,300.00	$ 3,300	$ 3,630	$ 4,283
Pitch Pockets / Tall Cone Flashing	60.0	ea	100.00	$ 6,000.00	n	130	$ 7,800.00	$ 13,800	$ 15,180	$ 17,912
				$ -	n	0	$ -	$ -	$ -	$ -
				$ -	n	0	$ -	$ -	$ -	$ -
				$ -	n	0	$ -	$ -	$ -	$ -
				$ -	n	0	$ -	$ -	$ -	$ -
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				$ -	n	0	$ -	$ -	$ -	$ -
				$ 187,000			**$ 133,900**	**$ 320,900**	**$ 352,990**	**$ 416,528**

ESTIMATE WORKSHEET	ORIGINATING OFFICE: Cleveland	DATE SUBMITTED: 09/23/13	PROJECT NO.: J20130278	CONTRACT NO.:
	PROJECT AND CITY: City of Seven Hills **RENEW Energy Audit** Seven Hills Ohio		PURPOSE: Estimated Project Cost	STUDY
			ITEM: City Hall Domestic Water Heater	
ESTIMATE VALID TO: 12/31/13	ESTIMATED BY: CLZ	LABOR RATE: $65.00 /HR	DATE: 10/07/13	Page 1 of 1

DESCRIPTION OF WORK	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	MATERIAL PER UNIT	MATERIAL SUBTOTAL	LABOR OT (y/n)	LABOR PER UNIT	LABOR SUBTOTAL	SUBTOTALS	ECCA	EXTENDED
DEMOLTION				$ -	n	0	$ -	$ -	$ -	$ -
Remove Existing DHW Heater	1.0	ls	50.00	$ 50	n	130	$ 130.00	$ 180	$ 198	$ 234
				$ -	n	0	$ -	$ -	$ -	$ -
EQUIPMENT				$ -	n	0	$ -	$ -	$ -	$ -
130-160 MBH DHW Heater - High Eff	1.0	ls	2,500.00	$ 2,500	n	0	$ -	$ 2,500	$ 2,750	$ 3,245
Set DHW Heater	1.0	ls	50.00	$ 50.00	n	390	$ 390.00	$ 440	$ 484	$ 571
Install Recirc Pump	1.0	ea	100.00	$ 100.00	n	65	$ 65.00	$ 165	$ 182	$ 214
				$ -	n	0	$ -	$ -	$ -	$ -
CONNECTIONS / INSTALLATION				$ -	n	0	$ -	$ -	$ -	$ -
Manlift / Scaffolding	1.0	ls	500.00	$ 500.00	n	0	$ -	$ 500	$ 550	$ 649
Connect DCW and DHW Piping	1.0	ls	50.00	$ 50.00	n	65	$ 65.00	$ 115	$ 127	$ 149
Flue & Comb Air Piping	1.0	ea	500.00	$ 500.00	n	260	$ 260.00	$ 760	$ 836	$ 986
Gas Piping	1.0	ea	50.00	$ 50.00	n	130	$ 130.00	$ 180	$ 198	$ 234
				$ -	n	0	$ -	$ -	$ -	$ -
Test / Check & Start Up	1.0	ea	50.00	$ 50.00	n	130	$ 130.00	$ 180	$ 198	$ 234
Commissioning	1.0	ea	25.00	$ 25.00	n	65	$ 65.00	$ 90	$ 99	$ 117
				$ -	n	0	$ -	$ -	$ -	$ -
				$ -	n	0	$ -	$ -	$ -	$ -
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				$ 3,875			**$ 1,235**	**$ 5,110**	**$ 5,621**	**$ 6,633**

ESTIMATE WORKSHEET	ORIGINATING OFFICE: Cleveland	DATE SUBMITTED: 10/07/13	PROJECT NO.: J20130278	CONTRACT NO.:
	PROJECT AND CITY: City of Seven Hills **RENEW Energy Audit** Seven Hills Ohio		PURPOSE: Estimated Project Cost	STUDY
			ITEM: Service Garage Roof Replacement	
ESTIMATE VALID TO: 12/31/13	ESTIMATED BY: CLZ	LABOR RATE: $65.00 /HR	DATE: 10/07/13	Page 1 of 1

DESCRIPTION OF WORK	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	MATERIAL PER UNIT	MATERIAL SUBTOTAL	LABOR OT (y/n)	LABOR PER UNIT	LABOR SUBTOTAL	SUBTOTALS	ECCA	EXTENDED
DEMOLTION				$ -	n	0	$ -	$ -	$ -	$ -
Remove Existing Roof - 5,000 sf	1.0	ls	500.00	$ 500	n	3250	$ 3,250.00	$ 3,750	$ 4,125	$ 4,868
				$ -	n	0	$ -	$ -	$ -	$ -
NEW WORK				$ -	n	0	$ -	$ -	$ -	$ -
Patch Roof Deck	500.0	sf	2.00	$ 1,000	n	3	$ 1,625.00	$ 2,625	$ 2,888	$ 3,407
Insulation - 3.5-inch polyiso	5000.0	sf	3.00	$ 15,000.00	n	1	$ 3,250.00	$ 18,250	$ 20,075	$ 23,689
EPDM Membrane	5000.0	sf	1.50	$ 7,500.00	n	2	$ 8,125.00	$ 15,625	$ 17,188	$ 20,281
Lift Existing HVAC Units	0.0	ls	2500.00	$ -	n	2600	$ -	$ -	$ -	$ -
Flashing - Against Wall	400.0	sf	10.00	$ 4,000.00	n	7	$ 2,600.00	$ 6,600	$ 7,260	$ 8,567
Flashing - Roof Edge	80.0	sf	10.00	$ 800.00	n	7	$ 520.00	$ 1,320	$ 1,452	$ 1,713
Flashing - Roof Curbs	0.0	sf	10.00	$ -	n	7	$ -	$ -	$ -	$ -
Pitch Pockets / Tall Cone Flashing	10.0	ea	100.00	$ 1,000.00	n	130	$ 1,300.00	$ 2,300	$ 2,530	$ 2,985
				$ -	n	0	$ -	$ -	$ -	$ -
				$ -	n	0	$ -	$ -	$ -	$ -
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				$ -	n	0	$ -	$ -	$ -	$ -
				$ 29,800			**$ 20,670**	**$ 50,470**	**$ 55,517**	**$ 65,510**

ESTIMATE WORKSHEET	ORIGINATING OFFICE: Cleveland	DATE SUBMITTED: 10/07/13	PROJECT NO.: J20130278	CONTRACT NO.:
	PROJECT AND CITY: City of Seven Hills **RENEW Energy Audit** Seven Hills Ohio		PURPOSE: Estimated Project Cost	STUDY
			ITEM: Rec Center Pool Heaters	
ESTIMATE VALID TO: 12/31/13	ESTIMATED BY: CLZ	LABOR RATE: $65.00 /HR	DATE: 10/07/13	Page 1 of 1

DESCRIPTION OF WORK	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	MATERIAL PER UNIT	MATERIAL SUBTOTAL	LABOR OT (y/n)	LABOR PER UNIT	LABOR SUBTOTAL	SUBTOTALS	ECCA	EXTENDED
DEMOLTION				$ -	n	0	$ -	$ -	$ -	$ -
Remove Existing Pool Heater	1.0	ls	250.00	$ 250	n	260	$ 260.00	$ 510	$ 561	$ 662
Patch Roof Flue Penetration	1.0	ls	500.00	$ 500	n	260	$ 260.00	$ 760	$ 836	$ 986
				$ -	n	0	$ -	$ -	$ -	$ -
EQUIPMENT				$ -	n	0	$ -	$ -	$ -	$ -
Two (2) High Efficiency Pool Heaters	600.0	mbh	20.00	$ 12,000	n	0	$ -	$ 12,000	$ 13,200	$ 15,576
Set Pool Heaters	2.0	ls	100.00	$ 200.00	n	780	$ 1,560.00	$ 1,760	$ 1,936	$ 2,284
				$ -	n	0	$ -	$ -	$ -	$ -
CONNECTIONS / INSTALLATION				$ -	n	0	$ -	$ -	$ -	$ -
Manlift / Scaffolding	1.0	ls	500.00	$ 500.00	n	0	$ -	$ 500	$ 550	$ 649
Flue & Comb Air Piping	2.0	ea	500.00	$ 1,000.00	n	520	$ 1,040.00	$ 2,040	$ 2,244	$ 2,648
Gas Piping	2.0	ea	50.00	$ 100.00	n	260	$ 520.00	$ 620	$ 682	$ 805
Pool Water Lines	2.0	ea	500.00	$ 1,000.00	n	520	$ 1,040.00	$ 2,040	$ 2,244	$ 2,648
Controls	2.0	ea	250.00	$ 500.00	n	260	$ 520.00	$ 1,020	$ 1,122	$ 1,324
Electrical	2.0	ea	250.00	$ 500.00	n	260	$ 520.00	$ 1,020	$ 1,122	$ 1,324
				$ -	n	0	$ -	$ -	$ -	$ -
Test / Check & Start Up	2.0	ea	50.00	$ 100.00	n	260	$ 520.00	$ 620	$ 682	$ 805
Commissioning	2.0	ea	25.00	$ 50.00	n	130	$ 260.00	$ 310	$ 341	$ 402
				$ -	n	0	$ -	$ -	$ -	$ -
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				$ -	n	0	$ -	$ -	$ -	$ -
				$ 16,700			**$ 6,500**	**$ 23,200**	**$ 25,520**	**$ 30,114**

OSBORN ENGINEERING **ESTIMATE WORKSHEET**	ORIGINATING OFFICE: Cleveland	DATE SUBMITTED: 10/07/13	PROJECT NO.: J20130278	CONTRACT NO.:
	PROJECT AND CITY: City of Seven Hills **RENEW Energy Audit** Seven Hills Ohio		PURPOSE: Estimated Project Cost	STUDY
			ITEM: Rec Center Pool DHU	
ESTIMATE VALID TO: 12/31/13	ESTIMATED BY: CLZ	LABOR RATE: $65.00 /HR	DATE: 10/07/13	Page 1 of 1

DESCRIPTION OF WORK	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	MATERIAL PER UNIT	MATERIAL SUBTOTAL	LABOR OT (y/n)	LABOR PER UNIT	LABOR SUBTOTAL	SUBTOTALS	ECCA	EXTENDED
DEMOLTION				$ -	n	0	$ -	$ -	$ -	$ -
Reclaim Refrigerant	1.0	ls	250.00	$ 250	n	260	$ 260.00	$ 510	$ 561	$ 662
Patch Roof	1.0	ls	7,500.00	$ 7,500	n	0	$ -	$ 7,500	$ 8,250	$ 9,735
Crane / Remove DHU & ACCU	1.0	ls	1,500.00	$ 1,500	n	1560	$ 1,560.00	$ 3,060	$ 3,366	$ 3,972
				$ -	n	0	$ -	$ -	$ -	$ -
EQUIPMENT				$ -	n	0	$ -	$ -	$ -	$ -
Pool DHU & ACCU	40000.0	cfm	9.00	$ 360,000	n	0	$ -	$ 360,000	$ 396,000	$ 467,280
Cut Roof / Set Curb	2.0	ea	500.00	$ 1,000	n	1560	$ 3,120.00	$ 4,120	$ 4,532	$ 5,348
Roof Framing - 4x4x1/4 L	2.0	ea	500.00	$ 1,000	n	1040	$ 2,080.00	$ 3,080	$ 3,388	$ 3,998
Roof Flashing	200.0	lft	75.00	$ 15,000	n	0	$ -	$ 15,000	$ 16,500	$ 19,470
Install SA / RA Duct Drops	2.0	ea	250.00	$ 500	n	130	$ 260.00	$ 760	$ 836	$ 986
Crane / Set Unit	2.0	ea	5,000.00	$ 10,000	n	1560	$ 3,120.00	$ 13,120	$ 14,432	$ 17,030
				$ -	n	0	$ -	$ -	$ -	$ -
ELECTRICAL 60.00 88.59	amps			$ -	n	0	$ -	$ -	$ -	$ -
60 HP Feeder	200.0	lft	7.65	$ 1,530	n	16	$ 3,250.00	$ 4,780	$ 5,258	$ 6,204
60-100 HP Motor Connection	2.0	ea	200.00	$ 400	n	520	$ 1,040.00	$ 1,440	$ 1,584	$ 1,869
60 HP Disconnect	2.0	ea	1,025.00	$ 2,050	n	520	$ 1,040.00	$ 3,090	$ 3,399	$ 4,011
60 HP Circuit Breaker (100 Amp)	2.0	ea	670.00	$ 1,340	n	150	$ 299.00	$ 1,639	$ 1,803	$ 2,127
60 HP Variable Frequency Drives	0.0	hp	150.00	$ -	n	0	$ -	$ -	$ -	$ -
UV Water Treatment	1.0	ls	50,000.00	$ 50,000	n	0	$ -	$ 50,000	$ 55,000	$ 64,900
CONNECTIONS / INSTALLATION				$ -	n	0	$ -	$ -	$ -	$ -
Manlift / Scaffolding	1.0	ls	2500.00	$ 2,500	n	0	$ -	$ 2,500	$ 2,750	$ 3,245
Connect to Existing SA / RA Ductwork	1.0	ls	500.00	$ 500	n	1040	$ 1,040.00	$ 1,540	$ 1,694	$ 1,999
Refrigeration Linesets	4.0	ea	500.00	$ 2,000	n	1040	$ 4,160.00	$ 6,160	$ 6,776	$ 7,996
Gas Piping	1.0	ls	500.00	$ 500	n	520	$ 520.00	$ 1,020	$ 1,122	$ 1,324
Pool Water Lines	1.0	ls	500.00	$ 500	n	1040	$ 1,040.00	$ 1,540	$ 1,694	$ 1,999
Controls	1.0	ls	2,500.00	$ 2,500	n	1040	$ 1,040.00	$ 3,540	$ 3,894	$ 4,595
Demolition Existing Duct & Grilles	1.0	ls	-	$ -	n	2600	$ 2,600.00	$ 2,600	$ 2,860	$ 3,375
Rework Main Ductwork	15000.0	lbs	4.00	$ 60,000	n	2	$ 24,375.00	$ 84,375	$ 92,813	$ 109,519
Install New RGD's	20.0	ea	75.00	$ 1,500	n	65	$ 1,300.00	$ 2,800	$ 3,080	$ 3,634
Structural Steel Rework	1.0	ls	10000.00	$ 10,000	n	0	$ -	$ 10,000	$ 11,000	$ 12,980
2-Part Epoxy Paint	10000.0	sf	0.75	$ 7,500	n	1	$ 7,800.00	$ 15,300	$ 16,830	$ 19,859
Replace Existing Lights	1.0	ls	25,827.00	$ 25,827	n	0	$ -	$ 25,827	$ 28,410	$ 33,523
Smart Meters	2.0	ea	3,500.00	$ 7,000	n	0	$ -	$ 7,000	$ 7,700	$ 9,086
BAS Integration	1.0	ls	25,000.00	$ 25,000	n	0	$ -	$ 25,000	$ 27,500	$ 32,450
Test / Check & Start Up	2.0	ea	250.00	$ 500	n	2600	$ 5,200.00	$ 5,700	$ 6,270	$ 7,399
Balancing	1.0	ls	500.00	$ 500	n	5200	$ 5,200.00	$ 5,700	$ 6,270	$ 7,399
Commissioning	1.0	ls	250.00	$ 250	n	5200	$ 5,200.00	$ 5,450	$ 5,995	$ 7,074
				$ 598,647			**$ 75,504**	**$ 674,151**	**$ 741,566**	**$ 875,048**

ESTIMATE WORKSHEET	ORIGINATING OFFICE: Cleveland	DATE SUBMITTED: 10/07/13	PROJECT NO.: J20130278	CONTRACT NO.:
	PROJECT AND CITY: City of Seven Hills **RENEW Energy Audit** Seven Hills Ohio		PURPOSE: Estimated Project Cost	STUDY
			ITEM: Fire Department A/C Units	
ESTIMATE VALID TO: 12/31/13	ESTIMATED BY: CLZ	LABOR RATE: $65.00 /HR	DATE: 10/07/13	Page 1 of 1

DESCRIPTION OF WORK	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	MATERIAL PER UNIT	MATERIAL SUBTOTAL	LABOR OT (y/n)	LABOR PER UNIT	LABOR SUBTOTAL	SUBTOTALS	ECCA	EXTENDED
DEMOLTION				$ -	n	0	$ -	$ -	$ -	$ -
Reclaim Refrigerant	4.0	ea	50.00	$ 200	n	65	$ 260	$ 460	$ 506	$ 597
Remove Outdoor Condensing Unit	4.0	ea	-	$ -	n	65	$ 260	$ 260	$ 286	$ 337
Remove Indoor Unit	4.0	ea	-	$ -	n	130	$ 520	$ 520	$ 572	$ 675
				$ -	n	0	$ -	$ -	$ -	$ -
EQUIPMENT				$ -	n	0	$ -	$ -	$ -	$ -
2 Ton HP Condensing Unit - 16.0 SEER	1.0	ea	2,000.00	$ 2,000	n	0	$ -	$ 2,000	$ 2,200	$ 2,596
2-1/2 Ton HP Condensing Unit - 16.0 SEER	0.0	ea	2,200.00	$ -	n	130	$ -	$ -	$ -	$ -
3 Ton HP Condensing Unit - 13.0 SEER	2.0	ea	2,400.00	$ 4,800	n	130	$ 260	$ 5,060	$ 5,566	$ 6,568
4 Ton HP Condensing Unit - 13.0 SEER	0.0	ea	3,000.00	$ -	n	130	$ -	$ -	$ -	$ -
5 Ton HP Condensing Unit - 13.0 SEER	1.0	ea	3,600.00	$ 3,600	n	130	$ 130	$ 3,730	$ 4,103	$ 4,842
40 MBH Furnace - 95% AFUE	0.0	ea	1,600.00	$ -	n	260	$ -	$ -	$ -	$ -
60 MBH Furnace - 95% AFUE	0.0	ea	1,800.00	$ -	n	260	$ -	$ -	$ -	$ -
80 MBH Furnace - 95% AFUE	0.0	ea	2,000.00	$ -	n	260	$ -	$ -	$ -	$ -
100 MBH Furnace - 95% AFUE	0.0	ea	2,200.00	$ -	n	260	$ -	$ -	$ -	$ -
120 MBH Furnace - 95% AFUE	0.0	ea	2,400.00	$ -	n	260	$ -	$ -	$ -	$ -
2 ton DX Cased Coil	1.0	ea	400.00	$ 400	n	65	$ 65	$ 465	$ 512	$ 604
2-1/2 ton DX Cased Coil	0.0	ea	450.00	$ -	n	65	$ -	$ -	$ -	$ -
3 ton DX Cased Coil	2.0	ea	500.00	$ 1,000	n	65	$ 130	$ 1,130	$ 1,243	$ 1,467
4 ton DX Cased Coil	0.0	ea	550.00	$ -	n	65	$ -	$ -	$ -	$ -
5 ton DX Cased Coil	1.0	ea	600.00	$ 600	n	65	$ 65	$ 665	$ 732	$ 863
				$ -	n	0	$ -	$ -	$ -	$ -
CONNECTIONS / INSTALLATION				$ -	n	0	$ -	$ -	$ -	$ -
Connect to Existing SA / RA Ductwork	4.0	ea	50.00	$ 200	n	130	$ 520	$ 720	$ 792	$ 935
Flue / Combustion Air Piping	0.0	ea	100.00	$ -	n	130	$ -	$ -	$ -	$ -
Linesets	4.0	ea	500.00	$ 2,000	n	130	$ 520	$ 2,520	$ 2,772	$ 3,271
Gas Piping	0.0	ea	50.00	$ -	n	33	$ -	$ -	$ -	$ -
Programmable TSTATs	4.0	ea	200.00	$ 800	n	65	$ 260	$ 1,060	$ 1,166	$ 1,376
				$ -	n	0	$ -	$ -	$ -	$ -
Test / Check & Start Up	4.0	ea	0.00	$ -	n	33	$ 130	$ 130	$ 143	$ 169
Balancing	4.0	ea	0.00	$ -	n	33	$ 130	$ 130	$ 143	$ 169
Commissioning	4.0	ea	0.00	$ -	n	33	$ 130	$ 130	$ 143	$ 169
				$ -	n	0	$ -	$ -	$ -	$ -
				$ -	n	0	$ -	$ -	$ -	$ -
				$ -	n	0	$ -	$ -	$ -	$ -
				$ -	n	0	$ -	$ -	$ -	$ -
				$ -	n	0	$ -	$ -	$ -	$ -
				$ -	n	0	$ -	$ -	$ -	$ -
				$ -	n	0	$ -	$ -	$ -	$ -
				$ 15,600			**$ 2,990**	**$ 18,590**	**$ 20,449**	**$ 22,494**

ESTIMATE WORKSHEET	ORIGINATING OFFICE: Cleveland	DATE SUBMITTED: 10/07/13	PROJECT NO.: J20130278	CONTRACT NO.:
	PROJECT AND CITY: City of Seven Hills **RENEW Energy Audit** Seven Hills Ohio		PURPOSE: Estimated Project Cost	STUDY
			ITEM: Fire Department Furnaces	
ESTIMATE VALID TO: 12/31/13	ESTIMATED BY: CLZ	LABOR RATE: $65.00 /HR	DATE: 10/07/13	Page 1 of 1

DESCRIPTION OF WORK	QUANTITY NO. UNITS	QUANTITY UNIT MEAS.	MATERIAL PER UNIT	MATERIAL SUBTOTAL	LABOR OT (y/n)	LABOR PER UNIT	LABOR SUBTOTAL	SUBTOTALS	ECCA	EXTENDED
DEMOLTION				$ -	n	0	$ -	$ -	$ -	$ -
Reclaim Refrigerant	0.0	ea	50.00	$ -	n	65	$ -	$ -	$ -	$ -
Remove Outdoor Condensing Unit	0.0	ea	-	$ -	n	65	$ -	$ -	$ -	$ -
Remove Indoor Unit	2.0	ea	-	$ -	n	130	$ 260	$ 260	$ 286	$ 337
				$ -	n	0	$ -	$ -	$ -	$ -
EQUIPMENT				$ -	n	0	$ -	$ -	$ -	$ -
2 Ton HP Condensing Unit - 16.0 SEER	0.0	ea	2,000.00	$ -	n	0	$ -	$ -	$ -	$ -
2-1/2 Ton HP Condensing Unit - 16.0 SEER	0.0	ea	2,200.00	$ -	n	130	$ -	$ -	$ -	$ -
3 Ton HP Condensing Unit - 16.0 SEER	0.0	ea	2,400.00	$ -	n	130	$ -	$ -	$ -	$ -
4 Ton HP Condensing Unit - 16.0 SEER	0.0	ea	3,000.00	$ -	n	130	$ -	$ -	$ -	$ -
5 Ton HP Condensing Unit - 16.0 SEER	0.0	ea	3,600.00	$ -	n	130	$ -	$ -	$ -	$ -
40 MBH Furnace - 95% AFUE	1.0	ea	1,600.00	$ 1,600	n	260	$ 260	$ 1,860	$ 2,046	$ 2,414
60 MBH Furnace - 95% AFUE	1.0	ea	1,800.00	$ 1,800	n	260	$ 260	$ 2,060	$ 2,266	$ 2,674
80 MBH Furnace - 95% AFUE	0.0	ea	2,000.00	$ -	n	260	$ -	$ -	$ -	$ -
100 MBH Furnace - 95% AFUE	0.0	ea	2,200.00	$ -	n	260	$ -	$ -	$ -	$ -
120 MBH Furnace - 95% AFUE	0.0	ea	2,400.00	$ -	n	260	$ -	$ -	$ -	$ -
2 ton DX Cased Coil	0.0	ea	400.00	$ -	n	65	$ -	$ -	$ -	$ -
2-1/2 ton DX Cased Coil	0.0	ea	450.00	$ -	n	65	$ -	$ -	$ -	$ -
3 ton DX Cased Coil	0.0	ea	500.00	$ -	n	65	$ -	$ -	$ -	$ -
4 ton DX Cased Coil	0.0	ea	550.00	$ -	n	65	$ -	$ -	$ -	$ -
5 ton DX Cased Coil	0.0	ea	600.00	$ -	n	65	$ -	$ -	$ -	$ -
				$ -	n	0	$ -	$ -	$ -	$ -
CONNECTIONS / INSTALLATION				$ -	n	0	$ -	$ -	$ -	$ -
Connect to Existing SA / RA Ductwork	2.0	ea	50.00	$ 100	n	130	$ 260	$ 360	$ 396	$ 467
Flue / Combustion Air Piping	2.0	ea	100.00	$ 200	n	130	$ 260	$ 460	$ 506	$ 597
Linesets	0.0	ea	500.00	$ -	n	130	$ -	$ -	$ -	$ -
Gas Piping	2.0	ea	50.00	$ 100	n	33	$ 65	$ 165	$ 182	$ 214
Programmable TSTATs	2.0	ea	200.00	$ 400	n	65	$ 130	$ 530	$ 583	$ 688
				$ -	n	0	$ -	$ -	$ -	$ -
Test / Check & Start Up	2.0	ea	0.00	$ -	n	33	$ 65	$ 65	$ 72	$ 84
Balancing	2.0	ea	0.00	$ -	n	33	$ 65	$ 65	$ 72	$ 84
Commissioning	2.0	ea	0.00	$ -	n	33	$ 65	$ 65	$ 72	$ 84
				$ -	n	0	$ -	$ -	$ -	$ -
				$ -	n	0	$ -	$ -	$ -	$ -
				$ -	n	0	$ -	$ -	$ -	$ -
				$ -	n	0	$ -	$ -	$ -	$ -
				$ -	n	0	$ -	$ -	$ -	$ -
				$ -	n	0	$ -	$ -	$ -	$ -
				$ -	n	0	$ -	$ -	$ -	$ -
				$ -	n	0	$ -	$ -	$ -	$ -
				$ 4,200			**$ 1,495**	**$ 5,695**	**$ 6,265**	**$ 6,891**

LIGHTING ENERGY SAVINGS & PROJECT COST

EXISTING												PROPOSED								COST		
Building	Area	Interior / Exterior / Exit	Area Code	Control	Hrs/yr	Fixture Code	Lamp Type	Number of Fixtures	Lamps per Fixture	Fixture Power (W)	Energy Usage (kWh/yr)	Control2	Hrs/yr2	Retrofit / Replace	Lamp Type2	Number of Fixtures2	Lamps per Fixture2	Fixture Power (W)2	Energy Usage (kWh/yr)2	Energy Savings (kWh/yr)	Energy Cost Savings ($/yr)	Total Implementation Costs ($)
City Hall	Meeting (Rm. 101)	Interior	M	LS	1,752	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	10	4	128	2,242	OS	1,082	None	Existing to Remain	10	4	128	1,384	858	$82	$383
City Hall	Council Conference (Rm. 125)	Interior	M	LS	1,752	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	9	4	128	2,018	OS	1,082	None	Existing to Remain	9	4	128	1,246	772	$74	$338
City Hall	Senior Citizens (Rm. 100)	Interior	P	LS	1,861	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	9	4	128	2,143	OS	1,357	None	Existing to Remain	9	4	128	1,563	580	$56	$338
City Hall	Law Department (Rm. 119)	Interior	P	LS	1,861	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	5	4	128	1,191	OS	1,357	None	Existing to Remain	5	4	128	868	322	$31	$203
City Hall	Council Records (Rm. 128)	Interior	P	LS	1,861	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	4	4	128	953	OS	1,357	None	Existing to Remain	4	4	128	695	258	$25	$158
City Hall	Law Director (Rm. 111)	Interior	P	LS	1,861	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	2	4	128	476	OS	1,357	None	Existing to Remain	2	4	128	347	129	$12	$90
City Hall	Clerk (Rm. 120)	Interior	P	LS	1,861	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	6	4	128	1,429	OS	1,357	None	Existing to Remain	6	4	128	1,042	387	$37	$225
City Hall	Equp. Law (Rm. 112)	Interior	P	LS	1,861	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	1	4	128	238	OS	1,357	None	Existing to Remain	1	4	128	174	64	$6	$45
City Hall	Equipment (Rm. 102)	Interior	P	LS	1,861	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	1	4	128	238	OS	1,357	None	Existing to Remain	1	4	128	174	64	$6	$45
City Hall	Finance Records (Rm. 103)	Interior	P	LS	1,861	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	4	4	128	953	OS	1,357	None	Existing to Remain	4	4	128	695	258	$25	$158
City Hall	Sewer Dept. (Rm. 105)	Interior	P	LS	1,861	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	1	4	128	238	OS	1,357	None	Existing to Remain	1	4	128	174	64	$6	$45
City Hall	Finance Office (Rm. 107)	Interior	P	LS	1,861	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	7	4	128	1,667	OS	1,357	None	Existing to Remain	7	4	128	1,216	451	$43	$270
City Hall	Files (Rm. 117)	Interior	S	LS	2,811	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	1	4	128	360	OS	1,568	None	Existing to Remain	1	4	128	201	159	$15	$45
City Hall	Tax Director (Rm. 114)	Interior	P	LS	1,861	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	2	4	128	476	OS	1,357	None	Existing to Remain	2	4	128	347	129	$12	$90
City Hall	Tax Files (Rm. 116)	Interior	S	LS	2,811	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	2	4	128	720	OS	1,568	None	Existing to Remain	2	4	128	401	318	$31	$90
City Hall	Tax Department (Rm. 115)	Interior	P	LS	1,861	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	4	4	128	953	OS	1,357	None	Existing to Remain	4	4	128	695	258	$25	$158
City Hall	Corridor	Interior	H	LS	7,749	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	11	4	128	10,911	OS	3,867	None	Existing to Remain	11	4	128	5,445	5,466	$525	$428
City Hall	Community Room (Rm. 140)	Interior	M	LS	1,752	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	12	4	128	2,691	OS	1,082	None	Existing to Remain	12	4	128	1,661	1,030	$99	$450
City Hall	Receptions & Collections (Rm. 141)	Interior	S	LS	2,811	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	3	4	128	1,079	OS	1,568	None	Existing to Remain	3	4	128	602	477	$46	$113
City Hall	Mayor's Files (Rm. 143)	Interior	S	LS	2,811	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	2	4	128	720	OS	1,568	None	Existing to Remain	2	4	128	401	318	$31	$90
City Hall	Mayor's Secretary (Rm. 142)	Interior	O	LS	4,064	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	5	4	128	2,601	OS	2,590	None	Existing to Remain	5	4	128	1,657	944	$91	$203
City Hall	Mayor's Office (Rm. 145)	Interior	P	LS	1,861	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	4	4	128	953	OS	1,357	None	Existing to Remain	4	4	128	695	258	$25	$158
City Hall	Conference Room (Rm. 152)	Interior	M	LS	1,752	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	6	4	128	1,345	OS	1,082	None	Existing to Remain	6	4	128	831	515	$49	$225
City Hall	Lounge (Rm. 153)	Interior	M	LS	1,752	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	6	4	128	1,345	OS	1,082	None	Existing to Remain	6	4	128	831	515	$49	$225
City Hall	Corridor (West Wing)	Interior	H	LS	7,749	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	10	4	128	9,919	OS	3,867	None	Existing to Remain	10	4	128	4,950	4,969	$477	$383
City Hall	Meeting Area (Rm. 138)	Interior	M	LS	1,752	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	15	4	128	3,364	OS	1,082	None	Existing to Remain	15	4	128	2,077	1,287	$124	$563
City Hall	Meeting Area (Rm. 138A)	Interior	M	LS	1,752	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	25	4	128	5,606	OS	1,082	None	Existing to Remain	25	4	128	3,461	2,145	$206	$945
City Hall	Conference Room (Rm. 156)	Interior	M	LS	1,752	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	2	4	128	448	OS	1,082	None	Existing to Remain	2	4	128	277	172	$16	$90
City Hall	Files/Copy (Rm. 158)	Interior	S	LS	2,811	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	1	4	128	360	OS	1,568	None	Existing to Remain	1	4	128	201	159	$15	$45
City Hall	Building Dept. (Rm. 159)	Interior	P	LS	1,861	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	7	4	128	1,667	OS	1,357	None	Existing to Remain	7	4	128	1,216	451	$43	$270
City Hall	Building Commissioner (Rm. 160)	Interior	P	LS	1,861	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	2	4	128	476	OS	1,357	None	Existing to Remain	2	4	128	347	129	$12	$90
City Hall	Engineer (Rm. 161)	Interior	P	LS	1,861	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	2	4	128	476	OS	1,357	None	Existing to Remain	2	4	128	347	129	$12	$90
City Hall	Reception (Rm. 157)	Interior	P	LS	1,861	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	2	4	128	476	OS	1,357	None	Existing to Remain	2	4	128	347	129	$12	$90
City Hall	Men's Locker Room	Interior	LKR	LS	5,694	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	1	4	128	729	OS	2,626	None	Existing to Remain	1	4	128	336	393	$38	$45
City Hall	Police Reports (Rm. 173)	Interior	P	LS	1,861	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	3	4	128	714	OS	1,357	None	Existing to Remain	3	4	128	521	193	$19	$113
City Hall	Sergeants (Rm. 179)	Interior	P	LS	1,861	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	4	4	128	953	OS	1,357	None	Existing to Remain	4	4	128	695	258	$25	$158
City Hall	Chief Office (Rm. 180)	Interior	P	LS	1,861	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	4	4	128	953	OS	1,357	None	Existing to Remain	4	4	128	695	258	$25	$158
City Hall	Lieutenant (Rm. 185)	Interior	P	LS	1,861	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	2	4	128	476	OS	1,357	None	Existing to Remain	2	4	128	347	129	$12	$90
City Hall	Secretary (Rm. 186)	Interior	P	LS	1,861	T8-2X4T-4L-1B	T8, 2x4 Troffer, 4 Lamps, 1 ballast	2	4	128	476	OS	1,357	None	Existing to Remain	2	4	128	347	129	$12	$90
City Hall	Evidence (Rm. 181)	Interior	P	LS	1,861	T8-2X4T-2L-1B	T8, 2x4 Troffer, 2 Lamps, 1 ballast	2	2	64	238	OS	1,357	None	Existing to Remain	2	2	64	174	64	$6	$90
City Hall	Passage	Interior	H	LS	7,749	T8-2X4T-1L-1B	T8, 2x4 Parabolic, 3 Lamps, dimmable ballasts	12	1	128	11,903	OS	3,867	None	Existing to Remain	12	1	128	5,940	5,962	$573	$450
City Hall	Building Light (Police South Side)	Exterior	E	TC	4,368	150W-AREA-HID	100W HID Wall Pack	2	1	115	1,005	TC	4,368	Replace	LED Wallpack with photocell	2	1	50	437	568	$55	$772
City Hall	Building Light (Police South Side)	Exterior	E	TC	4,368	150W-AREA-HID	Metal Halide Spot Light	2	1	115	1,005	TC	4,368	Replace	LED Wallpack with photocell	2	1	50	437	568	$55	$772
City Hall	Building Light (City Hall South Side)	Exterior	E	TC	4,368	150W-WP-HID	150W HID Wall Pack	2	1	172.5	1,507	TC	4,368	Replace	LED Wallpack with photocell	2	1	40	349	1,158	$111	$911
City Hall	Building Light (City Hall South Side)	Exterior	E	TC	4,368	100W-DL-INC-CFL	100W Incandescent Downlight / Wallwash	2	1	100	874	TC	4,368	Retrofit	Downlight / Wallwash CFL	2	1	26	227	646	$62	$38
City Hall	Gymansium	Interior	G	LS	6,462	300W-DL-INC-CFL	300W Incandescent Downlight / Wallwash	18	1	300	34,895	LS	6,462	Retrofit	Downlight / Wallwash CFL	18	1	84	9,771	25,124	$2,414	$1,170
City Hall	Kitchent (Rm. 148)	Interior	M	LS	1,752	100W-DL-INC-CFL	100W Incandescent Downlight / Wallwash	6	1	100	1,051	LS	1,752	Retrofit	Downlight / Wallwash CFL	6	1	26	273	778	$75	$114
City Hall	South Entry (Police)	Interior	V	LS	8,760	T12-2X4T-2L-1B	T12, 2x4 Troffer, 2 Lamps, 1 ballast	2	2	92	1,612	LS	8,760	Retrofit	T8, 2x4 Troffer, 2 Lamps, 1 ballast	2	2	64	1,121	491	$47	$250
City Hall	Police Garage	Interior	O	LS	4,064	T12-2X4T-2L-1B	T12, 2x4 Troffer, 2 Lamps, 1 ballast	44	2	92	16,452	LS	4,064	Retrofit	T8, 2x4 Troffer, 2 Lamps, 1 ballast	44	2	64	11,445	5,007	$481	$5,490
City Hall	Police Offices (Near N.I.C)	Interior	P	LS	1,861	T12-2X4T-2L-1B	T12, 2x4 Troffer, 2 Lamps, 1 ballast	4	2	92	685	LS	1,861	Retrofit	T8, 2x4 Troffer, 2 Lamps, 1 ballast	4	2	64	476	208	$20	$499
Fire Station	Flood Lights	Exterior	E	TC	4,368	250W HID FLOOD	250W HID Can Light	4	2	286.25	5,001	TC	4,368	Retrofit	80W LED Can Light	4	2	80	1,398	3,604	$346	$3,765
Fire Station	Eye Lid Wall Packs 100W MH	Exterior	E	DS	4,368	100W-WP-HID	100W HID Wall Pack	11	1	115	5,526	DS	4,368	Replace	LED Wallpack with photocell	11	1	40	1,922	3,604	$346	$4,244
Fire Station	Women's Restroom (Rm. 104)	Interior	R	LS	5,694	100W-DL-INC-CFL	100W Incandescent Downlight / Wallwash	1	1	100	569	LS	5,694	Retrofit	Downlight / Wallwash CFL	1	1	26	148	421	$40	$19
Fire Station	Men's Restroom (Rm. 108)	Interior	R	LS	5,694	75W-DL-INC-CFL	75W Incandescent Downlight / Wallwash	2	1	75	854	LS	5,694	Retrofit	Downlight / Wallwash CFL	2	1	20	228	626	$60	$31
Recreation Center	100 Watt MH Bollards	Exterior	E	DS	4,368	100W-HID-BLLRD	100W HID Bollard	11	1	165	7,928	DS	4,368	Replace	LED Bollard	11	1	25	1,201	6,727	$646	$7,862
Recreation Center	Site Lighting (Parking Lot)	Exterior	E	TC	4,368	PLDP400	PL Double Pole Shoebox 400MH	2	2	916	8,002	TC	4,368	Replace	PL Double Shoebox 400W Equivalent LED	2	2	324	2,830	5,172	$497	$5,145
Recreation Center	Stairwell to Gym	Interior	H	LS	7,749	250W HID CAN	250W HID Can Light	5	1	286.25	11,091	DL	3,875	Replace	80W LED Can Light	5	1	80	1,550	9,541	$917	$5,177
Recreation Center	Site Lighting (Parking Lot)	Exterior	E	TC	4,368	PLSP400	PL Single Pole Shoebox 400MH	23	1	458	46,013	TC	4,368	Replace	PL Single Shoebox 400W Equivalent LED	23	1	162	16,275	29,737	$2,858	$30,695
Recreation Center	Track	Interior	RC	LS	5,198	LB250HID	Low Bay 250HID	31	1	286.25	46,126	LS	5,198	Replace	T8 Low Bay Fluorescent, 4 Lamp	31	2	128	20,626	25,500	$2,451	$15,234
Service Garage	250W MH Post Top Floods	Exterior	E	TC	4,368	250W HID FLOOD	250W HID Can Light	4	1	286.25	5,001	TC	4,368	Replace	80W LED Can Light	4	2	80	1,398	3,604	$346	$4,141
Service Garage	175W MH Flood Lights	Exterior	E	TC	4,368	175W HID FLOOD	175W HID Flood	7	1	200.375	6,127	TC	4,368	Replace	70W LED Flood	7	1	50	1,529	4,598	$442	$3,263

GLOSSARY OF TERMS

AHU air handling unit.

APR annual percentage rate.

ASHRAE American Society of Heating, Refrigerating and Air-Conditioning Engineers

ASHRAE Standard 90.1 2007 is a standard provides minimum requirements for the energy-efficient design of buildings excluding low-rise residential buildings

BAS (Building Automation System) is a system of devices, sensors and programmable controllers that is utilized to control HVAC systems and can be used to control other building systems such as lighting.

BTU (British Thermal Unit) is a measure of energy. One BTU is the amount of energy it takes to raise the temperature of 1 pound of water, 1 °F at or near 39.2 °F and 1 atmosphere of pressure.

BTUH (BTUs per hour) is a unit of power. 3,412 Btuh equals 1 kW.

CCF is a unit of volume, typically of natural gas or water. One CCF equals 100 cubic feet.

CFL compact fluorescent light.

COP (Coefficient of Performance) a rating of efficiency that is the ratio of heating or cooling provided by a heat pump (or other refrigeration machine) to the energy consumed by the system under designated operating conditions (See Equation 1 below).

$$COP = \frac{12}{(3.412)(kW/ton)} = \frac{EER}{3.412} \qquad \textbf{Equation 1}$$

DCV Demand Control Ventilation is an energy conservation strategy that reduces the minimum outside air ventilation set point based on actual occupancy as indicated by a carbon dioxide sensor.

DOE Department of Energy

ECM Energy Conservation Measure

EER (Energy Efficiency Ratio) a rating of efficiency that is the ratio of heating or cooling provided by a heat pump (or other refrigeration machine) to the energy consumed by the system under designated operating conditions (See Equation 2 below).

$$EER = \frac{12}{(kW/ton)} = 3.412(COP) \qquad \textbf{Equation 2}$$

EIA Energy Information Administration

EUI (Energy Use Intensity) is the total energy usage of a building per square foot, commonly presented as BTU/ft^2.

°F degrees Fahrenheit.

GSF Gross Square Footage

HID high intensity discharge lights are a type of electrical lamp which produces light by means of an electric arc between tungsten electrodes housed inside a translucent or transparent fused quartz or fused alumina arc tube. These include metal halide, mercury vapor and high pressure sodium lights and are typically used in high-bay or exterior lighting.

HP horsepower. One horsepower translates to 746 watts (0.746 kW) of electricity

HP – Boiler, One boiler horsepower translates to 33,475 btu per hour output

HPS high pressure sodium lights are often used for exterior lighting and produce a pinkish-orange light when warmed.

HVAC Heating, Ventilation and Air-Conditioning.

IGV (Inlet Guide Vanes) are movable blades at the inlet of a fan that are used to vary the amount of airflow through the fan.

in wc Inches of water column. This is a unit of pressure, typically air pressure in HVAC.

IRR internal rate of return.

kBtu is a unit of energy. One kBtu equals 1,000 BTU.

Energy Type	UNIT	Conversion Factor for kBtu
Electricity	KWH	3.412
Natural Gas	NG MCF	1,030
Chilled Water	ton hours	12
Steam	klb	1,194

klb is 1,000 pounds, typical unit of measure for steam consumption.

kW (Kilowatt) is a unit of power, commonly used to express a buildings electrical consumption. One kilowatts is equal to 1,000 watts and 3,412 Btuh.

kWh (Kilowatt-hour) is a measure of energy, defined as the consumption of one kilowatt in one hour. One kilowatt-hour is equal to 3,412 BTUs.

kW/ton (Kilowatt per ton) is a rating of efficiency that is the ratio of energy consumed by a heat pump (or other refrigeration machine), in kW, to the heating or cooling provided. The lower the kW/ton the more efficient the system (See Equation 3 below).

$$kW/ton = \frac{12}{(EER)} = \frac{12}{3.412(COP)}$$ **Equation 3**

Latent Heat is the amount of heat absorbed or released by a substance undergoing a change of state but not temperature.

LCCA life cycle cost analysis.

LED light emitting diode.

Lighting Power Density is a measurement of power used for lighting, in an area, per the square footage that area, commonly presented in W/ft^2.

MBH thousand BTUs per hour.

MCF is a unit of volume, typically of natural gas. One MCF equals 1,000 cubic feet.

MER mechanical equipment room.

MH metal halide lights are often used for exterior lighting.

MMBTU is a unit of energy. One mmbtu equals 1,000,000 BTU.

$MTCO_2$ metric tons of carbon dioxide, a prevalent greenhouse gas indicator.

Energy Type	UNIT	Conversion Factor for $MTCO_2$
Electricity	KWH	0.000718
Natural Gas	NG MCF	0.05135
Chilled Water	ton hours	0.002051427
Steam	klb	0.0942663

PPH (Pounds per Hour) is a mass flow rate commonly used to quantify steam usage.

PSI measure of pressure, pounds per square inch.

R-22 is a refrigerant that contains hydro-chlorofluorocarbons. It is currently being phased out of use.

RCxA retrocommissioning.

ROI return on investment.

RTU is a rooftop unit for heating and cooling.

SEER Seasonal Energy Efficiency Ratio, a rating system used to establish the efficiency level of cooling equipment.

Sensible Heat is the heat that can be felt and measured by a thermometer.

SPP simple payback period.

T5HO is a high efficient, high output fluorescent lamp that measures 5/8" in diameter.

T8 is a fluorescent lamp that measures 1" (8/8") in diameter.

T12 is a fluorescent lamp that measures 1 1/2" (12/8") in diameter.

Therm is a measure of energy. One therm equals 100,000 BTUs.

Ton-Hour is a mass flow rate commonly used for chilled water / refrigerant. One ton-hour equals 12,000 BTUs.

VAV (Variable Air Volume) is a type of air distribution system that varies the amount of air to save energy.

VFD (Variable Frequency Drive) is a control put on a motor to vary the speed of the fan to save energy.

W (Watt) is a unit of power. One kilowatts (kW) is equal to 1,000 watts