ENERGY & WATER ASSESSMENT REPORT

Southface

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ASSESSMENT REPORT

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About Southface

Southface promotes sustainable homes, workplaces and communities through education, research, advocacy and technical assistance.

Our Vision: A regenerative economy, responsible resource use and social equity through a healthy built environment for all.

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ASSESSMENT REPORT

Montevallo Fire Station 1

9/22/2021

1140 Main St.
Montevallo, AL 35115

Site Details

- Building Type: Fire Station
- Square Footage: 8,000 sq ft
- Built: 2016

Energy & Water Benchmarks

- $7,517 - Annual Utility Cost
- 73% Cost - Electricity
- 25% Cost - Natural Gas
- 2% Cost - Water (estimated)

Project Contacts

- Bryant Hains

Senior Technical Project Manager
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Executive Summary

The Montevallo Fire Station 1 is a volunteer fire station with a gross floor area of around 8,000 square feet. The building consists of a large parking bay, open classroom area, offices, a lounge/kitchen, a lobby, bedrooms, and restrooms. Southface estimates that if all energy efficiency projects are undertaken, savings of up to 103% can be achieved.

Project Summary Table

#	Efficiency Measure	Annual Cost Savings	Budgetary Project Cost Estimate	Simple Payback (Years)	Estimated Annual Electricity Savings (kWh)	Estimated Annual Natural Gas Savings (therms)	Estimated Annual Water Savings (kGal)	Health Impact?
1	LED Retrofit and Controls	$123	1,025	8.3	814			
2	20 SEER/10 HSPF ASHP (ROB around 2032)	$1,743	**$15,750	9.0	2,271	974		
3	Wifi Thermostats (4x)	$416	$1,500	3.6	1,518	130		
4	Air Seal Attic	$83	$500	6.0	304	26		
5	Door Weather Stripping (3x)	$125	$150	1.2	455	39		
6	Heat Pump Water Heater (ROB around 2031)	$243	**$1,500	6.2	1,607			
7	Vending Miser for Coke Machine	$243	$150	0.6	1,612			
8	Solar PV (25kW)	$3,134	$62,500	19.9	33,695			
9	Maintenance: Airflow Adjustment (done on-site)							X
10	Maintenance: Change OA Filters							X
11	Maintenance: Clean A/C Condensate Traps							X
Total		**$6,110**	**$83,075**	**13.6**	**42,276**	**1,168**	**0**	

**These estimate costs are for a Replace on Burnout (ROB) scenario, so they are the incremental cost difference between replacing the HVAC units with identical models and replacing them with the higher efficiency option.

Energy & Water Profile

Consumption Profile

Fire Station 1 spends approximately $5,499 annually for electricity, $1,867 for natural gas, and an estimated $152 for water (based on equipment specs, occupancy schedule, and average local water rates). The average cost of the utilities is $0.151 per kWh for electricity, $1.438 per therm of natural gas, and $8 per thousand gallons of water.

Utility	Consumption Annual Use	Annual Cost	Cost Intensity ($/Sq-Ft)
Electricity	36,415 kWh	$5,499	$0.7/Sq-Ft
Natural Gas	1,298 therms	$1,867	$0.2/Sq-Ft
Water	*19 kGal	*$152	$0.0/Sq-Ft
Total Utilities		**$7,517**	**$0.9/Sq-Ft**

*These were estimated from the building's occupancy schedule, equipment and fixture specs, and local average utility rates.

Benchmarking

The Fire Station's energy performance was benchmarked using the ENERGY STAR Portfolio Manager tool comparisons. Benchmarking is the process of evaluating the energy performance of a facility relative to key indicators, including the performance of peers and the historic performance of one's own facility. Portfolio Manager provides a relevant source of comparative energy performance metrics by normalizing energy use of similar facilities by space-type, floor area, operating hours, climate, and other space attributes.

Utility	Annual Use	Current EUI	Estimated Post-Retrofit EUI	Estimated Post-Retrofit Savings %
Electricity	124,248 kBTU	32 kBTU/Sq-Ft	-1 kBTU/Sq-Ft	103%
Propane	129,789 kBTU			
Water	19 kGal	2 Gal/Sq-Ft	2 Gal/Sq-Ft	0%

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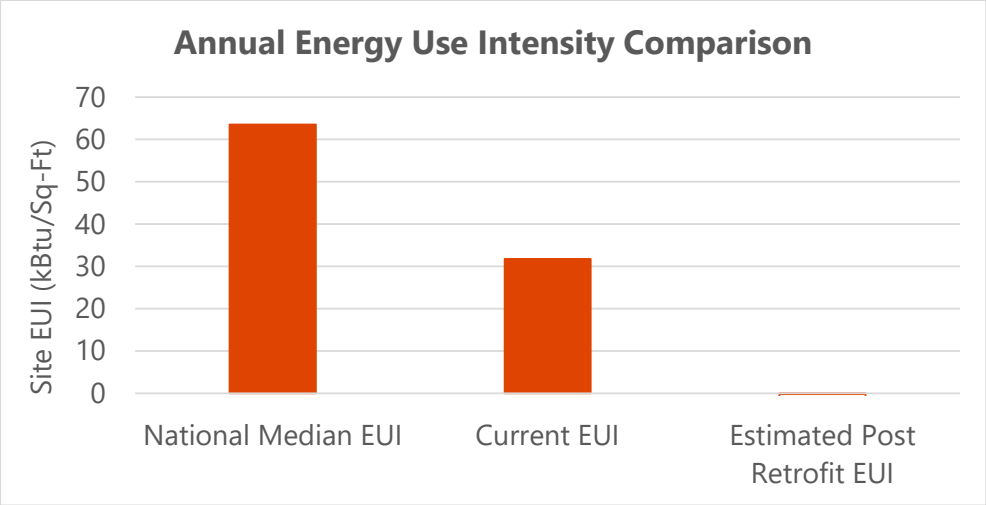
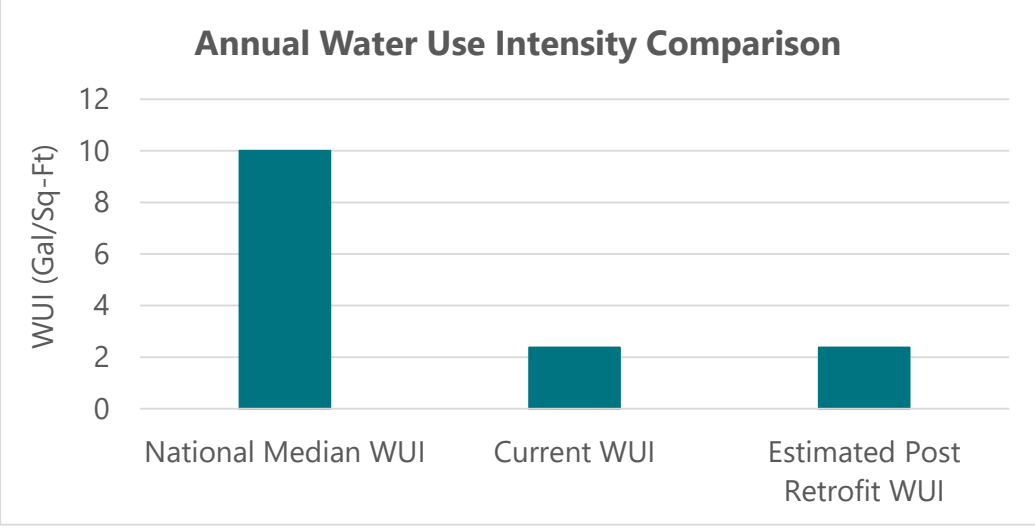
Energy Use Intensity (EUI) is a metric used to compare the annual energy usage of buildings, including all energy types consumed within the building, divided by gross floor area. Fire Station 1 already has a much lower site EUI than the national median for fire stations. The following chart shows how it compares to the median, and an estimate of the post-retrofit energy use (103% savings).

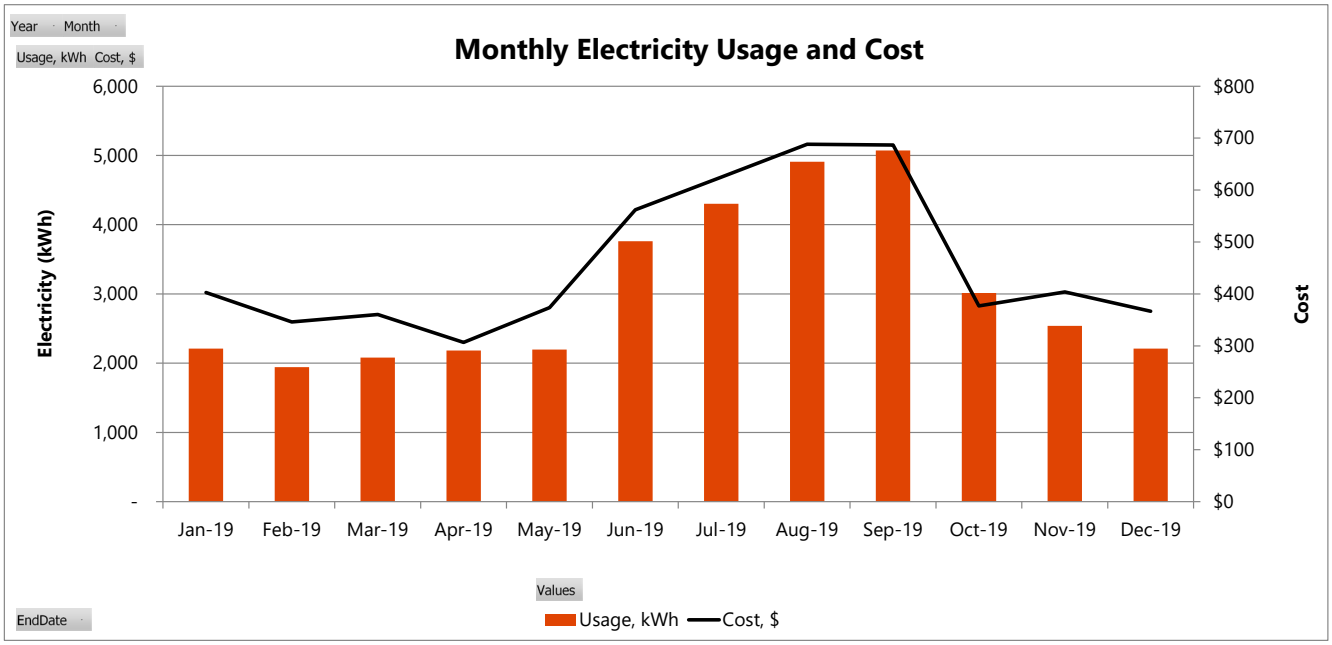


Water Use Intensity (WUI) is a metric used to compare the annual water usage of buildings divided by gross floor area. The following chart shows how the Fire Station compares to the national median WUI for similar building types, as well as an estimate of post-retrofit usage (0% savings). The water usage was estimated from the building's occupancy schedule and plumbing fixture specs.

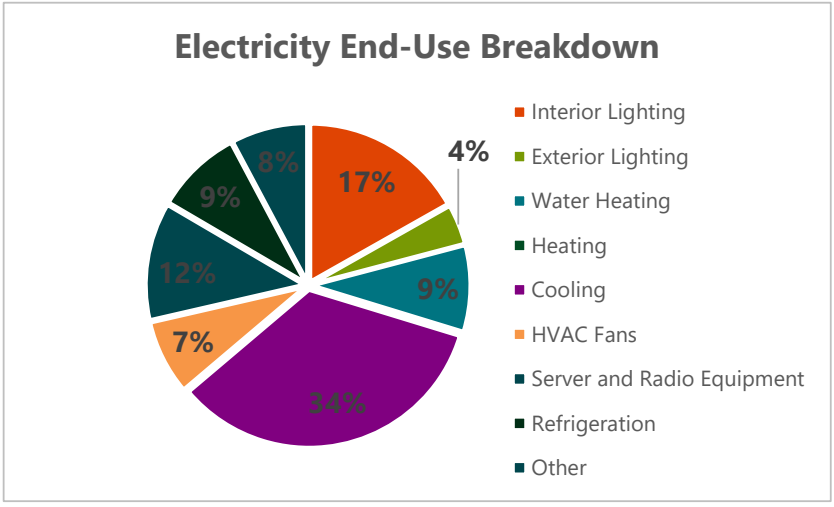


Electricity Profile and Breakdown by End Usage

The pre-COVID annual electricity profile for Fire Station 1 is displayed in the below figure. The monthly electricity use is highest in summer and lowest in winter, which is typical for buildings with gas heat.

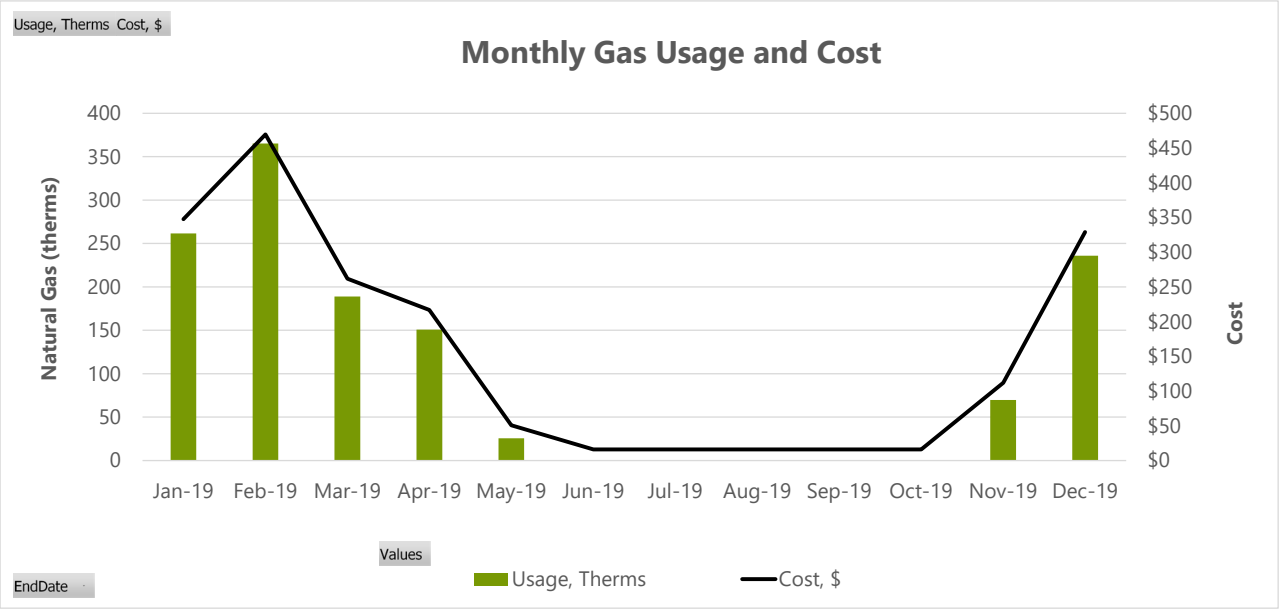


The electricity is broken out by end-use in the figure below. This is an estimate and was developed from the bottom-up using counts and specs from the lighting and HVAC surveys as well as top-down using the billing data. “Other” includes end uses such as plug loads and other ancillary equipment.

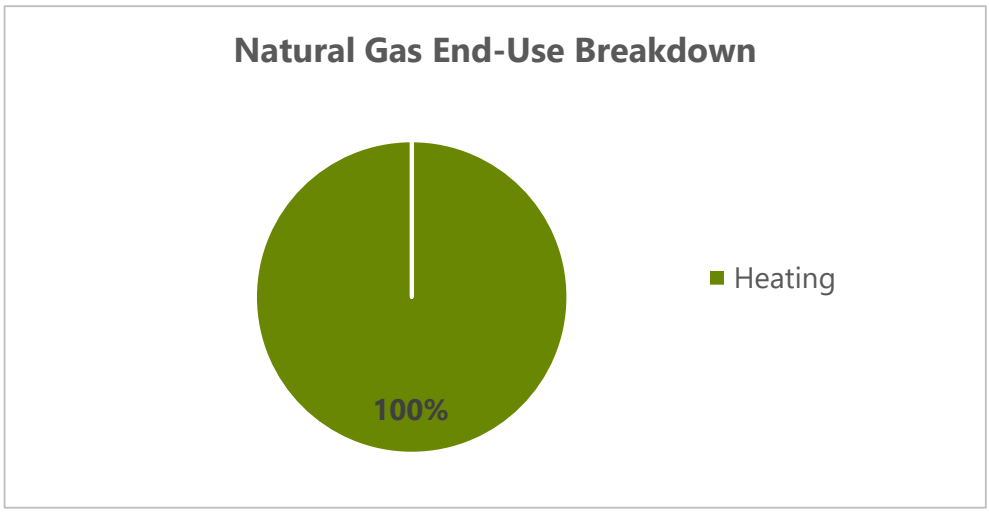


Natural Gas Profile and Breakdown by End Usage

The annual natural gas profile for the building is displayed in the below figure. The monthly gas use is high in the winter and 0 in the summer which is typical for buildings with gas heat and no other gas equipment.

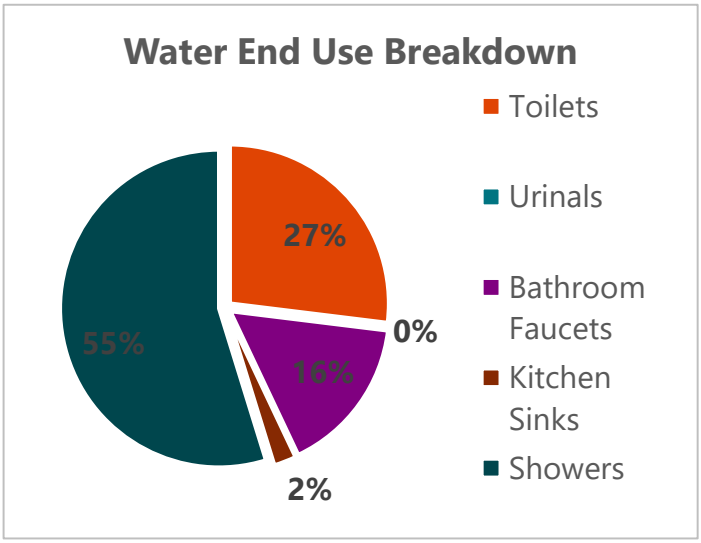


The gas is broken out by end-use in the figure below. All gas usage is for heating.



Water Breakdown by End Usage

The water is broken out by end-use in the figure below. This is an estimate and was developed from the bottom-up using counts and specs from the water fixture survey as well as occupancy schedule.



Project Recommendations

For any questions regarding the recommended projects, please contact your assigned engineer.

1. LED Retrofit and Controls

Almost all fixtures have been upgraded to LED lighting. The only remaining one is the 2x4 fluorescent in the server closet. We also recommend installing vacancy sensors in several appropriate areas throughout the facility. More detail can be seen in Appendix A.

2. 20 SEER/10 HSPF ASHP (ROB around 2032)

When it is time to replace the existing split system air source heat pump (ASHP), we recommend upgrading to a 20 SEER or higher unit rather than the current minimum efficiency of 14 SEER. Installing ASHPs also converts gas heat to electric and should allow transfer to a lower Alabama Power heat pump rate plan. The expected useful life of heat pumps is around 15 years and the current systems are from 2017. The cost associated with this project is the incremental difference between a standard unit and a higher efficiency one.

2. WiFi Thermostats (4x)

Installation of web-based thermostats (also referred to as Wi-Fi Thermostats) in place of the existing standard thermostats will allow consistent scheduling to be done throughout the building, as well as remote setpoint adjustment. This increases the ability of the facility manager to reduce power consumption in the building when unoccupied. Thermostats included are the 3 for the conditioned building interior and 1 for the bay heater. Note: If pursuing project #2, the 20 SEER units will require proprietary “communicating” thermostats that come with the system.

4. Air Seal Attic

Drop ceilings like the one above the heated/cooled office and classroom space are not intended air barriers, so technically the air barrier for the space is the ceiling of the metal building (top of picture) and the wall separating the bay from the attic. Adding an attic access door will help separate conditioned from unconditioned space. Additionally, after an attic door is added the wall (shown at right) can be insulated and the roof/wall junction can be air sealed. The structure isn’t an ideal setup from a building science perspective, but doing a little bit of air sealing should help with HVAC utility costs.

5. Door Weather Stripping (3x)

Adding weather stripping to the back door (pictured at right) will reduce the infiltration of hot air in the summer and prevent the chimney effect of warm air escaping in the winter. Additionally, the doors separating the bay from the classroom should have floor sweeps for the same purpose. This will reduce the heating and cooling loads of the building and will save HVAC energy.

6. Heat Pump Water Heater (ROB around 2031)

Southface recommends replacing the water heater with a heat pump water heater (HPWH) which is more than two times as efficient as a standard electric water heater. It also has the added benefit of dehumidifying and cooling the surrounding area.

7. Vending Miser for Coke Machine

Installing a vending miser on the cold beverage machine will reduce energy usage by automatically turning off the vending machine when no one is around, monitoring the room's temperature, and automatically re-powering cooling system to ensure product stays cold. Vend misers help reduce energy in vending machines to the level of Energy Star qualified equipment.

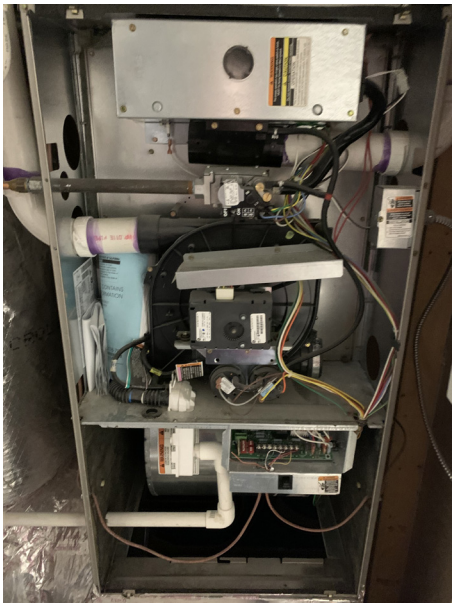
8. Solar PV (25kW)

Installation of a photovoltaic (solar panel) system will reduce utility costs immediately. The PV system sizing and production was estimated using an NREL-developed tool called PVWatts. Cost savings estimates assumed a buy-back rate equal to $0.035/kWh and 50% of production buy-back.

Speaking with a local or regional solar contractor is recommended to determine the specific procedures and buyback rates associated with installing rooftop solar in Alabama Power's territory. That will directly impact project payback time. Additional detail can be seen in Appendix C.

9. Maintenance: Airflow Adjustment (Fixed on-site)

The furnace/AC unit serving the bedroom area was not commissioned correctly so the blower speed was at the factory setting of high, which yielded a 500 cfm/ton airflow. This is extremely high and results in reduced dehumidification capacity. Bryant adjusted the blower speed during the site visit to a more appropriate 350 cfm/ton for the hot-humid climate zone that Montevallo is in.



10. Maintenance: Change OA Filters

The outside air (OA) filters appear to have been changed infrequently or never, which is understandable because they are located in a different duct from the return air filters inside this building. These filters filter the outside air before flowing through the air handler and coming into the building. The state of the existing filters indicates that there is almost no outside airflow currently, making it an indoor air quality (IAQ) issue.

11. Maintenance: Clean A/C Condensate Traps

The p-trap on two of the air handlers was discovered to be clogged and condensate was leaking around the base of the evaporator coil into the condensate drip pan. Mold can be seen at right around the condensate drains and it's likely that mold is growing inside the evaporator coil because of the standing water that has backed up inside the unit.

Existing Building Conditions

Building Envelope

The firehouse is a steel-framed metal building with a brick front, double pane windows, metal siding, and metal roof. Projects #4 and #5 address the energy issues observed on site.

Lighting

Lighting is almost entirely LED, with one fixture still fluorescent. Adding vacancy sensors to appropriate areas such as offices and restrooms (ultrasonic sensors are recommended for restrooms) can further reduce lighting energy usage.

Plumbing and Potable Water Use

There are 3 faucets, 2 toilets, 1 shower, and 1 sink in the facility. The faucets and shower meet WaterSense specifications. The toilets could be upgraded to WaterSense units, but the payback would be long (146 years). Detail can be seen in Appendix B.

Domestic Hot Water

The current water heater is a 40 gallon AO Smith electric resistance unit from 2018. The expected useful life of electric water heaters is around 13 years, so it could be replaced around 2031. A standard replacement is around $1000, so upgrading to a HPWH would be about $1500 more, resulting in a 6.2 year payback for the ROB scenario. The exposed hot water line seen in the picture should be insulated as well.

Health and Safety

The only health or safety issues are addressed by projects #9-11.

Additional Resources

Southface's Alabama Energy Code Field Guide

A helpful resource to see how new buildings should be constructed and how existing buildings measure-up is Southface's Alabama Energy Code Field Guide.

Commercial Code Field Guide:
https://4553qr1wvuj43kndml31ma60-wpengine.netdna-ssl.com/wp-content/uploads/2020/10/Alabama-Commercial-Field-Guide_FINAL-Sept-2020-1.pdf

Residential Code Field Guide:
https://4553qr1wvuj43kndml31ma60-wpengine.netdna-ssl.com/wp-content/uploads/2020/07/FINAL_Alabama_2020-Residential-Field-Guide.pdf

Alabama Power Rebate Program

There are limited rebates available through Alabama Power as well as some general tips. Details on rebate amounts and eligibility can be seen here:

https://www.alabamapower.com/business/save-money-and-energy.html

Appendices

Appendix A: Lighting & Controls Detail

Existing						Proposed					Cost		
Area	Fixture	Qty	Total Watts	Annual Hours	Annual kWh	Fixture Type	Total Watts	Lighting Controls	Controls % Savings	Annual kWh	Total Project Cost	Annual Cost Savings	Payback
Outside	LED Screw-in A19	1	10	8,760	88	no change	10	No Change	0%	88	$0	$0	
Outside	LED 150W Flood	2	300	3,996	1,199	no change	300	No Change	0%	1,199	$0	$0	
Outside	LED 50W Flood	1	50	3,996	200	no change	50	No Change	0%	200	$0	$0	
Bay	Led 15W shop fixture	15	225	8,760	1,971	no change	225	Vacancy	26%	1,451	$340	$79	4.3
Shop	Led 15W shop fixture	5	75	3,822	287	no change	75	No Change	0%	287	$0	$0	
Lobby	LED Can fixture	4	40	2,340	94	no change	40	Vacancy	26%	69	$85	$4	22.8
Classroom	LED Screw-in A19	4	40	3,822	153	no change	40	No Change	0%	153	$0	$0	
Classroom	LED 2x2 fixture	12	360	3,822	1,376	no change	360	No Change	0%	1,376	$0	$0	
Offices	LED 2x2 fixture	8	240	2,340	562	no change	240	Vacancy	26%	413	$340	$22	15.2
Offices	LED Screw-in A19	1	10	2,340	23	no change	10	No Change	0%	23	$0	$0	

Appendices

Appendix A: Lighting & Controls Detail

Server closet	2x4 T8 2L	1	60	2,340	140	LED Retrofit Kit (30-watts; 4ft)	30	Occupancy	22%	55	$90	$13	7.0
Conference room	LED 2x2 fixture	12	360	1,456	524	no change	360	No Change	0%	524	$0	$0	
Lounge/Kitchen	LED 2x2 fixture	6	180	3,822	688	no change	180	No Change	0%	688	$0	$0	
Baths	LED 2x2 fixture	3	90	1,456	131	no change	90	Vacancy	26%	96	$170	$5	32.5
Bedroom	LED 2x2 fixture	4	120	1,456	175	no change	120	No Change	0%	175	$0	$0	

Appendix B: Low Flow Plumbing Project Detail

Existing						Proposed				Savings and Payback		
Area	Fixture Type	Qty	GPF/ GPM	Annual kGal		Proposed Fixture Type	Annual kGal	Annual Cost	Fixture Cost (Each)	Annual Savings kGal	Annual Cost Savings	Payback (Years)
Baths	Faucet	3	1.2	3.04	$24							
Baths	Toilet	2	1.6	5.12	$41	Toilet - 1.28 GPF	1.28	4.1	$600	1.0	$8	146.6
Baths	Shower	1	2	10.40	$83							
Kitchen	Sink	1	2.2	0.43	$3							

Appendix C: Solar Panel Detail

The PV system sizing and production was estimated using PV Watts. The estimated monthly energy production and footprint can be seen below.

System Capacity: 25.0 kWdc (167 m2)

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NREL

Caution: Photovoltaic system performance predictions calculated by PVWatts® include many inherent assumptions and uncertainties and do not reflect variations between PV technologies nor site-specific characteristics except as represented by PVWatts® inputs. For example, PV modules with better performance are not differentiated within PVWatts® from lesser performing modules. Both NREL and private companies provide more sophisticated PV modeling tools (such as the System Advisor Model at https://sam.nrel.gov) that allow for more precise and complex modeling of PV systems.

The expected range is based on 30 years of actual weather data at the given location and is intended to provide an indication of the variation you might see. For more information, please refer to this NREL report: The Error Report.

Disclaimer: The PVWatts® Model ("Model") is provided by the National Renewable Energy Laboratory ("NREL"), which is operated by the Alliance for Sustainable Energy, LLC ("Alliance") for the U.S. Department Of Energy ("DOE") and may be used for any purpose whatsoever.

The names DOE/NREL/ALLIANCE shall not be used in any representation, advertising, publicity or other manner whatsoever to endorse or promote any entity that adopts or uses the Model. DOE/NREL/ALLIANCE shall not provide any support, consulting, training or assistance of any kind with regard to the use of the Model or any updates, revisions or new versions of the Model.

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The energy output range is based on analysis of 30 years of historical weather data for nearby, and is intended to provide an indication of the possible interannual variability in generation for a fixed (open rack) PV system at this location.

RESULTS

33,695 kWh/Year*

System output may range from 31,970 to 34,695 kWh per year near this location.

Month	Solar Radiation (kWh / m² / day)	AC Energy (kWh)	Value ($)
January	3.73	2,192	331
February	4.22	2,204	333
March	5.17	2,960	447
April	6.05	3,214	485
May	6.42	3,444	520
June	6.44	3,276	495
July	6.21	3,288	496
August	6.09	3,191	482
September	5.58	2,879	435
October	5.08	2,794	422
November	4.20	2,353	355
December	3.23	1,899	287
Annual	5.20	33,694	$ 5,088

Location and Station Identification

Requested Location	1140 Main Street montevallo, al
Weather Data Source	Lat, Lon: 33.09, -86.86 1.0 mi
Latitude	33.09° N
Longitude	86.86° W

PV System Specifications *(Commercial)*

DC System Size	25.0 kW
Module Type	Standard
Array Type	Fixed (roof mount)
Array Tilt	20°
Array Azimuth	200°
System Losses	14.08%
Inverter Efficiency	96%
DC to AC Size Ratio	1.2

Economics

Average Retail Electricity Rate	0.151 $/kWh

Performance Metrics

Capacity Factor	15.4%

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