Salem County

Energy Saving Plan for Salem County

Johnson Building

Inter-Agency Council

Emergency Services Building

Fenwick Building

Social Services Building

Agricultural Building

Main County Office

Admin Building

Summary of Revisions

8/11/2020:	Draft Report Submission
1/22/2021:	Third Party Revision 1

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1. Contacts

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2. Executive Summary

Site: Salem County Municipal Buildings

Dates of Audit: January - March 2020

Auditors: Tejas Desai, PE, Ozan Ogus, Sudhir Patel - Willdan Energy Solutions

Salem County contracted with Willdan Energy Solutions (Willdan) to develop an Energy Saving Plans (ESIP) for Salem County in Salem, NJ.

The scope of work is to develop an ESP for Salem County nine (9) municipal buildings. This report includes ECMs that were based on site surveys, data collection, review of bond referendum, consulting facility personnel and reviewing baseline utility bills. This report includes a financially viable plan to implement the Energy Conservation Measures (ECMs) and achieve operational energy savings to comply with the requirements of New Jersey Energy Savings Improvement Program (NJ ESIP) in accordance with NJ PL2012, c.55.

The main requirement of NJ ESIP is to justify cost estimate and energy saving calculations for all the proposed ECMs that will pay for itself through energy savings over fifteen (15) years. Pursuant to the NJ ESIP Law, N.J.S.A. 18A:18A-4.6(d)(2), the ESP shall:

- Contain the results of an Energy Audit.
- Describe the ECMs that will comprise the program.
- Estimate greenhouse-gas reductions resulting from those energy savings.
- Include an assessment of risks involved in the successful implementation of the plan.
- Identify the eligibility for and the costs and revenues associated with the PJM Independent System Operator for demand response and curtailable service activities.
- Include schedules showing calculations of all costs of implementing the proposed energy conservation measures and the projected energy savings.
- Identify maintenance requirements necessary to ensure continued energy savings and describe how they will be fulfilled.

There were many energy conservation measures evaluated during development of this ESP, and after careful consideration the list of ECMs were included in this report. Willdan will work closely with Salem County to determine ECMs included under ESIP project. This ESP is structured to comply with the ESIP Law with all the necessary information to make a firm decision. The possible areas of energy savings for Salem County, as described initially, are as follows:

- Lighting
- Unit Ventilators
- Boilers
- Plug-load controllers
- Solar
- Rooftop units and Air Handling Units

Willdan Energy Solutions has carefully considered the above possible areas of energy improvement and assessed the buildings to present a feasible ESIP project. The energy cost savings for all buildings have been derived through detailed energy analysis using spreadsheet calculations. The following tables highlight the overall energy savings per building. Note that the savings table does not include onsite electric generation potential from installation of solar PV panels.

Table 1: Estimated Total Utility & Cost Savings- Johnson Building

Savings			% Reduction
Annual Electric Energy	5,830	kWh	42%
Annual Electric Demand	1.5	kW	25%
Annual Natural Gas	462	therms	11%
Annual Utility Cost Savings	$1,236	$	

Table 2: Estimated Total Utility & Cost Savings- Inter Agency Council Human Services Building

Savings			% Reduction
Annual Electric Energy	14,180	kWh	23%
Annual Electric Demand	3.7	kW	14%
Annual Natural Gas	-	therms	0%
Annual Utility Cost Savings	$2,269	$	

Table 3: Estimated Total Utility & Cost Savings- Agriculture Building

Savings			% Reduction
Annual Electric Energy	63,865	kWh	38%
Annual Electric Demand	20.4	kW	23%
Annual Natural Gas	1,064	therms	11%
Annual Utility Cost Savings	$11,369	$	

Table 4: Estimated Total Utility & Cost Savings- Fenwick Building

Savings			% Reduction
Annual Electric Energy	12,757	kWh	6.8%
Annual Electric Demand	4.2	kW	5.9%
Annual Natural Gas	76	therms	1.5%
Annual Utility Cost Savings	$1,988	$	

Table 5: Estimated Total Utility & Cost Savings- Emergency Services Building

Savings			% Reduction
Annual Electric Energy	87,111	kWh	22%
Annual Electric Demand	25.4	kW	30%
Annual Natural Gas	454	therms	11%
Annual Utility Cost Savings	$13,442	$	

Table 6: Estimated Total Utility & Cost Savings- Social Services Building

Savings			% Reduction
Annual Electric Energy	39,078	kWh	20.1%
Annual Electric Demand	11.2	kW	16.5%
Annual Natural Gas	30	therms	1.2%
Annual Utility Cost Savings	$5,567	$	

Table 7: Estimated Total Utility & Cost Savings- Main County Office Building

Savings			% Reduction
Annual Electric Energy	58,141	kWh	10%
Annual Electric Demand	13.7	kW	6%
Annual Natural Gas	0	therms	0%
Annual Utility Cost Savings	$8,934	$	

Table 8: Estimated Total Utility & Cost Savings- Admin Building

Savings			% Reduction
Annual Electric Energy	97,026	kWh	44.9%
Annual Electric Demand	20.7	kW	45.1%
Annual Natural Gas	803	therms	5.8%
Annual Utility Cost Savings	$13,879	$	

Table 9: Estimated Total Utility & Cost Savings- Courthouse

Savings			% Reduction
Annual Electric Energy	195,221	kWh	24%
Annual Electric Demand	68.6	kW	25%
Annual Natural Gas	(594)	therms	-6%
Annual Utility Cost Savings	25,821	$	21%

Table 10: Estimated Total Utility & Cost Savings- Correctional Facility

Savings			% Reduction
Annual Electric Energy	469,929	kWh	19%
Annual Electric Demand	103.8	kW	21%
Annual Natural Gas	135	therms	0%
Annual Utility Cost Savings	55,771	$	14%

Note: Electric savings presented in Table 1 does not include onsite electric generation potential from installation of solar PV panels.

2.1 Overall Opportunity Summary

Johnson Building

Table 11:Projected Overall Savings

Measure		Annual Estimated Savings				CO_2 Emission Savings (tCO_2e)	Estimated Implementation Cost ($)	Estimated Simple Payback Period (Years)
Meas. No.	Description	Electricity (kWh)	Annual Demand (kW)	Natural Gas (Therms)	Cost Savings ($)			
ECM-1	LED Lighting Upgrades - Interior	5,812	1.50	0	$910	1.7	$4,263	0.0
ECM-2	Install Boiler Controls	0	0	462	$325	2.5	$3,699	11.4
ECM-3	Install Low Flow	19	0	0	$3	0.0	$17	0.0
ECM-4	Install Solar PV Panel	7,063	6	0	$753	2.0	$0	0.0
Total		**5,830**	**1**	**462**	**$1,238**	**4.1**	**$7,979**	**3.0**

Inter-Agency Council Human Services Building

Table 12:Projected Overall Savings

Measure		Annual Estimated Savings				CO_2 Emission Savings (tCO_2e)	Estimated Implementation Cost ($)	Estimated Simple Payback Period (Years)
Meas. No.	Description	Electricity (kWh)	Annual Demand (kW)	Natural Gas (Therms)	Cost Savings ($)			
ECM-1	LED Lighting Upgrades - Interior	13,394	3.2	0	$2,144	3.9	$90,000	42.0
ECM-2	Clean Condenser Coils	749	0.5	0	$120	0.2	$21,515	179.4
ECM-3	Install Low Flow Devices	37	0	0	$6	0.0	$43	7.2
ECM-4	Install Solar PV Panel	59,250	50	0	$6,520	17.1	$0	0.0
Total		**14,180**	**4**	**0**	**$2,269**	**4.1**	**$111,558**	**49.2**

Agriculture Building

Table 13:Projected Overall Savings

Measure		Annual Estimated Savings				CO_2 Emission Savings (tCO_2e)	Estimated Implementation Cost ($)	Estimated Simple Payback Period (Years)
Meas. No.	Description	Electricity (kWh)	Annual Demand (kW)	Natural Gas (Therms)	Cost Savings ($)			
ECM-1	LED Lighting Upgrades - Interior	52,355	17	0	$8,676	15.1	$48,813	5.6
ECM-2	Install New Split Units with Gas Furnace	6,591	3	1,045	$1,864	7.5	$149,767	80.3
ECM-3	Install Low-Flow DHW Devices	0	0	19	$14	0.1	$130	9.2
ECM-4	Install Energy Efficient Transformers	4,919	1	0	$815	1.4	$8,760	10.7
ECM-5	Install Solar PV Panel	296,250	250	0	$34,278	85.6	$0	0.0
Total		**63,865**	**20**	**1,064**	**$11,369**	**24.1**	**$207,470**	**18.2**

Fenwick Building

Table 14:Projected Overall Savings

Measure		Annual Estimated Savings				CO_2 Emission Savings (tCO_2e)	Estimated Implementation Cost ($)	Estimated Simple Payback Period (Years)
Meas. No.	Description	Electricity (kWh)	Annual Demand (kW)	Natural Gas (Therms)	Cost Savings ($)			
ECM-1	LED Lighting Upgrades - Interior	9,847	2	0	$1,489	2.8	$7,875	5.3
ECM-2	Replace Existing Split Units	2,910	2	0	$440	0.8	$26,875	61.1
ECM-3	Install Low Flow Devices	0	0	76	$59	0.4	$397	6.8
ECM-4	Install Solar PV Panel	37,170	30	0	$3,764	10.7	$0	0.0
Total		**12,757**	**4**	**76**	**$1,988**	**4.1**	**$35,147**	**17.7**

Emergency Services Building

Table 15:Projected Overall Savings

Measure		Annual Estimated Savings				CO_2 Emission Savings (tCO_2e)	Estimated Implementation Cost ($)	Estimated Simple Payback Period (Years)
Meas. No.	Description	Electricity (kWh)	Annual Demand (kW)	Natural Gas (Therms)	Cost Savings ($)			
ECM-1	LED Lighting Upgrades - Interior	61,644	16	0	$9,254	17.8	$28,622	3.1
ECM-2	Replace Existing Boilers	0	0	454	$364	2.4	$125,178	344.0
ECM-3	Install VFD on CW Pumps	13,560	8	0	$2,036	3.9	$91,967	45.2
ECM-4	Replace Existing WSHP	3,616	1	0	$543	1.0	$176,391	324.9
ECM-5	Implement Vending Machine Miser Controls	1,370	0	0	$206	0.4	$1,202	5.8
ECM-6	Install Low-Flow DHW Devices	1,039	0	0	$156	0.3	$232	1.5
ECM-7	Install Energy Efficient Transformers	5,882	1	0	$883	1.7	$20,338	23.0
ECM-8	Install Solar PV Panel	296,250	322	0	$29,662	85.6	$0	0.0
Total		**87,111**	**25**	**454**	**$13,442**	**27.6**	**$443,930**	**33.0**

Social Services Building

Table 16:Projected Overall Savings

Measure		Annual Estimated Savings				CO_2 Emission Savings (tCO_2e)	Estimated Implementation Cost ($)	Estimated Simple Payback Period (Years)
Meas. No.	Description	Electricity (kWh)	Annual Demand (kW)	Natural Gas (Therms)	Cost Savings ($)			
ECM-1	LED Lighting Upgrades - Interior	33,049	8	0	$4,682	9.6	$20,486	4.4
ECM-2	Replace Existing RTUs	4,659	3	0	$660	1.3	$53,092	80.4
ECM-3	Install Vending Machine Controls	1,370	0	0	$194	0.4	$1,306	6.7
ECM-4	Install Low Flow Devices	0	0	30	$31	0.2	$132	4.3
ECM-5	Install Solar PV Panel	124,425	105	0	$11,405	36.0	$0	0.0
Total		**39,078**	**11**	**30**	**$5,567**	**11.5**	**$75,017**	**9.8**

Main County Office Building

Table 17:Projected Overall Savings

Measure		Annual Estimated Savings				CO_2 Emission Savings (tCO_2e)	Estimated Implementation Cost ($)	Estimated Simple Payback Period (Years)
Meas. No.	Description	Electricity (kWh)	Annual Demand (kW)	Natural Gas (Therms)	Cost Savings ($)			
ECM-1	LED Lighting Upgrades - Interior	57,547	14	0	$8,842	16.6	$45,694	5.2
ECM-2	Install Low Flow Devices	594	0	0	$91	0.2	$132	1.5
ECM-3	Install Solar PV Panel	459,100	357	0	$47,588	132.7	$0	0.0
Total		**58,141**	**14**	**0**	**$8,934**	**16.8**	**$45,827**	**5.1**

Admin Building

Table 18:Projected Overall Savings

Measure		Annual Estimated Savings				CO_2 Emission Savings (tCO_2e)	Estimated Implementation Cost ($)	Estimated Simple Payback Period (Years)
Meas. No.	Description	Electricity (kWh)	Annual Demand (kW)	Natural Gas (Therms)	Cost Savings ($)			
ECM-1	LED Lighting Upgrades - Interior	94,031	21	0	$12,741	27.2	$56,003	4.4
ECM-2	Replace Existing Boilers	0	0	765	$697	4.1	$248,270	356.0
ECM-3	Upgrade Existing HHW/CHW Pumps	2,996	0	0	$406	0.9	$6,393	15.7
ECM-4	Install Low Flow Devices	0	0	38	$35	0.2	$199	5.7
ECM-5	Install Solar PV Panel	59,250	50	0	$16,638	56.2	$0	0.0
Total		**97,026**	**21**	**803**	**$13,879**	**32.3**	**$310,864**	**18.3**

Courthouse

Table 19:Projected Overall Savings

Measure		Annual Estimated Savings				CO_2 Emission Savings (tCO_2e)	Estimated Implementation Cost ($)	Estimated Simple Payback Period (Years)
Meas. No.	Description	Electricity (kWh)	Annual Demand (kW)	Natural Gas (Therms)	Cost Savings ($)			
ECM – 1	LED Lighting Upgrades - Interior	118,445	39.2	-951	$14,987	29.2	$202,905	13.5
ECM – 2	LED Lighting Upgrades - Exterior	442	0.0	0	$60	0.1	$2,404	40.1
ECM – 3	Replace Existing AHUs and Convert CAV System to VAV System	7,497	17.0	91	$1,123	2.6	$511,020	455.2
ECM – 4	Install VFDs on Heating Hot Water Pumps	9,396	0.0	-107	$1,153	2.1	$71,875	62.4
ECM – 5	Install VFDs on Chilled Water Pumps	30,377	10.9	0	$4,124	8.8	$85,119	20.6
ECM – 6	Implement Vending Machine Miser Controls	388	0.1	0	$53	0.1	$2,454	46.6
ECM – 7	BMS Upgrade	16,503	0.0	356	$2,650	6.7	$204,390	77.1
ECM – 8	Install Energy Efficient Transformers	12,173	1.4	0	$1,653	3.5	$24,846	15.0
ECM – 9	Install Low-Flow DHW Devices	0	0.0	17	$19	0.1	$348	18.2
ECM - 10	Install Solar PV Panel	59,250	50.0	0	$5,082	17.1	$0	0.0
Total		**195,221**	**68.6**	**-594**	**$25,821**	**53.3**	**$1,105,361**	**43**

[1] All energy savings accounts for interactive effects of each measure.

[2] Potential for onsite electricity generation (ECM-10) is not included in the "Total" row.

Correctional Facility

Table 20:Projected Overall Savings

Measure		Annual Estimated Savings				CO_2 Emission Savings (tCO_2e)	Estimated Implementation Cost ($)	Estimated Simple Payback Period (Years)
Meas. No.	**Description**	**Electricity (kWh)**	**Annual Demand (kW)**	**Natural Gas (Therms)**	**Cost Savings ($)**			
ECM - 1	LED Lighting Upgrades - Interior	191,372	52.0	-1,940	$20,450	45.0	$233,759	11.4
ECM – 2	LED Lighting Upgrades - Exterior	23,000	0.0	0	$2,722	6.6	$24,199	8.9
ECM – 3	Replace Existing Split DX AHUs with High Efficiency DX Units	118,527	48.8	-467	$13,499	31.8	$680,412	50.4
ECM – 4	Replace Existing Packaged RTUs with High Efficiency Packaged RTUs	8,894	4.0	0	$1,053	2.6	$168,130	159.7
ECM – 5	Install VFDs on Heating Hot Water Pumps	14,468	0.0	-535	$1,106	1.3	$75,900	68.6
ECM – 6	BMS Upgrades	58,406	-7.7	2,933	$10,238	32.5	$202,800	19.8
ECM – 7	Implement Vending Machine Miser Controls	3,422	0.8	-20	$383	0.9	$2,454	6.4
ECM – 8	Install Energy Efficient Transformers	51,839	5.9	0	$6,135	15.0	$65,952	10.7
ECM – 9	Install Low-Flow DHW Devices	0	0.0	163	$185	0.9	$1,529	8.3
ECM – 10	Install Solar PV Panel	296,250	250.0	0	$20,250	85.6	$0	0.0
Total		**469,929**	**103.8**	**135**	**$55,771**	**136.5**	**$1,455,135**	**26.1**

[1] All energy savings accounts for interactive effects of each measure.

[2] Potential for onsite electricity generation (ECM-10) is not included in the “Total” row.

As part of the major Budget Referendum, Willdan is supporting Salem County with a percentage of implementation costs through ESIP. From a list of improvements and additions, the chosen ECMs under this ESP have yield the following savings and cash flow.

FORM II
ESCO's PRELIMINARY ENERGY SAVINGS PLAN (ESP):
ENERGY CONSERVATION MEASUREs (ECMs) SUMMARY FORM

Salem County

ENERGY SAVING IMPROVEMENT PROGRAM

ESCO Name: Willdan Energy Solutions

Proposed Preliminary Energy Savings Plan: Base Project 15 years @ 2.1%

Energy Conservation Measures	Estimated Installed Hard Costs ($)	Estimated Annual Savings ($)	Estimated Simple Payback (Yrs)
ECM#1 - LED Lighting Upgrades - Interior	$580,234	$84,175	6.8
ECM#2 - LED Lighting Upgrades - Exterior	$26,603	$2,782	9.6
ECM#3 - Replace Existing Packaged RTUs with High Efficiency Packaged RTUs	$221,222	$1,713	129.0
ECM#4 - Replace Existing Split DX AHUs with High Efficiency DX Units	$680,412	$13,499	50.4
ECM#5 - Replace Existing AHUs and Convert CAV System to VAV System	$511,020	$1,123	455.2
ECM#6 - Install VFDs on Heating Hot Water Pumps	$147,775	$2,259	65.4
ECM#7 - Install VFDs on Chilled Water Pumps	$85,119	$4,124	20.6
ECM#8 - Implement Vending Machine Miser Controls	$7,416	$835	8.9
ECM#9 - BMS Upgrades - Implement SAT Reset	$407,190	$8,719	46.7
ECM#10 - BMS Upgrades - Implement HHW Reset	$0	$39	0.0
ECM#11 - BMS Upgrades - Schedule Setback	$0	$4,130	0.0
ECM#12 - Install Energy Efficient Transformers	$119,896	$9,486	12.6
ECM#13 - Install Low-Flow DHW Devices	$2,052	$599	3.4
ECM#14 - Install Boiler Controls	$3,699	$325	7.7
ECM#15 - Clean Condenser Coils	$21,515	$120	179.4
ECM#16 - Install New Split Units with Gas Furnace	$149,767	$1,864	80.1
ECM#17 - Replace Exisitng Split Units	$26,875	$440	60.6
ECM#18 - Replace Existing Boiler	$373,448	$1,061	339.6
ECM#19 - Install VFD on CW Pumps	$91,967	$2,036	45.2
ECM#20 - Replace Existing WSHP	$176,391	$543	322.7
ECM#21 - Upgrade Exisitng HHW/CHW Pumps	$6,393	$406	15.7
ECM#22 - Install Solar PV Panel	$0	$175,440	0.0
Project Summary:	**$3,638,994**	**$315,718**	**11.5**

Table 11: Salem County Form II

FORM III

ESCO's PRELIMINARY ENERGY SAVINGS PLAN (ESP): PROJECTED ANNUAL ENERGY SAVINGS DATA FORM

Salem County

ENERGY SAVING IMPROVEMENT PROGRAM

ESCO Name: Willdan Energy Solutions

Proposed Preliminary Energy Savings Plan: Base Project 15 years @ 2.1%

Energy/Water	ESCO Developed Baseline (Units) (2)	ESCO Developed Baseline (Costs $) (2)	Proposed Annual Savings (Units) (3)	Proposed Annual Savings (Costs $) (3)
Electric Demand (kW)	1,338		268.1	
Electric Energy (kWh)	5,119,279	$679,686	1,043,138	$138,512
Natural Gas (ccf)	135,528	$146,256	2,342	$1,765
AVOIDED EMISSIONS (1)	**Provide in Pounds (Lbs)**			
NOX	2,943	Lbs		
SO_2	6,780	Lbs		
CO_2	1,613,988	Lbs		

(1) ESCOs are to use the rates provided as part of this RFP to calculate Avoided Emissions. Calculation for all project energy savings and greenhouse gas reductions will be conducted in accordance with adopted NJBPU protocols

(2) "ESCOs Developed Baseline": Board's current annual usages and costs as determined by the proposing ESCO; based off Board's utility information as provided to proposing ESCO.

(3) "Proposed Annual Savings": ESCOs proposed annual savings resulting from the Board's implementation of the proposed ESP, as based upon "ESCOs Developed Baseline".

Table 12: Salem County Form III

FORM IV

ESCO's PRELIMINARY ENERGY SAVINGS PLAN (ESP):

PROJECTED ANNUAL ENERGY SAVINGS DATA FORM IN MMBTUs

ESCO's PRELIMINARY ENERGY SAVINGS PLAN (ESP):
PROJECTED ANNUAL ENERGY SAVINGS DATA FORM

Salem County

ENERGY SAVING IMPROVEMENT PROGRAM

ESCO Name: Willdan Energy Solutions

Proposed Preliminary Energy Savings Plan: Base Project 15 years @ 2.1%

The projected annual energy savings for each fuel type MUST be completed using the following format. Data should be given in equivalent MMBTUs.

ENERGY	ESCO Developed Baseline	ESCO Proposed Savings Annual	Comments
Electric Energy (MMBTUs)	1,746,698	355,919	
Natural Gas (MMBTUs)	14,054	243	
Fuel Oil (MMBTUs)	0	0	
Steam (MMBTUs)	0	0	
Other (Specify) (MMBTUs)	0	0	

NOTE: MMBTU Defined: A standard unit of measurement used to denote both the amount of heat energy in fuels and the ability of appliances and air conditioning systems to produce heating or cooling.

Table 13: Salem County Form IV

FORM V

ESCO's PRELIMINARY ENERGY SAVINGS PLAN (ESP):

ESCOs PROPOSED FINAL PROJECT COST FORM FOR BASE CASE PROJECT

Salem County

ENERGY SAVING IMPROVEMENT PROGRAM

ESCO Name: Willdan Energy Solutions

Proposed Preliminary Energy Savings Plan: Base Project 15 years @ 2.1%

PROPOSED CONSTRUCTION FEES

Fee Category	Fees [1] Dollar ($) Value	Percentage of Hard Cost
Estimated Value of Hard Costs [2]:	$3,638,994	
Project Service Fees		
Investment Grade Energy Audit	$109,170	3.0%
Design Engineering Fees	$163,755	4.5%
Construction Management & Project Administration	$145,560	4.0%
System Commissioning	$43,668	1.2%
Equipment Initial Training Fees	$25,473	0.7%
ESCO Overhead	$156,477	4.3%
ESCO Profit	$254,730	7.0%
Project Service Fees Sub Total	$898,831	24.7%
TOTAL FINANCED PROJECT COSTS:	$4,537,825	124.7%

PROPOSED ANNUAL SERVICE FEES

Fee Category	Fees [1] Dollar ($) Value	Percentage of Hard Cost
SAVINGS GUARANTEE (*OPTION*)		
Measurement and Verification (Associated w/ Savings Guarantee Option)	$45,487	1.25%
ENERGY STAR™ Services (*optional*)	Included Above	0.00%
Post Construction Services *(If applicable)*	Included Above	0.00%
Performance Monitoring	Included Above	0.00%
On-going Training Services	Included Above	0.00%
Verification Reports	Included Above	0.00%
TOTAL FIRST YEAR ANNUAL SERVICES	$45,487	1.25%

NOTES:

(1) Fees should include all mark-ups, overhead, and profit. Figures stated as a range will NOT be accepted.

(2) The total value of Hard Costs is defined in accordance with standard AIA definitions that include:

Labor Costs, Subcontractor Costs, Cost of Materials and Equipment, Temporary Facilities and Related Items, and Miscellaneous Costs such as Permits, Bonds Taxes, Insurance, Mark-ups,

ESCO's proposed interest rate at the time of submission: 2.5 % TO BE USED BY ALL RESPONDING ESCOs FOR PROPOSAL PURPOSES

Table 14: Salem County Form V

FORM VI

ESCO's PRELIMINARY ENERGY SAVINGS PLAN (ESP):

ESCO's PRELIMINARY ANNUAL CASH FLOW ANALYSIS FORM

Salem County

ENERGY SAVINGS IMPROVEMENT PROGRAM

ESCO Name: Willdan Energy Solutions

Proposed Preliminary Energy Savings Plan: Base Project 15 years @ 2.1%

Note: Respondents must use the following assumptions in all financial calculations:

(a) The cost of all types of energy should be assumed to inflate at 2.4 % gas, 2.2 % electric per year; and

1. Term of Agreement: 15 years (____ Months) 180

2. Construction Period (2) (months): 12

3. Cash Flow Analysis Format:

Estimated Installed Hard Costs	$3,638,994
ESCO's Fee (From Form V)	$898,831
Legal & Bond Fees	$110,000
Third Party Fees	$15,000
Project Cost [1]:	$4,662,825

Interest Rate to Be Used for Proposal Purposes: 2.1%

Year	Annual Energy Savings	Annual Operational Savings	Energy Rebates/ Incentives	Solar PPA	Total Annual Savings	Annual Project Costs	Board Cost	Annual Service Costs (3)	Net Cash-Flow to Client	Cummulative Cash Flow
Installation	$ -	$ -			$ -		$ -		$ -	$ -
1	$140,277	$43,374	$78,077	$175,440	$437,169	-$362,650	-$408,138	-$45,487	$5,524	$5,524
2	$143,367	$43,374	$2,295	$177,195	$366,231	-$362,650	-$362,650	$0	$5,524	$11,048
3	$146,525	$21,724	$2,295	$178,967	$349,511	-$362,650	-$362,650	$0	$5,524	$16,572
4	$149,752	$21,724	$2,295	$180,756	$354,528	-$362,650	-$362,650	$0	$5,524	$22,096
5	$153,050	$21,724		$182,564	$357,338	-$362,650	-$362,650	$0	$5,524	$27,620
6	$156,421			$184,390	$340,811	-$362,650	-$362,650	$0	$5,524	$33,144
7	$159,867			$186,234	$346,100	-$362,650	-$362,650	$0	$5,524	$38,668
8	$163,388			$188,096	$351,484	-$362,650	-$362,650	$0	$5,524	$44,192
9	$166,986			$189,977	$356,963	-$362,650	-$362,650	$0	$5,524	$49,716
10	$170,664			$191,877	$362,541	-$362,650	-$362,650	$0	$5,524	$55,240
11	$174,423			$193,795	$368,219	-$362,650	-$362,650	$0	$5,524	$60,764
12	$178,265			$195,733	$373,999	-$362,650	-$362,650	$0	$5,524	$66,288
13	$182,192			$197,691	$379,882	-$362,650	-$362,650	$0	$5,524	$71,812
14	$186,205			$199,668	$385,872	-$362,650	-$362,650	$0	$5,524	$77,336
15	$190,306			$201,664	$391,970	-$362,650	-$362,650	$0	$5,524	$82,860
Totals	$2,461,689	$151,920	$84,962	$2,824,047	$5,522,617	-$5,439,757	-$5,485,245	-$45,487	$82,860	

NOTES:

(1) Includes: Hard costs and project service fees defined in ESCO's PROPOSED "FORM V"

(2) No payments are made by Board during the construction period.

(3) This figure should equal the value indicated on the ESCO's PROPOSED "FORM V". DO NOT include in the Financed Project Cost

Table 15: Salem County Form II

2.2 Facility Information

Johnson Building

Figure 1: Johnson Building

Johnson Building is a 7,000 sqft office building located at 90 Market St, Salem, NJ which is operated 5 days a week, 8 hours a day. The built year is 1807 which includes office spaces, restrooms, a basement/boiler room and dedicated second floor for storage.

Table 21: Building Occupancy Schedule

Building Name	Weekday/ Weekend	Operating Schedule
Johnson Building	Weekday	8:30AM - 4:30PM
	Weekend	Closed

Building Condition

Envelop
The walls are made up of masonry brick with asphalt shingles on pitched roof. Most of the windows are single pane with wood frames. The glass-to-frame seals are in fair condition. The operable window weather seals are in fair condition, showing evidence of wear. Exterior doors have wood frames and are in fair condition with worn door seals. Degraded window and door seals increase drafts and outside air infiltration.

Lighting
The interior lighting fixtures for the building mainly comprise of T12 40W linear fluorescent lamps along with various CFL bulbs and incandescent fixtures with switch controls. The exterior walls are installed with wall packs, including HID or HPS lamps, also on switch control. Existing line-by-line fixture table is attached as an appendix.

Mechanical
The building is cooled via window ACs installed throughout the building. The building has six (6) window AC units. The heating is fulfilled using a steam boiler manufactured by Weil McLain. There are several radiators installed in the building.

Table 22: Building Equipment Schedule

Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (MBH, kW)
Offices	Offices	6	Window AC	1	0
Boiler Room	Entire Building	1	Steam Boiler	0	487.5
Boiler Room	Entire Building	1	Electric Water Heater	0	4.5

Figure 2: Steam Boiler

Domestic Hot Water (DHW)
Hot water is produced using an electric water heater with a 19-gallon storage capacity. Currently, the domestic water pipes are not insulated.

Figure 3: DHW Water Heater

Plug Loads
The building has nominal office equipment that account for 1.5% of overall electrical usage.

Plumbing Fixtures
The restrooms are equipped with standard flowing plumbing fixtures.

Inter-Agency Council Human Services Building

Figure 4: Inter-Agency Building

Inter-Agency Council and Human Services Building is a 9,260 sqft office building located at 96-98 Market St, Salem, NJ which is operated 5 days a week, 8 hours a day. The built year is 1885 which includes offices, copy room, break room, corridors, stairwells, conference and meeting rooms and a basement.

Table 23: Building Occupancy Schedule

Building Name	Weekday/ Weekend	Operating Schedule
Inter-Agency Building	Weekday	8:30AM - 4:30PM
	Weekend	Closed

Building Condition

Envelop
The building exterior walls are concrete over a wood frame. The roof is flat for the most plat with a small section that is slightly pitched. The roof is covered with a black membrane and it appears to be in fair condition. Most of the windows are single pane glazed with wood frames. The operable window weather seals appear to be in fair condition, showing signs of excessive wear. Exterior doors have wood frames and appear to be in fair condition.

Lighting
The interior lighting system consist of 32-Watt linear fluorescent T8 lamps. There are several 40-Watt T12 fixtures. Additionally, there are some incandescent general-purpose located in the attic. All exit signs are LED units. Existing line-by-line fixture table is attached as an appendix.

Mechanical
The building is conditioned by two split-system air conditioners which are controlled by zone thermosets. The split-units are equipped with electric heating with a capacity of 19MBH and 6-ton cooling capacity.

Table 24: Building Equipment Schedule

Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (MBH, kW)
Attic	Entire Building	2	Split-System	6	19.11kW
Bathroom Closet	Entire Building	2	Electric Heater	-	25kW

Domestic Hot Water (DHW)
Hot water is produced using two (2) tankless 25 kW water heaters.

Plug Loads
The utility bill analysis indicates that plug loads consume approximately 6.9% of total building energy use. There are 32 computers workstations throughout the facility. Plug loads throughout the building include office equipment, such as copiers and printers as well as water coolers, microwaves, a refrigerator, mini fridges, and coffee makers.

Plumbing Fixtures
The restrooms are equipped with standard flowing plumbing fixtures.

Agriculture Building

Figure 5: Agriculture Building

Agriculture Building is a 13,600 sqft office building located at 51 Cheney Rd, Woodstown, NJ which is operated 5 days a week, 8 hours a day. The built year is 1995 which includes offices,
corridors, stairwells, assembly room, restrooms, offices, a small kitchen, and various storage and mechanical spaces.

Table 25: Building Occupancy Schedule

Building Name	Weekday/ Weekend	Operating Schedule
Agriculture Building	Weekday	8:30AM - 4:30PM
	Weekend	Closed

Building Condition

Envelop
The building exterior walls are constructed of concrete masonry units (CMUs) as the foundation and the upper portions are poured concrete with a veneer and vinyl siding. The roof is pitched with asphalt shingles which appear to be in good condition. The windows are double glazed with low-e glass and storm windows.

Lighting
The interior lighting fixtures for the building mainly comprise of T12 40W linear fluorescent lamps along with various CFL bulbs and incandescent fixtures with switch controls. The exterior walls are installed with wall packs, including HID or HPS lamps, also on switch control. Existing line-by-line fixture table is attached as an appendix.

Mechanical
The building is conditioned by air handlers with heating and cooling components. There are seven (7) Trane model TWE units, each with a capacity of 50 MBH, and an efficiency rating of 86%. The units are controlled by local room thermostat and space temperature is maintained between 68°F and 71°F. Condenser for each of the unit is located outside of the building. There is a single 5-ton unit, three 7.5-ton units, two 10-ton units, and one 12.5-ton unit serving the main areas of the building. There is a server room and storage room which are served by individual mini-split systems. The server room is conditioned by a Mitsubishi model MUYGE09NA with a cooling capacity of 9,000 Btu/h. The server room is maintained at a constant temperature of 69°F. The storage room is served by a small Fujitsu heat pump with a cooling capacity of 22,000 Btu/h, and a heating capacity of 28,000 Btu/h.
.

Table19.11: Building Equipment Schedule

Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (MBH, kW)
Outside	Entire Building	2	Split-System AC	10	-
Outside	Entire Building	1	Split-System AC	0.75	-
Outside	Entire Building	1	Split-System AC	1.83	27.6
Outside	Entire Building	1	Split-System AC	12.5	-
Outside	Entire Building	3	Split-System AC	7.5	-
Outside	Entire Building	1	Split-System AC	5	-
Room Ceiling	Entire Building	7	Furnace	-	50
Closet	Entire Building	1	Gas-water Heater	-	60

Domestic Hot Water (DHW)
Domestic Hot water is produced using a 50-gallon, storage tank water heater with a capacity of 60 MBH and a thermal efficiency of 80%.

Plug Loads
The utility bill analysis indicates that plug loads consume approximately 1.9% of total building energy use. There are 30 computers workstations with desktop computers and LCD monitors throughout the facility. Plug loads throughout the building include general office equipment. There are typical office loads such as smartboards, desk printers, paper shredders, photo copiers, laptops and projectors.

Plumbing Fixtures
The restrooms are equipped with standard flowing plumbing fixtures.

Fenwick Building

Figure 6: Fenwick Building

Fenwick Building is a 24,600 sqft office building located at 85 Market St, Salem, NJ which is operated 5 days a week, 8 hours a day. The building was built in 1891 and renovated in 1989 which includes offices, conference rooms, corridors, stairwells, storage areas, breakrooms, and mechanical spaces.

Table 26: Building Occupancy Schedule

Building Name	Weekday/ Weekend	Operating Schedule
Fenwick Building	Weekday	8:30AM - 4:30PM
	Weekend	Closed

Building Condition

Envelop
The exterior of the building is contracted with brick with stucco on the sides of the building. The roof is flat with black membrane. The windows are single glazed with wood frames and appear to be in fair condition.

Lighting
Interior lighting consists of 32-Watt linear fluorescent T8 lamps as well as some 40-Watt T12 fixtures. Additionally, there are some compact fluorescent lamps (CFL), incandescent and LED general purpose lamps. Fixture types include 2-lamp and 4-lamp, 4-foot long recessed, fixtures and 2-foot fixtures with U-bend and linear tube lamps. Existing line-by-line fixture table is attached as an appendix.

Mechanical
The building is conditioned by a combination of split-system air conditioning (AC) units, ductless mini-split system ACs, and rooftop packaged units (RTU). The split-system AC units vary in capacity between 1.5 and 5 tons. There are two old McQuay slip units that are in poor condition. There are two ductless mini-split system AC units, one serving the kitchen area and the other serves the breakroom. These units have a capacity of 1.5 tons. The three RTUs range in capacity from 6 to 12.5 tons. The building is heated by two (2) Weil-McLain 310 MBH condensing hot water boilers with a rated thermal efficiency of 92.9%. The boilers serve a primary/secondary distribution system with three-speed fractional horsepower pumps circulating the primary loop and two constant speed 1/2 hp heating hot water pumps. The boilers provide hot water to the air handlers and fan coil units.

Table 27: Building Equipment Schedule

Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (MBH, kW)
Storage	Storage	1	Split-System AC	4	-
Mech Room	Finance	1	Split-System AC	5	-
Hallway Ceiling	Hallway	1	Split-System AC	4	-
Breakroom	Breakroom	1	Split-System AC	1.5	-
Outside	-	1	Split-System AC	4	-
Outside	-	1	Split-System AC	5	-
Kitchen	Kitchen	1	Split-System AC	1.5	-
Outside	-	1	Split-System AC	1.5	-
Outside	-	1	Split-System AC	2	-
Outside	-	1	Split-System AC	2	-
Roof	Entire Building	2	RTU	12.5	-
Roof	Entire Building	1	RTU	6	-
Boiler Room	Entire Building	1	Electric Water Heater	-	9kW

Table 28: Building Motor Schedule

Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Full Load Efficiency
Boiler Room	Boilers	1	Feedwater Pumps	1/5	60%
Boiler Room	AHUs	1	Hot Water Pumps	1/2	62%

Domestic Hot Water (DHW)

Hot water is produced using a 9-kW electric water heater with a 82-gallon storage capacity.

Plug Loads

The utility bill analysis indicates that plug loads consume approximately 15.4% of total building energy use. This is higher than a typical building. There are approximately 75 computers workstations throughout the facility. Plug loads throughout the building include general office equipment. There are several residential-style refrigerators and mini-refrigerators throughout the building that are used to store employee lunches and snacks.

Plumbing Fixtures

The restrooms are equipped with standard flowing plumbing fixtures.

Emergency Services / 911 Building

Figure 7: Emergency Services Building

The Emergency Services building is a 13,170 sqft building built in 1983. The building shares various spaces like offices, restrooms, conference rooms, kitchen and common areas such as corridors and stairwells. The space is occupied year-round, 18 hours a day.

Table 29: Building Occupancy Schedule

Building Name	Weekday/ Weekend	Operating Schedule
Emergency Services Building	Weekday	6:00AM - 12:00AM
	Weekend	6:00AM - 12:00AM

Building Condition

Envelop

The exterior walls are made of CMU with brick veneer and gypsum drywall interior finish. The windows are double glazed and low-e glass coating in an operable condition. The weather-stripping is in an average condition as well.

Lighting

The interior lighting fixtures for the building mainly comprise of T12 40W linear fluorescent lamps along with various CFL bulbs and incandescent fixtures with switch controls. The exterior walls are installed with wall packs and canopy lighting, all on time clock. Existing line-by-line fixture table is attached as an appendix.

Mechanical

The spaces are conditioned using ceiling mount Water Source Heat Pumps ranging from 1 ton to 2 tons with a heating capacity reaching 15 MBH. The units are in good condition. There are a few spaces that are retrofitted with newer equipment, with split ACs serving during summer season, and gas fired furnace for heating. The condenser loop for the WSHPs is served by one (1) H.B. Smith steam boiler, configured in an automated control scheme. The steam boiler produces low pressure steam which goes through a heat exchanger to produce 160F hot water to regulate the loop temperature during heating season. The gas fired furnaces only serve a section of the building, both on floor 1 and 2. There is a cooling tower that rejects heat from the condenser loop during summer season.

Table 30: Building Equipment Schedule

Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (MBH, kW)
Ceiling	Offices	20	WSHP	2	14
Ceiling	Offices	3	WSHP	1	15
Roof	Offices	1	Packaged AC	5	-
Roof	Offices	1	Packaged AC	5	-
Roof	Classroom	1	Packaged AC	4	-
Roof	Classroom	1	Packaged AC	2.8	-
Boiler Room	Entire Building	1	Steam Boiler	-	520

Boiler Room	Offices/Classrooms	4	Gas Fired Furnace	-	80
Boiler Room	Entire Building	1	Electric Water Heater	-	4.5
Boiler Room	Entire Building	1	Gas Fired Water Heater	-	38

Table 31: Building Motor Schedule

Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Full Load Efficiency
Boiler Room	Entire Building	1	Steam condensate pump	3	90%
Outdoor	Entire Building	2	Cooling Tower Fan Motor	10	87%
Outdoor Room	Entire Building	1	Condenser Loop Pump	1.5	87%
Furnace 1-4	Offices/Classrooms	4	Furnace Blower Motor	0.8	81%
Elevator room	Elevator	1	Elevator motor	20	72%

Domestic Water Heater (DWH)
The domestic water is served by two (2) water heaters, the first one is a tanked electric water heater and the other is a gas fired, 38 MBH water heater.

Plug loads
The building has numerous computers, screens, printers and other energy using plug loads that account for 25.2% of the total electric usage of the building.

Plumbing Fixtures
The restrooms and kitchen are equipped with standard flowing plumbing fixtures.

Social Services Building

Figure 8: Social Services Building

The Board of Social Services building is a 20,000 single story building located at 147 South Virginia Ave, Penns Grove, NJ built in 1950. The building is comprised of offices, restrooms, conference rooms, mechanical room, storage spaces and common areas such as corridor and cafeteria.

Table 32: Building Occupancy Schedule

Building Name	Weekday/ Weekend	Operating Schedule
Social Services Building	Weekday	8:30AM - 4:30PM
	Weekend	Closed

Building Condition

Envelop
The building walls are concrete block over structural steel with a brick façade. The roof is flat, covered in asphalt and in fair condition. Most windows are double pane with thermal breaks, showing great conditions. Some of the windows are operable, with the weather stripping is fairly better condition.

Lighting
Majority of the fixtures at the office are fitted with F32T8 linear fluorescent lamps however, those fixtures are in poor conditions in some areas. Other various types of fixtures are installed which are in good condition. Interior lighting fixtures are controlled by manual switches. Building exterior fixtures include wall packs and flood fixtures. The exterior fixtures are controlled through an 11-hour clock scheduled year-round. Existing line-by-line fixture table is attached as an appendix.

Mechanical
This office is served by packaged roof top units with gas furnace. There are six (6) RTUs, 4 in good condition and 2 almost at their end of life. The all have almost same efficiency and capacity. There is a server room which has its own dedicated split ac which is in fair condition.

Table 33: Building Equipment Schedule

Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (MBH, kW)
Roof	Offices	1	Packaged RTU	7.5	144
Roof	Offices	1	Packaged RTU	7.5	144
Roof	Offices	1	Packaged RTU	7.5	144
Roof	Offices	1	Packaged RTU	4	100
Roof	Offices	1	Packaged RTU	7.5	160
Roof	Offices	1	Packaged RTU	5	64
Boiler Room	Entire Building	1	Gas Fired Water Heater	-	40

Domestic Water Heater (DWH)
Hot water is produced using a tanked gas fired water heater to satisfy the domestic water load. The pipes are fairly insulated.

Plug load
The office has a dense quantity of plug loads which support the operation of the staff. The load account for approximately 22% of the over electrical usage. There are 95 computers workstations along with kitchen equipment and printers. There are two (2) vending machines which can be controlled.

Plumbing Fixtures
The restrooms, locker rooms and kitchen are equipped with standard flowing plumbing fixtures.

Main County Office Building

Figure 9: Main County Office Building

The Main County Office building is a 56,745 single-story building, located at 110 Fifth St, Salem, NJ built in 1950. The building is comprised of offices, restrooms, conference rooms, mechanical room, storage spaces and common areas such as corridor.

Table 34: Building Occupancy Schedule

Building Name	Weekday/ Weekend	Operating Schedule
Main County Office Building	Weekday	8:30AM - 4:30PM
	Weekend	Closed

Building Condition

Envelop
The building is constructed of concrete masonry units (CMUs) with a brick veneer and plaster interior finish. The building has a flat roof with white membrane which appears to be in good condition. The windows are double-paned with aluminum frames and appear to have been recently installed.

Lighting
The interior lighting system consist of linear fluorescent T8 (4-foot and 2-foot) lamps, with a few fixtures incorporating linear T5. Many fixtures have emergency back up in case of power failure. There are also a few fixtures that use compact fluorescent (CFL) lamps. Most exit signs use LED sources. Existing line-by-line fixture table is attached as an appendix.

Mechanical
The building is conditioned by two (2) packaged roof top units (RTUs). These units provide heating and cooling to the building. Each unit is 40 tons and has a natural gas-fired furnace that is rated at 400 MBH. These units are within their useful service life and are in fair condition. Each zone in the building is served by a VAV box that is controlled by individual zone level thermostats. There is a dedicated Split AC unit for the server room
.

Table 35: Building Equipment Schedule

Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (MBH, kW)
Roof	Server Room	1	Split-System AC	2.5	-
Roof	Offices	1	Packaged RTU	40	400
Roof	Offices	1	Packaged RTU	40	400

Domestic Water Heater (DWH)
At the time of the audit, we were unable to locate any domestic hot water heaters, however, based on the building type and the presence of restrooms, we assume that the building is served by a small electric hot water heater.

Plug load
The utility bill analysis indicates that plug loads consume 21% of total building energy use. There are 77 computers workstations throughout the facility. Plug loads throughout the building include office equipment, election machines and general break room equipment like coffee machines, minifridges and microwave.

Plumbing Fixtures
The restrooms and kitchen are equipped with standard flowing plumbing fixtures.

Admin Building

Figure 10: Admin Building

The Admin building is a 21,285 three story building, built in 1968. The building is comprised of offices, restrooms, conference rooms, mechanical room, storage spaces and common areas such as corridor.

Table 36: Building Occupancy Schedule

Building Name	Weekday/ Weekend	Operating Schedule
Admin Building	Weekday	8:30AM - 4:30PM

	Weekend	Closed

Building Condition

Envelop

The building walls are concrete block over structural steel with a brick façade. Part of the roof is flat, covered in asphalt and in fair condition, the of part is pitched cover with shingles. Most windows are double pane with thermal breaks, showing great conditions. Some of the windows are operable, with the weather stripping is fair condition.

Lighting

Majority of the fixtures at the office are fitted with F32T8 linear fluorescent lamps however, those fixtures are in poor conditions in some areas. Other various types of fixtures are installed which are in good condition. Interior lighting fixtures are controlled by manual switches. Building exterior fixtures include wall packs and flood fixtures. Existing line-by-line fixture table is attached as an appendix.

Mechanical

The building is condition by several fan coils and unit ventilators located in each room. Chilled water for these units is supplied from the Courthouse chiller plant. Heating hot water is supplied by two (2) Weil-Mclain gas fired 2,450 MBH hot water boilers.

Table 37: Building Equipment Schedule

Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (MBH, kW)
Boiler Room	Entire Building	1	Gas Fired Boiler	-	2,450
Boiler Room	Entire Building	1	Gas Fired Boiler	-	2,450
Boiler Room	Entire Building	1	Electric Water Heater	-	10kW

Table 38: Building Motor Schedule

Location	Area(s)/System(s) Served	Motor Quantity	Motor Application	HP Per Motor	Full Load Efficiency
Various	Entire Building	25	Supply Fan Unit Ventilators	1/2	60%
Boiler Room	Entire Building	2	Cooling Tower Fan Motor	10	87%
Boiler Room	Unit Ventilators	2	HW/CHW Supply Pump	5	89%

Domestic Water Heater (DWH)

Hot water is produced using a 50-gallon storage tank gas fired water heater to satisfy the domestic water load.

Plug load

The office has a dense quantity of plug loads which support the operation of the staff. The load account for approximately 4.9% of the over electrical usage.

Plumbing Fixtures

The restrooms, locker rooms and kitchen are equipped with standard flowing plumbing fixtures.

2.8 Utility Bill Energy Use Summary

A summary of monthly utility consumption and costs for Salem County was analyzed for the 12-month period This summary is useful for understanding the various uses of energy and the annual variation in energy usage.

The utility cost data was used to determine a blended rate. The blended rate is the overall annual rate per unit of consumption that the facility pays for electricity and natural gas. The blended rate is determined by dividing the total electric/natural gas cost for a time period by the total electric/natural gas consumption in kWh/therms for the same time period.

Table 39: All Building Energy Consumption and Costs

Energy Type	Johnson Building	Inter-Agency Building	Agriculture Building	Fenwick Building	Emergency Services	Social Services	Main County Office	Admin Building
Area (sqft)	7,000	62,440	13,600	24,600	13,170	20,000	56,745	21,285
Electrical Usage (kWh)	13,720	62,440	168,800	186,480	403,280	194,640	603,080	216,160
Natural Gas Usage (therms)	4,078	-	9,959	5,185	4,148	2,563	3,274	13,737
Total kBtu	454,627	213,045	1,571,619	1,154,693	1,790,806	920,367	2,384,985	2,110,947
Electrical Cost ($)	$2,148	$9,993	$27,971	$28,208	$60,543	$27,572	$92,666	$29,290
Natural Gas Cost ($)	$2,873	-	$7,357	$4,016	$3,323	$2,662	$2,681	$12,523
Total Annual Cost ($)	$5,022	$9,993	$35,329	$32,224	$63,866	$30,235	$95,347	$41,813
kBTU/SF	64.95	23.01	115.56	46.94	135.98	46.02	42.03	99.18
$/SF	$0.72	$1.08	$2.60	$1.31	$4.85	$1.51	$1.68	$1.96
$/kWh	$0.16	$0.16	$0.17	$0.15	$0.15	$0.14	$0.15	$0.14

2.8.1 Electric Energy Usage- Johnson Building

The facility's electric energy usage for the period of January 2018 through December 2018 was 13,720 kWh, with a peak demand of 6 kW. Peak electric demand is occurred in July when the facility experiences the highest cooling load.

Table 40: Electric Energy Usage (1/2018 – 12/2018)

Month-Year	Usage (kWh)	Demand (kW)	Total Electric Cost
Jan-18	936	4	$165
Feb-18	976	4	$170
Mar-18	424	4	$84
Apr-18	953	4	$169
May-18	917	5	$82
Jun-18	1,817	6	$297
Jul-18	2,068	6	$334
Aug-18	1,970	6	$322
Sep-18	1,161	5	$187
Oct-18	872	5	$149
Nov-18	751	4	$121
Dec-18	875	4	$69
Total/Peak	**13,720**	**Max: 6**	**$2,148**

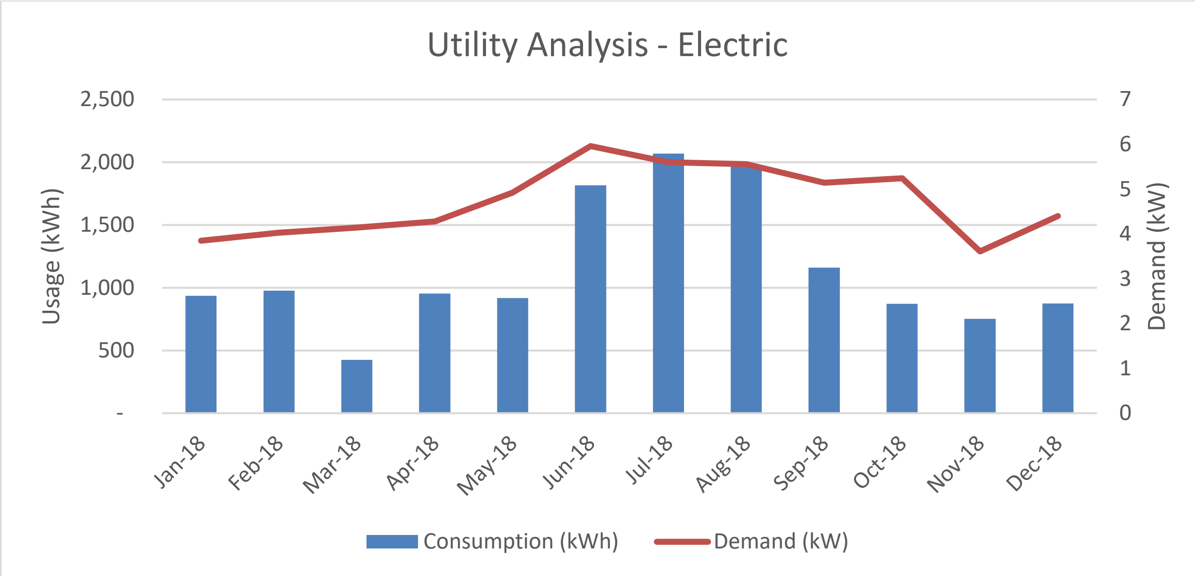

Figure 11: Electric Energy Usage Data (1/2018 – 12/2018)

2.8.2 Natural Gas Usage- Johnson Building

The facility's total natural gas usage for the period of July 2018 through June 2019 was 4,078 therms. Majority of the natural gas consumption occurs during winter season as the boilers are utilized for space heating.

Table 41. Natural Gas Energy Use (7/2018 – 6/2019)

Month-Year	Usage (Therms)	Total Gas Cost
Jul-18	166	$131
Aug-18	0	$0
Sep-18	0	$0
Oct-18	0	$0
Nov-18	0	$0
Dec-18	0	$0
Jan-19	346	$246
Feb-19	702	$491
Mar-19	796	$557
Apr-19	940	$658
May-19	712	$499
Jun-19	417	$292
Total	**4,078**	**$2,873**

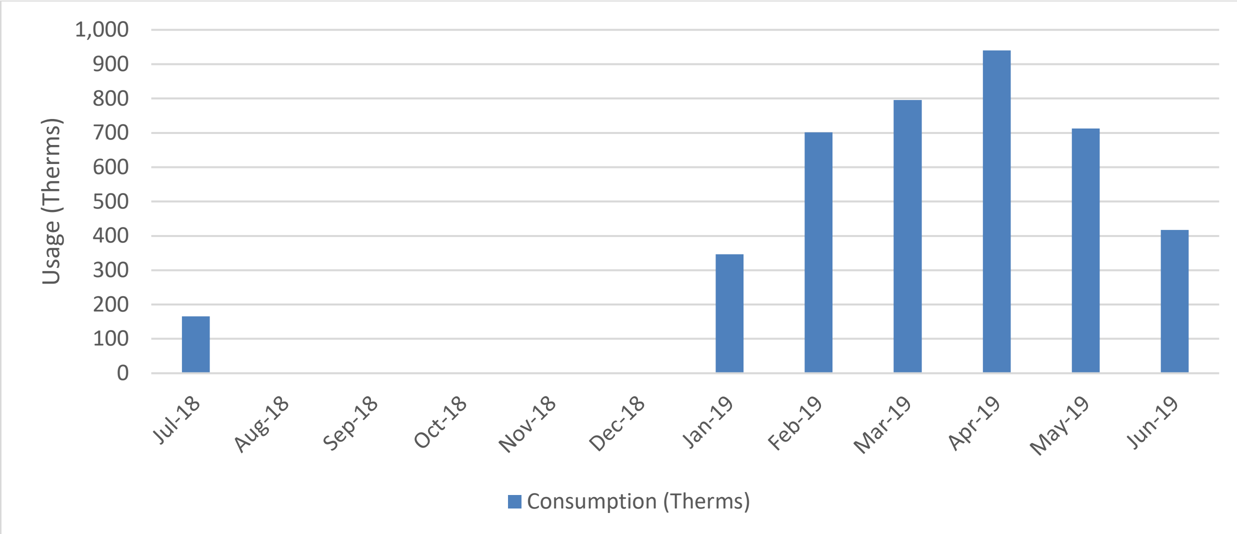

Figure 12: Natural Gas Usage Data (7/2018 – 6/2019)

2.9 End Use Breakdown Summary- Johnson Building

The tables below summarize the existing annual electric and natural gas end usage within the buildings. The figures and tables in this section shows an estimated distribution of electric and natural gas usage among the building systems. This breakdown is based on the energy model and, as a result, may vary from the site's actual energy distribution.

Table 42: End Use Breakdown Summary

End Use Type	Electricity	Electricity Usage	Natural Gas	Natural Gas Usage	Total Site Energy	Total Usage
	(kWh)	(%)	(therms)	(%)	(kBTU)	(%)
Space Heating	179	1.3%	4,176	100.0%	418,257	89.8%
Domestic Hot Water	396	2.8%	0	0.0%	1,350	0.3%
Space Cooling	3,780	26.8%	0	0.0%	12,897	2.8%
Ventilation	0	0.0%	0	0.0%	0	0.0%
Lighting	9,543	67.6%	0	0.0%	32,559	7.0%
Plug Loads/Miscellaneous	211	1.5%	0	0.0%	719	0.2%
Total Estimated	**14,108**	100.0%	**4,176**	100.0%	**465,784**	100.0%

2.9.1 Electric End Use Breakdown- Johnson Building

Approximately, 28% of the electrical energy used in the building was dedicated to HVAC use (fans, pumps & auxiliary equipment, cooling & heating) with lighting accounting for another 68% (interior light and exterior light). The remaining 2% was used for miscellaneous equipment and other process equipment.

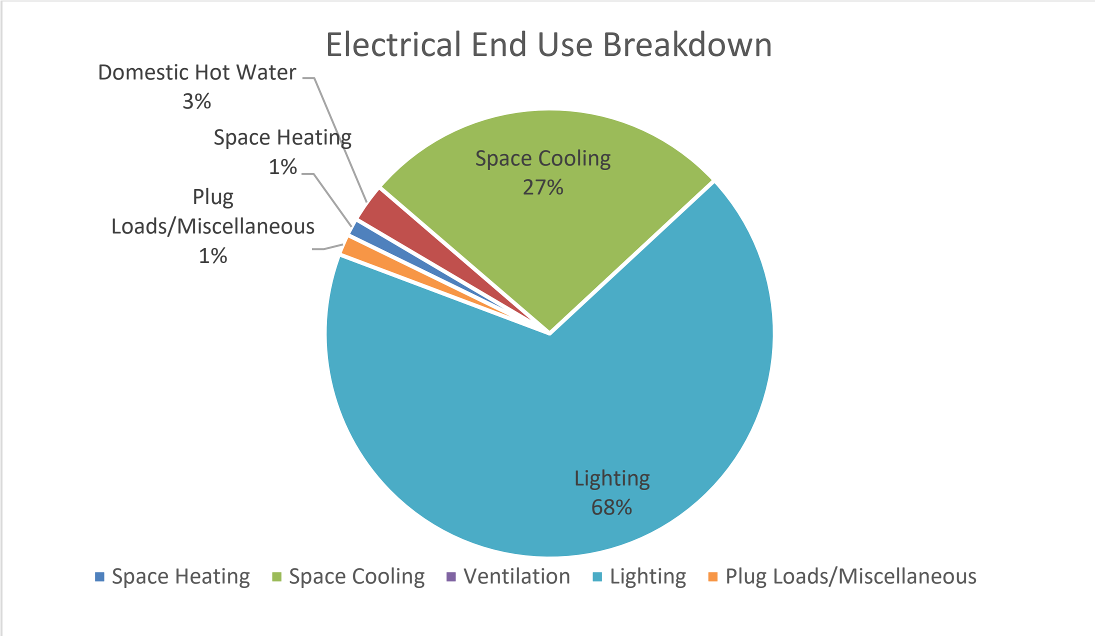

Figure 13: Electric End Use Breakdown

2.9.2 Natural Gas End Use Breakdown- Johnson Building

Space heating accounted for approximately 100% of the facility's natural gas usage. Domestic hot water generation is done via electric water heater.

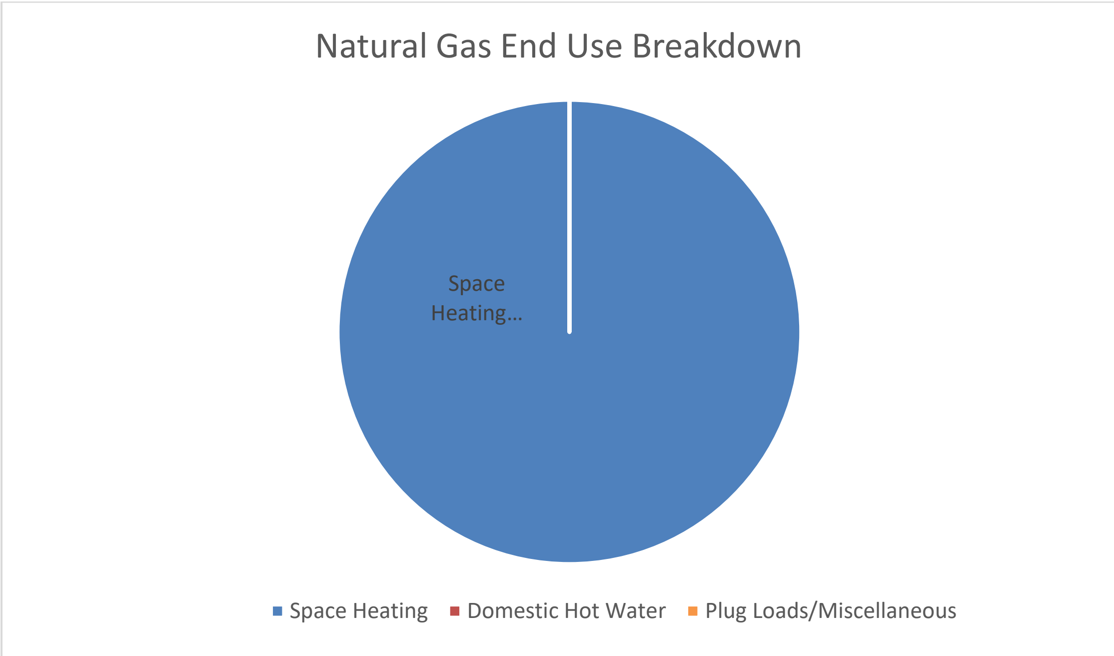

Figure 14: Natural gas End Use Breakdown

2.9.3 Total Energy Use Breakdown- Johnson Building

The conversion of each utility's consumption to a common energy unit, kBTU, allows for a total energy end use breakdown to be estimated. The figures below show an estimated distribution of energy usage among the building systems. This breakdown is based on the project energy model and, as a result, may vary from the site's real distribution.

Space heating accounted for approximately 90% of the energy usage, space cooling: 3%, lighting: 7%.

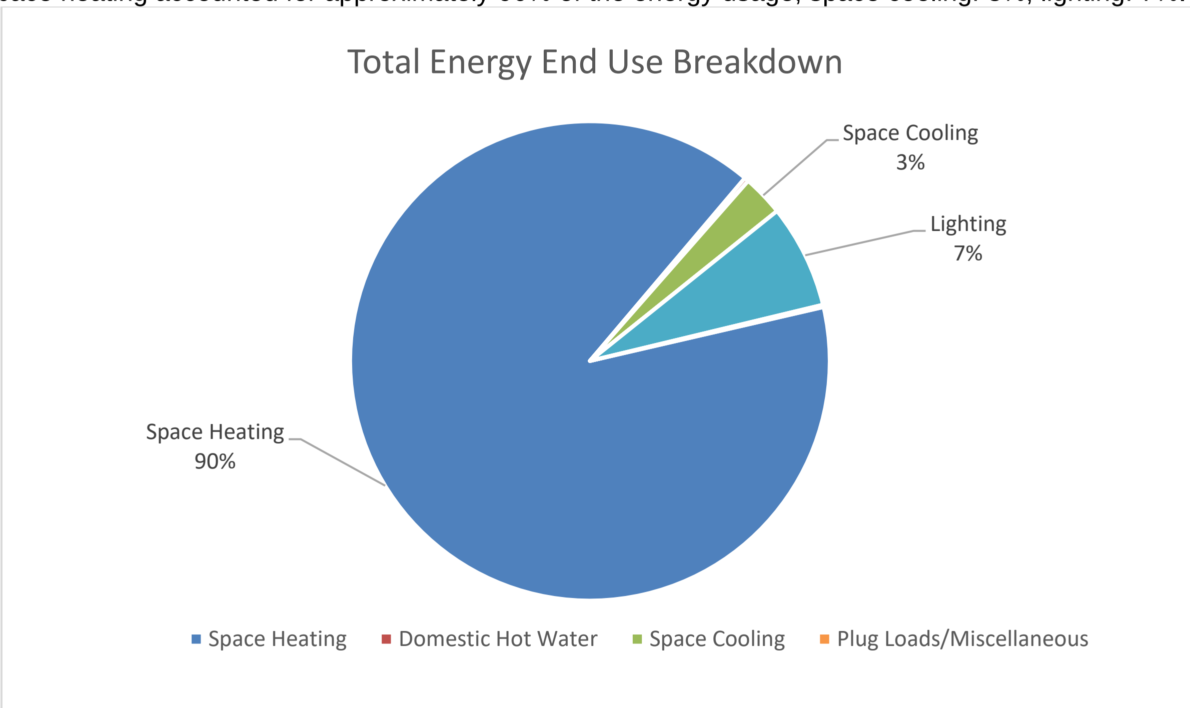

Figure 15: Total Energy Use Breakdown

2.8.1 Electric Energy Usage- Inter-Agency Council Building

The facility's electric energy usage for the period of April 2018 through March 2019 was 62,440 kWh, with a peak demand of 26.4 kW. Peak electric demand is occurred in July when the facility experiences the highest cooling load.

Table 43: Electric Energy Usage (4/2018 – 3/2019)

Month-Year	Usage (kWh)	Demand (kW)	Total Electric Cost
Apr-18	3,720	12	$639
May-18	4,640	14	$796
Jun-18	5,920	18	$968
Jul-18	7,560	20	$1,226
Aug-18	7,760	20	$1,259
Sep-18	4,240	18	$681
Oct-18	4,160	19	$684
Nov-18	4,480	14	$691
Dec-18	5,480	14	$834
Jan-19	5,240	26	$841
Feb-19	4,800	-	$675
Mar-19	4,440	14	$700
Total/Peak	**62,440**	**Max: 26.4**	**$9,993**

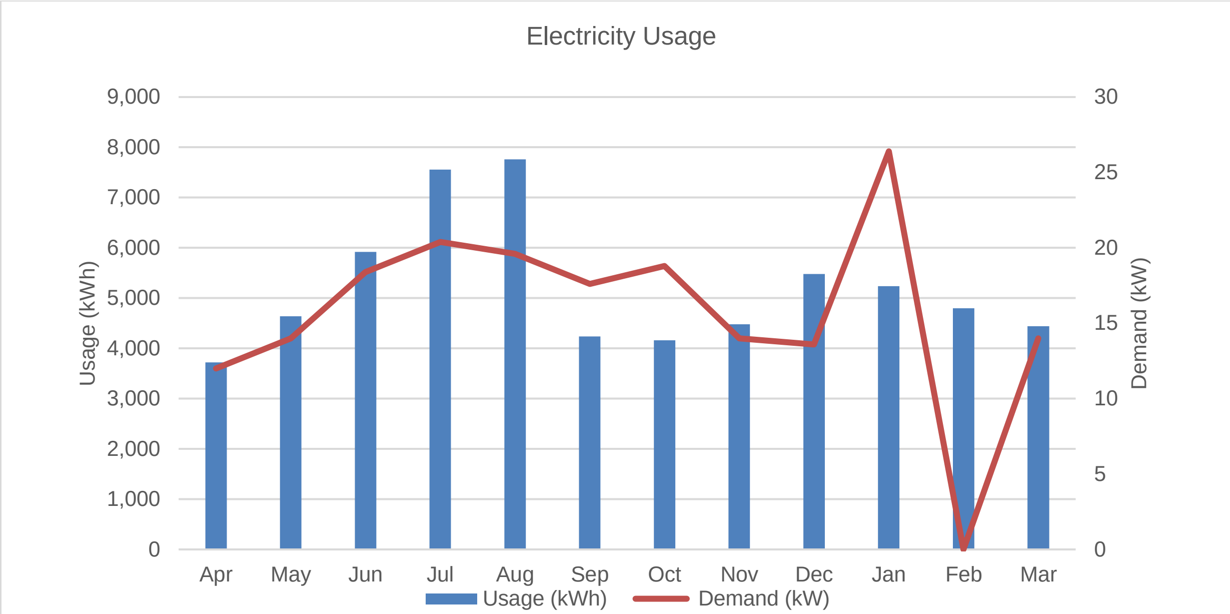

Figure 16: Electric Energy Usage Data (1/2018 – 12/2018)

2.9 End Use Breakdown Summary- Inter-Agency Council Building

The tables below summarize the existing annual electric and natural gas end usage within the buildings. The figures and tables in this section shows an estimated distribution of electric and natural gas usage among the building systems. This breakdown is based on the energy model and, as a result, may vary from the site's actual energy distribution.

Table 44: End Use Breakdown Summary

End Use Type	Electricity (kWh)	Electricity Usage (%)	Total Site Energy (kBTU)	Total Usage (%)
Space Heating	16,378	24.2%	55,882	24.2%
Domestic Hot Water	171	0.3%	585	0.3%
Space Cooling	11,460	16.9%	39,102	16.9%
Ventilation	3,640	5.4%	12,421	5.4%
Lighting	31,421	46.4%	107,208	46.4%
Plug Loads/Miscellaneous	4,649	6.9%	15,861	6.9%
Total Estimated	**67,719**	100.0%	**231,058**	100.0%

2.9.1 Electric End Use Breakdown- Inter-Agency Council Building

Approximately, 46% of the electrical energy used in the building was dedicated to HVAC use (fans, pumps & auxiliary equipment, cooling & heating) with lighting accounting for another 47% (interior light and exterior light) and plug loads accounted for 7%.

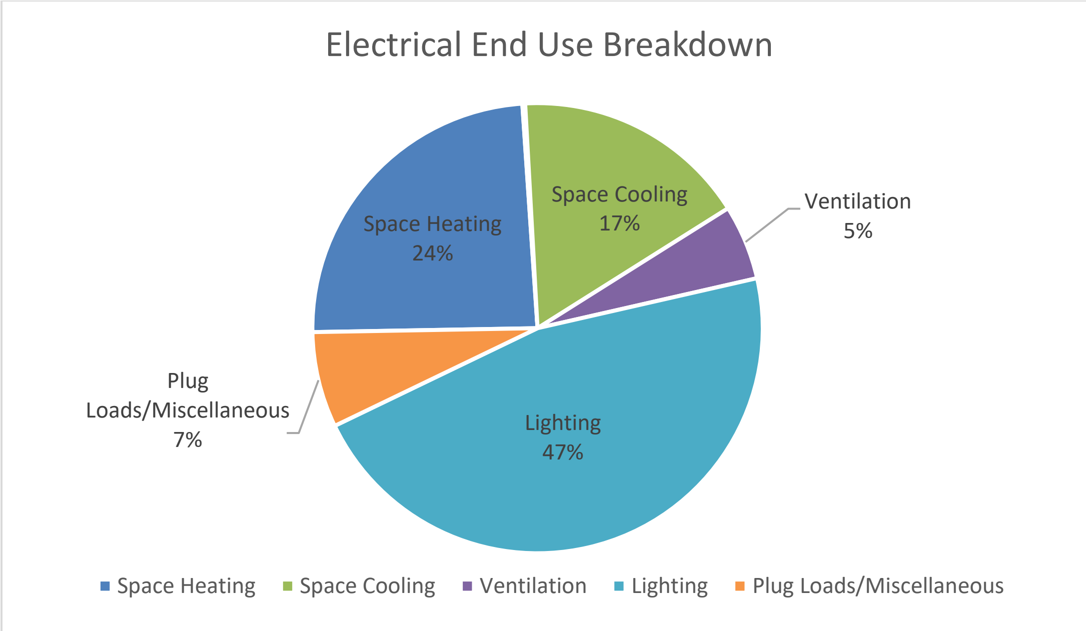

Figure 17: Electric End Use Breakdown

2.9.3 Total Energy Use Breakdown- Inter-Agency Council Building

The conversion of each utility's consumption to a common energy unit, kBTU, allows for a total energy end use breakdown to be estimated. The figures below show an estimated distribution of energy usage among the building systems. This breakdown is based on the project energy model and, as a result, may vary from the site's real distribution.

Space heating accounted for approximately 24% of the energy usage, space cooling: 17%, lighting: 47%, ventilation fans; 5% and plug loads 7%.

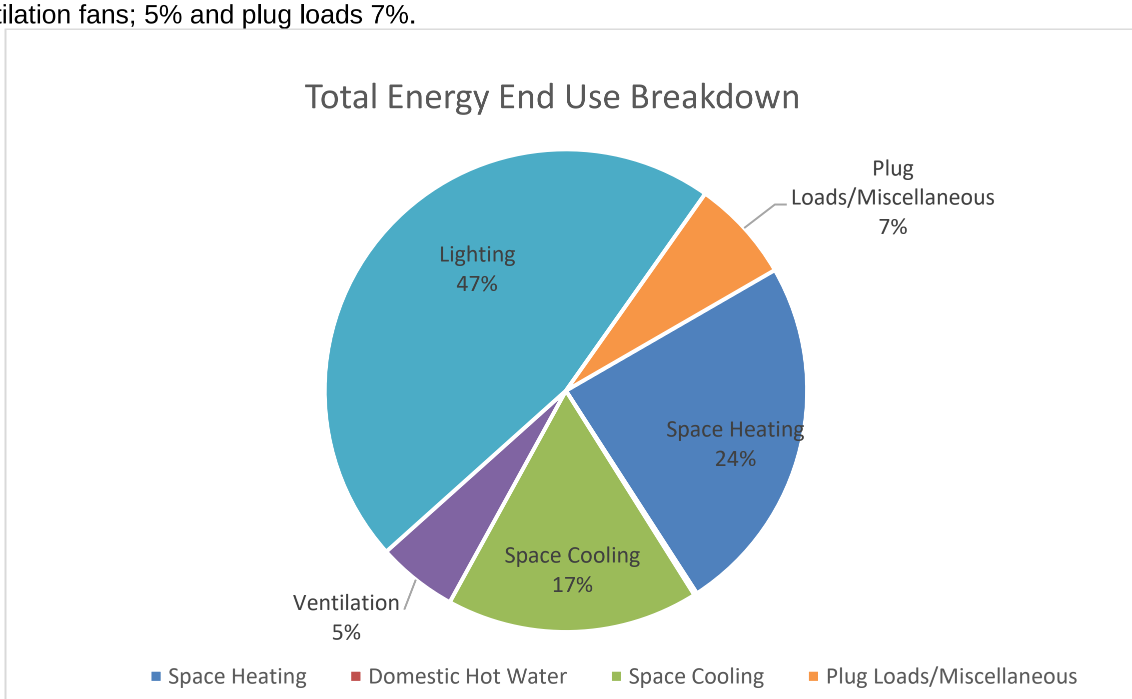

Figure 18: Total Energy Use Breakdown

2.8.1 Electric Energy Usage- Agriculture Building

The facility's electric energy usage for the period of April 2018 through March 2019 was 168,800 kWh, with a peak demand of 88.8 kW. Peak electric demand is occurred in July when the facility experiences the highest cooling load.

Table 45: Electric Energy Usage (4/2018 – 3/2019)

Month-Year	Usage (kWh)	Demand (kW)	Total Electric Cost
Apr-18	10,920	49	$1,977
May-18	14,240	62	$2,348
Jun-18	20,240	89	$3,361
Jul-18	21,560	86	$3,567
Aug-18	18,640	87	$3,225
Sep-18	14,000	74	$2,428
Oct-18	10,960	10	$1,718
Nov-18	11,360	30	$1,815
Dec-18	13,120	31	$2,095
Jan-19	10,400	32	$1,660
Feb-19	12,600	33	$2,014
Mar-19	10,760	40	$1,765
Total/Peak	**168,800**	**Max: 88.8**	**$27,971**

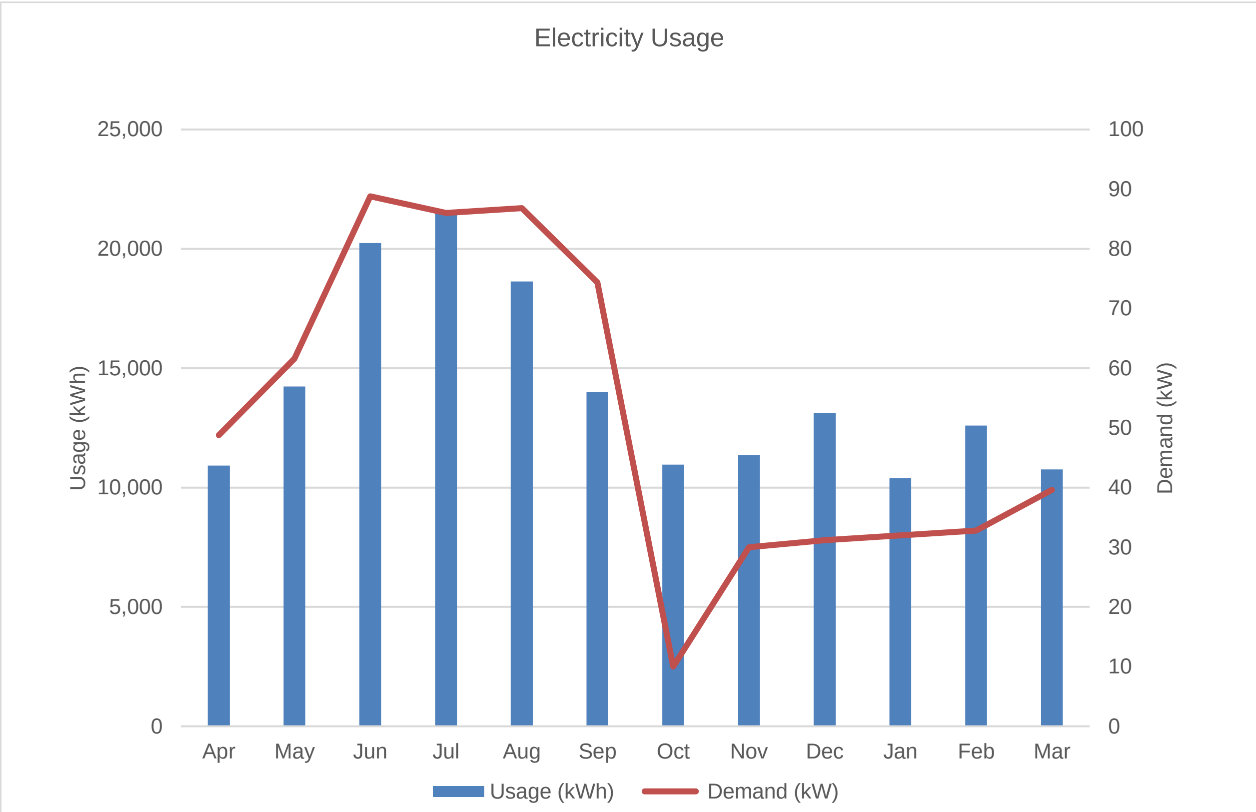

Figure 19: Electric Energy Usage Data (4/2018 – 3/2019)

2.8.2 Natural Gas Usage- Agriculture Building

The facility's total natural gas usage for the period of April 2018 through March 2019 was 9,959 therms. Majority of the natural gas consumption occurs during winter season as the boilers are utilized for space heating.

Table 46. Natural Gas Energy Use (4/2018 – 3/2019)

Month-Year	Usage (Therms)	Total Gas Cost
Apr-18	577	$468
May-18	80	$97
Jun-18	17	$47
Jul-18	10	$44
Aug-18	10	$41
Sep-18	13	$42
Oct-18	621	$461
Nov-18	1,860	$1,328
Dec-18	1,887	$1,349
Jan-19	1,888	$1,339
Feb-19	2,044	$1,450
Mar-19	953	$691
Total	**9,959**	**$7,357**

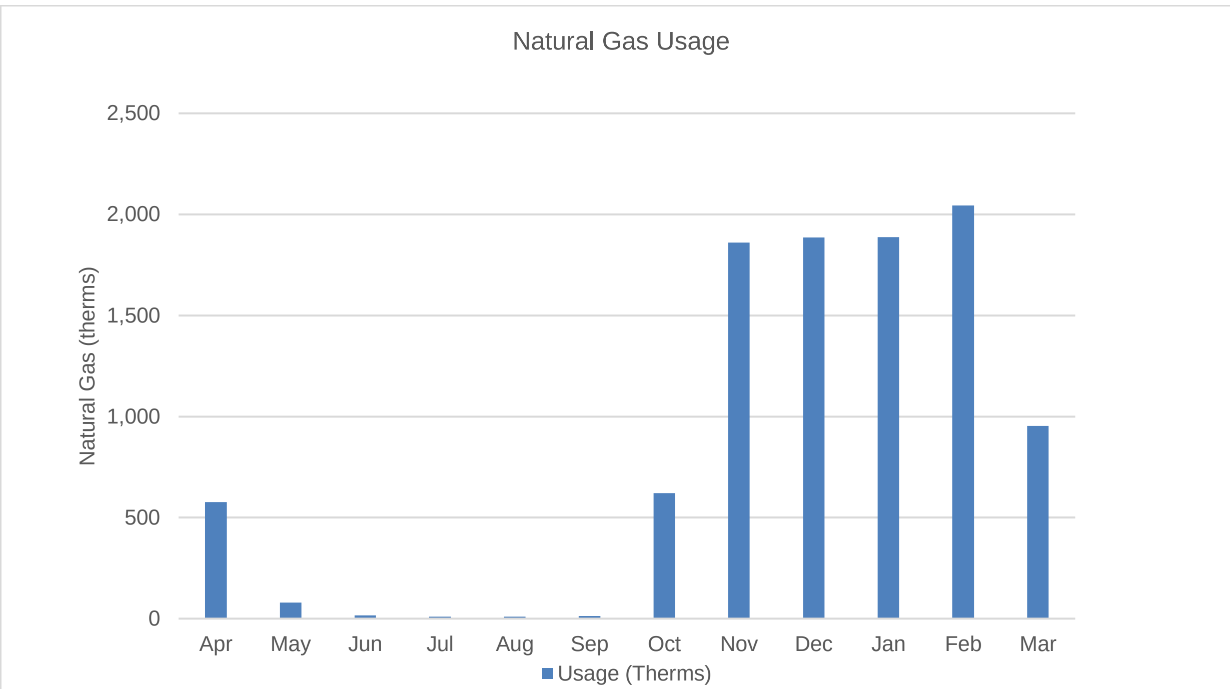

Figure 20: Natural Gas Usage Data (4/2018 – 3/2019)

2.9 End Use Breakdown Summary- Agriculture Building

The tables below summarize the existing annual electric and natural gas end usage within the buildings. The figures and tables in this section shows an estimated distribution of electric and natural gas usage among the building systems. This breakdown is based on the energy model and, as a result, may vary from the site's actual energy distribution.

Table 47: End Use Breakdown Summary

End Use Type	Electricity	Electricity Usage	Natural Gas	Natural Gas Usage	Total Site Energy	Total Usage
	(kWh)	(%)	(therms)	(%)	(kBTU)	(%)
Space Heating	6,797	3.9%	9,457	99.3%	968,916	62.4%
Domestic Hot Water	0	0.0%	70	0.7%	7,023	0.5%
Space Cooling	63,878	36.3%	0	0.0%	217,950	14.0%
Ventilation	6,507	3.7%	0	0.0%	22,202	1.4%
Lighting	95,318	54.2%	0	0.0%	325,226	20.9%
Plug Loads/Miscellaneous	3,414	1.9%	0	0.0%	11,647	0.7%
Total Estimated	**175,914**	100.0%	**9,527**	100.0%	**1,552,965**	100.0%

2.9.1 Electric End Use Breakdown- Agriculture Building

Approximately, 44% of the electrical energy used in the building was dedicated to HVAC use (fans, pumps & auxiliary equipment, cooling & heating) with lighting accounting for another 54% (interior light and exterior light). The remaining 2% was used for miscellaneous equipment and other process equipment.

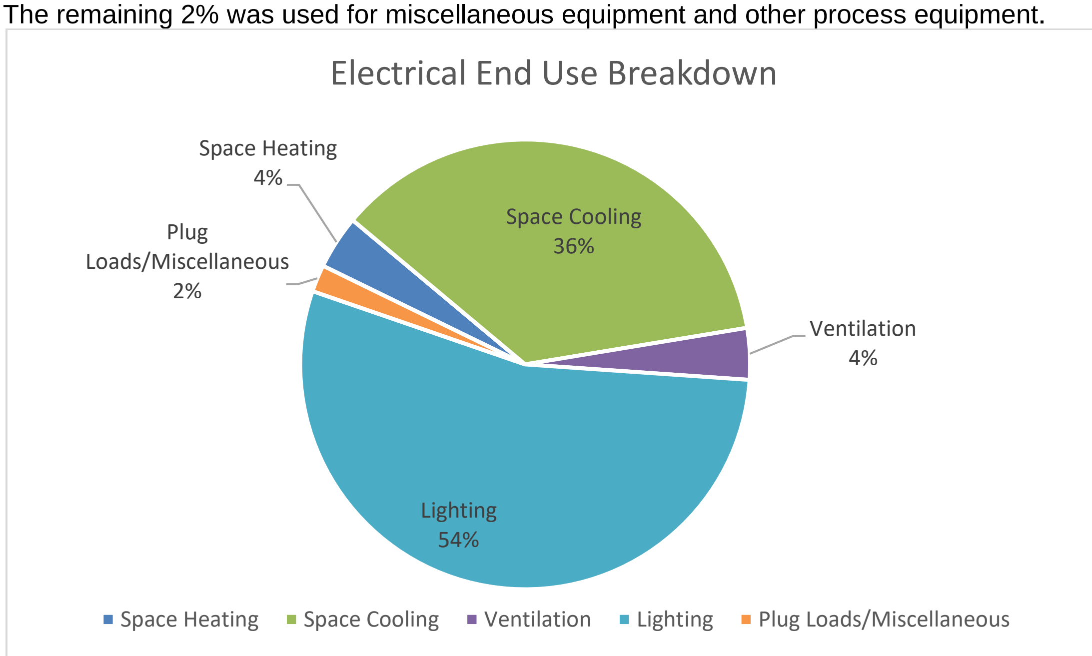

Figure 21: Electric End Use Breakdown

2.9.2 Natural Gas End Use Breakdown- Agriculture Building

Space heating accounted for approximately 99% of the facility's natural gas usage. Domestic hot water generation accounts for 1% of the facility's natural gas usage.

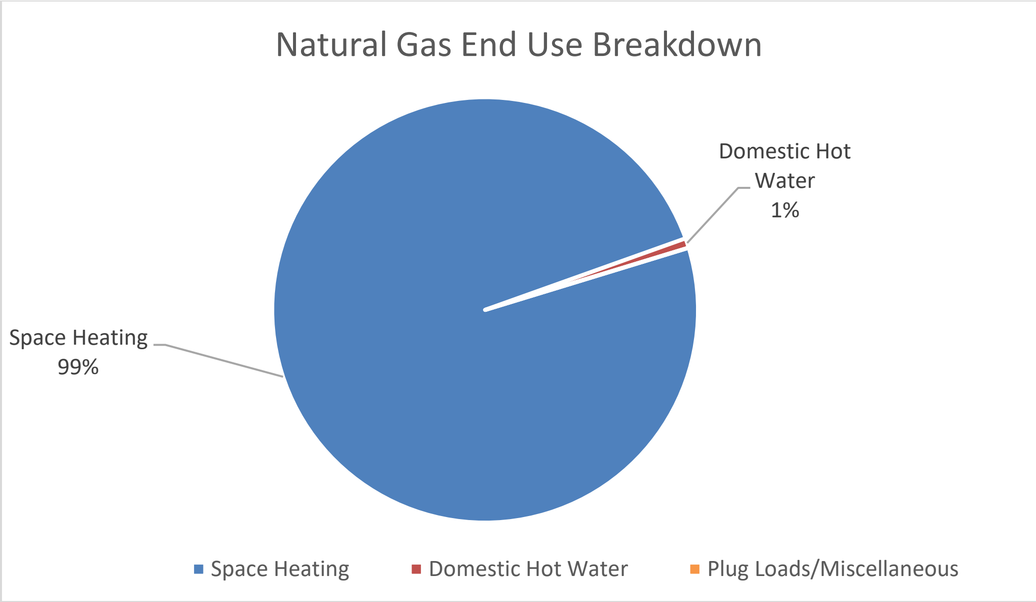

Figure 22: Natural gas End Use Breakdown

2.9.3 Total Energy Use Breakdown- Agriculture Building

The conversion of each utility's consumption to a common energy unit, kBTU, allows for a total energy end use breakdown to be estimated. The figures below show an estimated distribution of energy usage among the building systems. This breakdown is based on the project energy model and, as a result, may vary from the site's real distribution.

Space heating accounted for approximately 62% of the energy usage, domestic hot water generation: 1%, space cooling: 14%, lighting: 21%, miscellaneous equipment: 1%, pumps & auxiliary: 0%, ventilation fans; 1%.

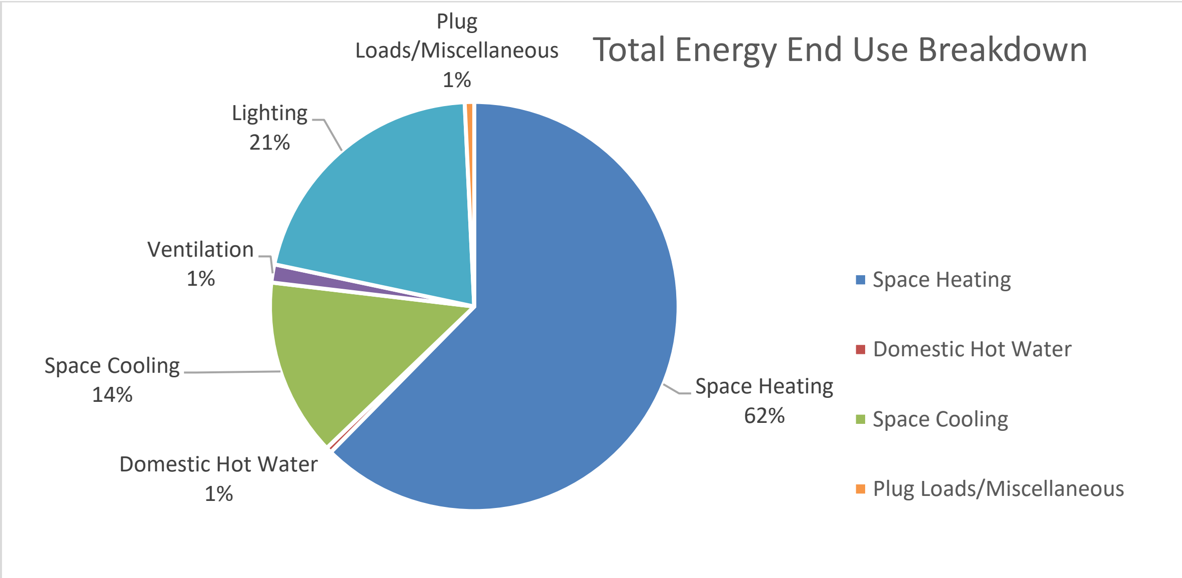

Figure 23: Total Energy Use Breakdown

2.8.1 Electric Energy Usage- Fenwick Building

The facility's electric energy usage for the period of April 2018 through Mach 2019 was 186,480 kWh, with a peak demand of 71.2 kW. Peak electric demand is occurred in July when the facility experiences the highest cooling load.

Table 48: Electric Energy Usage (1/2018 – 12/2018)

Month-Year	Usage (kWh)	Demand (kW)	Total Electric Cost
Apr-18	13,840	56	$2,310
May-18	15,600	60	$2,499
Jun-18	20,160	71	$2,814
Jul-18	19,760	66	$3,279
Aug-18	19,360	70	$2,810
Sep-18	15,680	60	$2,272
Oct-18	12,880	44	$1,989
Nov-18	14,160	45	$2,067
Dec-18	15,600	46	$2,299
Jan-19	13,680	48	$1,974
Feb-19	13,040	49	$1,913
Mar-19	12,720	53	$1,979
Total/Peak	**186,480**	**Max: 71.2**	**$28,208**

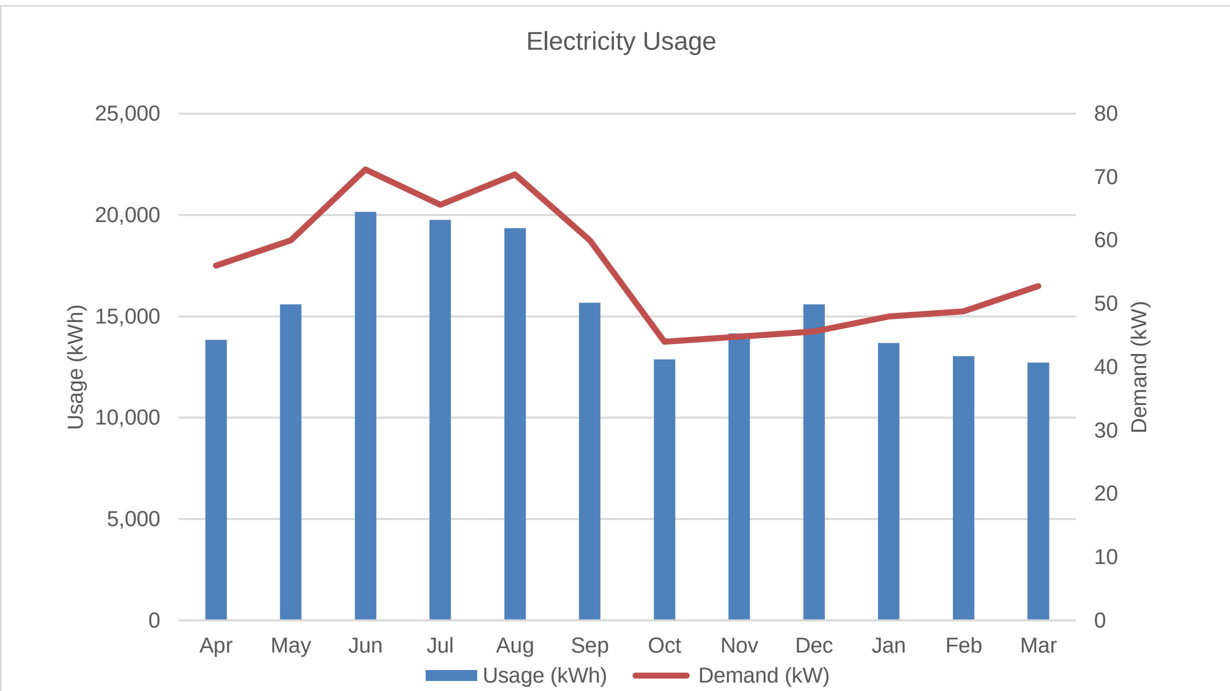

Figure 24: Electric Energy Usage Data (4/2018 – 3/2019)

2.8.2 Natural Gas Usage- Fenwick Building

The facility's total natural gas usage for the period of April 2018 through March 2019 was 5,185 therms. Majority of the natural gas consumption occurs during winter season as the boilers are utilized for space heating.

Table 49. Natural Gas Energy Use (4/2018 – 3/2019)

Month-Year	Usage (Therms)	Total Gas Cost
Apr-18	255	$230
May-18	0	$34
Jun-18	2	$38
Jul-18	0	$31
Aug-18	0	$34
Sep-18	0	$32
Oct-18	0	$34
Nov-18	1,229	$887
Dec-18	1,008	$738
Jan-19	1,168	$841
Feb-19	931	$675
Mar-19	593	$443
Total	**5,185**	**$4,016**

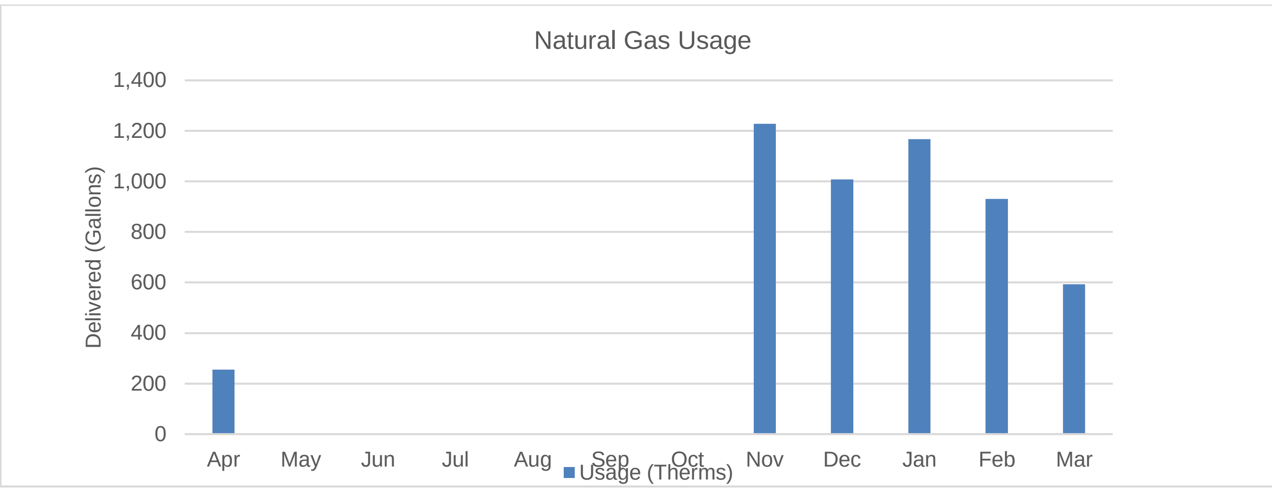

Figure 25: Natural Gas Usage Data (4/2018 – 3/2019)

2.9 End Use Breakdown Summary- Fenwick Building

The tables below summarize the existing annual electric and natural gas end usage within the buildings. The figures and tables in this section shows an estimated distribution of electric and natural gas usage among the building systems. This breakdown is based on the energy model and, as a result, may vary from the site's actual energy distribution.

Table 50: End Use Breakdown Summary

End Use Type	Electricity	Electricity Usage	Natural Gas	Natural Gas Usage	Total Site Energy	Total Usage
	(kWh)	(%)	(therms)	(%)	(kBTU)	(%)
Space Heating	733	0.4%	4,578	94.2%	460,340	40.4%
Domestic Hot Water	0	0.0%	281	5.8%	28,094	2.5%
Space Cooling	79,592	41.5%	0	0.0%	271,569	23.8%
Ventilation	10,441	5.4%	0	0.0%	35,625	3.1%
Lighting	71,483	37.3%	0	0.0%	243,901	21.4%
Plug Loads/Miscellaneous	29,638	15.4%	0	0.0%	101,125	8.9%
Total Estimated	**191,888**	100.0%	**4,859**	100.0%	**1,140,654**	100.0%

2.9.1 Electric End Use Breakdown- Fenwick Building

Approximately, 47% of the electrical energy used in the building was dedicated to HVAC use (fans, pumps & auxiliary equipment, cooling & heating) with lighting accounting for another 33% (interior light and exterior light). The remaining 23% was used for miscellaneous equipment and other process equipment.

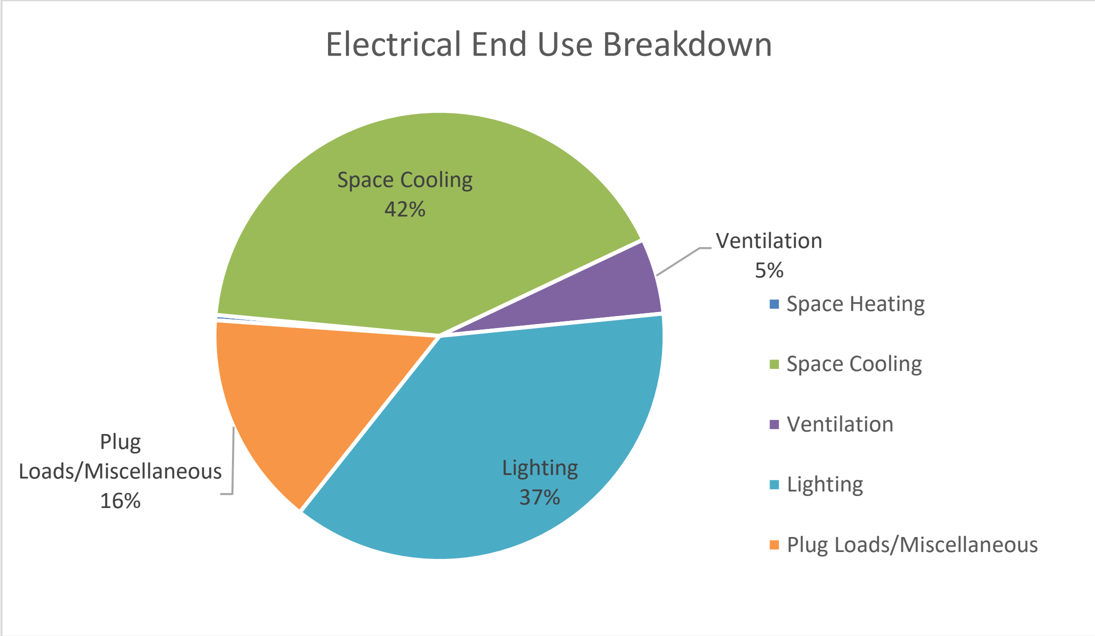

Figure 26: Electric End Use Breakdown

2.9.2 Natural Gas End Use Breakdown- Fenwick Building

Space heating accounted for approximately 94% of the facility's natural gas usage. Domestic hot water generation account for 6% of the facility's natural gas usage.

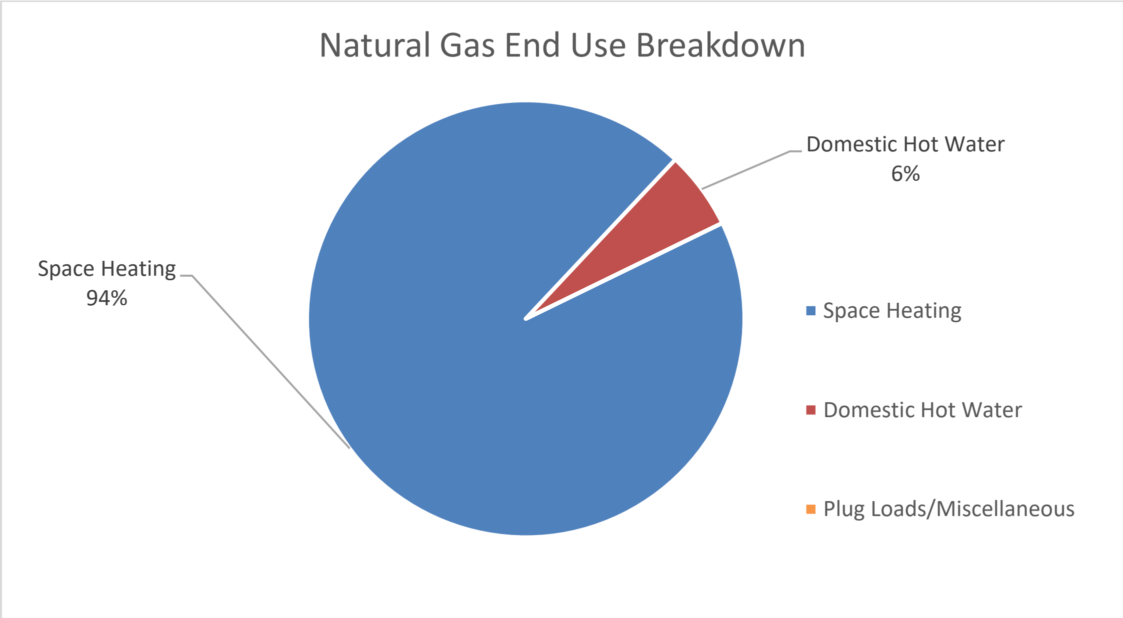

Figure 27: Natural gas End Use Breakdown

2.9.3 Total Energy Use Breakdown- Fenwick Building

The conversion of each utility's consumption to a common energy unit, kBTU, allows for a total energy end use breakdown to be estimated. The figures below show an estimated distribution of energy usage among the building systems. This breakdown is based on the project energy model and, as a result, may vary from the site's real distribution.

Space heating accounted for approximately 40% of the energy usage, domestic hot water generation: 3%, space cooling: 24%, lighting: 21%, miscellaneous equipment: 9%, ventilation fans; 3%.

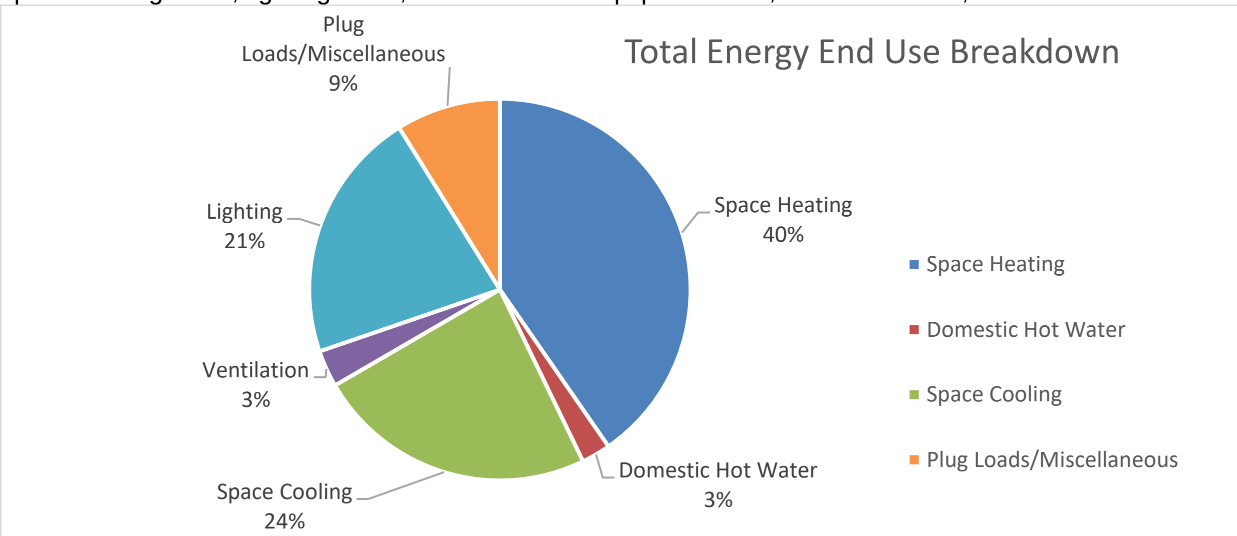

Figure 28: Total Energy Use Breakdown

2.8.1 Electric Energy Usage- Emergency Services Building

The facility's electric energy usage for the period of April 2018 through March 2019 was 403,280 kWh, with a peak demand of 83 kW. Peak electric demand occurred in June when the facility experiences the highest cooling load.

Table 51: Electric Energy Usage (1/2018 – 12/2018)

Month-Year	Usage (kWh)	Demand (kW)	Total Electric Cost
Apr-18	28,560	59	$4,491
May-18	30,640	69	$4,812
Jun-18	37,600	83	$5,835
Jul-18	38,160	75	$5,739
Aug-18	36,400	71	$5,476
Sep-18	42,480	78	$6,287
Oct-18	32,320	66	$4,746
Nov-18	33,040	80	$4,976
Dec-18	27,280	57	$4,039
Jan-19	39,600	64	$5,715
Feb-19	27,600	66	$4,104
Mar-19	29,600	64	$4,321
Total/Peak	**403,280**	**Max: 83**	**$60,543**

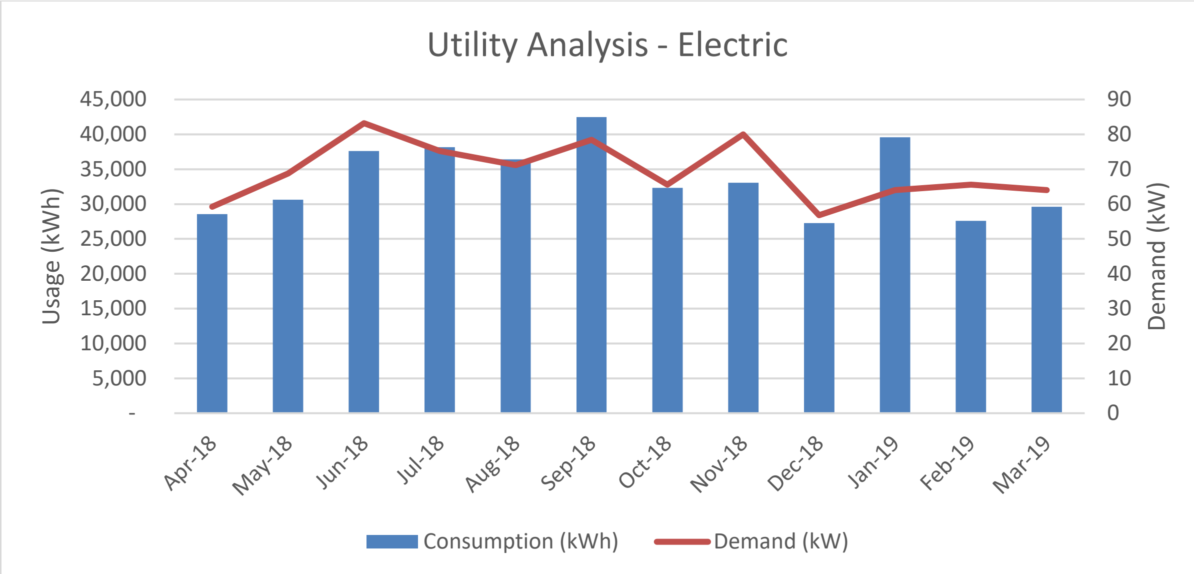

Figure 29: Electric Energy Usage Data (4/2018 – 3/2019)

2.8.2 Natural Gas Usage- Emergency Services Building

The facility's total natural gas usage for the period of July 2018 through June 2019 was 4,148 therms. Majority of the natural gas consumption occurs during winter season as the boilers are utilized for space heating.

Table 52. Natural Gas Energy Use (7/2018 – 6/2019)

Month-Year	Usage (Therms)	Total Gas Cost
Jul-18	262	$236
Aug-18	145	$143
Sep-18	83	$98
Oct-18	41	$66
Nov-18	35	$62
Dec-18	30	$56
Jan-19	42	$61
Feb-19	572	$431
Mar-19	634	$471
Apr-19	888	$655
May-19	739	$543
Jun-19	676	$499
Total	**4,148**	**$3,323**

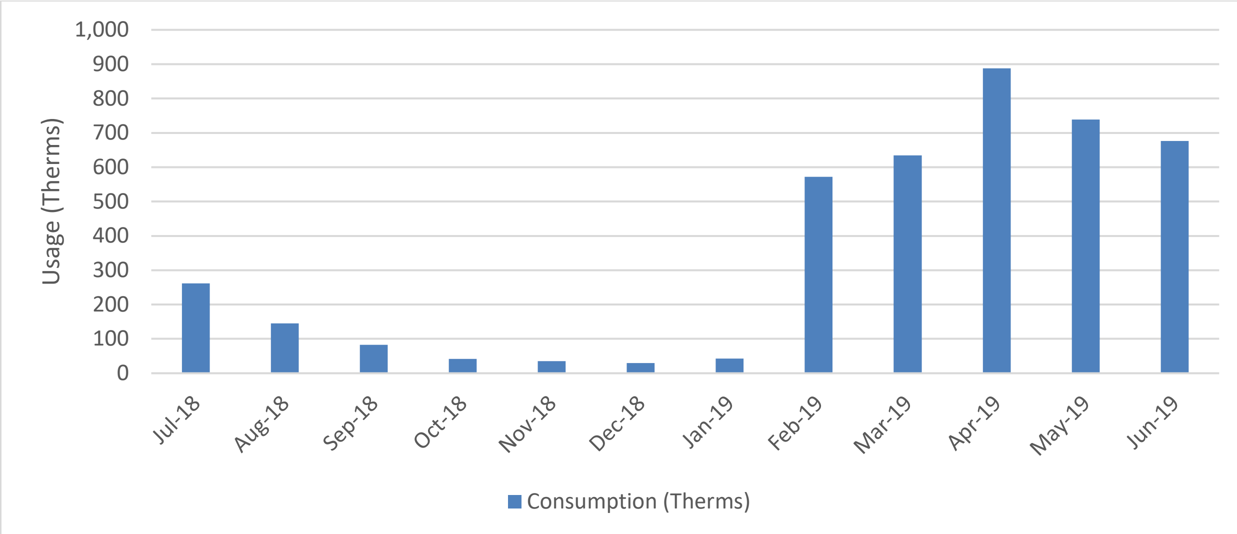

Figure 30: Natural Gas Usage Data (1/2018 – 12/2018)

2.9 End Use Breakdown Summary- Emergency Services Building

The tables below summarize the existing annual electric and natural gas end usage within the buildings. The figures and tables in this section shows an estimated distribution of electric and natural gas usage among the building systems. This breakdown is based on the energy model and, as a result, may vary from the site's actual energy distribution.

Table 53: End Use Breakdown Summary

End Use Type	Electricity	Electricity Usage	Natural Gas	Natural Gas Usage	Total Site Energy	Total Usage
	(kWh)	(%)	(therms)	(%)	(kBTU)	(%)
Space Heating	12,672	3.1%	4,025	93.1%	445,718	24.1%
Domestic Hot Water	1,583	0.4%	296	6.9%	35,042	1.9%
Space Cooling	179,750	43.4%	0	0.0%	613,306	33.2%
Ventilation	10,266	2.5%		0.0%	35,028	1.9%
Lighting	105,656	25.5%	0	0.0%	360,497	19.5%
Plug Loads/Miscellaneous	104,558	25.2%	0	0.0%	356,751	19.3%
Total Estimated	**414,485**	100.0%	**4,321**	100.0%	**1,846,343**	100.0%

2.9.1 Electric End Use Breakdown- Emergency Services Building

Approximately, 49% of the electrical energy used in the building was dedicated to HVAC use (fans, pumps & auxiliary equipment, cooling & heating) with lighting accounting for another 26% (interior light and exterior light). The remaining 25% was used for miscellaneous equipment and other process equipment.

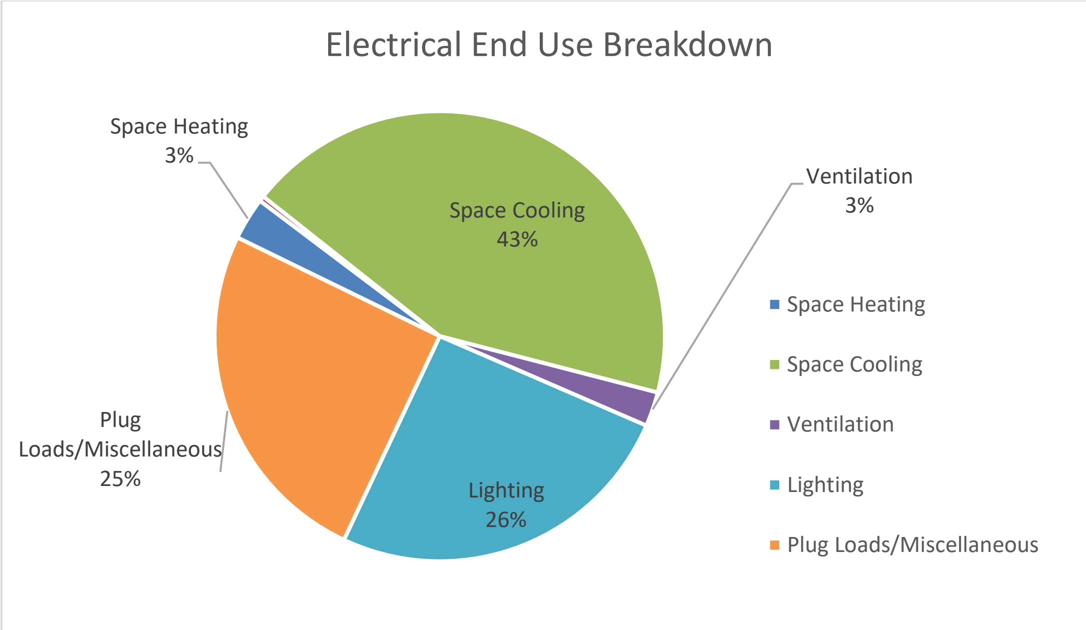

Figure 31: Electric End Use Breakdown

2.9.2 Natural Gas End Use Breakdown- Emergency Services Building

Space heating accounted for approximately 93% of the facility's natural gas usage. Domestic hot water generation accounts for 7% of the facility's natural gas usage.

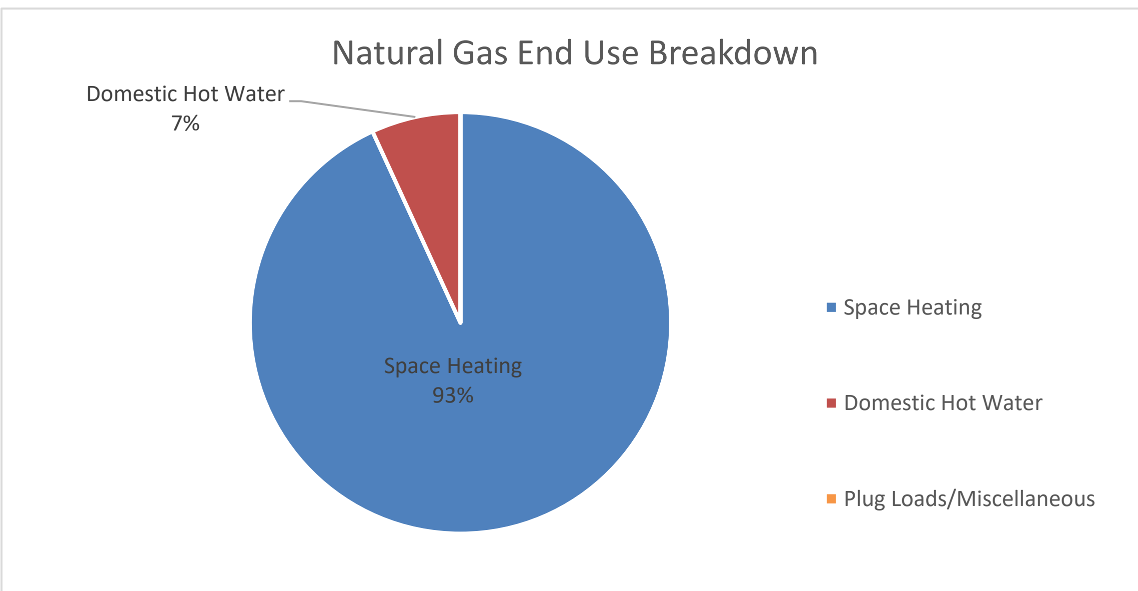

Figure 32: Natural gas End Use Breakdown

2.9.3 Total Energy Use Breakdown- Emergency Services Building

The conversion of each utility's consumption to a common energy unit, kBTU, allows for a total energy end use breakdown to be estimated. The figures below show an estimated distribution of energy usage among the building systems. This breakdown is based on the project energy model and, as a result, may vary from the site's real distribution.

Space heating accounted for approximately 33% of the energy usage, domestic hot water generation: 2%, space cooling: 24%, lighting: 20%, miscellaneous equipment: 19%, ventilation fans; 2%.

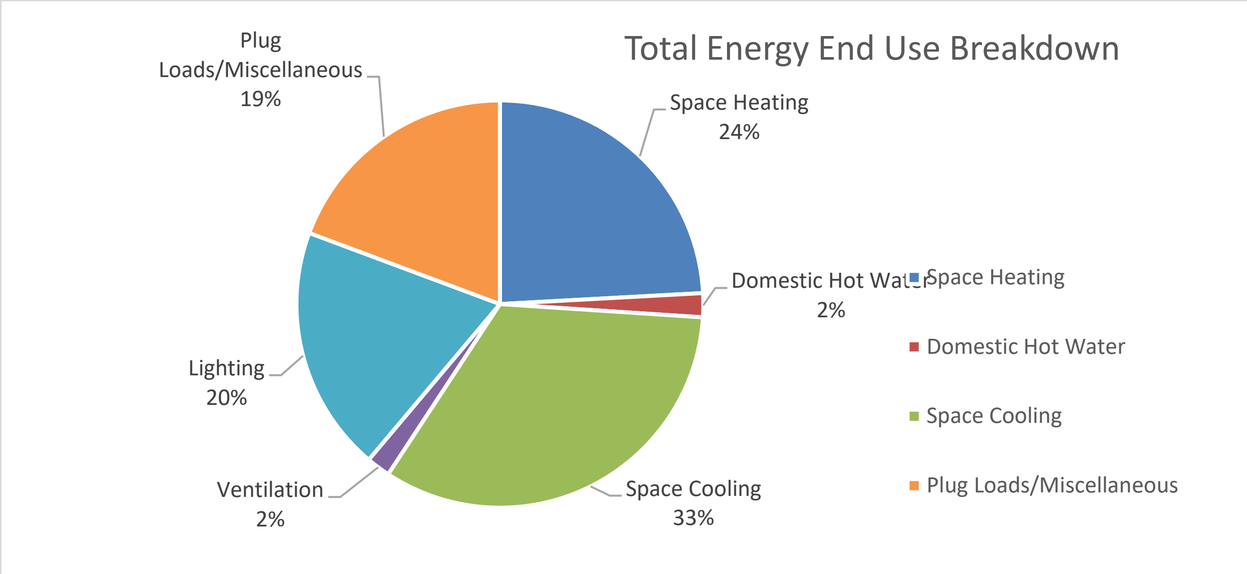

Figure 33: Total Energy Use Breakdown

2.8.1 Electric Energy Usage- Social Services Building

The facility's electric energy usage for the period of January 2018 through December 2018 was 194,640 kWh, with a peak demand of 68 kW. Peak electric demand is occurred in July when the facility experiences the highest cooling load.

Table 54: Electric Energy Usage (1/2018 – 12/2018)

Month-Year	Usage (kWh)	Demand (kW)	Total Electric Cost
Jan-18	17,600	57	$2,467
Feb-18	16,480	55	$2,391
Mar-18	17,200	57	$2,443
Apr-18	14,320	58	$2,122
May-18	17,520	57	$2,506
Jun-18	18,800	58	$2,533
Jul-18	18,400	68	$2,558
Aug-18	18,160	66	$2,599
Sep-18	13,120	58	$1,889
Oct-18	12,480	56	$1,847
Nov-18	15,360	50	$2,117
Dec-18	15,200	50	$2,102
Total/Peak	**194,640**	**Max: 68**	**$27,572**

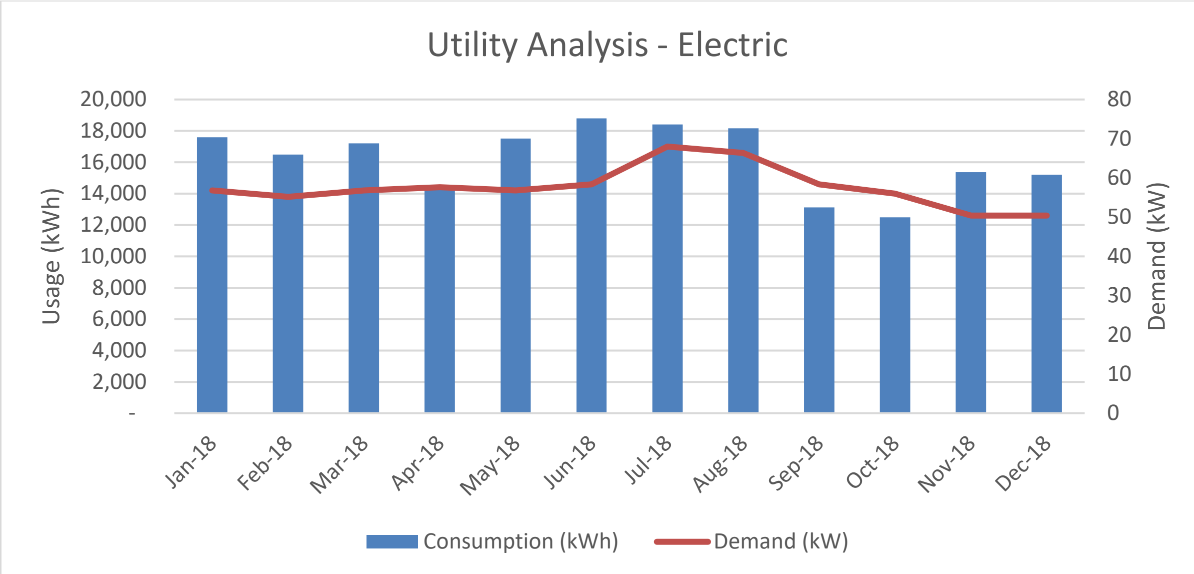

Figure 34: Electric Energy Usage Data (1/2018 – 12/2018)

2.8.2 Natural Gas Usage- Social Services Building

The facility's total natural gas usage for the period of January 2018 through December 2018 was 2,563 therms. Majority of the natural gas consumption occurs during winter season as the boilers are utilized for space heating.

Table 55. Natural Gas Energy Use (1/2018 – 12/2018)

Month-Year	Usage (Therms)	Total Gas Cost
Jan-18	600	$509.46
Feb-18	355	$327.90
Mar-18	290	$591.38
Apr-18	82	$99.17
May-18	14	$48.16
Jun-18	11	$42.47
Jul-18	11	$41.33
Aug-18	10	$43.93
Sep-18	11	$38.35
Oct-18	66	$78.66
Nov-18	423	$328.69
Dec-18	688	$512.83
Total	**2,563**	**$2,662**

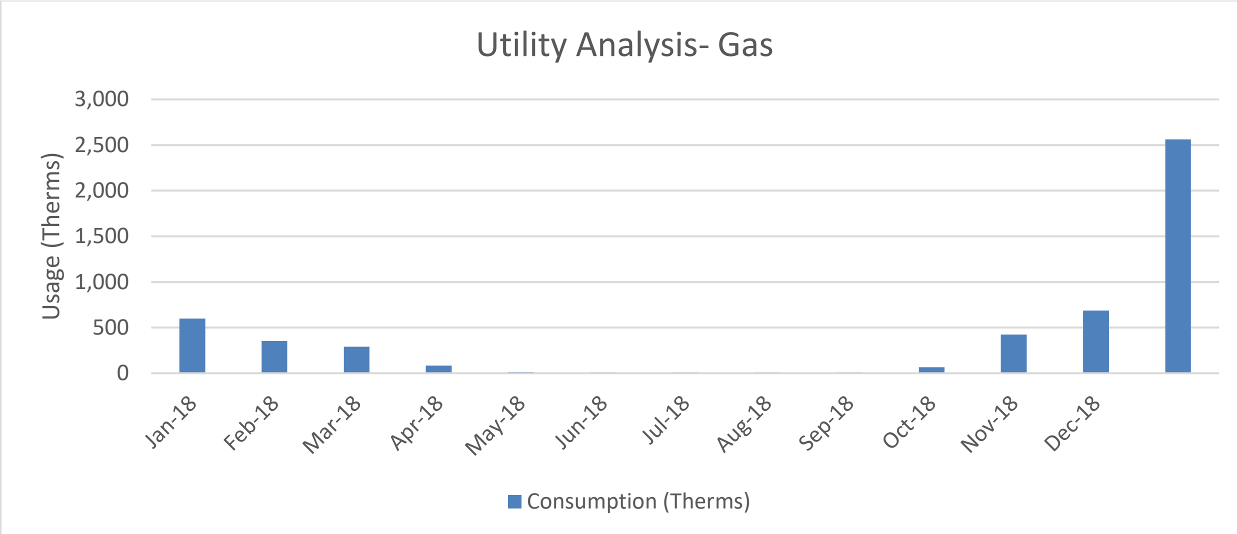

Figure 35: Natural Gas Usage Data (1/2018 – 12/2018)

2.9 End Use Breakdown Summary- Social Services Building

The tables below summarize the existing annual electric and natural gas end usage within the buildings. The figures and tables in this section shows an estimated distribution of electric and natural gas usage among the building systems. This breakdown is based on the energy model and, as a result, may vary from the site's actual energy distribution.

Table 56: End Use Breakdown Summary

End Use Type	Electricity	Electricity Usage	Natural Gas	Natural Gas Usage	Total Site Energy	Total Usage
	(kWh)	(%)	(therms)	(%)	(kBTU)	(%)
Space Heating	0	0%	2,535	96%	253,537	27%
Domestic Hot Water	0	0%	94	4%	9,365	1%
Space Cooling	47,127	24%	0	0%	160,798	17%
Ventilation	41,184	21%	0	0%	140,520	15%
Lighting	63,879	33%	0	0%	217,956	23%
Plug Loads/Miscellaneous	44,176	22%	0	0%	150,729	16%
Total Estimated	**196,367**	**100%**	**2,629**	**100%**	**932,904**	**100%**

2.9.1 Electric End Use Breakdown- Social Services Building

Approximately, 45% of the electrical energy used in the building was dedicated to HVAC use (fans, pumps & auxiliary equipment, cooling & heating) with lighting accounting for another 33% (interior light and exterior light). The remaining 22% was used for miscellaneous equipment and other process equipment.

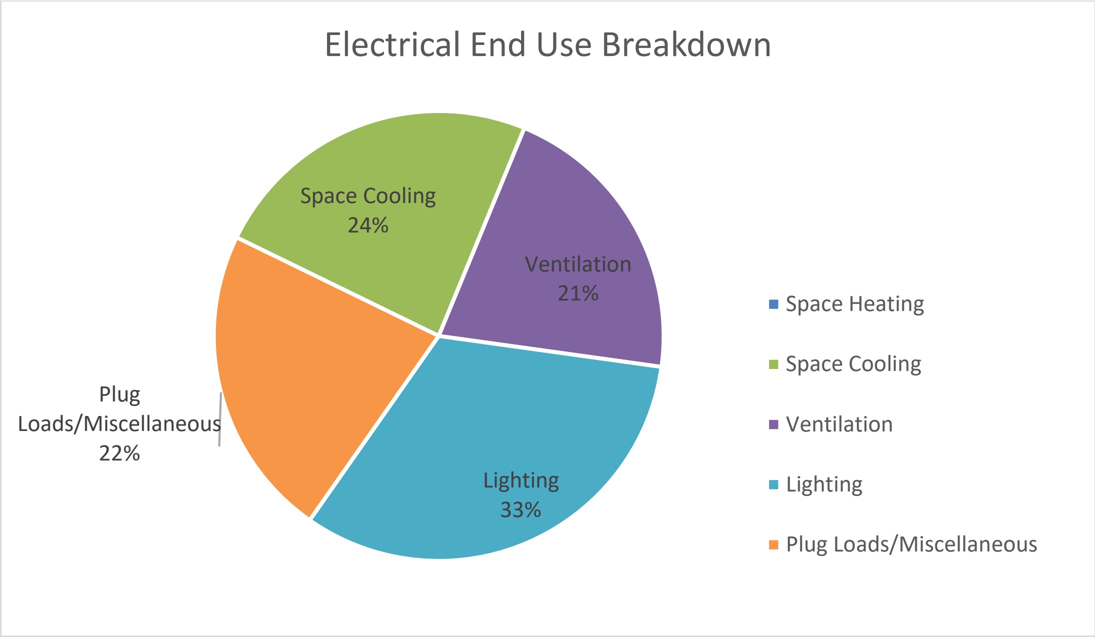

Figure 36: Electric End Use Breakdown

2.9.2 Natural Gas End Use Breakdown- Social Services Building

Space heating accounted for approximately 96% of the facility's natural gas usage. Domestic hot water generation accounts for 4% of the facility's natural gas usage.

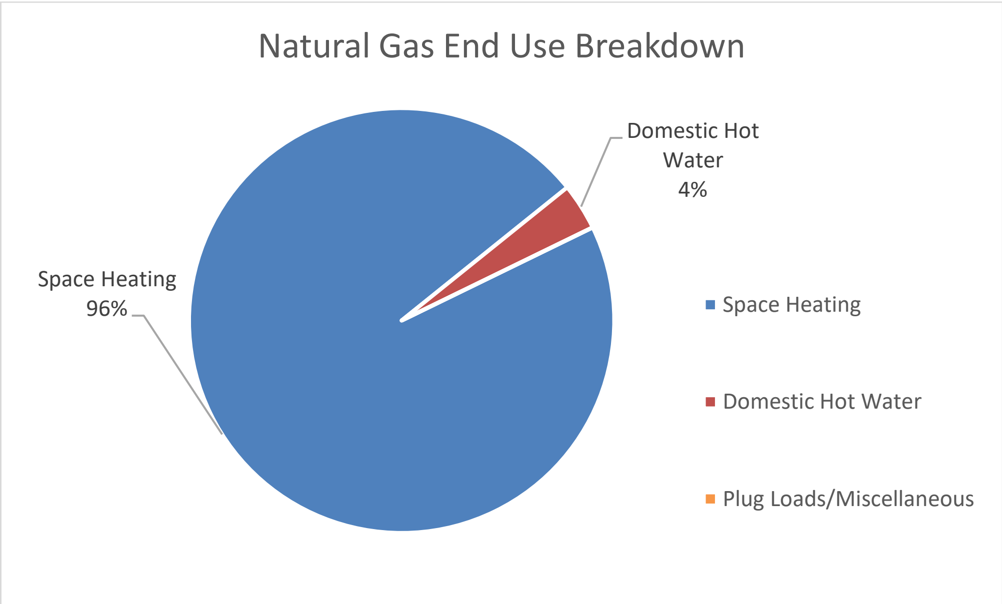

Figure 37: Natural gas End Use Breakdown

2.9.3 Total Energy Use Breakdown- Social Services Building

The conversion of each utility's consumption to a common energy unit, kBTU, allows for a total energy end use breakdown to be estimated. The figures below show an estimated distribution of energy usage among the building systems. This breakdown is based on the project energy model and, as a result, may vary from the site's real distribution.

Space heating accounted for approximately 27% of the energy usage, domestic hot water generation: 1%, space cooling: 17%, lighting: 24%, miscellaneous equipment: 16%, ventilation fans; 15%.

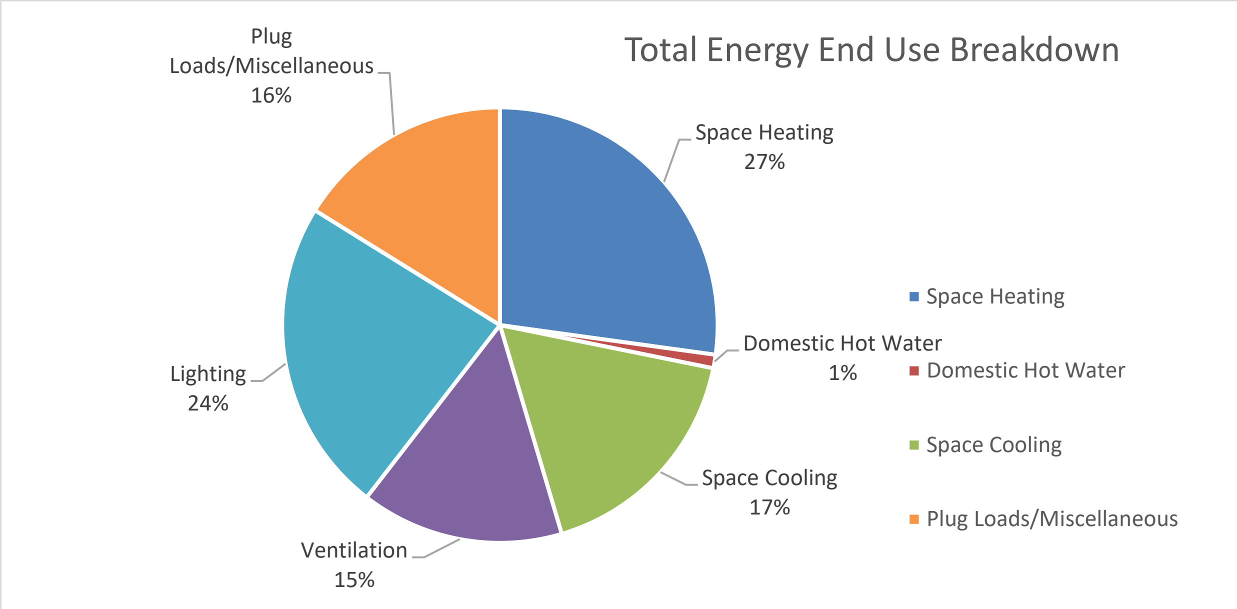

Figure 38: Total Energy Use Breakdown

2.8.1 Electric Energy Usage- Main Salem County Office Building

The facility's electric energy usage for the period of April 2018 through March 2019 was 603,080 kWh, with a peak demand of 212.8 kW. Peak electric demand is occurred in January when the facility experiences the highest heating load as the heating is electric heat for VAV boxes.

Table 57: Electric Energy Usage (4/2018 – 3/2019)

Month-Year	Usage (kWh)	Demand (kW)	Total Electric Cost
Apr-18	47,080	130	$7,205
May-18	44,080	124	$6,746
Jun-18	47,560	152	$7,279
Jul-18	41,960	131	$6,422
Aug-18	43,760	134	$7,142
Sep-18	39,600	129	$6,060
Oct-18	46,520	120	$7,119
Nov-18	58,920	172	$9,017
Dec-18	65,240	166	$9,944
Jan-19	62,080	213	$9,501
Feb-19	56,520	173	$8,615
Mar-19	49,760	155	$7,615
Total/Peak	**603,080**	**Max: 212.8**	**$92,666**

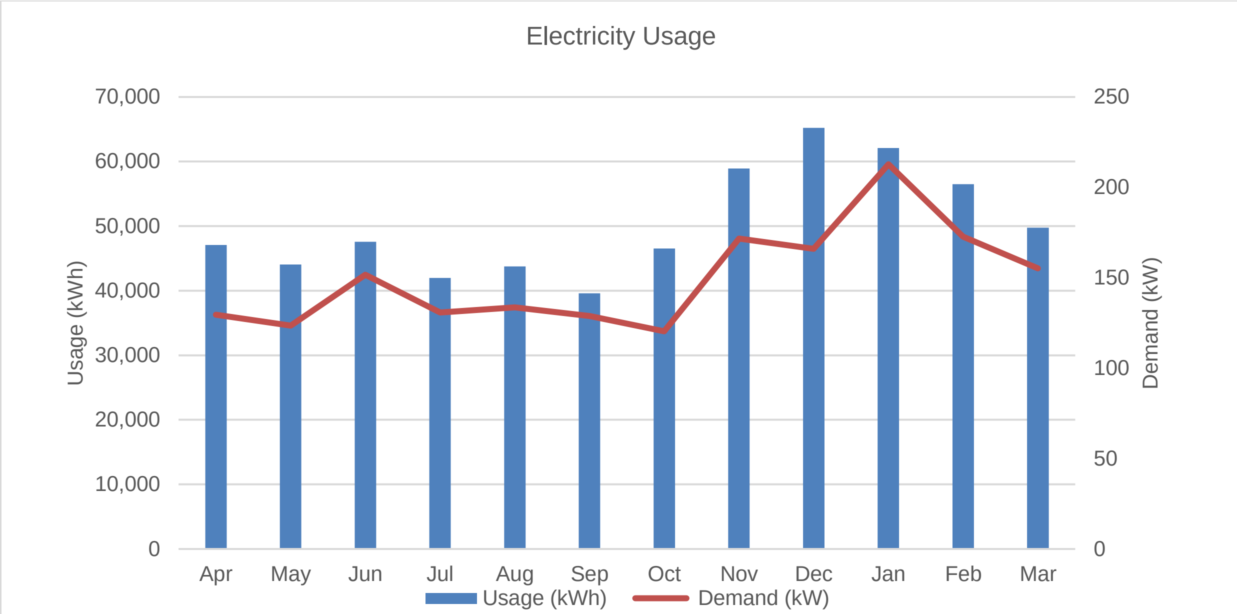

Figure 39: Electric Energy Usage Data (1/2018 – 12/2018)

2.8.2 Natural Gas Usage- Main Salem County Office Building

The facility's total natural gas usage for the period of April 2018 through March 2019 was 3,274 therms. Majority of the natural gas consumption occurs during winter season as the boilers are utilized for space heating.

Table 58. Natural Gas Energy Use (1/2018 – 12/2018)

Month-Year	Usage (Therms)	Total Gas Cost
Apr-18	135	$138
May-18	3	$37
Jun-18	0	$36
Jul-18	0	$33
Aug-18	0	$34
Sep-18	0	$32
Oct-18	194	$168
Nov-18	583	$438
Dec-18	645	$485
Jan-19	766	$562
Feb-19	668	$493
Mar-19	280	$226
Total	**3,274**	**$2,681**

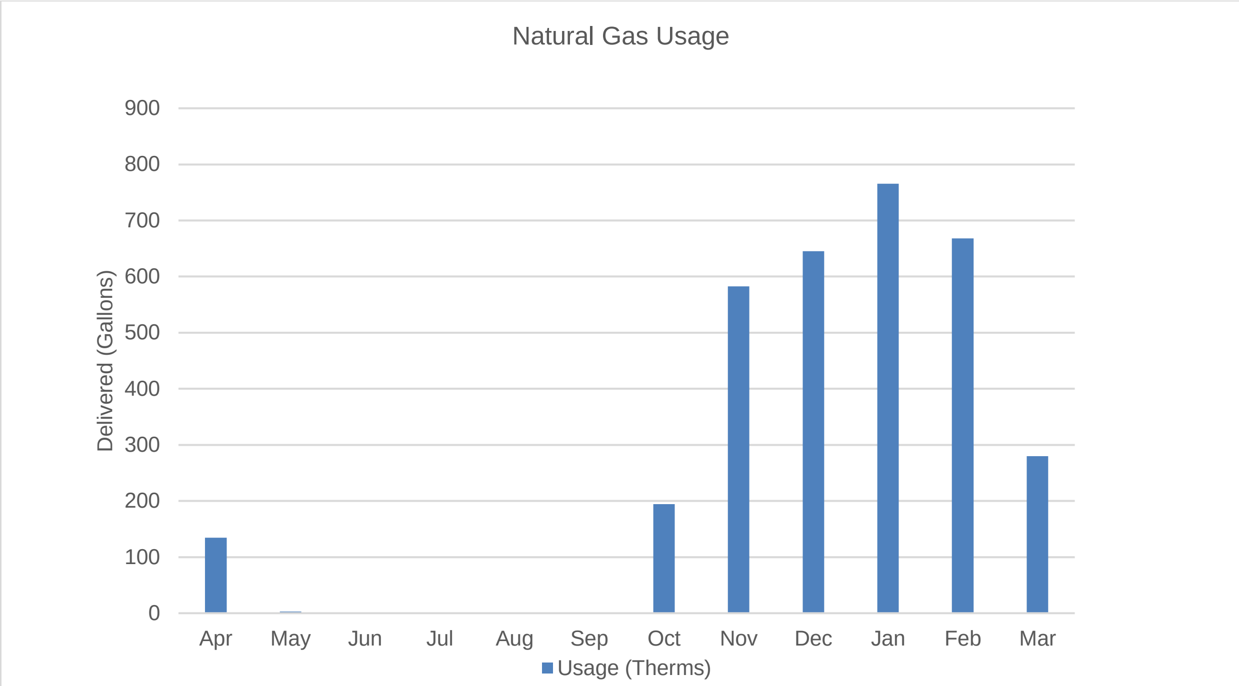

Figure 40: Natural Gas Usage Data (4/2018 – 3/2019)

2.9 End Use Breakdown Summary- Main Salem County Office Building

The tables below summarize the existing annual electric and natural gas end usage within the buildings. The figures and tables in this section shows an estimated distribution of electric and natural gas usage among the building systems. This breakdown is based on the energy model and, as a result, may vary from the site's actual energy distribution.

Table 59: End Use Breakdown Summary

End Use Type	Electricity	Electricity Usage	Natural Gas	Natural Gas Usage	Total Site Energy	Total Usage
	(kWh)	(%)	(therms)	(%)	(kBTU)	(%)
Space Heating	139,684	24%	3,415	100%	818,066	35%
Domestic Hot Water	2,196	0%	0	0%	7,492	0%
Space Cooling	87,363	15%	0	0%	298,083	13%
Ventilation	113,661	19%	0	0%	387,811	16%
Lighting	123,679	21%	0	0%	421,991	18%
Plug Loads/Miscellaneous	125,338	21%	0	0%	427,654	18%
Total Estimated	**591,920**	**100%**	**3,415**	**100%**	**2,361,096**	**100%**

2.9.1 Electric End Use Breakdown- Main Salem County Office Building

Approximately, 58% of the electrical energy used in the building was dedicated to HVAC use (fans, pumps & auxiliary equipment, cooling & heating) with lighting accounting for another 21% (interior light and exterior light). The remaining 21% was used for miscellaneous equipment and other process equipment.

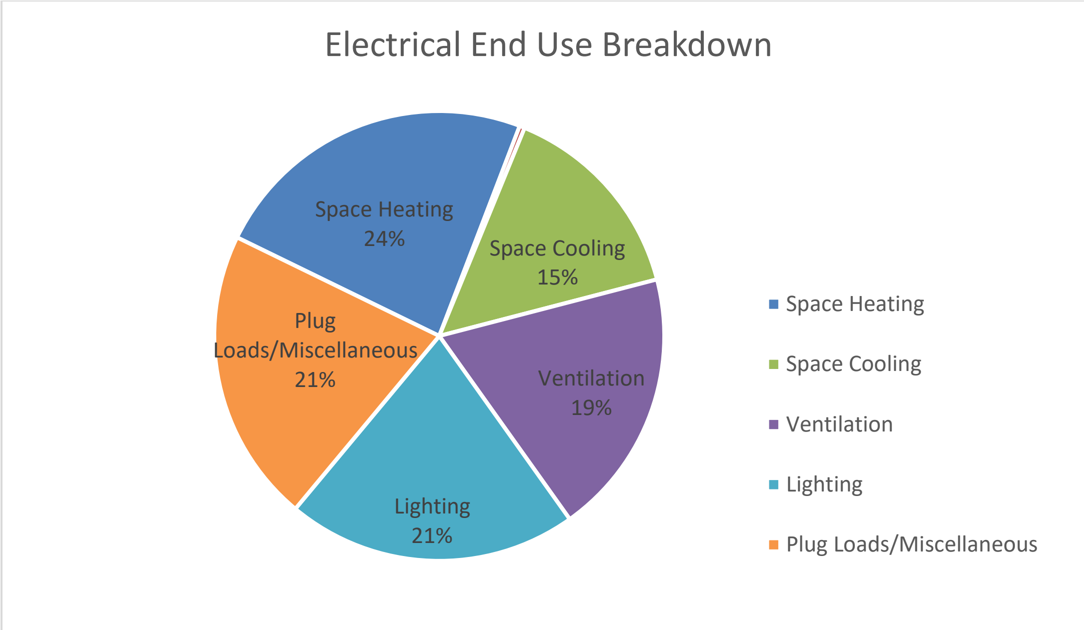

Figure 41: Electric End Use Breakdown

2.9.2 Natural Gas End Use Breakdown- Main Salem County Office Building

Space heating accounted for approximately 100% of the facility's natural gas usage. Domestic hot water generation is done via electric water heater.

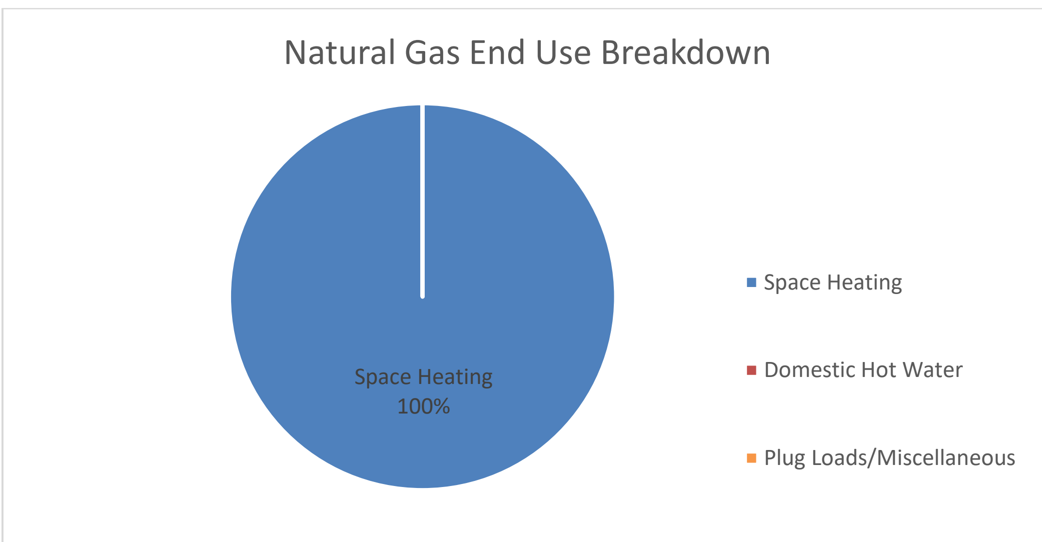

Figure 42: Natural gas End Use Breakdown

2.9.3 Total Energy Use Breakdown- Main Salem County Office Building

The conversion of each utility's consumption to a common energy unit, kBTU, allows for a total energy end use breakdown to be estimated. The figures below show an estimated distribution of energy usage among the building systems. This breakdown is based on the project energy model and, as a result, may vary from the site's real distribution.

Space heating accounted for approximately 35% of the energy usage, domestic hot water generation: 0.5%, space cooling: 13%, lighting: 18%, miscellaneous equipment: 18%, ventilation fans; 16%.

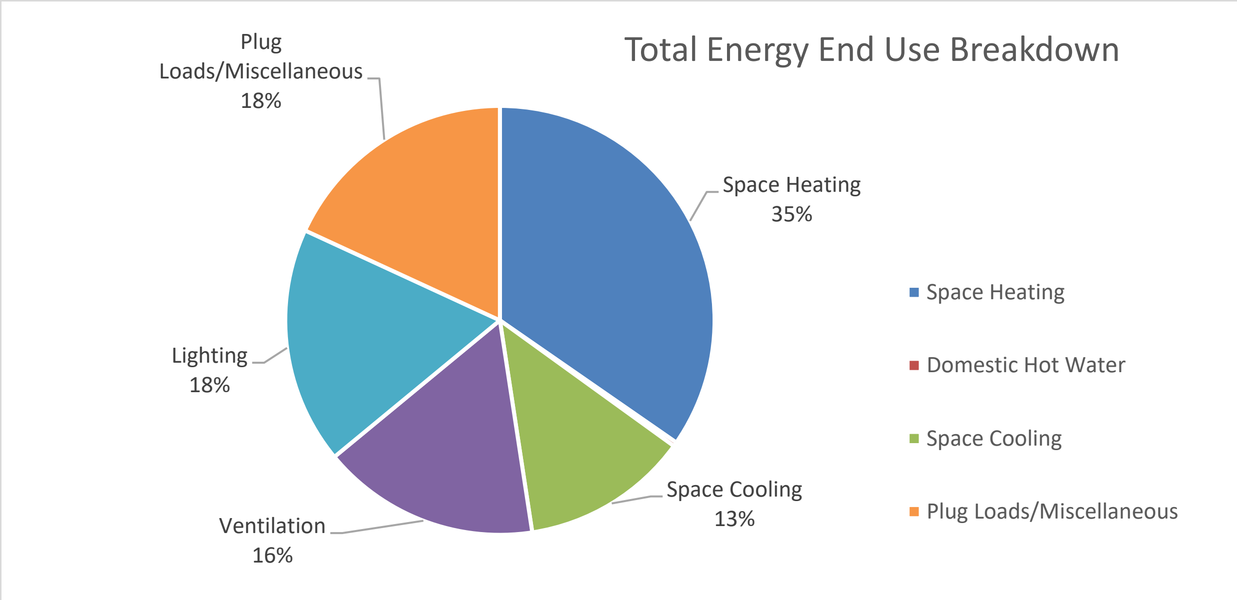

Figure 43: Total Energy Use Breakdown

2.8.1 Electric Energy Usage- Admin Building

The facility's electric energy usage for the period of April 2018 through March 2019 was 216,160 kWh, with a peak demand of 46 kW.

Table 60: Electric Energy Usage (4/2018 – 3/2019)

Month-Year	Usage (kWh)	Demand (kW)	Total Electric Cost
Apr-18	17,600	39	$2,435
May-18	16,640	39	$2,568
Jun-18	17,240	40	$2,156
Jul-18	19,840	42	$2,182
Aug-18	22,080	45	$2,494
Sep-18	15,560	45	$2,925
Oct-18	18,480	46	$2,136
Nov-18	18,160	43	$2,599
Dec-18	20,440	41	$2,460
Jan-19	17,120	46	$2,748
Feb-19	16,800	42	$2,315
Mar-19	16,200	39	$2,270
Total/Peak	**216,160**	**Max: 46**	**$29,290**

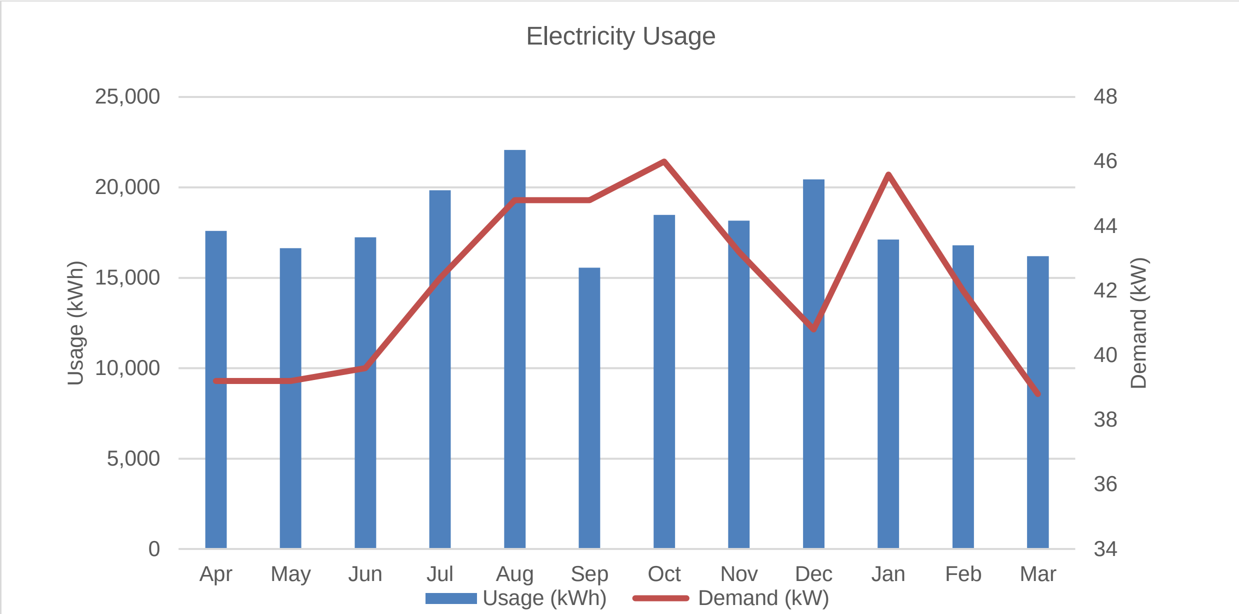

Figure 44: Electric Energy Usage Data (4/2018 – 3/2019)

2.8.2 Natural Gas Usage- Admin Building

The facility's total natural gas usage for the period of April 2018 through March 2019 was 13,737 therms. Majority of the natural gas consumption occurs during winter season as the boilers are utilized for space heating.

Table 61. Natural Gas Energy Use (1/2018 – 12/2018)

Month-Year	Usage (Therms)	Total Gas Cost
Apr-18	2,000	$3,174
May-18	673	$529
Jun-18	44	$801
Jul-18	46	$143
Aug-18	36	$132
Sep-18	45	$73
Oct-18	35	$53
Nov-18	855	$608
Dec-18	2,628	$1,848
Jan-19	2,849	$1,999
Feb-19	2,658	$1,859
Mar-19	1,867	$1,305
Total	**13,737**	**$12,523**

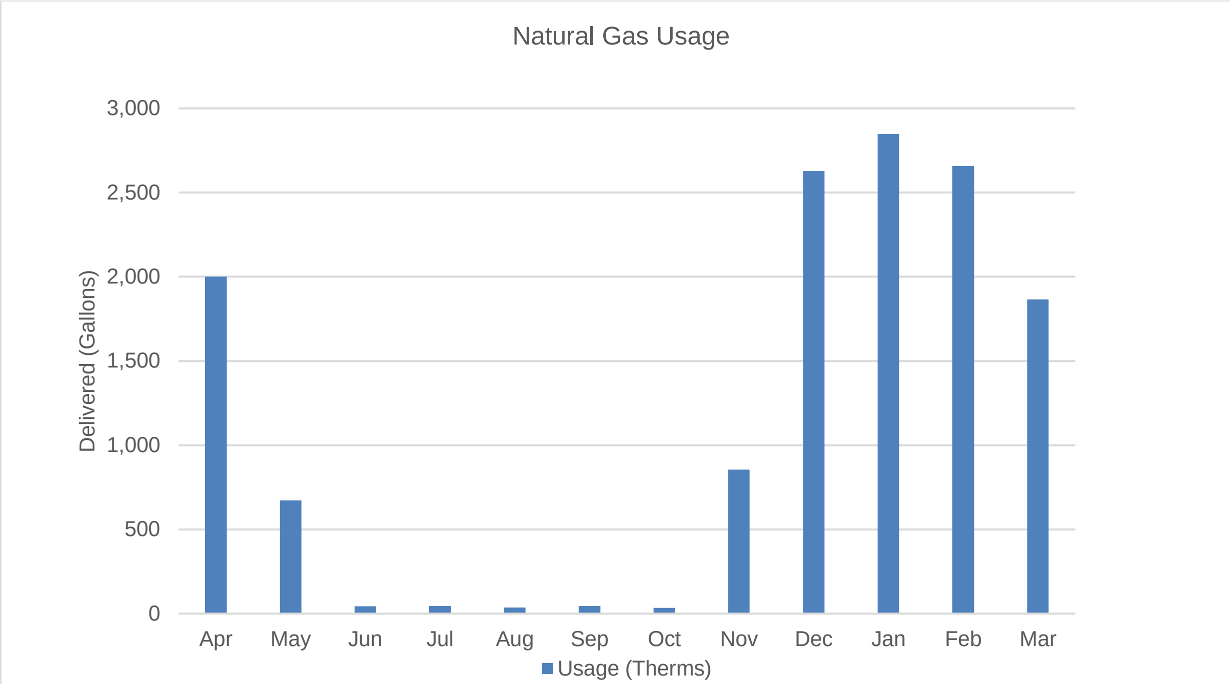

Figure 45: Natural Gas Usage Data (4/2018 – 3/2019)

2.9 End Use Breakdown Summary- Admin Building

The tables below summarize the existing annual electric and natural gas end usage within the buildings. The figures and tables in this section shows an estimated distribution of electric and natural gas usage among the building systems. This breakdown is based on the energy model and, as a result, may vary from the site's actual energy distribution.

Table 62: End Use Breakdown Summary

End Use Type	Electricity	Electricity Usage	Natural Gas	Natural Gas Usage	Total Site Energy	Total Usage
	(kWh)	(%)	(therms)	(%)	(kBTU)	(%)
Space Heating	2,021	0.9%	13,199	98.9%	1,326,824	63.7%
Domestic Hot Water	0	0.0%	140	1.1%	14,047	0.7%
Space Cooling	11,504	5.2%	0	0.0%	39,253	1.9%
Ventilation	42,662	19.4%	0	0.0%	145,562	7.0%
Lighting	153,096	69.6%	0	0.0%	522,365	25.1%
Plug Loads/Miscellaneous	10,685	4.9%	0	0.0%	36,457	1.7%
Total Estimated	**219,968**	**100.0%**	**13,340**	**100.0%**	**2,084,509**	**100.0%**

2.9.1 Electric End Use Breakdown- Admin Building

Approximately, 25% of the electrical energy used in the building was dedicated to HVAC use (fans, pumps & auxiliary equipment, cooling & heating) with lighting accounting for another 70% (interior light and exterior light). The remaining 5% was used for miscellaneous equipment and other process equipment. Note: chilled water for the admin building is provide by the Courthouse chiller plant.

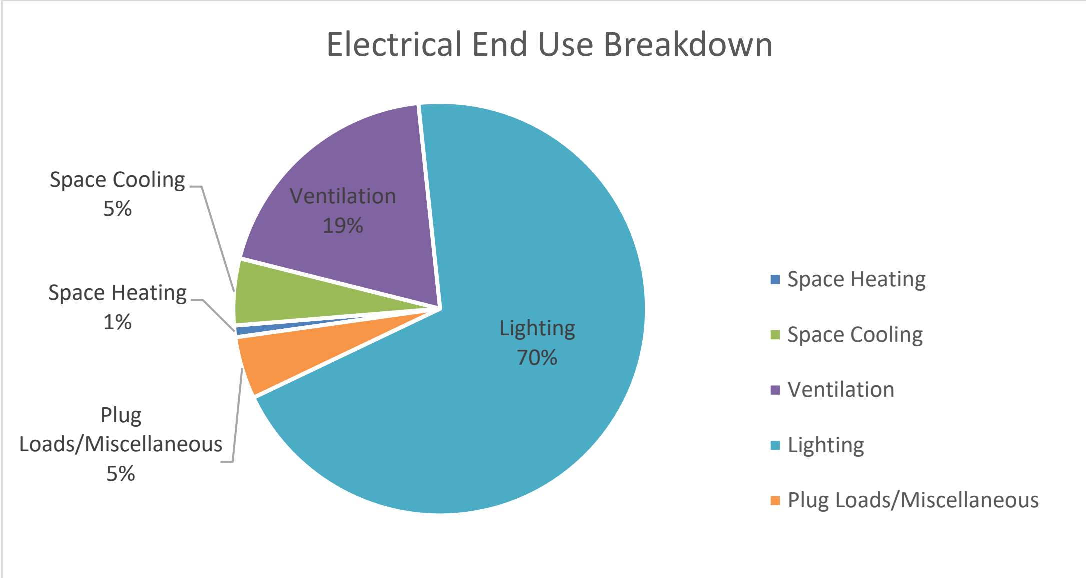

Figure 46: Electric End Use Breakdown

2.9.2 Natural Gas End Use Breakdown- Admin Building

Space heating accounted for approximately 99% of the facility's natural gas usage. Domestic hot water generation accounts for 1% of the facility's natural gas usage.

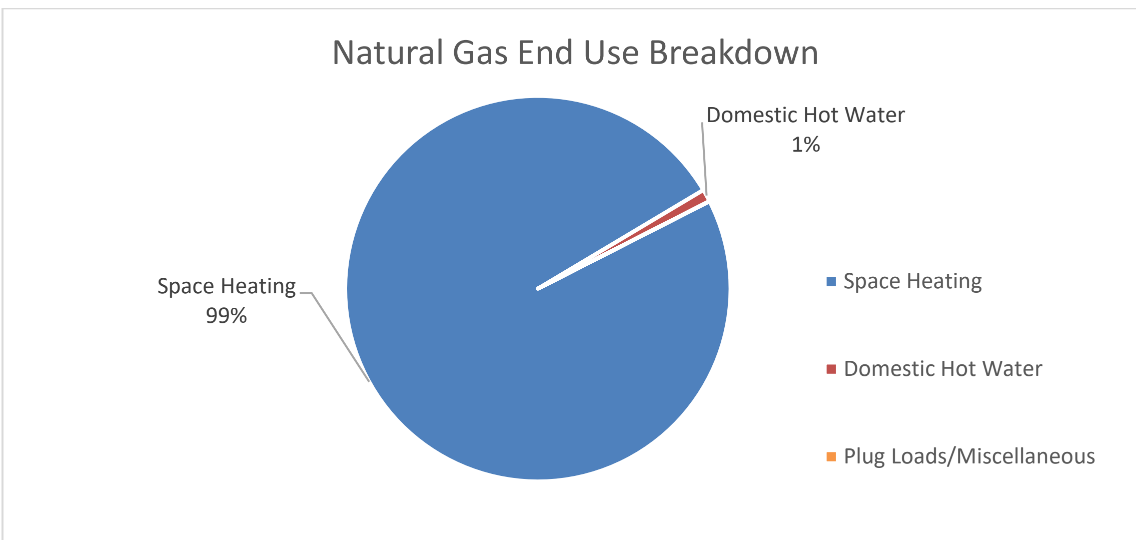

Figure 47: Natural gas End Use Breakdown

2.9.3 Total Energy Use Breakdown- Admin Building

The conversion of each utility's consumption to a common energy unit, kBTU, allows for a total energy end use breakdown to be estimated. The figures below show an estimated distribution of energy usage among the building systems. This breakdown is based on the project energy model and, as a result, may vary from the site's real distribution.

Space heating accounted for approximately 63% of the energy usage, domestic hot water generation: 1%, space cooling: 2%, lighting: 25%, miscellaneous equipment: 2%, ventilation fans; 7%.

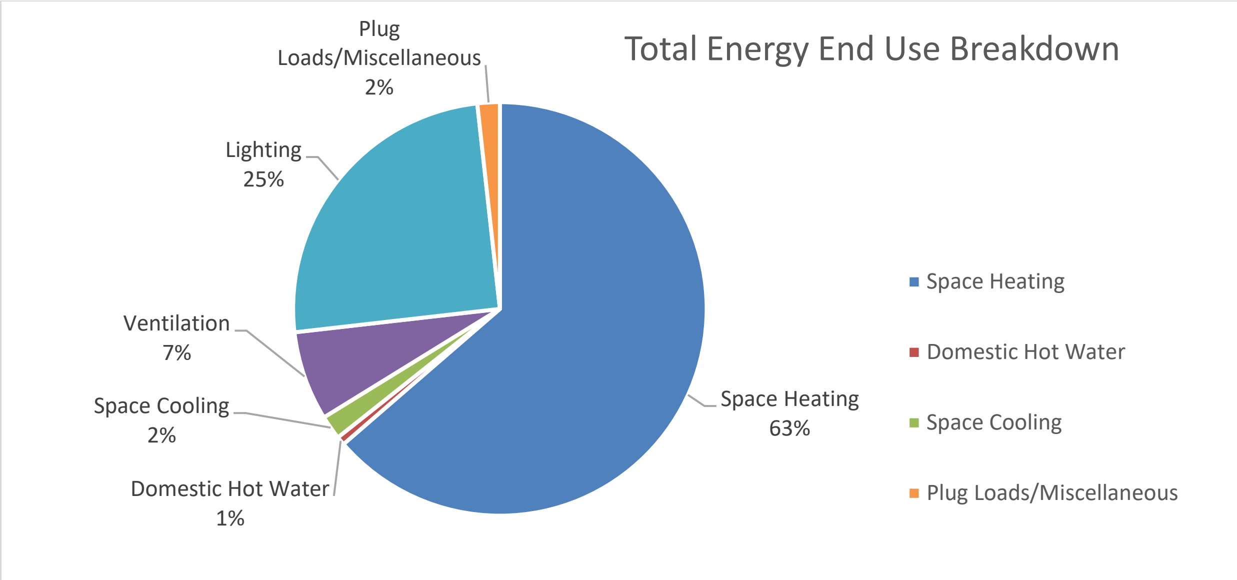

Figure 48: Total Energy Use Breakdown

2.9.4 Average Energy Cost

The average energy cost per square foot was calculated by dividing the total cost of all utilities – electric, and natural gas by the total conditioned area of the facility.

Table 63: Average Energy Cost per Square Foot- Johnson Building

Total Conditioned Area in SF	kBTU	Total Annual Cost ($)	$/SF
7,000	454,627	$5,022	$0.72

Table 64: Average Energy Cost per Square Foot- Inter-Agency Council Building

Total Conditioned Area in SF	kBTU	Total Annual Cost ($)	$/SF
9,260	213,045	$9,993	$1.08

Table 65: Average Energy Cost per Square Foot- Agriculture Building

Total Conditioned Area in SF	kBTU	Total Annual Cost ($)	$/SF
13,600	1,571,619	$35,329	$2.60

Table 66: Average Energy Cost per Square Foot- Fenwick Building

Total Conditioned Area in SF	kBTU	Total Annual Cost ($)	$/SF
24,600	1,154,693	$32,224	$1.31

Table 67: Average Energy Cost per Square Foot- Emergency Services Building

Total Conditioned Area in SF	kBTU	Total Annual Cost ($)	$/SF
13,170	1,790,806	$63,866	$4.85

Table 68: Average Energy Cost per Square Foot- Social Services Building

Total Conditioned Area in SF	kBTU	Total Annual Cost ($)	$/SF
20,000	920,367	$30,235	$1.51

Table 69: Average Energy Cost per Square Foot- Main Salem County Office Building

Total Conditioned Area in SF	kBTU	Total Annual Cost ($)	$/SF
56,745	2,384,985	$95,347	$1.68

Table 70: Average Energy Cost per Square Foot- Admin Building

Total Conditioned Area in SF	kBTU	Total Annual Cost ($)	$/SF
44,552	2,110,947	$41,813	$0.94

2.10 Peer Group Benchmarking

Willdan uses the U.S. Environmental Protection Agency (EPA) Portfolio Manager to rate the building on a scale of 1 to 100, as defined by its Energy Star score. This score compares a property under consideration to similar properties nationwide. The building is compared using a database of similar buildings from a national survey conducted by the Department of Energy. An Energy Star score of 50 indicates that the building, from an energy consumption standpoint, performs better than 50% of all similar buildings nationwide, while a rating of 75 indicates that the building performs better than 75% of all similar buildings nationwide.

The Site Energy Use Intensity (EUI) is the amount of heat and electricity consumed by a building, as commonly reflected in utility bills, divided by the facility's conditioned square footage. The Source EUI is the total amount of natural gas consumed in the generation and use of energy consumed at a building, such as electricity and Natural Gas, divided by the facility's square footage. A facility's site and source EUI can be obtained from the Statement of Performance (SOP). The SOP for this facility has been reiterated in table below. It incorporates generation, transmission, and storage losses, thereby enabling a complete assessment of energy use in a building.

The utility bills and other information gathered during the energy audit process were analyzed to obtain the site and source EUIs of the existing facility. The site and source U.S. Median EUIs mentioned below have been obtained from the EPA Portfolio Manager.

The following is a summary of the Portfolio Manager's results for the facility:

Table 71: Benchmarking EUI- Johnson Building-2017

Benchmarking*	This Facility	National Median
Site Energy Use Intensity (EUI kBTU/sf/yr)*	60.8	71.6
Source Energy Use Intensity (EUI kBTU/sf/yr)*	77.9	91.8
Energy Star Score	62	50

Table 72: Benchmarking EUI- Inter-Agency Council Building

Benchmarking*	This Facility	National Median
Site Energy Use Intensity (EUI kBTU/sf/yr)*	22.8	49.7

Source Energy Use Intensity (EUI kBTU/sf/yr)*	64.0	139.2
Energy Star Score	91	50

Table 73: Benchmarking EUI- Agriculture Building

Benchmarking*	This Facility	National Median
Site Energy Use Intensity (EUI kBTU/sf/yr)*	117.4	84.1
Source Energy Use Intensity (EUI kBTU/sf/yr)*	197.7	141.7
Energy Star Score	24	50

Table 74: Benchmarking EUI- Fenwick Building

Benchmarking*	This Facility	National Median
Site Energy Use Intensity (EUI kBTU/sf/yr)*	47.3	73.8
Source Energy Use Intensity (EUI kBTU/sf/yr)*	94.9	148.2
Energy Star Score	79	50

Table 75: Benchmarking EUI- Emergency Building-2017

Benchmarking*	This Facility	National Median
Site Energy Use Intensity (EUI kBTU/sf/yr)*	159	163.6
Source Energy Use Intensity (EUI kBTU/sf/yr)*	383.6	394.8
Energy Star Score	53	50

Table 76: Benchmarking EUI- Social Services Building-2017

Benchmarking*	This Facility	National Median
Site Energy Use Intensity (EUI kBTU/sf/yr)*	46.9	88
Source Energy Use Intensity (EUI kBTU/sf/yr)*	105.6	198.3
Energy Star Score	87	50

Table 77: Benchmarking EUI- Main Salem County Office Building

Benchmarking*	This Facility	National Median
Site Energy Use Intensity (EUI kBTU/sf/yr)*	42.2	167.1
Source Energy Use Intensity (EUI kBTU/sf/yr)*	108.0	65.4
Energy Star Score	78	50

Table 78: Benchmarking EUI- Admin Building

Benchmarking*	This Facility	National Median
Site Energy Use Intensity (EUI kBTU/sf/yr)*	95.4	118.7
Source Energy Use Intensity (EUI kBTU/sf/yr)*	161	200.3
Energy Star Score	65	50

3. Energy Efficiency Measures

The goal of this audit report is to identify and evaluate potential energy efficiency improvements, provide information about the cost effectiveness of those improvements, and recognize potential financial incentives from NJBPU as part of the final report.

The baseline for facility was obtained from monthly utility bills, equipment schedules, electric and natural gas usage data and other industry standard sources such as ASHRAE. This information was then analyzed against the local weather data. An energy estimates were developed for the baseline of the facility utilizing spreadsheet calculations, which performs simulations of energy use in buildings as a function of building systems, and general building and occupant activity. The simulation provides expected energy consumption, which is then calibrated to the utility data, as necessary.

Energy consumption associated with each measure was analyzed based on the technical performance of the recommended measure. It was then compared to the corresponding baseline energy consumption data to determine the resulting energy savings. Energy cost savings for each measure was determined using the projected energy savings and blended energy rates obtained from the utility information provided by the facility.

The following were assumed when calculating the energy savings:

- Building energy usage patterns will remain relatively unchanged in the near future (no significant occupancy changes and/or space conversion).
- Energy costs will remain relatively stable in near future.
- Building system operation will remain relatively unchanged (unless a change is related to a recommended ECM).
- All energy cost savings are based on blended rates. Actual cost savings can vary based on utility tariff structures and demand charges.

An economic analysis was performed for each measure using historical implementation cost estimates from industry standard sources, data obtained from similar projects and pricing solicited from vendors. Energy cost savings and implementation costs for each ECM were used to determine a simple payback associated with each measure. The calculations account for interacting effects between various system components.

Tables below presents a summary of energy-conservation measures. Payback in this report refers to simple payback associated with the implementation of each measure.

Johnson Building

Table 79:Projected Overall Savings

Measure		Annual Estimated Savings				CO_2 Emission Savings (tCO_2e)	Estimated Implementation Cost ($)	Estimated Simple Payback Period (Years)
Meas. No.	Description	Electricity (kWh)	Annual Demand (kW)	Natural Gas (Therms)	Cost Savings ($)			
ECM-1	LED Lighting Upgrades - Interior	5,812	1.50	0	$910	1.7	$4,263	0.0
ECM-2	Install Boiler Controls	0	0	462	$325	2.5	$3,699	11.4
ECM-3	Install Low Flow	19	0	0	$3	0.0	$17	0.0
ECM-4	Install Solar PV Panel	7,063	6	0	$753	2.0	$0	0.0
Total		**5,830**	**1**	**462**	**$1,238**	**4.1**	**$7,979**	**3.0**

Inter-Agency Council Human Services Building

Table 80:Projected Overall Savings

Measure		Annual Estimated Savings				CO_2 Emission Savings (tCO_2e)	Estimated Implementation Cost ($)	Estimated Simple Payback Period (Years)
Meas. No.	Description	Electricity (kWh)	Annual Demand (kW)	Natural Gas (Therms)	Cost Savings ($)			
ECM-1	LED Lighting Upgrades - Interior	13,394	3.2	0	$2,144	3.9	$90,000	42.0
ECM-2	Clean Condenser Coils	749	0.5	0	$120	0.2	$21,515	179.4
ECM-3	Install Low Flow Devices	37	0	0	$6	0.0	$43	7.2
ECM-4	Install Solar PV Panel	59,250	50	0	$6,520	17.1	$0	0.0
Total		**14,180**	**4**	**0**	**$2,269**	**4.1**	**$111,558**	**49.2**

Agriculture Building

Table 81:Projected Overall Savings

Measure		Annual Estimated Savings				CO_2 Emission Savings (tCO_2e)	Estimated Implementation Cost ($)	Estimated Simple Payback Period (Years)
Meas. No.	Description	Electricity (kWh)	Annual Demand (kW)	Natural Gas (Therms)	Cost Savings ($)			
ECM-1	LED Lighting Upgrades - Interior	52,355	17	0	$8,676	15.1	$48,813	5.6
ECM-2	Install New Split Units with Gas Furnace	6,591	3	1,045	$1,864	7.5	$149,767	80.3
ECM-3	Install Low-Flow DHW Devices	0	0	19	$14	0.1	$130	9.2
ECM-4	Install Energy Efficient Transformers	4,919	1	0	$815	1.4	$8,760	10.7
ECM-5	Install Solar PV Panel	296,250	250	0	$34,278	85.6	$0	0.0
Total		**63,865**	**20**	**1,064**	**$11,369**	**24.1**	**$207,470**	**18.2**

Fenwick Building

Table 82:Projected Overall Savings

Measure		Annual Estimated Savings				CO_2 Emission Savings (tCO_2e)	Estimated Implementation Cost ($)	Estimated Simple Payback Period (Years)
Meas. No.	Description	Electricity (kWh)	Annual Demand (kW)	Natural Gas (Therms)	Cost Savings ($)			
ECM-1	LED Lighting Upgrades - Interior	9,847	2	0	$1,489	2.8	$7,875	5.3
ECM-2	Replace Existing Split Units	2,910	2	0	$440	0.8	$26,875	61.1
ECM-3	Install Low Flow Devices	0	0	76	$59	0.4	$397	6.8
ECM-4	Install Solar PV Panel	37,170	30	0	$3,764	10.7	$0	0.0
Total		**12,757**	**4**	**76**	**$1,988**	**4.1**	**$35,147**	**17.7**

Emergency Services Building

Table 83:Projected Overall Savings

Measure		Annual Estimated Savings				CO_2 Emission Savings (tCO_2e)	Estimated Implementation Cost ($)	Estimated Simple Payback Period (Years)
Meas. No.	Description	Electricity (kWh)	Annual Demand (kW)	Natural Gas (Therms)	Cost Savings ($)			
ECM-1	LED Lighting Upgrades - Interior	61,644	16	0	$9,254	17.8	$28,622	3.1
ECM-2	Replace Existing Boilers	0	0	454	$364	2.4	$125,178	344.0
ECM-3	Install VFD on CW Pumps	13,560	8	0	$2,036	3.9	$91,967	45.2
ECM-4	Replace Existing WSHP	3,616	1	0	$543	1.0	$176,391	324.9
ECM-5	Implement Vending Machine Miser Controls	1,370	0	0	$206	0.4	$1,202	5.8
ECM-6	Install Low-Flow DHW Devices	1,039	0	0	$156	0.3	$232	1.5
ECM-7	Install Energy Efficient Transformers	5,882	1	0	$883	1.7	$20,338	23.0
ECM-8	Install Solar PV Panel	296,250	322	0	$29,662	85.6	$0	0.0
Total		**87,111**	**25**	**454**	**$13,442**	**27.6**	**$443,930**	**33.0**

Social Services Building

Table 84:Projected Overall Savings

Measure		Annual Estimated Savings				CO_2 Emission Savings (tCO_2e)	Estimated Implementation Cost ($)	Estimated Simple Payback Period (Years)
Meas. No.	Description	Electricity (kWh)	Annual Demand (kW)	Natural Gas (Therms)	Cost Savings ($)			
ECM-1	LED Lighting Upgrades - Interior	33,049	8	0	$4,682	9.6	$20,486	4.4
ECM-2	Replace Existing RTUs	4,659	3	0	$660	1.3	$53,092	80.4
ECM-3	Install Vending Machine Controls	1,370	0	0	$194	0.4	$1,306	6.7
ECM-4	Install Low Flow Devices	0	0	30	$31	0.2	$132	4.3
ECM-5	Install Solar PV Panel	124,425	105	0	$11,405	36.0	$0	0.0
Total		**39,078**	**11**	**30**	**$5,567**	**11.5**	**$75,017**	**9.8**

Main County Office Building

Table 85:Projected Overall Savings

Measure		Annual Estimated Savings				CO_2 Emission Savings (tCO_2e)	Estimated Implementation Cost ($)	Estimated Simple Payback Period (Years)
Meas. No.	Description	Electricity (kWh)	Annual Demand (kW)	Natural Gas (Therms)	Cost Savings ($)			
ECM-1	LED Lighting Upgrades - Interior	57,547	14	0	$8,842	16.6	$45,694	5.2
ECM-2	Install Low Flow Devices	594	0	0	$91	0.2	$132	1.5
ECM-3	Install Solar PV Panel	459,100	357	0	$47,588	132.7	$0	0.0
Total		**58,141**	**14**	**0**	**$8,934**	**16.8**	**$45,827**	**5.1**

Admin Building

Table 86:Projected Overall Savings

Measure		Annual Estimated Savings				CO_2 Emission Savings (tCO_2e)	Estimated Implementation Cost ($)	Estimated Simple Payback Period (Years)
Meas. No.	Description	Electricity (kWh)	Annual Demand (kW)	Natural Gas (Therms)	Cost Savings ($)			
ECM-1	LED Lighting Upgrades - Interior	94,031	21	0	$12,741	27.2	$56,003	4.4
ECM-2	Replace Existing Boilers	0	0	765	$697	4.1	$248,270	356.0
ECM-3	Upgrade Existing HHW/CHW Pumps	2,996	0	0	$406	0.9	$6,393	15.7
ECM-4	Install Low Flow Devices	0	0	38	$35	0.2	$199	5.7
ECM-5	Install Solar PV Panel	59,250	50	0	$16,638	56.2	$0	0.0
Total		**97,026**	**21**	**803**	**$13,879**	**32.3**	**$310,864**	**18.3**

3.1 Energy Efficiency Measure Descriptions

Johnson Building

ECM-1: LED Lighting Upgrades - Interior

Existing Conditions

Johnson Building uses a variety of interior fixtures throughout the building. The most prevalent lamp type used in the facility are 4-feet 32-watt linear fluorescent T8 lamps in fixtures equipped with 2, 3 or 4 lamps per fixture. There are also compact fluorescent and incandescent lamps used for interior lighting.

ECM Description

Willdan recommends retrofitting fixtures with T8 lamps with the more efficient Linear LED tubes. The existing compact fluorescent and incandescent lamps will be replaced with compatible LED replacements. In addition to electric usage and demand savings, maintenance savings may also be achieved since LED lamps last longer than other light sources and therefore do not need to be replaced as often. All recommended lighting is DLC and/or Energy Star compliant.

Measure Baseline and Proposed Upgrades

Baseline

- Existing fluorescent and incandescent lamps

Proposed

- High-efficiency LED lighting fixtures

Calculation Methodology

ECM-1 energy savings have been calculated using NJ Clean Energy Protocol. A full space-by-space lighting audit is completed to identify the baseline and the calculated lighting power density is used to calculate the baseline lighting energy consumption. A compatible LED replacement is selected for each fixture/lamp type in the facility.

Design Considerations

- Integration with lighting controls.
- Emergency lighting.

Maintenance Considerations

- Lamps/fixtures and associated ballasts shall be maintained as part of ongoing maintenance efforts by the facility engineers.

ECM-2 Install Boiler Control

Existing Conditions

Johnson Building has a steam boiler that provided heating to the building. The boiler operation is controls based on pressuretrol. The boiler does not have any controls to monitor outside air temperature and adjust heating requirement with colder/warmer weather.

ECM Description

Willdan recommends installing boiler controls which monitor outside air temperature and adjust boiler operation according to outside air temperature. These controls will allow reduce boiler cycle which reduce energy loss that occurs during the boiler purge resulting in natural gas savings.

Measure Baseline and Proposed Upgrades

Baseline

- 480 MBH Steam boiler with no temperature-based controls

Proposed

- 480 MBH Steam boiler with temperature-based controls

Calculation Methodology

ECM-3 energy savings have been calculated using spreadsheets and methodology and NJ clean energy protocol.

Design Considerations

- Controls Integration

Maintenance Considerations

- Boiler shall be maintained as per manufacturer's guidelines.

ECM-3: Install Low-Flow DHW Devices

Existing Conditions

There are currently one (1) lavatory faucet that is not equipped with low-flow aerators.

ECM Description

Willdan recommends installing low-flow domestic hot water devices to reduce overall hot water demand. Energy demand from domestic hot water heating systems can be reduced by reducing water usage in general. Faucet aerators can reduce hot water usage relative to standard aerators which saves energy. Low-flow devices reduce the overall water flow from the fixture while maintaining adequate pressure for washing.

When faucets deteriorate with age, it leads to leaks and excessive water flowing through the fixtures. In general, it is common to find fixtures consuming more than 2.2 gpm due to age. It is recommended that the aerators be replaced with appropriate spray type, pressure compensating flow moderators, which typically reduces the water flow rate to 1.5 gpm. In additions low flow aerators, low flow showerheads should also be installed at the facility which will reduce existing showerhead flow rate from 2.5 gpm to 2.0 gpm.

Measure Baseline and Proposed Upgrades

Baseline

- One (1) lavatory faucets (2.2 gpm).

Proposed

- One (1) lavatory faucet aerators (1.0 gpm).

Calculation Methodology

ECM-3 energy savings have been calculated using excel spreadsheet.

Design Considerations

- None

Maintenance Considerations

- Maintenance against leaks shall be performed by the facility maintenance staff.

ECM-4: Install Solar PV Panels

Existing Conditions

There is no solar photovoltaic system installed at the facility.

ECM Description

Willdan recommends installing a solar photovoltaic system to reduce dependence on the electric grid. The solar system can provide 56,055 kWh of electricity annually. Solar panels work by absorbing sunlight with photovoltaic cells, generating direct current (DC) energy and then converting it to usable alternating current (AC) energy with the help of inverter technology. AC energy then flows through the electrical panel and is distributed accordingly.

The solar PV sizing in the current phase is preliminary assessment of solar potential. A more in-depth study will be performed to further evaluate the solar energy production potential.

Calculation Methodology

ECM-4 energy savings have been prepared by Aurora Software.

Design Considerations

- Effect on utility tariffs and rate structures.
- Integration with existing building infrastructure.

Inter-Agency Council Building

ECM-1: LED Lighting Upgrades - Interior

Existing Conditions

Inter-Agency Council Building uses a variety of interior fixtures throughout the building. The most prevalent lamp type used in the facility are 4-feet 32-watt linear fluorescent T8 lamps in fixtures equipped with 2, 3 or 4 lamps per fixture. There are also compact fluorescent and incandescent lamps used for interior lighting.

ECM Description

Willdan recommends retrofitting fixtures with T8 lamps with the more efficient Linear LED tubes. The existing compact fluorescent and incandescent lamps will be replaced with compatible LED replacements. In addition to electric usage and demand savings, maintenance savings may also be achieved since LED lamps last longer than other light sources and therefore do not need to be replaced as often. All recommended lighting is DLC and/or Energy Star compliant.

Measure Baseline and Proposed Upgrades

Baseline

- Existing fluorescent and incandescent lamps

Proposed

- High-efficiency LED lighting fixtures

Calculation Methodology

ECM-1 energy savings have been calculated using NJ Clean Energy Protocol. A full space-by-space lighting audit is completed to identify the baseline and the calculated lighting power density is used to calculate the baseline lighting energy consumption. A compatible LED replacement is selected for each fixture/lamp type in the facility.

Design Considerations

- Integration with lighting controls.
- Emergency lighting.

Maintenance Considerations

- Lamps/fixtures and associated ballasts shall be maintained as part of ongoing maintenance efforts by the facility engineers.

ECM-2 Clean Condenser Coils

Existing Conditions

The building has three (3) split units with condenser outside. During the side visit the condenser coils were covered with dirt and debris.

ECM Description

Willdan recommends cleaning the condenser coils using non-corrosive coil cleaning solution. Clean coils provide effective heat rejection which reduces energy consumption of the compressor resulting in energy savings. Condenser coils should be cleaned on an annual basis.

Measure Baseline and Proposed Upgrades

Baseline

- Three (3) condenser with dirty coils.

Proposed
- Three (3) condensers with clean coils

Calculation Methodology

ECM-3 energy savings have been calculated using spreadsheet

Design Considerations

- Controls Integration

Maintenance Considerations

- Boiler shall be maintained as per manufacturer's guidelines.

ECM-3: Install Low-Flow DHW Devices

Existing Conditions

There are currently two (2) lavatory faucet that is not equipped with low-flow aerators.

ECM Description

Willdan recommends installing low-flow domestic hot water devices to reduce overall hot water demand. Energy demand from domestic hot water heating systems can be reduced by reducing water usage in general. Faucet aerators can reduce hot water usage relative to standard aerators which saves energy. Low-flow devices reduce the overall water flow from the fixture while maintaining adequate pressure for washing.

When faucets deteriorate with age, it leads to leaks and excessive water flowing through the fixtures. In general, it is common to find fixtures consuming more than 2.2 gpm due to age. It is recommended that the aerators be replaced with appropriate spray type, pressure compensating flow moderators, which typically reduces the water flow rate to 1.5 gpm. In additions low flow aerators, low flow showerheads should also be installed at the facility which will reduce existing showerhead flow rate from 2.5 gpm to 2.0 gpm.

Measure Baseline and Proposed Upgrades

Baseline
- Two (2) lavatory faucets (2.2 gpm).

Proposed
- Two (2) lavatory faucet aerators (1.0 gpm).

Calculation Methodology

ECM-3 energy savings have been calculated using excel spreadsheet.

Design Considerations

- None

Maintenance Considerations

- Maintenance against leaks shall be performed by the facility maintenance staff.

ECM-4: Install Solar PV Panels

Existing Conditions

There is no solar photovoltaic system installed at the facility.

ECM Description

Willdan recommends installing a solar photovoltaic system to reduce dependence on the electric grid. The solar system can provide 49,842 kWh of electricity annually. Solar panels work by absorbing sunlight with photovoltaic cells, generating direct current (DC) energy and then converting it to usable alternating current (AC) energy with the help of inverter technology. AC energy then flows through the electrical panel and is distributed accordingly.

The solar PV sizing in the current phase is preliminary assessment of solar potential. A more in-depth study will be performed to further evaluate the solar energy production potential.

Calculation Methodology

ECM-4 energy savings have been prepared by Aurora Software.

Design Considerations

- Effect on utility tariffs and rate structures.
- Integration with existing building infrastructure.

Agriculture Building

ECM-1: LED Lighting Upgrades - Interior

Existing Conditions

Agriculture Building uses a variety of interior fixtures throughout the building. The most prevalent lamp type used in the facility are 4-feet 32-watt linear fluorescent T8 lamps in fixtures equipped with 2, 3 or 4 lamps per fixture. There are also compact fluorescent and incandescent lamps used for interior lighting.

ECM Description

Willdan recommends retrofitting fixtures with T8 lamps with the more efficient Linear LED tubes. The existing compact fluorescent and incandescent lamps will be replaced with compatible LED replacements. In addition to electric usage and demand savings, maintenance savings may also be achieved since LED lamps last longer than other light sources and therefore do not need to be replaced as often. All recommended lighting is DLC and/or Energy Star compliant.

Measure Baseline and Proposed Upgrades

Baseline

- Existing fluorescent and incandescent lamps

Proposed

- High-efficiency LED lighting fixtures

Calculation Methodology

ECM-1 energy savings have been calculated using NJ Clean Energy Protocol. A full space-by-space lighting audit is completed to identify the baseline and the calculated lighting power density is used to calculate the baseline lighting energy consumption. A compatible LED replacement is selected for each fixture/lamp type in the facility.

Design Considerations

- Integration with lighting controls.
- Emergency lighting.

Maintenance Considerations

- Lamps/fixtures and associated ballasts shall be maintained as part of ongoing maintenance efforts by the facility engineers.

ECM-2 Install New Split Units with Gas Furnace

Existing Conditions

The building has seven (7) split units with condenser outside and gas fired furnaces. The units are original to the building and near the end of life.

ECM Description

Willdan recommends replacing seven (7) existing split units and gas furnaces. Replacing the split units has a long payback period and may not be justifiable based simply on energy considerations. However, the units that are being recommended for replacement at this facility are nearing or have reached the end of their normal useful life.

Measure Baseline and Proposed Upgrades

Baseline

- Seven (7) split units with gas furnaces near end of life.
  - Two (2) 10-ton split unit with gas furnace
  - One (1) 12.5-ton split unit with gas furnace
  - Three (3) 7.5-ton split unit with gas furnace
  - One (1) 5-ton split unit with gas furnace

Proposed

- Seven (7) new energy efficient split units with gas furnaces.

Calculation Methodology

ECM-3 energy savings have been calculated using spreadsheets and methodology presented in NJ Clean Energy Protocol.

Design Considerations

- Controls Integration

Maintenance Considerations

- Boiler shall be maintained as per manufacturer's guidelines.

ECM-3: Install Low-Flow DHW Devices

Existing Conditions

There are currently six (6) lavatory faucet that is not equipped with low-flow aerators.

ECM Description

Willdan recommends installing low-flow domestic hot water devices to reduce overall hot water demand. Energy demand from domestic hot water heating systems can be reduced by reducing water usage in general. Faucet aerators can reduce hot water usage relative to standard aerators which saves energy. Low-flow devices reduce the overall water flow from the fixture while maintaining adequate pressure for washing.

When faucets deteriorate with age, it leads to leaks and excessive water flowing through the fixtures. In general, it is common to find fixtures consuming more than 2.2 gpm due to age. It is recommended that the aerators be replaced with appropriate spray type, pressure compensating flow moderators, which typically reduces the water flow rate to 1.5 gpm. In additions low flow aerators, low flow showerheads should also be installed at the facility which will reduce existing showerhead flow rate from 2.5 gpm to 2.0 gpm.

Measure Baseline and Proposed Upgrades

Baseline

- Six (6) lavatory faucets (2.2 gpm).

Proposed

- Six (6) lavatory faucet aerators (1.0 gpm).

Calculation Methodology

ECM-3 energy savings have been calculated using excel spreadsheet.

Design Considerations

- None

Maintenance Considerations

- Maintenance against leaks shall be performed by the facility maintenance staff.

ECM-4: Install Energy Efficient Transformers

Existing Conditions

An on-site detailed survey of the dry-type transformers was performed by Powersmiths. The facility consists of one 75kVA transformer. The transformer is operating at a small fraction of its nameplate capacity, resulting in very low efficiency, and often produce large amounts of excess heat, resulting in energy losses, and higher electric costs.

ECM Description

Willdan recommends replacing the dry-type transformer with E-Saver transformers. Designed to provide the lowest life cycle cost, the E-Saver goes beyond US DOE 2016 efficiency, ensuring lower operating losses than standard off-the-shelf transformers. To provide superior performance and reduce environmental impact, the E-Saver comes with a superior Nomex based insulation system impregnated with an organic epoxy adhesive. Superior insulation prevents shorts as well, substantially prolonging the life of the transformer.

Based on the detailed field survey, the replacement E-Saver transformer will be a like-for-like, nominal kVA capacity, designed and manufactured to minimize losses for the application and fit within the existing constraints. This ECM can achieve energy saving by increasing the transformer efficiency.

Measure Baseline and Proposed Upgrades

Baseline

- One (1) 75kVA transfomers

Proposed

- Four (1) E-Saver-80R transformers.
- Four (1) Transformer Custom Enclosures & Adders

Calculation Methodology

ECM-4 energy savings have been calculated using excel spreadsheet.

Design Considerations

- Coordination with facility manager to minimize the effect on day-to-day operation.
- Disruption to electrical loads served by existing transformers.
- Seasonal loading on transformers.

ECM-5: Install Solar PV Panels

Existing Conditions

There is no solar photovoltaic system installed at the facility.

ECM Description

Willdan recommends installing a solar photovoltaic system to reduce dependence on the electric grid. The solar system can provide 145,600 kWh of electricity annually. Solar panels work by absorbing sunlight with photovoltaic cells, generating direct current (DC) energy and then converting it to usable alternating current (AC) energy with the help of inverter technology. AC energy then flows through the electrical panel and is distributed accordingly.

The solar PV sizing in the current phase is preliminary assessment of solar potential. A more in-depth study will be performed to further evaluate the solar energy production potential.

Calculation Methodology

ECM-4 energy savings have been prepared by Aurora Software.

Design Considerations

- Effect on utility tariffs and rate structures.
- Integration with existing building infrastructure.

Fenwick Building

ECM-1: LED Lighting Upgrades - Interior

Existing Conditions

Fenwick Building uses a variety of interior fixtures throughout the building. The most prevalent lamp type used in the facility are 4-feet 32-watt linear fluorescent T8 lamps in fixtures equipped with 2, 3 or 4 lamps per fixture. There are also compact fluorescent and incandescent lamps used for interior lighting.

ECM Description

Willdan recommends retrofitting fixtures with T8 lamps with the more efficient Linear LED tubes. The existing compact fluorescent and incandescent lamps will be replaced with compatible LED replacements. In addition to electric usage and demand savings, maintenance savings may also be achieved since LED lamps last longer than other light sources and therefore do not need to be replaced as often. All recommended lighting is DLC and/or Energy Star compliant.

Measure Baseline and Proposed Upgrades

Baseline

- Existing fluorescent and incandescent lamps

Proposed

- High-efficiency LED lighting fixtures

Calculation Methodology

ECM-1 energy savings have been calculated using NJ Clean Energy Protocol. A full space-by-space lighting audit is completed to identify the baseline and the calculated lighting power density is used to calculate the baseline lighting energy consumption. A compatible LED replacement is selected for each fixture/lamp type in the facility.

Design Considerations

- Integration with lighting controls.
- Emergency lighting.

Maintenance Considerations

- Lamps/fixtures and associated ballasts shall be maintained as part of ongoing maintenance efforts by the facility engineers.

ECM-2 Install New Split Units

Existing Conditions

The building has two (2) split units. The units are near the end of life and appear to be in poor condition.

ECM Description

Willdan recommends replacing seven (7) existing split units and gas furnaces. Replacing the split units has a long payback period and may not be justifiable based simply on energy considerations. However, the units that are being recommended for replacement at this facility are nearing or have reached the end of their normal useful life.

Measure Baseline and Proposed Upgrades

Baseline

- Seven (7) split units with gas furnaces near end of life.
    - Two (2) 10-ton split unit with gas furnace
    - One (1) 12.5-ton split unit with gas furnace
    - Three (3) 7.5-ton split unit with gas furnace
    - One (1) 5-ton split unit with gas furnace

Proposed

- Seven (7) new energy efficient split units with gas furnaces.

Calculation Methodology

ECM-3 energy savings have been calculated using spreadsheets and methodology presented in NJ Clean Energy Protocol.

Design Considerations

- Controls Integration

Maintenance Considerations

- Boiler shall be maintained as per manufacturer's guidelines.

ECM-3: Install Low-Flow DHW Devices

Existing Conditions

There are currently twenty-four (24) lavatory faucet that is not equipped with low-flow aerators.

ECM Description

Willdan recommends installing low-flow domestic hot water devices to reduce overall hot water demand. Energy demand from domestic hot water heating systems can be reduced by reducing water usage in general. Faucet aerators can reduce hot water usage relative to standard aerators which saves energy. Low-flow devices reduce the overall water flow from the fixture while maintaining adequate pressure for washing.

When faucets deteriorate with age, it leads to leaks and excessive water flowing through the fixtures. In general, it is common to find fixtures consuming more than 2.2 gpm due to age. It is recommended that the aerators be replaced with appropriate spray type, pressure compensating flow moderators, which typically reduces the water flow rate to 1.5 gpm. In additions low flow aerators, low flow showerheads should also be installed at the facility which will reduce existing showerhead flow rate from 2.5 gpm to 2.0 gpm.

Measure Baseline and Proposed Upgrades

Baseline

- Twenty-four (24) lavatory faucets (2.2 gpm).

Proposed

- Twenty-four (24) lavatory faucet aerators (1.0 gpm).

Calculation Methodology

ECM-3 energy savings have been calculated using excel spreadsheet.

Design Considerations

- None

Maintenance Considerations

- Maintenance against leaks shall be performed by the facility maintenance staff.

ECM-4: Install Solar PV Panels

Existing Conditions

There is no solar photovoltaic system installed at the facility.

ECM Description

Willdan recommends installing a solar photovoltaic system to reduce dependence on the electric grid. The solar system can provide 60,270 kWh of electricity annually. Solar panels work by absorbing sunlight with photovoltaic cells, generating direct current (DC) energy and then converting it to usable alternating current (AC) energy with the help of inverter technology. AC energy then flows through the electrical panel and is distributed accordingly.

The solar PV sizing in the current phase is preliminary assessment of solar potential. A more in-depth study will be performed to further evaluate the solar energy production potential.

Calculation Methodology

ECM-4 energy savings have been prepared by Aurora Software.

Design Considerations

- Effect on utility tariffs and rate structures.
- Integration with existing building infrastructure.

Emergency Services Building

ECM-1: LED Lighting Upgrades - Interior

Existing Conditions

Emergency Services Building uses a variety of interior fixtures throughout the building. The most prevalent lamp type used in the facility are 4-feet 32-watt linear fluorescent T8 lamps in fixtures equipped with 2, 3 or 4 lamps per fixture. There are also compact fluorescent and incandescent lamps used for interior lighting.

ECM Description

Willdan recommends retrofitting fixtures with T8 lamps with the more efficient Linear LED tubes. The existing compact fluorescent and incandescent lamps will be replaced with compatible LED replacements. In addition to electric usage and demand savings, maintenance savings may also be achieved since LED lamps last longer than other light sources and therefore do not need to be replaced as often. All recommended lighting is DLC and/or Energy Star compliant.

Measure Baseline and Proposed Upgrades

Baseline

- Existing fluorescent and incandescent lamps

Proposed

- High-efficiency LED lighting fixtures

Calculation Methodology

ECM-1 energy savings have been calculated using NJ Clean Energy Protocol. A full space-by-space lighting audit is completed to identify the baseline and the calculated lighting power density is used to calculate the baseline lighting energy consumption. A compatible LED replacement is selected for each fixture/lamp type in the facility.

Design Considerations

- Integration with lighting controls.
- Emergency lighting.

Maintenance Considerations

- Lamps/fixtures and associated ballasts shall be maintained as part of ongoing maintenance efforts by the facility engineers.

ECM-2 Replace Existing Boiler

Existing Conditions

The spaces are conditioned using ceiling mount Water Source Heat Pumps ranging from 1 ton to 2 tons with a heating capacity reaching 15 MBH. The units are in good condition. There are a few spaces that are retrofitted with newer equipment, with split ACs serving during summer season, and gas fired furnace for heating. The condenser loop for the WSHPs is served by one (1) H.B. Smith steam boiler, configured in an automated control scheme. The steam boiler produces low pressure steam which goes through a heat exchanger to produce 160F hot water to regulate the loop temperature during heating season.

ECM Description

Willdan recommends replacing one (1) 520 MBH existing gas-fired steam boiler with a new 520 MBH condensing boiler. The average expectancy of a traditional gas boiler is 20 years. The existing boilers inspected were inspected and found to be functional, but they are at the end of their useful service life. A condensing boiler extracts additional heat from the waste gases by condensing this water vapor to liquid water, thus recovering its latent heat of vaporization. While the effectiveness of the condensing process varies depending on the temperature of the water returning to the boiler, it is always at least as efficient as a non-condensing boiler. Compared to 77 - 80% with conventional designs, the proposed condensing boiler efficiency was conservatively taken as 88% based on the expected heating hot water return temperatures in the building.

Measure Baseline and Proposed Upgrades

Baseline

- One (1) steam boiler near end of life

Proposed

- One (1) 520 MBH condensing boiler.
- The boiler will operate at noncondensing boiler during design conditions, but will operate near condensing or condensing return hot water temperature during milder winter months or shoulder months

Calculation Methodology

ECM-2 energy savings have been calculated using spreadsheets and methodology presented in NJ Clean Energy Protocol.

Design Considerations

- Rigging & demolition of existing units.
- Scheduling of unit downtime during construction.
- Integration with the existing BMS and existing distribution system

Maintenance Considerations

- Boiler shall be maintained as per manufacturer's guidelines.

ECM-3 Install VFDs on Heating Hot Water Pumps and Cooling Tower Fans

Existing Conditions

The hydronic distribution system consists of a two-pipe heating system. Pipe insulation appeared to be in good condition. The hot water system is configured in a constant flow primary distribution with one (1) 3 hp constant speed hot water pump. The cooling tower has two (2) 10 hp constant speed fans.

ECM Description

Willdan recommends installing VFDs on the constant speed hot water pump and cooling tower fans. The pump/fans will run at variable speed in order to maintain the desired differential pressure set point. Since motor power consumption is proportional to the cube of the shaft speed under ideal conditions, running pumps at lower speeds provides energy savings when compared to operating pumps at full speed. For example, a 20% reduction in pump motor speed results in approximately a 50% reduction in pumping energy consumption. Willdan also recommends upgrading the standard efficiency motors on existing heating hot water pumps to premium efficiency pump motors (inverter duty motors).

Table 87: Heating Hot Water Pump and Cooling Tower Fan Upgrades

Tag	Location	Service	Make	Motor HP	Speed Control	VFD Upgrades (Y/N)	Premium Efficiency Motor Upgrades (Y/N)
HWP-1	Boiler Room	Hot Water Loop	Baldor	3	Constant	Y	Y
CT-1/2	Roof	Cooling Tower	-	10	Constant	Y	Y

Measure Baseline and Proposed Upgrades

Baseline

- One (1) 3-hp constant speed hot water pumps equipped with non-premium efficiency motors.
- Two (2) 10-hp constant speed cooling tower fans equipped with non-premium efficiency motors.

Proposed

- Install VFDs on one (1) heating hot water pump.
- Premium efficiency motors on one (1) heating hot water pump.
- Install VFDs on two (2) cooling tower fans.
- Premium efficiency motors on two (2) cooling tower fans.
- Testing and balancing of heating hot water systems.
- Provide connections to BMS to monitor and control new equipment.

Calculation Methodology

ECM-3 energy savings have been calculated using spreadsheet and methodology presented in NJ Clean Energy Protocol. Baseline motor efficiencies are based on the nameplate of the existing motors.

Design Considerations

- Integration with BMS and hydronic distribution system.

Maintenance Considerations

- VFDs, pumps and pump motors shall be maintained as per manufacturer's guidelines.

ECM-4 Replace Existing WSHP

Existing Conditions

The spaces are conditioned using twenty-three (23) ceiling mount Water Source Heat Pumps ranging from 1 ton to 2 tons with a heating capacity reaching 15 MBH. The units are in fair condition. There are a few spaces that are retrofitted with newer equipment, with split ACs serving during summer season, and gas fired furnace for heating.

ECM Description

Willdan recommends replacing twenty-three (23) existing WSHP. Replacing the WSHP has a long payback period and may not be justifiable based simply on energy considerations. However, the units that are being recommended for replacement at this facility are nearing or have reached the end of their normal useful life.

Measure Baseline and Proposed Upgrades

Baseline

- Twenty-three (23) existing WSHP near end of life.

Proposed

- Twenty-three (23) new high efficiency WSHP.

Calculation Methodology

ECM-4 energy savings have been calculated using spreadsheet with methodology presented in the NJ Clean Energy Protocol.

Design Considerations

- Rigging & demolition of existing units.
- Scheduling of unit downtime during construction.
- Disposal of refrigerant.
- Integration with the existing BMS and existing distribution system.

Maintenance Considerations

- WSHP shall be maintained as per manufacturer's guidelines.

ECM-5: Implement Vending Machine Miser Controls

Existing Conditions

There is one (2) refrigerated cold beverage vending machine at Salem County Emergency Services Building. It is currently not equipped with an occupancy-based controls and is operated 24/7.

ECM Description

Willdan recommends installing occupancy sensor controls for vending machine. Vending machines operate continuously, even during unoccupied hours and consumes several hundred dollars per year in electrical energy costs. The installation of the Vending Miser product will reduce the run time of the vending machine during periods when no occupancy is sensed in the area surrounding the machine. The smart electronics in the device will ensure product is kept cold through a cycling process while reducing total energy consumption. Another benefit from implementing vending miser controls is extended useful equipment life due to reduced lifetime. Energy savings are dependent on the vending machine and activity level in the area surrounding the machines.

Measure Baseline and Proposed Upgrades

Baseline

- Existing refrigerated vending machine operated 24/7.

Proposed

- Install occupancy sensor (vending miser controls) for the refrigerated vending machines.

Calculation Methodology

ECM-5 energy savings have been calculated using NJ Clean Energy Protcol.

Design Considerations

- None.

ECM-6: Install Low-Flow DHW Devices

Existing Conditions

There are currently Fourteen (14) lavatory faucet that is not equipped with low-flow aerators.

ECM Description

Willdan recommends installing low-flow domestic hot water devices to reduce overall hot water demand. Energy demand from domestic hot water heating systems can be reduced by reducing water usage in general. Faucet aerators can reduce hot water usage relative to standard aerators which saves energy. Low-flow devices reduce the overall water flow from the fixture while maintaining adequate pressure for washing.

When faucets deteriorate with age, it leads to leaks and excessive water flowing through the fixtures. In general, it is common to find fixtures consuming more than 2.2 gpm due to age. It is recommended that the aerators be replaced with appropriate spray type, pressure compensating flow moderators, which typically reduces the water flow rate to 1.5 gpm. In additions low flow aerators, low flow showerheads should also be installed at the facility which will reduce existing showerhead flow rate from 2.5 gpm to 2.0 gpm.

Measure Baseline and Proposed Upgrades

Baseline

- Fourteen (14) lavatory faucets (2.2 gpm).

Proposed

- Fourteen (14) lavatory faucet aerators (1.0 gpm).

Calculation Methodology

ECM-6 energy savings have been calculated using excel spreadsheet.

Design Considerations

- None

Maintenance Considerations

- Maintenance against leaks shall be performed by the facility maintenance staff.

ECM-7: Install Energy Efficient Transformers

Existing Conditions

An on-site detailed survey of the dry-type transformers was performed by Powersmiths. The facility consists of two 30kVA transformers. The transformers are operating at a small fraction of its nameplate capacity, resulting in very low efficiency, and often produce large amounts of excess heat, resulting in energy losses, and higher electric costs.

ECM Description

Willdan recommends replacing the dry-type transformers with E-Saver transformers. Designed to provide the lowest life cycle cost, the E-Saver goes beyond US DOE 2016 efficiency, ensuring lower operating losses than standard off-the-shelf transformers. To provide superior performance and reduce environmental impact, the E-Saver comes with a superior Nomex based insulation system impregnated with an organic epoxy adhesive. Superior insulation prevents shorts as well, substantially prolonging the life of the transformer.

Based on the detailed field survey, the replacement E-Saver transformers will be a like-for-like, nominal kVA capacity, designed and manufactured to minimize losses for the application and fit within the existing constraints. This ECM can achieve energy saving by increasing the transformer efficiency.

Measure Baseline and Proposed Upgrades

Baseline

- One (2) 30kVA transformers

Proposed

- Four (3) E-Saver-80R transformers.
- Four (3) Transformer Custom Enclosures & Adders

Calculation Methodology

ECM-7 energy savings have been calculated using excel spreadsheet.

Design Considerations

- Coordination with facility manager to minimize the effect on day-to-day operation.
- Disruption to electrical loads served by existing transformers.
- Seasonal loading on transformers.

ECM-8: Install Solar PV Panels

Existing Conditions

There is no solar photovoltaic system installed at the facility.

ECM Description

Willdan recommends installing a solar photovoltaic system to reduce dependence on the electric grid. The solar system can provide 358,431 kWh of electricity annually. Solar panels work by absorbing sunlight with photovoltaic cells, generating direct current (DC) energy and then converting it to usable alternating current (AC) energy with the help of inverter technology. AC energy then flows through the electrical panel and is distributed accordingly.

The solar PV sizing in the current phase is preliminary assessment of solar potential. A more in-depth study will be performed to further evaluate the solar energy production potential.

Calculation Methodology

ECM-8 energy savings have been prepared by Aurora Software.

Design Considerations

- Effect on utility tariffs and rate structures.
- Integration with existing building infrastructure.

Social Services Building

ECM-1: LED Lighting Upgrades - Interior

Existing Conditions

Social Services Building uses a variety of interior fixtures throughout the building. The most prevalent lamp type used in the facility are 4-feet 32-watt linear fluorescent T8 lamps in fixtures equipped with 2, 3 or 4 lamps per fixture. There are also compact fluorescent and incandescent lamps used for interior lighting.

ECM Description

Willdan recommends retrofitting fixtures with T8 lamps with the more efficient Linear LED tubes. The existing compact fluorescent and incandescent lamps will be replaced with compatible LED replacements. In addition to electric usage and demand savings, maintenance savings may also be achieved since LED lamps last longer than other light sources and therefore do not need to be replaced as often. All recommended lighting is DLC and/or Energy Star compliant.

Measure Baseline and Proposed Upgrades

Baseline

- Existing fluorescent and incandescent lamps

Proposed

- High-efficiency LED lighting fixtures

Calculation Methodology

ECM-1 energy savings have been calculated using NJ Clean Energy Protocol. A full space-by-space lighting audit is completed to identify the baseline and the calculated lighting power density is used to calculate the baseline lighting energy consumption. A compatible LED replacement is selected for each fixture/lamp type in the facility.

Design Considerations

- Integration with lighting controls.
- Emergency lighting.

Maintenance Considerations

- Lamps/fixtures and associated ballasts shall be maintained as part of ongoing maintenance efforts by the facility engineers.

ECM-2 Replace Existing RTUs

Existing Conditions

This office is served by packaged roof top units with gas furnace. There are six (6) RTUs, 4 in good condition and 2 almost at their end of life. The all have almost same efficiency and capacity. There is a server room which has its own dedicated split ac which is in fair condition.

Table 88: Building Equipment Schedule

Location	Area(s)/System(s) Served	System Quantity	System Type	Cooling Capacity per Unit (Tons)	Heating Capacity per Unit (MBH, kW)
Roof	Offices	1	Packaged RTU	4	100
Roof	Offices	1	Packaged RTU	7.5	160

Roof	Offices	1	Packaged RTU	5	64
Roof	Offices	1	Packaged RTU	3.5	-

ECM Description

Willdan recommends replacing four (4) existing RTUs. Replacing the split units has a long payback period and may not be justifiable based simply on energy considerations. However, the units that are being recommended for replacement at this facility are nearing or have reached the end of their normal useful life.

Measure Baseline and Proposed Upgrades

Baseline

- Four (4) split units with gas furnaces:
  - Six (1) 7.5-ton RTUs with gas furnace
  - One (1) 5-ton RTU with gas furnace
  - One (1) 4-ton RTU with gas furnace
  - One (1) 3.5-ton RTU with gas furnace

Proposed

- Four (4) new high efficiency RTUs with gas furnaces:
  - Six (6) 7.5-ton RTUs with gas furnace
  - One (1) 5-ton RTU with gas furnace
  - One (1) 4-ton RTU with gas furnace
  - One (1) 3.5-ton RTU with gas furnace

Calculation Methodology

ECM-2 energy savings have been calculated using spreadsheets and methodology presented in NJ Clean Energy Protocol.

Design Considerations

- Rigging & demolition of existing units.
- Scheduling of unit downtime during construction.
- Disposal of refrigerant.
- Integration with the existing BMS and existing distribution system

Maintenance Considerations

- RTUs shall be maintained as per manufacturer's guidelines.

ECM-3: Implement Vending Machine Miser Controls

Existing Conditions

There is one (2) refrigerated cold beverage vending machine at Salem County Social Services Building. It is currently not equipped with an occupancy-based controls and is operated 24/7.

ECM Description

Willdan recommends installing occupancy sensor controls for vending machine. Vending machines operate continuously, even during unoccupied hours and consumes several hundred dollars per year in electrical energy costs. The installation of the Vending Miser product will reduce the run time of the vending machine during periods when no occupancy is sensed in the area surrounding the machine. The smart electronics in the device will ensure product is kept cold through a cycling process while reducing total energy consumption. Another benefit from implementing vending miser controls is extended useful equipment life due to reduced lifetime. Energy savings are dependent on the vending machine and activity level in the area surrounding the machines.

Measure Baseline and Proposed Upgrades

Baseline

- Existing refrigerated vending machine operated 24/7.

Proposed

- Install occupancy sensor (vending miser controls) for the refrigerated vending machines.

Calculation Methodology

ECM-3 energy savings have been calculated using NJ Clean Energy Protcol.

Design Considerations

- None.

ECM-4: Install Low-Flow DHW Devices

Existing Conditions

There are currently eight (8) lavatory faucet that is not equipped with low-flow aerators.

ECM Description

Willdan recommends installing low-flow domestic hot water devices to reduce overall hot water demand. Energy demand from domestic hot water heating systems can be reduced by reducing water usage in general. Faucet aerators can reduce hot water usage relative to standard aerators which saves energy. Low-flow devices reduce the overall water flow from the fixture while maintaining adequate pressure for washing.

When faucets deteriorate with age, it leads to leaks and excessive water flowing through the fixtures. In general, it is common to find fixtures consuming more than 2.2 gpm due to age. It is recommended that the aerators be replaced with appropriate spray type, pressure compensating flow moderators, which typically reduces the water flow rate to 1.5 gpm. In additions low flow aerators, low flow showerheads should also be installed at the facility which will reduce existing showerhead flow rate from 2.5 gpm to 2.0 gpm.

Measure Baseline and Proposed Upgrades

Baseline

- Eight (8) lavatory faucets (2.2 gpm).

Proposed

- Eight (8) lavatory faucet aerators (1.0 gpm).

Calculation Methodology

ECM-4 energy savings have been calculated using excel spreadsheet.

Design Considerations

- None

Maintenance Considerations

- Maintenance against leaks shall be performed by the facility maintenance staff.

ECM-5: Install Solar PV Panels

Existing Conditions

There is no solar photovoltaic system installed at the facility.

ECM Description

Willdan recommends installing a solar photovoltaic system to reduce dependence on the electric grid. The solar system can provide 134,190 kWh of electricity annually. Solar panels work by absorbing sunlight with photovoltaic cells, generating direct current (DC) energy and then converting it to usable alternating current (AC) energy with the help of inverter technology. AC energy then flows through the electrical panel and is distributed accordingly.

The solar PV sizing in the current phase is preliminary assessment of solar potential. A more in-depth study will be performed to further evaluate the solar energy production potential.

Calculation Methodology

ECM-5 energy savings have been prepared by Aurora Software.

Design Considerations

- Effect on utility tariffs and rate structures.
- Integration with existing building infrastructure.

Main County Office Building

ECM-1: LED Lighting Upgrades - Interior

Existing Conditions

Social Services Building uses a variety of interior fixtures throughout the building. The most prevalent lamp type used in the facility are 4-feet 32-watt linear fluorescent T8 lamps in fixtures equipped with 2, 3 or 4 lamps per fixture. There are also compact fluorescent and incandescent lamps used for interior lighting.

ECM Description

Willdan recommends retrofitting fixtures with T8 lamps with the more efficient Linear LED tubes. The existing compact fluorescent and incandescent lamps will be replaced with compatible LED replacements. In addition to electric usage and demand savings, maintenance savings may also be achieved since LED lamps last longer than other light sources and therefore do not need to be replaced as often. All recommended lighting is DLC and/or Energy Star compliant.

Measure Baseline and Proposed Upgrades

Baseline

- Existing fluorescent and incandescent lamps

Proposed

- High-efficiency LED lighting fixtures

Calculation Methodology

ECM-1 energy savings have been calculated using NJ Clean Energy Protocol. A full space-by-space lighting audit is completed to identify the baseline and the calculated lighting power density is used to calculate the baseline lighting energy consumption. A compatible LED replacement is selected for each fixture/lamp type in the facility.

Design Considerations

- Integration with lighting controls.
- Emergency lighting.

Maintenance Considerations

- Lamps/fixtures and associated ballasts shall be maintained as part of ongoing maintenance efforts by the facility engineers.

ECM-2: Install Low-Flow DHW Devices

Existing Conditions

There are currently eight (8) lavatory faucet that is not equipped with low-flow aerators.

ECM Description

Willdan recommends installing low-flow domestic hot water devices to reduce overall hot water demand. Energy demand from domestic hot water heating systems can be reduced by reducing water usage in general. Faucet aerators can reduce hot water usage relative to standard aerators which saves energy. Low-flow devices reduce the overall water flow from the fixture while maintaining adequate pressure for washing.

When faucets deteriorate with age, it leads to leaks and excessive water flowing through the fixtures. In general, it is common to find fixtures consuming more than 2.2 gpm due to age. It is recommended that the aerators be replaced with appropriate spray type, pressure compensating flow moderators, which typically reduces the water flow rate to 1.5 gpm. In additions low flow aerators, low flow showerheads should also be installed at the facility which will reduce existing showerhead flow rate from 2.5 gpm to 2.0 gpm.

Measure Baseline and Proposed Upgrades

Baseline

- Eight (8) lavatory faucets (2.2 gpm).

Proposed

- Eight (8) lavatory faucet aerators (1.0 gpm).

Calculation Methodology

ECM-2 energy savings have been calculated using excel spreadsheet.

Design Considerations

- None

Maintenance Considerations

- Maintenance against leaks shall be performed by the facility maintenance staff.

ECM-3: Install Solar PV Panels

Existing Conditions

There is no solar photovoltaic system installed at the facility.

ECM Description

Willdan recommends installing a solar photovoltaic system to reduce dependence on the electric grid. The solar system can provide 134,190 kWh of electricity annually. Solar panels work by absorbing sunlight with photovoltaic cells, generating direct current (DC) energy and then converting it to usable alternating current (AC) energy with the help of inverter technology. AC energy then flows through the electrical panel and is distributed accordingly.

The solar PV sizing in the current phase is preliminary assessment of solar potential. A more in-depth study will be performed to further evaluate the solar energy production potential.

Calculation Methodology

ECM-3 energy savings have been prepared by Aurora Software.

Design Considerations

- Effect on utility tariffs and rate structures.
- Integration with existing building infrastructure.

Admin Building

ECM-1: LED Lighting Upgrades - Interior

Existing Conditions

Emergency Services Building uses a variety of interior fixtures throughout the building. The most prevalent lamp type used in the facility are 4-feet 32-watt linear fluorescent T8 lamps in fixtures equipped with 2, 3 or 4 lamps per fixture. There are also compact fluorescent and incandescent lamps used for interior lighting.

ECM Description

Willdan recommends retrofitting fixtures with T8 lamps with the more efficient Linear LED tubes. The existing compact fluorescent and incandescent lamps will be replaced with compatible LED replacements. In addition to electric usage and demand savings, maintenance savings may also be achieved since LED lamps last longer than other light sources and therefore do not need to be replaced as often. All recommended lighting is DLC and/or Energy Star compliant.

Measure Baseline and Proposed Upgrades

Baseline

- Existing fluorescent and incandescent lamps

Proposed

- High-efficiency LED lighting fixtures

Calculation Methodology

ECM-1 energy savings have been calculated using NJ Clean Energy Protocol. A full space-by-space lighting audit is completed to identify the baseline and the calculated lighting power density is used to calculate the baseline lighting energy consumption. A compatible LED replacement is selected for each fixture/lamp type in the facility.

Design Considerations

- Integration with lighting controls.
- Emergency lighting.

Maintenance Considerations

- Lamps/fixtures and associated ballasts shall be maintained as part of ongoing maintenance efforts by the facility engineers.

ECM-2 Replace Existing Boiler

Existing Conditions

The building is condition by several fan coils and unit ventilators located in each room. Chilled water for these units is supplied from the Courthouse chiller plant. Heating hot water is supplied by two (2) Weil-Mclain gas fired 2,450 MBH hot water boilers. The boiler are past their useful life.

ECM Description

Willdan recommends replacing two (2) 2,450 MBH existing gas-fired hot water boiler with a new 2,450 MBH condensing boiler. The average expectancy of a traditional gas boiler is 20 years. The existing boilers inspected were inspected and found to be functional, but they are at the end of their useful service life. A condensing boiler extracts additional heat from the waste gases by condensing this water vapor to liquid water, thus recovering its latent heat of vaporization. While the effectiveness of the condensing process varies depending on the temperature of the water returning to the boiler, it is always at least as efficient as a non-condensing boiler. Compared to 77 - 80% with conventional designs, the proposed condensing boiler efficiency was conservatively taken as 88% based on the expected heating hot water return temperatures in the building.

Measure Baseline and Proposed Upgrades

Baseline

- Two (2) 2,450 MBH hot water boiler near end of life.

Proposed

- Two (2) 2,450 MBH condensing boiler.

- The boiler will operate at noncondensing boiler during design conditions, but will operate near condensing or condensing return hot water temperature during milder winter months or shoulder months

Calculation Methodology

ECM-2 energy savings have been calculated using spreadsheets and methodology presented in NJ Clean Energy Protocol.

Design Considerations

- Controls Integration
- Rigging & demolition of existing units.
- Scheduling of unit downtime during construction.
- Integration with the existing BMS and existing distribution system

Maintenance Considerations

- Boiler shall be maintained as per manufacturer's guidelines.

ECM-3 Install VFDs on HHW/CHW Pumps

Existing Conditions

The hydronic distribution system consists of a two-pipe heating/cooling system. Pipe insulation appeared to be in good condition. The hot water/ chilled water system is configured in a constant flow primary distribution with one (2) 10 hp constant speed pumps.

ECM Description

Willdan recommends installing VFDs on the constant speed hot water/ chilled water pumps. The pumps will run at variable speed in order to maintain the desired differential pressure set point. Since motor power consumption is proportional to the cube of the shaft speed under ideal conditions, running pumps at lower speeds provides energy savings when compared to operating pumps at full speed. For example, a 20% reduction in pump motor speed results in approximately a 50% reduction in pumping energy consumption. Willdan also recommends upgrading the standard efficiency motors on existing heating hot water pumps to premium efficiency pump motors (inverter duty motors).

Table 89: Heating Hot Water Pump and Chilled Water Pump Upgrades

Tag	Location	Service	Make	Motor HP	Speed Control	VFD Upgrades (Y/N)	Premium Efficiency Motor Upgrades (Y/N)
HWP/CHWP-1/2	Boiler Room	Hot Water/ Chilled Water Loop	Baldor	10	Constant	Y	Y

Measure Baseline and Proposed Upgrades

Baseline

- Two (2) 10-hp constant speed hot water/ chilled water pumps equipped with non-premium efficiency motors.

Proposed

- Install VFDs on two (2) hot water/ chilled water pumps.
- Premium efficiency motors on two (2) hot water/ chilled water pumps.
- Testing and balancing of heating hot water systems.
- Provide connections to BMS to monitor and control new equipment.

Calculation Methodology

ECM-3 energy savings have been calculated using spreadsheet and methodology presented in NJ Clean Energy Protocol. Baseline motor efficiencies are based on the nameplate of the existing motors.

Design Considerations

- Integration with BMS and hydronic distribution system.

Maintenance Considerations

- VFDs, pumps and pump motors shall be maintained as per manufacturer's guidelines.

ECM-4: Install Low-Flow DHW Devices

Existing Conditions

There are currently Twelve (12) lavatory faucet that is not equipped with low-flow aerators.

ECM Description

Willdan recommends installing low-flow domestic hot water devices to reduce overall hot water demand. Energy demand from domestic hot water heating systems can be reduced by reducing water usage in general. Faucet aerators can reduce hot water usage relative to standard aerators which saves energy. Low-flow devices reduce the overall water flow from the fixture while maintaining adequate pressure for washing.

When faucets deteriorate with age, it leads to leaks and excessive water flowing through the fixtures. In general, it is common to find fixtures consuming more than 2.2 gpm due to age. It is recommended that the aerators be replaced with appropriate spray type, pressure compensating flow moderators, which typically reduces the water flow rate to 1.5 gpm. In additions low flow aerators, low flow showerheads should also be installed at the facility which will reduce existing showerhead flow rate from 2.5 gpm to 2.0 gpm.

Measure Baseline and Proposed Upgrades

Baseline

- Twelve (12) lavatory faucets (2.2 gpm).

Proposed

- Twelve (12) lavatory faucet aerators (1.0 gpm).

Calculation Methodology

ECM-4 energy savings have been calculated using excel spreadsheet.

Design Considerations

- None

Maintenance Considerations

- Maintenance against leaks shall be performed by the facility maintenance staff.

4.Utility and Other Rebates and Incentives Available for Project

A detailed description of all State and Federal tax benefits and energy grants, rebates and incentive programs Proposer anticipates incorporating into its proposal shall be provided as Section H-2.

Willdan has worked with various NJOCE Programs as well as utility programs in New Jersey. Willdan serves NJBPU as an approved Direct Install Program Implementation contractor. Willdan is the only ESCO that has been approved by NJOCE as a Direct Install Implementation Contractor, so will be able to help Salem County to apply as many measures under Direct Install program for qualified buildings. To date, Willdan has completed 400 projects under direct Install program. Willdan is also an approved Pay for Performance partner, so any building that qualify for Pay for Performance program, we would be able to help Salem County to apply under NJOCE Pay for Performance Program. Willdan has help more than 200 customers with NJOCE SmartStart Program.

Willdan will work with you to apply for and maximize all available rebates, utility incentives, PJM incentives or tax incentives. Willdan will also work with Salem County to explore all available markets for Carbon Credits. There are a number of programs available to help incentivize utility customers to reduce their dependence on the grid and move towards more energy efficient technology. The developers of the incentive programs understand, as we do, that the most efficient technology is not always the least expensive from a “first cost” standpoint, but they will lead to reduced operational costs and an improved environment over the “lifecycle” of your facilities.

Some of those rebates may include but are not limited to:

- Rebates and incentives available through the NJ SmartStart
- Program (via the NJ Clean Energy Program) – Equipment
- Incentives
- New Jersey Clean Energy “Pay for Performance” Incentive Program
- Energy Efficiency and Conservation Block Grants (New Jersey)
- (Recovery Act)
- Renewable Energy Incentive Program (REIP) (New Jersey)
- PJM Interconnection Incentive Programs (Demand Response and Frequency Regulation)
- Federal Government Energy Policy Act (Renewable Energy Technologies Tax Credits and
- Funding Grants)

Stimulus Funding Sources

- State Fiscal Stabilization Fund
- Qualified Zone Academy Bonds
- Energy Efficiency and Conservation Block Grants
- Qualified Energy Conservation Bonds
- Recovery Zone Bonds
- Build America Bonds

1. New Jersey Office of Clean Energy Smart Start Program

Incentives for Qualifying Equipment and Projects

A. Financial incentives are available for size projects which can offset some - or maybe even all - of the added cost to purchase qualifying energy-efficient equipment.
B. Support for Custom Energy-Efficiency Measures
C. Custom measures give you the opportunity to receive an incentive for unique energy-efficiency measures that are not on the prescriptive equipment list but are new/innovative or project/facility specific.

Application and Eligibility Process

D. We have made it even easier to participate! Pre-approval is no longer required for prescriptive measures, with the exception of prescriptive & performance lighting, lighting controls and custom measure applications. Please note that anyone who purchases and installs equipment without Program Manager approval does so at his/her own risk.

Building Name	NJOCE SmartStart
Johnson Building	$1,200
Inter-Agency Council Building	-
Agriculture Building	$536
Fenwick Building	$4,294
Emergency Services Building	$3,488
Social Services Building	$349
Main County Office Building	$5,630
Admin Building	$10,780

Table 90: District-Wide SmartStart Incentives

2. New Jersey Office of Clean Energy Combined Heat and Power Program

NJOCE Program support CHP projects and pays for up to 30-40% of the project cost. Willdan will evaluate this as an option during IGA and see if there is any opportunities for it. This not only extend the financing for 20 years but also provide energy saving compare the baseline for right application.

3. Energy Star Award Program

As part of the traditional guarantee measurement and guarantee process, Willdan will enroll Salem County into the EPA/DOE Energy Star program. The Energy Star Program has been developed by the EPA/DOE to reduce national energy dependency and pollution emissions. To achieve these ends, the program entices building owners to implement energy saving projects. These projects may include lighting, controls, HVAC replacement. Willdan will perform an Energy Star analysis for each building in this program. The Energy Star Benchmarking Tool provides a 1-100 ranking of a building's energy performance relative to the national building market. A higher SEP indicates a more energy efficient building. A score of 75 or higher is needed to qualify for the Energy Star label.

Willdan will prepare the information needed – utility bills and building information – for submittal to the EPA through our EnergyCAP™ program. EnergyCAP™ has a partnership with the EPA and Portfolio Manager and their program will assist in the information gathering and submittal process. After the original benchmark score, the data can be submitted monthly to see how the benchmark changes and also to renew the Energy Star rating on an annual basis. The decal will state the year in which the Energy Star rating was earned.

Before the building can be Energy Star designated it must be audited by a third-party engineer. As a participant, Salem County can expect free press, on both the local and national levels, to promote the positive impact of the project.

4. PJM Incentives

PJM's Energy Efficiency program pays businesses for permanent load reduction resulting from energy efficiency projects they have completed or will be complete in the future. The program pays organization capacity revenue for up to four years following the completion of a qualified project. Qualifying projects include those with permanent energy reductions involving lighting, refrigeration equipment, HVAC, motors, VFDs, and more. There is revenue to be earned from your organization using less energy and helping PJM reduce the overall load on the grid.

- Summer EE performance period: June- Aug between 2-6pm not including weekends or public holidays
- Winter EE performance period: Jan-Feb between 7-9am and between 6-8pm not including weekends or public holidays
- Solar PV systems are not eligible as PJM Energy Efficiency Resources
- BMS Systems load reductions are difficult to qualify under PJM's Manual 18B as "permanent, continuous"
- Savings achieved by fuel switching are not eligible as PJM EE Resources.
- Transformers and Motors/VFDs may have potential but at this stage for estimated value it is not simple enough to be viable to make that analysis.
- **Lighting upgrades** have represented almost 100% of the PJM EE Capacity kWs that we have qualified with PJM for municipal district projects. (>50 municipal districts in NJ in last five years) We have qualified some PTAC units which were utilized in the winter for heating as well as in summer for cooling but that was not a typical ECMs

Building Name	PJM Savings
DY 2021/22	$3,130
DY 2022/23	$2,295
DY 2023/24	$2,295
DY 2024/25	$2,295
TOTAL	**$10,015**

Table 91: District-Wide PJM Incentives

5. Operational and Maintenance Savings

ESIP Law allows energy savings as a energy cost reduction and maintenance cost reduction resulting from implementing energy conservation measures, when compared against established baseline of a previous energy cost, operating and maintenance cost including but not limited to future capital expenditure avoided because of equipment installed or services performed as part of the ESIP program. Willdan interviewed the site maintenance head and was made aware that Salem County allocated a base amount of $10,000 annually for regular operation and maintenance costs. Additionally, the board also reserves another $100,000 annually for incidental and other direct costs towards building operation and maintenance. Given a total budget of $100,000, Willdan is projecting a reduction of $90,000 annually towards operation and maintenance savings.

5. Measurement and Verification (M&V) Plan

Measurement and Verification

The M&V protocol developed collaboratively between Willdan and Salem County during the IGA process and as outlined in the M&V Plan will be utilized to measure and verify the project energy savings. Willdan will assign a dedicated M&V engineer familiar with Salem County facilities and its systems to work on-site throughout the M&V period. The dedicated M&V engineer will work closely with Salem County staff on continuous optimization and commissioning of systems to ensure savings are achieved.

The International Performance Measurement and Verification Protocol (IPMVP) is the industry standard protocol that Willdan follows. The IPMVP provides four methods to measure energy savings. Willdan generally prefers IPMVP Option C – *measuring savings at the utility meter* – in cases where realizing the project savings on the utility bill is critical; however, Option C is limited on a facility that undergoes significant changes or projects that also impact the utility meter. For this reason, more measure-specific savings tracking using submetering may be most appropriate.

Computation of Baseline

Willdan's preferred approach, IPMVP Option C: Whole Facility, whenever appropriate based upon ECM selection, facility type, and customer preference. Willdan's straightforward calculations for both the baseline and any adjustments are outlined in this section.

Methodology to Determine Baseline Energy Use

In the simplest terms, the baseline is the sum of the energy consumption and costs for a specific, 12-month period prior to the installation of an energy efficiency project. The Baseline Year is the period that establishes the pre-retrofit conditions used as the point of reference for calculating energy savings. This baseline is developed prior to contract execution and established with input and agreement of Salem County.

Willdan's approach to calculating a baseline for Option C is summarized in this section; Option A and B baselines are customized based on ECMs implemented and measured.

Data Collection

Building and system information gathered during the IGEA is documented in the Energy Savings M&V Plan to document the conditions present that resulted in the baseline energy use. This data includes, but is not limited to:

- Building metered utility data (from utility provider meters)
- Weather conditions collected from the nearest National Weather Service Station
- A lighting level survey, with a count of the number of burned out lamps
- A summary of typical space temperatures during occupied periods
- An inventory of the HVAC and domestic water heating systems serving the building
- The operating hours of each building
- Function and utilization of each space within the building
- Building plans showing current construction and floorplans showing physical layout of spaces

Baseline Year Consumption Calculations – IPMVP Option C: Whole Facility

For IPMVP Option C: Whole Facility M&V methodology, utility consumption and demand are obtained from utility bills, shown below, for the Guarantee Meters during the baseline period, which forms the basis of the energy baseline.

The following equations will be used to determine baseline electrical consumption and demand:

Baseline Energy (or Demand) Consumption = ∑ Tracked Utility Meters' Consumption (of Demand) ± Baseline Adjustments, where:

Baseline Adjustment = ∑ ± Routine Adjustment to reporting period conditions ± Non-Routine Adjustments to reporting-period conditions

Routine Adjustments include, but are not limited to, weather and billing period length

Non-Routine Adjustments include changes in key conditions from the baseline period to the reporting period, including, but no limited to, occupancy; hours of operation; changes to building function and use; changes to operation, capacity or quantity of equipment or systems within the facility; and additions to the building

	Johnson Building	Inter-Agency Building	Agriculture Building	Fenwick Building	Emergency Services	Social Services	Main County Office	Admin Building
Area (sqft)	7,000	62,440	13,600	24,600	13,170	20,000	56,745	21,285
Electrical Usage (kWh)	13,720	62,440	168,800	186,480	403,280	194,640	603,080	216,160
Natural Gas Usage (therms)	4,078	-	9,959	5,185	4,148	2,563	3,274	13,737
Total kBtu	454,627	213,045	1,571,619	1,154,693	1,790,806	920,367	2,384,985	2,110,947
Electrical Cost ($)	$2,148	$9,993	$27,971	$28,208	$60,543	$27,572	$92,666	$29,290
Natural Gas Cost ($)	$2,873	-	$7,357	$4,016	$3,323	$2,662	$2,681	$12,523
Total Annual Cost ($)	$5,022	$9,993	$35,329	$32,224	$63,866	$30,235	$95,347	$41,813
kBTU/SF	64.95	23.01	115.56	46.94	135.98	46.02	42.03	99.18
$/SF	$0.72	$1.08	$2.60	$1.31	$4.85	$1.51	$1.68	$1.96
$/kWh	$0.16	$0.16	$0.17	$0.15	$0.15	$0.14	$0.15	$0.14
$/therm	$0.70	-	$0.74	$0.77	$0.80	$1.04	$0.82	$0.91

Table 92: District-Wide Utility Baseline

M&V activities are performed to assure guaranteed savings are met to satisfy the contract and legislation. A general M&V approach is necessary to outline the methods that will significantly affect how the baseline is defined and the energy savings justified. An Adjusted Baseline is also used to incorporate any changes with facility use, such as operating hours, occupancy, renovation or any other reason that will impact a significant use in energy as compared to the baseline. Willdan Energy Solutions calculates the baseline for any facility based on actual existing systems and operating conditions. There are various approached that WES takes to accumulate the necessary data to construct the baseline. Such methods are listed below:

- Site measurements for electrical loads such as lighting, HVAC equipment, plug loads, circulation pumps, process loads, etc.
- Equipment operating hours based on trend data

This section contains a description of the types of Measurement and Verification (M&V) methodologies that Willdan Energy Solutions will use to guarantee the performance of this project.
They have been developed and defined by two independent authorities:

- International Performance Measurement and Verification Protocol (IPMVP)
- Federal Energy Management Program (FEMP)

There are four guarantee options that may be used to measure and verify the performance of a particular energy conservation measure. Each of the option is described below.

Option A – Retrofit Isolation: Key Parameter Measurement

Energy savings is determined by field measurement of the key parameters affecting the energy use of the system(s) to which an improvement measure was applied separate from the energy use of the rest of the facility. Measurement frequency ranges from short-term to continuous, depending on the expected variations in the measured parameter, and the length of the reporting period. Measurement of key parameters means that those parameters not selected for field measurement will be estimated. Estimates can be based on historical data, manufacturer's specifications, or engineering judgment. Documentation of the source or justification of the estimated parameter will be described in the M&V plan in the contract. Energy savings is determined through engineering calculations of the baseline and post-retrofit energy used based on the combination of measured and estimated parameters, along with any routine adjustments.

Option B – Retrofit Isolation: All Parameter Measurement

Like Option A, energy savings is determined by field measurement of the energy use of the systems to which an improvement measure was applied separate from the energy use of the rest of the facility. However, all of the key parameters affecting energy use are measured; there are no estimated parameters used for Option B. Measurement frequency ranges from short-term to continuous, depending on the expected variations in the savings and the length of the reporting period. Energy savings is determined through engineering calculations of the baseline and post-retrofit energy used based on the measured parameters, along with any routine adjustments.

Option C – Whole Building Metering/Utility Bill Comparisons

Option C involves the use of utility meters or whole building sub-meters to assess the energy performance of a total building. Option C assesses the impact of any type of improvement measure, but not individually if more than one is applied to an energy meter. This option determines the collective savings of all improvement measures applied to the part of the facility monitored by the energy meter. In addition, since whole building meters are used, savings reported under Option C include the impact of any other change made in facility energy use (positive or negative). Option C may be used in cases where there is a high degree of interaction between installed improvement measures or between improvement measures and the rest of the building or the isolation and measurement of individual improvement measures is difficult or too costly. This Option is intended for projects where savings are expected to be large enough to be discernable from the random or unexplained energy variations that are normally found at the level of the whole facility meter. The larger the savings, or the smaller the unexplained variations in the baseline, the easier it will be to identify savings. In addition, the longer the period of savings analysis after installing the improvement measure, the less significant is the impact of short-term unexplained variations. Typically, savings should be more than 20% of the baseline energy use if they are to be separated from the noise in the baseline data. Periodic inspections should be made of all equipment and operations in the facility after the improvement measure installation. These inspections will identify changes from baseline conditions or intended operations. Accounting for changes (other than those caused by the improvement measures) is the major challenge associated with Option C-particularly when savings are to be monitored for long periods. Savings are calculated through analysis of whole facility utility meter or sub-meter data using techniques from simple comparison to regression analysis.

Option D – Calibrated Simulation

Option D involves the use of computer simulation software to predict energy use, most often in cases where baseline data does not exist. Such simulation models must be calibrated so that it predicts an energy use and demand pattern that reasonably matches actual utility consumption and demand data from either the base-year or a post-retrofit year. Option D may be used to assess the performance of all improvement measures in a facility, akin to Option C. However, different from Option C, multiple runs of the simulation in Option D allow estimates of the savings attributable to each improvement measure within a multiple improvement measure project. Option D may also be used to assess just the performance of individual systems within a facility, akin to Option A and B. In this case, the system's energy use must be isolated from that of the rest of the facility by appropriate meters. Savings are calculated using energy use simulation models, calibrated with hourly or monthly utility billing data and/or end-use metering. Using the given options, Salem County will be going through various M&V options. The following is the decision per building

Johnson Building

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Willdan has recommended option C for Measurement and Verification at Johnson Building. The energy consumption for the existing building has been calculated using the guidelines set forth in the New Jersey Clean Energy Program's Savings Protocol FY19 and calibrated against recent 12 months of utility bills. The calibration has given an understanding of the building's operating schedule. The energy savings from proposed ECMs have been calculated based off the baseline. Savings calculated will be verified using 12 months of utility bills post installation to justify the interactive effects between newly installed system and the building as whole.

Inter-Agency Council Building

Willdan has recommended option C for Measurement and Verification at Inter-Agency Council Building. The energy consumption for the existing building has been calculated using the guidelines set forth in the New Jersey Clean Energy Program's Savings Protocol FY19 and calibrated against recent 12 months of utility bills. The calibration has given an understanding of the building's operating schedule. The energy savings from proposed ECMs have been calculated based off the baseline. Savings calculated will be verified using 12 months of utility bills post installation to justify the interactive effects between newly installed system and the building as whole.

Agriculture Building

Willdan has recommended option C for Measurement and Verification at Agriculture Building. The energy consumption for the existing building has been calculated using the guidelines set forth in the New Jersey Clean Energy Program's Savings Protocol FY19 and calibrated against recent 12 months of utility bills. The calibration has given an understanding of the building's operating schedule. The energy savings from proposed ECMs have been calculated based off the baseline. Savings calculated will be verified using 12 months of utility bills post installation to justify the interactive effects between newly installed system and the building as whole.

Fenwick Building

Willdan has recommended option C for Measurement and Verification at Fenwick Building. The energy consumption for the existing building has been calculated using the guidelines set forth in the New Jersey Clean Energy Program's Savings Protocol FY19 and calibrated against recent 12 months of utility bills. The calibration has given an understanding of the building's operating schedule. The energy savings from proposed ECMs have been calculated based off the baseline. Savings calculated will be verified using 12 months of utility bills post installation to justify the interactive effects between newly installed system and the building as whole.

Emergency Services Building

Willdan has recommended option C for Measurement and Verification at Emergency Services Building. The energy consumption for the existing building has been calculated using the guidelines set forth in the New Jersey Clean Energy Program's Savings Protocol FY19 and calibrated against recent 12 months of utility bills. The calibration has given an understanding of the building's operating schedule. The energy savings from proposed ECMs have been calculated based off the baseline. Savings calculated will be verified using 12 months of utility bills post installation to justify the interactive effects between newly installed system and the building as whole.

Social Services Building

Willdan has recommended option C for Measurement and Verification at Social Services Building. The energy consumption for the existing building has been calculated using the guidelines set forth in the New Jersey Clean Energy Program's Savings Protocol FY19 and calibrated against recent 12 months of utility bills. The calibration has given an understanding of the building's operating schedule. The energy savings from proposed ECMs have been calculated based off the baseline. Savings calculated will be verified using 12 months of utility bills post installation to justify the interactive effects between newly installed system and the building as whole.

Main County Office Building

Willdan has recommended option C for Measurement and Verification at Main County Office Building. The energy consumption for the existing building has been calculated using the guidelines set forth in the New Jersey Clean Energy Program's Savings Protocol FY19 and calibrated against recent 12 months of utility bills. The calibration has given an understanding of the building's operating schedule. The energy savings from proposed ECMs have been calculated based off the baseline. Savings calculated will be verified using 12 months of utility bills post installation to justify the interactive effects between newly installed system and the building as whole.

Admin Building

Willdan has recommended option C for Measurement and Verification at Admin Building. The energy consumption for the existing building has been calculated using the guidelines set forth in the New Jersey Clean Energy Program's Savings Protocol FY19 and calibrated against recent 12 months of utility bills. The calibration has given an understanding of the building's operating schedule. The energy savings from proposed ECMs have been calculated based off the baseline. Savings calculated will be verified using 12 months of utility bills post installation to justify the interactive effects between newly installed system and the building as whole.

6. Disclaimer

For various combinations of HVAC measures, ECMs have complex interactive effects which cannot always be isolated on an individual measure basis.

The intent of this energy analysis report is to estimate energy savings associated with recommended upgrades to the HVAC systems, lighting systems, and other relevant energy consumers at your facility. Appropriate detail is included to make decisions about implementing energy efficiency measures at the facility. However, this report is not intended to serve as a detailed engineering design document, as the description of the improvements are diagrammatic in nature only in order to document the basis of cost estimates and savings, and to demonstrate the feasibility of constructing the improvements. Interactive effects between the individual measures can cause the total project savings to be larger or smaller depending on which recommendations are selected for implementation.

While the recommendations in this report have been reviewed for technical accuracy and are believed to be reasonable and accurate, the findings are estimates and actual results may vary. As a result, Willdan are not liable if projected estimated savings or economics are not actually achieved. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

In no event will Willdan be liable for the failure of the customer to achieve a specified amount of energy savings, the operation of customer's facilities, or any incidental or consequential damages of any kind in connection with this report or the installation of recommended measures.

Salem County Courthouse

92 Market St
Salem, NJ 08079

Energy Saving Plan for Salem County

Summary of Revisions

8/11/2020:	Draft Report Submission
1/21/2021:	Third Party Revision 1

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1. Contacts

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2. Executive Summary

Site: Salem County Courthouse

Dates of Audit: January - March 2020

Auditors: Tejas Desai, PE, Ozan Ogus, Sudhir Patel - Willdan Energy Solutions

Salem County contracted with Willdan Energy Solutions (Willdan) to develop an Energy Saving Plans (ESIP) for Salem County Courthouse in Salem, NJ.

This report summarizes the Energy Conservation Measures (ECMs) that Willdan identified, along with the associated energy and cost savings for each measure. Section 2 summarizes the estimated savings, describes the site, and discusses the building occupancy and use, the local climate conditions, the existing building systems, the facility's utility use, the facility's energy end use, and peer benchmarking of the facility. Section 3 describes each ECM in detail.

The energy cost savings have been derived through detailed energy analysis using both spreadsheet analysis and eQuest energy modelling to model the building systems.

Table 1 shows the energy and energy cost savings for Salem County Courthouse.

Table 1: Estimated Total Utility & Cost Savings

Savings			% Reduction
Annual Electric Energy	195,221	kWh	24%
Annual Electric Demand	68.6	kW	25%
Annual Natural Gas	(594)	therms	-6%
Annual Utility Cost Savings	25,821	$	21%

Note: Electric savings presented in Table 1 does not include onsite electric generation potential from installation of solar PV panels.

2.1 Overall Opportunity Summary

Salem County Courthouse

The table below presents the projected savings for Salem County Courthouse.

Table 2:Projected Overall Savings

Measure		Annual Estimated Savings				CO_2 Emission Savings (tCO_2e)	Estimated Implementation Cost ($)	Estimated Simple Payback Period (Years)
Meas. No.	Description	Electricity (kWh)	Annual Demand (kW)	Natural Gas (Therms)	Cost Savings ($)			
ECM – 1	LED Lighting Upgrades - Interior	118,445	39.2	-951	$14,987	29.2	$202,905	13.5
ECM – 2	LED Lighting Upgrades - Exterior	442	0.0	0	$60	0.1	$2,404	40.1
ECM – 3	Replace Existing AHUs and Convert CAV System to VAV System	7,497	17.0	91	$1,123	2.6	$511,020	455.2
ECM – 4	Install VFDs on Heating Hot Water Pumps	9,396	0.0	-107	$1,153	2.1	$71,875	62.4
ECM – 5	Install VFDs on Chilled Water Pumps	30,377	10.9	0	$4,124	8.8	$85,119	20.6
ECM – 6	Implement Vending Machine Miser Controls	388	0.1	0	$53	0.1	$2,454	46.6
ECM – 7	BMS Upgrade	16,503	0.0	356	$2,650	6.7	$204,390	77.1
ECM – 8	Install Energy Efficient Transformers	12,173	1.4	0	$1,653	3.5	$24,846	15.0
ECM – 9	Install Low-Flow DHW Devices	0	0.0	17	$19	0.1	$348	18.2
ECM - 10	Install Solar PV Panel	59,250	50.0	0	$5,082	17.1	$0	0.0
Total		**195,221**	**68.6**	**-594**	**$25,821**	**53.3**	**$1,105,361**	**43**

[1] All energy savings accounts for interactive effects of each measure.

[2] Potential for onsite electricity generation (ECM-10) is not included in the “Total” row.

2.2 Site Background Information

Salem County Courthouse

Project Name:	Salem County Courthouse
Location:	92 Market St, Salem, NJ 08079
Building Type:	Courthouse
Occupancy Type:	Office (Based on eQuest model)
Conditioned Building Area:	Approximately 44,183 sq. ft. (Estimated based on eQuest model)
Owner:	Salem County
Year Built:	1968
Hours of Operation:	Weekday- 8:30 AM to 4:30 PM, Weekends- Closed

2.3 Site Description

Salem County Courthouse (SCC) is located at 92 Market St, Salem, NJ 08079. The facility consists of two floors. The building includes offices, courtrooms, break areas, conference and meeting rooms, corridors, restrooms, storage space, stairwells, and electric and mechanical rooms.

2.4 Local Climate Conditions

Local climate is an important factor in a building's energy use. Outdoor temperatures affect the building envelope and drive heat transfer through the "skin" of the building. Outdoor temperatures also dictate the energy required to condition fresh air that is drawn into the building for occupant ventilation, which is typically a large portion of the overall heating and cooling load for this type of buildings. Outdoor weather conditions also determine the types of technologies and systems that will be effective in an HVAC system. The following design conditions apply.

Location: Salem, New Jersey

Cooling Season Design Condition: 90.4° F Dry Bulb / 73.3° F Wet Bulb

Heating Season Design Condition: 14.8° F Dry Bulb

In Pilesgrove, the summers are warm and humid, the winters are very cold, and it is wet and partly cloudy year-round. Over the course of the year, the temperature typically varies from 26 °F to 86 °F and is very rarely below 13°F or above 94°F.

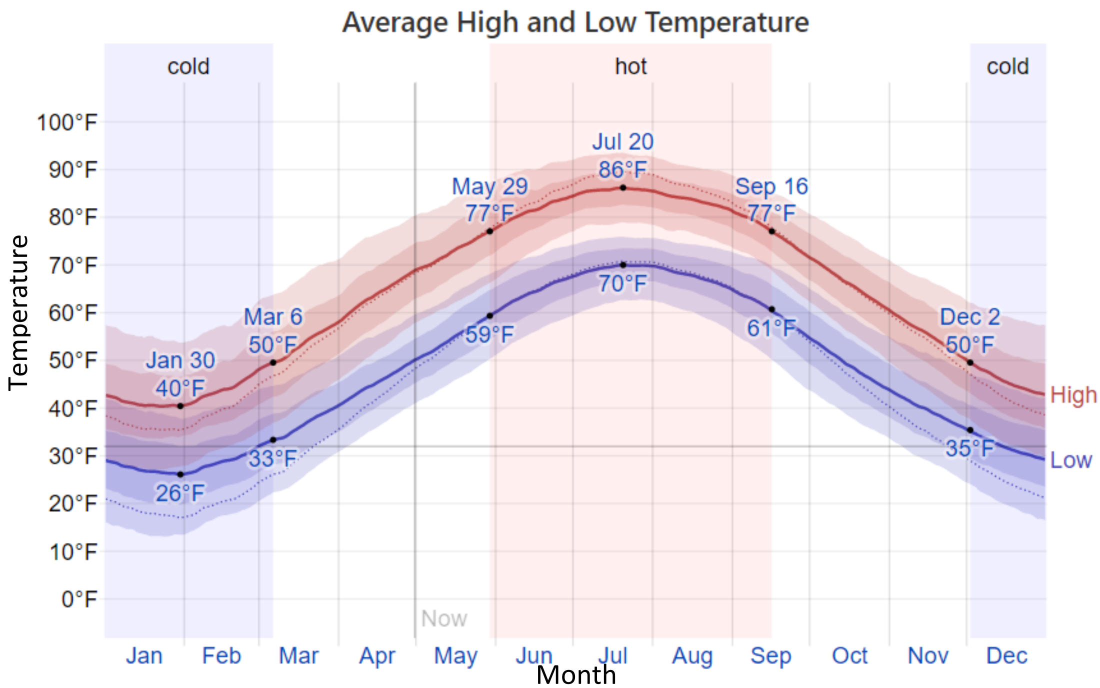

Figure 1: Historical Weather Conditions for Salem, NJ

2.5 Envelope

Building walls are rick masonry over wooden frame. There is a section of the roof that is flat and covered with a membrane and a low pitch portion with asphalt shingles. The roof is in fair condition. The operable windows are single pane with storm window. The glass-to-frame seals and operable and window weather seals are in fair condition. Exterior doors are wooden with wooden frames and have adequate door seals.

2.6 Building Occupancy & Usage

Salem County Courthouse is occupied year-round. Offices in the administration area are occupied Weekdays from 8:30 AM to 4:30 PM.

Table 3: Building Schedule

Building Name	Weekday/Weekend	Operating Schedule
Courthouse	Weekday	8:30 am – 4:30 pm
	Weekend	Closed

2.7 Building Systems Description

Heating, ventilating and air-conditioning (HVAC) is provided for conditioned spaces. The HVAC systems maintain a comfortable environment in the building and provide required ventilation to meet occupancy. This section describes the main systems in the facility, which include HVAC systems, domestic hot water system, and lighting.

2.7.1 Heating Hot Water System

The heating hot water system consists of four (4) 750 MBH input capacity, gas-fired, condensing hot water boilers. The hot water supply temperature setpoint is maintained at 180 ºF. According to the site personnel, during peak heating season, hot water is typically generated using three boilers. Based on the visual inspection and information obtained from the site personnel, the boilers, in general, are in good operating condition and appeared to be well maintained. The boilers were installed in 2010 and are within their useful service life.

The burners on the boilers are controlled with a high fire/low fire sequence. Based on the set-points, burners switch between the low-fire and high-fire stages to meet the needs of the facility. According to building operators, the boilers have no outside air heating hot water reset control.

Table 4: Boiler Schedule

Tag	Manufacturer	Model #	Year Installed	Natural Gas Input (MBH)	Output (MBH)	Description
Boiler No. 1	Weil-Mclain	Ultra 750	2010	750	702	Gas-fired boiler
Boiler No. 2	Weil-Mclain	Ultra 750	2010	750	702	Gas-fired boiler
Boiler No. 3	Weil-Mclain	Ultra 750	2010	750	702	Gas-fired boiler
Boiler No. 4	Weil-Mclain	Ultra 750	2010	750	702	Gas-fired boiler

Figure 2: Two (2) 750 MBH Gas-Fired Boilers

2.7.2 Central Chiller Plant

Chiller

All cooling at Salem County courthouse is provided via chilled water produced by the central chiller plant. The central chiller plant has a multi-stack chiller with four modules rated capacity of 186 tons. The central chiller plant also serves the admin building adjacent to the courthouse. The admin building is similar in size to the courthouse and estimated to have similar cooling load as the courthouse.

Table 5: Chiller Schedule

Tag	Manufacturer	Model #	Year Installed	Capacity (tons)	Description
Chiller #1	Multistack	MS50X6H2W1-R410A	2010	186.3	Water-Cooled Chiller
Chiller #2	Multistack	MS50X6H2W1-R410A	2010		Water-Cooled Chiller
Chiller #3	Multistack	MS50X6H2W1-R410A	2010		Water-Cooled Chiller
Chiller #4	Multistack	MS30X6H2W1-R410A	2010		Water-Cooled Chiller

Figure 3: Multistack Chiller

Heat Rejection

The cooling tower (CTs) providing heat rejection for the central chiller plant is located on the roof of the courthouse. The heat rejection plant consists of one 230-ton, single cell, counter-flow, open-circuit cooling tower manufactured by Evapco (CT-1). The cooling tower cell has one 10-hp fan motor. The cooling tower fan motor is, equipped with variable frequency drive and controlled to maintain condenser water supply temperature set point of 72°F

Table 6: Cooling Tower Schedule

Tag	Manufacturer	Model #	Year Installed	Capacity (tons)	CT Fan HP	Description
CT-1	Evapco	UT-19-78	2010	230	10	Open-circuit cooling tower

Figure 4: Multistack Chiller

2.7.3 Hydronic Distribution System

The hydronic distribution system for the SCC consists of a heating hot water system, chiller water system and condenser water system. Pipe insulation appeared to be in good condition. The chilled water system in a constant flow primary and constant flow secondary distribution with two (2) 10 hp constant speed primary pumps and two (2) 3 hp constant speed secondary pumps. There are two (2) additional 7.5 hp constant speed secondary pumps that supply chilled water to the admin building. The hot water system is configured in a constant flow primary distribution with two (2) 5 hp constant speed hot water pumps operating in a lead-lag control sequence. The boilers provide hot water to radiators, air handling units and unit ventilators throughout the building. Table 7 below summarizes the inventory of the pumps at the facility.

Table 7: Pump Schedule

Tag	Location	Service	Make	Motor HP	Motor Eff (%)	Pup Flow (GPM)	Speed Control
HWP-1	Boiler Room	Hot Water Loop	Baldor	5	89.5%	170	Constant
HWP-2	Boiler Room	Hot Water Loop	Baldor	5	89.5%	170	Constant
CHWP-1	Boiler Room	Primary CHW	Baldor	10	92%	350	Constant
CHWP-2	Boiler Room	Primary CHW	Baldor	10	92%	350	Constant
CHWP-3	Boiler Room	Secondary CHW	Baldor	7.5	91%	160	Constant
CHWP-4	Boiler Room	Secondary CHW	Baldor	7.5	91%	160	Constant
CHWP-5	Boiler Room	Secondary CHW	Baldor	3	90%	100	Constant
CHWP-6	Boiler Room	Secondary CHW	Baldor	3	90%	100	Constant
CWP-1	Boiler Room	CW Loop	Baldor	15	93%	540	Constant
CWP-2	Boiler Room	CW Loop	Baldor	15	93%	540	Constant

2.7.4 HVAC Units

Air Handling Units

SCC has Eight (8) air handling units located in the penthouse. Majority of the air handling units serve the courthouse or open office space. These units have hot water coils and chilled water coils. These units appeared in poor condition and beyond its useful service life. Facility staff reported issues with dampers on most of the units. The evaporator coils were dirty and signs of corrosion on unit casing was observed.

Figure 5: AC-6 serving Law Library

Table 8: AHU Units Schedule

Tag	Manufacturer	Location	Area served	Cooling System Type	Heating System Type	Cooling Capacity (MBH)	Heating Capacity (MBH)	System Type	Year Installed
AC-1	Nesbitt	Penthouse	Supreme Court Waiting Room 2nd FL	Chilled Water	HW	123	138	Air Handling Units	1980
AC-2	Nesbitt	Penthouse	Freehold Room 1st FL	Chilled Water	HW	94.5	135	Air Handling Units	1980
AC-3	Nesbitt	Penthouse	Jury Management	Chilled Water	HW	126.5	125	Air Handling Units	1980

Tag	Manufacturer	Location	Area served	Cooling System Type	Heating System Type	Cooling Capacity (MBH)	Heating Capacity (MBH)	System Type	Year Installed
AC-4	Nesbitt	Penthouse	Treasurer & Civic Office 1st FL	Chilled Water	HW	94	124	Air Handling Units	1980
AC-5	Nesbitt	Penthouse	Sheriff's Lunchroom	Chilled Water	HW	35.4	22	Air Handling Units	1980
AC-6	Nesbitt	Penthouse	Criminal Management Office 2nd FL	Chilled Water	HW	107	150	Air Handling Units	1980
AC-7	Nesbitt	Penthouse	Court Room 2 & 3 2nd FL	Chilled Water	HW	214	230	Air Handling Units	1980
AC-8	Nesbitt	Penthouse	Court Room 1 2nd FL	Chilled Water	HW	143	158	Air Handling Units	1980

[*] Unit heating capacity data could not be extracted from the unit nameplate.

Unit Ventilators

Most offices are conditioned by unit ventilators that supply heating and cooling to the zones. There is a total of thirty-eight (38) unit ventilators in the building. While a handful of these units were replaced due to failures in 2010. These unit ventilators have supply fan motors, outside air dampers, and three-way valves on the heating hot water and chilled water coils.

Table 9: AHU Units Schedule

Tag	Location	Area served	Cooling System Type	Heating System Type	Cooling Capacity (MBH)	Heating Capacity (MBH)	System Type	Year Installed
1	B5	B5	Chilled Water	HW	36.5	40.0	Unit Ventilator	-
2	B5	B5	Chilled Water	HW	36.5	40.0	Unit Ventilator	-
3	B6	B6	Chilled Water	HW	46.8	48.0	Unit Ventilator	-
4	B6	B6	Chilled Water	HW	46.8	48.0	Unit Ventilator	-
5	B7	B7	Chilled Water	HW	40.5	40.0	Unit Ventilator	-
6	B7	B7	Chilled Water	HW	40.5	40.0	Unit Ventilator	-
7	B8	B8	Chilled Water	HW	66.0	70.0	Unit Ventilator	-
8	B17	B17	Chilled Water	HW	57.8	48.0	Unit Ventilator	-
10	106	106	Chilled Water	HW	18.9	-	Unit Ventilator	-
9	106	106	Chilled Water	HW	21.5	23.0	Unit Ventilator	-
11	108	108	Chilled Water	HW	16.0	16.5	Unit Ventilator	-
12	111	111	Chilled Water	HW	17.9	20.0	Unit Ventilator	-
13	113	113	Chilled Water	HW	9.3	12.0	Unit Ventilator	-
14	114	114	Chilled Water	HW	9.8	10.0	Unit Ventilator	-
15	115	115	Chilled Water	HW	9.8	10.0	Unit Ventilator	-
16	116	116	Chilled Water	HW	20.5	32.0	Unit Ventilator	-
17	118	118	Chilled Water	HW	40.0	34.5	Unit Ventilator	-
24	118	118	Chilled Water	HW	13.5	-	Unit Ventilator	-
18	120	120	Chilled Water	HW	9.8	11.0	Unit Ventilator	-
19	121	121	Chilled Water	HW	38.4	36.5	Unit Ventilator	-

Tag	Location	Area served	Cooling System Type	Heating System Type	Cooling Capacity (MBH)	Heating Capacity (MBH)	System Type	Year Installed
20	123	123	Chilled Water	HW	23.1	21.0	Unit Ventilator	-
21	123	123	Chilled Water	HW	32.0	29.0	Unit Ventilator	-
23	123	123	Chilled Water	HW	17.2	-	Unit Ventilator	-
22	124	124	Chilled Water	HW	14.3	14.0	Unit Ventilator	-
25	128	128	Chilled Water	HW	30.3	30.0	Unit Ventilator	-
26	138	138	Chilled Water	HW	17.9	20.0	Unit Ventilator	-
27	139	139	Chilled Water	HW	23.1	20.5	Unit Ventilator	-
28	207	207	Chilled Water	HW	30.2	28.0	Unit Ventilator	-
37	215	215	Chilled Water	HW	9.6	-	Unit Ventilator	-
29	217	217	Chilled Water	HW	22.0	25.0	Unit Ventilator	-
30	217	217	Chilled Water	HW	22.0	25.0	Unit Ventilator	-
31	220	220	Chilled Water	HW	23.1	22.0	Unit Ventilator	-
32	221	221	Chilled Water	HW	21.5	21.0	Unit Ventilator	-
33	221	221	Chilled Water	HW	21.5	21.0	Unit Ventilator	-
34	223	223	Chilled Water	HW	23.1	22.0	Unit Ventilator	-
35	226	226	Chilled Water	HW	22.0	25.0	Unit Ventilator	-
36	226	226	Chilled Water	HW	22.0	25.0	Unit Ventilator	-
38	232	232	Chilled Water	HW	8.4	7.5	Unit Ventilator	-

2.7.5 Building Management System

Salem county Courthouse has a Siemens building management system. The Siemens system controls the boilers and heating system, the chiller and chilled water system, air handling unit and light for each of the rooms. The boilers are enabled when the outdoor air temperature is below ~56°F. The chiller is enabled when the outdoor air temperature is above ~58°F.

This BMS is capable of controlling equipment scheduling and heating water loop temperatures, and chilled water loop temperatures. The BMS has limited control capabilities of the air handling units.

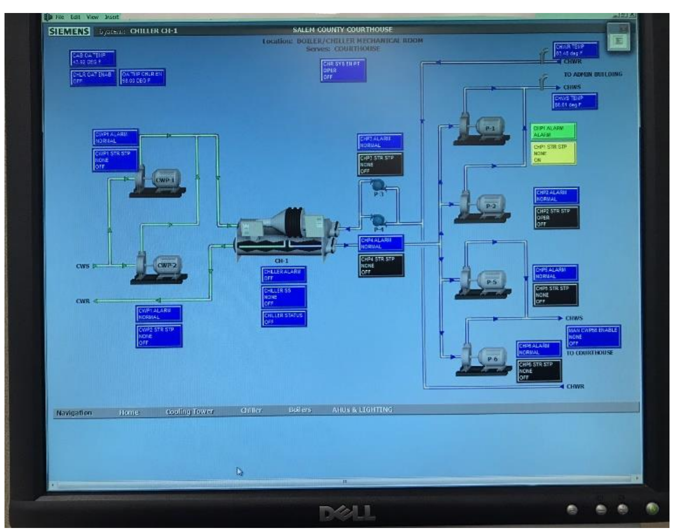

Figure 6: Building BMS

2.7.6 Domestic Hot Water

Hot water is produced with one (1) 40 gal electric storage tank Rheem water heater. This serves all of the building's domestic hot water needs including restrooms and kitchen load. The domestic hot water pipes are insulated, and the insulation is in good condition.

Figure 7: DHW-1 Boiler Room

Table 10. Existing Domestic Hot Water Heater

Tag	Manufacture	Year Installed	Model Number	Location	Storage Capacity (Gal)
DHW-1	Rheem	2010	1PZ74	Boiler Room	40

2.7.7 Lighting Systems

Salem County Courthouse uses a variety of interior fixtures throughout the building. The most prevalent lamp type used in the facility is 4-feet 32-watt linear fluorescent T8 lamps in fixtures equipped with 2, 3 or 4 lamps per fixture. There are also compact fluorescent and incandescent lamps used for interior lighting. Additionally, there are several 40-Watt T12 fixtures which use magnetic ballasts.

2.8 Utility Bill Energy Use Summary

A summary of monthly utility consumption and costs for Salem County Courthouse was analyzed for the 12-month period between July 2018 and June 2019. This summary is useful for understanding the various uses of energy and the annual variation in energy usage. The total electricity consumed by the facility in the analyzed period was 832,960 kWh. Additionally, the facility also consumed 9,987 therms of natural gas based on the utility bills provided by the facility.

The utility cost data was used to determine a blended rate. The blended rate is the overall annual rate per unit of consumption that the facility pays for electricity and natural gas. The blended rate is determined by dividing the total electric/natural gas cost for a time period by the total electric/natural gas consumption in kWh/therms for the same time period.

The blended rate for electricity was determined to be $0.135 per kilowatt-hour. The blended rate for natural gas was determined to be $1.151 per therm.

Table 11: Base Building Energy Consumption and Costs (7/2018 – 6/2019)

Energy Type	Total Annual Use	Units	kBTU	% Energy	Total Annual Cost ($)	% Cost	kBTU/SF	$/SF
Electricity	815,040	kWh	2,780,916	74%	$110,660	91%	66.59	$2.65
Natural Gas	9,997	Therms	999,458	26%	$11,516	9%	23.93	$0.28
Total			**3,780,375**	**100%**	**$122,175**	**100%**	**90.53**	**$2.93**

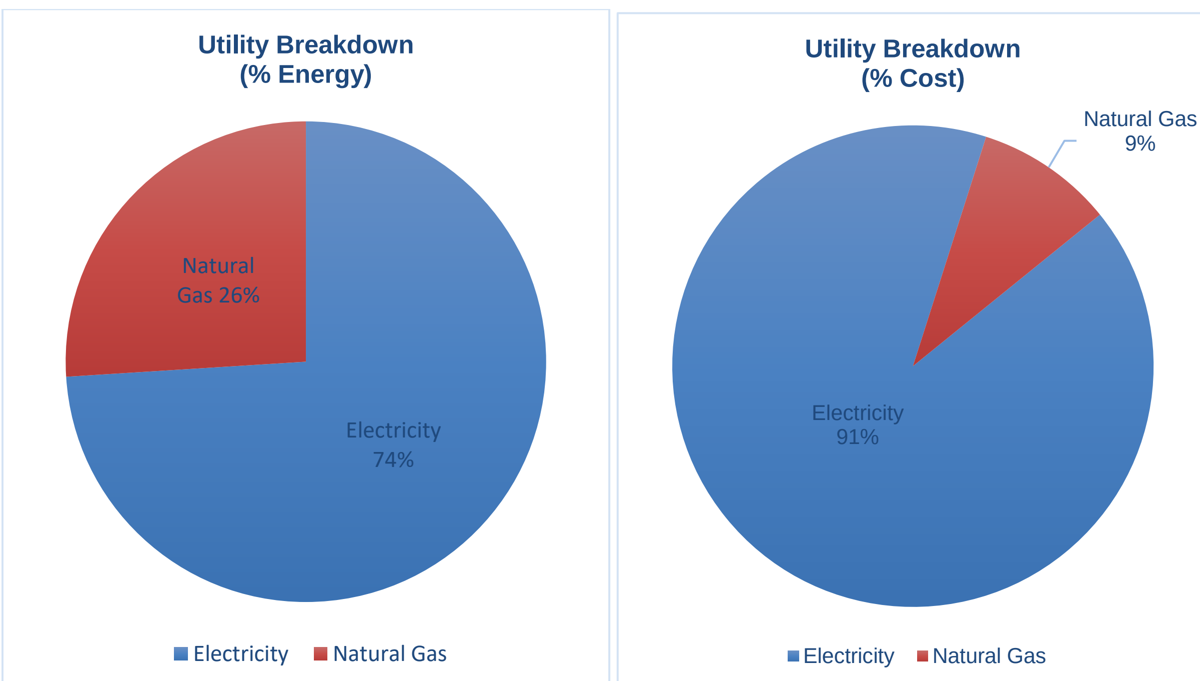

Figure 8: Utility Breakdown (7/2018 – 6/2019)

Table 12: Unit Energy Cost Summary (7/2018 – 6/2019)

Utility	Blended Rate	Rate Units
Electric	$0.135	$/kWh
Natural Gas	$1.151	$/Therms

2.8.1 Electric Energy Usage

The facility's electric energy usage for the period of June 2018 through May 2019 was 815,040 kWh, with a peak demand of 280 kW. Peak electric demand is occurred in July when the facility experiences the highest cooling load.

Table 13: Electric Energy Usage (6/2018 – 5/2019)

Month-Year	Usage (kWh)	Demand (kW)	Total Electric Cost
Jun-18	79,200	219	$10,496
Jul-18	94,240	232	$11,984
Aug-18	111,360	280	$14,374
Sep-18	118,880	266	$15,552
Oct-18	85,600	226	$10,376
Nov-18	44,000	224	$6,386
Dec-18	38,720	224	$5,891
Jan-19	44,960	224	$6,778
Feb-19	37,600	224	$5,561
Mar-19	38,560	224	$5,726
Apr-19	41,760	224	$6,342
May-19	80,160	261	$11,195
Total/Peak	**815,040**	**Max: 280**	**$110,660**

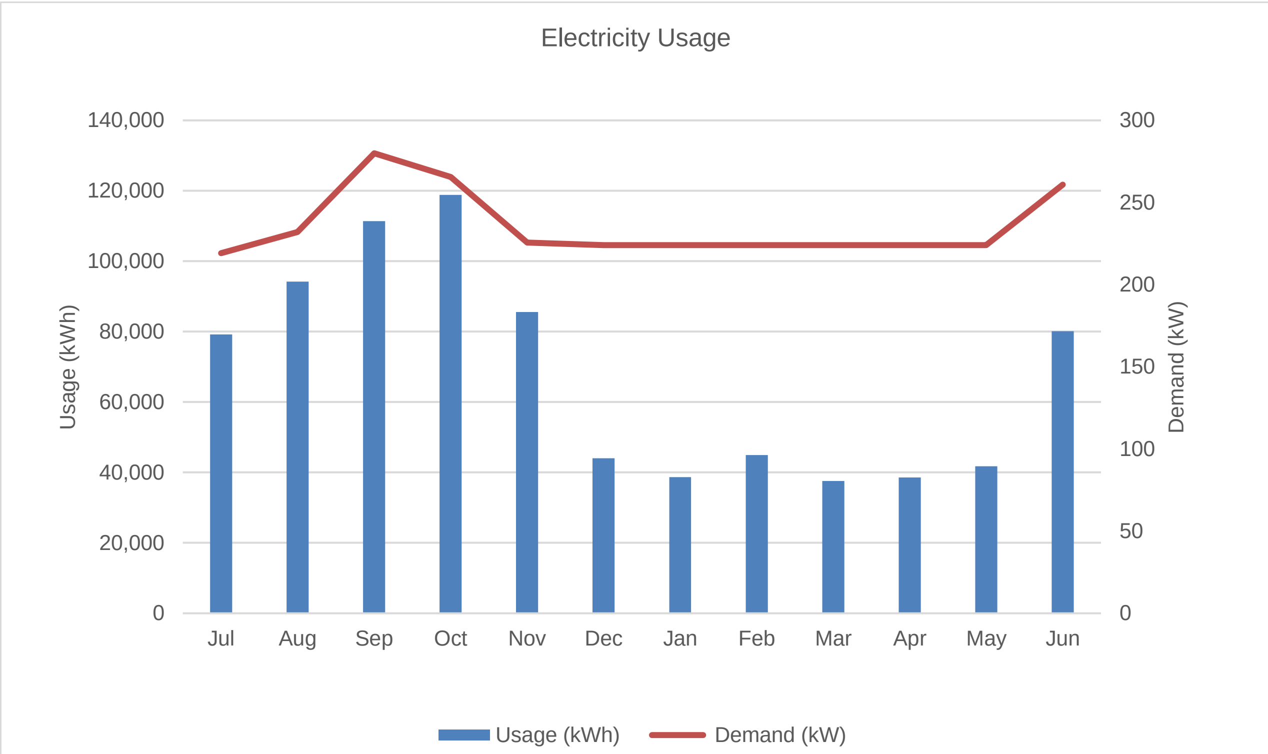

Figure 9: Electric Energy Usage Data (6/2018 – 5/2019)

2.8.2 Natural Gas Usage

The facility's total natural gas usage for the period of June 2018 through May 2019 was 9,997 therms. Majority of the natural gas consumption occurs during winter season as the boilers are utilized for space heating.

Table 14. Natural Gas Energy Use (6/2018 – 5/2019)

Month-Year	Usage (Therms)	Total Gas Cost
Jun-18	10	$18
Jul-18	0	$0
Aug-18	0	$0
Sep-18	0	$0
Oct-18	0	$0
Nov-18	578	$675
Dec-18	1,159	$1,335
Jan-19	2,714	$3,123
Feb-19	2,465	$2,830
Mar-19	2,510	$2,882
Apr-19	498	$577
May-19	62	$74
Total	**9,997**	**$11,516**

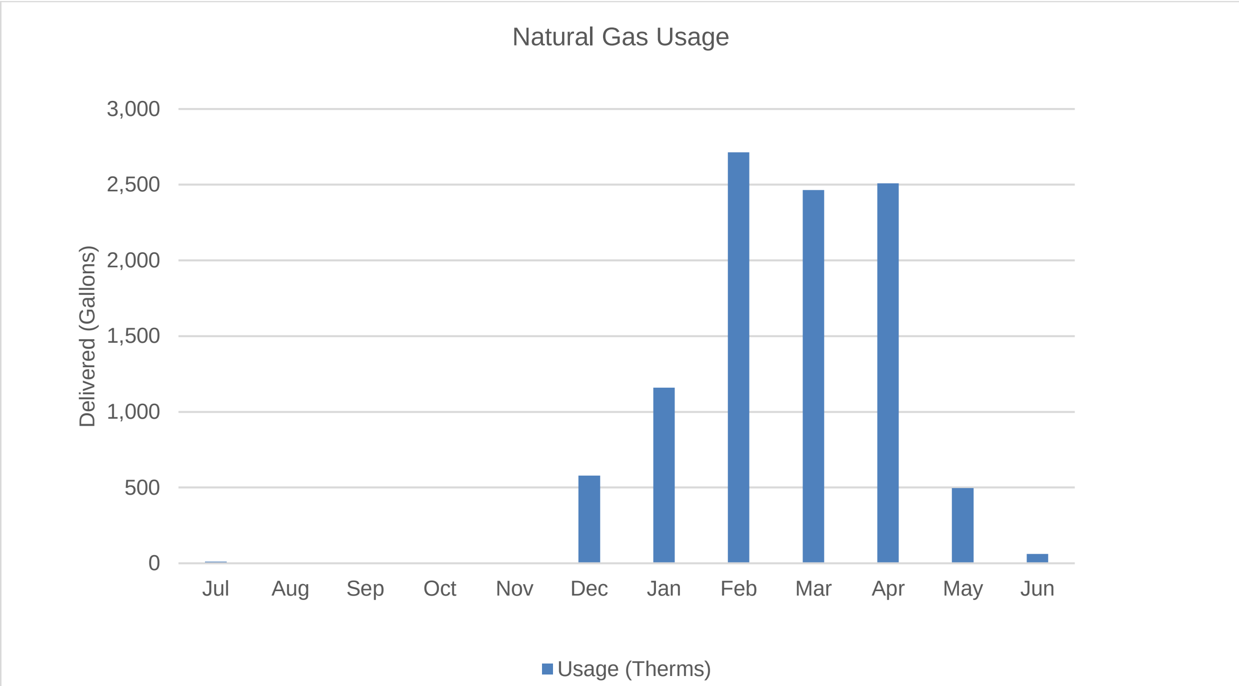

Figure 10: Natural Gas Usage Data (6/2018 – 5/2019)

2.9 Energy End Use Breakdown

The tables below summarize the existing annual electric and natural gas end usage within the buildings. The end use breakdown is based on the eQuest Model. The eQuest baseline model was calibrated to the actual facility energy consumption using utility bills for electric and natural gas consumption. The figures and tables in this section shows an estimated distribution of electric and natural gas usage among the building systems. This breakdown is based on the energy model and, as a result, may vary from the site's actual energy distribution.

Table 15: End Use Breakdown Summary

End Use Type	Electricity	Electricity Usage	Natural Gas	Natural Gas Usage	Total Site Energy	Total Usage
	(kWh)	(%)	(therms)	(%)	(kBTU)	(%)
Lighting	220,080	35%	0	0%	751	22%
Misc Equip	108,490	17%	0	0%	370	11%
Primary heating	730	0%	12,629	100%	1,265	37%
Primary cooling	83,440	13%	0	0%	285	8%
Pumps & Aux	69,580	11%	0	0%	237	7%
Vent Fans	135,970	22%	0	0%	464	14%
Domestic Hot WTR	9,250	1%	0	0%	32	1%
Exterior Light	1,220	0%	0	0%	4	0%
Total Estimated	628,760	100%	12,629	100%	3,408	100%

2.9.1 Electric End Use Breakdown

Approximately, 46% of the electrical energy used in the building was dedicated to HVAC use (fans, pumps & auxiliary equipment, cooling & heating) with lighting accounting for another 36% (interior light and exterior light). The remaining 18% was used for miscellaneous equipment and other process equipment.

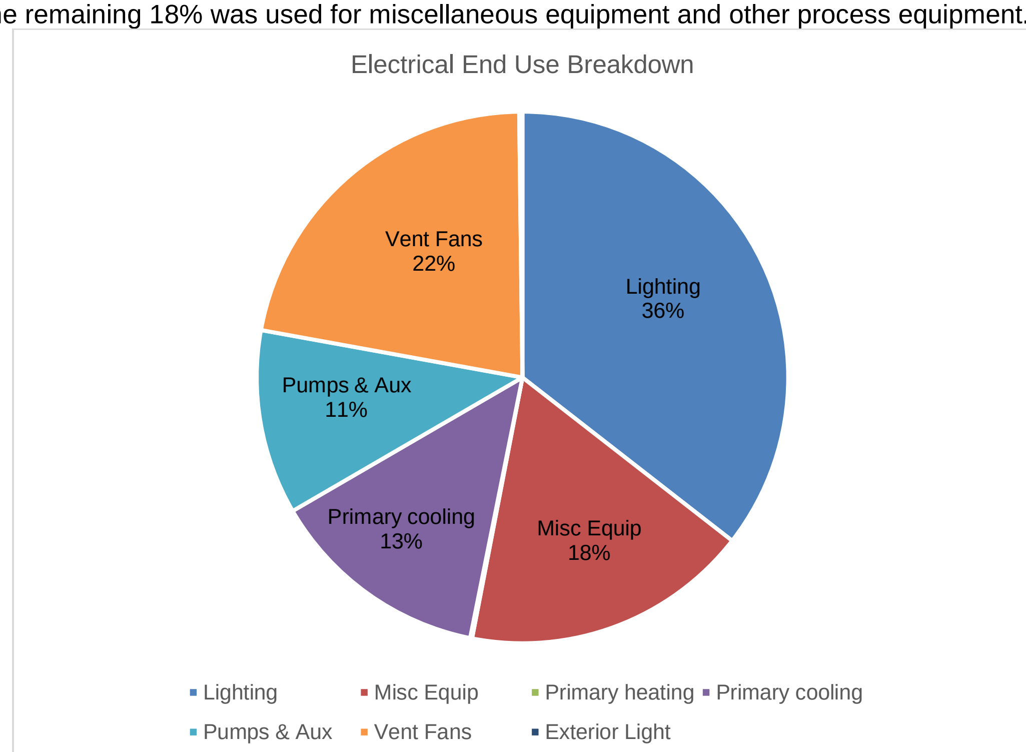

Figure 11: Electric End Use Breakdown

2.9.2 Natural Gas End Use Breakdown

Space heating accounted for approximately 100% of the facility's natural gas usage. Domestic hot water generation is done via electric water heater.

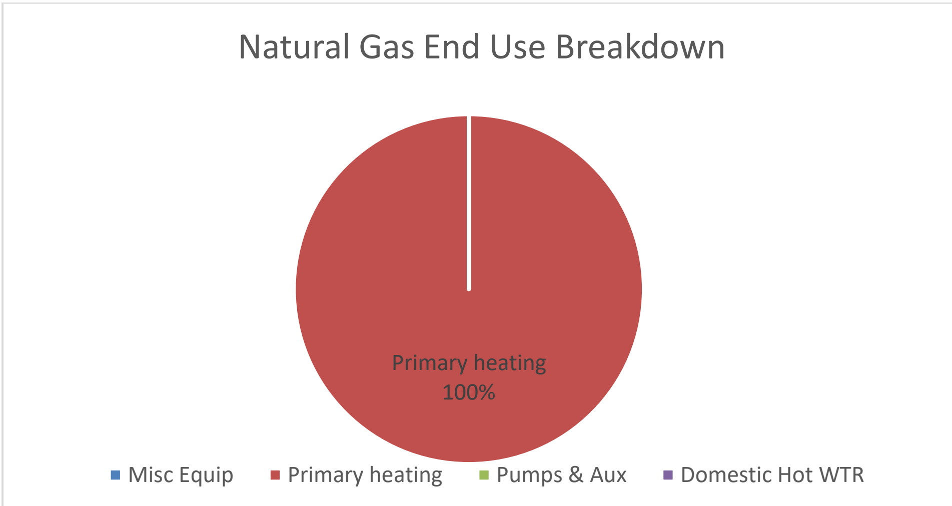

Figure 12: Natural gas End Use Breakdown

2.9.3 Total Energy Use Breakdown

The conversion of each utility's consumption to a common energy unit, kBTU, allows for a total energy end use breakdown to be estimated. The figures below show an estimated distribution of energy usage among the building systems. This breakdown is based on the project energy model and, as a result, may vary from the site's real distribution.

Space heating accounted for approximately 37% of the energy usage, domestic hot water generation: 1%, space cooling: 8%, lighting: 22%, miscellaneous equipment: 11%, pumps & auxiliary: 7%, ventilation fans; 14%.

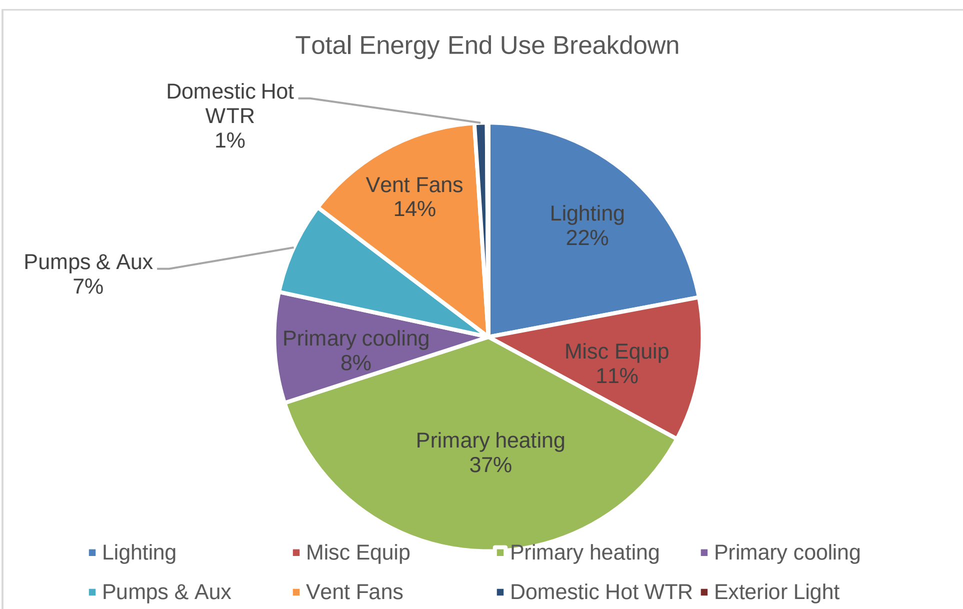

Figure 13: Total Energy Use Breakdown

2.9.4 Average Energy Cost

The average energy cost per square foot was calculated by dividing the total cost of all utilities – electric, and natural gas by the total conditioned area of the facility.

Table 16: Average Energy Cost per Square Foot

Total Conditioned Area in SF	kBTU	Total Annual Cost ($)	$/SF
41,760	3,780,375	$122,175	$2.93

Note: Each conditioned space was created in the eQuest energy model using the floor plan drawings provided by the facility. eQuest model was used to estimate the total conditioned area.

2.10 Peer Group Benchmarking

Willdan uses the U.S. Environmental Protection Agency (EPA) Portfolio Manager to rate the building on a scale of 1 to 100, as defined by its Energy Star score. This score compares a property under consideration to similar properties nationwide. The building is compared using a database of similar buildings from a national survey conducted by the Department of Energy. An Energy Star score of 50 indicates that the building, from an energy consumption standpoint, performs better than 50% of all similar buildings nationwide, while a rating of 75 indicates that the building performs better than 75% of all similar buildings nationwide.

2.10.1 Current EUI

The Site Energy Use Intensity (EUI) is the amount of heat and electricity consumed by a building, as commonly reflected in utility bills, divided by the facility's conditioned square footage. The Source EUI is the total amount of natural gas consumed in the generation and use of energy consumed at a building, such as electricity and Natural Gas, divided by the facility's square footage. A facility's site and source EUI can be obtained from the Statement of Performance (SOP). The SOP for this facility has been reiterated in table below. It incorporates generation, transmission, and storage losses, thereby enabling a complete assessment of energy use in a building.

The utility bills and other information gathered during the energy audit process were analyzed to obtain the site and source EUIs of the existing facility. The site and source U.S. Median EUIs mentioned below have been obtained from the EPA Portfolio Manager.

The Site Energy Use Intensity (EUI) for Salem County Courthouse is 88.9 kBTU/SF, as compared to a national median EUI for similar buildings of 62.8 kBTU/SF. The Source EUI for the facility is 200.6 kBTU/SF, as compared to a national median EUI for similar buildings of 146.9 kBTU/SF. The following is a summary of the Portfolio Manager's results for the facility:

Table 17: Benchmarking EUI

Benchmarking*	This Facility	National Median
Site Energy Use Intensity (EUI kBTU/sf/yr)*	88.9	62.8
Source Energy Use Intensity (EUI kBTU/sf/yr)*	200.6	146.9
Energy Star Score	22	50

* From EPA Portfolio Manager, Building Type: Prison/Incarceration.

3. Energy Efficiency Measures

The goal of this audit report is to identify and evaluate potential energy efficiency improvements, provide information about the cost effectiveness of those improvements, and recognize potential financial incentives from NJBPU as part of the final report.

The baseline for facility was obtained from monthly utility bills, equipment schedules, electric and natural gas usage data and other industry standard sources such as ASHRAE. This information was then analyzed against the local weather data. An energy models were developed for the baseline of the facility utilizing eQuest, which performs detailed hourly simulations of energy use in buildings as a function of building construction, building systems, and general building and occupant activity. The simulation provides expected energy consumption, which is then calibrated to the utility data, as necessary.

Energy consumption associated with each measure was analyzed based on the technical performance of the recommended measure. It was then compared to the corresponding baseline energy consumption data to determine the resulting energy savings. Energy cost savings for each measure was determined using the projected energy savings and blended energy rates obtained from the utility information provided by the facility.

The following were assumed when calculating the energy savings:

- Building energy usage patterns will remain relatively unchanged in the near future (no significant occupancy changes and/or space conversion).
- Energy costs will remain relatively stable in near future.
- Building system operation will remain relatively unchanged (unless a change is related to a recommended ECM).
- All energy cost savings are based on blended rates. Actual cost savings can vary based on utility tariff structures and demand charges.

An economic analysis was performed for each measure using historical implementation cost estimates from industry standard sources, data obtained from similar projects and pricing solicited from vendors. Energy cost savings and implementation costs for each ECM were used to determine a simple payback associated with each measure. The calculations account for interacting effects between various system components.

Table 18 below presents a summary of energy-conservation measures. Payback in this report refers to simple payback associated with the implementation of each measure.

Salem County Courthouse

Willdan performed a detailed audit of Salem County Courthouse. The facility's management provided extensive information, facility access, and made facility engineers available. This allowed for Willdan to determine ECM recommendations. The ECMs, energy savings, and cost savings are shown in the table below.

Table 18: Projected Overall Savings

Measure		Annual Estimated Savings				CO_2 Emission Savings (tCO_2e)	Estimated Implementation Cost ($)	Estimated Simple Payback Period (Years)
Meas. No.	Description	Electricity (kWh)	Annual Demand (kW)	Natural Gas (Therms)	Cost ($)			
ECM - 1	LED Lighting Upgrades - Interior	118,445	39.2	-951	$14,987	29.2	$202,905	13.5
ECM - 2	LED Lighting Upgrades - Exterior	442	0.0	0	$60	0.1	$2,404	40.1
ECM - 3	Replace Existing AHUs and Convert CAV System to VAV System	7,497	17.0	91	$1,123	2.6	$511,020	455.2
ECM - 4	Install VFDs on Heating Hot Water Pumps	9,396	0.0	-107	$1,153	2.1	$71,875	62.4
ECM - 5	Install VFDs on Chilled Water Pumps	30,377	10.9	0	$4,124	8.8	$85,119	20.6
ECM - 6	Implement Vending Machine Miser Controls	388	0.1	0	$53	0.1	$2,454	46.6
ECM - 7	BMS Upgrade	16,503	0.0	356	$2,650	6.7	$204,390	77.1
ECM - 8	Install Energy Efficient Transformers	12,173	1.4	0	$1,653	3.5	$24,846	15.0
ECM - 9	Install Low-Flow DHW Devices	0	0.0	17	$19	0.1	$348	18.2
ECM - 10	Install Solar PV Panel	59,250	50.0	0	$5,082	17.1	$0	0.0
Total		**195,221**	**68.6**	**-594**	**$25,821**	**53.3**	**$1,105,361**	**43**

* All energy savings were calculated accounted for the interacting effects between various system components.

4.1 Energy Efficiency Measure Descriptions

ECM-1: LED Lighting Upgrades - Interior

Existing Conditions

Salem County Courthouse uses a variety of interior fixtures throughout the building. The most prevalent lamp type used in the facility are 4-feet 32-watt linear fluorescent T8 lamps in fixtures equipped with 2, 3 or 4 lamps per fixture. There are also compact fluorescent and incandescent lamps used for interior lighting. Additionally, there are several 40-Watt T12 fixtures which use magnetic ballasts.

ECM Description

Willdan recommends retrofitting fixtures with T8 and T12 lamps with the more efficient Linear LED tubes. The existing compact fluorescent and incandescent lamps will be replaced with compatible LED replacements. In addition to electric usage and demand savings, maintenance savings may also be achieved since LED lamps last longer than other light sources and therefore do not need to be replaced as often. All recommended lighting is DLC and/or Energy Star compliant.

Measure Baseline and Proposed Upgrades

Baseline

- Existing fluorescent and incandescent lamps

Proposed

- High-efficiency LED lighting fixtures

Calculation Methodology

ECM-1 energy savings have been calculated using eQuest. A full space-by-space lighting audit is completed to identify the baseline and the calculated lighting power density is used to calculate the baseline lighting energy consumption. A compatible LED replacement is selected for each fixture/lamp type in the facility.

Energy Savings Metrics: Cost Savings

Table 19: ECM-1 Summary Table

Electric Usage Savings	118,445	kWh
Electric Annual Demand Savings	39.2	kW
Electric Cost Savings	16,081	$
Natural Gas Usage Savings	-951	therms
Natural Gas Cost Savings	-1,095	$
Total MMBTU Savings	309	MMBtu
Total Cost Savings	14,987	$
Estimated Installation Cost	202,905	$

Design Considerations

- Integration with lighting controls.
- Emergency lighting.

Maintenance Considerations

- Lamps/fixtures and associated ballasts shall be maintained as part of ongoing maintenance efforts by the facility engineers.

ECM-2: LED Lighting Upgrades - Exterior

Existing Conditions

Salem County Courthouse has very few exterior fixtures. Most of the fixtures use screw-in bulbs which have been replaced with LED bulbs.

ECM Description

Willdan recommends replacing the existing lighting metal halide HID lamps with compatible LED retrofits. Fixtures equipped with incandescent, compact fluorescent lamps will also be replaced with plug-and-play LED lamps.

Measure Baseline and Proposed Upgrades

Baseline

- Existing metal halide, fluorescent and incandescent lamps

Proposed

- High-efficiency LED lighting.

Calculation Methodology

ECM-2 energy savings have been calculated using eQuest. A full exterior space lighting audit is completed to identify the baseline and the calculated total exterior lighting power is used to calculate the baseline lighting energy consumption. A compatible LED replacement is selected for each fixture/lamp type being recommended for upgrades

Energy Savings Metrics: Cost Savings

Table 20: ECM-2 Summary Table

Electric Usage Savings	442	kWh
Electric Annual Demand Savings	0.0	kW
Electric Cost Savings	60	$
Natural Gas Usage Savings	0	therms
Natural Gas Cost Savings	0	$
Total MMBTU Savings	2	MMBtu
Total Cost Savings	60	$
Estimated Installation Cost	2,404	$

Design Considerations

- Integration with lighting controls.
- Emergency lighting.

Maintenance Considerations

Lamps/fixtures and associated ballasts shall be maintained as part of ongoing maintenance efforts by the facility engineers.

ECM-3 Replace Existing AHUs and Convert CAV System to VAV System

Existing Conditions

The facility provides HVAC through a combination of AHUs and Unit Ventilator. Unit details including size, areas served, and age are discussed in the “HVAC Units” section.

ECM Description

Willdan recommends replacing eight (8) existing AHUs with two (2) new vibrable air volume AHUs. Replacing the AHUs units has a long payback period and may not be justifiable based simply on energy considerations. However, the units that are being recommended for replacement at this facility are nearing or have reached the end of their normal useful life. Along with the replacement of the AHUs, the spaces served by the AHUs will have variable air volume boxes which will improve space comfort while conserving energy.

Measure Baseline and Proposed Upgrades

Baseline

- Eight (8) existing consent volume AHUs:

Table 21: AHU Units Schedule

Tag	Manufacturer	Model	Location	Area served	Cooling System Type	Heating System Type	Cooling Capacity (MBH)	Heating Capacity (MBH)	System Type	Year Installed
AC-1	Nesbitt	-	Penthouse	Supreme Court Waiting Room 2nd FL	CHW	HW	123	138	Air Handling Units	-
AC-2	Nesbitt	-	Penthouse	Freehold Room 1st FL	CHW	HW	94.5	135	Air Handling Units	-
AC-3	Nesbitt	-	Penthouse	Jury Management	CHW	HW	126.5	125	Air Handling Units	-
AC-4	Nesbitt	-	Penthouse	Treasurer & Civic Office 1st FL	CHW	HW	94	124	Air Handling Units	-
AC-5	Nesbitt	-	Penthouse	Sheriff's Lunchroom	CHW	HW	35.4	22	Air Handling Units	-
AC-6	Nesbitt	-	Penthouse	Criminal Management Office 2nd FL	CHW	HW	107	150	Air Handling Units	-
AC-7	Nesbitt	-	Penthouse	Court Room 2 & 3 2nd FL	CHW	HW	214	230	Air Handling Units	-
AC-8	Nesbitt	-	Penthouse	Court Room 1 2nd FL	CHW	HW	143	158	Air Handling Units	-

[*] Unit heating capacity data could not be extracted from the unit nameplate.

Proposed

- Two (2) new high efficiency variable air volume AHUs.

Calculation Methodology

ECM-3 energy savings have been calculated using eQuest.

Energy Savings Metrics: Cost Savings

Table 22: ECM-3 Summary Table

Electric Usage Savings	7,497	kWh
Electric Annual Demand Savings	17.0	kW
Electric Cost Savings	1,018	$
Natural Gas Usage Savings	91	therms
Natural Gas Cost Savings	105	$
Total MMBTU Savings	35	MMBtu
Total Cost Savings	1,123	$
Estimated Installation Cost	511,020	$

Design Considerations

- Rigging & demolition of existing units.
- Scheduling of unit downtime during construction.
- Disposal of refrigerant.
- Integration with the existing BMS and existing distribution system.

Maintenance Considerations

- AHUs shall be maintained as per manufacturer’s guidelines.

ECM-4 Install VFDs on Heating Hot Water Pumps

Existing Conditions

The hydronic distribution system consists of a two-pipe heating system. Pipe insulation appeared to be in good condition. The hot water system is configured in a constant flow primary distribution with two (2) 5 hp constant speed hot water pumps operating with a lead-lag control sequence. The boilers provide hot water to radiators, zone reheat, and air handling units and unit ventilators throughout the building.

ECM Description

Willdan recommends installing VFDs on the constant speed hot water pumps and installing two-way valves at the terminal units. Instead of bypassing the water across the hot water coils using three-way valves, the pumps will run at variable speed in order to maintain the desired differential pressure set point. Since motor power consumption is proportional to the cube of the shaft speed under ideal conditions, running pumps at lower speeds provides energy savings when compared to operating pumps at full speed. For example, a 20% reduction in pump motor speed results in approximately a 50% reduction in pumping energy consumption. Willdan also recommends upgrading the standard efficiency motors on existing heating hot water pumps to premium efficiency pump motors (inverter duty motors).

Table 23: Heating Hot Water Pump Upgrades

Tag	Location	Service	Make	Motor HP	Speed Control	VFD Upgrades (Y/N)	Premium Efficiency Motor Upgrades (Y/N)
HWP-1	Boiler Room	Hot Water Loop	Baldor	5	Constant	Y	Y
HWP-2	Boiler Room	Hot Water Loop	Baldor	5	Constant	Y	Y

Measure Baseline and Proposed Upgrades

Baseline

- Two (2) 5-hp constant speed hot water pumps equipped with non-premium efficiency motors.

Proposed

- Install VFDs on two (2) heating hot water pumps.
- Premium efficiency motors on two (2) heating hot water pumps.
- Convert all three-way valves to two-way valves for proper operation of VFDs.
- Testing and balancing of heating hot water systems.
- Provide connections to BMS to monitor and control new equipment.

Calculation Methodology

ECM-4 energy savings have been calculated using eQuest. Baseline motor efficiencies are based on the nameplate of the existing motors.

Energy Savings Metrics: Cost Savings

Table 24: ECM-4 Summary Table

Electric Usage Savings	9,396	kWh
Electric Annual Demand Savings	0.0	kW
Electric Cost Savings	1,276	$
Natural Gas Usage Savings	-107	therms
Natural Gas Cost Savings	-123	$
Total MMBTU Savings	21	MMBtu
Total Cost Savings	1,153	$
Estimated Installation Cost	71,875	$

Design Considerations

- Integration with BMS and hydronic distribution system.

Maintenance Considerations

VFDs, pumps and pump motors shall be maintained as per manufacturer's guidelines.

ECM-5 Install VFDs on Chilled Water Pumps

Existing Conditions

The hydronic distribution system consists of a two-pipe cooling system. Pipe insulation appeared to be in good condition. The chilled water system is configured in a constant flow primary distribution with two (2) 10 hp constant speed chilled water pumps operating with a lead-lag control sequence and constant flow secondary distribution with two (2) 7.5 hp constant speed chilled water pumps and two (2) 3 hp constant speed pumps for the admin building. The chiller provides chilled water to unit ventilators and air handling units throughout the building.

ECM Description

Willdan recommends installing VFDs on the constant speed chilled water pumps and installing two-way valves at the terminal units. Instead of bypassing the water across the chilled water coils using three-way valves, the pumps will run at variable speed in order to maintain the desired differential pressure set point. Since motor power consumption is proportional to the cube of the shaft speed under ideal conditions, running pumps at lower speeds provides energy savings when compared to operating pumps at full speed. For example, a 20% reduction in pump motor speed results in approximately a 50% reduction in pumping energy consumption. Willdan also recommends upgrading the standard efficiency motors on existing heating hot water pumps to premium efficiency pump motors (inverter duty motors).

Table 25: Chilled Water Pump Upgrades

Tag	Location	Service	Make	Motor HP	Speed Control	VFD Upgrades (Y/N)	Premium Efficiency Motor Upgrades (Y/N)
CHWP-1	Boiler Room	Primary CHW	Baldor	10	10	Y	Y
CHWP-2	Boiler Room	Primary CHW	Baldor	10	10	Y	Y
CHWP-3	Boiler Room	Secondary CHW	Baldor	7.5	10	Y	Y
CHWP-4	Boiler Room	Secondary CHW	Baldor	7.5	10	Y	Y

Measure Baseline and Proposed Upgrades

Baseline

- Two (2) 5-hp constant speed primary chilled water pumps equipped with non-premium efficiency motors.
- Two (2) 7.5-hp constant speed secondary chilled water pumps equipped with non-premium efficiency motors.

Proposed

- Install VFDs on four (4) chilled water pumps.
- Premium efficiency motors on four (4) chilled water pumps.
- Convert all three-way valves to two-way valves for proper operation of VFDs.
- Testing and balancing of heating hot water systems.
- Provide connections to BMS to monitor and control new equipment.

Calculation Methodology

ECM-5 energy savings have been calculated using eQuest. Baseline motor efficiencies are based on the nameplate of the existing motors.

Energy Savings Metrics: Cost Savings

Table 26: ECM-5 Summary Table

Electric Usage Savings	30,377	kWh
Electric Annual Demand Savings	10.9	kW
Electric Cost Savings	4,124	$
Natural Gas Usage Savings	0	therms
Natural Gas Cost Savings	0	$
Total MMBTU Savings	104	MMBtu
Total Cost Savings	4,124	$
Estimated Installation Cost	85,119	$

Design Considerations

- Integration with BMS and hydronic distribution system.

Maintenance Considerations

- VFDs, pumps and pump motors shall be maintained as per manufacturer's guidelines.

ECM-6: Implement Vending Machine Miser Controls

Existing Conditions

There is one (2) refrigerated cold beverage vending machine at Salem County Courthouse. It is currently not equipped with an occupancy-based controls and is operated 24/7.

ECM Description

Willdan recommends installing occupancy sensor controls for vending machine. Vending machines operate continuously, even during unoccupied hours and consumes several hundred dollars per year in electrical energy costs. The installation of the Vending Miser product will reduce the run time of the vending machine during periods when no occupancy is sensed in the area surrounding the machine. The smart electronics in the device will ensure product is kept cold through a cycling process while reducing total energy consumption. Another benefit from implementing vending miser controls is extended useful equipment life due to reduced lifetime. Energy savings are dependent on the vending machine and activity level in the area surrounding the machines.

Measure Baseline and Proposed Upgrades

Baseline

- Existing refrigerated vending machine operated 24/7.

Proposed

- Install occupancy sensor (vending miser controls) for the refrigerated vending machines.

Calculation Methodology

ECM-6 energy savings have been calculated using eQuest.

Energy Savings Metrics: Cost Savings

Table 27: ECM-6 Summary Table

Electric Usage Savings	388	kWh
Electric Annual Demand Savings	0.1	kW
Electric Cost Savings	53	$
Natural Gas Usage Savings	0	therms
Natural Gas Cost Savings	0	$
Total MMBTU Savings	1	MMBtu
Total Cost Savings	53	$
Estimated Installation Cost	2,454	$

Design Considerations

- None.

ECM-7: BMS Upgrades

Existing Conditions

Salem County Courthouse currently has a Siemens building management system. The existing BMS provides control of chiller plant and boiler plant. AHUs are manually controlled at zone level.

ECM Description

This measure includes installation of new direct digital control (DDC) systems for all the major HVAC equipment and lighting systems replacing the controls controlling various pieces of equipment. The new BMS will combine all HVAC and lighting equipment. With the communication between the control devices and the new updated digital interface/software, will give the opportunity to take advantage of better scheduling, temperature set-back controls based on outside air temperature and occupancy levels while maintaining adequate heating, cooling and ventilation requirements in the facility. The DDC system will also aid in the response time to service/maintenance issues when the facility is not under normal maintenance supervision i.e. after-hours. Implementation of this measure is also important in achieving full potential of other measures recommended by providing the necessary means of properly controlling the equipment. Several control strategies that were evaluated are described below:

Implement Scheduling of AHUs

Currently the courthouse operate the AHUs for an extenuated period of time after the building is unoccupied. Implement an aggressive AHUs schedule will help reduce fan energy consumption while also reducing cooling and heating energy consumption.

BMS Upgrades - Implement SAT Reset

Supply air temperature reset is a control scheme that allows an airside system to modulate the supply air temperature based on outside air temperature. When enabled, the temperature of supply air is increased, which allows for reduced compressor energy or reheat energy, but also increases fan energy in a VAV system. When supply air temperature reset is based on outside air temperature, the supply air temperature can be increased as the outside air temperature decreases.

Measure Baseline and Proposed Upgrades

Baseline

- AHUs currently operate after the building is unoccupied.
- SAT on AHUs kept constant.

Proposed

- Upgraded BMS to include:
  - Revise existing AHU schedule to conserve energy.
  - Implement SAT reset on air-side HVAC units.

Calculation Methodology

ECM-7 energy savings have been calculated using eQuest. Interactivity effects of different control strategies are taken into account with the use of eQuest modelling software.

Energy Savings Metrics: Cost Savings

Table 28: ECM-7 Summary Table

Electric Usage Savings	16,503	kWh
Electric Annual Demand Savings	0.0	kW
Electric Cost Savings	2,241	$
Natural Gas Usage Savings	356	therms
Natural Gas Cost Savings	410	$
Total MMBTU Savings	92	MMBtu
Total Cost Savings	2,650	$
Estimated Installation Cost	204,390	$

Design Considerations

- The sizing of these heating coils places a lower limit on the degree to which the entering boiler water temperature can be reduced in mild weather.
- Cooling loads that are being served by higher supply air temperatures often require more air and increased fan energy. SAT reset schedule should be optimized in consideration of both fan and compressor energy consumption.

Maintenance Considerations

Ongoing maintenance shall be performed by the control's contractor.

ECM-8: Install Energy Efficient Transformers

Existing Conditions

An on-site detailed survey of the dry-type transformers was performed by Powersmiths. The facility consists of one 30kVA, one 45kVA and one 75kVA transformers. The transformers are operating at a small fraction of their nameplate capacity, resulting in very low efficiency, and are often producing large amounts of excess heat, resulting in energy losses, and higher electric costs.

ECM Description

Willdan recommends replacing the dry-type transformers with E-Saver transformers. Designed to provide the lowest life cycle cost, the E-Saver goes beyond US DOE 2016 efficiency, ensuring lower operating losses than standard off-the-shelf transformers. To provide superior performance and reduce environmental impact, the E-Saver comes with a superior Nomex based insulation system impregnated with an organic epoxy adhesive. Superior insulation prevents shorts as well, substantially prolonging the life of the transformer.

Based on the detailed field survey, the replacement E-Saver transformers will be a like-for-like, nominal kVA capacity, designed and manufactured to minimize losses for the application and fit within the existing constraints. This ECM can achieve energy saving by increasing the transformer efficiency.

Measure Baseline and Proposed Upgrades

Baseline

- One (1) 30kVA transformers
- One (1) 45kWA transformers
- One (1) 75kVA transfomers

Proposed

- Three (3) E-Saver-80R transformers.
- Three (3) Transformer Custom Enclosures & Adders

Calculation Methodology

ECM-8 energy savings have been calculated using excel spreadsheet.

Energy Savings Metrics: Cost Savings

Table 29: ECM-8 Summary Table

Electric Usage Savings	12,173	kWh
Electric Annual Demand Savings	1.4	kW
Electric Cost Savings	1,653	$
Natural Gas Usage Savings	0	therms
Natural Gas Cost Savings	0	$
Total MMBTU Savings	42	MMBtu
Total Cost Savings	1,653	$
Estimated Installation Cost	24,846	$

Design Considerations

- Coordination with facility manager to minimize the effect on day-to-day operation.
- Disruption to electrical loads served by existing transformers.
- Seasonal loading on transformers.

ECM-9: Install Low-Flow DHW Devices

Existing Conditions

There are currently fifty-one (21) lavatory faucets and showerhead that are not equipped with low-flow aerators located in the Courthouse.

ECM Description

Willdan recommends installing low-flow domestic hot water devices to reduce overall hot water demand. Energy demand from domestic hot water heating systems can be reduced by reducing water usage in general. Faucet aerators can reduce hot water usage relative to standard aerators which saves energy. Low-flow devices reduce the overall water flow from the fixture while maintaining adequate pressure for washing.

When faucets deteriorate with age, it leads to leaks and excessive water flowing through the fixtures. In general, it is common to find fixtures consuming more than 2.2 gpm due to age. It is recommended that the aerators be replaced with appropriate spray type, pressure compensating flow moderators, which typically reduces the water flow rate to 1.5 gpm.

Measure Baseline and Proposed Upgrades

Baseline

- Twenty-one (21) lavatory faucets (2.2 gpm).

Proposed

- Twenty-one (21) lavatory faucet aerators (1.0 gpm).

Calculation Methodology

ECM-9 energy savings have been calculated using excel spreadsheet.

Energy Savings Metrics: Cost Savings

Table 30: ECM-9 Summary Table

Electric Usage Savings	0	kWh
Electric Annual Demand Savings	0.0	kW
Electric Cost Savings	0	$
Natural Gas Usage Savings	17	therms
Natural Gas Cost Savings	19	$
Total MMBTU Savings	2	MMBtu
Total Cost Savings	19	$
Estimated Installation Cost	348	$

Design Considerations

- None

Maintenance Considerations

- Maintenance against leaks shall be performed by the facility maintenance staff.

ECM-10: Install Solar PV Panels

Existing Conditions

There is no solar photovoltaic system installed at the Courthouse.

ECM Description

Willdan recommends installing a solar photovoltaic system to reduce dependence on the electric grid. The solar system can provide 449,728 kWh of electricity annually. Solar panels work by absorbing sunlight with photovoltaic cells, generating direct current (DC) energy and then converting it to usable alternating current (AC) energy with the help of inverter technology. AC energy then flows through the electrical panel and is distributed accordingly.

The solar PV sizing in the current phase is preliminary assessment of solar potential. A more in-depth study will be performed to further evaluate the solar energy production potential.

Calculation Methodology

ECM-10 energy savings have been prepared by Aurora Software.

Energy Savings Metrics: Cost Savings

Table 31: ECM-10 Summary Table

Electric Usage Savings	59,250	kWh
Electric Annual Demand Savings	50.0	kW
Electric Cost Savings	5,082	$
Natural Gas Usage Savings	0	therms
Natural Gas Cost Savings	0	$
Total MMBTU Savings	202	MMBtu
Total Cost Savings	5,082	$
Estimated Installation Cost	0	$

Note: A preliminary rate of $0.05 is used to project solar PV cost savings.

Design Considerations

- Effect on utility tariffs and rate structures.
- Integration with existing building infrastructure.

4.Utility and Other Rebates and Incentives Available for Project

A detailed description of all State and Federal tax benefits and energy grants, rebates and incentive programs Proposer anticipates incorporating into its proposal shall be provided as Section H-2.

Willdan has worked with various NJOCE Programs as well as utility programs in New Jersey. Willdan serves NJBPU as an approved Direct Install Program Implementation contractor. Willdan is the only ESCO that has been approved by NJOCE as a Direct Install Implementation Contractor, so will be able to help Salem County to apply as many measures under Direct Install program for qualified buildings. To date, Willdan has completed 400 projects under direct Install program. Willdan is also an approved Pay for Performance partner, so any building that qualify for Pay for Performance program, we would be able to help Salem County to apply under NJOCE Pay for Performance Program. Willdan has help more than 200 customers with NJOCE SmartStart Program.

Willdan will work with you to apply for and maximize all available rebates, utility incentives, PJM incentives or tax incentives. Willdan will also work with Salem County to explore all available markets for Carbon Credits. There are a number of programs available to help incentivize utility customers to reduce their dependence on the grid and move towards more energy efficient technology. The developers of the incentive programs understand, as we do, that the most efficient technology is not always the least expensive from a “first cost” standpoint, but they will lead to reduced operational costs and an improved environment over the “lifecycle” of your facilities.

Some of those rebates may include but are not limited to:

- Rebates and incentives available through the NJ SmartStart
- Program (via the NJ Clean Energy Program) – Equipment
- Incentives
- New Jersey Clean Energy “Pay for Performance” Incentive Program
- Energy Efficiency and Conservation Block Grants (New Jersey)
- (Recovery Act)
- Renewable Energy Incentive Program (REIP) (New Jersey)
- PJM Interconnection Incentive Programs (Demand Response and Frequency Regulation)
- Federal Government Energy Policy Act (Renewable Energy Technologies Tax Credits and
- Funding Grants)

Stimulus Funding Sources

- State Fiscal Stabilization Fund
- Qualified Zone Academy Bonds
- Energy Efficiency and Conservation Block Grants
- Qualified Energy Conservation Bonds
- Recovery Zone Bonds
- Build America Bonds

1. New Jersey Office of Clean Energy Smart Start Program

Incentives for Qualifying Equipment and Projects

A. Financial incentives are available for size projects which can offset some - or maybe even all - of the added cost to purchase qualifying energy-efficient equipment.
B. Support for Custom Energy-Efficiency Measures
C. Custom measures give you the opportunity to receive an incentive for unique energy-efficiency measures that are not on the prescriptive equipment list but are new/innovative or project/facility specific.

Application and Eligibility Process

D. We have made it even easier to participate! Pre-approval is no longer required for prescriptive measures, with the exception of prescriptive & performance lighting, lighting controls and custom measure applications. Please note that anyone who purchases and installs equipment without Program Manager approval does so at his/her own risk.

Table 32: Smart Start Incentive

Incentive Category	Estimated Incentive ($)
Custom Measure	$21,617.88

2. New Jersey Office of Clean Energy Combined Heat and Power Program

NJOCE Program support CHP projects and pays for up to 30-40% of the project cost. Willdan will evaluate this as an option during IGA and see if there is any opportunities for it. This not only extend the financing for 20 years but also provide energy saving compare the baseline for right application.

3. Energy Star Award Program

As part of the traditional guarantee measurement and guarantee process, Willdan will enroll Salem County into the EPA/DOE Energy Star program. The Energy Star Program has been developed by the EPA/DOE to reduce national energy dependency and pollution emissions. To achieve these ends, the program entices building owners to implement energy saving projects. These projects may include lighting, controls, HVAC replacement. Willdan will perform an Energy Star analysis for each building in this program. The Energy Star Benchmarking Tool provides a 1-100 ranking of a building's energy performance relative to the national building market. A higher SEP indicates a more energy efficient building. A score of 75 or higher is needed to qualify for the Energy Star label.

Willdan will prepare the information needed – utility bills and building information – for submittal to the EPA through our EnergyCAP™ program. EnergyCAP™ has a partnership with the EPA and Portfolio Manager and their program will assist in the information gathering and submittal process. After the original benchmark score, the data can be submitted monthly to see how the benchmark changes and also to renew the Energy Star rating on an annual basis. The decal will state the year in which the Energy Star rating was earned. Before the building can be Energy Star designated it must be audited by a third-party engineer. As a participant, Salem County can expect free press, on both the local and national levels, to promote the positive impact of the project.

4. PJM Incentives

PJM's Energy Efficiency program pays businesses for permanent load reduction resulting from energy efficiency projects they have completed or will be complete in the future. The program pays organization capacity revenue for up to four years following the completion of a qualified project. Qualifying projects include those with permanent energy reductions involving lighting, refrigeration equipment, HVAC, motors, VFDs, and more. There is revenue to be earned from your organization using less energy and helping PJM reduce the overall load on the grid.

- Summer EE performance period: June- Aug between 2-6pm not including weekends or public holidays
- Winter EE performance period: Jan-Feb between 7-9am and between 6-8pm not including weekends or public holidays
- Solar PV systems are not eligible as PJM Energy Efficiency Resources
- BMS Systems load reductions are difficult to qualify under PJM's Manual 18B as "permanent, continuous"
- Savings achieved by fuel switching are not eligible as PJM EE Resources.
- Transformers and Motors/VFDs may have potential but at this stage for estimated value it is not simple enough to be viable to make that analysis.
- **Lighting upgrades** have represented almost 100% of the PJM EE Capacity kWs that we have qualified with PJM for municipal district projects. (>50 municipal districts in NJ in last five years)   We have qualified some PTAC units which were utilized in the winter for heating as well as in summer for cooling but that was not a typical ECMs

5. Operational and Maintenance Savings

ESIP Law allows energy savings as a energy cost reduction and maintenance cost reduction resulting from implementing energy conservation measures, when compared against established baseline of a previous energy cost, operating and maintenance cost including but not limited to future capital expenditure avoided because of equipment installed or services performed as part of the ESIP program. Willdan interviewed the site maintenance head and was made aware that Salem County allocated a base amount of $10,000 annually for regular operation and maintenance costs. Additionally, the board also reserves another $100,000 annually for incidental and other direct costs towards building operation and maintenance. Given a total budget of $100,000, Willdan is projecting a reduction of $10,000 annually towards operation and maintenance savings.

5. Measurement and Verification (M&V) Plan

Measurement and Verification

The M&V protocol developed collaboratively between Willdan and Salem County during the IGA process and as outlined in the M&V Plan will be utilized to measure and verify the project energy savings. Willdan will assign a dedicated M&V engineer familiar with Salem County facilities and its systems to work on-site throughout the M&V period. The dedicated M&V engineer will work closely with Salem County staff on continuous optimization and commissioning of systems to ensure savings are achieved.

The International Performance Measurement and Verification Protocol (IPMVP) is the industry standard protocol that Willdan follows. The IPMVP provides four methods to measure energy savings. Willdan generally prefers IPMVP Option C – *measuring savings at the utility meter* – in cases where realizing the project savings on the utility bill is critical; however, Option C is limited on a facility that undergoes significant changes or projects that also impact the utility meter. For this reason, more measure-specific savings tracking using submetering may be most appropriate.

Computation of Baseline

Willdan's preferred approach, IPMVP Option C: Whole Facility, whenever appropriate based upon ECM selection, facility type, and customer preference. Willdan's straightforward calculations for both the baseline and any adjustments are outlined in this section.

Methodology to Determine Baseline Energy Use

In the simplest terms, the baseline is the sum of the energy consumption and costs for a specific, 12-month period prior to the installation of an energy efficiency project. The Baseline Year is the period that establishes the pre-retrofit conditions used as the point of reference for calculating energy savings. This baseline is developed prior to contract execution and established with input and agreement of Salem County.

Willdan's approach to calculating a baseline for Option C is summarized in this section; Option A and B baselines are customized based on ECMs implemented and measured.

Data Collection

Building and system information gathered during the IGEA is documented in the Energy Savings M&V Plan to document the conditions present that resulted in the baseline energy use. This data includes, but is not limited to:

- Building metered utility data (from utility provider meters)
- Weather conditions collected from the nearest National Weather Service Station
- A lighting level survey, with a count of the number of burned out lamps
- A summary of typical space temperatures during occupied periods
- An inventory of the HVAC and domestic water heating systems serving the building
- The operating hours of each building
- Function and utilization of each space within the building
- Building plans showing current construction and floorplans showing physical layout of spaces

Baseline Year Consumption Calculations – IPMVP Option C: Whole Facility

For IPMVP Option C: Whole Facility M&V methodology, utility consumption and demand are obtained from utility bills, shown below, for the Guarantee Meters during the baseline period, which forms the basis of the energy baseline.

The following equations will be used to determine baseline electrical consumption and demand:

Baseline Energy (or Demand) Consumption = ∑ Tracked Utility Meters' Consumption (of Demand) ± Baseline Adjustments, where:

Baseline Adjustment = ∑ ± Routine Adjustment to reporting period conditions ± Non-Routine Adjustments to reporting-period conditions

Routine Adjustments include, but are not limited to, weather and billing period length

Non-Routine Adjustments include changes in key conditions from the baseline period to the reporting period, including, but no limited to, occupancy; hours of operation; changes to building function and use; changes to operation, capacity or quantity of equipment or systems within the facility; and additions to the building

Table 33: District-Wide Utility Baseline

Energy Type	Total Annual Use	Units	kBTU	% Energy	Total Annual Cost ($)	% Cost	kBTU/SF	$/SF
Electricity	815,040	kWh	2,780,916	74%	$110,660	91%	66.59	$2.65
Natural Gas	9,997	Therms	999,458	26%	$11,516	9%	23.93	$0.28
Total			**3,780,375**	**100%**	**$122,175**	**100%**	**90.53**	**$2.93**

M&V activities are performed to assure guaranteed savings are met to satisfy the contract and legislation. A general M&V approach is necessary to outline the methods that will significantly affect how the baseline is defined and the energy savings justified. An Adjusted Baseline is also used to incorporate any changes with facility use, such as operating hours, occupancy, renovation or any other reason that will impact a significant use in energy as compared to the baseline. Willdan Energy Solutions calculates the baseline for any facility based on actual existing systems and operating conditions. There are various approached that WES takes to accumulate the necessary data to construct the baseline. Such methods are listed below:

- Site measurements for electrical loads such as lighting, HVAC equipment, plug loads, circulation pumps, process loads, etc.
- Equipment operating hours based on trend data

This section contains a description of the types of Measurement and Verification (M&V) methodologies that Willdan Energy Solutions will use to guarantee the performance of this project.
They have been developed and defined by two independent authorities:

- International Performance Measurement and Verification Protocol (IPMVP)
- Federal Energy Management Program (FEMP)

There are four guarantee options that may be used to measure and verify the performance of a particular energy conservation measure. Each of the option is described below.

Option A – Retrofit Isolation: Key Parameter Measurement

Energy savings is determined by field measurement of the key parameters affecting the energy use of the system(s) to which an improvement measure was applied separate from the energy use of the rest of the facility. Measurement frequency ranges from short-term to continuous, depending on the expected variations in the measured parameter, and the length of the reporting period. Measurement of key parameters means that those parameters not selected for field measurement will be estimated. Estimates can be based on historical data, manufacturer's specifications, or engineering judgment. Documentation of the source or justification of the estimated parameter will be described in the M&V plan in the contract. Energy savings is determined through engineering calculations of the baseline and post-retrofit energy used based on the combination of measured and estimated parameters, along with any routine adjustments.

Option B – Retrofit Isolation: All Parameter Measurement

Like Option A, energy savings is determined by field measurement of the energy use of the systems to which an improvement measure was applied separate from the energy use of the rest of the facility. However, all of the key parameters affecting energy use are measured; there are no estimated parameters used for Option B. Measurement frequency ranges from short-term to continuous, depending on the expected variations in the savings and the length of the reporting period. Energy savings is determined through engineering calculations of the baseline and post-retrofit energy used based on the measured parameters, along with any routine adjustments.

Option C – Whole Building Metering/Utility Bill Comparisons

Option C involves the use of utility meters or whole building sub-meters to assess the energy performance of a total building. Option C assesses the impact of any type of improvement measure, but not individually if more than one is applied to an energy meter. This option determines the collective savings of all improvement measures applied to the part of the facility monitored by the energy meter. In addition, since whole building meters are used, savings reported under Option C include the impact of any other change made in facility energy use (positive or negative). Option C may be used in cases where there is a high degree of interaction between installed improvement measures or between improvement measures and the rest of the building or the isolation and measurement of individual improvement measures is difficult or too costly. This Option is intended for projects where savings are expected to be large enough to be discernable from the random or unexplained energy variations that are normally found at the level of the whole facility meter. The larger the savings, or the smaller the unexplained variations in the baseline, the easier it will be to identify savings. In addition, the longer the period of savings analysis after installing the improvement measure, the less significant is the impact of short-term unexplained variations. Typically, savings should be more than 20% of the baseline energy use if they are to be separated from the noise in the baseline data. Periodic inspections should be made of all equipment and operations in the facility after the improvement measure installation. These inspections will identify changes from baseline conditions or intended operations. Accounting for changes (other than those caused by the improvement measures) is the major challenge associated with Option C-particularly when savings are to be monitored for long periods. Savings are calculated through analysis of whole facility utility meter or sub-meter data using techniques from simple comparison to regression analysis.

Option D – Calibrated Simulation

Option D involves the use of computer simulation software to predict energy use, most often in cases where baseline data does not exist. Such simulation models must be calibrated so that it predicts an energy use and demand pattern that reasonably matches actual utility consumption and demand data from either the base-year or a post-retrofit year. Option D may be used to assess the performance of all improvement measures in a facility, akin to Option C. However, different from Option C, multiple runs of the simulation in Option D allow estimates of the savings attributable to each improvement measure within a multiple improvement measure project. Option D may also be used to assess just the performance of individual systems within a facility, akin to Option A and B. In this case, the system's energy use must be isolated from that of the rest of the facility by appropriate meters. Savings are calculated using energy use simulation models, calibrated with hourly or monthly utility billing data and/or end-use metering. Using the given options, Salem County will be going through various M&V options. The following is the decision per building

Salem County Courthouse

Willdan has recommended option C for Measurement and Verification at Salem County Courthouse. The energy consumption for the existing building has been calculated using the guidelines set forth in the New Jersey Clean Energy Program's Savings Protocol FY19 and calibrated against recent 12 months of utility bills. The calibration has given an understanding of the building's operating schedule. The energy savings from proposed ECMs have been calculated based off the baseline. Savings calculated will be verified using 12 months of utility bills post installation to justify the interactive effects between newly installed system and the building as whole.

6. Disclaimer

For various combinations of HVAC measures, ECMs have complex interactive effects which cannot always be isolated on an individual measure basis.

The intent of this energy analysis report is to estimate energy savings associated with recommended upgrades to the HVAC systems, lighting systems, and other relevant energy consumers at your facility. Appropriate detail is included to make decisions about implementing energy efficiency measures at the facility. However, this report is not intended to serve as a detailed engineering design document, as the description of the improvements are diagrammatic in nature only in order to document the basis of cost estimates and savings, and to demonstrate the feasibility of constructing the improvements. Interactive effects between the individual measures can cause the total project savings to be larger or smaller depending on which recommendations are selected for implementation.

While the recommendations in this report have been reviewed for technical accuracy and are believed to be reasonable and accurate, the findings are estimates and actual results may vary. As a result, Willdan are not liable if projected estimated savings or economics are not actually achieved. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

In no event will Willdan be liable for the failure of the customer to achieve a specified amount of energy savings, the operation of customer's facilities, or any incidental or consequential damages of any kind in connection with this report or the installation of recommended measures.

Salem County Correctional Facility
125 Cemetery Road,
Pilesgrove, NJ 08098

Energy Savings Plan Report

Summary of Revisions

8/11/2020:	Draft Report Submission
1/21/2021:	Third Party Revision 1

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1. Contacts

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2. Executive Summary

Site: Salem County Correctional Facility

Dates of Audit: January - March 2020

Auditors: Tejas Desai, PE, Ozan Ogus, Sudhir Patel - Willdan Energy Solutions

Salem County contracted with Willdan Energy Solutions (Willdan) to develop an Energy Saving Plans (ESIP) for Salem County Correctional Facility in Pilesgrove, NJ.

This report summarizes the Energy Conservation Measures (ECMs) that Willdan identified, along with the associated energy and cost savings for each measure. Section 2 summarizes the estimated savings, describes the site, and discusses the building occupancy and use, the local climate conditions, the existing building systems, the facility's utility use, the facility's energy end use, and peer benchmarking of the facility. Section 3 describes each ECM in detail.

The energy cost savings have been derived through detailed energy analysis using both spreadsheet analysis and eQuest energy modelling to model the building systems.

Table 1 shows the energy and energy cost savings for Salem County Correctional Facility.

Table 1: Estimated Total Utility & Cost Savings

Savings			% Reduction
Annual Electric Energy	469,929	kWh	19%
Annual Electric Demand	103.8	kW	21%
Annual Natural Gas	135	therms	0%
Annual Utility Cost Savings	55,771	$	14%

Note: Electric savings presented in Table 1 does not include onsite electric generation potential from installation of solar PV panels.

2.1 Overall Opportunity Summary

Salem County Correctional Facility

The table below presents the projected savings for Salem.

Table 2:Projected Overall Savings

Measure		Annual Estimated Savings				CO_2 Emission Savings (tCO_2e)	Estimated Implementation Cost ($)	Estimated Simple Payback Period (Years)
Meas. No.	Description	Electricity (kWh)	Annual Demand (kW)	Natural Gas (Therms)	Cost Savings ($)			
ECM - 1	LED Lighting Upgrades - Interior	191,372	52.0	-1,940	$20,450	45.0	$233,759	11.4
ECM – 2	LED Lighting Upgrades - Exterior	23,000	0.0	0	$2,722	6.6	$24,199	8.9
ECM – 3	Replace Existing Split DX AHUs with High Efficiency DX Units	118,527	48.8	-467	$13,499	31.8	$680,412	50.4
ECM – 4	Replace Existing Packaged RTUs with High Efficiency Packaged RTUs	8,894	4.0	0	$1,053	2.6	$168,130	159.7
ECM – 5	Install VFDs on Heating Hot Water Pumps	14,468	0.0	-535	$1,106	1.3	$75,900	68.6
ECM – 6	BMS Upgrades	58,406	-7.7	2,933	$10,238	32.5	$202,800	19.8
ECM – 7	Implement Vending Machine Miser Controls	3,422	0.8	-20	$383	0.9	$2,454	6.4
ECM – 8	Install Energy Efficient Transformers	51,839	5.9	0	$6,135	15.0	$65,952	10.7
ECM – 9	Install Low-Flow DHW Devices	0	0.0	163	$185	0.9	$1,529	8.3
ECM – 10	Install Solar PV Panel	296,250	250.0	0	$20,250	85.6	$0	0.0
Total		**469,929**	**103.8**	**135**	**$55,771**	**136.5**	**$1,455,135**	**26.1**

[1] All energy savings accounts for interactive effects of each measure.

[2] Potential for onsite electricity generation (ECM-10) is not included in the “Total” row.

2.2 Site Background Information

Salem County Correctional Facility

Project Name:	Salem County Correctional Facility
Location:	125 Cemetery Road, Pilesgrove, NJ 08098
Building Type:	Detention Center
Occupancy Type:	Correctional Facility
Conditioned Building Area:	Approximately 99,594 sq. ft.
Owner:	Salem County
Year Built:	1993
Hours of Operation:	24/7/365

2.3 Site Description

Salem County Correctional Facility (SCCF) is located at 125 Cemetery Road, Pilesgrove, NJ 08098. The facility consists of two floors. The building includes holding cells, recreational rooms, infirmary, offices, cafeteria, corridors, stairwells, chapel, library, dining rooms, a commercial kitchen and various mechanical and storage areas. The exterior area mainly comprises of parking lot and outdoor recreational area for inmates.

2.4 Local Climate Conditions

Local climate is an important factor in a building's energy use. Outdoor temperatures affect the building envelope and drive heat transfer through the "skin" of the building. Outdoor temperatures also dictate the energy required to condition fresh air that is drawn into the building for occupant ventilation, which is typically a large portion of the overall heating and cooling load for this type of buildings. Outdoor weather conditions also determine the types of technologies and systems that will be effective in an HVAC system. The following design conditions apply.

Location: Pilesgrove, New Jersey

Cooling Season Design Condition: 90.4° F Dry Bulb / 73.3° F Wet Bulb

Heating Season Design Condition: 14.8° F Dry Bulb

In Pilesgrove, the summers are warm and humid, the winters are very cold, and it is wet and partly cloudy year-round. Over the course of the year, the temperature typically varies from 26 °F to 86 °F and is very rarely below 13°F or above 93°F.

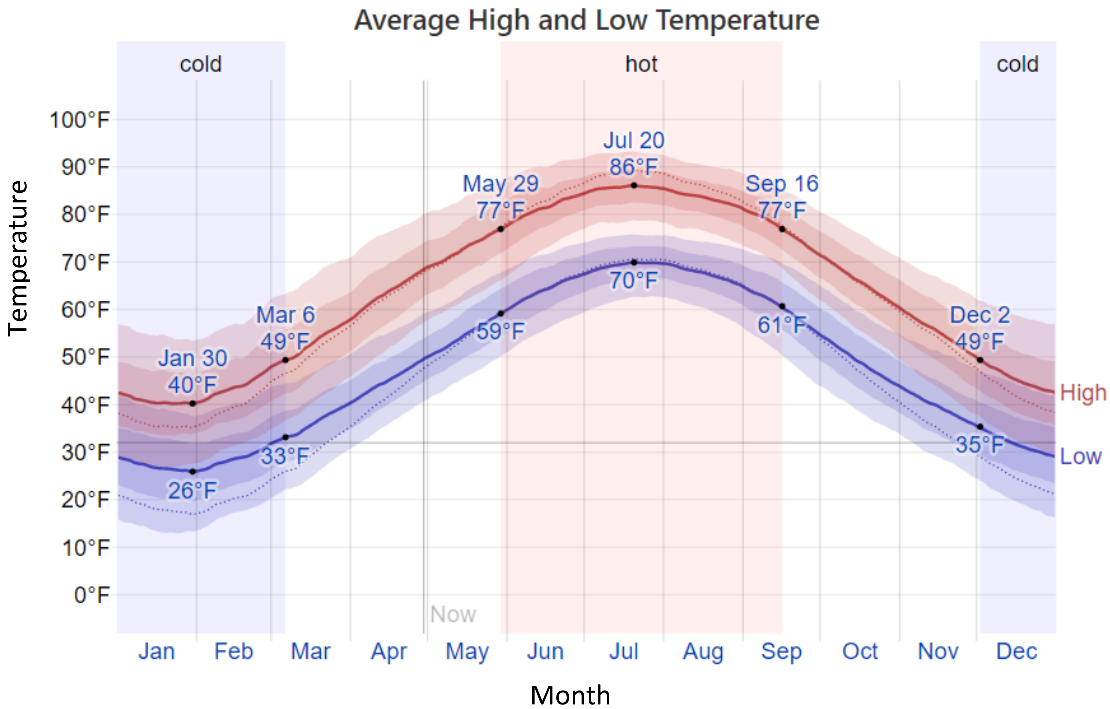

Figure 1: Historical Weather Conditions for Pilesgrove, NJ

2.5 Envelope

Building walls are made of concrete masonry units (CMUs) with a textured stone facade. The roof is flat, covered with stones, and in fair condition. The operable windows are double glazed and have aluminum frames with thermal frames. The glass-to-frame seals and operable and window weather seals are in good condition. Exterior doors are metal with metal frames and have adequate door seals.

2.6 Building Occupancy & Usage

Salem County Correctional Facility is occupied 24/7 year-round. Offices in the administration area are occupied Weekdays from 8:00 AM to 4:30 PM. On a typical day, according to the facility staff, occupancy is 136 staff and 316 inmates.

Table 3: Building Schedule

Building Name	Weekday/Weekend	Operating Schedule
Correctional Facility	Weekday	24/7
	Weekend	24/7

2.7 Building Systems Description

Heating, ventilating and air-conditioning (HVAC) is provided for conditioned spaces. The HVAC systems maintain a comfortable environment in the building and provide required ventilation to meet occupancy. This section describes the main systems in the facility, which include HVAC systems, domestic hot water system, lighting, food service equipment, and refrigeration.

2.7.1 Heating Hot Water System

The heating hot water system consists of two (2) 6,000 MBH input capacity, gas-fired, hot water boilers installed in 2011. The hot water supply temperature setpoint is maintained at 180 ºF. According to the site personnel, during peak heating season, hot water is typically generated using two boilers. Based on the visual inspection and information obtained from the site personnel, the boilers, in general, are in good operating condition and appeared to be well maintained.

The burners on the boilers are controlled with a high fire/low fire sequence. Based on the set-points, burners switch between the low-fire and high-fire stages to meet the needs of the facility. A piston operated mechanical lever controls the air intake opening of the burner based on the mode of operation. According to building operators, the boilers have no outside air heating hot water reset control.

Table 4: Boiler Schedule

Tag	Manufacturer	Model #	Year Installed	Natural Gas Input (MBH)	Output (MBH)	Description
Boiler No. 1	Cleaver Brooks	FLX-200-600-160HW	2011	6,000	5,124	Gas-fired boiler
Boiler No. 2	Cleaver Brooks	FLX-200-600-160HW	2011	6,000	5,124	Gas-fired boiler


Figure 2: Two (2) 6,00 MBH Input Gas-Fired Boilers

2.7.2 DX Cooling System

All cooling at Salem Correctional Facility provided by package DX rooftop and split DX air handling units. There are various condensing units located on the roof. Condensing unit on AHU-2, 5, 7, 8A, and 8B were replaced in 2012. Remaining Trane condensing units were installed in 1992 when the building was built and are past their useful life. These units also use R-22 refrigerant which is no longer being manufactured.

Table 5: Condenser Schedule

Tag	Unit Location	Manufacturer	Model #	Year Installed	Capacity (MBH)	Description
AHU-2	Roof	Heatcraft	BLV2001HD	2012	183.2	Air-Cooled Chiller
AHU-3	Roof	Trane	TTA180B400BA	1992	180	Air-Cooled Chiller
AHU-4A	Roof	Trane	TTA180B400BA	1992	180	Air-Cooled Chiller
AHU-4B	Roof	Trane	TTA180B400BA	1992	180	Air-Cooled Chiller
AHU-4C	Roof	Trane	TTA180B400BA	1992	180	Air-Cooled Chiller
AHU-4D	Roof	Trane	TTA180B400BA	1992	180	Air-Cooled Chiller
AHU-5	Roof	Heatcraft	BLV2001HD	2012	183.2	Air-Cooled Chiller
AHU-6	Roof	Trane	TTA120B400BA	1992	120	Air-Cooled Chiller
AHU-7	Roof	Heatcraft	BLV3500M6D	2012	298	Air-Cooled Chiller
AHU-8A	Roof	Heatcraft	BLV3500M6D	2012	298	Air-Cooled Chiller
AHU-8B	Roof	Heatcraft	BLV3501H6D	2012	298	Air-Cooled Chiller
AHU-9	Roof	Trane	TTA036C400A0	1992	36	Air-Cooled Chiller
AHU-10	Roof	Johnson Controls	GAW14L24C22SA	2010	24	Air-Cooled Chiller
AHU-11	Roof	Allegiance 13	4A7A3036A1000AA	2010	36	Air-Cooled Chiller
RAC-1-81	Roof	Trane	TCD075C40GAA	1992	72	Air-Cooled Chiller
RAC-2-80	Roof	Trane	TCD048A400BA	1992	48	Air-Cooled Chiller
RAC-3-79	Roof	Trane	TSC072F4R0A09	1992	75	Air-Cooled Chiller
RAC-4-78	Roof	Trane	TCD075C40GAA	1992	72	Air-Cooled Chiller
RAC-5A	Roof	Trane	TCD048A400BA	1992	48	Air-Cooled Chiller
RAC-5B	Roof	Trane	TCD048A400BA	1992	48	Air-Cooled Chiller
RAC-5C	Roof	Trane	TCD150840G08	1992	150	Air-Cooled Chiller
RAC-5D	Roof	Trane	TCD048A400BA	1992	48	Air-Cooled Chiller
RAC-5E	Roof	Trane	TCD048A400BA	1992	48	Air-Cooled Chiller
RAC-5F	Roof	Trane	TCD048A400BA	1992	48	Air-Cooled Chiller

Figure 3: AHU-5 Heatcraft Air-cooled Condenser (top), AHU-3 Trane Air-cooled Condenser (bottom)

2.7.3 Hydronic Distribution System

The hydronic distribution system for the SCCF consists of a constant volume heating hot water system. Pipe insulation appeared to be in good condition. The hot water system is configured in a constant flow primary distribution with two (2) 25 hp constant speed hot water pumps operating in a lead-lag control sequence. The boilers provide hot water to radiators, air handling units throughout the building. Table 6 below summarizes the inventory of the pumps at the facility.

Table 6: HW Pump Schedule

Tag	Location	Service	Make	Motor HP	Motor Eff (%)	Pump Flow (GPM)	Speed Control
HWP-1	Boiler Room	Hot Water Loop	Marathon	25	88.5%	530	Constant
HWP-2	Boiler Room	Hot Water Loop	Marathon	25	88.5%	530	Constant

2.7.4 HVAC Units

Heating and Ventilation Units

The gymnasium is conditioned by heating-ventilation units. They have supply fan motors and hot water coils. They are controlled by a manual dial thermostat in the gym. No cooling is provided to the gym. The kitchen and laundry also have dedicated heating-ventilation units with a supply fan and a heating coil. Based on the visual inspections, the units are appeared to be in good condition.

Table 7: Heating and Ventilation Units Schedule

Tag	Manufacturer	Model	Location	Area served	Cooling System Type	Heating System Type	Cooling Capacity (tons)	Heating Capacity (MBH)	System Type	Year Installed
HV-1	Trane	MCCA017GAB	Boiler Room	Kitchen	N/A	HW	N/A	*	H&V Unit	1992
HV-2A	Trane	MCCA014GAB	2nd Floor MER	Group Recreational	N/A	HW	N/A	*	H&V Unit	1992
HV-2B	Trane	MCCA014NAB	2nd Floor MER	Group Recreational	N/A	HW	N/A	*	H&V Unit	1992
HV-3	Trane	MCCA014GAB	2nd Floor MER	Laundry	N/A	HW	N/A	*	H&V Unit	1992

[*] Heating coil capacities could not be acquired from the nameplate data.

Figure 4: HV-2A Gym

Air Handling Units

SCCF has fourteen (14) split DX air handling units located throughout the facility. Majority of the air handling units serve inmate holding cells and dayroom area. This units have hot water coils and configured as a split air-conditioning (AC) system with an outdoor condensing unit. This units appeared in poor condition and beyond its useful service life. Facility staff reported issues with dampers on most of the units. The evaporator coils were dirty and signs of corrosion on unit casing was observed.

Figure 5: AHU-2 serving B-5 Housing

Table 8: AHU Units Schedule

Tag	Manufacturer	Model	Location	Area served	Cooling System Type	Heating System Type	Cooling Capacity (MBH)	Heating Capacity (MBH)	System Type	Year Installed
AHU-2	Trane	MCCA017NAB	2nd Floor B-5 MER	B-5 Housing	Split DX	HW	183.2	*	Air Handling Units	1992
AHU-3	Trane	MCCA012NAB	2nd Floor B-6 MER	B-6 Housing	Split DX	HW	180	*	Air Handling Units	1992
AHU-4A	Trane	MCCA014GAB	2nd Floor B-1 MER	B-1 Housing	Split DX	HW	180	*	Air Handling Units	1992
AHU-4B	Trane	MCCA014NAB	2nd Floor B-2 MER	B-2 Housing	Split DX	HW	180	*	Air Handling Units	1992
AHU-4C	Trane	MCCA014NAB	2nd Floor B-3 MER	B-3 Housing	Split DX	HW	180	*	Air Handling Units	1992
AHU-4D	Trane	MCCA014NAB	2nd Floor B-4 MER	B-4 Housing	Split DX	HW	180	*	Air Handling Units	1992
AHU-5	Trane	MCCA017GAB	2nd Floor MER	Admin offices	Split DX	HW	183.2	*	Air Handling Units	1992
AHU-6	Trane	MCCA008GAB	2nd Floor MER	Lobby	Split DX	HW	120	*	Air Handling Units	1992
AHU-7	Trane	MCCA021MAB	2nd Floor A-1 MER	A-1 Housing	Split DX	HW	298	*	Air Handling Units	1992
AHU-8A	Trane	MCCA021MAB	2nd Floor A-3 MER	A-3 Housing	Split DX	HW	298	*	Air Handling Units	1992
AHU-8B	Trane	MCCA021DEC	2nd Floor A-2 MER	A-2 Housing	Split DX	HW	298	*	Air Handling Units	1992
AHU-9	Trane	MCCA003BBC	2nd Floor MER	Library	Split DX	HW	36	*	Air Handling Units	1992
AHU-10	Johnson Controls	-	Maintenance Shop	Maintenance Shop	Split DX	HW	24	*	Air Handling Units	1992
AHU-11	Trane	4TEH3F36B1000AB	Communications Room	Communications Room	Split DX	N/A	36	*	Air Handling Units	1992

[*] Unit heating capacity data could not be extracted from the unit nameplate.

Packaged Units

SSCF has ten (10) package roof top units located on the roof of the building. Each packaged roof top unit (RTU) has a supply fan motor, a hot water heating coil located at zone level for heating and a direct expansion (DX) coil for cooling. All the RTU's were installed in 1992 except for RAC-3-79 which was replaced in 2016. Most of the units are past their useful life and appear to be in poor condition.

Figure 6: RAC-2-80 Medical/DU

Table 9: Packaged DX Units Schedule

Tag	Manufacturer	Model	Location	Area served	Cooling System Type	Heating System Type	Cooling Capacity (MBH)	Heating Capacity (MBH)	System Type	Year Installed
RAC-1-81	Trane	TCD075C4 0GAA	Roof	Booking	Packaged DX	HW	72	*	Packaged DX	1992
RAC-2-80	Trane	TCD048A4 00BA	Roof	Medical/DU	Packaged DX	HW	48	*	Packaged DX	1992
RAC-3-79	Trane	TSC072F4 R0A09	Roof	C-Wing Office/Central	Packaged DX	HW	75	*	Packaged DX	2016
RAC-4-78	Trane	TCD075C4 0GAA	Roof	ODR	Packaged DX	HW	72	*	Packaged DX	1992
RAC-5A	Trane	TCD048A4 00BA	Roof	C-Wing 1st Floor Corridor	Packaged DX	HW	48	*	Packaged DX	1992
RAC-5B	Trane	TCD048A4 00BA	Roof	C-Wing 2nd Floor Corridor	Packaged DX	HW	48	*	Packaged DX	1992
RAC-5C	Trane	TCD150840 G08	Roof	B-Wing 1st Floor Corridor	Packaged DX	HW	150	*	Packaged DX	1992
RAC-5D	Trane	TCD048A4 00BA	Roof	B-Wing 2nd Floor Corridor	Packaged DX	HW	48	*	Packaged DX	1992
RAC-5E	Trane	TCD048A4 00BA	Roof	A-Wing 1st Floor Corridor	Packaged DX	HW	48	*	Packaged DX	1992
RAC-5F	Trane	TCD048A4 00BA	Roof	A-Wing 2nd Floor Corridor	Packaged DX	HW	48	*	Packaged DX	1992

[*] Unit heating capacity data could not be extracted from the unit nameplate.

2.7.5 Building Management System

SCCF had a building management system that monitored and controlled AHUs and RTUs but the system is no longer in service and units are currently controlled manually at unit level.

2.7.6 Domestic Hot Water

Hot water is produced with two (2) 1,260 MBH input capacity gas fired Raypak water heaters with 1,616-gallon storage tank. This serves the building's domestic hot water needs including laundry and kitchen load. The domestic hot water pipes are insulated and based on the visual inspections the insulation is in good condition.

Figure 7: DHW-1 Boiler Room

Table 10. Existing Domestic Hot Water Heater

Tag	Manufacture	Year Installed	Model Number	Location	Input Capacity (MBH)
DHW-1	Raypak	2012	WH9-1262B	Boiler Room	1,260
DHW-2	Raypak	2012	WH9-1262B	Boiler Room	1,260

2.7.7 Lighting Systems

Salem County Correctional Facility uses a variety of interior fixtures throughout the building. The most prevalent lamp type used in the facility is 4-feet 32-watt linear fluorescent T8 lamps in fixtures equipped with 2, 3 or 4 lamps per fixture. There are also compact fluorescent and incandescent lamps used for interior lighting. Additionally, there are several 40-Watt T12 fixtures which use magnetic ballasts.

The indoor recreation room, vehicle sally port, lobby, multi-purpose room, housing blocks, and gymnasium fixtures are high bay high intensity discharge (HID) fixtures.

Majority of the high energy consuming exterior lighting consists of metal halide HID lamps of 150 or 250-watts.

2.8 Utility Bill Energy Use Summary

A summary of monthly utility consumption and costs for Salem County Correctional Facility was analyzed for the 12-month period between June 2018 and May 2019. This summary is useful for understanding the various uses of energy and the annual variation in energy usage. The total electricity consumed by the facility in the analyzed period was 2,455,639 kWh. Additionally, the facility also consumed 87,601 therms of natural gas based on the utility bills provided by the facility.

The utility cost data was used to determine a blended rate. The blended rate is the overall annual rate per unit of consumption that the facility pays for electricity and natural gas. The blended rate is determined by dividing the total electric/natural gas cost for a time period by the total electric/natural gas consumption in kWh/therms for the same time period.

The blended rate for electricity was determined to be $0.118 per kilowatt-hour. The blended rate for natural gas was determined to be $1.134 per therm.

Table 11: Base Building Energy Consumption and Costs (6/2018 – 5/2019)

Energy Type	Total Annual Use	Units	kBTU	% Energy	Total Annual Cost ($)	% Cost	kBTU/SF	$/SF
Electricity	2,455,639	kWh	8,378,640	49%	$290,635	75%	84.13	$2.92
Natural Gas	87,601	Therms	8,758,009	51%	$99,304	25%	87.94	$1.00
Total			**17,136,650**	**100%**	**$389,939**	**100%**	**172.07**	**$3.92**

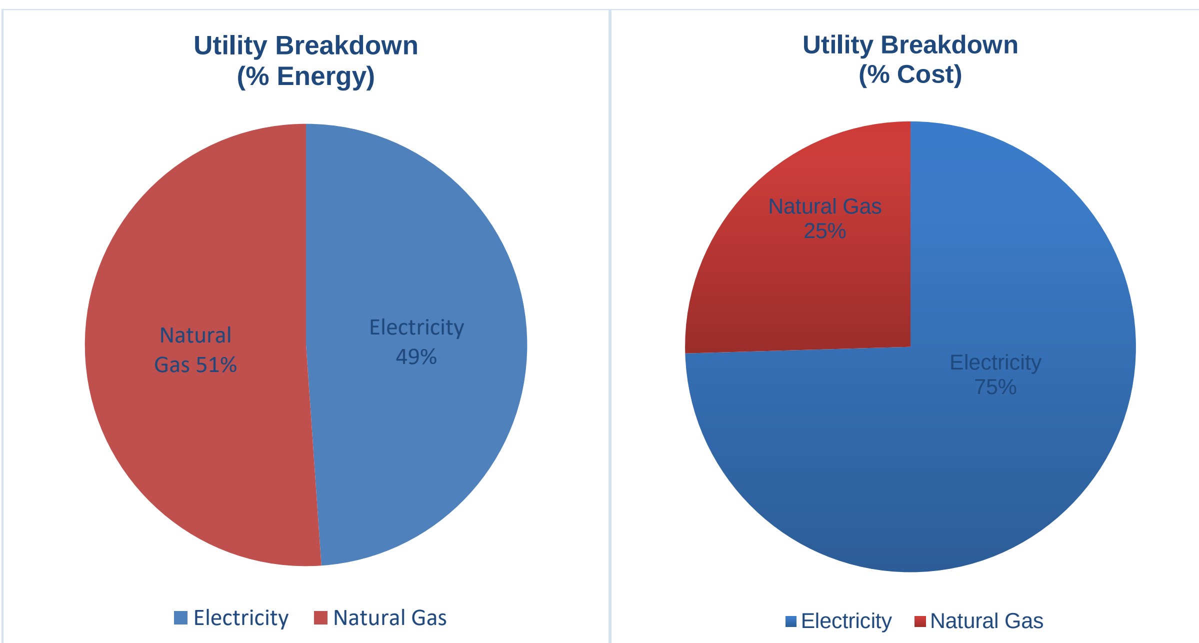

Figure 8: Utility Breakdown (6/2018 – 5/2019)

Table 12: Unit Energy Cost Summary (6/2018 – 5/2019)

Utility	Blended Rate	Rate Units
Electric	$0.118	$/kWh
Natural Gas	$1.134	$/Therms

2.8.1 Electric Energy Usage

The facility's electric energy usage for the period of June 2018 through May 2019 was 2,455,639 kWh, with a peak demand of 502 kW. Peak electric demand is occurred in July when the facility experiences the highest cooling load.

Table 13: Electric Energy Usage (6/2018 – 5/2019)

Month-Year	Usage (kWh)	Demand (kW)	Total Electric Cost
Jun-18	219,682	470	$27,080
Jul-18	290,174	502	$35,045
Aug-18	294,498	497	$36,200
Sep-18	228,728	488	$28,687
Oct-18	210,149	442	$23,682
Nov-18	172,864	368	$19,418
Dec-18	178,056	294	$19,983
Jan-19	177,561	291	$19,926
Feb-19	160,268	298	$17,995
Mar-19	161,580	281	$18,238
Apr-19	169,354	288	$20,310
May-19	192,725	456	$24,072
Total/Peak	**2,455,639**	**Max: 502**	**$290,635**

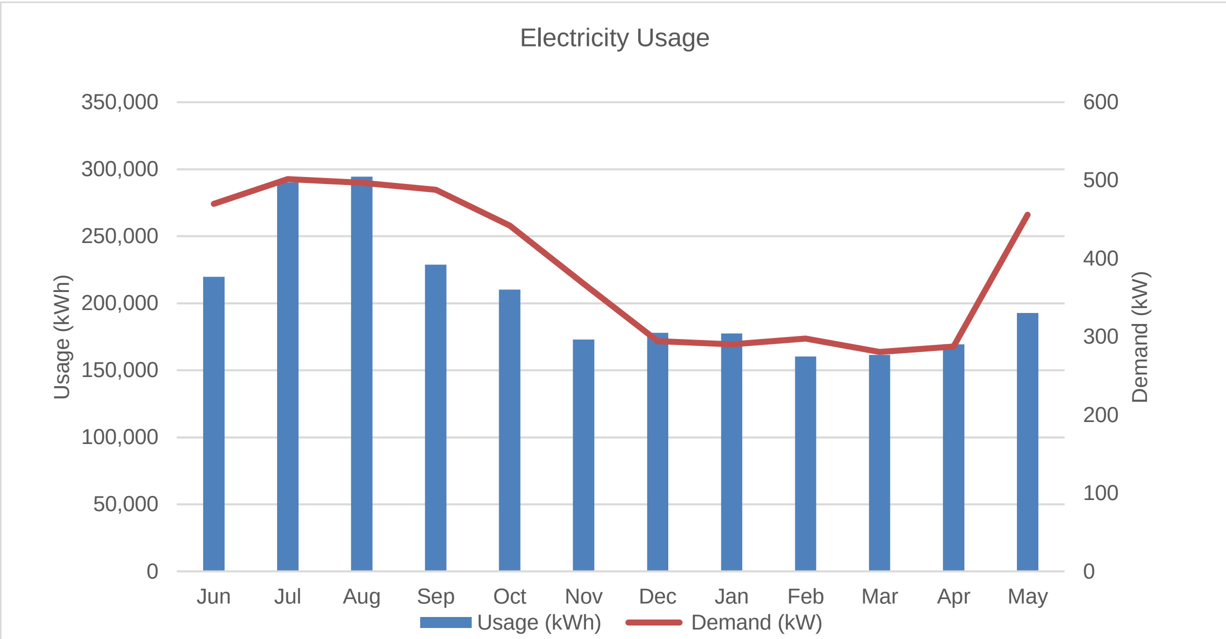

Figure 9: Electric Energy Usage Data (6/2018 – 5/2019)

2.8.2 Natural Gas Usage

The facility's total natural gas usage for the period of June 2018 through May 2019 was 87,601 therms. Majority of the natural gas consumption occurs during winter season as the boilers are utilized for space heating.

Table 14. Natural Gas Energy Use (6/2018 – 5/2019)

Month-Year	Usage (Therms)	Total Gas Cost
Jun-18	2,624	$3,152
Jul-18	2,292	$2,757
Aug-18	2,310	$2,779
Sep-18	2,293	$2,757
Oct-18	2,428	$2,817
Nov-18	9,607	$10,853
Dec-18	12,120	$13,718
Jan-19	16,276	$18,420
Feb-19	14,193	$16,032
Mar-19	12,921	$14,315
Apr-19	7,300	$8,101
May-19	3,237	$3,603
Total	**87,601**	**$99,304**

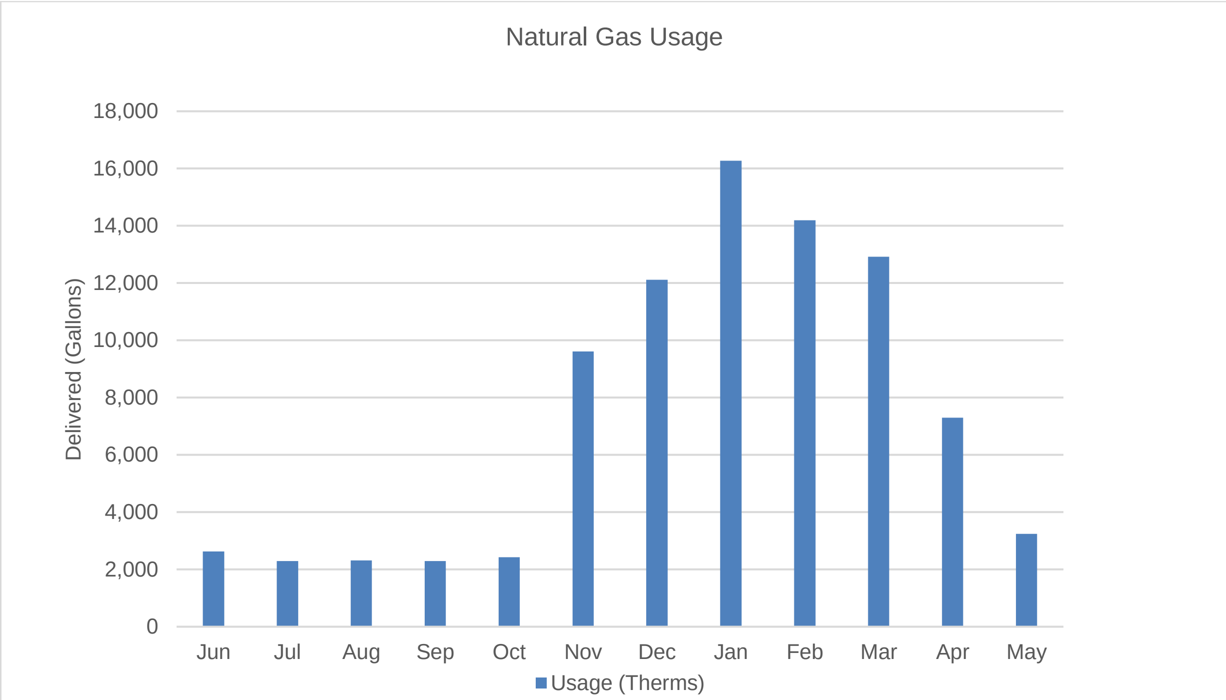

Figure 10: Natural Gas Usage Data (6/2018 – 5/2019)

2.9 Energy End Use Breakdown

The tables below summarize the existing annual electric and natural gas end usage within the buildings. The end use breakdown is based on the eQuest Model. The eQuest baseline model was calibrated to the actual facility energy consumption using utility bills for electric and natural gas consumption. The figures and tables in this section shows an estimated distribution of electric and natural gas usage among the building systems. This breakdown is based on the energy model and, as a result, may vary from the site's actual energy distribution.

The eQuest baseline model was calibrated to be within 1% for electricity utilities bills and 7% of the natural gas usage annually.

Table 15: End Use Breakdown Summary

End Use Type	Electricity	Electricity Usage	Natural Gas	Natural Gas Usage	Total Site Energy	Total Usage
	(kWh)	(%)	(therms)	(%)	(kBTU)	(%)
Lighting	673,400	29%	0	0%	2,298	14%
Misc Equip	367,600	16%	17,104	19%	2,964	18%
Primary heating	0	0%	61,215	68%	6,120	36%
Primary cooling	675,500	29%	0	0%	2,305	14%
Pumps & Aux	59,700	3%	0	0%	204	1%
Vent Fans	478,800	21%	0	0%	1,634	10%
Domestic Hot WTR	0	0%	11,803	13%	1,180	7%
Exterior Light	38,600	2%	0	0%	132	1%
Total Estimated	2,293,600	100%	90,122	100%	16,836	100%

2.9.1 Electric End Use Breakdown

Approximately, 53% of the electrical energy used in the building was dedicated to HVAC use (fans, pumps & auxiliary equipment, cooling & heating) with interior & exterior lighting accounting for another 31%.The remaining 16% was used for miscellaneous equipment and other process equipment.

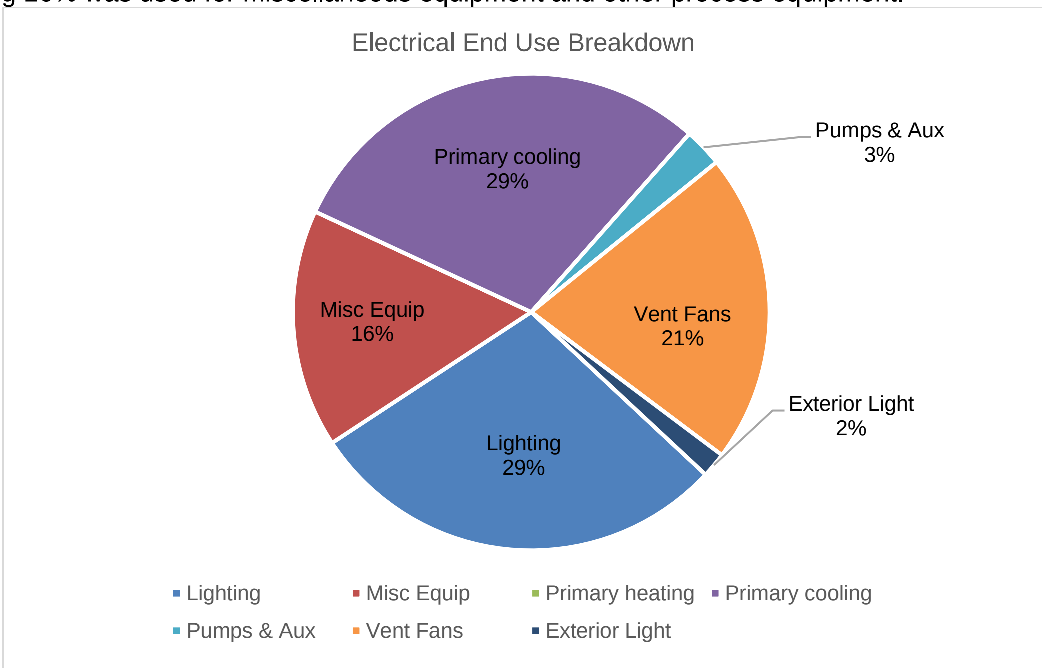

Figure 11: Electric End Use Breakdown

2.9.2 Natural Gas End Use Breakdown

Space heating accounted for approximately 68% of the facility's natural gas usage. Domestic hot water generation accounted for approximately 13%. The remaining 19% was used for miscellaneous equipment (kitchen gas ranges) and auxiliary equipment (laundry).

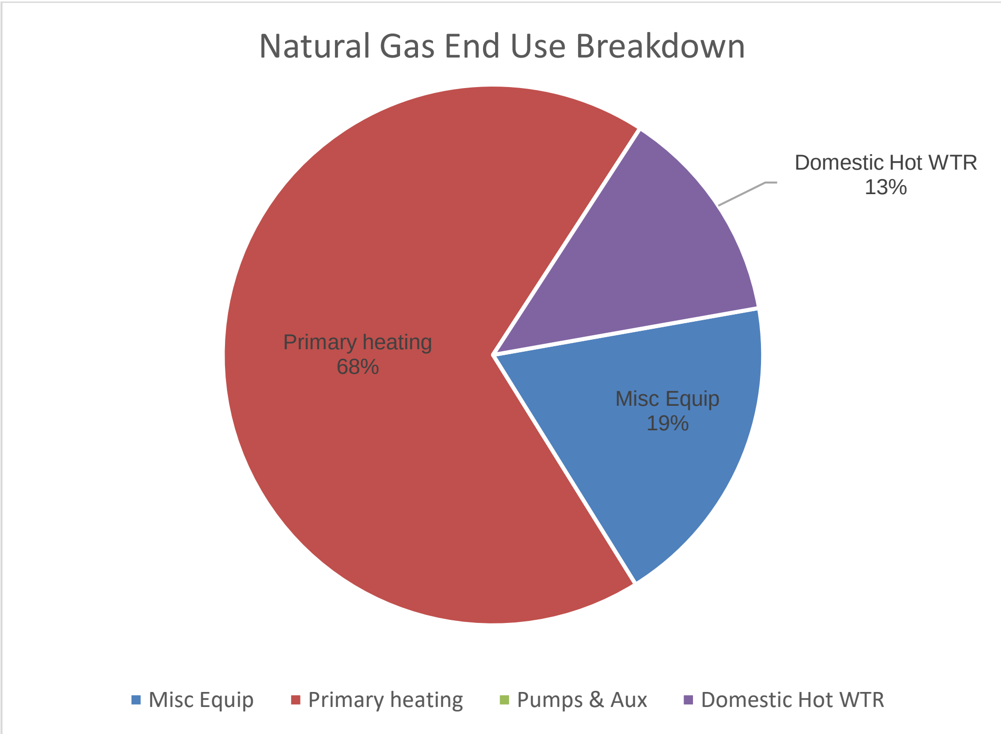

Figure 12: Natural gas End Use Breakdown

2.9.3 Total Energy Use Breakdown

The conversion of each utility's consumption to a common energy unit, kBTU, allows for a total energy end use breakdown to be estimated. The figures below show an estimated distribution of energy usage among the building systems. This breakdown is based on the project energy model and, as a result, may vary from the site's real distribution.

Space heating accounted for approximately 36% of the energy usage, domestic hot water generation: 7%, space cooling: 14%, lighting: 14%, miscellaneous equipment: 17%, pumps & auxiliary: 1%, ventilation fans; 10%.

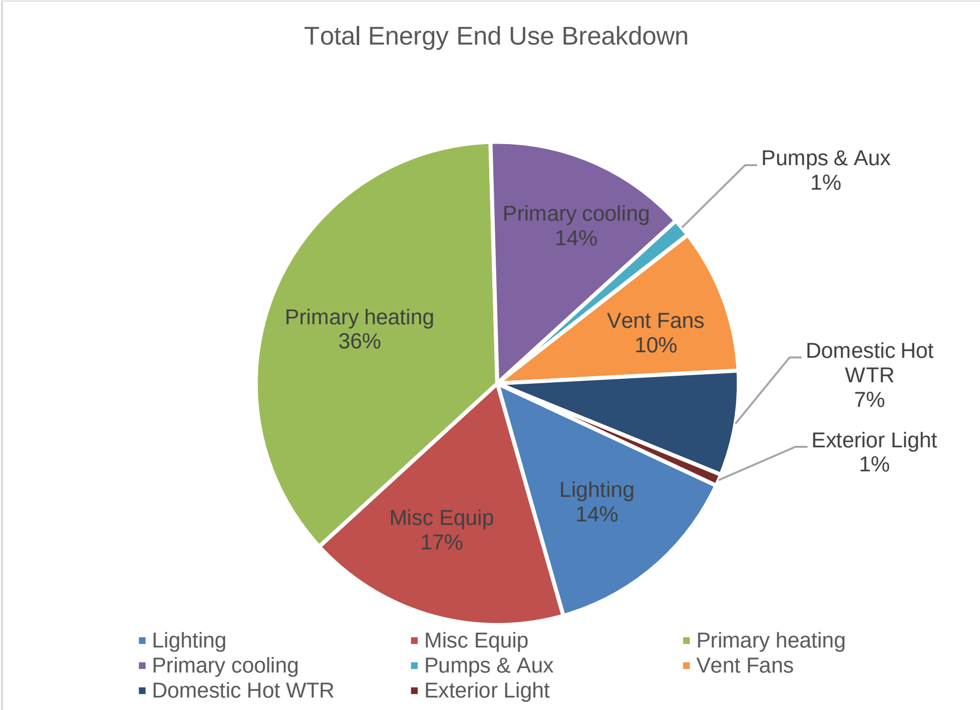

Figure 13: Total Energy Use Breakdown

2.9.4 Average Energy Cost

The average energy cost per square foot was calculated by dividing the total cost of all utilities – electric, and natural gas by the total conditioned area of the facility.

Table 16: Average Energy Cost per Square Foot

Total Conditioned Area in SF	kBTU	Total Annual Cost ($)	$/SF
99,594	17,136,650	$389,939	$3.92

Note: Each conditioned space was created in the eQuest energy model using the floor plan drawings provided by the facility. eQuest model was used to estimate the total conditioned area.

2.10 Peer Group Benchmarking

Willdan uses the U.S. Environmental Protection Agency (EPA) Portfolio Manager to rate the building on a scale of 1 to 100, as defined by its Energy Star score. This score compares a property under consideration to similar properties nationwide. The building is compared using a database of similar buildings from a national survey conducted by the Department of Energy. An Energy Star score of 50 indicates that the building, from an energy consumption standpoint, performs better than 50% of all similar buildings nationwide, while a rating of 75 indicates that the building performs better than 75% of all similar buildings nationwide.

2.10.1 Current EUI

The Site Energy Use Intensity (EUI) is the amount of heat and electricity consumed by a building, as commonly reflected in utility bills, divided by the facility's conditioned square footage. The Source EUI is the total amount of energy consumed in the generation and use of energy consumed at a building, such as electricity and natural gas, divided by the facility's square footage. A facility's site and source EUI can be obtained from the Statement of Performance (SOP). The SOP for this facility has been reiterated in table below. It incorporates generation, transmission, and storage losses, thereby enabling a complete assessment of energy use in a building. Energy star portfolio manager has a list of eligible building types that can receive a score, but Prison/Incarceration facility is not listed on their list. There is limited data for these kinds of facilities hence a score is not provided.

The utility bills and other information gathered during the energy audit process were analyzed to obtain the site and source EUIs of the existing facility. The site and source U.S. Median EUIs mentioned below have been obtained from the EPA Portfolio Manager.

The Site Energy Use Intensity (EUI) for Salem County Correctional Facility is 171.7 kBTU/SF, as compared to a national median EUI for similar buildings of 82.1 kBTU/SF. The Source EUI for the facility is 327.1 kBTU/SF, as compared to a national median EUI for similar buildings of 156.4 kBTU/SF. The following is a summary of the Portfolio Manager's results for the facility:

Table 17: Benchmarking EUI

Benchmarking*	This Facility	National Median
Site Energy Use Intensity (EUI kBTU/sf/yr)*	171.7	82.1
Source Energy Use Intensity (EUI kBTU/sf/yr)*	327.1	156.4
Energy Star Score	-	-

* From EPA Portfolio Manager, Building Type: Prison/Incarceration. Energy Star Portfolio Manager does not provide Energy Star score for Prison/Incarceration.

3. Energy Efficiency Measures

The goal of this audit report is to identify and evaluate potential energy efficiency improvements, provide information about the cost effectiveness of those improvements, and recognize potential financial incentives from NJBPU as part of the final report.

The baseline for facility was obtained from monthly utility bills, equipment schedules, electric and natural gas usage data and other industry standard sources such as ASHRAE. This information was then analyzed against the local weather data. An energy models were developed for the baseline of the facility utilizing eQuest, which performs detailed hourly simulations of energy use in buildings as a function of building construction, building systems, and general building and occupant activity. The simulation provides expected energy consumption, which is then calibrated to the utility data, as necessary.

Energy consumption associated with each measure was analyzed based on the technical performance of the recommended measure. It was then compared to the corresponding baseline energy consumption data to determine the resulting energy savings. Energy cost savings for each measure was determined using the projected energy savings and blended energy rates obtained from the utility information provided by the facility.

The following were assumed when calculating the energy savings:

- Building energy usage patterns will remain relatively unchanged in the near future (no significant occupancy changes and/or space conversion).
- Energy costs will remain relatively stable in near future.
- Building system operation will remain relatively unchanged (unless a change is related to a recommended ECM).
- All energy cost savings are based on blended rates. Actual cost savings can vary based on utility tariff structures and demand charges.

An economic analysis was performed for each measure using historical implementation cost estimates from industry standard sources, data obtained from similar projects and pricing solicited from vendors. Energy cost savings and implementation costs for each ECM were used to determine a simple payback associated with each measure. The calculations account for interacting effects between various system components.

Table 18 below presents a summary of energy-conservation measures. Payback in this report refers to simple payback associated with the implementation of each measure.

Salem County Correctional Facility

Willdan performed a detailed audit of Salem County correctional Facility. The facility's management provided extensive information, facility access, and made facility engineers available. This allowed for Willdan to determine ECM recommendations. The ECMs, energy savings, and cost savings are shown in the table below.

Table 18: Projected Overall Savings

Measure		Annual Estimated Savings				CO_2 Emission Savings (tCO_2e)	Estimated Implementation Cost ($)	Estimated Simple Payback Period (Years)
Meas. No.	Description	Electricity (kWh)	Annual Demand (kW)	Natural Gas (Therms)	Cost ($)			
ECM - 1	LED Lighting Upgrades - Interior	191,372	52.0	-1,940	$20,450	45.0	$233,759	11.4
ECM – 2	LED Lighting Upgrades - Exterior	23,000	0.0	0	$2,722	6.6	$24,199	8.9
ECM – 3	Replace Existing Split DX AHUs with High Efficiency DX Units	118,527	48.8	-467	$13,499	31.8	$680,412	50.4
ECM – 4	Replace Existing Packaged RTUs with High Efficiency Packaged RTUs	8,894	4.0	0	$1,053	2.6	$168,130	159.7
ECM – 5	Install VFDs on Heating Hot Water Pumps	14,468	0.0	-535	$1,106	1.3	$75,900	68.6
ECM – 6	BMS Upgrades	58,406	-7.7	2,933	$10,238	32.5	$202,800	19.8
ECM – 7	Implement Vending Machine Miser Controls	3,422	0.8	-20	$383	0.9	$2,454	6.4
ECM – 8	Install Energy Efficient Transformers	51,839	5.9	0	$6,135	15.0	$65,952	10.7
ECM – 9	Install Low-Flow DHW Devices	0	0.0	163	$185	0.9	$1,529	8.3
ECM – 10	Install Solar PV Panel	296,250	250.0	0	$20,250	85.6	$0	0.0
Total		**469,929**	**103.8**	**135**	**$55,771**	**136.5**	**$1,455,135**	**26.1**

* All energy savings were calculated accounted for the interacting effects between various system components.

3.1 Energy Efficiency Measure Descriptions

ECM-1: LED Lighting Upgrades - Interior

Existing Conditions

Salem County Correctional Facility uses a variety of interior fixtures throughout the building. The most prevalent lamp type used in the facility are 4-feet 32-watt linear fluorescent T8 lamps in fixtures equipped with 2, 3 or 4 lamps per fixture. There are also compact fluorescent and incandescent lamps used for interior lighting. Additionally, there are several 40-Watt T12 fixtures which use magnetic ballasts.

The indoor recreation room, vehicle sally port, lobby, multi-purpose room, housing blocks, and gymnasium fixtures are high bay high intensity discharge (HID) fixtures.

ECM Description

Willdan recommends retrofitting fixtures with T8 and T12 lamps with the more efficient Linear LED tubes. The existing compact fluorescent and incandescent lamps will be replaced with compatible LED replacements. In addition to electric usage and demand savings, maintenance savings may also be achieved since LED lamps last longer than other light sources and therefore do not need to be replaced as often. All recommended lighting is DLC and/or Energy Star compliant.

Measure Baseline and Proposed Upgrades

Baseline

- Existing fluorescent and incandescent lamps

Proposed

- High-efficiency LED lighting fixtures

Calculation Methodology

ECM-1 energy savings have been calculated using eQuest. A full space-by-space lighting audit is completed to identify the baseline and the calculated lighting power density is used to calculate the baseline lighting energy consumption. A compatible LED replacement is selected for each fixture/lamp type in the facility.

Energy Savings Metrics: Cost Savings

Table 19: ECM-1 Summary Table

Electric Usage Savings	191,372	kWh
Electric Annual Demand Savings	52.0	kW
Electric Cost Savings	22,650	$
Natural Gas Usage Savings	-1,940	therms
Natural Gas Cost Savings	-2,199	$
Total MMBTU Savings	459	MMBtu
Total Cost Savings	20,450	$
Estimated Installation Cost	233,759	$

Design Considerations

- Integration with lighting controls.
- Emergency lighting.

Maintenance Considerations

- Lamps/fixtures and associated ballasts shall be maintained as part of ongoing maintenance efforts by the facility engineers.

ECM-2: LED Lighting Upgrades - Exterior

Existing Conditions

Majority of the high energy consuming exterior lighting consists of metal halide HID lamps of 150 or 250-watts some of these fixtures are for the parking lot.

ECM Description

Willdan recommends replacing the existing lighting metal halide HID lamps with compatible LED retrofits. Fixtures equipped with incandescent, compact fluorescent, 4-feet T8 and T12 lamps will also be replaced with plug-and-play LED lamps.

Measure Baseline and Proposed Upgrades

Baseline

- Existing metal halide, fluorescent and incandescent lamps

Proposed

- High-efficiency LED lighting.

Calculation Methodology

ECM-2 energy savings have been calculated using eQuest. A full exterior space lighting audit is completed to identify the baseline and the calculated total exterior lighting power is used to calculate the baseline lighting energy consumption. A compatible LED replacement is selected for each fixture/lamp type being recommended for upgrades

Energy Savings Metrics: Cost Savings

Table 20: ECM-2 Summary Table

Electric Usage Savings	23,000	kWh
Electric Annual Demand Savings	0.0	kW
Electric Cost Savings	2,722	$
Natural Gas Usage Savings	0	therms
Natural Gas Cost Savings	0	$
Total MMBTU Savings	78	MMBtu
Total Cost Savings	2,722	$
Estimated Installation Cost	24,199	$

Design Considerations

- Integration with lighting controls.
- Emergency lighting.

Maintenance Considerations

Lamps/fixtures and associated ballasts shall be maintained as part of ongoing maintenance efforts by the facility engineers.

ECM-3 Replace Existing Split DX AHUs with High Efficiency DX Units

Existing Conditions

The facility provides HVAC through a combination of RTUs, split AC units and HV units. Unit details including size, areas served, and age are discussed in the "HVAC Units" section.

ECM Description

Willdan recommends replacing exiting split DX AHUs with high efficiency split DX units. Replacing the DX units has a long payback period and may not be justifiable based simply on energy considerations. However, the units that are being recommended for replacement at this facility are nearing or have passed the end of their normal useful life. In addition to condenser replacement, indoor units will also be replaced with supply variable frequency drives and NEMA premium efficiency motors.

Measure Baseline and Proposed Upgrades

Baseline

- Ten (10) existing DX units:

Table 21: AHU Units Schedule

Tag	Manufacturer	Model	Location	Area served	Cooling System Type	Heating System Type	Cooling Capacity (MBH)	Heating Capacity (MBH)	System Type	Year Installed
AHU-2	Trane	MCCA017NAB	2nd Floor B-5 MER	B-5 Housing	DX	HW	183.2	*	Air Handling Units	1992
AHU-3	Trane	MCCA012NAB	2nd Floor B-6 MER	B-6 Housing	DX	HW	180	*	Air Handling Units	1992
AHU-4A	Trane	MCCA014GAB	2nd Floor B-1 MER	B-1 Housing	DX	HW	180	*	Air Handling Units	1992
AHU-4B	Trane	MCCA014NAB	2nd Floor B-2 MER	B-2 Housing	DX	HW	180	*	Air Handling Units	1992
AHU-4C	Trane	MCCA014NAB	2nd Floor B-3 MER	B-3 Housing	DX	HW	180	*	Air Handling Units	1992
AHU-4D	Trane	MCCA014NAB	2nd Floor B-4 MER	B-4 Housing	DX	HW	180	*	Air Handling Units	1992
AHU-5	Trane	MCCA017GAB	2nd Floor MER	Admin offices	DX	HW	183.2	*	Air Handling Units	1992
AHU-6	Trane	MCCA008GAB	2nd Floor MER	Lobby	DX	HW	120	*	Air Handling Units	1992
AHU-7	Trane	MCCA021MAB	2nd Floor A-1 MER	A-1 Housing	DX	HW	298	*	Air Handling Units	1992
AHU-8A	Trane	MCCA021MAB	2nd Floor A-3 MER	A-3 Housing	DX	HW	298	*	Air Handling Units	1992
AHU-8B	Trane	MCCA021DEC	2nd Floor A-2 MER	A-2 Housing	DX	HW	298	*	Air Handling Units	1992
AHU-9	Trane	MCCA003BBC	2nd Floor MER	Library	DX	HW	36	*	Air Handling Units	1992

[*] Unit heating capacity data could not be extracted from the unit nameplate.

Proposed

- Ten (10) new high efficiency DX units.

Calculation Methodology

ECM-3 energy savings have been calculated using eQuest.

Energy Savings Metrics: Cost Savings

Table 22: ECM-3 Summary Table

Electric Usage Savings	118,527	kWh
Electric Annual Demand Savings	48.8	kW
Electric Cost Savings	14,028	$
Natural Gas Usage Savings	-467	therms
Natural Gas Cost Savings	-529	$
Total MMBTU Savings	358	MMBtu
Total Cost Savings	13,499	$
Estimated Installation Cost	680,412	$

Design Considerations

- Rigging & demolition of existing units.
- Scheduling of unit downtime during construction.
- Disposal of refrigerant.
- Integration with the existing BMS and the existing distribution system.

Maintenance Considerations

- AHUs shall be maintained as per manufacturer's guidelines.

ECM-4 Replace Existing Packaged RTUs with High Efficiency Packaged RTUs

Existing Conditions

The facility provides HVAC through a combination of RTUs, split AC units and HV units. Unit details including size, areas served, and age are discussed in the "HVAC Units" section.

ECM Description

Willdan recommends replacing exiting packaged RTUs with high efficiency packaged RTUs. Replacing these units has a long payback period and may not be justifiable based simply on energy considerations. However, the units that are being recommended for replacement at this facility are nearing or have passed the end of their normal useful life. New RTUs will have premium efficiency motors that will provide motor energy savings. Technological advancement in dx cooling systems has also improve the efficiency of these system providing sufficient cooling to zones while using less energy.

Measure Baseline and Proposed Upgrades

Baseline

- Nine (9) existing DX units:

Table 23: Packaged DX Units Schedule

Tag	Manufacturer	Model	Location	Area served	Cooling System Type	Heating System Type	Cooling Capacity (MBH)	Heating Capacity (MBH)	System Type	Year Installed
RAC-1-81	Trane	TCD075C4 0GAA	Roof	Booking	DX	HW	72	*	Packaged DX	1992
RAC-2-80	Trane	TCD048A4 00BA	Roof	Medical/DU	DX	HW	48	*	Packaged DX	1992
RAC-4-78	Trane	TCD075C4 0GAA	Roof	ODR	DX	HW	72	*	Packaged DX	1992
RAC-5A	Trane	TCD048A4 00BA	Roof	C-Wing 1st Floor Corridor	DX	HW	48	*	Packaged DX	1992
RAC-5B	Trane	TCD048A4 00BA	Roof	C-Wing 2nd Floor Corridor	DX	HW	48	*	Packaged DX	1992

RAC-5C	Trane	TCD150840 G08	Roof	B-Wing 1st Floor Corridor	DX	HW	150	*	Packaged DX	1992
RAC-5D	Trane	TCD048A4 00BA	Roof	B-Wing 2nd Floor Corridor	DX	HW	48	*	Packaged DX	1992
RAC-5E	Trane	TCD048A4 00BA	Roof	A-Wing 1st Floor Corridor	DX	HW	48	*	Packaged DX	1992
RAC-5F	Trane	TCD048A4 00BA	Roof	A-Wing 2nd Floor Corridor	DX	HW	48	*	Packaged DX	1992

[*] Unit heating capacity data could not be extracted from the unit nameplate.

Proposed

- Nine (9) new high efficiency DX units.

Calculation Methodology

ECM-4 energy savings have been calculated using eQuest.

Energy Savings Metrics: Cost Savings

Table 24: ECM-4 Summary Table

Electric Usage Savings	8,894	kWh
Electric Annual Demand Savings	4.0	kW
Electric Cost Savings	1,053	$
Natural Gas Usage Savings	0	therms
Natural Gas Cost Savings	0	$
Total MMBTU Savings	30	MMBtu
Total Cost Savings	1,053	$
Estimated Installation Cost	168,130	$

Design Considerations

- Rigging & demolition of existing units.
- Scheduling of unit downtime during construction.
- Disposal of refrigerant.
- Integration with the existing BMS and existing distribution system.

Maintenance Considerations

- RTUs shall be maintained as per manufacturer's guidelines.

ECM-5 Install VFDs on Heating Hot Water Pumps

Existing Conditions

The hydronic distribution system for the SCCF consists of a constant volume heating hot water system. Pipe insulation appeared to be in good condition. The hot water system is configured in a constant flow primary distribution with two (2) 25 hp constant speed hot water pumps operating with a lead-lag control sequence. The boilers provide hot water to radiators, zone reheat, and air handling units throughout the building.

ECM Description

Willdan recommends installing VFDs on the constant speed hot water pumps and installing two-way valves at the terminal units. Instead of bypassing the water across the hot water coils using bypass with factional hp pump, the pumps will run at variable speed in order to maintain the desired differential pressure set point. Since motor power consumption is proportional to the cube of the shaft speed under ideal conditions, running pumps at lower speeds provides energy savings when compared to operating pumps at full speed. For example, a 20% reduction in pump motor speed results in approximately a 50% reduction in pumping energy consumption. Willdan also recommends upgrading the standard efficiency motors on existing heating hot water pumps to premium efficiency pump motors (inverter duty motors).

Table 25: Heating Hot Water Pump Upgrades

Tag	Location	Service	Make	Motor HP	Speed Control	VFD Upgrades (Y/N)	Premium Efficiency Motor Upgrades (Y/N)
HWP-1	Boiler Room	Hot Water Loop	Marathon	25	Constant	Y	Y
HWP-2	Boiler Room	Hot Water Loop	Marathon	25	Constant	Y	Y

Measure Baseline and Proposed Upgrades

Baseline

- Two (2) 25-hp constant speed hot water pumps equipped with non-premium efficiency motors.

Proposed

- Install VFDs on two (2) heating hot water pumps.
- Premium efficiency motors on two (2) heating hot water pumps.
- Convert all terminal level bypass to two-way valves for proper operation of VFDs.
- Testing and balancing of heating hot water systems.
- Provide connections to BMS to monitor and control new equipment.

Calculation Methodology

ECM-5 energy savings have been calculated using eQuest. Baseline motor efficiencies are based on the nameplate of the existing motors.

Energy Savings Metrics: Cost Savings

Table 26: ECM-5 Summary Table

Electric Usage Savings	14,468	kWh
Electric Annual Demand Savings	0.0	kW
Electric Cost Savings	1,712	$
Natural Gas Usage Savings	-535	therms
Natural Gas Cost Savings	-606	$
Total MMBTU Savings	-4	MMBtu
Total Cost Savings	1,106	$
Estimated Installation Cost	75,900	$

Design Considerations

- Integration with BMS and hydronic distribution system.

Maintenance Considerations

- VFDs, pumps and pump motors shall be maintained as per manufacturer's guidelines.

ECM-6: BMS Upgrades

Existing Conditions

Salem County Correctional Facility correctly has no functioning building management system. The existing BMS failed and no longer provides control of HVAC systems. AHUs and RTUs are manually controlled at the unit level.

ECM Description

This measure includes installation of new direct digital control (DDC) systems for all the major HVAC equipment and lighting systems replacing the controls controlling various pieces of equipment. The new BMS will combine all HVAC and lighting equipment. HVAC units that are replaced as part of the pervious ECMs will be provided with new sensors that will be connected to new BMS and all malfunctioning dampers/actuator will be replaced for proper controls. With the communication between the control devices and the new updated digital interface/software, will give the opportunity to take advantage of better scheduling, temperature set-back controls based on outside air temperature and occupancy levels while maintaining adequate heating, cooling and ventilation requirements in the facility. The DDC system will also aid in the response time to service/maintenance issues when the facility is not under normal maintenance supervision i.e. after-hours. Implementation of this measure is also important in achieving full potential of other measures recommended by providing the necessary means of properly controlling the equipment. Several control strategies that were evaluated are described below:

Implement HHW Reset

Hot-water outside air reset adjusts the hot-water set point based on the outside air temperature to reducing the energy consumption of the boiler. As the outdoor air temperature warms, the temperature to which the hot water is heated gradually reduces from a maximum value to a minimum value. During this process, the energy consumption to produce the heat decreases.

Implement SAT Reset

Supply air temperature reset is a control scheme that allows an airside system to modulate the supply air temperature based on outside air temperature. When enabled, the temperature of supply air is increased, which allows for reduced compressor energy or reheat energy, but also increases fan energy in a VAV system. When supply air temperature reset is based on outside air temperature, the supply air temperature can be increased as the outside air temperature decreases.

Implement AHU-5 Unoccupied Schedule

Salem county correction facility is occupied 24/7 but the administration area which is served by AHU-5 is occupied from 8:30am to 4:30pm. Since this area does not need 24/7 conditioning it is recommend this unit should be put on a schedule. All other units need to operate as those areas are occupied 24/7.

Measure Baseline and Proposed Upgrades

Baseline

- HHW supply temperature manually adjusted based on operators' judgement.
- SAT on DX rooftop and make-up air units kept constant.
- AHU-5 operating during unoccupied hours

Proposed

- Upgraded BMS to include:
    - Implement HHW automated supply temperature reset.
    - Implement SAT reset on air-side HVAC units.
    - Implement AHU-5 unoccupied schedule.

Calculation Methodology

ECM-6 energy savings have been calculated using eQuest. Interactivity effects of different control strategies are taken into account with the use of eQuest modelling software.

Energy Savings Metrics: Cost Savings

Table 27: ECM-6 Summary Table

Electric Usage Savings	58,406	kWh
Electric Annual Demand Savings	-8	kW
Electric Cost Savings	6,913	$
Natural Gas Usage Savings	2,933	therms
Natural Gas Cost Savings	3,325	$
Total MMBTU Savings	493	MMBtu
Total Cost Savings	10,238	$
Estimated Installation Cost	202,800	$

Design Considerations

- The sizing of these heating coils places a lower limit on the degree to which the entering boiler water temperature can be reduced in mild weather.
- Cooling loads that are being served by higher supply air temperatures often require more air and increased fan energy. SAT reset schedule should be optimized in consideration of both fan and compressor energy consumption.

Maintenance Considerations

Ongoing maintenance shall be performed by the control's contractor.

ECM-7: Implement Vending Machine Miser Controls

Existing Conditions

There is two (2) refrigerated cold beverage vending machine at Salem County Correctional Facility. It is currently not equipped with an occupancy-based controls and is operated 24/7.

ECM Description

Willdan recommends installing occupancy sensor controls for vending machine. Vending machines operate continuously, even during unoccupied hours and consumes several hundred dollars per year in electrical energy costs. The installation of the Vending Miser product will reduce the run time of the vending machine during periods when no occupancy is sensed in the area surrounding the machine. The smart electronics in the device will ensure product is kept cold through a cycling process while reducing total energy consumption. Another benefit from implementing vending miser controls is extended useful equipment life due to reduced lifetime. Energy savings are dependent on the vending machine and activity level in the area surrounding the machines.

Measure Baseline and Proposed Upgrades

Baseline

- Existing refrigerated vending machine operated 24/7.

Proposed

- Install occupancy sensor (vending miser controls) for the refrigerated vending machines.

Calculation Methodology

ECM-7 energy savings have been calculated using eQuest.

Energy Savings Metrics: Cost Savings

Table 28: ECM-7 Summary Table

Electric Usage Savings	3,422	kWh
Electric Annual Demand Savings	0.8	kW
Electric Cost Savings	405	$
Natural Gas Usage Savings	-20	therms
Natural Gas Cost Savings	-22	$
Total MMBTU Savings	10	MMBtu
Total Cost Savings	383	$
Estimated Installation Cost	2,454	$

Design Considerations

- None.

ECM-8: Install Energy Efficient Transformers

Existing Conditions

An on-site detailed survey of the dry-type transformers was performed by Powersmiths. The facility consists of two 30kVA, five 45kVA and one 112.5kVA transformers. The transformers are operating at a small fraction of their nameplate capacity, resulting in very low efficiency, and are often producing large amounts of excess heat, resulting in energy losses, and higher electric costs.

ECM Description

Willdan recommends replacing the dry-type transformers with E-Saver transformers. Designed to provide the lowest life cycle cost, the E-Saver goes beyond US DOE 2016 efficiency, ensuring lower operating losses than standard off-the-shelf transformers. To provide superior performance and reduce environmental impact, the E-Saver comes with a superior Nomex based insulation system impregnated with an organic epoxy adhesive. Superior insulation prevents shorts as well, substantially prolonging the life of the transformer.

Based on the detailed field survey, the replacement E-Saver transformers will be a like-for-like, nominal kVA capacity, designed and manufactured to minimize losses for the application and fit within the existing constraints. This ECM can achieve energy saving by increasing the transformer efficiency.

Measure Baseline and Proposed Upgrades

Baseline

- Three (3) 30kVA transformers
- Five (5) 45kWA transformers
- One (1) 112.5kVA transformers

Proposed

- Nine (9) E-Saver-80R transformers.
- Nine (9) Transformer Custom Enclosures & Adders

Calculation Methodology

ECM-8 energy savings have been calculated using excel spreadsheet.

Energy Savings Metrics: Cost Savings

Table 29: ECM-8 Summary Table

Electric Usage Savings	51,839	kWh
Electric Annual Demand Savings	5.9	kW
Electric Cost Savings	6,135	$
Natural Gas Usage Savings	0	therms
Natural Gas Cost Savings	0	$
Total MMBTU Savings	177	MMBtu
Total Cost Savings	6,135	$
Estimated Installation Cost	65,952	$

Design Considerations

- Coordination with facility manager to minimize the effect on day-to-day operation.
- Disruption to electrical loads served by existing transformers.
- Seasonal loading on transformers.

ECM-9: Install Low-Flow DHW Devices

Existing Conditions

There are currently fifty-one (51) lavatory faucets and showerheads that are not equipped with low-flow aerators located in the Correctional Facility.

ECM Description

Willdan recommends installing low-flow domestic hot water devices to reduce overall hot water demand. Energy demand from domestic hot water heating systems can be reduced by reducing water usage in general. Faucet aerators can reduce hot water usage relative to standard aerators which saves energy. Low-flow devices reduce the overall water flow from the fixture while maintaining adequate pressure for washing.

When faucets deteriorate with age, it leads to leaks and excessive water flowing through the fixtures. In general, it is common to find fixtures consuming more than 2.2 gpm due to age. It is recommended that the aerators be replaced with appropriate spray type, pressure compensating flow moderators, which typically reduces the water flow rate to 1.5 gpm. In additions low flow aerators, low flow showerheads should also be installed at the facility which will reduce existing showerhead flow rate from 2.5 gpm to 2.0 gpm.

Measure Baseline and Proposed Upgrades

Baseline

- Eighteen (18) lavatory faucets (2.2 gpm).
- Thirty-three (33) showerhead (2.5 gpm).

Proposed

- Eighteen (18) lavatory faucet aerators (1.0 gpm).
- Thirty-three (33) low flow showerheads (2.0 gpm).

Calculation Methodology

ECM-9 energy savings have been calculated using excel spreadsheet.

Energy Savings Metrics: Cost Savings

Table 30: ECM-9 Summary Table

Electric Usage Savings	0	kWh
Electric Annual Demand Savings	0.0	kW
Electric Cost Savings	0	$
Natural Gas Usage Savings	163	therms
Natural Gas Cost Savings	185	$
Total MMBTU Savings	16	MMBtu
Total Cost Savings	185	$
Estimated Installation Cost	1,529	$

Design Considerations

- None

Maintenance Considerations

- Maintenance against leaks shall be performed by the facility maintenance staff.

ECM-10: Install Solar PV Panels

Existing Conditions

There is no solar photovoltaic system installed at the Correctional Facility.

ECM Description

Willdan recommends installing a solar photovoltaic system to reduce dependence on the electric grid. The solar system can provide 318,568 kWh of electricity annually. Solar panels work by absorbing sunlight with photovoltaic cells, generating direct current (DC) energy and then converting it to usable alternating current (AC) energy with the help of inverter technology. AC energy then flows through the electrical panel and is distributed accordingly.

The solar PV sizing in the current phase is preliminary assessment of solar potential. A more in-depth study will be performed to further evaluate the solar energy production potential.

Calculation Methodology

ECM-10 energy savings have been prepared by Aurora Software.

Energy Savings Metrics: Cost Savings

Table 31: ECM-10 Summary Table

Electric Usage Savings	296,250	kWh
Electric Annual Demand Savings	250.0	kW
Electric Cost Savings	20,250	$
Natural Gas Usage Savings	0	therms
Natural Gas Cost Savings	0	$
Total MMBTU Savings	1,011	MMBtu
Total Cost Savings	20,250	$
Estimated Installation Cost	0	$

Note: A preliminary rate of $0.05 is used to project solar PV cost savings.

Design Considerations

- Effect on utility tariffs and rate structures.
- Integration with existing building infrastructure.

4.Utility and Other Rebates and Incentives Available for Project

A detailed description of all State and Federal tax benefits and energy grants, rebates and incentive programs Proposer anticipates incorporating into its proposal shall be provided as Section H-2.

Willdan has worked with various NJOCE Programs as well as utility programs in New Jersey. Willdan serves NJBPU as an approved Direct Install Program Implementation contractor. Willdan is the only ESCO that has been approved by NJOCE as a Direct Install Implementation Contractor, so will be able to help Salem County to apply as many measures under Direct Install program for qualified buildings. To date, Willdan has completed 400 projects under direct Install program. Willdan is also an approved Pay for Performance partner, so any building that qualify for Pay for Performance program, we would be able to help Salem County to apply under NJOCE Pay for Performance Program. Willdan has help more than 200 customers with NJOCE SmartStart Program.

Willdan will work with you to apply for and maximize all available rebates, utility incentives, PJM incentives or tax incentives. Willdan will also work with Salem County to explore all available markets for Carbon Credits. There are a number of programs available to help incentivize utility customers to reduce their dependence on the grid and move towards more energy efficient technology. The developers of the incentive programs understand, as we do, that the most efficient technology is not always the least expensive from a “first cost” standpoint, but they will lead to reduced operational costs and an improved environment over the “lifecycle” of your facilities.

Some of those rebates may include but are not limited to:

- Rebates and incentives available through the NJ SmartStart
- Program (via the NJ Clean Energy Program) – Equipment
- Incentives
- New Jersey Clean Energy “Pay for Performance” Incentive Program
- Energy Efficiency and Conservation Block Grants (New Jersey)
- (Recovery Act)
- Renewable Energy Incentive Program (REIP) (New Jersey)
- PJM Interconnection Incentive Programs (Demand Response and Frequency Regulation)
- Federal Government Energy Policy Act (Renewable Energy Technologies Tax Credits and
- Funding Grants)

Stimulus Funding Sources

- State Fiscal Stabilization Fund
- Qualified Zone Academy Bonds
- Energy Efficiency and Conservation Block Grants
- Qualified Energy Conservation Bonds
- Recovery Zone Bonds
- Build America Bonds

1. Pay for Performance - Existing Buildings - Participation Steps

Willdan is preapproved partner for existing building pay for performance program.

Eligibility

Existing commercial, industrial and institutional buildings with a peak demand over 200 kW for any of the preceding twelve months are eligible to participate including hotels and casinos, large office buildings, supermarkets, manufacturing facilities schools, shopping malls and restaurants. Additionally, select multifamily buildings with a peak demand over 100kW are also eligible. Your energy reduction plan must define a comprehensive package of measures capable of reducing the existing energy consumption of your building by 15% or more.

Exceptions to the 15% threshold requirement may be made for certain industrial, manufacturing, water treatment, hospital, and datacenter building types whose annual energy consumption is heavily weighted on process loads.

Participating in the Pay for Performance Program is easy. Just follow this step-by-step process.

- Select a program partner from this list of approved partners. Be sure to download this flyer for tips on how to select a partner as well as ideas for what to expect from your working relationship.
- Submit Application Package - With your assistance, your partner will download and complete the Application and Participation Agreement and submit the forms and required documentation according to the Instructions section of the application.
- Receive Approval Notice - Program representatives will review your application package and if approved, will send a notice to proceed. A case manager will be assigned to your project.
- Develop Benchmarks and Goals. Your partner will benchmark your building, identify performance goals and create an energy reduction plan to achieve no less than 15% energy savings.
- Submit Your Plan - Your partner will submit your energy reduction plan, a complete benchmarking report and partner-participant contract with a request for Incentive #1 as defined in the participation agreement. When the energy reduction plan is approved, you will receive Incentive #1.
- Implement Your Project - Your partner will help you with the bidding process and will monitor construction to ensure that the appropriate steps are being taken to achieve the expected performance goals.
- Submit Request for Second Incentive - Your partner will submit a request for Incentive #2 along with the material and labor invoices when the project is complete. When approved, you will receive Incentive #2.
- Submit Request for Final Incentive - Within approximately 12 months after the project is completed, your partner will re-benchmark the building and submit a request for Incentive #3 along with the post-construction benchmarking report. If the building performance goal is met, you will receive Incentive #3.

Building Name	NJOCE P4P
Salem County Correctional Facility	$62,202.94

Table 32: District-Wide P4P Incentives

2. New Jersey Office of Clean Energy Combined Heat and Power Program

NJOCE Program support CHP projects and pays for up to 30-40% of the project cost. Willdan will evaluate this as an option during IGA and see if there is any opportunities for it. This not only extend the financing for 20 years but also provide energy saving compare the baseline for right application.

3. Energy Star Award Program

As part of the traditional guarantee measurement and guarantee process, Willdan will enroll Salem County into the EPA/DOE Energy Star program. The Energy Star Program has been developed by the EPA/DOE to reduce national energy dependency and pollution emissions. To achieve these ends, the program entices building owners to implement energy saving projects. These projects may include lighting, controls, HVAC replacement. Willdan will perform an Energy Star analysis for each building in this program. The Energy Star Benchmarking Tool provides a 1-100 ranking of a building's energy performance relative to the national building market. A higher SEP indicates a more energy efficient building. A score of 75 or higher is needed to qualify for the Energy Star label.

Willdan will prepare the information needed – utility bills and building information – for submittal to the EPA through our EnergyCAP™ program. EnergyCAP™ has a partnership with the EPA and Portfolio Manager and their program will assist in the information gathering and submittal process. After the original benchmark score, the data can be submitted monthly to see how the benchmark changes and also to renew the Energy Star rating on an annual basis. The decal will state the year in which the Energy Star rating was earned. Before the building can be Energy Star designated it must be audited by a third-party engineer. As a participant, Salem County can expect free press, on both the local and national levels, to promote the positive impact of the project.

4. Operational and Maintenance Savings

ESIP Law allows energy savings as a energy cost reduction and maintenance cost reduction resulting from implementing energy conservation measures, when compared against established baseline of a previous energy cost, operating and maintenance cost including but not limited to future capital expenditure avoided because of equipment installed or services performed as part of the ESIP program. Willdan interviewed the site maintenance head and was made aware that Salem County allocated a base amount of $10,000 annually for regular operation and maintenance costs. Additionally, the county also reserves another $180,000 annually for incidental and other direct costs towards building operation and maintenance. Given a total budget of $300,000, Willdan is projecting a reduction of $30,000 annually towards operation and maintenance savings.

5. Measurement and Verification (M&V) Plan

Measurement and Verification

The M&V protocol developed collaboratively between Willdan and Salem County during the IGA process and as outlined in the M&V Plan will be utilized to measure and verify the project energy savings. Willdan will assign a dedicated M&V engineer familiar with Salem County facilities and its systems to work on-site throughout the M&V period. The dedicated M&V engineer will work closely with Salem County staff on continuous optimization and commissioning of systems to ensure savings are achieved.

The International Performance Measurement and Verification Protocol (IPMVP) is the industry standard protocol that Willdan follows. The IPMVP provides four methods to measure energy savings. Willdan generally prefers IPMVP Option C – *measuring savings at the utility meter* – in cases where realizing the project savings on the utility bill is critical; however, Option C is limited on a facility that undergoes significant changes or projects that also impact the utility meter. For this reason, more measure-specific savings tracking using submetering may be most appropriate.

Computation of Baseline

Willdan's preferred approach, IPMVP Option C: Whole Facility, whenever appropriate based upon ECM selection, facility type, and customer preference. Willdan's straightforward calculations for both the baseline and any adjustments are outlined in this section.

Methodology to Determine Baseline Energy Use

In the simplest terms, the baseline is the sum of the energy consumption and costs for a specific, 12-month period prior to the installation of an energy efficiency project. The Baseline Year is the period that establishes the pre-retrofit conditions used as the point of reference for calculating energy savings. This baseline is developed prior to contract execution and established with input and agreement of Salem County.

Willdan's approach to calculating a baseline for Option C is summarized in this section; Option A and B baselines are customized based on ECMs implemented and measured.

Data Collection

Building and system information gathered during the IGEA is documented in the Energy Savings M&V Plan to document the conditions present that resulted in the baseline energy use. This data includes, but is not limited to:

- Building metered utility data (from utility provider meters)
- Weather conditions collected from the nearest National Weather Service Station
- A lighting level survey, with a count of the number of burned out lamps
- A summary of typical space temperatures during occupied periods
- An inventory of the HVAC and domestic water heating systems serving the building
- The operating hours of each building
- Function and utilization of each space within the building
- Building plans showing current construction and floorplans showing physical layout of spaces

Baseline Year Consumption Calculations – IPMVP Option C: Whole Facility

For IPMVP Option C: Whole Facility M&V methodology, utility consumption and demand are obtained from utility bills, shown below, for the Guarantee Meters during the baseline period, which forms the basis of the energy baseline.

The following equations will be used to determine baseline electrical consumption and demand:

Baseline Energy (or Demand) Consumption = ∑ Tracked Utility Meters' Consumption (of Demand) ± Baseline Adjustments, where:

Baseline Adjustment = ∑ ± Routine Adjustment to reporting period conditions ± Non-Routine Adjustments to reporting-period conditions

Routine Adjustments include, but are not limited to, weather and billing period length

Non-Routine Adjustments include changes in key conditions from the baseline period to the reporting period, including, but no limited to, occupancy; hours of operation; changes to building function and use; changes to operation, capacity or quantity of equipment or systems within the facility; and additions to the building

Table 33: District-Wide Utility Baseline

Energy Type	Total Annual Use	Units	kBTU	% Energy	Total Annual Cost ($)	% Cost	kBTU/SF	$/SF
Electricity	2,455,639	kWh	8,378,640	49%	$290,635	75%	84.13	$2.92
Natural Gas	87,601	Therms	8,758,009	51%	$99,304	25%	87.94	$1.00
Total			**17,136,650**	**100%**	**$389,939**	**100%**	**172.07**	**$3.92**

M&V activities are performed to assure guaranteed savings are met to satisfy the contract and legislation. A general M&V approach is necessary to outline the methods that will significantly affect how the baseline is defined and the energy savings justified. An Adjusted Baseline is also used to incorporate any changes with facility use, such as operating hours, occupancy, renovation or any other reason that will impact a significant use in energy as compared to the baseline. Willdan Energy Solutions calculates the baseline for any facility based on actual existing systems and operating conditions. There are various approached that WES takes to accumulate the necessary data to construct the baseline. Such methods are listed below:

- Site measurements for electrical loads such as lighting, HVAC equipment, plug loads, circulation pumps, process loads, etc.
- Equipment operating hours based on trend data

This section contains a description of the types of Measurement and Verification (M&V) methodologies that Willdan Energy Solutions will use to guarantee the performance of this project.
They have been developed and defined by two independent authorities:

- International Performance Measurement and Verification Protocol (IPMVP)
- Federal Energy Management Program (FEMP)

There are four guarantee options that may be used to measure and verify the performance of a particular energy conservation measure. Each of the option is described below.

Option A – Retrofit Isolation: Key Parameter Measurement

Energy savings is determined by field measurement of the key parameters affecting the energy use of the system(s) to which an improvement measure was applied separate from the energy use of the rest of the facility. Measurement frequency ranges from short-term to continuous, depending on the expected variations in the measured parameter, and the length of the reporting period. Measurement of key parameters means that those parameters not selected for field measurement will be estimated. Estimates can be based on historical data, manufacturer's specifications, or engineering judgment. Documentation of the source or justification of the estimated parameter will be described in the M&V plan in the contract. Energy savings is determined through engineering calculations of the baseline and post-retrofit energy used based on the combination of measured and estimated parameters, along with any routine adjustments.

Option B – Retrofit Isolation: All Parameter Measurement

Like Option A, energy savings is determined by field measurement of the energy use of the systems to which an improvement measure was applied separate from the energy use of the rest of the facility. However, all of the key parameters affecting energy use are measured; there are no estimated parameters used for Option B. Measurement frequency ranges from short-term to continuous, depending on the expected variations in the savings and the length of the reporting period. Energy savings is determined through engineering calculations of the baseline and post-retrofit energy used based on the measured parameters, along with any routine adjustments.

Option C – Whole Building Metering/Utility Bill Comparisons

Option C involves the use of utility meters or whole building sub-meters to assess the energy performance of a total building. Option C assesses the impact of any type of improvement measure, but not individually if more than one is applied to an energy meter. This option determines the collective savings of all improvement measures applied to the part of the facility monitored by the energy meter. In addition, since whole building meters are used, savings reported under Option C include the impact of any other change made in facility energy use (positive or negative). Option C may be used in cases where there is a high degree of interaction between installed improvement measures or between improvement measures and the rest of the building or the isolation and measurement of individual improvement measures is difficult or too costly. This Option is intended for projects where savings are expected to be large enough to be discernable from the random or unexplained energy variations that are normally found at the level of the whole facility meter. The larger the savings, or the smaller the unexplained variations in the baseline, the easier it will be to identify savings. In addition, the longer the period of savings analysis after installing the improvement measure, the less significant is the impact of short-term unexplained variations. Typically, savings should be more than 20% of the baseline energy use if they are to be separated from the noise in the baseline data. Periodic inspections should be made of all equipment and operations in the facility after the improvement measure installation. These inspections will identify changes from baseline conditions or intended operations. Accounting for changes (other than those caused by the improvement measures) is the major challenge associated with Option C-particularly when savings are to be monitored for long periods. Savings are calculated through analysis of whole facility utility meter or sub-meter data using techniques from simple comparison to regression analysis.

Option D – Calibrated Simulation

Option D involves the use of computer simulation software to predict energy use, most often in cases where baseline data does not exist. Such simulation models must be calibrated so that it predicts an energy use and demand pattern that reasonably matches actual utility consumption and demand data from either the base-year or a post-retrofit year. Option D may be used to assess the performance of all improvement measures in a facility, akin to Option C. However, different from Option C, multiple runs of the simulation in Option D allow estimates of the savings attributable to each improvement measure within a multiple improvement measure project. Option D may also be used to assess just the performance of individual systems within a facility, akin to Option A and B. In this case, the system's energy use must be isolated from that of the rest of the facility by appropriate meters. Savings are calculated using energy use simulation models, calibrated with hourly or monthly utility billing data and/or end-use metering. Using the given options, Salem County will be going through various M&V options. The following is the decision per building

Salem County Correctional Facility- M&V

Willdan has recommended option C for Measurement and Verification at Salem County Correctional Facility. The energy consumption for the existing building has been calculated using the guidelines set forth in the New Jersey Clean Energy Program's Savings Protocol FY19 and calibrated against recent 12 months of utility bills. The calibration has given an understanding of the building's operating schedule. The energy savings from proposed ECMs have been calculated based off the baseline. Savings calculated will be verified using 12 months of utility bills post installation to justify the interactive effects between newly installed system and the building as whole.

6. Disclaimer

For various combinations of HVAC measures, ECMs have complex interactive effects which cannot always be isolated on an individual measure basis.

The intent of this energy analysis report is to estimate energy savings associated with recommended upgrades to the HVAC systems, lighting systems, and other relevant energy consumers at your facility. Appropriate detail is included to make decisions about implementing energy efficiency measures at the facility. However, this report is not intended to serve as a detailed engineering design document, as the description of the improvements are diagrammatic in nature only in order to document the basis of cost estimates and savings, and to demonstrate the feasibility of constructing the improvements. Interactive effects between the individual measures can cause the total project savings to be larger or smaller depending on which recommendations are selected for implementation.

While the recommendations in this report have been reviewed for technical accuracy and are believed to be reasonable and accurate, the findings are estimates and actual results may vary. As a result, Willdan are not liable if projected estimated savings or economics are not actually achieved. All savings and cost estimates in the report are for informational purposes and are not to be construed as a design document or as guarantees.

In no event will Willdan be liable for the failure of the customer to achieve a specified amount of energy savings, the operation of customer's facilities, or any incidental or consequential damages of any kind in connection with this report or the installation of recommended measures.