ENERGY & WATER ASSESSMENT REPORT

Southface

Southface

ASSESSMENT REPORT

Table of Contents

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.

Southface

ASSESSMENT REPORT

Montevallo Fire Station 2

6/28/2021

4560 Highway 119
Montevallo, AL 35115

Site Details

- Building Type: Fire Station
- Square Footage: 3,900 sq ft
- Built: 2003

Energy & Water Benchmarks

- $6,221 - Annual Utility Cost
- 84% Cost - Electricity
- 12% Cost - Propane (estimated)
- 4% Cost - Water (estimated)

Project Contacts

- Bryant Hains

Senior Technical Project Manager
bhains@southface.org

Executive Summary

The Montevallo Fire Station 2 is a 24/7 occupancy fire station with a gross floor area of around 3,900 square feet. The building consists of a large parking bay, open dayroom area, lobby, bedrooms, and restrooms. Southface estimates that if all energy and water efficiency projects are undertaken, savings of up to 87% energy and 27% water can be achieved.

Project Summary Table

#	Efficiency Measure	Annual Cost Savings	Budgetary Project Cost Estimate	Simple	Estimated Annual Electricity Savings (kWh)	Estimated Annual Water Savings (kGal)
1	LED Retrofit	$1,481	$3,960	2.7	8,858	
2	Heat Pump Water Heater	$353	$2,400	6.8	2,109	
3	20+ SEER ASHP Upgrade (ROB)	$432	$7,500**	17.4	1,296	
4	Replace (3x) Doors from Interior to Bay with Fiberglass or Steel Foam Core Doors	$230	$2,250	9.8	1,374	
5	Low Flow Plumbing Fixtures	$67	$1,270	18.9		8
6	Solar PV (15kW)	$2,024	$45,000	22.2	20,019	
Total		**$4,586**	**$62,380**	**13.6**	**34,943**	**8**

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

Energy & Water Profile

Consumption Profile

The Recycling Center spends approximately $5,234 annually for electricity, an estimated $741 for propane, and an estimated $247 for water (based on equipment specs, occupancy schedule, and average local water and propane rates). The average cost of the utilities is $0.167 per kWh for electricity and assumed $2.46 per therm of propane ($2.25/gallon) and $8 per thousand gallons of water.

Utility	Consumption Annual Use	Annual Cost	Cost Intensity ($/Sq-Ft)
Electricity	31,309 kWh	$5,234	$1.3/Sq-Ft
Propane	301 therms*	$741*	$0.2/Sq-Ft
Water	31 kGal*	$247*	$0.1/Sq-Ft
Total Utilities		**$6,221**	**$1.6/Sq-Ft**

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

Benchmarking

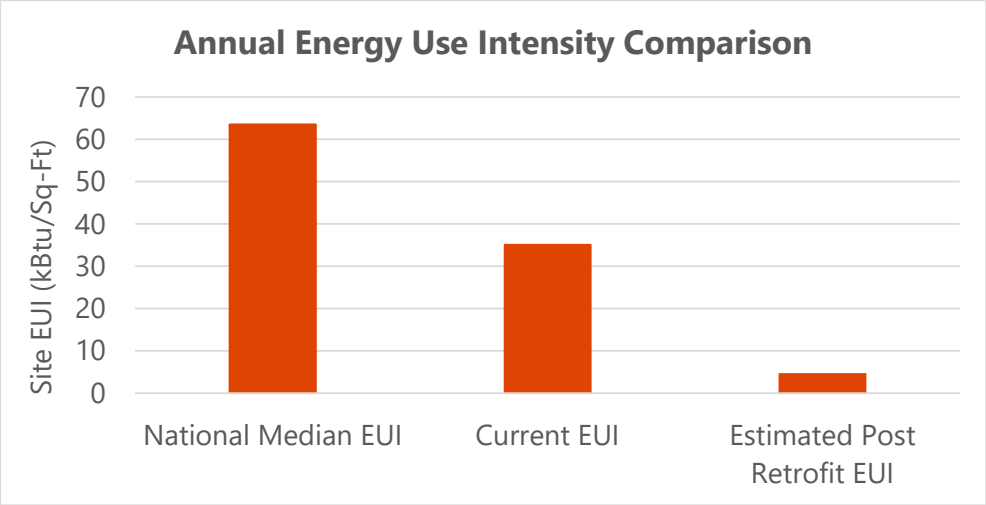
The Fire Station's energy performance was benchmarked using the ENERGY STAR Portfolio Manager tool comparisons. Benchmarking is the process of evaluating the energy performance of a facility relative to key indicators, including the performance of peers and the historic performance of one's own facility. 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	106,826 kBTU	35 kBTU/Sq-Ft	5 kBTU/Sq-Ft	87%
Propane	30,120 kBTU			
Water	31 kGal	8 Gal/Sq-Ft	6 Gal/Sq-Ft	27%

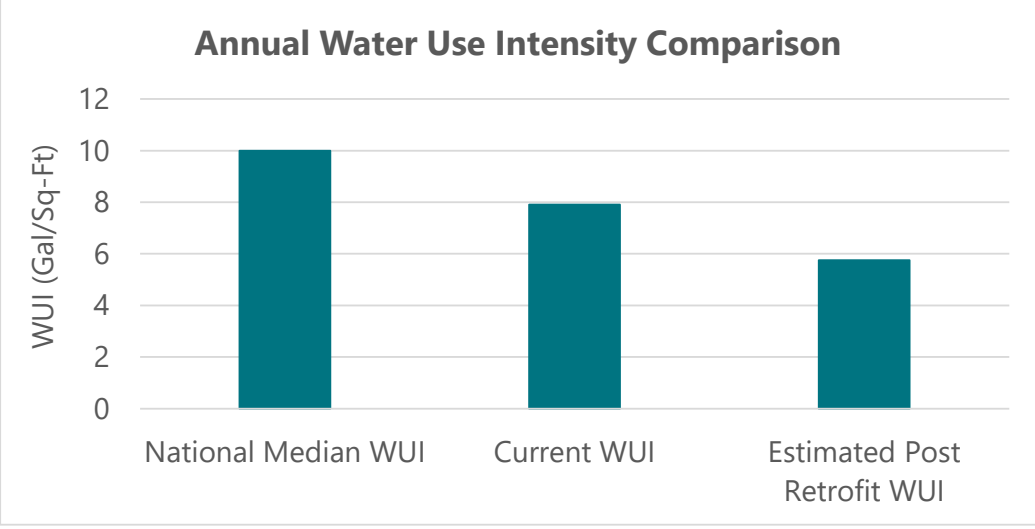
Southface

ASSESSMENT REPORT

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 2 already has a 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 (87% savings).

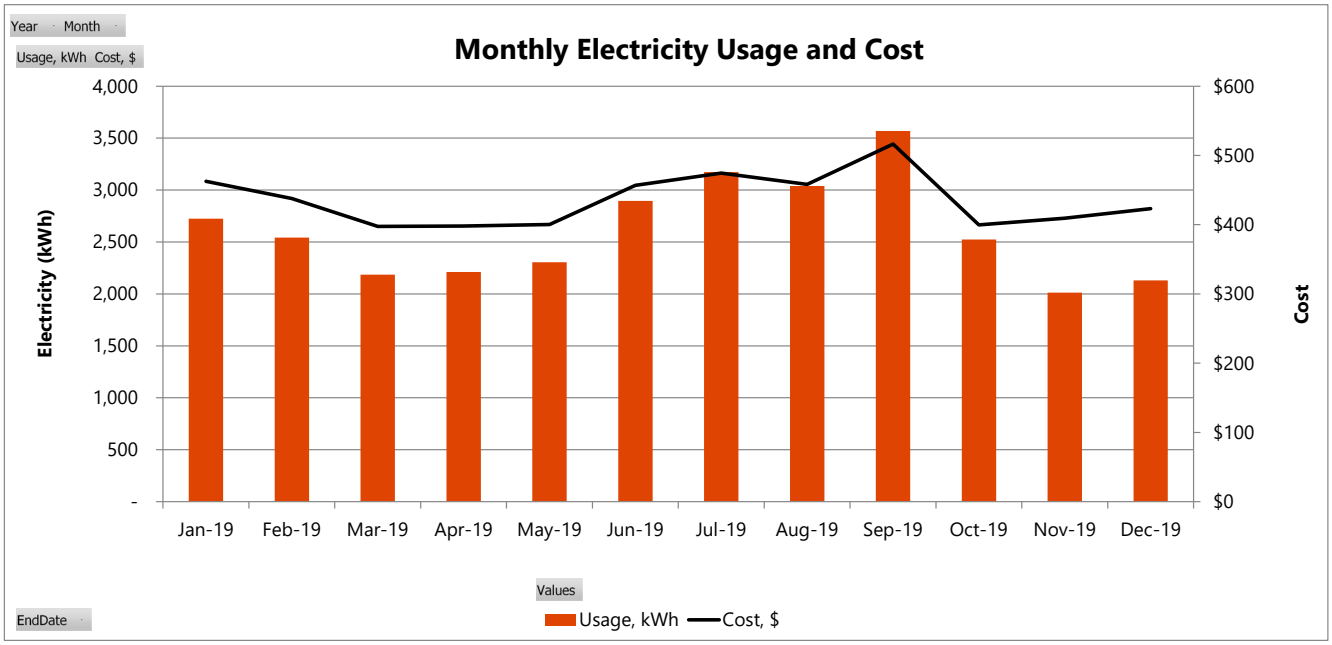


Water Use Intensity (WUI) is a metric used to compare the annual water usage of buildings divided by gross floor area. The following chart shows how the Fire Station compares to the national median WUI for similar building types, as well as an estimate of post-retrofit usage (27% savings). The water usage was estimated from the building's occupancy schedule and plumbing fixture specs.

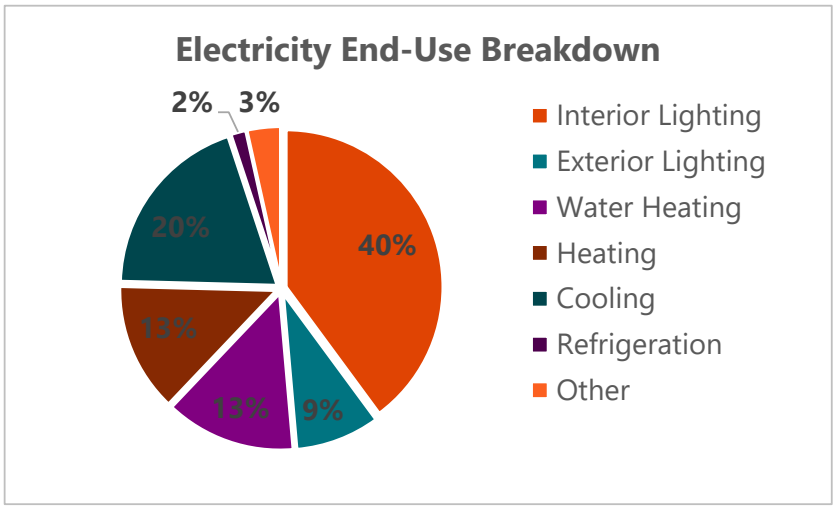


Electricity Profile and Breakdown by End Usage

The pre-COVID annual electricity profile for Fire Station 2 is displayed in the below figure. The monthly electricity use is highest in mid-summer and mid-winter, which is typical for buildings with electric heat pumps.

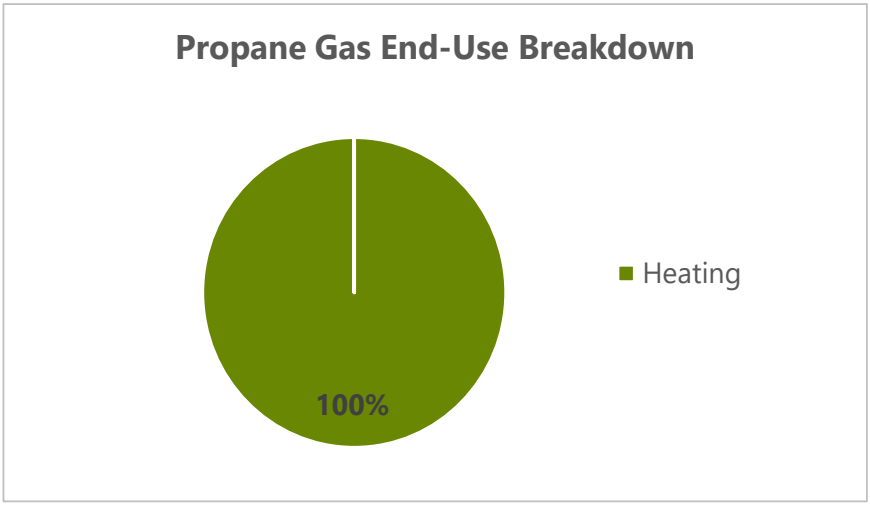


The electricity is broken out by end-use in the figure below. This is an estimate and was developed from the bottom-up using counts and specs from the lighting and HVAC surveys as well as top-down using the billing data. “Other” includes end uses such as plug loads and other ancillary equipment.



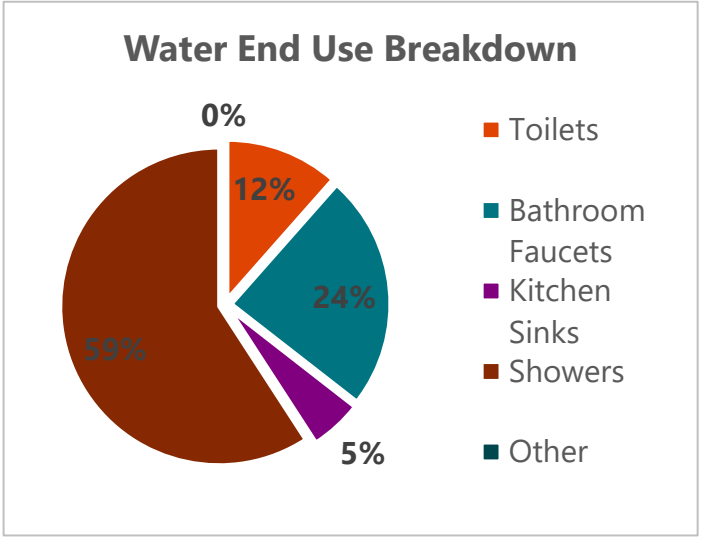
Propane Breakdown by End Usage

Propane 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 heaters and HVAC surveys as well as top-down using the billing data.



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 Lighting Retrofit

Convert existing fixtures to LED lighting. The efficiency, long equipment life, and controllability coupled with the absence of mercury reduce the overall environmental impact of artificial lighting. LED would also provide a more consistent color temperature and superior quality. Note that Southface Institute recommends either full fixture replacement or retrofit kits with external drivers over “plug and play” LED tubes. Reach out to your project engineer if you have questions on this. Additional detail can be seen in Appendix A.

2. Heat Pump Water Heater

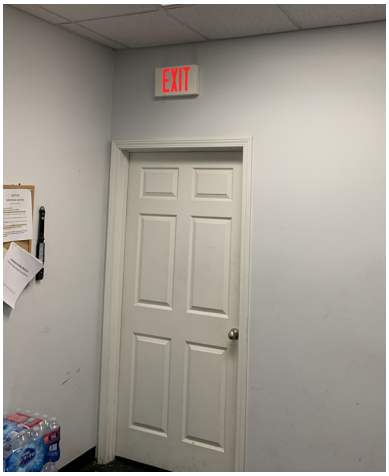
Southface recommends replacing the water heater with a heat pump water heater (HPWH) which is more than two times as efficient as a standard electric water heater. It also has the added benefit of dehumidifying and cooling the surrounding area.

3. 20+ SEERASHP Upgrade (ROB around 2029)

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. The expected useful life of heat pumps is around 15 years and the current system is from 2014. The cost associated with this project is the incremental difference between a standard unit and a higher efficiency one.

4. Replace (3x) Doors

Replace the three doors that separate the heated and cooled portion of the building from the parking bay with fiberglass or steel foam-core doors. This will save both cooling and heating energy, due to better insulation and air sealing.



5. Low Flow Plumbing Fixtures

Existing plumbing fixtures can be replaced with WaterSense certified low-flow plumbing fixtures. This will help reduce usage in multiple ways, as the fixtures have lower GPM and GPF, and the installation of new fixtures will resolve any leaks that may have gone unnoticed over time. WaterSense specs are:
Toilet: 1.28GPF
Urinal: 0.5 GPF
Faucet: 0.5 GPM
Shower: 2.0 GPM

Additional detail can be seen in Appendix B.

6. Solar PV (15kW)

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.

Existing Building Conditions

Building Envelope

The firehouse is a steel-framed metal building with a brick front, metal siding, and metal roof. Project #4 addresses the only energy issues observed on site. There were however additional issues with rainwater roof runoff seeping through the wall on the south side of the building. If persistent, this can result in mold growth within the walls.

Lighting

Lighting is primarily T8 fluorescent indoors and metal halide outdoors and in the bay. The building would benefit greatly from the superior efficiency and quality of LED lighting (project #1), especially due to the long operating hours of the facility. Dimmable fixtures may be desired indoors for lower output at night.

Plumbing and Potable Water Use

There are 2 faucets, 2 toilets, 2 showers, and 1 sink in the facility and all are standard efficiency fixtures. Replacing them with WaterSense certified fixtures or aerators is recommended (project #5). Replacement of existing fixtures may be necessary anyways due to mineral build up from hard water.

Domestic Hot Water

The current water heater is a 50 gallon AO Smith electric resistance unit from 2003. The expected useful life of electric water heaters is around 13 years, so it could be replaced at anytime. A standard replacement is around $1000, so upgrading to a HPWH would be about $1400 more, resulting in a 4 year payback for the ROB scenario.

Health and Safety

There were no health or safety issues observed while on site.

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
Bay	400W Metal Halide	4	1,720	5,460	9,391	LED Highbay	640	No Change	0%	3,494	$1,440	$986	1.5
Dayroom	2 Lamp T8	7	420	5,460	2,293	LED Retrofit Kit (30-watts; 4ft)	210	No Change	0%	1,147	$630	$192	3.3
Bathrooms	3 Lamp T8	2	176	1,456	256	LED Retrofit Kit (30-watts; 4ft)	60	No Change	0%	87	$180	$28	6.4
Lobby	3 Lamp T8	7	616	364	224	LED Retrofit Kit (30-watts; 4ft)	210	No Change	0%	76	$630	$25	25.5
Bedroom	4 Lamp T8	2	224	1,456	326	LED Retrofit Kit (30-watts; 4ft)	60	No Change	0%	87	$180	$40	4.5
Outdoors	175W Metal Halide Wallpack	3	615	3,996	2,458	LED Wallpack with Photocell and Motion Sensor	300	No Change	0%	1,199	$900	$210	4.3
Outdoors	100W LED Flood	2	200	364	73	No Change	200	No Change	0%	73	$0	$0	n/a
Outdoors	10W LED Bulb	2	20	3,996	80	No Change	20	No Change	0%	80	$0	$0	n/a
Sign	10W LED Flood	3	30	3,996	120	No Change	30	No Change	0%	120	$0	$0	n/a

Appendix B: Low Flow Plumbing Project Detail

Existing						Proposed				Savings and Payback		
Area	Fixture Type	Qty	GPF/ GPM	Annual kGal	Annual Cost	Proposed Fixture Type	Annual kGal	Annual Cost	Fixture Cost (Each)	Annual Savings kGal	Annual Cost Savings	Payback
Bathrooms	Toilet	2	1.6	3.55	$28	Toilet - 1.28 GPF	2.8	$23	$600	0.7	$6	211.11
Bathrooms	Faucet	2	2.2	7.41	$59	Faucet Aerator- 1 GPM	3.4	$27	$5	4.0	$32	0.31
Bathrooms	Shower	2	2.5	18.25	$146	Shower - 2 GPM	14.6	$117	$30	3.7	$29	2.05
Wash/Dryer	Sink	1	3	1.64	$13	No Change						

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: 15.0 kWdc (100 m2)

Southface

ASSESSMENT REPORT

6/15/2021

PVWatts Calculator

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.

YOU AGREE TO INDEMNIFY DOE/NREL/ALLIANCE, AND ITS AFFILIATES, OFFICERS, AGENTS, AND EMPLOYEES AGAINST ANY CLAIM OR DEMAND, INCLUDING REASONABLE ATTORNEYS' FEES, RELATED TO YOUR USE, RELIANCE, OR ADOPTION OF THE MODEL FOR ANY PURPOSE WHATSOEVER. THE MODEL IS PROVIDED BY DOE/NREL/ALLIANCE "AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE EXPRESSLY DISCLAIMED. IN NO EVENT SHALL DOE/NREL/ALLIANCE BE LIABLE FOR ANY SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES OR ANY DAMAGES WHATSOEVER, INCLUDING BUT NOT LIMITED TO CLAIMS ASSOCIATED WITH THE LOSS OF DATA OR PROFITS, WHICH MAY RESULT FROM ANY ACTION IN CONTRACT, NEGLIGENCE OR OTHER TORTIOUS CLAIM THAT ARISES OUT OF OR IN CONNECTION WITH THE USE OR PERFORMANCE OF THE MODEL.

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

20,018 kWh/Year*

System output may range from 18,993 to 20,664 kWh per year near this location.

Month	Solar Radiation (kWh / m² / day)	AC Energy (kWh)	Value ($)
January	3.74	1,319	220
February	4.24	1,329	222
March	5.21	1,787	298
April	5.90	1,889	315
May	6.24	2,033	340
June	6.42	1,947	325
July	6.18	1,965	328
August	6.12	1,873	313
September	5.58	1,726	288
October	5.03	1,653	276
November	4.17	1,401	234
December	3.15	1,097	183
Annual	5.17	20,019	$ 3,342

Location and Station Identification	
Requested Location	4560 Highway 119 montevallo
Weather Data Source	Lat, Lon: 33.13, -86.82 1.3 mi
Latitude	33.13° N
Longitude	86.82° W

PV System Specifications *(Commercial)*	
DC System Size	15.0 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	0.167 $/kWh

Performance Metrics	
Capacity Factor	15.2%

ENERGY & WATER ASSESSMENT REPORT

Southface