RUHL Armory
Military Division
1035, YORK ROAD, TOWSON, MD 21204

Energy Survey Analysis Report

Prepared for:
Maryland Department of General Services (DGS)*

Department of
General Services

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Introduction

Project Team

The Smart and Small Thermal Systems (S2TS) group, led by Professor Dr. Michael Ohadi, within the Center for Environmental Energy Engineering at the University of Maryland, College Park (UMD), is performing this project, which is managed by the Maryland Department of General Services (DGS) Office of Energy and Sustainability and collaborates with multiple state agencies. Principal investigator and project Director is Prof. Michael Ohadi. Project Deputy Director is Dr. Amir Shooshtari. The UMD S2TS team members who contributed to the present building audit project included Dr. Roxana Family, Alibek Bekenov, Ji Bae, Yash Jatin Oza, and Aditya Ramnarayan (Team Leader).

Acknowledgment

We would like to acknowledge the building Mr. David Grafton and Mr. Joseph Krause of the building maintenance staff at the RUHL Armory, Military Division, as well as the other staff members for their help and cooperation during the walkthroughs and for answering our questions. We would also like to thank other officers and the armory building for their overall guidance to accomplish this project. We are also grateful to Mr. Tony Myers, Mr. Lorenzo Taylor, and Olatunde Babalola for their diverse help including coordinating the walkthroughs, assisting with the gathering of the relevant technical information for the buildings studied, and review of the reports and feedback to the energy audit team, among others.

Overview

This energy audit supports Governor Hogan’s Executive Order 01.01.2019.08 - Energy Savings Goals for the State of Maryland Government, which was issued in July 2019 to signal the administration’s desire to improve the energy efficiency of state-owned buildings, to reduce their environmental impact, and to save taxpayers’ money. The executive order sets the energy savings goal at 10% savings over a 2018 baseline by 2029. The executive order requires DGS to audit 2 million square feet of State facilities annually, and to present the audit reports to each building’s owner. The executive order goes on to state that:

> **Each unit of state government that occupies the space audited shall, to the fullest extent practicable, implement the measures identified in the audit.**

The UMD’s S2TS group, led by Professor Michael Ohadi, typically conducts the energy audit in two stages: Building walkthrough and its comprehensive understanding, followed by the relevant Energy Efficiency Measures/Opportunities Analysis. For the current project the team carried out a facility walkthrough, analyzed the utility data and building plans to evaluate the energy usage profile of the building, and summarized the respective findings in this report, with a focus on listing actionable energy-saving opportunities to increase the building’s energy efficiency.

The DGS Office of Energy and Sustainability will coordinate with each building owner on financing and implementing the measures identified in this audit report.

Building Description

The RUHL Armory is located at 1035, York Road, Towson, MD 21204. Fig. 1 shows the aerial view of the RUHL armory building. The building was constructed in 1980 and is a two-story building with an overall area of 71,699 ft^2 as specified in the EnergyCAP system. The building is utilized as a readiness and training center by the National Guard's, Military Division.

Fig. 1: Aerial View of RUHL Armory (Photo courtesy Google Earth) [1].

The building houses 16 offices, 3 administrative and meeting rooms, 1 gymnasium, 2 garages, 4 vaults, 1 kitchen connected to a dining area, 2 locker rooms, 6 storage rooms, 1 motor pool, 1 drill hall and 1 large classroom as specified by building manager in building assessment questionnaire. Occupancy in the building varies from 30 to maximum of 250 people during peak usage. Buildings have a lot of open space around, which can be utilized to maximize usage of renewable natural resources.

Based on the questionnaire, the building occupancy schedule is from 9 AM to 5 PM on weekdays. The building consumes energy from two primary energy sources: electricity and natural gas. The electricity consumption is metered and supplied by Constellation New Energy and BGE/ Baltimore Gas and Electric company, while the natural gas is metered and supplied by WGL/ Washington Gas and BGE/ Baltimore Gas and Electric company.

Since the start of the COVID-19 pandemic, the kitchen has not been utilized except to store certain food products in refrigerators, which are already EnergyStar certified. Other equipment in the kitchen include an electric microwave unit, an ice machine, a natural gas commercial oven, natural gas stove. Other major plug inventories in the building are computer systems, copier machines, drinking fountains, high wall type split air conditioner systems.

The building has a roof area of roughly 47,150 ft^2 which can be utilized to maximize the usage of on-site Solar Power generation.

EUI Analysis

Table 1 shows the Energy Use Intensity (EUI) analysis of the Ruhl Armory and its comparison with the widely known EnergyStar reference. The EUI for the building was calculated for FYs 2018 and 2019 based on the data available in EnergyCAP [2].

Table 1: EUI analysis of the Ruhl Armory.

Building name	FYs 2018 and 2019 EUI (E-cap) [2]	Ref. EUI (Energy Star) [3]
Ruhl Armory	15.29 kWh/sq. ft.** (52.17 kBTU/sq. ft.)	15.5 kWh/sq. ft. (52.9 kBTU/sq. ft.)

The EUI values for 2020 and 2021 were not included, due to the COVID-19 pandemic and the fact that buildings were not operating with normal occupancy, among other factors. For example, the EUI for 2021 was 13.60 kWh/sq. ft. (46.41 kBtu/sq. ft.), which is ~10% below the average for 2018 and 2019. The calculations listed in Table 1 (above) considered electricity and natural gas consumption based on the available data. However, as stated above, missing crude oil consumption data, as well as highly irregular natural gas consumption in 2018 all cast uncertainty on the seemingly low EUI value listed in table 1. Based on our team walkthrough and further analysis, the building's envelope and the HVAC equipment are mostly outdated and far from receiving an EnergyStar rating. This issue needs to be revisited to determine a realistic EUI for this building with more recent data as they become available.

Energy Modeling wasn't performed for the facility as no redundant/oversized systems were found to be present in the facility which required further detailed modeling studies. However, numerous energy efficiency measures were identified that can improve the energy efficiency of the facility and are discussed in detail in later sections of this report.

Energy Spend Analysis

Year	Cost
2020	$ 53,580
2021	$ 58,724
2022	$ 66,475
2023YTD	$ 1,897
'18 Baseline Annual	$ 64,196
'18 Baseline YTD	$ 10.309

Fig. 2: Total energy cost summary for the Ruhl Armory [2].

Building Observations:

- Roof Top Units (RTU) are original to the building (over 30 yrs. old) and have surpassed their service life expectancy.
- The interior lighting of the building is provided by HPS and CFL/ fluorescent lamps.
- Water meters were installed, but the data of water usage was not recorded on a specific time interval basis.
- 2 Thermostats installed in the system, (one in the main office on the first floor) and the other in the kitchen area, were out of service or not operating properly.
- No occupancy sensors were found for automatic control of lighting.
- The building does not have any BAS/ Building Automation system for efficient use of resources.
- The Faucets systems were manual. They need to be replaced with sensor-based systems.

Combined/Comprehensive EEMs

EEM 1- HVAC Equipment Replacement

Cooling and Heating Units

In total, a combination of 9 RTUs/ Roof Top Units are mounted on the roof of the building for heating and cooling loads of the building, the data for each unit is as mentioned in Table 2 below.

Table 2: List of existing HVAC systems in RUHL armory.

Manufacturer	Model No.	Type	Cooling Capacity		Heating Capacity	
			(BTU/h)	**kW**	**(BTU/h)**	**kW**
American Standard	TCC030F100BA	Cool Only	36000	10.5	NA	NA
American Standard	TCD180B30AHA	Cool & Heat RTU	182000	53	203000	59
Carrier	50HJ006521	Cool & Heat RTU	60000	17	No Data Available	No Data
Carrier	50TCQA06A2A5A0A0A0	Cool & Heat RTU	61500	18	58000	17
Modine	MD110CA030904B	Heating Unit	NA	NA	110000	32
Modine	MD118CA032104G	Heating Unit	NA	NA	118000	34
EMI	SHD120DDA000AA0A	Cool only condenser unit	12000	3.5	NA	NA
Samsung	AQV36JAN	Inverter Split System Heat Pump	33000	10	34000	10

Findings for Cooling and Heating Units

- The major HVAC system used in the building is more than twenty years old and uses an old R-22-based system, except for the Carrier 50TCQA006 and Samsung AQV36JAN model which use the R410A system and seem to be about 10 years old. Reciprocating compressor-based R-22 systems are inefficient. Moreover, R-22 systems have been banned due to R-22's high global warming potential (GWP) rating. As of January 1, 2020, the EPA no longer allows the manufacturing or import of R-22.

Figure 3: Damaged RTU Heat Exchanger Coil (Left); Corroded Condenser Fan Motor (Right).

- Visual inspection revealed that heat exchangers and fan blades of the system have surpassed their life and need to be replaced. We observed abnormal operation of the condenser fan motor in the TCC030 cool only unit, while the unit was not supposed to be running.
- One of the heating unit on the northern roof of the building was out of service and we recommend a replacement.
- All of the above inefficiencies lead to very high consumption of electricity; thus, unnecessary increase in EUI of the building.

Boiler and Hot water system

The mechanical room of the building had 3 natural gas fired boilers (186MBH Capacity) (set point 180°F) about 26 years old integrated with a burner and fixed speed pump system (1/2 hp) in a parallel circuit for finned tube radiator-based heaters; only one boiler system operates at a time and the other two are kept on standby mode. The building also had 1 instant natural gas-fired water heater for hot water supply. Pumps and other valves are controlled using an old pneumatic system, and an air compressor is used to supply air as working fluid in this control system. Details of the systems present in the mechanical room are mentioned in Table 3 below.

Table 3: Boilers and Hot water system in RUHL armory.

Type	Manufacturer	Model No.	Capacity
Natural Gas Boiler	Smith Cast Iron	Series 8	186 MBH (Steam), 217 MBH (Water)
Natural Gas Burner	Power Flame	CR1-GO-12HBS-8	300 – 1082 MBH(Max)
Natural Gas Instant water heater	State Industries Sandblaster	SBD100390NEA	100 Gal.; 390000 BTU/h
Duplex Splash Lubricated Tank-	Quincy	QC2012D	8.60 CFM at 80 PSIG

Mount Reciprocating Air-Compressor			

Findings for Boiler and Hot water system

- The boilers used in the building were manufactured in 1996 and need to be replaced. Also, for any new boiler installation, we recommend recalculating the boiler size requirement for the building as we believe the current system is oversized.
- Hot water heaters should be replaced with Heat pump water heaters (HPWHs).
    - ENERGY STAR certified electric storage water heaters use a highly efficient heat pump – essentially a refrigerator run in reverse – to transfer heat from the surrounding air to the water, using less than half the energy of an electric resistance unit.

Variable Refrigerant Flow (VRF) system

We recommend replacing current HVAC equipment with a Dedicated Outdoor Air System (DOAS) coupled with a Variable Refrigerant Flow (VRF) system. VRF is an HVAC system configuration with multiple outdoor (condenser) units connected in a modular fashion and multiple indoor (evaporator) units that will take care of the sensible loads within a zone whereas a DOAS will be dedicated toward the latent loads in a zone. The DOAS combined with VRF provides the ability of this system to decouple the sensible and latent loads in a zone, enabling the use of multiple evaporators of differing capacities and configurations, improved Indoor Air Quality (IAQ), individualized comfort control, simultaneous heating and cooling in different zones, appropriate ventilation, and satisfaction of all building occupants. Implementing a DOAS with VRF offers greater design flexibility as the equipment is more compact than traditional systems and has the added benefit of being easily integrated with Building Automation Systems (BAS). Fig. 4 shows a schematic DOAS and VRF arrangement.

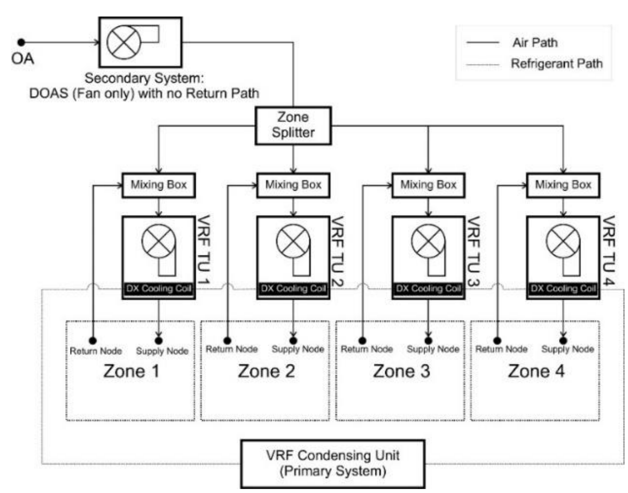


Fig. 4: Schematic VRF arrangement [4].

DOAS equipped with Energy Recovery Ventilators (ERV) recapture cooling and heating energy while ventilating and equalizing humidity levels [5]. An ERV typically handles half of the load required to bring outside air to the required temperature. In other words, facilities with a ventilation system that lacks an ERV will require nearly double the tonnage of mechanical cooling and heating. Even if a facility makes use of a VRF system, the building will still need an ERV to achieve its maximum potential. In typical designs, where DOAS handles ventilation and the VRF system handles cooling and heating, ventilation air is delivered directly to conditioned spaces at room temperature, making it easier to implement proper ventilation rates compliant with ASHRAE 62.1 [6]. A DOAS in conjunction with a VRF system offers better control and IAQ that translates into a healthy and productive work environment for the occupants [5].

DOAS integrated with VRF systems such as the ones offered by Mitsubishi Electric can be considered for the Ruhl Armory [7]. The City Multi products (R2 series, Y-series, WR2-series, WY-series) from Mitsubishi for VRF and PremiSys® DOAS series (MPF1 and MPF2) are designed for commercial applications [8]. They provide zone control, design flexibility, quiet operation, hyper heating inverter (H2i), personalized comfort control, quality air filtration (MERV 8 or MERV 13), and simultaneous cooling and heating operations (R2 and WR2-series). The City Multi Controls Network (CMCN) enables control of multiple centralized controllers, and it can be utilized from any networked PC, tablet, or smartphone. DOAS in conjunction with VRF systems has high energy savings potential which leads to a relatively shorter payback period of five years or less [9].

DOAS plus VRF systems are typically 25% more efficient than conventional HVAC systems [9] due to partial load operation, speed modulation, zoning capabilities, and energy-recovery technology. It could replace current RTUs, window AC and split systems, and boilers of the building, and would also enable progress towards the State of Maryland's future greenhouse gas and environmental goals, starting with the electrification of State Buildings and elimination of Fossil Fuel Systems.

In addition, the system discussed is completely powered by electricity, which eliminates the cost of transporting and storing oil for the boiler.

EEM 2 - Lighting Upgrades

The Lighting system

Major part of the building uses the traditional T-8 (2 or 3 Tubes arrangement in a fixture) CFL lighting. High-Pressure Sodium (HPS) lamps are the source of lighting in the drill hall. Due to the absence of an active control system, the majority of lights were still operating even though the building was nearly empty/very low occupancy.

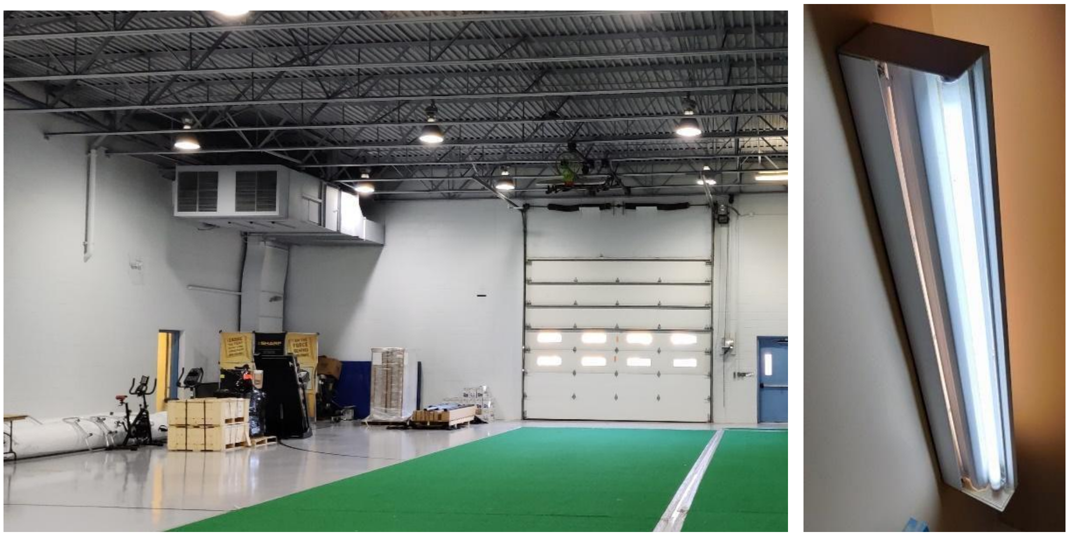


Figure 5: HPS Lighting in Drill Hall (Left); T-8 in Office area (Right).

Findings on lighting

- The lighting system is relatively old and needs to be replaced with new and efficient dimmable LED lights.
- No occupancy sensors were found in any rooms; Strongly recommended to install occupancy sensors.
- Daylighting is not utilized properly in the building.

The building mostly employs CFL T-8’s (Picture 3) with some HPS lighting as well, with no occupancy sensors. Upgrading these fixtures to LED solutions has multiple end-user benefits. Installation of LED lighting, along with occupancy sensors can yield significant energy savings while also reducing the maintenance and labor costs associated with fluorescent and incandescent lighting. LED light fixtures have a longer rated life which would mean fewer costs associated with replacing them. This work would need to be contracted out as the lights would need to be retrofitted to fit LEDs. Lighting control options further enhance the energy-saving potential of LED lighting. During the retrofit, controls such as daylight saving, occupancy sensing operation, and dimming can be integrated into the lighting system to yield energy savings. It is recommended to upgrade CFL and HPS (Sodium) lamps in the building with newer dimmable LED bulbs and occupancy sensors. Transitioning towards LED lighting along with the implementation of controls could yield electricity savings of around 50% of total annual lighting consumption with short payback periods of 2-3 years [10]. The lighting disposal and replacements as well as the lighting controls shall be Design Lights Consortium (DLC) or Energy Star certified and comply with the Maryland Green Purchasing Committee Approved Specifications [11].

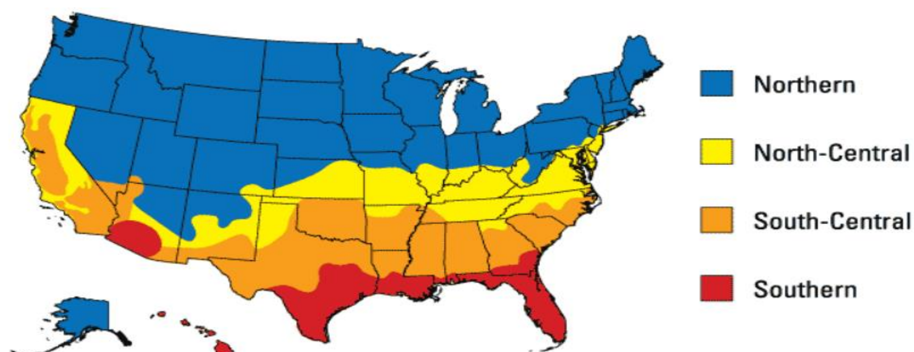
EEM 3 - Windows Upgrade

- Replace old single-glazed and double-glazed windows and doors with new double-glazed, energy-efficient windows and doors.

This upgrade involves replacement of all windows located in the key spaces such as classrooms, offices, recreation room, and other relevant spaces with energy efficient windows.

Approximately 30% of the energy loss can occur through windows and doors [12]. At present, the armory building has partially tinted single glazed windows. Replacing with modern energy efficient windows will help to reduce flow rate of outside air into a building. Since the building is located in North Central climate zone, it is recommended to install windows that meet performance criteria certified by the National Fenestration Rating Council (NFRC) [13]: U-factor <= 0.30 BTU/(h·ft^2·°F) and Solar Heat Gain Coefficient/ SHGC <= 0.40. Low-E glass double-glazed tinted windows with U-factor = 0.33 BTU/(h·ft^2·°F) and SHGC = 0.38 are close to recommended by NFRC. Low-E glass reduces energy use by as much as 30-50%, especially during hot summer months [12].

Replacing the existing windows in the facility can help reduce energy consumption by reducing heat and energy losses through infiltration and thermal radiation losses. Windows are designed for a useful life of 15-20 years [14]. From a study conducted by EPA, it was found that energy-efficient windows for the North-Central Climate Zone criteria would save, on average, $80.75 per year per window, with a payback of 8.5 years [15].



WINDOWS

CLIMATE ZONE	U-FACTOR[1]	SHGC[2]	
Northern	≤0.27	Any	Prescriptive
	=0.28	≥0.32	Equivalent Energy Performance
	=0.29	≥0.37	
	=0.30	≥0.42	
North Central	≤ 0.30	≤ 0.40	
South Central	≤ 0.30	≤ 0.25	
Southern	≤ 0.40	≤ 0.25	

SKYLIGHTS

CLIMATE ZONE	U-FACTOR[1]	SHGC[2]
Northern	≤ 0.50	Any
North Central	≤ 0.53	≤ 0.35
South Central	≤ 0.53	≤ 0.28
Southern	≤ 0.60	≤ 0.28

Air Leakage ≤ 0.3 cfm/ft2

[1] Btu/h ft2·°F
[2] Solar Heat Gain Coefficient

Fig. 6: Energy Star qualified windows by climate zones [13].

EEM 4 - Water Conservation Measures

1) Bathroom Sink Faucets/Accessories
- Replace older models with new WaterSense labeled faucets to reduce water usage. WaterSense labeled products are 20% more water-efficient than average products with payback periods as short as 2-3 years [16].

2) Toilets and Waterless Urinals
- Many high-efficiency toilets are sold in two parts, with the tank and bowl sold separately. When components combine to make a WaterSense labeled product, tanks should include the words "When used in combination with [bowl model number/name]" in close proximity to the label, and similarly with bowl labeling.
- Waterless urinals are available in the market which uses Eco-Trap technology and can last up to 1500 sanitary uses [17].
- A waterless urinal can replace a standard one gallon per flush urinal and save up to 40,000 gallons of water annually [18].

3) Showerheads
- With a WaterSense labeled showerhead, you can save a considerable amount of this water. Water-saving showerheads that earn the WaterSense label must demonstrate that they use no more than 2.0 GPM. The WaterSense label also ensures that these products provide a satisfactory shower that is equal to or better than conventional showerheads on the market.

Summary of Energy and Dollar Savings Potential

EEMs	Proposed Solution	Annual Energy Savings Potential	Annual Dollar Savings Potential	Water Savings (Gallons)
Variable Refrigerant Flow (VRF) system	Replacing current HVAC equipment with a Dedicated Outdoor Air System (DOAS) coupled with a Variable Refrigerant Flow (VRF) system	4.86-5.54 kWh/sq. ft. [19]	-	-
Lighting Upgrades	Replacing the CFLs and T8 fluorescent lamps	-	$0.33/sq. ft. or higher [20]	-

	past their useful life with LEDs			
Windows and doors Upgrade	Replacing old single glazed and double-glazed windows and doors with new double-glazed, energy efficient windows and doors	-	$80.75/year/ window [15]	-
Water Conservation	WaterSense Labelled products and Waterless urinals for efficient use of water in the facility.	-	-	Up to 40,000 gallons of water annually [18].

Summary Scope of Work

A summary scope of work is provided in the following table. The estimated payback periods are to be used as a general guide and otherwise represent average estimated costs offered in the open domain. With the current inflationary market prices, the numbers will certainly need updating when the implementation of any/all of the respective EEMs is intended.

System Description	**Current System/Issue**	**Proposed System/Solution**	**Comments**
HVAC system upgrade	HVAC systems past their useful life and working inefficiently. Old and outdated R-22 based system.	Replace the old equipment with high-efficiency systems such as DOAS and VRF systems with a centralized controller.	DOAS with VRF systems are nearly 25% more efficient than conventional HVAC systems [8]. Due to its high energy savings potential, DOAS/VRF systems can pay for themselves in an estimated five years or less [8].
Lighting upgrades	CFL and HPS lamps employed for lighting.	Replace with LED lighting along with occupancy sensors and controls for daylight harvesting and dimming.	LED lights with the implementation of controls could give 50% electricity savings annually while having a typical estimated payback period as short as

			2-3 years [10].
Windows Throughout the Entire Building	Single glazed windows.	Replace with Low emissivity (Low-E glass) double glazed tinted windows.	Low-E glass reduces energy use by as much as 30-50% [12] and with an average estimated payback of 8.5 years [15].
Water Conservation Measures	Identify and implement WaterSense opportunities, including leak detection. ●Hot water heaters should be replaced with Heat pump water heaters (HPWHs).	WaterSense rated sinks, faucets, and urinals. Leak detection system.	Water-saving techniques by installing WaterSense labeled products that have typically short payback periods of 2-3 years [16].
Renewable Energy	No Solar PV system in place.	Installing Solar Panels for electricity generation.	Based on a 77,350 ft^2 roof (which represents 50% of the available roof area) a 400-kW solar PV system can produce about 563,553 kWh/year of electricity [21]. The typical payback period of a Solar PV system in Maryland is ~11 years [23].

Future Renewable Energy Scope

The Climate Solutions Now Act of 2022 increases Maryland's target for reducing greenhouse gas emissions to 60 percent below 2006 levels by 2031 and sets a 2045 deadline for achieving net-zero greenhouse gas emissions across the state's economy. It also creates a building energy performance standard for the state that will require most buildings over 35,000 square feet to start reporting their data in 2025 and achieve a 20% reduction in direct emissions (as compared to 2025 levels for average buildings of similar construction) by January 1, 2030, and net-zero direct emissions by January 1, 2040.

Building electrification is a critical part of the path to transition away from fossil fuels and to meet the state's aggressive climate goals. Based on DGS data on carbon emissions by the year 2029, the carbon emissions in lb/MWh from the electricity grid will be along the same level as the amount from natural gas sources. This downward trend would continue after 2029 with the CO2 emissions from the electricity grid being less than that of natural gas sources.

Transitioning towards an all-electric system for heating, cooling, and hot water needs, instead of burning natural gas or fuel oil can reduce overall energy use, reduce emissions, and ensure that occupants have access to cleaner, healthier, more resilient buildings.

The building has wide open space around it (parking) as well as free space on a higher roof (Fig. 24), where solar PV panels can be installed to provide supplemental electricity. The solar system would need to be provided with a battery system to offset the intermittent availability of sunlight throughout the year at the location. Using the NREL PVWATTS Calculator, an assumption of the system parameters can be made [21]. For example, at the Ruhl Armory, by assuming 50% of the total roof area for installation of a Solar PV system, a 350-kW solar system can generate about 487,531 kWh/year of AC energy. This system can be sized appropriately based on the available space at the site, preferably the roof. If the roof space is limited, further space can be explored near the site such as parking spaces or other open spaces. Further opportunities include purchasing renewable electricity from utilities wherein the sourced renewable energy could go hand in hand with the site renewable energy implementation. Rebate incentives can be claimed in the form of Solar Renewable Energy Credit (SRECs) [22], also called alternative energy credits in Maryland. SRECs are created for each 1,000 kWh of electricity produced by a qualified alternative energy source. There is no specific size limit, but the systems generally must be connected to the distribution system serving the State, for qualifying.

General Low cost-No cost Energy Efficiency Opportunities (General EnergyStar recommendations)

Following is a general list of low cost/no-cost energy saving opportunities that apply to most buildings in the areas of lighting, heating, cooling, and water heating consumption. It is offered as a supplementary piece of information for the report.

✓ Regularly change or clean HVAC filters, particularly during peak cooling or heating season, as dirty filters cost more to use, overwork the equipment, and result in lower indoor air quality.

✓ Calibrate thermostats to ensure that their ambient temperature readings are correct, and adjust temperature set points for seasonal changes.

✓ Maximize daylight harvesting by opening or closing blinds to make the best use of the natural daylight. Take advantage of skylights or other natural daylight sources to reduce lighting consumption during daytime hours.

✓ Program the lights so that they are off when not in use or when natural daylight is sufficient. This can reduce lighting energy consumption expenses by 10-40% [24].

Appendix

List of the Nomenclature used in the report

AHU – Air Handling Unit
BAS – Building Automation System
BGE – Baltimore Gas and Electric company
CFL – Compact Fluorescent Lamp
DGS – Department of General Services
DOAS – Dedicated Outdoor Air System
GMP – Gallons Per Minute
IAQ – Indoor Air Quality
DHW – Domestic Hot Water
DLC – Design Lights Consortium
EEM – Energy Efficiency Measure
EUI - Energy Use Intensity
ERV – Energy Recovery Ventilator
HID – High-Intensity Discharge
LED – Light-Emitting Diode
NFRC – National Fenestration Rating Council
RTU – Roof Top Unit
S2TS – Smart and Small Thermal Systems
SCIF – Sensitive Compartmented Information Facility
SHGC – Solar Heat Gain Coefficient
SREC – Solar Renewable Energy Credit
VFD – Variable Frequency Drive
WGL – Washington Gas Limited

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