REQUEST FOR QUOTES RESPONSE FOR A
GUARANTEED ENERGY SAVINGS PROJECT AT:

PENNSYLVANIA DEPARTMENT OF GENERAL SERVICES READING, SCRANTON, HARRISBURG, PA

VOLUME II

ECM/COST QUOTE

GESA 2023-1 | May 24, 2023 at 2:00pm

prepared for:
Becky Tomlinson
RFQ Coordinator

Department of General Services
403 North Office Building
401 North Street
Harrisburg, PA 17120

Brewer-Garrett
6800 Eastland Rd
Middleburg Hts, OH 44130
440.243.3535

brewer-garrett.com

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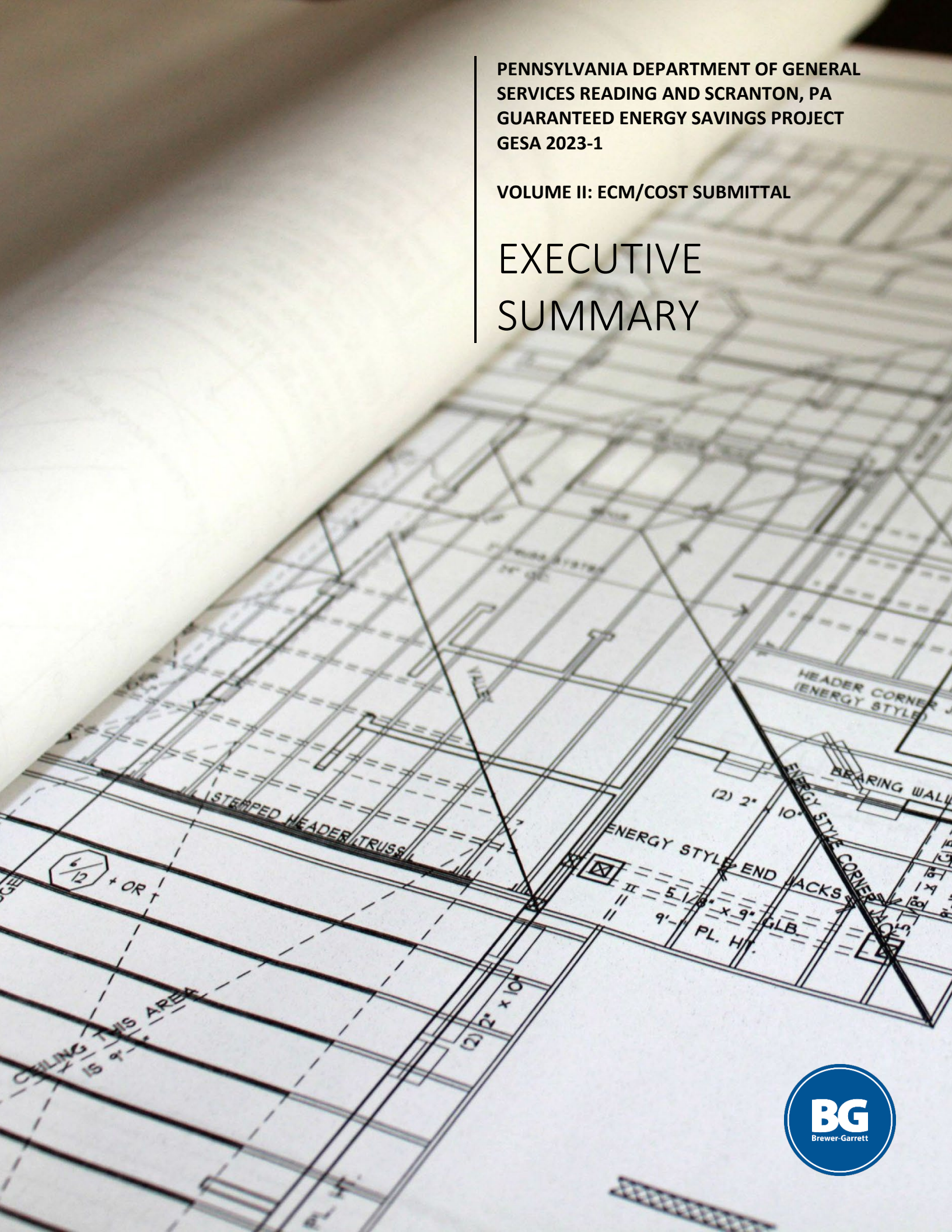
EXECUTIVE SUMMARY



EXECUTIVE SUMMARY

BG is pleased to submit this proposal in response to the Department of General Services Reading, Scranton, Harrisburg, Pennsylvania Request for Quotes issued by the Pennsylvania Department of General Services for this Guaranteed Energy Savings Agreement (GESA) Project.

The Department of General Services Reading, Scranton, and Harrisburg, Pennsylvania GESA project is key to our growth strategy in Pennsylvania. Our aim is to show DGS and the staff at each facility why BG is the best suited firm to execute this project. As a company from Ohio, we must go above and beyond with our best team, most competitive pricing, and most creative solutions to earn your selection and partnership. Because our growth is built on reputation and references, a long-term partnership with DGS contributes to our success throughout the Commonwealth of Pennsylvania.

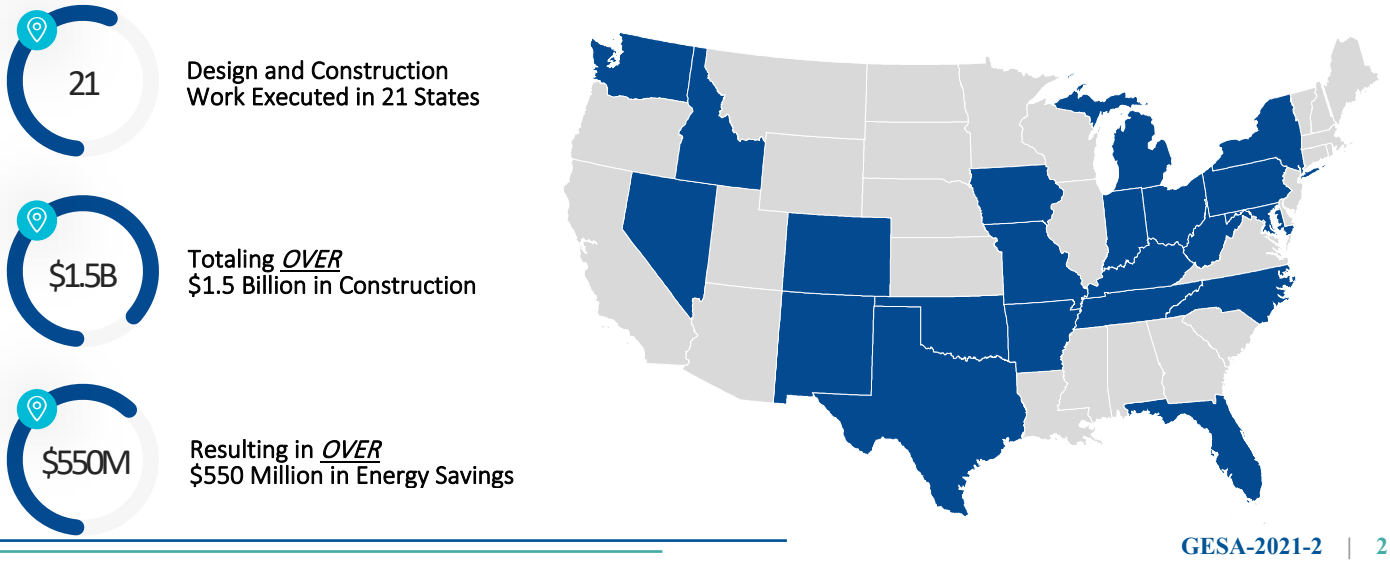
Throughout its history, BG's team has successfully implemented GESA projects in similar facilities throughout various industries and markets—in the last 10 years alone, BG has completed similar projects at 30 universities, 15 hospitals, and five (5) correctional institutions. Many of the management team and key personnel responsible for these projects have been assigned to the DGS GESA project team.

Additionally, throughout Pennsylvania BG is currently:

- Developing several energy projects for the United States Army Corps of Engineers (USACE)
- Finalizing an investment grade audit (IGA) for the GESA project at the Department of Corrections' SCI Frackville facility
- Under contract for a $2.2 million multi-phase energy project at Brandywine Heights Area Schools
- Wrapping up construction on an $8.5 million energy project at Shamokin Area Schools
- In negotiations for an energy project with Wilkes-Barre Area Schools

BG's value is in its dedicated staff of in-house professionals; we provide first-tier solutions with our customer's best interest in mind. We deliver direct engineering and construction project controls that safeguard quality, maximize performance, contain costs, and remove the middleman. This structure allows us to maximize the return on investment for our customers and enables us to guarantee cost effective solutions and on-time installations geared toward customer satisfaction.

"Since 1996, BG has successfully designed and implemented over 830 energy conservation projects totaling over $1.5 billion for customers in 21 States."



Recognitions include:

- NAESCO-Accredited Energy Service Company (ESCO)
- U.S. Department of Energy (DOE) Qualified ESCO
- U.S. Department of Energy (DOE) IDIQ ESPC Contract Holder (Generation 3)
- 1 of 21 ESCOs in the world qualified to execute work under this contract
- Five-time Ohio Governor's Award for Excellence in Energy Efficiency
- Mechanical Service Contractor of America (MSCA) Green Star Award
- Ernst & Young Entrepreneur of the Year Award
- S.D Corp. Contractor of the Year Award
- MCAA Innovation Award
- ASHRAE Technology Award

BG is proud to present the DGS, facility staff, and Entech with an **Energy Only** solution that utilizes no operations & maintenance (O&M) savings or energy related cost savings (ERCS); *our intent is to provide the GESA Project Team with the outline of a project without leverage that can be built out during the IGA to include a number of additional ECMs based on the highest priority needs of the DGS.* A **Base** solution utilizing all core Energy Conservation Measures (ECMs) outlined in Appendix R. Lastly, we have also provided a **Recommended** solution that addresses most of the core ECMs outlined in Appendix R with some supplementary ECMs to provide additional opportunities.

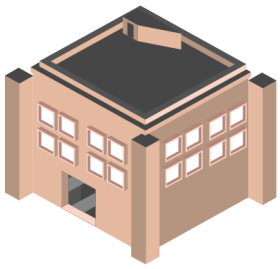
Our proposed projects will achieve the following goals identified in the request for quote:

1. Improving comfort conditions and indoor air quality
2. Replacing and/or upgrading old and/or inefficient systems
3. Improving utilization of technology
4. Upgrading air conditioning systems where applicable
5. Collecting and managing building/ facility information in real time
6. Minimizing financial and technical risk to the Commonwealth
7. Establishing current base usage for all energy
8. Reducing energy usage
9. Reducing operating costs

Note: BG intends to design, construct, and manage its own GESA project solutions. All developed solutions at this stage are representative of our preliminary assessment—no scope is finalized without conducting an investment grade audit (IGA) or without considerable input from the DGS, site staff, and energy consultant.

COMMERCIAL & LOCAL GOVERNMENT EXPERIENCE

NORTHEAST OHIO REGIONAL SEWER DISTRICT (NEORSD)



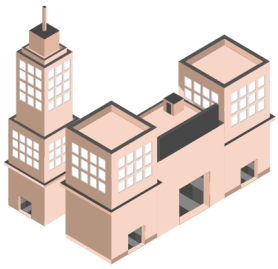
GUARANTEED SAVINGS
$7.1M

TOTAL COST
$6M

185,142 SQUARE FEET

PROJECT RELEVANCE: | De-Centralized Campus-Wide Steam Plant

GALLERIA AND TOWER AT ERIEVIEW



GUARANTEED SAVINGS
$10M

TOTAL COST
$7M

950,000 SQUARE FEET

PROJECT RELEVANCE: | Eliminated Reliance on District Steam

CITY OF BROOK PARK

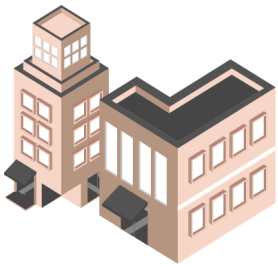
GUARANTEED SAVINGS
$8.4M

TOTAL COST
$9.5M

429,000 SQUARE FEET

PROJECT RELEVANCE: | Renovations to Consolidate City Hall

CUYAHOGA COUNTY



GUARANTEED SAVINGS
$5M

TOTAL COST
$5M

1,257,534 SQUARE FEET

PROJECT RELEVANCE: | Urban Area Construction in Occupied Buildings

PENNSYLVANIA DEPARTMENT OF GENERAL SERVICES READING AND SCRANTON, PA GUARANTEED ENERGY SAVINGS PROJECT GESA 2023-1

VOLUME II: ECM/COST SUBMITTAL

2.6.C.1 INVESTMENT GRADE AUDIT

BG
Brewer-Garrett

PENNSYLVANIA DEPARTMENT OF GENERAL SERVICES READING AND SCRANTON, PA GUARANTEED ENERGY SAVINGS PROJECT GESA 2023-1

VOLUME II: ECM/COST SUBMITTAL

C.1.A. INVESTMENT GRADE AUDIT SCOPE

BG Brewer-Garrett

2.6.C.1 INVESTMENT GRADE AUDIT – *C.1.a. Investment Grade Audit Scope*

a. Quote clearly and thoroughly describes the scope of the IGA, including systems covered, personnel, methodology and schedule milestones.

Upon selection as the successful offeror, the IGA phase will commence to produce a final IGA report for review. This effort will be led by Solutions Manager, James Wilbanks; and supported by Energy Integration Manager/Performance Assurance Engineer, Ted Howell. Mr. Wilbanks has 20 years of experience and has successfully developed more than $150 million in energy savings performance contracts, including multiple healthcare institutions. Mr. Howell has 36 years of experience in energy efficiency for centrally distributed utilities across higher education, healthcare, and correctional institutions.

BG energy engineers will provide the DGS, funding agency, site staff, and energy consultant a comprehensive report detailing current conditions, savings opportunities, guaranteed savings projections, and the guaranteed maximum price of ECMs. Our in-house energy engineering and estimating resources allow for technical and financial review of multiple solutions to ensure that the most functional and cost-effective solution is achieved. The diligence of BG's efforts to date will ensure that the energy savings projected in the final scope of work will be + or - 95% of the savings projected in our quote, the actual ECM costs will be + or - 10% of the costs listed in the quote, and the project will be self-funded over the financial term of the project or a maximum term of 18 years.

Based on the initial review and feedback on our submitted Energy Only solution, Base solution, and Recommended solution in the quote by the DGS, funding agency, site staff, and energy consultant, we will execute a co-authored final IGA report utilizing the process defined in the graphic below.

PRELIMINARY ASSESSMENT & INVESTMENT GRADE AUDIT

James Wilbanks
Solutions Manager
(Single Point of Contact)
LEEP AP BD+C

PRELIMINARY ASSESSMENT & INVESTMENT GRADE AUDIT METHODOLOGY
John Pouliot
Project Development Specialist

TECHNICAL APPROACH
Ted Howell
Energy Integration Manager
CBCP, CEM, LEED AP BD+C, CLEP

Noah Brewer, PE
Senior Energy Engineer
CEM, OSHA 30, DGCP

COST ESTIMATING
Bryan Phlipot
Estimating Manager
OSHA 30

Zach Durbin
Preconstruction Specialist
OSHA 30

IGA PROCESS

1 *Commencement of IGA*
1 DAY

BG will incorporate the DGS, funding agency, site staff, and energy consultant's feedback into our three proposed solutions, conduct project kick-off meeting, and establish lines of communication with DGS, site staff, funding agency, and energy consultant

2 *Final IGA Investigation*
60 DAYS

a. Bi-weekly meetings and conference calls to ensure agreement on scope intent with energy consultant
b. Conduct final site visits
c. Conduct additional surveys of existing conditions and as-built record drawings as needed
d. Final review of codes and permits as needed
e. Perform final land survey (if necessary)
f. Perform final subsurface and related site investigation (if needed)
g. Final review of design restrictions as needed

3 *IGA Approval*
25 DAYS

Final review and approval of IGA by DGS, funding agency, site staff, and energy consultant

4 *Contract Negotiation & Execution*
60 DAYS

BG will conduct contract negotiations and execution as necessary with the DGS, funding agency, site staff, and energy consultant

BG's investment grade audit will be conducted in concert with the DGS, funding agency, site staff, and energy consultant. Bi-weekly meetings and critical ECM workshops will be administered to gain input from facility personnel and the DGS representatives. Additional site visits will also be scheduled to verify preliminary assessment findings and more clearly define the scope and savings potential for each ECM.

- Establish final baseline energy use and utility rates
- Review current lighting, mechanical, electrical, plumbing, and controls systems
- Investigate physical site conditions including building envelope and general trades
- Conduct equipment counts
- Gather nameplate data
- Evaluate controls strategies

Design development will be at least 35% complete to correctly estimate implementation costs and calculate life cycle cost analyses so that final implementation costs per ECM are developed accurately.

Detailed energy savings calculations will be prepared and included with a complete measurement and verification plan, based upon the International Performance Measurement and Verification Protocol (IPMVP) v.12 developed by the Efficiency Valuation Organization with support for the U.S. Department of Energy. For all ECMs, a commissioning approach will be created with operations, maintenance, and training methodology considerations included.

Systems Included in IGA Scope

The following scopes of work will be thoroughly investigated during the IGA phase utilizing the methodologies identified below. Additionally, we provided the estimated timeframe the investigation and analysis of each scope of work will require.

BUILDING AUTOMATION SYSTEM	
6 **WEEKS**	***Methodology:*** • Identify existing controls system in use • Verify existing sequences of operation • Evaluate existing system, in particular, pneumatic controls system to determine potential savings

LIGHTING SYSTEMS	
6 **WEEKS**	***Methodology:*** • In-depth detailed quantification of existing quantity of lamps • Pre-measure circuit amperage • Pre-measure light levels • Photometric analysis of exterior light levels • Adjustments to all systems to ensure light levels meet desired IES and ACA standards

CHILLER SYSTEM	
1 **WEEK**	***Methodology:*** • Verify existing chilled water loads and pipe sizes • Verify existing equipment in chiller plant, existing tower, chilled water pumps, condenser water pumps • Appropriately size the chiller for connected load and verify appropriate sizing of ancillary hydronic equipment • Verify existing electrical distribution system and redesign as required to accommodate new electrical load of the chiller

BOILER & ASSOCIATED STEAM DISTRIBUTION SYSTEM	
4 **WEEKS**	***Methodology:*** • Interview boiler plant operating personnel to investigate operational issues • Verify steam loads to ensure new piping sizes and routings will meet current needs and future expansion needs • Field verify existing steam trap locations and sizes and review to ensure proper

DOMESTIC HOT WATER HEATERS	
4 **WEEKS**	***Methodology:*** • Review all existing steam to domestic hot water heat exchangers, sizing application and control methodology • Investigate part and peak load conditions to ensure heaters are properly sized • Interview maintenance and operating personnel to ensure all existing operational issues are addressed

MECHANICAL SYSTEMS

6 WEEKS

Methodology:

- Test air flow rates of existing air handling units including total supply air, outdoor air, and return air and inspect condition of each existing air handling unit
- Review existing hot water systems including steam hot water heat exchangers, pumping arrangements, and end users

BUILDING ENVELOPE

2 WEEKS

Methodology:

- Visual inspection of tuckpointing, window seals, door seals
- Thermal scan of all exterior structures

ELECTRICAL AND EMERGENCY POWER SYSTEMS

6 WEEKS

Methodology:

- Review and validation of existing electrical power and switchgear systems
- Validation of existing emergency power connected loads
- Adjust system as required to meet new connected loads and desired emergency power loads

SAFETY AND SECURITY SYSTEMS

2 WEEKS

Methodology:

- Validate code compliance of existing system
- Modify existing system as required

The following table identifies the roles on the BG team that will be responsible for investigating each of the identified scopes of work.

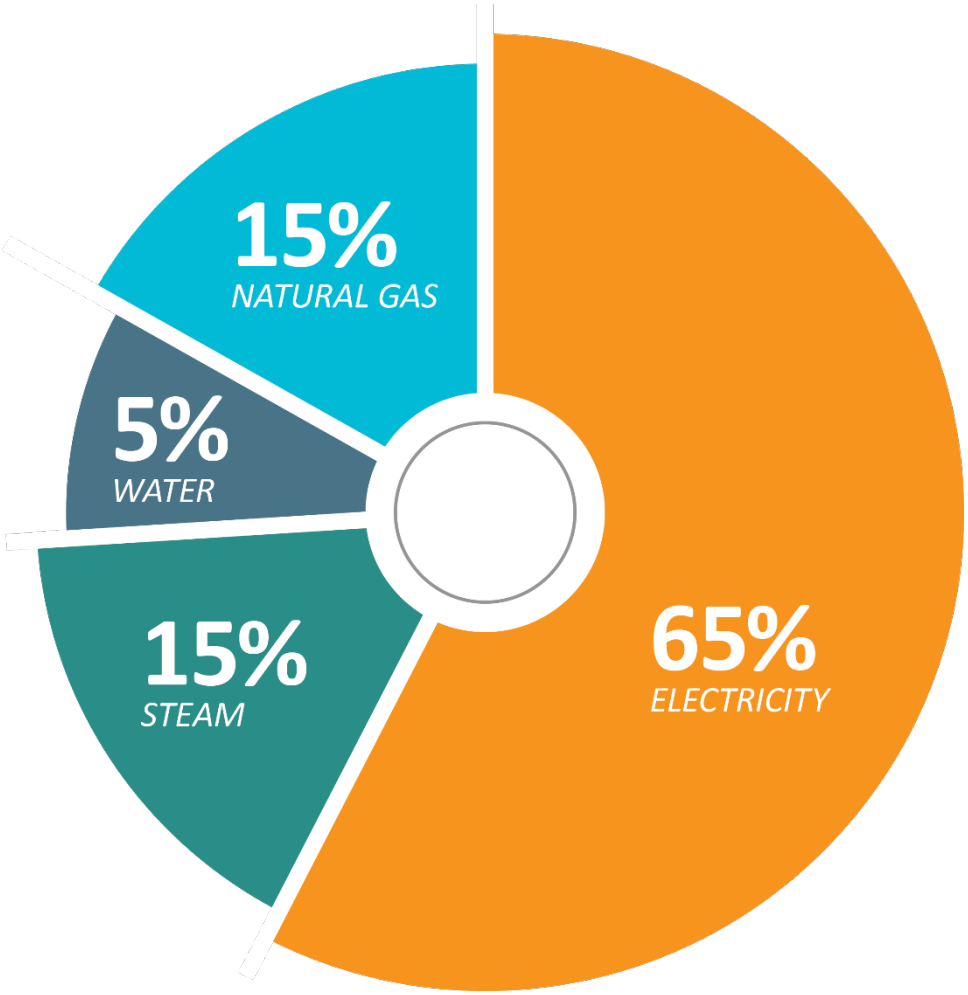
	Solutions Manager	Senior Energy Engineer	Energy Integration Manager	Estimating Manager	Engineering Manager	Mechanical Engineering	Electrical Engineering	Building Solutions
Building Automation System	✔	✔		✔	✔	✔	✔	✔
Lighting Systems	✔	✔	✔	✔	✔		✔	
Chiller System	✔	✔		✔	✔	✔	✔	✔
Boiler & Associated Steam Distribution System	✔	✔		✔	✔	✔		✔
Domestic Hot Water Heaters	✔	✔		✔	✔	✔		
Mechanical Systems	✔	✔		✔	✔	✔	✔	✔
Building Envelope	✔	✔		✔	✔	✔		
Electrical & Emergency Power Systems	✔		✔	✔	✔		✔	
Safety & Security Systems	✔			✔	✔		✔	✔

Baseline Development

To set baselines, BG's energy engineers follow the International Performance Measurement and Verification Protocol (IPMVP) Core Concepts industry standards and best practice for Measurement & Verification (M&V) of energy savings. For the purposes of this submission, BG has rationalized the data provided in the RFQ. Consumption for each utility was averaged over the data set. This approach accounts for weather related anomalies to provide a more realistic quantification of annual consumption.

Baseline development will continue from the IGA phase and into the construction phase. To ensure proper diligence when establishing this baseline, BG's approach will follow the template used by our federal government team, which is defined by the Federal Energy Management Program (FEMP) through the Department of Energy (DOE). A completed M&V plan, and how it correlates to the finalized baseline, will be presented with the IGA. This plan will include all assumptions made, adjustment factors anticipated, and service maintenance required.

Lastly, BG's very own in-house Energy Integration Manager/Performance Assurance Engineer, Ted Howell, will establish a baseline by benchmarking the DGS Reading, Scranton, and Harrisburg facilities' energy consumption against 20 healthcare, higher education, and correctional institutions. Accounting for size and population will allow BG to take a harder look at the facilities' system designs and necessary capacities.



READING STATE OFFICE BUILDING

Electricity: $/kWh	**Natural Gas:** $/MCF	**Water:** $/MGAL	**Energy Use Intensity (Electric, Coal, and Gas:** mmBTU/SF)
$0.07415	$8.65	$31.07	0.04

SCRANTON STATE OFFICE BUILDING

Electricity: $/kWh	**Natural Gas:** $/MCF	**Water:** $/MGAL	**Energy Use Intensity (Electric, Coal, and Gas:** mmBTU/SF)
$0.08556	$85.75	$26.12	0.05

NORTHWEST OFFICE BUILDING

Electricity: $/kWh	**Natural Gas:** $/MCF	**Water:** $/MGAL	**Energy Use Intensity (Electric, Coal, and Gas:** mmBTU/SF)
$0.08141	$24.01	*	0.06

** Information not provided*

BUILDING 55

Electricity: $/kWh	**Natural Gas:** $/MCF	**Water:** $/MGAL	**Energy Use Intensity (Electric, Coal, and Gas:** mmBTU/SF)
$0.11689	$12.09	$19.58	**

*** Not enough information to generate*

*Rates used in Preliminary Assessment baseline for energy use as directed in the RFQ: Part 5 - Work Statement - Section 5.3 Project Parameters

PENNSYLVANIA DEPARTMENT OF GENERAL SERVICES READING AND SCRANTON, PA GUARANTEED ENERGY SAVINGS PROJECT GESA 2023-1

VOLUME II: ECM/COST SUBMITTAL

C.1.B. PROPOSED ENERGY CONSERVATION MEASURES

C.1.b. Proposed Energy Conservation Measures

b. Every ECM described in Energy Conservation Measures Appendix of this RFQ is calculated into the Project scope & includes calculations. If ECM is excluded from scope, Offeror set forth a detailed justification for exclusion.

BG is proud to present the DGS, facility staff, and Entech with an **Energy Only** solution that utilizes no operations & maintenance (O&M) savings or energy related cost savings (ERCS); *our intent is to provide the GESA Project Team with the outline of a project without leverage that can be built out during the IGA to include a number of additional ECMs based on the highest priority needs of the DGS.* A **Base** solution utilizing all core Energy Conservation Measures (ECMs) outlined in Appendix R. Lastly, we have also provided a **Recommended** solution that addresses most of the core ECMs outlined in Appendix R with some supplementary ECMs to provide additional opportunities.

Specifics including project costs, rebates, savings, simple paybacks, and details for each individual ECM can be found in Section C.1.C – Preliminary Assessment of ECMs for Energy Only Solution, for the **Energy Only,** and in Section C.1.G – Brewer-Garrett's Base Solution, for the **Base** solution, and finally for the **Recommended** solution in Section C.1.G – Brewer-Garrett's Recommended Solution.

Detailed savings calculations for all provided solutions can be found in Appendix C – Supplemental Information.

The remainder of this section contains tables clarifying each ECM in the **Energy Only**, **Base**, and **Recommended** solutions.

READING

ECM #	ECM Title	*Energy ONLY*	*BASE*	*Recommended*
ECM-01	LED lighting retro fit / replacement throughout the building.		✔	✔
ECM-02	Upgrade or replace AHUs. Consolidate where possible and add air-side economizer.		✔	
ECM-03	Replace VAV boxes and eliminate dual duct simultaneous heating and cooling. Include ultraviolet (UV) decontamination in AHUs. Provide supply air reset control. Equip AHUs with VFDs and twoway valves for variable volume pumping for heating and cooling. All chilled water valves should be the Belimo Energy Valve to combat low delta T syndrome in the building.		✔	✔
ECM-04	Replace the remaining chiller and associated pumps. Convert to variable volume pumping.		✔	
ECM-05	Provide VFD(s) and associated controls for cooling tower fan(s) or recommission existing.		✔	✔
ECM-06	Eliminate pneumatic controls; install a new building automation system (BAS).		✔	✔
ECM-07	Install a dedicated radon mitigation system for the basement to allow better control and scheduling of the heating, ventilation, and air conditioning (HVAC) and restore outdoor air to rates required for space occupancy.		✔	✔
ECM-08	Replace sewage pump(s).		✔	✔
ECM-09	Explore improvements for the lobby tinted/reflective window film and revolving doors for main entrance.		✔	
ECM-10	Implement water conservation for restrooms (new flush valves).	✔	✔	✔
ECM-11	Overall building weatherization.	✔	✔	✔
ECM-12	Evaluate replacement of electrical main distribution panel to 480V from 208V and eliminate step up transformers.		✔	

SCRANTON

		Energy ONLY	*BASE*	*Recommended*
ECM-13	LED lighting retrofit / replacement throughout the building.	✔	✔	
ECM-14	Overall building weatherization.	✔	✔	✔
ECM-15	Upgrade or replace AHUs. Add air-side economizer. Include UV decontamination in AHUs. Equip AHUs with VFDs and two-way valves for variable volume pumping for heating and cooling. Provide supply air reset control. Replace existing VAV control boxes with new zone dampers and reheat for humidity control. All chilled water valves should be the Belimo Energy Valve to combat low delta T syndrome in the building.		✔	✔
ECM-16	Convert from electric resistance heat to hot water heating. Install a condensing boiler plant in the penthouse storage area and pipe to new hot water coils (included with new AHUs or added to existing in duct).		✔	✔
ECM-17	Replace or refurbish the cooling tower. Provide VFDs and associated controls for cooling tower fan or recommission existing.		✔	
ECM-18	Eliminate pneumatic controls. Extend direct digital controls (DDC) controls to new and remaining equipment. Add/reconfigure control zones to match existing space layout. Provide central control to perimeter baseboard for use as secondary heat for shell load on very cold days.		✔	✔
ECM-19	Convert electric DHW to natural gas or heat pump. Considering the new condition of the existing system and relatively low impact on energy use, this may not be a base ECM; however, gas service could be roughed in to prepare for future conversion.		✔	

DGS ANNEX

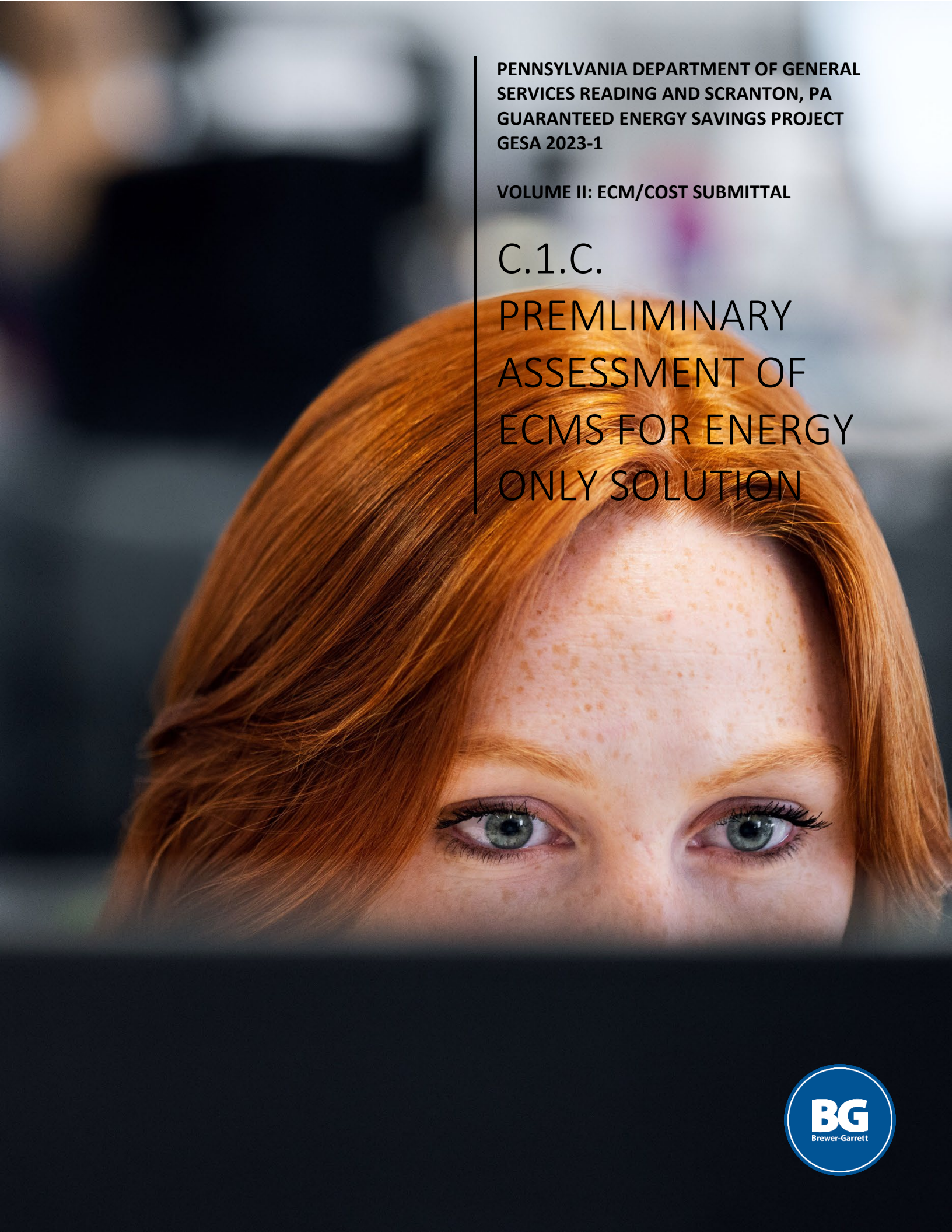
		Energy ONLY	*BASE*	*Recommended*
ECM-20	LED lighting retro fit / replacement throughout the building.	✔	✔	✔
ECM-21	Overall building weatherization.	✔	✔	✔
ECM-22	Install gas boiler and cooling upgrades possible high efficiency heat pumps.		✔	
ECM-23	Explore the value of a possible geothermal system.		✔	
ECM-24	Eliminate pneumatic controls; install a new building automation system (BAS).		✔	✔
ECM-25	Building recommissioning.	✔	✔	✔

NORTHWEST OFFICE

		Energy ONLY	*BASE*	*Recommended*
ECM-26	Replace existing chillers with high efficiency chillers.		✔	✔

ALTERNATIVES

		Energy ONLY	*BASE*	*Recommended*
ECM-27	Rooftop Solar Array.			✔
ECM-28	New High Performance 208V Chiller. (ECM #12 Alternate).			✔
ECM-29	Electric VAV.			✔
ECM-30	Gas Fired RTUs (ECM #22 Alternate).			✔
ECM-31	Steam Trap Repair.			✔
ECM-32	Building Envelope and Film.	✔		✔



PENNSYLVANIA DEPARTMENT OF GENERAL SERVICES READING AND SCRANTON, PA GUARANTEED ENERGY SAVINGS PROJECT GESA 2023-1

VOLUME II: ECM/COST SUBMITTAL

C.1.C. PREMLIMINARY ASSESSMENT OF ECMS FOR ENERGY ONLY SOLUTION

BG Brewer-Garrett

C.1.c. Preliminary Assessment of ECMs for Energy Only Solution

c. Quote provides a preliminary assessment of the ECMs, including a detailed estimate of implementation costs and energy cost savings, with detailed calculations for each ECM without usage of O&M savings or energy related cost savings.

The following pages illustrate the **Energy Only** solution that utilizes no operations & maintenance (O&M) savings or energy related cost savings (ERCS). Contained in this section is:

- **The ECM Chart** highlighting project cost, rebates, savings, and simple payback at a glance
- **Individual ECM templates** detailing observations on existing conditions and proposed solutions as well as preliminary cost and savings data

Detailed savings calculations can be found in Appendix C – Supplemental Information.

Energy ONLY

ECM #	ECM Title	
ECM-10	Implement water conservation for restrooms (new flush valves).	✔
ECM-11	Overall building weatherization.	✔
ECM-13	LED lighting retrofit / replacement throughout the building.	✔
ECM-14	Overall building weatherization.	✔
ECM-20	LED lighting retro fit / replacement throughout the building.	✔
ECM-21	Overall building weatherization.	✔
ECM-25	Building recommissioning.	✔
ECM-32	Building Envelope and Film.	✔

DGS Reading, Scranton, and Harrisburg GESA
Energy Only GESA Project Summary

Project Column Description
A: Construction cost to supply, install, and start up ECM
B: Calculated utility rebate
C: Calculated energy savings
D: Operation and Maintenance (O&M) savings - detail provided below
E: C + D
F: A / E
G: Calculated utility savings (energy constant by ESCO)
H: Additional funds needed annually for 18 year project simple payback

ECM #	ECM Description	A Construction Cost	B Utility Rebates	C Annual Energy Savings	D O&M Savings	E Total Energy and O&M Savings (C + D)	F Simple Payback (A / E)	G Annual Utility Savings					H Annual SPB Shortfall
								Natural Gas (MCF)	Electric (kWh)	Water (CCF)	Sewer (CCF)	Oil (Kgal)	
Reading													
10	Implement water conservation for restrooms (new flush valves).	$53,564	$0	$4,064		$4,064	13.2	7	0	390	390		
11	Overall building weatherization	$19,931	$0	$1,342		$1,342	14.9	129	3,041	0	0		
Scranton													
13								0		0	0		
14	Overall building weatherization	$37,069	$0	$7,424		$7,424	5.0	0	86,730	0	0		
DGS Annex													
20	LED lighting retro fit / replacement throughout the building.	$37,980	$1,653	$4,806		$4,806	7.9	0	41,114	0	0		
21	Overall building weatherization.	$66,559	$0	$8,128		$8,128	8.2	333	35,072	0	0		
25	Building recommissioning.	$58,634	$0	$5,678		$5,678	10.3	228	24,996	0	0		
Northwest Office													
Alternatives													
32	Building Envelope and Film.	$162,455	$0	$14,750		$14,750	11.0	383	68,161	0	0		
	Energy Consultant Fee (7%)	$30,533											
	Totals	**$466,725**	**$1,653**	**$46,192**	**$0**	**$46,192**	**10.1**	**1,080**	**259,113**	**390**	**390**	**0**	**0**

Utility Rebates (B)	$1,653
Annual SPB Shortfall (H)	$0
Financed Amount (A - B)	$465,072

Annual Shortfall Detail
Shortfall = (ECM Cost/18) - (ECM Savings)

IMPLEMENT WATER CONSERVATION FOR RESTROOMS (NEW FLUSH VALVES)

ECM Category: Energy Only / Base / Recommended
Location: Reading State Office Building

ECM 10

EXISTING CONDITION

Building staff indicated a water conservation project had been completed in or around 2014. Most of the toilets are 1.6gpf, with newer china. The urinals are high flow and the sink faucets, for the most part are already low flow.

PROPOSED SOLUTION

Thirty (30) existing flush valves will be replaced with 1.28gpf piston valves.

Two (2) existing wall mounted water closets will be replaced with new china and 1.28gpf flush valve.

Ten (10) existing high flow urinals will be replaced with .125gpf urinals.

The sink faucets and/or aerators will not be replaced.

IMPLEMENTATION COST

$53,564

ENERGY COST SAVINGS

$4,064

MAINTENANCE CONSIDERATIONS

- No additional maintenance required

M&V OPTION

OPTION A

OVERALL BUILDING WEATHERIZATION

ECM Category: Energy Only / Base / Recommended
Location: Reading State Office Building

ECM 11

EXISTING CONDITION	PROPOSED SOLUTION
The Reading State Office Building is a 5-story brick building. During the site surveys it was observed that there was air being lost through exterior doors, interior doors and the roof / wall joints.	BG recommends weather stripping the doors and sealing the roof / wall joints as described below: Exterior doors all levels (18) weatherstrip and seal Interior doors in penthouse (1) weather strip and seal Roof/Wall (520) lineal feet seal with two-part foam

IMPLEMENTATION COST	*ENERGY COST SAVINGS*
$19,931	**$1,342**

MAINTENANCE CONSIDERATIONS	M&V OPTION
• No additional maintenance required	**Option A**

LED LIGHTING RETROFIT/REPLACEMENT THROUGHOUT BUILDING

ECM Category: Energy Only / Base Solution
Location: Scranton State Office Building

ECM 13

EXISTING CONDITION

Interior: The existing lighting system at Scranton is very efficient by fluorescent standards and there are a limited amount of occupancy sensors on site. It was upgraded at some point to reduced wattage (25w) T8 lamps and low ballast factor ballast. The majority of the recessed fixtures have been delamped from 2 lamps to 1 lamp. Also present are recessed can lights with pin based CFL's, other fixtures with a screw base lamp, and some fixtures using LED technology.

Exterior: Currently there is not a large quantity of exterior lighting, however there are HID wall packs and flood lights on the outside of the building.

PROPOSED SOLUTION

Interior: BG is proposing to retrofit the existing linear fluorescent fixtures with 10.5w UL Type B TLED's lamp for lamp basis maintaining the delamped configuration of the fixture. 2x2 fixtures will receive a reflector kit and straight 2' 7w TLED's. Recessed can lights with pin based CFL's will receive a retrofit kit. Recessed cans and other fixtures with a screw base lamp will receive an LED lamp of the appropriate size and wattage.

LED fixtures will be left as is.

At this time, we are not recommending any additional occupancy sensors, however we can investigate the viability of the technology further during the IGA.

Exterior: The HID wall packs on the outside of the building will receive new fixtures and flood lights will receive new LED lamps.

IMPLEMENTATION COST

$252,463

ENERGY COST SAVINGS

$10,173

MAINTENANCE CONSIDERATIONS

- Reduces O&M Costs
- Reduces material cost (lamps/ballast)
- Extends life of the lighting system

M&V OPTION

OPTION A

OVERALL BUILDING WEATHERIZATION

ECM Category: Energy Only / Base / Recommended
Location: Scranton State Office Building

ECM 14

EXISTING CONDITION

The Scranton State Office Building is a 4-story brick building with windows on all exposures. During the site surveys it was observed that air was being lost through exterior doors, interior doors and the roof / wall joints. It was also noted the windows could benefit from a reflective window film.

PROPOSED SOLUTION

BG recommends weather stripping the doors and sealing the roof / wall joints as described below:

- Exterior doors all levels (17) weatherstrip and seal
- Interior doors all levels (10) weather strip and seal
- Overhead door (1) sealed on 4 sides
- Roof/Wall (750) lineal feet seal with two-part foam

BG recommends a reflective window film be applied as described below:

Apply 2,035 square feet of film on 264 windows around the building.

IMPLEMENTATION COST

$37,069

ENERGY COST SAVINGS

$7,424

MAINTENANCE CONSIDERATIONS

- No additional Maintenance for doors
- Using abrasive tools or harsh chemicals for window washing will be harmful to film

M&V OPTION

Option A

LED LIGHTING RETROFIT/ REPLACEMENT THROUGHOUT THE BUILDING

ECM Category: Energy Only / Base / Recommended
Location: DGS Annex Building

ECM 20

EXISTING CONDITION

Interior: The existing lighting system at the DGS Annex building utilizes reduced wattage (28w) T8 lamps and normal ballast factor ballast. Also present are recessed can lights with pin based CFL's, other fixtures with a screw base lamp and some fixtures using LED technology.

Exterior: Currently there is not a large quantity of exterior lighting, however, there are pin based CFL wall packs and fluorescent vapor tight fixtures on the outside of the building.

PROPOSED SOLUTION

Interior: BG is proposing to retrofit the existing linear fluorescent fixtures with 10.5w UL Type B TLED's lamp for lamp basis. Recessed can lights with pin based CFL's will receive a retrofit kit. Recessed cans and other fixtures with a screw base lamp will receive an LED lamp of the appropriate size and wattage.

LED fixtures will be left as is.

Exterior: The pin based CFL wall packs and fluorescent vapor tight fixtures on the outside of the building will receive new fixtures.

IMPLEMENTATION COST

$37,980

ENERGY COST SAVINGS

$4,806

MAINTENANCE CONSIDERATIONS

- Reduces O&M Costs
- Reduces material cost (lamps/ballast)
- Extends life of the lighting system

M&V OPTION

OPTION A

OVERALL BUILDING WEATHERIZATION

ECM Category: Energy Only / Base / Recommended
Location: DGS Annex Building 55

ECM 21

EXISTING CONDITION

The DGS Annex Building 55 is a 3-story brick building with windows on all exposures. During the site surveys it was observed that air was being lost through exterior doors, interior doors, and the roof / wall joints. It was also noted the windows could benefit from a reflective window film.

PROPOSED SOLUTION

BG recommends weather stripping the doors and sealing the roof / wall joints as described below:

- Exterior doors all levels (37) weatherstrip and seal
- Interior doors all levels (1) weather strip and seal
- Overhead door (2) sealed on 4 sides
- Roof/Wall (100) lineal feet seal with one-part foam

BG recommends a reflective window film be applied as described below:

Apply 1,849 square feet of film on 359 windows around the building.

IMPLEMENTATION COST

$66,559

ENERGY COST SAVINGS

$8,128

MAINTENANCE CONSIDERATIONS

- No additional Maintenance for doors
- Using abrasive tools or harsh chemicals for window washing will be harmful to film

M&V OPTION

OPTION A

BUILDING RECOMMISSIONING

ECM Category: Energy Only / Base / Recommended
Location: DGS Annex Building 55

ECM 25

EXISTING CONDITION

ASHRAE considers retro-commissioning/re-commissioning a critical step to ensure a building performs optimally. Given that the Annex Building 55 is 50+ years old and has undergone several different modifications, it is due for a re-commissioning effort.

PROPOSED SOLUTION

The BG retro-commissioning approach is one that utilizes a question-and-answer process for controlled systems. This system is neither product nor approach biased. It merely evaluates the design intent of the system and how successful it is in achieving its goal. The actual operation is then scrutinized to develop the most optimal system given the current building characteristics. For this program to be successful, it cannot be deployed with a broad brush and providing canned recommendations. Buildings need to be selected based upon their energy intensity and the capability of the system to truly operate better. The age of this building indicates it is an appropriate candidate for retro-commissioning/re-commissioning.

The Retro-commissioning effort can be broken down into 4 main sections:

1. Investigation and framing of the program
2. Field Testing
3. Documentation and Analysis
4. Action Item List Development

IMPLEMENTATION COST

$58,634

ENERGY COST SAVINGS

$5,678

MAINTENANCE CONSIDERATIONS

- No additional maintenance required

M&V OPTION

OPTION D

BUILDING ENVELOPE AND FILM

ECM Category: Energy Only / Recommended
Location: Northwest Building

ECM 32

EXISTING CONDITION

The Northwest Building 55 is a 3-story brick building with windows on all exposures. During the site surveys it was observed that air was being lost through exterior doors, interior doors, and the roof / wall joints. It was also noted the windows could benefit from a reflective window film.

PROPOSED SOLUTION

BG recommends weather stripping the doors and sealing the roof / wall joints as described below:

- 4 interior doors weather-stripped & sealed for isolation
- 10 exterior doors weather-stripped & sealed
- 6240 feet of window system to be sealed
- 44 feet of over-head doors to be sealed on 4 sides

BG recommends a reflective window film be applied as described below:

Apply 5,216 square feet of film on 624 windows around the building.

IMPLEMENTATION COST

$162,455

ENERGY COST SAVINGS

$14,750

MAINTENANCE CONSIDERATIONS

- No additional maintenance required for doors
- Using abrasive tools or harsh chemicals for window washing will be harmful to film

M&V OPTION

N/A

PENNSYLVANIA DEPARTMENT OF GENERAL SERVICES READING AND SCRANTON, PA GUARANTEED ENERGY SAVINGS PROJECT GESA 2023-1

VOLUME II: ECM/COST SUBMITTAL

C.1.D. TECHNICAL FEASIBILITY

BG Brewer-Garrett

C.1.d. Technical Feasibility

d. Quote thoroughly demonstrates the technical feasibility, sustainability, reasonableness, comprehensiveness and acceptability of the proposed ECMs, including the proposed equipment and level of quality of the equipment for the proposed savings.

As the GESA offeror, BG's goal is to provide the DGS, funding agency, site staff, and energy consultant with options that will exceed your solution expectations and creates an environment that is not only sustainable, but also the most reasonable and efficient fit. We will work diligently to co-author solutions with DGS, funding agency, site staff, and energy consultant to provide a comprehensive plan that will meet and surpass the goals outlined in the RFQ.

Our proposed projects will achieve the following goals identified in the request for quote:

1. Improving comfort conditions and indoor air quality
2. Replacing and/or upgrading old and/or inefficient systems
3. Improving utilization of technology
4. Upgrading air conditioning systems where applicable
5. Collecting and managing building/facility information in real time
6. Minimizing financial and technical risk to the Commonwealth
7. Establishing current base usage for all energy
8. Reducing energy usage
9. Reducing operating costs

Each measure selected by the Commonwealth, and proposed by BG, is highly technically feasible. We understand the challenges of operating in a fully occupied facility and realize that each item needs to be a reasonable solution that will fit within the safety and security standards of the facility. BG has implemented each of the proposed measures in the past during other projects and stands ready to bring this experience to these DGS facilities. Further, as we do not represent any technology vendors or manufacturers—BG does not have any incentive to specify equipment that may conflict with each facility's needs.

During ECM development, all energy consuming equipment will be evaluated based on load/usage, facility needs, and efficiency. BG will not simply replace existing equipment on a one-for-one basis to increase nominal efficiency. Taking a simple one-for-one approach for a project does provide the quickest solution but is not quality based. Often, it leads to incorrect equipment sizing, reduced operating efficiency, lost opportunity to make a change to a more appropriate technology, and the potential to not meet load/demand needs. BG will evaluate all equipment to be replaced to ensure the correct equipment type, size, and efficiency will meet building(s) needs and save energy.

PENNSYLVANIA DEPARTMENT OF GENERAL SERVICES READING AND SCRANTON, PA GUARANTEED ENERGY SAVINGS PROJECT GESA 2023-1

VOLUME II: ECM/COST SUBMITTAL

C.1.E. TRAINING PROVIDED TO FUNDING AGENCY

C.1.e. Training Provided to Funding Agency

e. Quote thoroughly describes training to be provided to Funding Agency staff, including scope and personnel who will be providing the training and whether the training will be videotaped for future use.

BG's systems integration and training team will provide the funding agency and site staff with hands on training of all installed systems for each ECM. We will additionally videotape the training for future use by the funding agency and site staff. We have an in-house marketing team that can assist on the development of the recorded training.

Senior Building Solutions Manager
Jason Zorc
26 *years of experience*

Controls Operations Manager
Andrew Krueger
15 *years of experience*

Senior Systems Specialist
Joe Mollica
25 *years of experience*

BG places a high priority on training to ensure that our customers have a full and complete understanding of their systems. Personnel training typically follows a successful system start-up and is conducted by BG personnel and/or a manufacturer's representative if applicable. A training sign-in sheet is circulated for signatures to document attendance and, typically, an equipment demonstration form is presented to the Owner for signature to verify acceptance of the new equipment.

The skill development of the funding agency and site staff is an integral part of BG's approach to protect the project's savings guarantee. It is critical that all systems run as intended in order to generate the guaranteed savings. Our training will ingrain a strong customer orientation based upon the principles of flexibility, superior quality, and rapid-response service. The following training is available for all partners of BG:

- **Unlimited on-site sessions training** utilizing internal staff and subject matter experts from BG
- **Seasonal training** on heating and cooling systems
- Retraining of systems **90 days after initial training**
- Informal **"brown-bag" sessions** conducted by staff members of BG
- **Suppliers or vendor training** specific to facility's systems
- **Unlimited** virtual training
- **Building automation training** focused on optimal system operation
- Additional training **whenever requested** by DGS staff

We will work with the site staff to customize a training program that will focus on building their strengths and addressing areas that will help them to increase the life of the systems while reducing energy usage. We will work with the funding agency and site maintenance team to tailor a program that considers the following goals:

- **Instructional Design and Delivery -** BG's content and process experts will work with the funding agency and site staff to design assessments, training curriculum, and outcome measures specific to the learning goals and requirements of the project.
- **Program Design Approach to Learning -** BG provides comprehensive programs to develop talent and drive lasting behavior change. Each program element is designed around the funding agency's objectives and operational realities, and incorporates examples and case studies from your organization to help participants connect the training to their job.
- **Technical Program Training Recommendations** - For HVAC systems, BG's technical personnel can provide training on calibration, adjustments, alignment, lubrication, tightening, and securing system components to help prevent equipment failure and extend the useful life of equipment. This training will help ensure issues are mitigated in a timely and effective manner.
- **Credit, Non-Credit, Certificates or Continuing Education Units (CEU's) -** BG can offer opportunities to credential training to provide a value add for DGS employees. Specifically, training for the project can be designed to earn certificates, CEUs, or to achieve or maintain licensing. Using technology to better manage energy usage and enhance sustainability has the power to impact the funding agency's financial results and transform related business practices.
- **Critical Thinking -** Sustained benefits from the implementation of an energy conservation program is derived not just from the technology but from people making the right decisions about deployment and usage. Enhancing problem solving and decision-making skills will enhance overall program outcomes and improve productivity throughout the organization.
- **Results Orientation -** Once commitment to achieving energy conservation is achieved, the next step in the process is holding the right people accountable for the right outcomes. If each person in the organization understands the drivers for the implementation and the strategic goals, an effective energy conservation program also can be used to create a culture where actions matter by helping each employee understand the impact of their actions on sustainability and energy savings for the funding agency.
- **Program Design-Approach to Learning -** BG provides comprehensive programs to develop talent and drive lasting behavioral change. Each program element is designed around the funding agency's objectives and operational realities and incorporates examples and case studies from your organization to help participants connect the training to their job.

PENNSYLVANIA DEPARTMENT OF GENERAL SERVICES READING AND SCRANTON, PA GUARANTEED ENERGY SAVINGS PROJECT GESA 2023-1

VOLUME II: ECM/COST SUBMITTAL

C.1.F. METHODOLOGY FOR THE PROPOSED ECMS

BG Brewer-Garrett

C.1.f. Methodology for the Proposed ECMs

f. Degree to which the Offeror explained the methodology for the proposed ECMs.

BG takes a comprehensive look at all potential solutions to provide a balance of energy and cost savings as well as considerations towards the operational nature of the facility and it is needs. By addressing each of the Core ECMs outlined in Appendix R, interviewing site staff, and our extensive commercial and local government facility experience, we are confident in our ability to deliver these measures in a cohesive, turn-key project.

Our goal in designing alternate approaches is simply to provide the DGS, funding agency, site staff, and energy consultant another option to address the needs of the facilities. We believe a collaborative environment between all the stakeholders involved with open and unrestricted communication will ultimately deliver the best project.

Each individual ECM methodology is provided in the narratives found in section C.1.c. Preliminary Assessment of ECMs for Energy Only Solution, C.1.g. Brewer-Garrett's Base Solution, and C.1.g. Brewer-Garrett's Recommended Solution.

PENNSYLVANIA DEPARTMENT OF GENERAL SERVICES READING AND SCRANTON, PA GUARANTEED ENERGY SAVINGS PROJECT GESA 2023-1

VOLUME II: ECM/COST SUBMITTAL

C.1.G. BREWER-GARRETT'S BASE SOLUTION

C.1.g. Brewer-Garrett's Base Solution

g. Proposal includes additional innovative ECMs not already included in the project.

The following pages illustrate the **Base solution** that addresses most of the core Energy Conservation Measures (ECMs) outlined in Appendix R. Contained in this section is:

- **The ECM Chart** highlighting preliminary project cost, rebates, savings, and simple payback at a glance
- **Individual ECM templates** detailing observations on existing conditions and proposed solutions as well as preliminary cost and savings data

Detailed savings calculations can be found in Appendix C – Supplemental Information.

BASE

ECM #	ECM Title	
ECM-01	LED lighting retro fit / replacement throughout the building.	✔
ECM-02	Upgrade or replace AHUs. Consolidate where possible and add air-side economizer.	✔
ECM-03	Replace VAV boxes and eliminate dual duct simultaneous heating and cooling. Include ultraviolet (UV) decontamination in AHUs. Provide supply air reset control. Equip AHUs with VFDs and twoway valves for variable volume pumping for heating and cooling. All chilled water valves should be the Belimo Energy Valve to combat low delta T syndrome in the building.	✔
ECM-04	Replace the remaining chiller and associated pumps. Convert to variable volume pumping.	✔
ECM-05	Provide VFD(s) and associated controls for cooling tower fan(s) or recommission existing.	✔
ECM-06	Eliminate pneumatic controls; install a new building automation system (BAS).	✔
ECM-07	Install a dedicated radon mitigation system for the basement to allow better control and scheduling of the heating, ventilation, and air conditioning (HVAC) and restore outdoor air to rates required for space occupancy.	✔
ECM-08	Replace sewage pump(s).	✔
ECM-09	Explore improvements for the lobby tinted/reflective window film and revolving doors for main entrance.	✔
ECM-10	Implement water conservation for restrooms (new flush valves).	✔
ECM-11	Overall building weatherization.	✔
ECM-12	Evaluate replacement of electrical main distribution panel to 480V from 208V and eliminate step up transformers.	✔
ECM-13	LED lighting retrofit / replacement throughout the building.	✔
ECM-14	Overall building weatherization.	✔
ECM-15	Upgrade or replace AHUs. Add air-side economizer. Include UV decontamination in AHUs. Equip AHUs with VFDs and two-way valves for variable volume pumping for heating and cooling. Provide supply air reset control. Replace existing VAV control boxes with new zone dampers and reheat for humidity control. All chilled water valves should be the Belimo Energy Valve to combat low delta T syndrome in the building.	✔
ECM-16	Convert from electric resistance heat to hot water heating. Install a condensing boiler plant in the penthouse storage area and pipe to new hot water coils (included with new AHUs or added to existing in duct).	✔
ECM-17	Replace or refurbish the cooling tower. Provide VFDs and associated controls for cooling tower fan or recommission existing.	✔

BASE (continued)		
ECM-18	Eliminate pneumatic controls. Extend direct digital controls (DDC) controls to new and remaining equipment. Add/reconfigure control zones to match existing space layout. Provide central control to perimeter baseboard for use as secondary heat for shell load on very cold days.	✔
ECM-19	Convert electric DHW to natural gas or heat pump. Considering the new condition of the existing system and relatively low impact on energy use, this may not be a base ECM; however, gas service could be roughed in to prepare for future conversion.	✔
ECM-20	LED lighting retro fit / replacement throughout the building.	✔
ECM-21	Overall building weatherization.	✔
ECM-22	Install gas boiler and cooling upgrades possible high efficiency heat pumps.	✔
ECM-23	Explore the value of a possible geothermal system.	✔
ECM-24	Eliminate pneumatic controls; install a new building automation system (BAS).	✔
ECM-25	Building recommissioning.	✔
ECM-26	Replace existing chillers with high efficiency chillers.	✔

DGS Reading, Scranton, and Harrisburg GESA
Base GESA Project Summary

Project Column Description
A: Construction cost to supply, install, and start up ECM
B: Calculated utility rebate
C: Calculated energy savings
D: Operation and Maintenance (O&M) savings - detail provided below
E: C + D
F: A / E
G: Calculated utility savings (energy constant by ESCO)
H: Additional funds needed annually for 18 year project simple payback

ECM #	ECM Description	A Construction Cost	B Utility Rebates	C Annual Energy Savings	D O&M Savings	E Total Energy and O&M Savings (C + D)	F Simple Payback (A / E)	G Annual Utility Savings					H Annual SPB Shortfall
								Natural Gas (MCF)	Electric (kWh)	Water (CCF)	Sewer (CCF)	Oil (Kgal)	
Reading													
1	LED lighting retro fit / replacement throughout the building.	$186,648	$5,066	$7,482	$1,789	$9,271	20.1	0	100,967	0	0		1,099
2	Upgrade or replace AHUs. Consolidate where possible and add air-side economizer.	$1,211,044	$0	$1,839	$3,685	$5,524	219.2	0	24,823	0	0		61,756
3	Replace VAV boxes and eliminate dual duct simultaneous heating and cooling. Include ultraviolet (UV) decontamination in AHUs. Provide supply air reset control. Equip AHUs with VFDs and twoway valves for variable volume pumping for heating and cooling. All chilled water valves should be the Belimo Energy Valve to combat low delta T syndrome in the building.	$2,461,190	$0	$2,626	$7,488	$10,114	243.3	0	35,436	0	0		126,619
4	Replace the remaining chiller and associated pumps. Convert to variable volume pumping.	$856,187	$0	$3,355	$1,949	$5,304	161.4	0	45,271	0	0		42,262
5	Provide VFD(s) and associated controls for cooling tower fan(s) or recommission existing.	$30,373	$0	$978	$92	$1,070	28.4	0	13,201	0	0		617
6	Eliminate pneumatic controls; install a new building automation system (BAS).	$641,768	$0	$294	$1,953	$2,247	285.6	20	1,634	0	0		33,407
7	Install a dedicated radon mitigation system for the basement to allow better control and scheduling of the heating, ventilation, and air conditioning (HVAC) and restore outdoor air to rates required for space occupancy.	$100,780	$0	$978	$307	$1,285	78.4	0	13,201	0	0		4,314
8	Replace sewage pump(s).	$89,880	$0	$0	$273	$273	329.2	0	0	0	0		4,720
9	Explore improvements for the lobby tinted/reflective window film and revolving doors for main entrance.	$109,138	$0	$192	$332	$524	208.3	8	1,604	0	0		5,539
10	Implement water conservation for restrooms (new flush valves).	$53,564	$0	$4,064	$163	$4,227	12.7	7	0	390	390		(1,251)
11	Overall building weatherization	$19,931	$0	$1,342	$61	$1,403	14.2	129	3,041	0	0		(296)
12	Evaluate replacement of electrical main distribution panel to 480V from 208V and eliminate step up transformers.	$955,763	$0	$0	$2,908	$2,908	328.7	0	0	0	0		50,190
Scranton													
13	LED lighting retrofit / replacement throughout the building.	$252,463	$4,212	$10,173	$2,726	$12,899	19.6	0	118,840	0	0		1,127
14	Overall building weatherization	$37,069	$0	$7,424	$16,172	$23,596	1.6	0	86,730	0	0		(21,537)
15	Upgrade or replace AHUs. Add air-side economizer. Include UV decontamination in AHUs. Equip AHUs with VFDs and two-way valves for variable volume pumping for heating and cooling. Provide supply air reset control. Replace existing VAV control boxes with new zone dampers and reheat for humidity control. All chilled water valves should be the Belimo Energy Valve to combat low delta T syndrome in the building.	$3,265,408	$0	$6,104	$4,527	$10,631	307.1	0	71,314	0	0		170,780
16	Convert from electric resistance heat to hot water heating. Install a condensing boiler plant in the penthouse storage area and pipe to new hot water coils (included with new AHUs or added to existing in duct).	$914,131	$0	$31,673	$434	$32,107	28.5	(2,555)	628,178	0	0		18,678
17	Replace or refurbish the cooling tower. Provide VFDs and associated controls for cooling tower fan or recommission existing.	$118,700	$0	$1,798	$4,041	$5,839	20.3	0	21,002	0	0		756
18	Eliminate pneumatic controls. Extend direct digital controls (DDC) controls to new and remaining equipment. Add/reconfigure control zones to match existing space layout. Provide central control to perimeter baseboard for use as secondary heat for shell load on very cold days.	$815,931	$0	$1,510	$96	$1,606	507.9	0	17,646	0	0		43,723
19	Convert electric DHW to natural gas or heat pump. Considering the new condition of the existing system and relatively low impact on energy use, this may not be a base ECM; however, gas service could be roughed in to prepare for future conversion.	$19,328	$0	$0	$188	$188	102.8	0	0	0	0		886
DGS Annex													
20	LED lighting retro fit / replacement throughout the building.	$37,980	$1,653	$4,806	$858	$5,664	6.7	0	41,114	0	0		(3,554)
21	Overall building weatherization.	$66,559	$0	$8,128	$0	$8,128	8.2	333	35,072	0	0		(4,431)
22	Install gas boiler and cooling upgrades possible high efficiency heat pumps.	$4,879,039	$0	$20,118	$0	$20,118	242.5	1,153	52,851	0	0		250,940
23	Explore the value of a possible geothermal system.	$1,975,702	$0	$3,195	$0	$3,195	618.3	0	27,337	0	0		106,566
24	Eliminate pneumatic controls; install a new building automation system (BAS).	$206,897	$0	$2,269	$0	$2,269	91.2	91	9,998	0	0		9,225
25	Building recommissioning.	$58,634	$0	$5,678	$0	$5,678	10.3	228	24,996	0	0		(2,421)
Northwest Office													
26	Replace existing chillers with high efficiency chillers.	$1,315,875	$0	$8,872	$97,600	$106,472	12.4	0	108,987	0	0		(33,367)
Alternatives													
	Energy Consultant Fee (4%)	$827,199											45,956
	Totals	**$21,507,181**	**$10,931**	**$134,898**	**$147,642**	**$282,540**	**76.1**	**-585**	**1,483,243**	**390**	**390**	**0**	**912,304**

Utility Rebates (B)	$10,931
Annual SPB Shortfall (H)	$912,304
Financed Amount (A - B)	$21,496,250

Annual Shortfall Detail
Shortfall = (ECM Cost/18) - (ECM Savings)
SPB with shortfall = A / (E + H)
18.0

LED LIGHTING RETROFIT/REPLACEMENT THROUGHOUT BUILDING

ECM Category: Base / Recommended
Location: Reading State Office Building

ECM 01

EXISTING CONDITION

Interior: The existing lighting system at Reading is very efficient by fluorescent standards and there is a limited amount of occupancy sensors on site. It was upgraded during a project in 2008 to reduce wattage (25w) T8 lamps and low ballast factor ballast. Most of the recessed fixtures have been delamped from 4 lamps to 2 lamps, or 2 lamps to 1 lamp. Also present are recessed can lights with pin based CFL's, other fixtures with a screw base lamp, and some fixtures using LED technology.

Exterior: Currently there is not a large quantity of exterior lighting, however there are canopy and flood fixtures on the outside of the building.

PROPOSED SOLUTION

Interior: BG is proposing to retrofit the existing linear fluorescent fixtures with 10.5w UL Type B TLED's lamp for lamp. Fixtures will be retrofit on a lamp for lamp basis, maintaining the delamped configuration of the fixture. 2x2 fixtures will receive a reflector kit and straight 2' 7-watt TLED's. Recessed can lights with pin based CFL's will receive a retrofit kit. Recessed cans and other fixtures with a screw base lamp will receive an LED lamp of the appropriate size and wattage.

LED fixtures will be left as is.

At this time, we are not recommending any additional occupancy sensors, however we can investigate the viability of the technology further during the IGA.

Exterior: The existing canopy and flood fixtures will be replaced with new LED fixtures.

IMPLEMENTATION COST

$186,648

ENERGY COST SAVINGS

$7,482

MAINTENANCE CONSIDERATIONS

- Reduces O&M Costs
- Reduces material cost (lamps/ballast)
- Extends life of the lighting system

M&V OPTION

OPTION A

UPGRADE OR REPLACE AHU(s) CONSOLIDATE WHERE POSSIBLE AND ADD AIR-SIDE ECONOMIZER

ECM Category: Base
Location: Reading State Office Building

ECM 02

EXISTING CONDITION

The existing HVAC system uses heating air handling units with cooling air handling units to serve a combination of dual-duct (heating-cooling) and single duct (cooling only) terminal units throughout the occupied spaces. The air handling units currently bring in a fixed outdoor air percentage and therefore have limited economizer operations. Supply air temperature setpoints for both the heating and cooling air handling units are fixed. Heating hot water valves have been replaced with electronic DDC two-way control valves as part of a building boiler upgrade. The existing chilled water system uses constant volume primary-secondary pumping with pneumatic three-way valves at all end users.

PROPOSED SOLUTION

BG is proposing to remove the existing one (1) heating and one (1) cooling AHU in both the basement and penthouse. In both the basement and penthouse, one (1) VAV AHU with chilled water coils will be installed. These new air handling units will be complete with full airside economizer control, updated filtration to meet code requirements, and UV lighting to provide further protection for building occupants. New outside air duct will be routed for the new basement and penthouse AHUs along with new outside air louvers. Also, new relief air dampers will be installed. The new outside air duct will be appropriately sized to allow for economization. Chilled water piping will be routed to the new AHUs and connected to the coils with appropriate valving.

IMPLEMENTATION COST

$1,211,044

ENERGY COST SAVINGS

$1,839

MAINTENANCE CONSIDERATIONS

- No additional maintenance required

M&V OPTION

OPTION C

REPLACE VAV BOXES AND ELIMINATE DUAL DUCT SIMULTANEOUS HEATING AND COOLING. INCLUDE ULTRAVIOLET (UV) DECONTAMINATION IN AHUs. PROVIDE SUPPLY AIR RESET CONTROL. EQUIP AHUs WITH VFDs AND TWO-WAY VALVES FOR VARIABLE VOLUME PUMPING FOR HEATING AND COOLING. ALL CHILLED WATER VALVES SHOULD BE THE BELIMO ENERGY VALVE TO COMBAT LOW DELTA T SYNDROME IN THE BUILDING

ECM

03

ECM Category: Base / Recommended
Location: Reading State Office Building

EXISTING CONDITION

The existing HVAC system uses heating air handling units with cooling air handling units to serve a combination of dual-duct (heating-cooling) and single duct (cooling only) terminal units throughout the occupied spaces. The air handling units currently bring in a fixed outdoor air percentage and therefore have limited economizer operations. Supply air temperature setpoints for both the heating and cooling air handling units are fixed. Heating hot water valves have been replaced with electronic DDC two-way control valves as part of a building boiler upgrade. The existing chilled water system uses constant volume primary-secondary pumping with pneumatic three-way valves at all end users.

PROPOSED SOLUTION

BG's solution will overlap several of these ECMs. In this case, BG will remove all existing dual-duct and single-duct terminal units. These units will be replaced with single-duct terminal units with hot water reheat. Air handling units will be removed and replaced with single common combined units in the mechanical penthouse and basement. These new air handling units will be complete with full airside economizer control, updated filtration to meet code requirements, and UV lighting to provide further protection for building occupants. The single-duct terminal units will allow the air handlers to operate as variable air volume systems complete with new variable speed drives on the units. Air supplied from these units will be dehumidified year-round. This will be accomplished through the new automatic temperature control system, allowing supply air temperature to be reset based on building occupancy and ambient conditions. The existing DDC heating valves will be reused to a great extent and new chilled water valves will be Belimo energy valves. Overall, the new HVAC system included in this and other ECMs will provide a state-of-the-art system with many years of service life.

IMPLEMENTATION COST

$2,461,190

ENERGY COST SAVING

$2,626

MAINTENANCE CONSIDERATIONS

M&V OPTION

OPTION C

REPLACE THE REMAINING CHILLER AND ASSOCIATED PUMPS, CONVERT TO VARIABLE VOLUME PUMPING

ECM Category: Base
Location: Reading State Office Building

ECM 04

EXISTING CONDITION

The existing chilled water system is fed by two (2) existing water-cooled Trane chillers. One (1) of the existing chillers has been removed and is in the process of being replaced. The chilled water distribution system serves existing air handling units, each with three-way control valves. The piping arrangement for the existing chilled water system is a constant volume primary-secondary type, with constant volume pumping on the condenser water as well.

PROPOSED SOLUTIONS

BG will install a new magnetic drive of the same manufacturer and size as the one currently being installed. Along with the new mag-drive chiller, BG will install new chilled water distribution and condenser water pumps with variable frequency drives. Additionally, control valve upgrades on the air handling units will allow the pumping to become a variable volume type, further reducing energy usage of the system. The upgrades to the BAS will also improve energy efficient operations of the chilled water system by varying the chilled water and condenser water temperatures, when possible, to allow the entire system to operate as efficiently as possible.

IMPLEMENTATION COST

$856,187

ENERGY COST SAVING

$3,355

MAINTENANCE CONSIDERATIONS

- No additional maintenance required

M&V OPTION

OPTION C

PROVIDE VFD(s) ASSOCIATED CONTROLS FOR COOLING TOWER FAN(s) OR RECOMMISSION EXISTING

ECM 05

ECM Category: Base / Recommended
Location: Reading State Office Building

EXISTING CONDITION

The cooling tower fan is sized appropriately and in relatively good repair. Additionally, the existing fan motor is rated class F, which allows it to accept a variable frequency drive.

PROPOSED SOLUTION

BG recommends installing one (1) new VFD for the 25 HP cooling tower fan motor. The new VFD will be integrated into the existing BAS. This will work in concert with the variable condenser water pumps and upgraded chilled water system in ECM-4 to provide a much improved overall operating efficiency to the chilled water production.

IMPLEMENTATION COST

$30,373

ENERGY COST SAVING

$978

MAINTENANCE CONSIDERATIONS

- No additional maintenance required

M&V OPTION

OPTION C

ELIMINATE PNEUMATIC CONTROSL; INSTALL A NEW BUILDING AUTOMATION SYSTEM (BAS)

ECM Category: Base / Recommended
Location: Reading State Office Building

ECM 06

EXISTING CONDITION

Currently, the building consists of both dated DDC and pneumatic controls. This situation makes it increasingly difficult to both maintain and repair the existing systems. In addition, there is also the problem of the pneumatics control extent to be somewhat undefined. In many instances, once pneumatics is deployed within a facility, it will be utilized to control many auxiliary components such as valves or exhaust fans. However, these changes will not be fully documented, resulting in the control strategy of many mechanical systems being unknown.

PROPOSED SOLUTION

BG will perform a comprehensive review of the building to identify all mechanical components that are currently under some sort of automatic control, either DDC or pneumatic, to develop and deploy a new building automation system. This information will be used in concert with all other accepted ECMs to provide the city with a comprehensive BAS. In addition, the new system will have the capability to utilize numerous energy saving automation algorithms such as demand control ventilation, discharge temperature reset, discharge static reset, and many others. Ultimately, the building will receive a fully modern automation system with upgraded graphics, trending, alarming, and reporting capabilities along with unlimited training on the new system to ensure the system is operated at its maximum efficiency.

IMPLEMENTATION COST

$641,768

ENERGY COST SAVING

$294

MAINTENANCE CONSIDERATIONS

- Compressor maintenance will be eliminated

M&V OPTION

OPTION C

INSTALL A DEDICATED RADON MITIGATION SYSTEM FOR THE BASEMENT TO ALLOW BETTER CONTROL AND SCHEDULING OF THE HEATING, VENTILATION, AND AIR CONDITIONING (HVAC) AND RESTORE OUTDOOR AIR TO RATES REQUIRED FOR SPACE OCCUPANCY

ECM
07

ECM Category: Base / Recommended
Location: Reading State Office Building

EXISTING CONDITION	PROPOSED SOLUTION
The existing radon mitigation system, while effective, wastes large amounts of energy. Air handling units serving the basement level are operated 24/7 to ensure that radon is removed from the building. The operation of these units in this manner, with a fixed outdoor air intake damper of 10%, has required the building to install and operate an auxiliary air-cooled chiller as required to maintain space temperature and humidity conditions. The net result is that, while effective, the existing radon mitigation is energy wasteful.	BG proposes to install (4) dedicated radon mitigation exhaust systems throughout the affected areas of the building. This system will be a variable volume type, controlled to operate on an as-needed basis and will result in significant annual energy savings for the facility. Additionally, the existing system recirculates approximately 90% of the space air volume delivered. The dedicated radon mitigation system will provide 100% outdoor air, eliminating potential recirculation of the radon gases. Installing the radon mitigation will eliminate the year-round operation of the basement level AHU's, and allow removal of the air-cooled chiller.

IMPLEMENTATION COST	*ENERGY COST SAVINGS*
$100,780	**$978**

MAINTENANCE CONSIDERATIONS	M&V OPTION
	OPTION C

- Additional maintenance required on new radon systems

REPLACE SEWAGE PUMP(s)

ECM Category: Base / Recommended
Location: Reading State Office Building

ECM 08

EXISTING CONDITION	PROPOSED SOLUTION
These pumps are at the end of their useful life.	Replace one (1) sanitary pump set to include a duplex, 75GPM, 20 ft HD, 3/4HP 208v pumps. Replace one (1) RW sump pump set to include duplex, 50 GPM, 20 ftHD, 1/2 HP, 208v pumps.
IMPLEMENTATION COST	***ENERGY COST SAVING***
$89,880	**$0**

MAINTENANCE CONSIDERATIONS	M&V OPTION
• No additional maintenance for pumps • Avoid unplanned failures	**N/A**

EXPLORE IMPROVEMENTS FOR THE LOBBY TINTED/REFLECTIVE WINDOW FILM AND REVOVLING DOORS FOR MAIN ENTRANCE

ECM Category: Base
Location: Reading State Office Building

ECM 09

EXISTING CONDITION	PROPOSED SOLUTION
The Reading State Office Building is a 5-story brick building with windows on each exposure.	Approximately 455 square feet of security window film will be installed for both ground level entry way windows and doors. Additionally, one (1) revolving door will be installed for the main entryway in the same location as the existing door.

IMPLEMENTATION COST	*ENERGY COST SAVINGS*
$109,138	**$192**

MAINTENANCE CONSIDERATIONS	M&V OPTION
• No additional maintenance for doors • Using abrasive tools or harsh chemicals for window washing will be harmful to film	**OPTION A**

IMPLEMENT WATER CONSERVATION FOR RESTROOMS (NEW FLUSH VALVES)

ECM Category: Energy Only / Base / Recommended
Location: Reading State Office Building

ECM 10

EXISTING CONDITION

Building staff indicated a water conservation project had been completed in or around 2014. Most of the toilets are 1.6gpf, with newer china. The urinals are high flow and the sink faucets, for the most part are already low flow.

PROPOSED SOLUTION

Thirty (30) existing flush valves will be replaced with 1.28gpf piston valves.

Two (2) existing wall mounted water closets will be replaced with new china and 1.28gpf flush valve.

Ten (10) existing high flow urinals will be replaced with .125gpf urinals.

The sink faucets and/or aerators will not be replaced.

IMPLEMENTATION COST

$53,564

ENERGY COST SAVINGS

$4,064

MAINTENANCE CONSIDERATIONS

- No additional maintenance required

M&V OPTION

OPTION A

OVERALL BUILDING WEATHERIZATION

ECM Category: Energy Only / Base / Recommended
Location: Reading State Office Building

ECM 11

EXISTING CONDITION	PROPOSED SOLUTION
The Reading State Office Building is a 5-story brick building. During the site surveys it was observed that there was air being lost through exterior doors, interior doors and the roof / wall joints.	BG recommends weather stripping the doors and sealing the roof / wall joints as described below: Exterior doors all levels (18) weatherstrip and seal Interior doors in penthouse (1) weather strip and seal Roof/Wall (520) lineal feet seal with two-part foam

IMPLEMENTATION COST	*ENERGY COST SAVINGS*
$19,931	**$1,342**

MAINTENANCE CONSIDERATIONS	M&V OPTION
• No additional maintenance required	**Option A**

EVALUATE REPLACEMENT OF ELECTRICAL MAIN DISTRIBUTION PANEL TO 480V FROM 208V AND ELIMANTE STEP UP TRANFORMERS

ECM Category: Base
Location: Reading State Office Building

ECM 12

EXISTING CONDITION	PROPOSED SOLUTION
The existing electrical distribution panel is at the end of its useful life and has inadequate space for breakers to support the addition of new mechanical equipment.	BG will design and install a new distribution system for HVAC equipment. The new main distribution panel will be 480/277V – 3Φ – 4W supplied from the new pad-mount service transformer. The existing 208V distribution will be back fed from a new dry type transformer. The existing lighting and branch circuit panels not associated with new HVAC equipment will remain.

IMPLEMENTATION COST

$955,763

ENERGY COST SAVINGS

$0

MAINTENANCE CONSIDERATIONS	M&V OPTION
• No additional maintenance for panels • Avoid unplanned failures	**N/A**

LED LIGHTING RETROFIT/REPLACEMENT THROUGHOUT BUILDING

ECM Category: Energy Only / Base Solution
Location: Scranton State Office Building

ECM 13

EXISTING CONDITION

Interior: The existing lighting system at Scranton is very efficient by fluorescent standards and there are a limited amount of occupancy sensors on site. It was upgraded at some point to reduced wattage (25w) T8 lamps and low ballast factor ballast. The majority of the recessed fixtures have been delamped from 2 lamps to 1 lamp. Also present are recessed can lights with pin based CFL's, other fixtures with a screw base lamp, and some fixtures using LED technology.

Exterior: Currently there is not a large quantity of exterior lighting, however there are HID wall packs and flood lights on the outside of the building.

PROPOSED SOLUTION

Interior: BG is proposing to retrofit the existing linear fluorescent fixtures with 10.5w UL Type B TLED's lamp for lamp basis maintaining the delamped configuration of the fixture. 2x2 fixtures will receive a reflector kit and straight 2' 7w TLED's. Recessed can lights with pin based CFL's will receive a retrofit kit. Recessed cans and other fixtures with a screw base lamp will receive an LED lamp of the appropriate size and wattage.

LED fixtures will be left as is.

At this time, we are not recommending any additional occupancy sensors, however we can investigate the viability of the technology further during the IGA.

Exterior: The HID wall packs on the outside of the building will receive new fixtures and flood lights will receive new LED lamps.

IMPLEMENTATION COST

$252,463

ENERGY COST SAVINGS

$10,173

MAINTENANCE CONSIDERATIONS

- Reduces O&M Costs
- Reduces material cost (lamps/ballast)
- Extends life of the lighting system

M&V OPTION

OPTION A

OVERALL BUILDING WEATHERIZATION

ECM Category: Energy Only / Base / Recommended
Location: Scranton State Office Building

ECM 14

EXISTING CONDITION

The Scranton State Office Building is a 4-story brick building with windows on all exposures. During the site surveys it was observed that air was being lost through exterior doors, interior doors and the roof / wall joints. It was also noted the windows could benefit from a reflective window film.

PROPOSED SOLUTION

BG recommends weather stripping the doors and sealing the roof / wall joints as described below:

- Exterior doors all levels (17) weatherstrip and seal
- Interior doors all levels (10) weather strip and seal
- Overhead door (1) sealed on 4 sides
- Roof/Wall (750) lineal feet seal with two-part foam

BG recommends a reflective window film be applied as described below:

Apply 2,035 square feet of film on 264 windows around the building.

IMPLEMENTATION COST

$37,069

ENERGY COST SAVINGS

$7,424

MAINTENANCE CONSIDERATIONS

- No additional Maintenance for doors
- Using abrasive tools or harsh chemicals for window washing will be harmful to film

M&V OPTION

Option A

UPGRADE OR REPLACE AHUs. ADD AIR-SIDE ECONOMIZER. INCLUDE UV DECONTAMINATION IN AHUs. EQUIP AHUs WITH VFDs AND TWO-WAY VALVES FOR VARIABLE VOLUME PUMPING FOR HEATING AND COOLING. PROVIDE SUPPLY AIR RESET CONTROL. REPLACE EXISTING VAV CONTROL BOXES WITH NEW ZONE DAMPERS AND REHEAT FOR HUMIDITY CONTROL. ALL CHILLED WATER VALVES SHOULD BE THE BELIMO ENERGY VALVE TO COMBAT LOW DELTA T SYNDROME IN THE BUILDING

ECM 15

ECM Category: Base Solution/ Recommended
Location: **Scranton State Office Building**

EXISTING CONDITION

Outside of computer and data rooms, there are five air handling units serving this building. Two of these have been recently replaced, while the remaining three are original to the building construction. Each air handling unit serves a single floor, delivering a variable air volume as required. Two-way DDC chilled water valves have been installed on four of these units, while one uses a three-way control valve to provide minimum chilled water flow. Heating is provided for each unit through a large electric duct heater located in the return air duct.

PROPOSED SOLUTION

BG proposes replacing the air handling units that have not yet been replaced and upgrading the newer units that have been installed. Each air handling unit will be furnished complete with mixing box, filter section, chilled water-cooling coil, UV decontamination, and array-style supply fans. The units will deliver a variable air volume as required to the occupied spaces through use of a VFD controlling the supply. The existing ductwork distribution system will be modified to include single-duct variable air volume terminal units with hot water reheat. New chilled water valves will be Belimo energy valves. Additionally, the existing zone boxes will be replaced with single duct hot water reheat VAVs.

IMPLEMENTATION COST

$3,265,408

ENERGY COST SAVINGS

$6,104

MAINTENANCE CONSIDERATIONS

- No additional maintenance required

M&V OPTION

OPTION C

CONVERT FROM ELECTRIC RESISTANCE HEAT TO HOT WATER HEATING, INSTALL A CONDENSING BOILER PLANT IN THE PENTHOUSE STORAGE AREA AND PIPE TO NEW HOT WATER COILS (INCLUDED WITH NEW AHUs OR ADDED TO EXISTING IN DUCT)

ECM 16

ECM Category: Base Solution/ Recommended

Location: **DGS Scranton Office Building**

EXISTING CONDITION

The existing building heat is an entirely electric resistance system, perimeter heat and duct heaters in the return air ducts. This type of heat is prone to failures and is expensive to operate.

PROPOSED SOLUTION

A new condensing hot water boiler plant will be installed in the penthouse, adjacent to the elevator equipment room. This plant will include condensing hot water boilers, variable volume primary pumping, variable volume secondary pumping, and a hot water piping distribution system throughout the building to serve the single-duct terminal unit reheat coils. Flue ducts will be routed through the roof of the penthouse, direct-ducted combustion air will utilize the existing outdoor air intake louver, and natural gas will be routed to the penthouse, and heating water distribution pumps will be located in the penthouse.

IMPLEMENTATION COST

$914,131

ENERGY COST SAVINGS

$31,673

MAINTENANCE CONSIDERATIONS

- Additional maintenance required for new boiler

M&V OPTION

OPTION C

REPLACE OR REFURBISH THE COOLING TOWER, PROVIDE VFDs AND ASSOCIATED CONTROLS FOR COOLING TOWER FAN OR RECOMMISSION EXISTING

ECM 17

ECM Category: Base Solution
Location: Scranton State Office Building

EXISTING CONDITION

Replacement or refurbishment of the existing cooling tower was requested. A variable frequency drive and new controls for the cooling tower fan were requested. Recommissioning of existing cooling tower fan was listed as an alternative to new.

The existing tower operations show excessive drift, resulting in an unacceptable loss of water. The cooling tower fan is sized appropriately, is in relatively good repair and is approximately 25 years old.

PROPOSED SOLUTION

BG recommends that the existing tower be completely refurbished. The structural members are in good condition. The deteriorating fill media and louver supports will be removed. With fill removed, the interior seams of stainless-steel basin will be coated with a urethane liner. All new fill media, fill supports, and louver supports will be installed. The tower will then be checked for proper operation.

BG will also replace the cooling tower motor, repair and refurbish the belt-drive system, and install a new VFD for the tower fan. The new fan and VFD will be integrated into the existing BAS.

IMPLEMENTATION COST

$118,700

ENERGY COST SAVINGS

$1,798

MAINTENANCE CONSIDERATIONS

- No additional maintenance required

M&V OPTION

OPTION C

ELIMINATE PNEUMATIC CONTROLS, EXTEND DIRECT DIGITAL CONTROLS (DDC) TO NEW AND REMAINING EQUIPMENT, ADD/RECONFIGURE CONTROL ZONES TO MATCH EXISTING SPACE LAYOUT, PROVIDE CENTRAL CONTROL TO PERIMETER BASEBOARD FOR USE AS SECONDARY HEAT FOR SHELL LOAD ON VERY COLD DAYS

ECM 18

ECM Category: Base Solution / Recommended
Location: **Scranton State Office Building**

EXISTING CONDITION

Currently, the building consists of predominantly proprietary DDC and some pneumatic controls. This situation makes it increasingly difficult to both maintain and repair the existing systems. There is also a significant number of electric powered baseboard heaters under each window that are intended to be used as supplemental heat on very cold days, however, it is possible these heaters may be running when not necessary.

PROPOSED SOLUTION

BG will perform a comprehensive review of the building to identify all mechanical components that are currently under some sort of automatic control, either DDC or pneumatic, to develop and deploy a new building automation system. This information will be used in concert with all other accepted ECMs to provide the city with a comprehensive BAS. In addition, the new system will have the capability to utilize numerous energy saving automation algorithms such as demand control ventilation, discharge temperature reset, discharge static reset, and many others. Ultimately, the DGS will receive a fully modern automation system with upgraded graphics, trending, alarming, and reporting capabilities along with unlimited training on the new system to ensure the system is operated at its maximum efficiency. In regard to the baseboard heaters, relays will be added to the system that will disable banks of heaters when it is determined via outside air temperature that they will not be needed. This will be reported and available for override at the frontend of the BAS.

IMPLEMENTATION COST

$815,931

ENERGY COST SAVINGS

$1,510

MAINTENANCE CONSIDERATIONS

- Compressor maintenance will be eliminated

M&V OPTION

OPTION C

CONVERT ELECTRIC DHW TO NATURAL GAS OR HEAT PUMP

ECM Category: Base Solution
Location: Scranton State Office Building

ECM 19

EXISTING CONDITION	PROPOSED SOLUTION
It was requested that the value of converting electric DHW to natural gas be explored.	BG recommends leaving the existing electric DHW system in place as it is a relatively new installation. In preparation for a conversion to natural gas, BG will rough in a new gas line in the basement mechanical room and terminate with a shutoff valve and cap the pipe.

IMPLEMENTATION COST	*ENERGY COST SAVINGS*
$19,328	**$0**

MAINTENANCE CONSIDERATIONS	M&V OPTION
• No maintenance required	**N/A**

LED LIGHTING RETROFIT/ REPLACEMENT THROUGHOUT THE BUILDING

ECM Category: Energy Only / Base / Recommended
Location: DGS Annex Building

ECM 20

EXISTING CONDITION

Interior: The existing lighting system at the DGS Annex building utilizes reduced wattage (28w) T8 lamps and normal ballast factor ballast. Also present are recessed can lights with pin based CFL's, other fixtures with a screw base lamp and some fixtures using LED technology.

Exterior: Currently there is not a large quantity of exterior lighting, however, there are pin based CFL wall packs and fluorescent vapor tight fixtures on the outside of the building.

PROPOSED SOLUTION

Interior: BG is proposing to retrofit the existing linear fluorescent fixtures with 10.5w UL Type B TLED's lamp for lamp basis. Recessed can lights with pin based CFL's will receive a retrofit kit. Recessed cans and other fixtures with a screw base lamp will receive an LED lamp of the appropriate size and wattage.

LED fixtures will be left as is.

Exterior: The pin based CFL wall packs and fluorescent vapor tight fixtures on the outside of the building will receive new fixtures.

IMPLEMENTATION COST

$37,980

ENERGY COST SAVINGS

$4,806

MAINTENANCE CONSIDERATIONS

- Reduces O&M Costs
- Reduces material cost (lamps/ballast)
- Extends life of the lighting system

M&V OPTION

OPTION A

OVERALL BUILDING WEATHERIZATION

ECM Category: Energy Only / Base / Recommended
Location: DGS Annex Building 55

ECM 21

EXISTING CONDITION

The DGS Annex Building 55 is a 3-story brick building with windows on all exposures. During the site surveys it was observed that air was being lost through exterior doors, interior doors, and the roof / wall joints. It was also noted the windows could benefit from a reflective window film.

PROPOSED SOLUTION

BG recommends weather stripping the doors and sealing the roof / wall joints as described below:

- Exterior doors all levels (37) weatherstrip and seal
- Interior doors all levels (1) weather strip and seal
- Overhead door (2) sealed on 4 sides
- Roof/Wall (100) lineal feet seal with one-part foam

BG recommends a reflective window film be applied as described below:

Apply 1,849 square feet of film on 359 windows around the building.

IMPLEMENTATION COST

$66,559

ENERGY COST SAVINGS

$8,128

MAINTENANCE CONSIDERATIONS

- No additional Maintenance for doors
- Using abrasive tools or harsh chemicals for window washing will be harmful to film

M&V OPTION

OPTION A

INSTALL GAS BOILER AND COOLING UPGRADES POSSIBLE HIGH EFFICENCY HEAT PUMPS

ECM Category: Base Solution
Location: DGS Annex Building 55

ECM 22

EXISTING CONDITION

The entire building has been unused for some time and the mechanical equipment is all in varying states of disrepair. Building heat is steam provided from an adjacent energy center building. The energy center building is scheduled for demolition.

The existing electrical distribution panel is at the end of its useful life and has inadequate space for breakers to support the addition of new mechanical equipment.

PROPOSED SOLUTION

BG proposes to install a hydronic heat pump system for this building, including rooftop water-cooled heat pumps with ducted supply and return air. In the office area, (1) one true VAV rooftop unit and (11) eleven VAV boxes will be installed. General shop areas will utilize (6) six single-zone VAV roof top units throughout the space. The base bid will include a closed-loop cooling tower and hydronic boilers designed to maintain the condenser water loop temperature in ranges as required by the heat pump system. The boiler system will also provide heating hot water reheat for the VAV boxes. Variable speed drives will be utilized on the closed-loop cooling tower and water distribution pumps to provide maximum energy efficiency. The hot water boilers will be variable flow, condensing type, ideal for use in heat pump systems.

Due to the building utilizing district steam, a natural gas main must be provided for the building. BG has provided an allowance per lineal foot up to 500 lineal feet in our proposal.

BG will design and install a new distribution system for HVAC equipment. The new main distribution panel will be 480/277V – 3Φ – 4W supplied from the new pad-mount service transformer. The existing 208V distribution will be back fed from a new dry-type transformer. The existing lighting and branch circuit panels not associated with new HVAC equipment will remain.

IMPLEMENTATION COST

$4,879,039

ENERGY COST SAVINGS

$20,118

MAINTENANCE CONSIDERATIONS

- Heat pumps will need be maintained
- Boilers will need to be maintained
- Rooftop units will need to be maintained

M&V OPTION

OPTION D

EXPLORE THE VALUE OF A POSSIBLE GEOTHERMAL SYSTEM

ECM Category: Base Solution
Location: DGS Annex Building 55

ECM 23

EXISTING CONDITION

It was requested that the value of a geothermal system be explored.

Geothermal systems are very efficient. However, they require an area for geothermal wells and a diligent maintenance routine.

PROPOSED SOLUTION

BG proposes installation of a seventy-five (75) well geothermal well field in vacant land adjacent to the Annex Building. Geothermal well systems can operate for much of the year without an external heat source, but occasionally require the external heat source. A boiler plant system with heat exchangers is included in ECM-22. Two water loops are included, one for the geothermal wells and one for the building distribution. The building will be served by rooftop water-cooled heat pumps, included in ECM-22. All pumps will be provided with variable speed drives to ensure optimal efficiency operations, also included in ECM-22.

IMPLEMENTATION COST

$1,975,702

ENERGY COST SAVINGS

$3,195

MAINTENANCE CONSIDERATIONS

- Inspect ducts, filters, blower, and indoor coil for dirt and other obstructions
- Diagnose and seal duct leakage
- Verify adequate airflow by measurement
- Verify correct refrigerant charge by measurement
- Check for refrigerant leaks
- Inspect electric terminals, and, if necessary, clean and tighten connections, and apply nonconductive coating
- Lubricate motors and inspect belts for tightness and wear
- Verify correct electric control, making sure that heating is locked out when the thermostat calls for cooling and vice versa
- Verify correct thermostat operation

M&V OPTION

OPTION D

ELIMINATE PNEUMATIC CONTROLS; INSTALL A NEW BUILDING AUTOMATION SYSTEM (BAS)

ECM Category: Base Solution / Recommended
Location: DGS Annex Building 55

ECM 24

EXISTING CONDITION

Currently, the building consists of both dated DDC and pneumatic controls. This situation makes it increasingly difficult to both maintain and repair the existing systems. In addition, there is also the problem of the pneumatics control extent to be somewhat undefined. In many instances, once pneumatics is deployed within a facility, it will be utilized to control many auxiliary components such as valves or exhaust fans. However, these changes will not be fully documented, resulting in the control strategy of many mechanical systems being unknown.

PROPOSED SOLUTION

BG will perform a comprehensive review of the building to identify all mechanical components that are currently under some sort of automatic control, either DDC or pneumatic, to develop and deploy a new building automation system. This information will be used in concert with all other accepted ECMs to provide the DGS with a comprehensive BAS. In addition, the new system will have the capability to utilize numerous energy saving automation algorithms such as demand control ventilation, discharge temperature reset, discharge static reset, and many others. Ultimately, the DGS will receive a fully modern automation system with upgraded graphics, trending, alarming, and reporting capabilities along with unlimited training on the new system to ensure the system is operated at its maximum efficiency.

IMPLEMENTATION COST

$206,897

ENERGY COST SAVINGS

$2,269

MAINTENANCE CONSIDERATIONS

- Compressor maintenance will be eliminated

M&V OPTION

OPTION D

BUILDING RECOMMISSIONING

ECM Category: Energy Only / Base / Recommended
Location: DGS Annex Building 55

ECM 25

EXISTING CONDITION

ASHRAE considers retro-commissioning/re-commissioning a critical step to ensure a building performs optimally. Given that the Annex Building 55 is 50+ years old and has undergone several different modifications, it is due for a re-commissioning effort.

PROPOSED SOLUTION

The BG retro-commissioning approach is one that utilizes a question-and-answer process for controlled systems. This system is neither product nor approach biased. It merely evaluates the design intent of the system and how successful it is in achieving its goal. The actual operation is then scrutinized to develop the most optimal system given the current building characteristics. For this program to be successful, it cannot be deployed with a broad brush and providing canned recommendations. Buildings need to be selected based upon their energy intensity and the capability of the system to truly operate better. The age of this building indicates it is an appropriate candidate for retro-commissioning/re-commissioning.

The Retro-commissioning effort can be broken down into 4 main sections:

5. Investigation and framing of the program
6. Field Testing
7. Documentation and Analysis
8. Action Item List Development

IMPLEMENTATION COST

$58,634

ENERGY COST SAVINGS

$5,678

MAINTENANCE CONSIDERATIONS

- No additional maintenance required

M&V OPTION

OPTION D

REPLACE EXISTING CHILLERS WITH HIGH EFFICIENCY CHILLERS

ECM Category: Base Solution / Recommended
Location: DGS Northwest Building

ECM 26

EXISTING CONDITION

The chilled water system is fed by two existing water-cooled York Chillers located in Penthouse #1. The chilled water distribution system serves existing air handling units, each with three-way control valves. The piping arrangement for the existing chilled water and condenser water system is a constant volume type. The existing chillers are in disrepair and at the end of their useful life.

PROPOSED SOLUTION

The existing chillers were installed first, and piping and duct then installed around the chillers making removal and replacement very difficult. There is an existing outside air louver located behind three large round duct legs. The three duct legs will be removed to gain access to the louver. The louver will be removed, and the opening utilized for rigging out the existing chillers and rigging in the new chillers. After project completion, the louver and ductwork will be reinstalled.

Due to the space constraints, BG proposes to install modular style chillers. These chillers are shipped in small modular sections and combined in the field to create a single large chiller. Each of the two new chillers will contain (5) five 30-ton modules for a total of 150-tons each. Valving will be included to shut off each 30-ton module separatetly from entire 150-ton section. This creates easy access for maintenance and provides redundancy in the event a repair is needed. The new chiller will be reconnected into the existing pipe and pumping distribution.

IMPLEMENTATION COST

$1,315,875

ENERGY COST SAVINGS

$8,872

MAINTENANCE CONSIDERATIONS

M&V OPTION

N/A

PENNSYLVANIA DEPARTMENT OF GENERAL SERVICES READING AND SCRANTON, PA GUARANTEED ENERGY SAVINGS PROJECT GESA 2023-1

VOLUME II: ECM/COST SUBMITTAL

C.1.G. BREWER-GARRETT'S RECOMMENED SOLUTION

C.1.g. Brewer-Garrett's Recommended Solution –

g. Proposal includes additional innovative ECMs not already included in the project.

The following pages illustrate the **Recommended** solution that addresses most of the core Energy Conservation Measures (ECMs) outlined in Appendix R as well as some supplementary ECMs to provide additional opportunities. Contained in this section is:

- **The ECM Chart** highlighting preliminary project cost, rebates, savings, and simple payback at a glance
- **Individual ECM templates** detailing observations on existing conditions and proposed solutions as well as preliminary cost and savings data

Detailed savings calculations can be found in Appendix C – Supplemental Information.

Recommended

ECM #	ECM Title	
ECM-01	LED lighting retro fit / replacement throughout the building.	✔
ECM-03	Replace VAV boxes and eliminate dual duct simultaneous heating and cooling. Include ultraviolet (UV) decontamination in AHUs. Provide supply air reset control. Equip AHUs with VFDs and twoway valves for variable volume pumping for heating and cooling. All chilled water valves should be the Belimo Energy Valve to combat low delta T syndrome in the building.	✔
ECM-05	Provide VFD(s) and associated controls for cooling tower fan(s) or recommission existing.	✔
ECM-06	Eliminate pneumatic controls; install a new building automation system (BAS).	✔
ECM-07	Install a dedicated radon mitigation system for the basement to allow better control and scheduling of the heating, ventilation, and air conditioning (HVAC) and restore outdoor air to rates required for space occupancy.	✔
ECM-08	Replace sewage pump(s).	✔
ECM-10	Implement water conservation for restrooms (new flush valves).	✔
ECM-11	Overall building weatherization.	✔
ECM-14	Overall building weatherization.	✔
ECM-15	Upgrade or replace AHUs. Add air-side economizer. Include UV decontamination in AHUs. Equip AHUs with VFDs and two-way valves for variable volume pumping for heating and cooling. Provide supply air reset control. Replace existing VAV control boxes with new zone dampers and reheat for humidity control. All chilled water valves should be the Belimo Energy Valve to combat low delta T syndrome in the building.	✔
ECM-16	Convert from electric resistance heat to hot water heating. Install a condensing boiler plant in the penthouse storage area and pipe to new hot water coils (included with new AHUs or added to existing in duct).	✔
ECM-17	Replace or refurbish the cooling tower. Provide VFDs and associated controls for cooling tower fan or recommission existing.	✔
ECM-18	Eliminate pneumatic controls. Extend direct digital controls (DDC) controls to new and remaining equipment. Add/reconfigure control zones to match existing space layout. Provide central control to perimeter baseboard for use as secondary heat for shell load on very cold days.	✔
ECM-20	LED lighting retro fit / replacement throughout the building.	✔
ECM-21	Overall building weatherization.	✔
ECM-24	Eliminate pneumatic controls; install a new building automation system (BAS).	✔
ECM-25	Building recommissioning.	✔

Recommended (continued)		
ECM-26	Replace existing chillers with high efficiency chillers.	✔
ECM-27	Rooftop Solar Array.	✔
ECM-28	New High Performance 208V Chiller. (ECM #12 Alternate).	✔
ECM-29	Electric VAV.	✔
ECM-30	Gas Fired RTUs (ECM #22 Alternate).	✔
ECM-31	Steam Trap Repair.	✔
ECM-32	Building Envelope and Film.	✔

DGS Reading, Scranton, and Harrisburg GESA
Recommended GESA Project Summary

Project Column Description
A: Construction cost to supply, install, and start up ECM
B: Calculated utility rebate
C: Calculated energy savings
D: Operation and Maintenance (O&M) savings - detail provided below
E: C + D
F: A / E
G: Calculated utility savings (energy constant by ESCO)
H: Additional funds needed annually for 18 year project simple payback

ECM #	ECM Description	A Construction Cost	B Utility Rebates	C Annual Energy Savings	D O&M Savings	E Total Energy and O&M Savings (C + D)	F Simple Payback (A / E)	G Annual Utility Savings					H Annual SPB Shortfall
								Natural Gas (MCF)	Electric (kWh)	Water (CCF)	Sewer (CCF)	Oil (Kgal)	
Reading													
1	LED lighting retro fit / replacement throughout the building.	$186,648	$5,066	$7,482	$1,789	$9,271	20.1	0	100,967	0	0		1,099
2	Upgrade or replace AHUs. Consolidate where possible and add air-side economizer.	$1,211,044	$0	$1,839	$3,685	$5,524	219.2	0	24,823	0	0		61,756
3	Replace VAV boxes and eliminate dual duct simultaneous heating and cooling. Include ultraviolet (UV) decontamination in AHUs. Provide supply air reset control. Equip AHUs with VFDs and twoway valves for variable volume pumping for heating and cooling. All chilled water valves should be the Belimo Energy Valve to combat low delta T syndrome in the building.	$2,461,190	$0	$2,626	$7,488	$10,114	243.3	0	35,436	0	0		126,619
5	Provide VFD(s) and associated controls for cooling tower fan(s) or recommission existing.	$30,373	$0	$978	$92	$1,070	28.4	0	13,201	0	0		617
6	Eliminate pneumatic controls; install a new building automation system (BAS).	$641,768	$0	$294	$1,953	$2,247	285.6	20	1,634	0	0		33,407
7	Install a dedicated radon mitigation system for the basement to allow better control and scheduling of the heating, ventilation, and air conditioning (HVAC) and restore outdoor air to rates required for space occupancy.	$100,780	$0	$978	$307	$1,285	78.4	0	13,201	0	0		4,314
8	Replace sewage pump(s).	$89,880	$0	$0	$273	$273	329.2	0	0	0	0		4,720
10	Implement water conservation for restrooms (new flush valves).	$53,564	$0	$4,064	$163	$4,227	12.7	7	0	390	390		(1,251)
11	Overall building weatherization	$19,931	$0	$1,342	$61	$1,403	14.2	129	3,041	0	0		(296)
Scranton													
14	Overall building weatherization	$37,069	$0	$7,424	$16,172	$23,596	1.6	0	86,730	0	0		(21,537)
15	Upgrade or replace AHUs. Add air-side economizer. Include UV decontamination in AHUs. Equip AHUs with VFDs and two-way valves for variable volume pumping for heating and cooling. Provide supply air reset control. Replace existing VAV control boxes with new zone dampers and reheat for humidity control. All chilled water valves should be the Belimo Energy Valve to combat low delta T syndrome in the building.	$3,265,408	$0	$6,104	$4,527	$10,631	307.1	0	71,314	0	0		170,780
16	Convert from electric resistance heat to hot water heating. Install a condensing boiler plant in the penthouse storage area and pipe to new hot water coils (included with new AHUs or added to existing in duct).	$914,131	$0	$31,673	$434	$32,107	28.5	(2,555)	628,178	0	0		18,678
17	Replace or refurbish the cooling tower. Provide VFDs and associated controls for cooling tower fan or recommission existing.	$118,700	$0	$1,798	$4,041	$5,839	20.3	0	21,002	0	0		756
18	Eliminate pneumatic controls. Extend direct digital controls (DDC) controls to new and remaining equipment. Add/reconfigure control zones to match existing space layout. Provide central control to perimeter baseboard for use as secondary heat for shell load on very cold days.	$815,931	$0	$1,510	$96	$1,606	507.9	0	17,646	0	0		43,723
DGS Annex													
20	LED lighting retro fit / replacement throughout the building.	$37,980	$1,653	$4,806	$858	$5,664	6.7	0	41,114	0	0		(3,554)
21	Overall building weatherization.	$66,559	$0	$8,128	$0	$8,128	8.2	333	35,072	0	0		(4,431)
24	Eliminate pneumatic controls; install a new building automation system (BAS).	$206,897	$0	$2,269	$0	$2,269	91.2	91	9,998	0	0		9,225
25	Building recommissioning.	$58,634	$0	$5,678	$0	$5,678	10.3	228	24,996	0	0		(2,421)
Northwest Office													
26	Replace existing chillers with high efficiency chillers.	$1,315,875	$0	$8,872	$97,600	$106,472	12.4	0	108,987	0	0		(33,367)
Alternatives													
27	Rooftop Solar Array.	$422,442	$8,448	$14,080	$3,991	$18,071	23.4	0	281,596	0	0		5,398
28	New high performance 208v Water cooled scroll chiller (ECM #4 & #12 Alternate).	$768,056	$0	$2,951	$0	$2,951	260.2	0	39,804	0	0		39,718
29	Electric VAV.	$2,118,114	$0	$0	$0	$0	#DIV/0!	0	0	0	0		117,673
30	Gas Fired RTUs (ECM #22 & #23 Alternate).	$3,510,418	$0	$18,727	$0	$18,727	187.5	1,038	52,851	0	0		176,296
31	Steam Trap Repair.	$90,026	$0	$4,820	$0	$4,820	18.7	201	0	0	0		181
32	Building Envelope and Film.	$162,455	$0	$14,750	$0	$14,750	11.0	383	68,161	0	0		(5,725)
	Energy Consultant Fee (4%)	$748,155											41,564
	Totals	**$19,452,028**	**$15,167**	**$153,194**	**$143,530**	**$296,724**	**65.6**	**-125**	**1,679,751**	**390**	**390**	**0**	**783,944**

Utility Rebates (B)	$15,167
Annual SPB Shortfall (H)	$783,944
Financed Amount (A - B)	$19,436,861

Annual Shortfall Detail
Shortfall = (ECM Cost/18) - (ECM Savings)
SPB with shortfall = A / (E + H)
18.0

ECM 27 = Solar PV

Production	281,596	
Total Project kWh Savings	1,679,751	including solar production
Total kWh Savings	1,398,155	consumption savings (project savings - production)

LED LIGHTING RETROFIT/REPLACEMENT THROUGHOUT BUILDING

ECM Category: Base / Recommended
Location: Reading State Office Building

ECM 01

EXISTING CONDITION

Interior: The existing lighting system at Reading is very efficient by fluorescent standards and there is a limited amount of occupancy sensors on site. It was upgraded during a project in 2008 to reduce wattage (25w) T8 lamps and low ballast factor ballast. Most of the recessed fixtures have been delamped from 4 lamps to 2 lamps, or 2 lamps to 1 lamp. Also present are recessed can lights with pin based CFL's, other fixtures with a screw base lamp, and some fixtures using LED technology.

Exterior: Currently there is not a large quantity of exterior lighting, however there are canopy and flood fixtures on the outside of the building.

PROPOSED SOLUTION

Interior: BG is proposing to retrofit the existing linear fluorescent fixtures with 10.5w UL Type B TLED's lamp for lamp. Fixtures will be retrofit on a lamp for lamp basis, maintaining the delamped configuration of the fixture. 2x2 fixtures will receive a reflector kit and straight 2' 7-watt TLED's. Recessed can lights with pin based CFL's will receive a retrofit kit. Recessed cans and other fixtures with a screw base lamp will receive an LED lamp of the appropriate size and wattage.

LED fixtures will be left as is.

At this time, we are not recommending any additional occupancy sensors, however we can investigate the viability of the technology further during the IGA.

Exterior: The existing canopy and flood fixtures will be replaced with new LED fixtures.

IMPLEMENTATION COST

$186,648

ENERGY COST SAVINGS

$7,482

MAINTENANCE CONSIDERATIONS

- Reduces O&M Costs
- Reduces material cost (lamps/ballast)
- Extends life of the lighting system

M&V OPTION

OPTION A

REPLACE VAV BOXES AND ELIMINATE DUAL DUCT SIMULTANEOUS HEATING AND COOLING. INCLUDE ULTRAVIOLET (UV) DECONTAMINATION IN AHUs. PROVIDE SUPPLY AIR RESET CONTROL. EQUIP AHUs WITH VFDs AND TWO-WAY VALVES FOR VARIABLE VOLUME PUMPING FOR HEATING AND COOLING. ALL CHILLED WATER VALVES SHOULD BE THE BELIMO ENERGY VALVE TO COMBAT LOW DELTA T SYNDROME IN THE BUILDING

ECM 03

ECM Category: Base / Recommended
Location: Reading State Office Building

EXISTING CONDITION

The existing HVAC system uses heating air handling units with cooling air handling units to serve a combination of dual-duct (heating-cooling) and single duct (cooling only) terminal units throughout the occupied spaces. The air handling units currently bring in a fixed outdoor air percentage and therefore have limited economizer operations. Supply air temperature setpoints for both the heating and cooling air handling units are fixed. Heating hot water valves have been replaced with electronic DDC two-way control valves as part of a building boiler upgrade. The existing chilled water system uses constant volume primary-secondary pumping with pneumatic three-way valves at all end users.

PROPOSED SOLUTION

BG's solution will overlap several of these ECMs. In this case, BG will remove all existing dual-duct and single-duct terminal units. These units will be replaced with single-duct terminal units with hot water reheat. Air handling units will be removed and replaced with single common combined units in the mechanical penthouse and basement. These new air handling units will be complete with full airside economizer control, updated filtration to meet code requirements, and UV lighting to provide further protection for building occupants. The single-duct terminal units will allow the air handlers to operate as variable air volume systems complete with new variable speed drives on the units. Air supplied from these units will be dehumidified year-round. This will be accomplished through the new automatic temperature control system, allowing supply air temperature to be reset based on building occupancy and ambient conditions. The existing DDC heating valves will be reused to a great extent and new chilled water valves will be Belimo energy valves. Overall, the new HVAC system included in this and other ECMs will provide a state-of-the-art system with many years of service life.

IMPLEMENTATION COST

$2,461,190

ENERGY COST SAVING

$2,626

MAINTENANCE CONSIDERATIONS

M&V OPTION

OPTION C

PROVIDE VFD(s) ASSOCIATED CONTROLS FOR COOLING TOWER FAN(s) OR RECOMMISSION EXISTING

ECM 05

ECM Category: Base / Recommended
Location: Reading State Office Building

EXISTING CONDITION

The cooling tower fan is sized appropriately and in relatively good repair. Additionally, the existing fan motor is rated class F, which allows it to accept a variable frequency drive.

PROPOSED SOLUTION

BG recommends installing one (1) new VFD for the 25 HP cooling tower fan motor. The new VFD will be integrated into the existing BAS. This will work in concert with the variable condenser water pumps and upgraded chilled water system in ECM-4 to provide a much improved overall operating efficiency to the chilled water production.

IMPLEMENTATION COST

$30,373

ENERGY COST SAVING

$978

MAINTENANCE CONSIDERATIONS

- No additional maintenance required

M&V OPTION

OPTION C

ELIMINATE PNEUMATIC CONTROSL; INSTALL A NEW BUILDING AUTOMATION SYSTEM (BAS)

ECM Category: Base / Recommended
Location: Reading State Office Building

ECM 06

EXISTING CONDITION

Currently, the building consists of both dated DDC and pneumatic controls. This situation makes it increasingly difficult to both maintain and repair the existing systems. In addition, there is also the problem of the pneumatics control extent to be somewhat undefined. In many instances, once pneumatics is deployed within a facility, it will be utilized to control many auxiliary components such as valves or exhaust fans. However, these changes will not be fully documented, resulting in the control strategy of many mechanical systems being unknown.

PROPOSED SOLUTION

BG will perform a comprehensive review of the building to identify all mechanical components that are currently under some sort of automatic control, either DDC or pneumatic, to develop and deploy a new building automation system. This information will be used in concert with all other accepted ECMs to provide the city with a comprehensive BAS. In addition, the new system will have the capability to utilize numerous energy saving automation algorithms such as demand control ventilation, discharge temperature reset, discharge static reset, and many others. Ultimately, the building will receive a fully modern automation system with upgraded graphics, trending, alarming, and reporting capabilities along with unlimited training on the new system to ensure the system is operated at its maximum efficiency.

IMPLEMENTATION COST

$641,768

ENERGY COST SAVING

$294

MAINTENANCE CONSIDERATIONS

- Compressor maintenance will be eliminated

M&V OPTION

OPTION C

INSTALL A DEDICATED RADON MITIGATION SYSTEM FOR THE BASEMENT TO ALLOW BETTER CONTROL AND SCHEDULING OF THE HEATING, VENTILATION, AND AIR CONDITIONING (HVAC) AND RESTORE OUTDOOR AIR TO RATES REQUIRED FOR SPACE OCCUPANCY

ECM
07

ECM Category: Base / Recommended
Location: Reading State Office Building

EXISTING CONDITION	PROPOSED SOLUTION
The existing radon mitigation system, while effective, wastes large amounts of energy. Air handling units serving the basement level are operated 24/7 to ensure that radon is removed from the building. The operation of these units in this manner, with a fixed outdoor air intake damper of 10%, has required the building to install and operate an auxiliary air-cooled chiller as required to maintain space temperature and humidity conditions. The net result is that, while effective, the existing radon mitigation is energy wasteful.	BG proposes to install (4) dedicated radon mitigation exhaust systems throughout the affected areas of the building. This system will be a variable volume type, controlled to operate on an as-needed basis and will result in significant annual energy savings for the facility. Additionally, the existing system recirculates approximately 90% of the space air volume delivered. The dedicated radon mitigation system will provide 100% outdoor air, eliminating potential recirculation of the radon gases. Installing the radon mitigation will eliminate the year-round operation of the basement level AHU's, and allow removal of the air-cooled chiller.

IMPLEMENTATION COST	*ENERGY COST SAVINGS*
$100,780	**$978**

MAINTENANCE CONSIDERATIONS	M&V OPTION
	OPTION C

- Additional maintenance required on new radon systems

REPLACE SEWAGE PUMP(s)

ECM Category: Base / Recommended
Location: Reading State Office Building

ECM 08

EXISTING CONDITION	PROPOSED SOLUTION
These pumps are at the end of their useful life.	Replace one (1) sanitary pump set to include a duplex, 75GPM, 20 ft HD, 3/4HP 208v pumps. Replace one (1) RW sump pump set to include duplex, 50 GPM, 20 ftHD, 1/2 HP, 208v pumps.
IMPLEMENTATION COST	***ENERGY COST SAVING***
$89,880	**$0**

MAINTENANCE CONSIDERATIONS	M&V OPTION
• No additional maintenance for pumps • Avoid unplanned failures	**N/A**

IMPLEMENT WATER CONSERVATION FOR RESTROOMS (NEW FLUSH VALVES)

ECM Category: Energy Only / Base / Recommended
Location: Reading State Office Building

ECM 10

EXISTING CONDITION

Building staff indicated a water conservation project had been completed in or around 2014. Most of the toilets are 1.6gpf, with newer china. The urinals are high flow and the sink faucets, for the most part are already low flow.

PROPOSED SOLUTION

Thirty (30) existing flush valves will be replaced with 1.28gpf piston valves.

Two (2) existing wall mounted water closets will be replaced with new china and 1.28gpf flush valve.

Ten (10) existing high flow urinals will be replaced with .125gpf urinals.

The sink faucets and/or aerators will not be replaced.

IMPLEMENTATION COST

$53,564

ENERGY COST SAVINGS

$4,064

MAINTENANCE CONSIDERATIONS

- No additional maintenance required

M&V OPTION

OPTION A

OVERALL BUILDING WEATHERIZATION

ECM Category: Energy Only / Base / Recommended
Location: Reading State Office Building

ECM 11

EXISTING CONDITION	PROPOSED SOLUTION
The Reading State Office Building is a 5-story brick building. During the site surveys it was observed that there was air being lost through exterior doors, interior doors and the roof / wall joints.	BG recommends weather stripping the doors and sealing the roof / wall joints as described below: Exterior doors all levels (18) weatherstrip and seal Interior doors in penthouse (1) weather strip and seal Roof/Wall (520) lineal feet seal with two-part foam

IMPLEMENTATION COST	*ENERGY COST SAVINGS*
$19,931	**$1,342**

MAINTENANCE CONSIDERATIONS	M&V OPTION
• No additional maintenance required	**Option A**

OVERALL BUILDING WEATHERIZATION

ECM Category: Energy Only / Base / Recommended
Location: Scranton State Office Building

ECM 14

EXISTING CONDITION

The Scranton State Office Building is a 4-story brick building with windows on all exposures. During the site surveys it was observed that air was being lost through exterior doors, interior doors and the roof / wall joints. It was also noted the windows could benefit from a reflective window film.

PROPOSED SOLUTION

BG recommends weather stripping the doors and sealing the roof / wall joints as described below:

- Exterior doors all levels (17) weatherstrip and seal
- Interior doors all levels (10) weather strip and seal
- Overhead door (1) sealed on 4 sides
- Roof/Wall (750) lineal feet seal with two-part foam

BG recommends a reflective window film be applied as described below:

Apply 2,035 square feet of film on 264 windows around the building.

IMPLEMENTATION COST

$37,069

ENERGY COST SAVINGS

$7,424

MAINTENANCE CONSIDERATIONS

- No additional Maintenance for doors
- Using abrasive tools or harsh chemicals for window washing will be harmful to film

M&V OPTION

Option A

UPGRADE OR REPLACE AHUs. ADD AIR-SIDE ECONOMIZER. INCLUDE UV DECONTAMINATION IN AHUs. EQUIP AHUs WITH VFDs AND TWO-WAY VALVES FOR VARIABLE VOLUME PUMPING FOR HEATING AND COOLING. PROVIDE SUPPLY AIR RESET CONTROL. REPLACE EXISTING VAV CONTROL BOXES WITH NEW ZONE DAMPERS AND REHEAT FOR HUMIDITY CONTROL. ALL CHILLED WATER VALVES SHOULD BE THE BELIMO ENERGY VALVE TO COMBAT LOW DELTA T SYNDROME IN THE BUILDING

ECM 15

ECM Category: Base Solution/ Recommended
Location: **Scranton State Office Building**

EXISTING CONDITION

Outside of computer and data rooms, there are five air handling units serving this building. Two of these have been recently replaced, while the remaining three are original to the building construction. Each air handling unit serves a single floor, delivering a variable air volume as required. Two-way DDC chilled water valves have been installed on four of these units, while one uses a three-way control valve to provide minimum chilled water flow. Heating is provided for each unit through a large electric duct heater located in the return air duct.

PROPOSED SOLUTION

BG proposes replacing the air handling units that have not yet been replaced and upgrading the newer units that have been installed. Each air handling unit will be furnished complete with mixing box, filter section, chilled water-cooling coil, UV decontamination, and array-style supply fans. The units will deliver a variable air volume as required to the occupied spaces through use of a VFD controlling the supply. The existing ductwork distribution system will be modified to include single-duct variable air volume terminal units with hot water reheat. New chilled water valves will be Belimo energy valves. Additionally, the existing zone boxes will be replaced with single duct hot water reheat VAVs.

IMPLEMENTATION COST

$3,265,408

ENERGY COST SAVINGS

$6,104

MAINTENANCE CONSIDERATIONS

- No additional maintenance required

M&V OPTION

OPTION C

CONVERT FROM ELECTRIC RESISTANCE HEAT TO HOT WATER HEATING, INSTALL A CONDENSING BOILER PLANT IN THE PENTHOUSE STORAGE AREA AND PIPE TO NEW HOT WATER COILS (INCLUDED WITH NEW AHUs OR ADDED TO EXISTING IN DUCT)

ECM 16

ECM Category: Base Solution/ Recommended

Location: **DGS Scranton Office Building**

EXISTING CONDITION

The existing building heat is an entirely electric resistance system, perimeter heat and duct heaters in the return air ducts. This type of heat is prone to failures and is expensive to operate.

PROPOSED SOLUTION

A new condensing hot water boiler plant will be installed in the penthouse, adjacent to the elevator equipment room. This plant will include condensing hot water boilers, variable volume primary pumping, variable volume secondary pumping, and a hot water piping distribution system throughout the building to serve the single-duct terminal unit reheat coils. Flue ducts will be routed through the roof of the penthouse, direct-ducted combustion air will utilize the existing outdoor air intake louver, and natural gas will be routed to the penthouse, and heating water distribution pumps will be located in the penthouse.

IMPLEMENTATION COST

$914,131

ENERGY COST SAVINGS

$31,673

MAINTENANCE CONSIDERATIONS

- Additional maintenance required for new boiler

M&V OPTION

OPTION C

REPLACE OR REFURBISH THE COOLING TOWER, PROVIDE VFDs AND ASSOCIATED CONTROLS FOR COOLING TOWER FAN OR RECOMMISSION EXISTING

ECM 17

ECM Category: Base Solution
Location: Scranton State Office Building

EXISTING CONDITION

Replacement or refurbishment of the existing cooling tower was requested. A variable frequency drive and new controls for the cooling tower fan were requested. Recommissioning of existing cooling tower fan was listed as an alternative to new.

The existing tower operations show excessive drift, resulting in an unacceptable loss of water. The cooling tower fan is sized appropriately, is in relatively good repair and is approximately 25 years old.

PROPOSED SOLUTION

BG recommends that the existing tower be completely refurbished. The structural members are in good condition. The deteriorating fill media and louver supports will be removed. With fill removed, the interior seams of stainless-steel basin will be coated with a urethane liner. All new fill media, fill supports, and louver supports will be installed. The tower will then be checked for proper operation.

BG will also replace the cooling tower motor, repair and refurbish the belt-drive system, and install a new VFD for the tower fan. The new fan and VFD will be integrated into the existing BAS.

IMPLEMENTATION COST

$118,700

ENERGY COST SAVINGS

$1,798

MAINTENANCE CONSIDERATIONS

- No additional maintenance required

M&V OPTION

OPTION C

ELIMINATE PNEUMATIC CONTROLS, EXTEND DIRECT DIGITAL CONTROLS (DDC) TO NEW AND REMAINING EQUIPMENT, ADD/RECONFIGURE CONTROL ZONES TO MATCH EXISTING SPACE LAYOUT, PROVIDE CENTRAL CONTROL TO PERIMETER BASEBOARD FOR USE AS SECONDARY HEAT FOR SHELL LOAD ON VERY COLD DAYS

ECM
18

ECM Category: Base Solution / Recommended
Location: **Scranton State Office Building**

EXISTING CONDITION

Currently, the building consists of predominantly proprietary DDC and some pneumatic controls. This situation makes it increasingly difficult to both maintain and repair the existing systems. There is also a significant number of electric powered baseboard heaters under each window that are intended to be used as supplemental heat on very cold days, however, it is possible these heaters may be running when not necessary.

PROPOSED SOLUTION

BG will perform a comprehensive review of the building to identify all mechanical components that are currently under some sort of automatic control, either DDC or pneumatic, to develop and deploy a new building automation system. This information will be used in concert with all other accepted ECMs to provide the city with a comprehensive BAS. In addition, the new system will have the capability to utilize numerous energy saving automation algorithms such as demand control ventilation, discharge temperature reset, discharge static reset, and many others. Ultimately, the DGS will receive a fully modern automation system with upgraded graphics, trending, alarming, and reporting capabilities along with unlimited training on the new system to ensure the system is operated at its maximum efficiency. In regard to the baseboard heaters, relays will be added to the system that will disable banks of heaters when it is determined via outside air temperature that they will not be needed. This will be reported and available for override at the frontend of the BAS.

IMPLEMENTATION COST

$815,931

ENERGY COST SAVINGS

$1,510

MAINTENANCE CONSIDERATIONS

- Compressor maintenance will be eliminated

M&V OPTION

OPTION C

LED LIGHTING RETROFIT/ REPLACEMENT THROUGHOUT THE BUILDING

ECM Category: Energy Only / Base / Recommended
Location: DGS Annex Building

ECM 20

EXISTING CONDITION

Interior: The existing lighting system at the DGS Annex building utilizes reduced wattage (28w) T8 lamps and normal ballast factor ballast. Also present are recessed can lights with pin based CFL's, other fixtures with a screw base lamp and some fixtures using LED technology.

Exterior: Currently there is not a large quantity of exterior lighting, however, there are pin based CFL wall packs and fluorescent vapor tight fixtures on the outside of the building.

PROPOSED SOLUTION

Interior: BG is proposing to retrofit the existing linear fluorescent fixtures with 10.5w UL Type B TLED's lamp for lamp basis. Recessed can lights with pin based CFL's will receive a retrofit kit. Recessed cans and other fixtures with a screw base lamp will receive an LED lamp of the appropriate size and wattage.

LED fixtures will be left as is.

Exterior: The pin based CFL wall packs and fluorescent vapor tight fixtures on the outside of the building will receive new fixtures.

IMPLEMENTATION COST

$37,980

ENERGY COST SAVINGS

$4,806

MAINTENANCE CONSIDERATIONS

- Reduces O&M Costs
- Reduces material cost (lamps/ballast)
- Extends life of the lighting system

M&V OPTION

OPTION A

OVERALL BUILDING WEATHERIZATION

ECM Category: Energy Only / Base / Recommended
Location: DGS Annex Building 55

ECM 21

EXISTING CONDITION

The DGS Annex Building 55 is a 3-story brick building with windows on all exposures. During the site surveys it was observed that air was being lost through exterior doors, interior doors, and the roof / wall joints. It was also noted the windows could benefit from a reflective window film.

PROPOSED SOLUTION

BG recommends weather stripping the doors and sealing the roof / wall joints as described below:

- Exterior doors all levels (37) weatherstrip and seal
- Interior doors all levels (1) weather strip and seal
- Overhead door (2) sealed on 4 sides
- Roof/Wall (100) lineal feet seal with one-part foam

BG recommends a reflective window film be applied as described below:

Apply 1,849 square feet of film on 359 windows around the building.

IMPLEMENTATION COST

$66,559

ENERGY COST SAVINGS

$8,128

MAINTENANCE CONSIDERATIONS

- No additional Maintenance for doors
- Using abrasive tools or harsh chemicals for window washing will be harmful to film

M&V OPTION

OPTION A

ELIMINATE PNEUMATIC CONTROLS; INSTALL A NEW BUILDING AUTOMATION SYSTEM (BAS)

ECM Category: Base Solution / Recommended
Location: DGS Annex Building 55

ECM 24

EXISTING CONDITION

Currently, the building consists of both dated DDC and pneumatic controls. This situation makes it increasingly difficult to both maintain and repair the existing systems. In addition, there is also the problem of the pneumatics control extent to be somewhat undefined. In many instances, once pneumatics is deployed within a facility, it will be utilized to control many auxiliary components such as valves or exhaust fans. However, these changes will not be fully documented, resulting in the control strategy of many mechanical systems being unknown.

PROPOSED SOLUTION

BG will perform a comprehensive review of the building to identify all mechanical components that are currently under some sort of automatic control, either DDC or pneumatic, to develop and deploy a new building automation system. This information will be used in concert with all other accepted ECMs to provide the DGS with a comprehensive BAS. In addition, the new system will have the capability to utilize numerous energy saving automation algorithms such as demand control ventilation, discharge temperature reset, discharge static reset, and many others. Ultimately, the DGS will receive a fully modern automation system with upgraded graphics, trending, alarming, and reporting capabilities along with unlimited training on the new system to ensure the system is operated at its maximum efficiency.

IMPLEMENTATION COST

$206,897

ENERGY COST SAVINGS

$2,269

MAINTENANCE CONSIDERATIONS

- Compressor maintenance will be eliminated

M&V OPTION

OPTION D

BUILDING RECOMMISSIONING

ECM Category: Energy Only / Base / Recommended
Location: DGS Annex Building 55

ECM 25

EXISTING CONDITION

ASHRAE considers retro-commissioning/re-commissioning a critical step to ensure a building performs optimally. Given that the Annex Building 55 is 50+ years old and has undergone several different modifications, it is due for a re-commissioning effort.

PROPOSED SOLUTION

The BG retro-commissioning approach is one that utilizes a question-and-answer process for controlled systems. This system is neither product nor approach biased. It merely evaluates the design intent of the system and how successful it is in achieving its goal. The actual operation is then scrutinized to develop the most optimal system given the current building characteristics. For this program to be successful, it cannot be deployed with a broad brush and providing canned recommendations. Buildings need to be selected based upon their energy intensity and the capability of the system to truly operate better. The age of this building indicates it is an appropriate candidate for retro-commissioning/re-commissioning.

The Retro-commissioning effort can be broken down into 4 main sections:

9. Investigation and framing of the program
10. Field Testing
11. Documentation and Analysis
12. Action Item List Development

IMPLEMENTATION COST

$58,634

ENERGY COST SAVINGS

$5,678

MAINTENANCE CONSIDERATIONS

- No additional maintenance required

M&V OPTION

OPTION D

REPLACE EXISTING CHILLERS WITH HIGH EFFICIENCY CHILLERS

ECM Category: Base Solution / Recommended
Location: DGS Northwest Building

ECM 26

EXISTING CONDITION

The chilled water system is fed by two existing water-cooled York Chillers located in Penthouse #1. The chilled water distribution system serves existing air handling units, each with three-way control valves. The piping arrangement for the existing chilled water and condenser water system is a constant volume type. The existing chillers are in disrepair and at the end of their useful life.

PROPOSED SOLUTION

The existing chillers were installed first, and piping and duct then installed around the chillers making removal and replacement very difficult. There is an existing outside air louver located behind three large round duct legs. The three duct legs will be removed to gain access to the louver. The louver will be removed, and the opening utilized for rigging out the existing chillers and rigging in the new chillers. After project completion, the louver and ductwork will be reinstalled.

Due to the space constraints, BG proposes to install modular style chillers. These chillers are shipped in small modular sections and combined in the field to create a single large chiller. Each of the two new chillers will contain (5) five 30-ton modules for a total of 150-tons each. Valving will be included to shut off each 30-ton module separatetly from entire 150-ton section. This creates easy access for maintenance and provides redundancy in the event a repair is needed. The new chiller will be reconnected into the existing pipe and pumping distribution.

IMPLEMENTATION COST

$1,315,875

ENERGY COST SAVINGS

$8,872

MAINTENANCE CONSIDERATIONS

M&V OPTION

N/A

ROOFTOP SOLAR ARRAY

ECM Category: Recommended Only
Location: Reading State Office Building

ECM 27

EXISTING CONDITION

The Reading State Office Building rooftop is large, flat, largely unused, and has unimpeded access to the sky facing south – ideal for a rooftop solar array. The facility currently has no solar array.

PROPOSED SOLUTION

BG will install a roof mounted solar array rated at 222.30 kW DC. The array will consist of 458 panels and will generate a guaranteed first year production of 281,596 kWh. As part of the installation, BG will work with the facility's existing roofing contractor to ensure all pathways to rooftop equipment are properly protected. Additionally, BG is a federally approved EV charging station installer. As part of this project, BG could add EV charging stations at the facilities direction.

IMPLEMENTATION COST

$422,442

ENERGY COST SAVINGS

$14,080

MAINTENANCE CONSIDERATIONS

- Maintenance for the solar array will be required

M&V OPTION

N/A

NEW HIGH PERFORMANCE 208V CHILLER (ECM #4 & #12 ALTERNATE).

ECM Category: Recommended Only
Location: Reading State Office Building

ECM 28

EXISTING CONDITION

The existing chilled water system is fed by two existing water-cooled Trane chillers. One (1) of the existing chillers has been removed and is in the process of being replaced. The chilled water distribution system serves existing air handling units, each with three-way control valves. The piping arrangement for the existing chilled water system is a constant volume primary-secondary type, with constant volume pumping on the condenser water as well.

PROPOSED SOLUTIONS

BG will install one (1) new high performance 100-ton scroll chiller to match the size of the existing chiller. The new chiller will be 208v and eliminate the need for the 480v power upgrade. BG will install new chilled water distribution and condenser water pumps with variable frequency drives. Additionally, control valve upgrades on the air handling units will allow the pumping to become a variable volume type, further reducing energy usage of the system. The upgrades to the BAS will also improve energy-efficient operations of the chilled water system by varying the chilled water and condenser water temperatures, when possible, to allow the entire system to operate as efficiently as possible.

IMPLEMENTATION COST

$768,056

ENERGY COST SAVINGS

$2,951

MAINTENANCE CONSIDERATIONS

- No additional maintenance required

M&V OPTION

N/A

ELECTRIC VAV

ECM Category: Recommended Only
Location: Scranton State Office Building

ECM 29

EXISTING CONDITION

The request is to replace the existing dual-duct terminal units to eliminate simultaneous heating and cooling in the building HVAC system. Through several ECMs, BG has proposed installation of a comprehensive building HVAC solution including expansion and further utilization of the building's high efficiency heating hot water system. Utilizing hot water for reheat increased first cost, so BG has explored other options.

PROPOSED SOLUTIONS

This proposed solution includes the scope of work in ECM-15 less the hot water reheats VAVs and hot water distribution piping. This ECM also eliminates the need for a natural gas condensing hot water heating system in ECM-16. BG proposes installation of electric terminal VAV boxes. The existing duct heaters for the (5) AHUs will be removed, and the power will be distributed to the electric VAVs for heating and control at the zone level.

IMPLEMENTATION COST

$2,118,114

ENERGY COST SAVINGS

$0

MAINTENANCE CONSIDERATIONS

- No additional maintenance required

M&V OPTION

N/A

ELECTRIC VAV

ECM Category: Recommended Only
Location: DGS Annex Building 55

ECM 30

EXISTING CONDITION

The entire building has been unused for some time and the mechanical equipment is all in varying states of disrepair. Building heat is steam provided from an adjacent energy center building. The energy center building is scheduled for demolition.

PROPOSED SOLUTIONS

BG proposes installation of (7) seven high efficiency gas/dx packaged rooftop air conditioning units throughout the building. The units will ducted supply and return air. In the office area, the (1) RTU unit will be true VAV with terminal unit zoning. General shop areas will utilize single-zone VAV RTU's throughout the space. Natural gas will be extended from the new gas main provided in this ECM.

Due to the building utilizing district steam, a natural gas main must be provided for the building. BG has provided an allowance per lineal foot up to 500 lineal feet in our proposal.

Additionally, this ECM includes installation of hydronic boilers designed to provide heating hot water reheat for the (11) eleven office VAV boxes. Variable speed drives will be utilized on the water distribution pumps to provide maximum energy efficiency. The hot water boilers will be variable flow, condensing type.

IMPLEMENTATION COST

$3,510,418

ENERGY COST SAVINGS

$18,727

MAINTENANCE CONSIDERATIONS

- No additional maintenance required

M&V OPTION

N/A

STEAM TRAP REPAIR

ECM Category: Recommended Only
Location: Northwest Building

ECM 31

EXISTING CONDITION	PROPOSED SOLUTION
Float, thermostatic and inverted bucket traps are located in a mechanical room and require on-going maintenance and or replacement.	Remove and dispose of existing traps and replace them with new traps. Traps currently used as vacuum breakers will be replaced with vacuum breakers. Mechanical traps for which replacement is not feasible—due to location, size, or configuration—will be retrofitted with a new insert and gasket; the existing cover will be reused (in some instances a new cover will be provided). • Replace 26 existing traps with new float & thermostatic trap • Replace 9 Existing traps with new inverted bucket trap
IMPLEMENTATION COST	***ENERGY COST SAVINGS***
$90,026	**$4,820**

MAINTENANCE CONSIDERATIONS	M&V OPTION
• No additional maintenance required	**N/A**

BUILDING ENVELOPE AND FILM

ECM Category: Energy Only / Recommended
Location: Northwest Building

ECM 32

EXISTING CONDITION

The Northwest Building 55 is a 3-story brick building with windows on all exposures. During the site surveys it was observed that air was being lost through exterior doors, interior doors, and the roof / wall joints. It was also noted the windows could benefit from a reflective window film.

PROPOSED SOLUTION

BG recommends weather stripping the doors and sealing the roof / wall joints as described below:

- 4 interior doors weather-stripped & sealed for isolation
- 10 exterior doors weather-stripped & sealed
- 6240 feet of window system to be sealed
- 44 feet of over-head doors to be sealed on 4 sides

BG recommends a reflective window film be applied as described below:

Apply 5,216 square feet of film on 624 windows around the building.

IMPLEMENTATION COST

$162,455

ENERGY COST SAVINGS

$14,750

MAINTENANCE CONSIDERATIONS

- No additional maintenance required for doors
- Using abrasive tools or harsh chemicals for window washing will be harmful to film

M&V OPTION

N/A

PENNSYLVANIA DEPARTMENT OF GENERAL SERVICES READING AND SCRANTON, PA GUARANTEED ENERGY SAVINGS PROJECT GESA 2023-1

VOLUME II: ECM/COST SUBMITTAL

C.1.H ANNUAL FINANCIAL PROJECTIONS

BG Brewer-Garrett

DGS Reading, Scranton, and Harrisburg GESA
Energy Only GESA Cash Flow

Energy Performance Contract Cash Flow

Project Cost	$526,725	Includes Energy Consultant Fee & 3-Years M&V Services	Interest Rate	4.25%	
Utility Rebate	$1,653		Utility Escalation Rate [1]	1.0%	
Net Project Cost To Be Financed	$525,072		Maintenance Escalation Rate [1]	1.0%	
Energy Related Cost Savings	$0		Project Term (Years)	18	
First Year Energy Savings	$46,192		Payment Frequency	Annual	
Construction Period Savings	$7,209				
Year 1 Savings = First Year + Construction	$53,401				

Year	A Annual Energy Costs Without Improvements	B Annual Energy Costs With Improvements	C Annual Energy Cost Savings (A - B)	D O&M Savings (Provided)	E Total Savings (C + D)	F Payments for Financing Equipment	G Energy Related Cost Savings	H [2] Payments for Monitoring & Maintenance Services	I [3] Net Annual Benefit (E + F + G)	J Cumulative Cash Flow	K [4] Net Present Value of Cash Flow
0											
1	$296,672	$243,271	$53,401	$0	$53,401	-$41,787	$0	-$20,000	$11,614	$11,614	
2	$259,190	$212,536	$46,654	$0	$46,654	-$41,787	$0	-$20,000	$4,868	$16,482	
3	$261,782	$214,661	$47,121	$0	$47,121	-$41,787	$0	-$20,000	$5,334	$21,816	
4	$264,400	$216,808	$47,592	$0	$47,592	-$41,787	$0	$0	$5,805	$27,622	
5	$267,044	$218,976	$48,068	$0	$48,068	-$41,787	$0	$0	$6,281	$33,903	
6	$269,714	$221,166	$48,549	$0	$48,549	-$41,787	$0	$0	$6,762	$40,665	
7	$272,412	$223,377	$49,034	$0	$49,034	-$41,787	$0	$0	$7,247	$47,912	
8	$275,136	$225,611	$49,524	$0	$49,524	-$41,787	$0	$0	$7,738	$55,650	
9	$277,887	$227,867	$50,020	$0	$50,020	-$41,787	$0	$0	$8,233	$63,883	
10	$280,666	$230,146	$50,520	$0	$50,520	-$41,787	$0	$0	$8,733	$72,617	
11	$283,473	$232,447	$51,025	$0	$51,025	-$41,787	$0	$0	$9,238	$81,855	
12	$286,307	$234,772	$51,535	$0	$51,535	-$41,787	$0	$0	$9,749	$91,604	
13	$289,170	$237,120	$52,051	$0	$52,051	-$41,787	$0	$0	$10,264	$101,868	
14	$292,062	$239,491	$52,571	$0	$52,571	-$41,787	$0	$0	$10,785	$112,652	
15	$294,983	$241,886	$53,097	$0	$53,097	-$41,787	$0	$0	$11,310	$123,963	
16	$297,932	$244,305	$53,628	$0	$53,628	-$41,787	$0	$0	$11,841	$135,804	
17	$300,912	$246,748	$54,164	$0	$54,164	-$41,787	$0	$0	$12,378	$148,181	
18	$303,921	$249,215	$54,706	$0	$54,706	-$41,787	$0	$0	$12,919	$161,101	$115,671
Totals	**$5,073,663**	**$4,160,403**	**$913,259**	**$0**	**$913,259**	**-$752,159**	**$0**	**-$60,000**	**$161,101**		**$115,671**

Notes: **1 - Escalation Rates per GESA contract Part 2-1.A .**

2 - Monitoring & Maintenance Services costs shown annually, total costs are included in the financing payment.

3 - Net Annual Benefit does not include M&V costs in column H. These costs are included in the financing payment already.

4 - Net Present Value of Cash Flow is calculated using an assumed Internal Rate of Return of 3% which is based on a 18-year long term investment rate alternative.

DGS Reading, Scranton, and Harrisburg GESA
Base GESA Cash Flow

Energy Performance Contract Cash Flow

Project Cost	$21,591,181	Includes Energy Consultant Fee & 3-Years M&V Services	Interest Rate	4.25%	
Utility Rebate	$10,931		Utility Escalation Rate [1]	1.0%	
Net Project Cost To Be Financed	$21,580,250		Maintenance Escalation Rate [1]	1.0%	
Energy Related Cost Savings	$912,304		Project Term (Years)	18	
First Year Energy Savings	$134,898		Payment Frequency	Annual	
Construction Period Savings	$33,690				
Year 1 Savings = First Year + Construction	$168,588				

Year	A Annual Energy Costs Without Improvements	B Annual Energy Costs With Improvements	C Annual Energy Cost Savings (A - B)	D O&M Savings (Provided)	E Total Savings (C + D)	F Payments for Financing Equipment	G Energy Related Cost Savings	H [2] Payments for Monitoring & Maintenance Services	I [3] Net Annual Benefit (E + F + G)	J Cumulative Cash Flow	K [4] Net Present Value of Cash Flow
0											
1	$936,600	$768,012	$168,588	$147,642	$316,230	-$1,717,411	$1,460,047	-$28,000	$58,866	$58,866	
2	$756,927	$620,680	$136,247	$149,118	$285,365	-$1,717,411	$1,460,047	-$28,000	$28,001	$86,867	
3	$764,496	$626,887	$137,609	$150,610	$288,219	-$1,717,411	$1,460,047	-$28,000	$30,855	$117,722	
4	$772,141	$633,156	$138,985	$152,116	$291,101	-$1,717,411	$1,460,047	$0	$33,737	$151,458	
5	$779,862	$639,487	$140,375	$153,637	$294,012	-$1,717,411	$1,460,047	$0	$36,648	$188,106	
6	$787,661	$645,882	$141,779	$155,173	$296,952	-$1,717,411	$1,460,047	$0	$39,588	$227,694	
7	$795,538	$652,341	$143,197	$156,725	$299,922	-$1,717,411	$1,460,047	$0	$42,557	$270,252	
8	$803,493	$658,864	$144,629	$158,292	$302,921	-$1,717,411	$1,460,047	$0	$45,557	$315,808	
9	$811,528	$665,453	$146,075	$159,875	$305,950	-$1,717,411	$1,460,047	$0	$48,586	$364,394	
10	$819,643	$672,107	$147,536	$161,474	$309,010	-$1,717,411	$1,460,047	$0	$51,645	$416,040	
11	$827,840	$678,828	$149,011	$163,089	$312,100	-$1,717,411	$1,460,047	$0	$54,736	$470,775	
12	$836,118	$685,617	$150,501	$164,720	$315,221	-$1,717,411	$1,460,047	$0	$57,857	$528,632	
13	$844,479	$692,473	$152,006	$166,367	$318,373	-$1,717,411	$1,460,047	$0	$61,009	$589,640	
14	$852,924	$699,398	$153,526	$168,030	$321,557	-$1,717,411	$1,460,047	$0	$64,192	$653,833	
15	$861,453	$706,392	$155,062	$169,711	$324,772	-$1,717,411	$1,460,047	$0	$67,408	$721,241	
16	$870,068	$713,456	$156,612	$171,408	$328,020	-$1,717,411	$1,460,047	$0	$70,656	$791,897	
17	$878,768	$720,590	$158,178	$173,122	$331,300	-$1,717,411	$1,460,047	$0	$73,936	$865,833	
18	$887,556	$727,796	$159,760	$174,853	$334,613	-$1,717,411	$1,460,047	$0	$77,249	$943,082	$1,559,775
Totals	**$14,887,095**	**$12,207,418**	**$2,679,677**	**$2,895,961**	**$5,575,638**	**-$30,913,400**	**$26,280,844**	**-$84,000**	**$943,082**		**$1,559,775**

Notes: **1 - Escalation Rates per GESA contract Part 2-1.A .**

2 - Monitoring & Maintenance Services costs shown annually, total costs are included in the financing payment.

3 - Net Annual Benefit does not include M&V costs in column H. These costs are included in the financing payment already.

4 - Net Present Value of Cash Flow is calculated using an assumed Internal Rate of Return of 3% which is based on a 18-year long term investment rate alternative.

DGS Reading, Scranton, and Harrisburg GESA
Recommended GESA Cash Flow

Energy Performance Contract Cash Flow

Project Cost	$19,542,028	Includes Energy Consultant Fee & 3-Years M&V Services	Interest Rate	4.25%	
Utility Rebate	$15,167		Utility Escalation Rate [1]	1.0%	
Net Project Cost To Be Financed	$19,526,861		Maintenance Escalation Rate [1]	1.0%	
Energy Related Cost Savings	$783,944		Project Term (Years)	18	
First Year Energy Savings	$153,194		Payment Frequency	Annual	
Construction Period Savings	$18,431				
Year 1 Savings = First Year + Construction	$171,625				

Year	A Annual Energy Costs Without Improvements	B Annual Energy Costs With Improvements	C Annual Energy Cost Savings (A - B)	D O&M Savings (Provided)	E Total Savings (C + D)	F Payments for Financing Equipment	G Energy Related Cost Savings	H [2] Payments for Monitoring & Maintenance Services	I [3] Net Annual Benefit (E + F + G)	J Cumulative Cash Flow	K [4] Net Present Value of Cash Flow
0											
1	$953,475	$781,849	$171,625	$143,530	$315,155	-$1,553,997	$1,284,307	-$30,000	$45,465	$45,465	
2	$859,590	$704,864	$154,726	$144,965	$299,691	-$1,553,997	$1,284,307	-$30,000	$30,001	$75,466	
3	$868,186	$711,912	$156,273	$146,415	$302,688	-$1,553,997	$1,284,307	-$30,000	$32,998	$108,464	
4	$876,868	$719,031	$157,836	$147,879	$305,715	-$1,553,997	$1,284,307	$0	$36,025	$144,489	
5	$885,636	$726,222	$159,415	$149,358	$308,772	-$1,553,997	$1,284,307	$0	$39,082	$183,571	
6	$894,493	$733,484	$161,009	$150,851	$311,860	-$1,553,997	$1,284,307	$0	$42,170	$225,740	
7	$903,438	$740,819	$162,619	$152,360	$314,979	-$1,553,997	$1,284,307	$0	$45,288	$271,029	
8	$912,472	$748,227	$164,245	$153,883	$318,128	-$1,553,997	$1,284,307	$0	$48,438	$319,467	
9	$921,597	$755,709	$165,887	$155,422	$321,310	-$1,553,997	$1,284,307	$0	$51,619	$371,086	
10	$930,813	$763,266	$167,546	$156,977	$324,523	-$1,553,997	$1,284,307	$0	$54,832	$425,918	
11	$940,121	$770,899	$169,222	$158,546	$327,768	-$1,553,997	$1,284,307	$0	$58,078	$483,996	
12	$949,522	$778,608	$170,914	$160,132	$331,046	-$1,553,997	$1,284,307	$0	$61,355	$545,351	
13	$959,017	$786,394	$172,623	$161,733	$334,356	-$1,553,997	$1,284,307	$0	$64,666	$610,017	
14	$968,607	$794,258	$174,349	$163,350	$337,700	-$1,553,997	$1,284,307	$0	$68,009	$678,027	
15	$978,293	$802,201	$176,093	$164,984	$341,077	-$1,553,997	$1,284,307	$0	$71,386	$749,413	
16	$988,076	$810,223	$177,854	$166,634	$344,487	-$1,553,997	$1,284,307	$0	$74,797	$824,210	
17	$997,957	$818,325	$179,632	$168,300	$347,932	-$1,553,997	$1,284,307	$0	$78,242	$902,452	
18	$1,007,937	$826,508	$181,429	$169,983	$351,412	-$1,553,997	$1,284,307	$0	$81,721	$984,173	$1,460,951
Totals	**$16,796,096**	**$13,772,799**	**$3,023,297**	**$2,815,303**	**$5,838,600**	**-$27,971,949**	**$23,117,523**	**-$90,000**	**$984,173**		**$1,460,951**

Notes: **1 - Escalation Rates per GESA contract Part 2-1.A .**

2 - Monitoring & Maintenance Services costs shown annually, total costs are included in the financing payment.

3 - Net Annual Benefit does not include M&V costs in column H. These costs are included in the financing payment already.

4 - Net Present Value of Cash Flow is calculated using an assumed Internal Rate of Return of 3% which is based on a 18-year long term investment rate alternative.

PENNSYLVANIA DEPARTMENT OF GENERAL SERVICES READING AND SCRANTON, PA GUARANTEED ENERGY SAVINGS PROJECT GESA 2023-1

VOLUME II: ECM/COST SUBMITTAL

C.1.I. REASONABLENESS OF SAVINGS

BG Brewer-Garrett

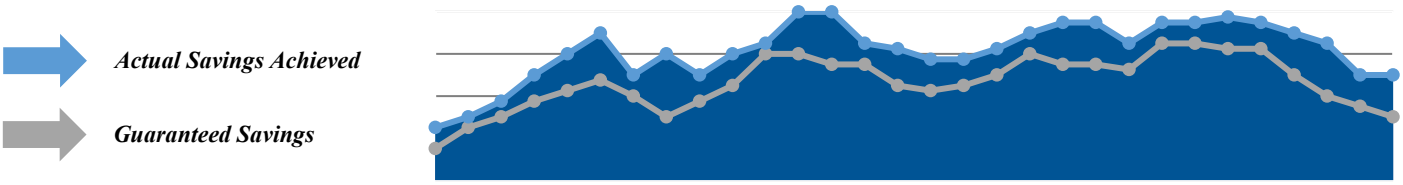
C.1.i. Reasonableness of Savings

i. Proposed energy analysis demonstrates sound engineering principles and the reasonableness of the proposed savings.

Our team thoroughly reviewed the existing infrastructure at each DGS facility and the available utility information against a developed baseline of 20 healthcare, higher education, and correctional institutions. This comparison allows us to design our proposed solutions and calculate savings with real world examples and anecdotal experience.

Further, the detailed energy savings calculations provided in Appendix C - Supplemental Information were developed by our very own in-house professional engineers and certified energy managers. BG's savings guarantee methodology is based on projecting realistic and achievable guarantees. With being conservative in our projections of guaranteed savings, our customers typically exceed the expected savings, as shown in the graph below.

29% **HIGHER SAVINGS** OVER PROJECTED ENERGY GUARANTEE **ON AVERAGE.**



Ability to Provide Guarantee

BG's in-house energy engineering team has successfully developed and implemented over $550 million of energy conservation projects and energy guarantees and $430 million of which has been satisfied to date. Since the 1990s, BG has designed and installed over 830 energy conservation projects across 21 states. Our energy services division maintains a staff of certified energy managers that are highly experienced in the energy services field, certified lighting professionals, MEP engineers, and energy engineers/auditors, comprised of certified measurement and verification professionals, with capabilities utilizing Metrix™ software to measure and ensure energy cost savings.

Project/Customer	*Project Value*	*Guaranteed Energy Savings*	*Guaranteed Savings to Actual Savings %*
Aultman Hospital	*$18,600,000*	*$10,874,713*	**104%**
Central State University	*$16,165,560*	*$14,553,291*	**101%**
Southeastern Correctional Institution	*$2,437,140*	*$3,410,273*	**110%**
Otterbein University	*$4,640,031*	*$5,015,065*	**103%**
Northeast Ohio Regional Sewer District (NEORSD)	*$2,376,167*	*$2,920,305*	**300%**
Kent State University Main Campus Phase I	*$24,816,900*	*$33,762,090*	**291%**

PENNSYLVANIA DEPARTMENT OF GENERAL SERVICES READING AND SCRANTON, PA GUARANTEED ENERGY SAVINGS PROJECT GESA 2023-1

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2.6.C.1 MONITORING AND MAINTENANCE SERVICES

PENNSYLVANIA DEPARTMENT OF GENERAL SERVICES READING AND SCRANTON, PA GUARANTEED ENERGY SAVINGS PROJECT GESA 2023-1

VOLUME II: ECM/COST SUBMITTAL

C.1.J. MONITORING AND MAINTENANCE PLAN

BG Brewer-Garrett

2.6.C.1 MONITORING AND MAINTENANCE SERVICES

C.1.j. Monitoring and Maintenance Plan

j. Quote thoroughly describes the methods, schedule, scope, and personnel who will be performing ongoing monitoring and maintenance services.

Ongoing Project Monitoring and Maintenance

BG's approach to operations and maintenance begins with our commitment to our customer. The BG commitment extends from the president of our company down through each employee to ensure every customer receives the highest consistent and quality service available. Ongoing project monitoring and maintenance is handled by our post construction team, managed by the Energy Engineering Manager, Meg Bair.

Preventive Maintenance

Regularly scheduled preventive maintenance is vital to maximizing the useful life of equipment; however, BG does not anticipate the need for an additional outside service agreement. BG will work in conjunction with equipment manufacturers to fully train site staff to carry out these services on all installed equipment. Andrew Krueger will be responsible for the initial training post construction; these sessions will be videotaped for the training or re-training of staff members in the future.

Warranty Work

As a part of the post construction project close-out procedures, BG will provide details on warranty of labor and material for equipment installed.

Emergency Service

During construction, a BG team member will always be on-site and available. Matt Baker will be responsible for all on-site coordination throughout construction.

BG is a large, highly qualified service provider of HVAC repair and emergency services, that serves over 700 customers. We are staffed with qualified and experienced technicians, and have a fully equipped fleet to handle any emergency 24/7/365 within two hours of a request for emergency service.

BG is a member of a national association of quality like-minded HVAC contractors and can engage these partners in the event of emergency service if needed. Additionally, if requested due to our location in Ohio, BG will vet and retain local tradespeople to provide emergency services at each DGS facilities via service contract. These personnel will receive the same training as all of BG's service technicians and have the full range of dispatch and work tracking tools at their disposal.

Working in an Occupied Facility

BG has extensive experience working in occupied environments and secure facilities. We fully understand that our work at each DGS facility comes second to each building's overall security, safety, and mission. BG will ensure that all personnel and subcontractors have the requisite clearances and badging to avoid any unexpected challenges with facility access and that this is coordinated with DGS staff. All tool storage and inventory requirements will be adhered to closely, and any utility shutdowns will be coordinated with the site staff well in advance of the planned shutdown.

PENNSYLVANIA DEPARTMENT OF GENERAL SERVICES READING AND SCRANTON, PA GUARANTEED ENERGY SAVINGS PROJECT GESA 2023-1

VOLUME II: ECM/COST SUBMITTAL

C.1.K. PROPOSED MEASUREMENT AND VERIFICATION PLAN

BG Brewer-Garrett

C.1.k. Proposed Measurement and Verification Plan

k. Proposed Measurement and Verification (M&V) plan adheres to all M&V protocol standards and describes the choice of M&V method and why it is the most appropriate method to show true savings.

Any energy savings guaranteed by BG will be validated using the International Performance Measurement and Verification Protocol (IPMVP). The framework provided by the IPMVP has become the industry standard for savings verification after the implementation of an energy conservation program. The IPMVP utilizes a very basic formula for calculating savings:

Energy Savings = Base Year Energy Use – Post Program Energy Use + or – Adjustments

Option A. Partially Measured Retrofit Isolation	**Option B.** Retrofit Isolation	**Option C.** Whole Facility	**Option D.** Simulated Calibration
Savings are determined by partial field measurement of the energy use of the system(s) to which an ECM was the energy use of the system(s) to which an ECM was applied, separate from the energy use of the rest of the facility. Measurements may be either short-term or continuous.	Savings are determined by field measurement of the energy use of the systems to which the ECM was applied, separate from the energy use of the rest of the facility. Short-term or continuous measurements are taken throughout the post-retrofit period.	Savings are determined by measuring energy use at the whole facility level. Short-term or continuous measurements are taken throughout the post-retrofit period.	Savings are determined through simulation of the energy use of the component or the whole facility through modeling.

Our plan was built around the core ECMs requested in the RFQ. Once selected a detailed M&V plan will be finalized during the investment grade audit phase. Baselines will be validated for accuracy. BG has reviewed the utility information and the occupancy data provided with the RFQ. It appears that the baseline use is lower than expected based upon the EIA CBECS data for Mid Atlantic Region. The M&V plan for the core ECMs will be comprised of a combination of all the options of the IPMVP.

The DGS, funding agency, site staff, and energy consultant will have a dedicated performance assurance engineer to manage the ongoing measurement and verification of installed ECMs during the reporting period. The performance assurance engineer will collect utility and operational data monthly, conduct site surveys, and analyze data. This data is used to generate the annual performance report due 90 days after receipt of all utility data.

We have provided an M&V specific table below to describe our proposed M&V option for each of the core ECMs along with the justification of why each method was selected.

ECM Number	ECM Title	Proposed M&V Option	Appropriate Method Justification to Show True Savings
01	Interior & exterior light conversion to LED	*IPMVP: A*	Option A is based on a combination of measured and estimated factors. In the case of lighting the following process will be followed. **Data Gathered:** Detailed lighting audit, including fixture quantity, type, type and number of lamps and ballasts, locations, use of space (administrative, industrial, etc.), estimated occupancy and operating hours, and light levels **Baseline:** Measure baseline fixture wattages for a representative sample of fixtures from a number of pre-installation lamp and ballast combination groups. Determine operating hours through facility interviews and investigations supplemented with short-term monitoring of operating hours in a sample of spaces. **Post Installation:** Measure post-installation fixture wattages for a representative sample of fixtures from a number of post-installation groups. Operating hours remain the same as baseline.
02	Upgrade or replace AHUs. Consolidate where possible and add air-side economizer.	*IPMVP: C*	Option C is based on a reductions occurring at the utility meters. A statistical regression for both natural gas and electricity will be developed to calculate the baseline.
03	Replace VAV boxes and eliminate dual duct simultaneous heating and cooling. Include ultraviolet (UV) decontamination in AHUs. Provide supply air reset control. Equip AHUs with VFDs and twoway valves for variable volume pumping for heating and cooling. All chilled water valves should be the Belimo Energy Valve to combat low delta T syndrome in the building.	*IPMVP: C*	Option C is based on a reductions occurring at the utility meters. A statistical regression for both natural gas and electricity will be developed to calculate the baseline.

ECM Number	ECM Title	Proposed M&V Option	Appropriate Method Justification to Show True Savings
04	Replace the remaining chiller and associated pumps. Convert to variable volume pumping.	*IPMVP: C*	Option C is based on a reductions occurring at the utility meters. A statistical regression for both natural gas and electricity will be developed to calculate the baseline.
05	Provide VFD(s) and associated controls for cooling tower fan(s) or recommission existing.	*IPMVP: C*	Option C is based on a reductions occurring at the utility meters. A statistical regression for both natural gas and electricity will be developed to calculate the baseline.
06	Eliminate pneumatic controls; install a new building automation system (BAS).	*IPMVP: C*	Option C is based on a reductions occurring at the utility meters. A statistical regression for both natural gas and electricity will be developed to calculate the baseline.
07	Install a dedicated radon mitigation system for the basement to allow better control and scheduling of the heating, ventilation, and air conditioning (HVAC) and restore outdoor air to rates required for space occupancy.	*IPMVP: C*	Option C is based on a reductions occurring at the utility meters. A statistical regression for both natural gas and electricity will be developed to calculate the baseline.
08	Replace sewage pump(s).	*N/A*	No savings are being claimed

ECM Number	ECM Title	Proposed M&V Option	Appropriate Method Justification to Show True Savings
09	Explore improvements for the lobby tinted/reflective window film and revolving doors for main entrance.	*IPMVP: A*	Option A is based on a combination of measured and estimated factors. In the case of windows, the measured parameter will be the size of windows and difference in the U value of glazing and leaks sealed.
10	Implement water conservation for restrooms (new flush valves).	*IPMVP: A*	Option A is based on a combination of measured and estimated factors. In the case of water, the measured parameter will be the fixture flow.
11	Overall building weatherization	*IPMVP: A*	Option A is based on a combination of measured and estimated factors. In the case of envelope, the measured parameter will be the size of leaks sealed through weatherization
12	Evaluate replacement of electrical main distribution panel to 480V from 208V and eliminate step up transformers.	*N/A*	No savings being claimed
13	LED lighting retrofit / replacement throughout the building.	*IPMVP: A*	Option A is based on a combination of measured and estimated factors. In the case of lighting the following process will be followed. Data Gathered: Detailed lighting audit, including fixture quantity, type, type and number of lamps and ballasts, locations, use of space (administrative, industrial, etc.), estimated occupancy and operating hours, and light levels Baseline: Measure baseline fixture wattages for a representative sample of fixtures from a number of pre-installation lamp and ballast combination groups. Determine operating hours through facility interviews and investigations supplemented with short-term monitoring of operating hours in a sample of spaces. Post Installation: Measure post-installation fixture wattages for a representative sample of fixtures from a number of post-installation groups. Operating hours remain the same as baseline.

ECM Number	ECM Title	Proposed M&V Option	Appropriate Method Justification to Show True Savings
14	Overall building weatherization	*IPMVP: A*	Option A is based on a combination of measured and estimated factors. In the case of envelope, the measured parameter will be the size of leaks sealed through weatherization
15	Upgrade or replace AHUs. Add air-side economizer. Include UV decontamination in AHUs. Equip AHUs with VFDs and two-way valves for variable volume pumping for heating and cooling. Provide supply air reset control. Replace existing VAV control boxes with new zone dampers and reheat for humidity control. All chilled water valves should be the Belimo Energy Valve to combat low delta T syndrome in the building.	*IPMVP: C*	Option C is based on reductions occurring at the utility meters. A statistical regression for both natural gas and electricity will be developed to calculate the baseline.
16	Convert from electric resistance heat to hot water heating. Install a condensing boiler plant in the penthouse storage area and pipe to new hot water coils (included with new AHUs or added to existing in duct).	*IPMVP: C*	Option C is based on reductions occurring at the utility meters. A statistical regression for both natural gas and electricity will be developed to calculate the baseline.

ECM Number	ECM Title	Proposed M&V Option	Appropriate Method Justification to Show True Savings
17	Replace or refurbish the cooling tower. Provide VFDs and associated controls for cooling tower fan or recommission existing.	*IPMVP: C*	Option C is based on reductions occurring at the utility meters. A statistical regression for both natural gas and electricity will be developed to calculate the baseline.
18	Eliminate pneumatic controls. Extend direct digital controls (DDC) controls to new and remaining equipment. Add/reconfigure control zones to match existing space layout. Provide central control to perimeter baseboard for use as secondary heat for shell load on very cold days.	*IPMVP: C*	Option C is based on reductions occurring at the utility meters. A statistical regression for both natural gas and electricity will be developed to calculate the baseline.
19	Convert electric DHW to natural gas or heat pump. Considering the new condition of the existing system and relatively low impact on energy use, this may not be a base ECM; however, gas service could be roughed in to prepare for future conversion.	*N/A*	No savings being claimed.

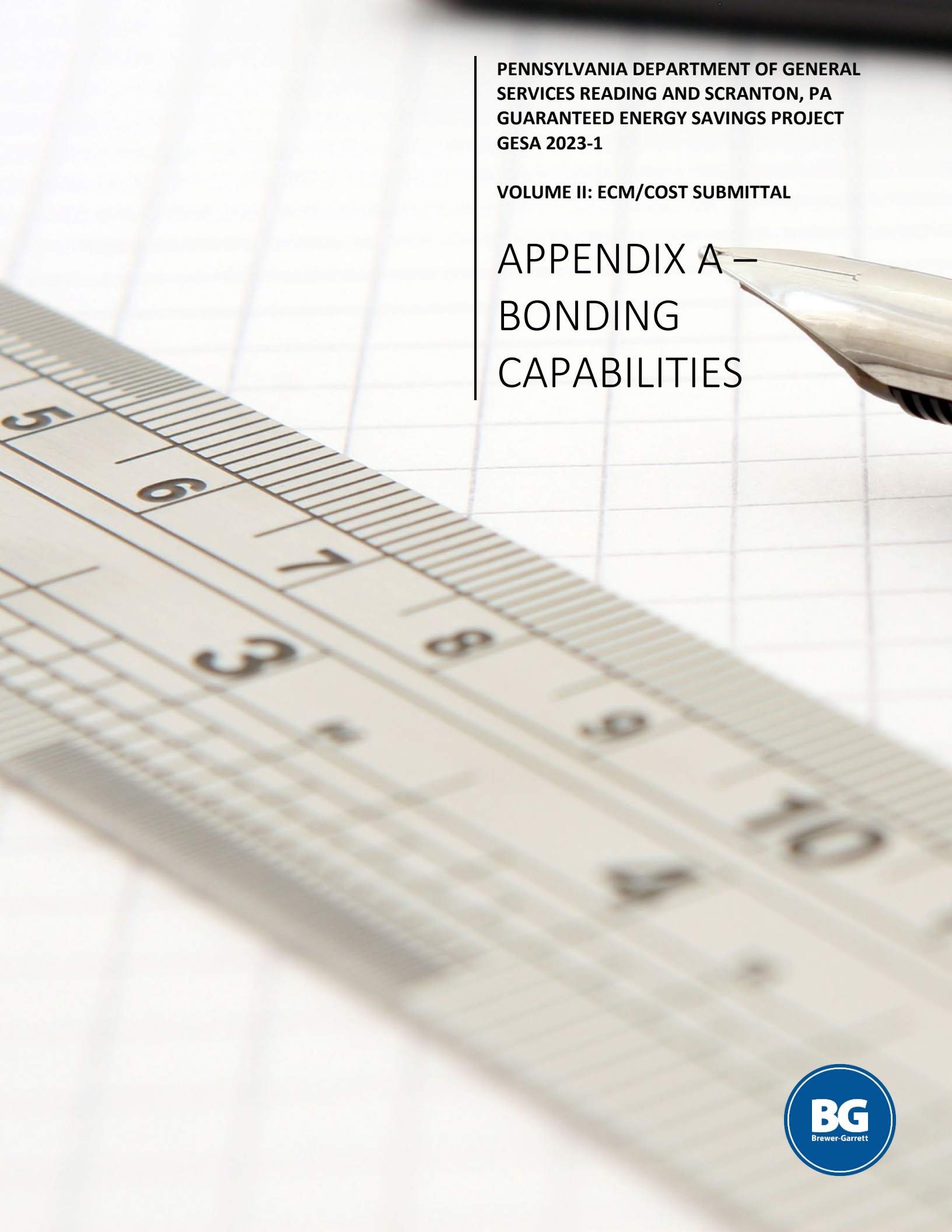
ECM Number	ECM Title	Proposed M&V Option	Appropriate Method Justification to Show True Savings
20	LED lighting retro fit / replacement throughout the building.	***IPMVP: A***	Option A is based on a combination of measured and estimated factors. In the case of lighting the following process will be followed. Data Gathered: Detailed lighting audit, including fixture quantity, type, type and number of lamps and ballasts, locations, use of space (administrative, industrial, etc.), estimated occupancy and operating hours, and light levels Baseline: Measure baseline fixture wattages for a representative sample of fixtures from a number of pre-installation lamp and ballast combination groups. Determine operating hours through facility interviews and investigations supplemented with short-term monitoring of operating hours in a sample of spaces. Post Installation: Measure post-installation fixture wattages for a representative sample of fixtures from a number of post-installation groups. Operating hours remain the same as baseline.
21	Overall building weatherization.	***IPMVP: A***	Option A is based on a combination of measured and estimated factors. In the case of envelope, the measured parameter will be the size of leaks sealed through weatherization
22	Install gas boiler and cooling upgrades possible high efficiency heat pumps.	***IPMVP: D***	Option D is based on a model of the building. No utility information was available to determine the baseline. Baseline and savings will be determined through a mathematical model.
23	Explore the value of a possible geothermal system.	***IPMVP: D***	Option D is based on a model of the building. No utility information was available to determine the baseline. Baseline and savings will be determined through a mathematical model.

ECM Number	ECM Title	Proposed M&V Option	Appropriate Method Justification to Show True Savings
24	Eliminate pneumatic controls; install a new building automation system (BAS).	*IPMVP: D*	Option D is based on a model of the building. No utility information was available to determine the baseline. Baseline and savings will be determined through a mathematical model.
25	Building recommissioning.	*IPMVP: D*	Option D is based on a model of the building. No utility information was available to determine the baseline. Baseline and savings will be determined through a mathematical model.

PENNSYLVANIA DEPARTMENT OF GENERAL SERVICES READING AND SCRANTON, PA GUARANTEED ENERGY SAVINGS PROJECT GESA 2023-1

VOLUME II: ECM/COST SUBMITTAL

APPENDIX A – BONDING CAPABILITIES



APPENDIX A – BONDING CAPABILITIES

Financial Stability

BG has been exceeding customer expectations with successful projects for over 61 years. Our financial strength and long-term viability are evidenced by solid and ongoing operating results, strong liquidity, and capital adequacy. BG is a privately held company and as such is very circumspect regarding its financial information. BG has attached a separate sealed packet containing summarized data prepared by a certified public accounting firm located in the proposal marked "Original." If more detailed information is required you may contact our Controller, Billy Lawless, at any time at 440-243-3535. BG's Federal Tax ID number is 34-0836142.

Bonding Information

BG's bonding company is Cincinnati Insurance. This A+XV carrier is one of the most highly rated bonding companies in the country. BG's largest financed and guaranteed energy conservation program in the last five years was $42 million. BG, in over 61 years of providing premier energy services, engineering, and design-build construction, has never had a bond invoked. In addition, the company has never been denied a bond. Our total bonding capacity is $55 million. The following page contains a surety letter from Hotaling & Associates Agency, Inc.

Name of Bonding Agent:
Hotaling & Associates Agency, Inc.
8803 Brecksville Road, Suite 7-211
Brecksville, Ohio 44141
216.447.1004

Insurance Information

BG has provided our Certificate of Insurance on the following page. The Certificate of Insurance showing commercial general liability insurance in amount not less than $1,000,000 each occurrence, comprehensive automotive liability insurance in amount not less than $1,000,000 and workers compensation insurance in accordance with Worker's Compensation Act of the Commonwealth of Pennsylvania, is included below. In addition, Contractor's Professional Liability insurance coverage requirements for engineering design work in the Commonwealth of Pennsylvania, $5,000,000 Per Claim and $5,000,000 Aggregate, is included on this certificate.

PENNSYLVANIA DEPARTMENT OF GENERAL SERVICES READING AND SCRANTON, PA GUARANTEED ENERGY SAVINGS PROJECT GESA 2023-1

VOLUME II: ECM/COST SUBMITTAL

BONDING INFORMATION

Brewer-Garrett

Hotaling & Associates Agency, Inc.

8803 Brecksville Road | Suite# 7-211 | Brecksville, Ohio 44141 | 216-447-1004 | www.hotalingassoc.com

May 3, 2023

Ms. Becky Tomlinson
Commonwealth of Pennsylvania
Department of General Services
403 North Office Bldg.
401 North Street
Harrisburg, PA 17120

Re:	***Contractor:***	***The Brewer-Garrett Company***
	Project Number:	***2023-1***
	Project:	***Guaranteed Energy Savings Project-Dept of General Services***
	Surety:	***The Cincinnati Insurance Company/2022 A. M. Best Rating: A+ XV***

Dear Ms. Tomlinson:

By way of introduction, the associates of Hotaling & Associates Agency, Inc. have been servicing the Risk Management and Surety requirements of The Brewer-Garrett Company for the past 32 years. We have genuinely enjoyed an excellent relationship over that period, and we highly recommend our contractor/ client for your favorable consideration of any project that you may propose.

The Brewer-Garrett Company has successfully completed numerous multi-million-dollar projects and we are both impressed and confident in the scope of their expertise. The Brewer-Garrett Company's Surety, The Cincinnati Insurance Company, (2022 A.M. Best Rating A+, XV) has been providing surety bonds for The Brewer-Garrett Company since 1991. The Cincinnati Insurance Company has written various Performance & Payment/Contract Bonds and Energy Savings Guaranty Bonds for The Brewer-Garrett Company covering specific projects more than $40,000,000 with work programs more than $70,000,000 and bid bonds for projects as large as $90,000,000. As of this writing, the client/principal remains in excellent standing with Cincinnati Insurance Company.

Should a Performance & Payment Bond and/or Energy Savings Guaranty Bond be required on any projects, The Cincinnati Insurance Company would be more than willing to consider same. Any specific request for bonds is between The Brewer-Garrett Company and their Surety and will be underwritten on its own merit, subject to review and satisfaction of the construction contract as well as evidence of complete financing. Cincinnati Insurance Company has approved and written surety bonds like the ones required in this scope/RFQ.

Should you have any questions, please feel free to contact the undersigned individual.

Respectfully yours,

Robert T. Hotaling

Robert T. Hotaling
President - Hotaling & Associates Agency, Inc.
Attorney-In-Fact – The Cincinnati Insurance Company

RTH/ch

PENNSYLVANIA DEPARTMENT OF GENERAL SERVICES READING AND SCRANTON, PA GUARANTEED ENERGY SAVINGS PROJECT GESA 2023-1

VOLUME II: ECM/COST SUBMITTAL

INSURANCE INFORMATION

BG Brewer-Garrett

CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY): 05/03/2023

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must have ADDITIONAL INSURED provisions or be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER	CONTACT NAME:	Robert Hotaling	
Hotaling & Associates Agency, Inc. 8803 Brecksville Road, Suite 7-211 Brecksville, OH 44141	PHONE (A/C, No, Ext):	216 447-1004	FAX (A/C, No):
	E-MAIL ADDRESS:	hotaling_r@hotalingassoc.com	

INSURER(S) AFFORDING COVERAGE	NAIC #
INSURER A : Liberty Mutual Fire Insurance Company	23035
INSURER B : First Liberty Insurance Corporation	33588
INSURER C : Liberty Insurance Corporation	42404
INSURER D : Pacific Insurance Company, LTD	10046
INSURER E :	
INSURER F :	

INSURED
The Brewer-Garrett Company
6800 Eastland Road
Middleburg Heights OH 44130

COVERAGES **CERTIFICATE NUMBER:** **REVISION NUMBER:**

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSD	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
A	X COMMERCIAL GENERAL LIABILITY CLAIMS-MADE X OCCUR X Underground incl. XCU GEN'L AGGREGATE LIMIT APPLIES PER: POLICY X PRO-JECT X LOC OTHER:			TB7-Z51-291519-023	01/01/23	01/01/24	EACH OCCURRENCE DAMAGE TO RENTED PREMISES (Ea occurrence) MED EXP (Any one person) PERSONAL & ADV INJURY GENERAL AGGREGATE PRODUCTS - COMP/OP AGG	$ 2,000,000 $ 300,000 $ 10,000 $ 2,000,000 $ 4,000,000 $ 4,000,000
B	AUTOMOBILE LIABILITY X ANY AUTO OWNED AUTOS ONLY / SCHEDULED AUTOS X HIRED AUTOS ONLY / X NON-OWNED AUTOS ONLY			AS6-Z51-291519-013	01/01/23	01/01/24	COMBINED SINGLE LIMIT (Ea accident) BODILY INJURY (Per person) BODILY INJURY (Per accident) PROPERTY DAMAGE (Per accident)	$ 1,000,000 $ $ $
C	X UMBRELLA LIAB / X OCCUR EXCESS LIAB / CLAIMS-MADE DED RETENTION $			TH7-Z51-291519-043	01/01/23	01/01/24	EACH OCCURRENCE AGGREGATE	$ 15,000,000 $ 15,000,000
A	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY ANYPROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBEREXCLUDED? Y/N (Mandatory in NH) If yes, describe under DESCRIPTION OF OPERATIONS below	N/A		WC2-Z51-291519-033 All States Workers Comp, incl. PA	01/01/23	01/01/24	X PER STATUTE / OTH-ER E.L. EACH ACCIDENT E.L. DISEASE - EA EMPLOYEE E.L. DISEASE - POLICY LIMIT	$ 1,000,000 $ 1,000,000 $ 1,000,000
D	Contractor's Professional Design E&O & Pollution Liability			45 CPI GA 9947	01/01/23	01/01/24	$5,000,000 per claim/$10,000,000 aggregate/$25,000 SIR - E&O $5,000,000 per claim/$5,000,000 agg $25,000 SIR - Pollution	

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (ACORD 101, Additional Remarks Schedule, may be attached if more space is required)
With respect to: Guaranteed Energy Savings Project - Department of General Services; Reading, Scranton & Harrisburg
Project No. GESA-2023-1

Additional Insured status and any other required coverages can be designated upon award of contract
90 Days Written Notice of Cancellation/10 days Written Notice of Cancellation for Non Payment

CERTIFICATE HOLDER
The Commonwealth of Pennsylvania
Department of General Services
403 North Office Bldg.
401 North Street
Harrisburg, PA 17120

CANCELLATION
SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE
Robert T. Hotaling

ACORD 25 (2016/03) The ACORD name and logo are registered marks of ACORD

PENNSYLVANIA DEPARTMENT OF GENERAL SERVICES READING AND SCRANTON, PA GUARANTEED ENERGY SAVINGS PROJECT GESA 2023-1

VOLUME II: ECM/COST SUBMITTAL

REQUIREMENTS CHECKLIST

Brewer-Garrett

Requirements Checklist

RESPONSIVENESS CHECKLIST

RFQ Project Number: GESA 2023-1

Offeror's Name: The Brewer-Garrett Company

Office of Chief Counsel Rep: _____ Date: _____

Bidding Unit Representative: _____ Date: _____

Mandatory Submittal Requirements

Indicate in the spaces provided if the Quote meets each of following mandatory Quote requirements. Any Quote that has a "No" checked will be rejected as non-responsive.

Mandatory requirements	Yes	No
Offeror appears on DGS' list of plan holders	X	
Technical, ECM/Cost, SDB/VBE Submittals included and separately sealed	X	
If Offeror is a Joint Venture:	-	-
• Joint Venture Agreement submitted	-	-
• Entity Authorization to Enter into Joint Venture is included	-	-
Non-Collusion Affidavit properly completed and notarized	X	
• If Joint Venture, one Non-Collusion Affidavit for each entity	-	-
Quote Signature properly completed and signed	X	
Technical Quote contains no project specific Cost Submission Information	X	
SDB Participation Submission (SDB-2) completed	X	
SDB Utilization Schedule (SDB-3) completed	X	
• If SDB goal not met in part or full, Good Faith Efforts Waiver Request completed	-	-
VBE Participation Submission (VBE-2) completed	X	
VBE Utilization Schedule (VBE-3) completed	X	
• If VBE goal not met in part or full, Good Faith Efforts Waiver Request completed	-	-
Worker Protection and Investment Form (Appendix T) properly completed and signed	X	

Appendix D

WORKER PROTECTION AND INVESTMENT CERTIFICATION FORM

A. Pursuant to Executive Order 2021-06, *Worker Protection and Investment* (October 21, 2021), the Commonwealth is responsible for ensuring that every worker in Pennsylvania has a safe and healthy work environment and the protections afforded them through labor laws. To that end, contractors and grantees of the Commonwealth must certify that they are in compliance with Pennsylvania's Unemployment Compensation Law, Workers' Compensation Law, and all applicable Pennsylvania state labor and workforce safety laws including, but not limited to:

1. Construction Workplace Misclassification Act
2. Employment of Minors Child Labor Act
3. Minimum Wage Act
4. Prevailing Wage Act
5. Equal Pay Law
6. Employer to Pay Employment Medical Examination Fee Act
7. Seasonal Farm Labor Act
8. Wage Payment and Collection Law
9. Industrial Homework Law
10. Construction Industry Employee Verification Act
11. Act 102: Prohibition on Excessive Overtime in Healthcare
12. Apprenticeship and Training Act
13. Inspection of Employment Records Law

B. Pennsylvania law establishes penalties for providing false certifications, including contract termination; and three-year ineligibility to bid on contracts under 62 Pa. C.S. § 531 (Debarment or suspension).

CERTIFICATION

I, the official named below, certify I am duly authorized to execute this certification on behalf of the contractor/grantee identified below, and certify that the contractor/grantee identified below is compliant with applicable Pennsylvania state labor and workplace safety laws, including, but not limited to, those listed in Paragraph A, above. I understand that I must report any change in the contractor/grantee's compliance status to the Purchasing Agency immediately. I further confirm and understand that this Certification is subject to the provisions and penalties of 18 Pa. C.S. § 4904 (Unsworn falsification to authorities).

	5/23/2023
Signature	***Date***
Jeffrey L. Zellers	
Name (Printed)	
Vice President	
Title of Certifying Official (Printed)	
The Brewer-Garrett Company	
Contractor/Grantee Name (Printed)	

PENNSYLVANIA DEPARTMENT OF GENERAL SERVICES READING AND SCRANTON, PA GUARANTEED ENERGY SAVINGS PROJECT GESA 2023-1

VOLUME II: ECM/COST SUBMITTAL

APPENDIX B – ECMS EVALUATED BUT NOT INCLUDED

APPENDIX B – ECMS EVALUATED BUT NOT INCLUDED

While investigating the DGS facilities during BG's preliminary assessment, several ECMs were evaluated but not included due to lack of viability, lack of energy savings, inability to investigate further at this stage, or were found to be cost prohibitive. The ECMs outlined below could be reconsidered during the Investment Grade Audit (IGA) and with further input from project stakeholders.

Variable Refrigerant Flow (VRF) at DGS Annex Building 55

This ECM was evaluated as an alternative to ECM #22 to addressing heating and cooling at the DGS Annex Building 55 but VRF difficult to install and maintain. Ultimately, BG has recommended a gas fired RTU solution instead.

Demand Control Ventilation (DCV) at All Four Locations

BG explored the possibility of developing a DCV proposal to include at each of the locations to save energy. However, due to the uncertainty of the occupancy of the buildings in the future and the cost to install DCV, this solution was abandoned. This could be revisited during the IGA should BG be awarded the project.

Fridge Replacement at All Four Locations

BG has successfully proposed this ECM as a part of other GESA projects in the past and would like to explore this ECM as an option for the DGS GESA but BG wasn't able to capture all the necessary information on all of the fridges at each of the facilities to put together a cost and savings estimates. This will be revisited during the IGA should BG be awarded the project.

PENNSYLVANIA DEPARTMENT OF GENERAL SERVICES READING AND SCRANTON, PA GUARANTEED ENERGY SAVINGS PROJECT GESA 2023-1

VOLUME II: ECM/COST SUBMITTAL

APPENDIX C – ECM CALCS

Brewer-Garrett

APPENDIX C – ECM CALCS

Please see attached for select individual ECM calcs.

ECM 1, ECM 13, ECM 20

DGS State Office Buildings

RFQ Response

Facility		Fixture Quantity	Peak kW Savings	kWh Savings	O&M Savings	Rebate
#	**Total**	**6,357**	**87.2**	**260,921**	**$5,373**	**$10,931**
1	Reading State Office Building	2,035	36.2	100,967	$1,789	$5,066
2	Scranton State Office Building	3,920	36.3	118,840	$2,726	$4,212
13	DGS Annex Building 55	402	14.7	41,114	$858	$1,653

BTU per bin temp_c | **Current** | **DGS GESA 2023-1** Retro-commissioning

KWH Savings				$	MCF	$	Total Savings	$ 401
5,411				401.20	0	$ -		

BTU's																							KWH										
				Occupied										Unoccupied							Low Occupancy ventilation			Occupied			Unoccupied						
Temp	Occ hrs	Un Oc hrs	Lo Occ Hrs	Hr below balance point	Heat transfer Walls	Heat transfer Window	Heat Transfer Window Radiant	Window Infiltration	Roof heat transfer	Ventilation	Kitchen+HW load (BTU) cooling	Kitchen+HW load (BTU) heating	Lt&computer Load (BTU) cooling	Lt&computer Load (BTU) Heating	People load Cooling	People load Heating	Heat transfer Walls	Heat transfer Window	Roof heat Transfer	Ventilation (Night cycle)	Total Current Heating Btu	Total Current Cooling Btu	Ventilation	Total Current Heating Btu	Total Current Cooling Btu	Fan motor (kwh)	Heating Pump (kwh)	Cooling Pump (kwh)	Fan motor (kwh)	Heating Pump (kwh)	Cooling Pump (kwh)		
-1	2	3		2	216,000	756,000			127,033	2,378,160					-	(495,117)	315,360	1,103,760	185,467	173,606	4,760,269	-	-			106	-	-	21	-	-	2	-
0	2	3		2	213,120	745,920			125,339	2,346,451					-	(495,117)	311,040	1,088,640	182,927	171,228	4,689,547	-	-			106	-	-	21	-	-	2	-
1	1	8		1	105,120	367,920			61,822	1,157,371					-	(247,559)	817,920	2,862,720	481,030	450,265	6,056,610	-	-			53	-	-	57	-	-	1	-
2	0	4		0	-	-			-	-					-	-	403,200	1,411,200	237,127	221,962	2,273,489	-	-			-	-	-	28	-	-	-	-
3	3	4		3	306,720	1,073,520			180,386	3,376,987					-	(742,676)	397,440	1,391,040	233,740	218,791	6,435,948	-	-			159	-	-	28	-	-	4	-
4	0	5		0	-	-			-	-					-	-	489,600	1,713,600	287,940	269,525	2,760,665	-	-			-	-	-	35	-	-	-	-
5	1	2		1	99,360	347,760			58,435	1,093,954					-	(247,559)	192,960	675,360	113,482	106,224	2,439,977	-	-			53	-	-	14	-	-	1	-
6	3	4		3	293,760	1,028,160			172,764	3,234,298					-	(742,676)	380,160	1,330,560	223,577	209,278	6,129,882	-	-			159	-	-	28	-	-	4	-
7	2	2		2	192,960	675,360			113,482	2,124,490					-	(495,117)	187,200	655,200	110,095	103,054	3,666,723	-	-			106	-	-	14	-	-	2	-
8	1	4		1	95,040	332,640			55,894	1,046,390					-	(247,559)	368,640	1,290,240	216,802	202,936	3,361,025	-	-			53	-	-	28	-	-	1	-
9	8	22		8	748,800	2,620,800			440,379	8,244,288					-	(1,980,468)	1,995,840	6,985,440	1,173,780	1,098,710	21,327,570	-	-			424	-	-	155	-	-	10	-
10	4	10		4	368,640	1,290,240			216,802	4,058,726					-	(990,234)	892,800	3,124,800	525,068	491,486	9,978,329	-	-			212	-	-	71	-	-	5	-
11	10	8		10	907,200	3,175,200			533,537	9,988,272					-	(2,475,585)	702,720	2,459,520	413,279	386,847	16,090,990	-	-			530	-	-	57	-	-	12	-
12	5	10		5	446,400	1,562,400			262,534	4,914,864					-	(1,237,793)	864,000	3,024,000	508,130	475,632	10,820,167	-	-			265	-	-	71	-	-	6	-
13	10	20		10	878,400	3,074,400			516,599	9,671,184					-	(2,475,585)	1,699,200	5,947,200	999,322	935,410	21,246,130	-	-			530	-	-	141	-	-	12	-
14	10	14		10	864,000	3,024,000			508,130	9,512,640					-	(2,475,585)	1,169,280	4,092,480	687,669	643,689	18,026,303	-	-			530	-	-	99	-	-	12	-
15	15	26		15	1,274,400	4,460,400			749,492	14,031,144					-	(3,713,378)	2,134,080	7,469,280	1,255,081	1,174,811	28,835,310	-	-			795	-	-	184	-	-	18	-
16	11	20		11	918,720	3,215,520			540,312	10,115,107					-	(2,723,144)	1,612,800	5,644,800	948,509	887,846	21,160,471	-	-			583	-	-	141	-	-	13	-
17	13	21		13	1,067,040	3,734,640			627,541	11,748,110					-	(3,218,261)	1,663,200	5,821,200	978,150	915,592	23,337,212	-	-			689	-	-	148	-	-	16	-
18	29	26		29	2,338,560	8,184,960			1,375,339	25,747,546					-	(7,179,197)	2,021,760	7,076,160	1,189,024	1,112,979	41,867,131	-	-			1,537	-	-	184	-	-	35	-
19	22	28		22	1,742,400	6,098,400			1,024,729	19,183,824					-	(5,446,287)	2,136,960	7,479,360	1,256,775	1,176,396	34,652,557	-	-			1,166	-	-	198	-	-	27	-
20	20	36		20	1,555,200	5,443,200			914,634	17,122,752					-	(4,951,170)	2,695,680	9,434,880	1,585,366	1,483,972	35,284,513	-	-			1,060	-	-	254	-	-	24	-
21	28	29		28	2,136,960	7,479,360			1,256,775	23,527,930					-	(6,931,638)	2,129,760	7,454,160	1,252,540	1,172,433	39,478,280	-	-			1,484	-	-	205	-	-	34	-
22	38	38		38	2,845,440	9,959,040			1,673,441	31,328,294					-	(9,407,223)	2,736,000	9,576,000	1,609,078	1,506,168	51,826,239	-	-			2,014	-	-	268	-	-	46	-
23	38	31		38	2,790,720	9,767,520			1,641,260	30,725,827					-	(9,407,223)	2,187,360	7,655,760	1,286,416	1,204,142	47,851,782	-	-			2,014	-	-	219	-	-	46	-
24	53	36		53	3,816,000	13,356,000			2,244,241	42,014,160					-	(13,120,601)	2,488,320	8,709,120	1,463,414	1,369,820	62,340,475	-	-			2,808	-	-	254	-	-	65	-
25	30	23		30	2,116,800	7,408,800			1,244,919	23,305,968					-	(7,426,755)	1,556,640	5,448,240	915,481	856,930	35,427,023	-	-			1,590	-	-	162	-	-	37	-
26	55	37		55	3,801,600	13,305,600			2,235,772	41,855,616					-	(13,615,718)	2,450,880	8,578,080	1,441,395	1,349,209	61,402,435	-	-			2,914	-	-	261	-	-	67	-
27	70	39		70	4,737,600	16,581,600			2,786,246	52,160,976					-	(17,329,095)	2,527,200	8,845,200	1,486,280	1,391,224	73,187,231	-	-			3,709	-	-	276	-	-	85	-
28	68	29		68	4,504,320	15,765,120			2,649,051	49,592,563					-	(16,833,978)	1,837,440	6,431,040	1,080,623	1,011,511	66,037,690	-	-			3,603	-	-	205	-	-	83	-
29	67	31		67	4,341,600	15,195,600			2,553,353	47,801,016					-	(16,586,620)	1,919,520	6,718,320	1,128,895	1,056,696	64,128,581	-	-			3,550	-	-	219	-	-	82	-
30	58	31		58	3,674,880	12,862,080			2,161,246	40,460,429					-	(14,358,393)	1,874,880	6,562,080	1,102,642	1,032,121	55,371,966	-	-			3,073	-	-	219	-	-	71	-
31	59	44		59	3,653,280	12,786,480			2,148,543	40,222,613					-	(14,605,952)	2,597,760	9,092,160	1,527,778	1,430,067	58,852,729	-	-			3,126	-	-	311	-	-	72	-
32	74	60		74	4,475,520	15,664,320			2,632,113	49,275,475					-	(18,319,329)	3,456,000	12,096,000	2,032,520	1,902,528	73,215,148	-	-			3,921	-	-	424	-	-	90	-
33	66	56		66	3,896,640	13,638,240			2,291,666	42,902,006					-	(16,338,861)	3,144,960	11,007,360	1,849,593	1,731,300	64,122,905	-	-			3,497	-	-	396	-	-	80	-
34	62	38		62	3,571,200	12,499,200			2,100,271	39,318,912					-	(15,348,627)	2,079,360	7,277,760	1,222,900	1,144,688	53,865,663	-	-			3,285	-	-	268	-	-	76	-
35	66	36		66	3,706,560	12,972,960			2,179,878	40,809,226					-	(16,338,861)	1,918,080	6,713,280	1,128,049	1,055,903	54,145,074	-	-			3,497	-	-	254	-	-	80	-
36	96	53		96	5,253,120	18,385,920			3,089,430	57,836,851					-	(23,765,616)	2,747,520	9,616,320	1,615,853	1,512,510	76,291,909	-	-			5,087	-	-	374	-	-	117	-
37	91	37		91	4,848,480	16,969,680			2,851,456	53,381,765					-	(22,527,824)	1,864,800	6,526,800	1,096,714	1,026,572	66,038,444	-	-			4,822	-	-	261	-	-	111	-
38	103	65		103	5,339,520	18,688,320			3,140,243	58,788,115					-	(25,498,526)	3,182,400	11,138,400	1,871,612	1,751,911	78,401,996	-	-			5,458	-	-	459	-	-	125	-
39	56	64		56	2,822,400	9,878,400			1,659,891	31,074,624					-	(13,863,276)	3,041,280	10,644,480	1,788,618	1,674,225	48,720,642	-	-			2,967	-	-	452	-	-	68	-
40	89	87		89	4,357,440	15,251,040			2,562,669	47,975,414					-	(22,032,707)	4,008,960	14,031,360	2,357,723	2,206,932	70,718,833	-	-			4,716	-	-	615	-	-	108	-
41	59	46		59	2,803,680	9,812,880			1,648,882	30,868,517					-	(14,605,952)	2,053,440	7,187,040	1,207,656	1,130,419	42,106,562	-	-			3,126	-	-	325	-	-	72	-
42	72	74		72	3,317,760	11,612,160			1,951,219	36,528,538					-	(17,824,212)	3,196,800	11,188,800	1,880,081	1,759,838	53,610,984	-	-			3,815	-	-	523	-	-	88	-
43	52	46		52	2,321,280	8,124,480			1,365,176	25,557,293					-	(12,873,042)	1,920,960	6,723,360	1,129,742	1,057,488	35,326,738	-	-			2,755	-	-	325	-	-	63	-
44	64	80		64	2,764,800	9,676,800			1,626,016	30,440,448					-	(15,843,744)	3,225,600	11,289,600	1,897,019	1,775,693	46,852,231	-	-			3,391	-	-	565	-	-	78	-
45	70	62		70	2,923,200	10,231,200			1,719,173	32,184,432					-	(17,329,095)	2,410,560	8,436,960	1,417,683	1,327,013	43,321,126	-	-			3,709	-	-	438	-	-	85	-
46	45	44		45	1,814,400	6,350,400			1,067,073	19,976,544					-	(11,140,133)	1,647,360	5,765,760	968,835	906,872	27,357,111	-	-			2,384	-	-	311	-	-	55	-
47	60	53		60	2,332,800	8,164,800			1,371,951	25,684,128					-	(14,853,510)	1,908,000	6,678,000	1,122,120	1,050,354	33,458,643	-	-			3,179	-	-	374	-	-	73	-
48	56	45		56	2,096,640	7,338,240			1,233,062	23,084,006					-	(13,863,276)	1,555,200	5,443,200	914,634	856,138	28,657,844	-	-			2,967	-	-	318	-	-	68	-
49	50	54		50	1,800,000	6,300,000			1,058,604	19,818,000					-	(12,377,925)	1,788,480	6,259,680	1,051,829	984,558	26,683,227	-	-			2,649	-	-	382	-	-	61	-
50	62	42		62	2,142,720	7,499,520			1,260,162	23,591,347					-	(15,348,627)	1,330,560	4,656,960	782,520	732,473	26,647,636	-	-			3,285	-	-	297	-	-	76	-
51	70	52		70	2,318,400	8,114,400			1,363,482	25,525,584					-	(17,329,095)	1,572,480	5,503,680	924,797	865,650	28,859,378	-	-			3,709	-	-	367	-	-	85	-
52	73	50		73	2,312,640	8,094,240			1,360,095	25,462,166					-	(18,071,771)	1,440,000	5,040,000	846,883	792,720	27,276,974	-	-			3,868	-	-	353	-	-	89	-
53	66	42		66	1,995,840	6,985,440			1,173,780	21,974,198					-	(16,338,861)	1,149,120	4,021,920	675,813	632,591	22,269,841	-	-			3,497	-	-	297	-	-	80	-
54	66	79		66	1,900,800	6,652,800			1,117,886	20,927,808					-	(16,338,861)	2,047,680	7,166,880	1,204,268	1,127,248	25,806,509	-	-			3,497	-	-	558	-	-	80	-
55	71	80		71	1,942,560	6,798,960			1,142,446	21,387,586					-	(17,576,654)	1,958,400	6,854,400	1,151,761	1,078,099	24,737,558	-	-			3,762	-	-	565	-	-	86	-
56	90	76		90	2,332,800	8,164,800			1,371,951	25,684,128					-	(22,280,265)	1,751,040	6,128,640	1,029,810	963,948	25,146,852	-	-			4,769	-	-	537	-	-	110	-
57	65	56		65	1,591,200	5,569,200			935,806	17,519,112					-	(16,091,303)	1,209,600	4,233,600	711,382	665,885	16,344,482	-	-			3,444	-	-	396	-	-	79	-
58	72	78		72	1,658,880	5,806,080			975,610	18,264,269					-	(17,824,212)	1,572,480	5,503,680	924,797	865,650	17,747,233	-	-			3,815	-	-	551	-	-	88	-
59	61	68		61	1,317,600	4,611,600			774,898	14,506,776					-	(15,101,069)	1,272,960	4,455,360	748,645	700,764	13,287,535	-	-			3,232	-	-	480	-	-	74	-
60	89	74		0	1,537,920	5,382,720			904,471	16,932,499					-	-	1,491,840	5,221,440	877,371	821,258	-	-	-			4,716	-	-	523	-	-	108	-
61	60	70		0	950,400	3,326,400			558,943	10,463,904					14,853,510	-	1,310,400	4,586,400	770,664	721,375	-	-	14,853,510			3,179	-	-	585	-	-	73	-
62	57	88		0	820,800	2,872,800			482,724	9,037,008					14,110,835	-	1,520,640	5,322,240	894,309	837,112	-	-	14,110,835			3,020	-	-	622	-	-	69	-
63	104	98		0	1,347,840	4,717,440			792,683	14,839,718					25,746,084	-	1,552,320	5,433,120	912,940	854,552	-	-	25,746,084			5,511	-	-	692	-	-	127	-
64	71	74		0	817,920	2,862,720			481,030	9,005,299					17,576,654	-	1,065,600	3,729,600	626,694	586,613	-	-	17,576,654			3,762	-	-	523	-	-	86	-
65	87	99		0	876,960	3,069,360			515,752	9,655,330					21,537,590	-	1,283,040	4,490,640	754,573	706,314	-	-	21,537,590			4,610	-	-	699	-	-	106	-
66	61	86		0	527,040	1,844,640			309,959	5,802,710					15,101,069	-	990,720	3,467,520	582,656	545,391	-	-	15,101,069			3,232	-	-	608	-	-	74	-
67	69	102		0	496,800	1,738,800			292,175	5,469,768					17,081,537	-	1,028,160	3,598,560	604,675	566,002	-	-	17,081,537			3,656	-	-	721	-	-	84	-
68	54	98		0	311,040	1,088,640			182,927	3,424,550					13,368,159	-	846,720	2,963,520	497,967	466,119	-	-	13,368,159			2,861	-	-	692	-	-	66	-
69	77	130		0	332,640	1,164,240			195,630	3,662,366					19,062,005	-	936,000	3,276,000	550,474	515,268	-	-	19,062,005			4,080	-	-	918	-	-	94	-
70	63	100		0	181,440	635,040			106,707	1,997,654					15,596,186	-	576,000	2,016,000	338,753	317,088	-	-	15,596,186			3,338	-	-	707	-	-	77	-
71	72	108		0	103,680	362,880			60,976	1,141,517					17,824,212	-	466,560	1,632,960	274,390	256,841	-	-	17,824,212			3,815	-	-	763	-	-	88	-
72	84	133		0	-	-			-	-					20,794,914	-	383,040	1,340,640	225,271	210,864	-	-	20,794,914			4,451	-	-	940	-	-	102	-
73	75	84		0	(108,000)	(378,000)			(63,516)	(1,189,080)					18,566,888	-	120,960	423,360	71,138	66,588	-	-	16,828,291			3,974	-	-	593	-	-	91	-
74	83	87		0	(239,040)	(836,640)			(140,583)	(2,631,830)					20,547,356	-	-	-	-	-	-	-	16,699,262			4,398	-	-	615	-	-	101	-
75	67	57		0	(289,440)	(1,013,040)			(170,224)	(3,186,734)					16,586,420	-	(82,080)	(287,280)	(48,272)	(45,185)	-	-	11,464,164			3,550	-	-	403	-	-	82	-
76	53	75		0	(305,280)	(1,068,480)			(179,539)	(3,361,133)					13,120,601	-	(216,000)	(756,000)	(127,033)	(118,908)	-	-	6,988,228			2,808	-	-	530	-	-	65	-
77	39	60		0	(280,800)	(982,800)			(165,142)	(3,091,608)					9,654,782	-	(259,200)	(907,200)	(152,439)	(142,690)	-	-	3,672,903			2,067	-	-	424	-	-	48	-
78	55	71		0	(475,200)	(1,663,200)			(279,472)	(5,231,952)					13,615,718	-	(408,960)	(1,431,360)	(240,515)	(225,132)	-	-	3,659,927			2,914	-	-	502	-	-	67	-
79	45	47		0	(453,600)	(1,587,600)			(266,768)	(4,994,136)					11,140,133	-	(338,400)	(1,184,400)	(199,018)	(186,289)	-	-	1,929,921			2,384	-	-	332	-	-	55	-
80	48	53		0	(552,960)	(1,935,360)			(325,203)	(6,088,090)					11,882,808	-	(457,920)	(1,602,720)	(269,309)	(252,085)	-	-	399,161			2,543	-	-	374	-	-	58	-
81	64	45		0	(829,440)	(2,903,040)			(487,805)	(9,132,134)					15,843,744	-	(453,600)	(1,587,600)	(266,768)	(249,707)	-	-	(66,350)			3,391	-	-	318	-	-	78	-
82	52	25		0	(748,800)	(2,620,800)			(440,379)	(8,244,288)					12,873,042	-	(288,000)	(1,008,000)	(169,377)	(158,544)	-	-	(805,146)			2,755	-	-	177	-	-	63	-
83	53	33		0	(839,520)	(2,938,320)			(493,733)	(9,243,115)					13,120,601	-	(427,680)	(1,496,880)	(251,524)	(235,438)	-	-	(2,805,610)			2,808	-	-	233	-	-	65	-
84	31	26		0	(535,680)	(1,874,880)			(315,041)	(5,897,837)					7,674,314	-	(374,400)	(1,310,400)	(220,190)	(206,107)	-	-	(3,060,221)			1,643	-	-	184	-	-	38	-
85	38	21		0	(711,360)	(2,489,760)			(418,360)	(7,832,074)					9,407,223	-	(332,640)	(1,164,240)	(195,630)	(183,118)	-	-	(3,919,959)			2,014	-	-	148	-	-	46	-
86	20	27		0	(403,200)	(1,411,200)			(237,127)	(4,439,232)					4,951,170	-	(466,560)	(1,632,960)	(274,390)	(256,841)	-	-	(4,170,341)			1,060	-	-	191	-	-	24	-
87	29	17		0	(626,400)	(2,192,400)			(368,394)	(6,896,664)					7,179,197	-	(318,240)	(1,113,840)	(187,161)	(175,191)	-	-	(4,699,094)			1,537	-	-	120	-	-	35	-
88	22	13		0	(506,880)	(1,774,080)			(298,103)	(5,580,749)					5,446,287	-	(262,080)	(917,280)	(154,133)	(144,275)	-	-	(4,191,293)			1,166	-	-	92	-	-	27	-
89	10	13		0	(244,800)	(856,800)			(143,970)	(2,695,248)					2,475,585	-	(280,800)	(982,800)	(165,142)	(154,580)	-	-	(3,048,556)			530	-	-	92	-	-	12	-
90	17	7		0	(440,640)	(1,542,240)			(259,146)	(4,851,446)					4,208,495	-	(161,280)	(564,480)	(94,851)	(88,785)	-	-	(3,794,374)			901	-	-	49	-	-	21	-
91	4	2		0	(109,440)	(383,040)			(64,363)	(1,204,934)					990,234	-	(48,960)	(171,360)	(28,794)	(26,952)	-	-	(1,047,610)			212	-	-	14	-	-	##########	5	-
92	11	1		0	(316,800)	(1,108,800)			(186,314)	(3,487,968)					2,723,144	-	(25,920)	(90,720)	(15,244)	(14,269)	-	-	(2,522,892)			583	-	-	7	-	-	(69,254.47)	3412	13	-
93	5	0		0	(151,200)	(529,200)			(88,923)	(1,664,712)					1,237,793	-	-	-	-	-	-	-	(1,196,242)			265	-	-	-	-	-	(21,642.02)	3.2	6	-
94	8	0		0	(253,440)	(887,040)			(149,051)	(2,790,374)					1,980,468	-	-	-	-	-	-	-	(2,099,438)			424	-	-	-	-	-	(1,298.52)	0.06	10	-
95	2	0		0	(66,240)	(231,840)			(38,957)	(729,302)					495,117	-	-	-	-	-	-	-	(571,222)			106	-	-	-	-	-			2	-
96	0	0		0	-	-			-	-					-	-	-	-	-	-	-	-	-			-	-	-	-	-	-			-	-
97	0	0		0	-	-			-	-					-	-	-	-	-	-	-	-	-			-	-	-	-	-	-			-	-
98	0	0		0	-	-			-	-					-	-	-	-	-	-	-	-	-			-	-	-	-	-	-			-	-
99	0	0		0	-	-			-	-					-	-	-	-	-	-	-	-	-			-	-	-	-	-	-			-	-
100	0	0		0	-	-			-	-					-	-	-	-	-	-	-	-	-			-	-	-	-	-	-			(229,962)	-
Current	4442	4295	2663		131,826,240	461,391,840			77,528,782	1,451,406,902	315,201,886	(471,828,343)	805,451,217	(1,205,686,673)	418,373,865	(659,248,286)	116,580,960	406,929,600	68,377,360	64,177,818	2,087,364,056	(236,296,262)				235,372	-	-	30,344	-	-				-
		8737	1779																		$ 21,771	$ (1,605)				$ 17,452	$ -	$ -	$ 2,250	$ -	$ -				-
Future	4442	4295			131,826,240	461,391,840			77,528,782	1,451,406,902	315,201,886	(471,828,343)	805,451,217	(1,205,686,673)	418,373,865	(659,248,286)	116,580,960	408,033,360	68,562,828	64,177,818	2,087,364,056	(236,296,262)				229,962	-	-	30,344	-	-				-
		8737			-	-			-	-	-	-	-	-	-	-	-	-	-	-	$ 21,771	$ (1,605)				$ 17,051	$ -	$ -	$ 2,250	$ -	$ -	Total		Electric	Gas	-
Difference	0	0			-	-			-	-	-	-	-	-	-	-	-	(1,103,760)	(185,467)	-	-	-				5,411	-	-	-	-	-		5,411 KWH		5,411	0 MCF
Cur-fut		0			-	-			-	-	-	-	-	-	-	-	-	-	-	-	$ -	$ -				$ 401	$ -	$ -	$ -	$ -	$ -		401.20 $		$ 401	$ - $ -

Ton-hrs

Morning warm-up and OA closed limited occupancy

	Current	Future	Difference		#DIV/0!
less 73 heating	1,554,682,464	1554682464	-	-	#DIV/0!
More 75 cooling	(100,643,731)	(100,643,731)	-	#DIV/0!	(21,641) (22,267.41)
				#DIV/0!	3412.969283

	CF NG	Electric
CBECS space heating	27.4	2

	Total energy use (MMBtu/yr)	Electric energy use (kWh/yr)	Electric energy cost, Year 1, ($/yr)	Electric demand* (kW/yr)	Electric demand cost, Year 1, ($/yr)	Natural gas use (MCF/yr)**	Fuel Costs Year 1 ($/yr)	Other energy use (CCF/yr)**	Other energy cost, Year 1 ($/yr)	Total Energy and water cost, Year 1 ($/yr)	Other energy-related O&M costs, Year 1 ($/yr)	Total costs, Year 1 ($/yr)
Baseline use												
Post installation use												
Savings		5,411	401							$0		$0

W:\Customers\GESA DGS Reading Scranton use Share point file\Energy Savings transfer\ECM-02 Reading AHUs and economizer 20230516.xlsm

ECM 3 Dual duct to VAV - pump savings

	Total energy use (MMBtu/yr)	Electric energy use (kWh/yr)	Electric energy cost, Year 1, ($/yr)	Electric demand* (kW/yr)	Electric demand cost, Year 1, ($/yr)	Natural gas use (MCF/yr)**	Fuel Costs Year 1 ($/yr)	Other energy use (CCF/yr)**	Other energy cost, Year 1 ($/yr)	Total Energy and water cost, Year 1 ($/yr)	Other energy-related O&M costs, Year 1 ($/yr)	Total costs, Year 1 ($/yr)
Baseline use												
Post installation use												
Savings		9,933	736							$0		$0

From fan or pump Analysis

ECM 04 Replace chillers

Existing Model Numbers

Tons	150
Quanity	2
Original EER:	11.0
btu cooling	1,800,000
Rated nominal Watts	163,636
Nominal KWh	163.6
Gas Fired Burner Efficiency	

New RTU Models

Tons	150
New EER:	14.3
btu cooling	1,800,000
Rated nominal Watts	125,874
Nominal KWh	126
Gas Fired Burner Efficiency	

Savings Calculations (Air Conditioning)			From Bills
AC Usage hours (EFLH)		1198.9	
Existing KWH		196,176	357,083
New KWH		150,905	
Price per KWh	$	0.07415	
Cooling Savings	$	3,357	
KWH savings		45,271	

	Total energy use (MMBtu/yr)	Electric energy use (kWh/yr)	Electric energy cost, Year 1, ($/yr)	Electric demand* (kW/yr)	Electric demand cost, Year 1, ($/yr)	Natural gas use (MCF/yr)**	Fuel Costs Year 1 ($/yr)	Other energy use (CCF/yr)**	Other energy cost, Year 1 ($/yr)	Total Energy and water cost, Year 1 ($/yr)	Other energy-related O&M costs, Year 1 ($/yr)	Total costs, Year 1 ($/yr)
Baseline use												
Post installation use												
Savings		45,271	$ 3,357							$0		$0

ECM 5 cooling tower fan

	Total energy use (MMBtu/yr)	Electric energy use (kWh/yr)	Electric energy cost, Year 1, ($/yr)	Electric demand* (kW/yr)	Electric demand cost, Year 1, ($/yr)	Natural gas use (MCF/yr)**	Fuel Costs Year 1 ($/yr)	Other energy use (CCF/yr)**	Other energy cost, Year 1 ($/yr)	Total Energy and water cost, Year 1 ($/yr)	Other energy-related O&M costs, Year 1 ($/yr)	Total costs, Year 1 ($/yr)
Baseline use												
Post installation use												
Savings		26,401	1,958							$0		$0

From fan or pump Analysis

ECM 6 Reading

Utility Data Range:		Jan-21	to	Dec-21		
Month	CDD	kW	kWh	Cost $	Non Clg base load	Cooling Cost
Jan-21	0		51,945	4,067		
Feb-21	0		55,140	4,112		
Mar-21	5		53,685	3,746		
Apr-21	18.4		56,650	4,075		
May-21	91.2		59,573	4,430	4075	355
Jun-21	228.7		59,264	4,387	4075	312
Jul-21	241		79,524	5,577	4075	1,502
Aug-21	290.1		66,050	5,003	4075	928
Sep-21	108.2		82,569	6,193	4075	2,118
Oct-21	34.2		66,734	4,916	4075	841
Nov-21	0.4		60,373	4,576		
Dec-21	0		53,667	4,170		
Annual Total	1,017	0.0	745,174	55,252		6,056 Total

121 Dollars
1,634 KWH

Control Savings
2%

Utility Data Range:		Jan-21	to	Dec-21		
Month	HDD	MCF	$/MCF	Cost $	Non Htg base load	Heating cost
Jan-21	1,080	273	7.93	2,166	452	1,714
Feb-21	1,008	281	7.93	2,231	452	1,779
Mar-21	685	167	8.00	1,338	452	886
Apr-21	435	112	8.07	906	452	454
May-21	250	66	8.28	543	452	91
Jun-21	48	56	8.55	482		
Jul-21	22	53	8.61	458		
Aug-21	18	51	8.86	452		
Sep-21	98	55	9.38	513	452	61
Oct-21	229	79	9.26	728	452	276
Nov-21	739	206	9.35	1,928	452	1,476
Dec-21	787	226	10.27	2,316	452	1,864
Annual Total	5,398	1,625	8.65	14,061		8,601 Total

172 Dollars
20 MCF

Control Savings
2%

ECM 7 radon pump

	Total energy use (MMBtu/yr)	Electric energy use (kWh/yr)	Electric energy cost, Year 1, ($/yr)	Electric demand* (kW/yr)	Electric demand cost, Year 1, ($/yr)	Natural gas use (MCF/yr)**	Fuel Costs Year 1 ($/yr)	Other energy use (CCF/yr)**	Other energy cost, Year 1 ($/yr)	Total Energy and water cost, Year 1 ($/yr)	Other energy-related O&M costs, Year 1 ($/yr)	Total costs, Year 1 ($/yr)
Baseline use												
Post installation use												
Savings		26,401	1,958							$0		$0

From fan or pump Analysis

ECM-09

— The researchers also counted 837 passages per hour into the building, and their calculations assumed the building was open for 9 hours per day, 365 days per year, so that's a total of 2,749,545 passages.
— That means each individual passage saves 0.03564227377 kWh of energy, or 35.64 watt hours.

From <https://www.vox.com/2014/8/13/5995537/do-revolving-doors-save-energy>

50*9*5*52=117,000
50 people 9 hours per day 5 days a week x 52 weeks
35.64*117000=4169880
4169880/1000=4169.88 kwh

50	People per hour	50	People per hour
9	hours	9	hours
5	day per week	5	day per week
20	weeks	32	weeks
35.64	watt per person	35.64	watt per person
1,603,800	watt per person	2,566,080	watt per person
1,604	KWh	2,566	KWh
0.074146334	$/kwh	8,755,464.96	BTU
118.9158898	$	8.76	mmbtu
		8.343846743	$/mmbtu
ECM 09 revolving door		73.05	$

	Total energy use (MMBtu/yr)	Electric energy use (kWh/yr)	Electric energy cost, Year 1, ($/yr)	Electric demand* (kW/yr)	Electric demand cost, Year 1, ($/yr)	Natural gas use (MCF/yr)**	Fuel Costs Year 1 ($/yr)	Other energy use (CCF/yr)**	Other energy cost, Year 1 ($/yr)	Total Energy and water cost, Year 1 ($/yr)	Other energy-related O&M costs, Year 1 ($/yr)	Total costs, Year 1 ($/yr)
Baseline use												
Post installation use												
Savings		1,604	119		73.05	8.44	73.05			$0		$0

ECM-10 Water

Water	$	13.7482
Gas	$	0.8650
Electric	$	0.0814

$/kgal? Must be from rate because it does match UDA

3.00

SAVING BY DOLLARS		Reading State Office Building
Plumbing	Water	$ 4,005.71
	GAS	$ 60.29
	Electric	
	O&M	$ 371.49
Water	**$ 4,005.71**	$ 4,005.71
GAS	**$ 60.29**	$ 60.29
Electric	**$ -**	$ -
O&M	**$ 471.49**	$ 371.49
	$ 4,537.49	**$ 4,437.49**

SAVING BY UNIT		Office Building				
Plumbing	Water	291.36	kgal	13.7482	convert kgal 1.336898	CCF 389.52
	GAS	69.70				21
	Electric					
	O&M	$ 371.49				
Water	**291.36**	291.36				
GAS	**69.70**	69.70				
Electric	**-**	-				
O&M	**371.49**	$ 371.49				

ECM 10 Water

	Total energy use (MMBtu/yr)	Electric energy use (kWh/yr)	Electric energy cost, Year 1, ($/yr)	Electric demand* (kW/yr)	Electric demand cost, Year 1, ($/yr)	Natural gas use (MCF/yr)**	Fuel Costs Year 1 ($/yr)	Other energy use (CCF/yr)**	Other energy cost, Year 1 ($/yr)	Total Energy and water cost, Year 1 ($/yr)	Other energy-related O&M costs, Year 1 ($/yr)	Total costs, Year 1 ($/yr)
Baseline use												
Post installation use												
Savings							$ 60.29	389.52	$ 4,005.71	$0	$ 471.49	$ 4,066.00

TOTAL PROJECT PRICING:

Building	therm Savings	kWh Savings
Northwest Office Building	3,900.55	6,928.50
DGS Annex Building 55	1,678.61	1,924.60
Reading State Office Building	1,768.41	3,041.33
Scranton State Office Building	3,462.91	5,536.01

TYPE OF MEASURES:

	Building Level	quantity or distance
Int. Door(s) to be weather-stripped & sealed for isolation.	Penthouse	4 Doors
Ext. Door(s) to be weather-stripped & sealed.	All Levels	10 Doors
Window System(s) to be sealed.	All Levels	6240 Feet
Over-head Door(s) to be sealed on 4 sides.	Basement	44 Feet

AIR LEAKAGE:

	feet	inches		
Doors	80	3/32	0.63	sq ft
Doors	200	3/32	1.56	sq ft
Windows	6240	1/32	16.25	sq ft
OHDoors	44	3/16	0.69	sq ft
Totals	-		19.13	sq ft
			1.78	sq meter

ASSUMPTIONS & CALCULATIONS:

Power Rate		$0.080	per Kwh
Heating Fuel	100% Natural Gas	$0.800	perTherm
Building K	130		

Example Calculation

$$\frac{(\text{leakage x bldg "K"}) \times (\text{wind P factor}) \times (\text{HDD} \times 24 \times 60) \times (.075) \times (.243)}{100{,}000 \times \text{System Efficiency\%}}$$

TYPE OF MEASURES:

	Building Level	quantity or distance
Ext. Door(s) to be weather-stripped & sealed.	All Levels	37 Doors
Int. Door(s) to be weather-stripped & sealed for isolation.	All Levels	1 Doors
Roof / Wall Joint to be Sealed with 1 part foam.	First	100 Feet
Over-head Door(s) to be sealed on 4 sides.	First	2 OHDoors
Seal of air-conditioner w/ weather-strip, & flexible cover up to 20"H x 28"W	All Levels	12 Units
Seal air-conditioner w/ weather-strip, & flexible cover up to 17"H x 25"W	All Levels	5 Units
Seal air-conditioner w/ weather-strip, & flexible cover up to 14"H x 20"W	All Levels	1 Units

AIR LEAKAGE:

	feet	inches		
Doors	740	3/32	5.78	sq ft
Doors	20	3/32	0.16	sq ft
RoofWall	100	1/32	0.26	sq ft
OHDoors	60	1/4	1.25	sq ft
AirConditionerCovers	100	3/16	1.56	sq ft
AirConditionerCovers	30	3/16	0.47	sq ft
AirConditionerCovers	4	3/16	0.06	sq ft
Totals	-		9.54	sq ft
			0.89	sq meter

ASSUMPTIONS & CALCULATIONS:

Power Rate		$0.080	per Kwh
Heating Fuel	100% Natural Gas	$0.800	perTherm
Building K	120		

Example Calculation

$$\frac{(\text{leakage x bldg "K"}) \times (\text{wind P factor}) \times (\text{HDD} \times 24 \times 60) \times (.075) \times (.243)}{100{,}000 \times \text{System Efficiency\%}}$$

			Max CFM	102,080	RA temp	70
				0.009	% OA	25%
OA temp	Occupied H	% CFM	BTU			
10	4	10%	2,645,914			
11	10	11%	7,089,946			
12	5	12%	3,772,632			
13	10	13%	7,980,737			
14	10	14%	8,396,366			
15	15	15%	13,188,226			
16	11	15%	10,084,900			
17	13	16%	12,381,442			
18	29	17%	28,595,270			
19	22	18%	22,389,059			
20	20	19%	20,946,816			
21	28	20%	30,100,354			
22	38	21%	41,826,602			
23	38	22%	42,727,315			
24	53	23%	60,744,443			
25	30	24%	34,975,670			
26	55	24%	65,098,294			
27	70	25%	83,955,941			
28	68	26%	82,494,294			
29	67	27%	82,071,499			
30	58	28%	71,616,061			
31	59	29%	73,312,643			
32	74	30%	92,383,837			
33	66	31%	82,651,065			
34	62	32%	77,758,109			
35	66	33%	82,767,485			
36	96	33%	120,187,979			
37	91	34%	113,556,989			
38	103	35%	127,906,991			
39	56	36%	69,090,978			
40	89	37%	108,912,419			
41	59	38%	71,491,373			
42	72	39%	86,235,616			
43	52	40%	61,450,020			
44	64	41%	74,480,704			
45	70	42%	80,066,448			
46	45	42%	50,484,031			
47	60	43%	65,876,634			
48	56	44%	60,034,016			
49	50	45%	52,207,183			
50	62	46%	62,884,547			
51	70	47%	68,768,397			
52	73	48%	69,244,882			
53	66	49%	60,240,176			
54	66	50%	57,744,418			
55	71	50%	58,706,208	20-55	30-55	40-55
			2,661,524,931	2,545,000,440	2,000,059,210	1,088,827,072
			$ 20,856	$ 19,943	$ 15,673	$ 8,532

ECM-15 AHU Econ

	Total energy use (MMBtu/yr)	Electric energy use (kWh/yr)	Electric energy cost, Year 1, ($/yr)	Electric demand* (kW/yr)	Electric demand cost, Year 1, ($/yr)	Natural gas use (MCF/yr)**	Fuel Costs Year 1 ($/yr)	Other energy use (CCF/yr)**	Other energy cost, Year 1 ($/yr)	Total Energy and water cost, Year 1 ($/yr)	Other energy-related O&M costs, Year 1 ($/yr)	Total costs, Year 1 ($/yr)
Baseline use												
Post installation use												
Savings		99,724	8,532							$0		$0

ECM-15 pump vfd

	Total energy use (MMBtu/yr)	Electric energy use (kWh/yr)	Electric energy cost, Year 1, ($/yr)	Electric demand* (kW/yr)	Electric demand cost, Year 1, ($/yr)	Natural gas use (MCF/yr)**	Fuel Costs Year 1 ($/yr)	Other energy use (CCF/yr)**	Other energy cost, Year 1 ($/yr)	Total Energy and water cost, Year 1 ($/yr)	Other energy-related O&M costs, Year 1 ($/yr)	Total costs, Year 1 ($/yr)
Baseline use												
Post installation use												
Savings		21,452	1,835							$0		$0

From fan or pump Analysis

ECM-16 Electric to gas
System Change
Heating
Existing Steam boiler

1589 By calculation. Adjust to match bills

		EFLH (Heating)		Mmbtu		Tag	KW	
2,081,320	Btu/hr	1029.8 =		2,143.34		RHC-1		20
						HC-1		90
						HC-2		100
	Cost per MCF (Readi		8.65			HC-3		140
	Cost per mmbtu		8.97			HC-4		140
	Boiler Eff		87%			HC-5		140
	Burner tip cost		10.31					610
							3412	2,081,320
	Annual Cost		22,105					
	MCF		2,554.8					

Current electric heater

				2,143.34		
	Cost per kwh		0.086			
		$/mmbtu	25.076			
	Annual Cost		53,747		53,745	From 2021 bills
	Annual KWH		628,178			
	$ Savings		31,641.40			

	Total energy use (MMBtu/yr)	Electric energy use (kWh/yr)	Electric energy cost, Year 1, ($/yr)	Electric demand* (kW/yr)	Electric demand cost, Year 1, ($/yr)	Natural gas use (MCF/yr)**	Fuel Costs Year 1 ($/yr)	Other energy use (CCF/yr)**	Other energy cost, Year 1 ($/yr)	Total Energy and water cost, Year 1 ($/yr)	Other energy-related O&M costs, Year 1 ($/yr)	Total costs, Year 1 ($/yr)
Baseline use												
Post installation use												
Savings		628,178	53,747			(2,554.8)	(22,105)			75,852		$0

Scranton

ECM 17 Cooling Tower Fan referbush and VFD controls

	Total energy use (MMBtu/yr)	Electric energy use (kWh/yr)	Electric energy cost, Year 1, ($/yr)	Electric demand* (kW/yr)	Electric demand cost, Year 1, ($/yr)	Natural gas use (MCF/yr)**	Fuel Costs Year 1 ($/yr)	Other energy use (CCF/yr)**	Other energy cost, Year 1 ($/yr)	Total Energy and water cost, Year 1 ($/yr)	Other energy-related O&M costs, Year 1 ($/yr)	Total costs, Year 1 ($/yr)
Baseline use												
Post installation use												
Savings		21,002	1,798							$0		$0

ECM 18 control

Utility Data Range:		Jan-21	to	Dec-21										
Month	CDD	kW	kWh	Cost $	Non Htg/Clg base load	HDD	CDD	Heating cost	$/hdd	Cooling Cost				
Jan-21			255,026	21,334	10000	1080.1	0	11,334	10.49347					
Feb-21			238,392	19,957	10000	1008	0	9,957	9.877976					
Mar-21			191,971	17,178	10000	685.1	5	7,178	10.4773					
Apr-21			161,826	13,607	10000	434.6	18.4	3,607	8.299586	0				
May-21			173,865	16,553	10000	250.4	91.2	2,308		4,245				
Jun-21			170,809	15,801	10000	48.3	228.7	445		5,356				
Jul-21			175,445	14,355	10000	21.6	241			4,355				
Aug-21			163,306	14,445	10000	17.5	290.1			4,445				
Sep-21			163,359	14,246	10000	98	108.2	903		3,343				
Oct-21			185,910	15,543	10000	228.6	34.2	5,543		0				
Nov-21			191,885	13,823	10000	738.8	0.4	3,823	5.174607					
Dec-21			213,021	18,646	10000	786.9	0	8,646	10.98742					
Annual Total	0	0.0	2,284,815	195,488				53,745	9.218394	21,743	Total			Control Savir
								1,075		435		1,510	Dollars	2%
								12,563		5,083		17,646	KWH	

ECM 22 window to other AC methods

Existing Model Numbers

Tons	132
Quanity	1
Original EER:	9.0
btu cooling	1,587,040
Rated nominal Watts	176,338
Nominal KWh	176.3
Gas Fired Burner Efficiency	

New RTU Models

Tons	132
New EER:	12.0
btu cooling	1,587,040
Rated nominal Watts	132,253
Nominal KWh	132
Gas Fired Burner Efficiency	

Savings Calculations (Air Conditioning)

AC Usage hours (EFLH)		1198.9
Existing KWH		211,403
New KWH		158,553
Price per KWh	$	0.11689
Cooling Savings	$	6,178
KWH savings		52,851

	Total energy use (MMBtu/yr)	Electric energy use (kWh/yr)	Electric energy cost, Year 1, ($/yr)	Electric demand* (kW/yr)	Electric demand cost, Year 1, ($/yr)	Natural gas use (MCF/yr)**	Fuel Costs Year 1 ($/yr)	Other energy use (CCF/yr)**	Other energy cost, Year 1 ($/yr)	Total Energy and water cost, Year 1 ($/yr)	Other energy-related O&M costs, Year 1 ($/yr)	Total costs, Year 1 ($/yr)
Baseline use												
Post installation use												
Savings		52,851	$ 6,178							$0		$0

Heating Savings

ECM-22 heating DSC building 55 Boiler replacement

System Change

			BTU/sq ft	
Heating	Square ft	39,676	30	1,190,280

Existing Steam boiler plant

		EFLH (Heating)		Mmbtu needed
1,190,280	Btu/hr	1589	=	
Set back thermostat	No	1589	=	1,891.35

Cost per MCF	12.09
Boiler Eff	60%
MMBTU burned	3,152.26
MCF	3,040

Future Heating plant

		EFLH (Heating)		Mmbtu with set back	Electric
1,190,280	Btu/hr	1589			NG
Set back thermostat	Yes	1430.1	=	1,702.22	

Cost per MCF	12.09
Boiler Eff	87%
MMBTU burned	1,956.57
MCF	1,887
MCF saved	1,153
Annual Savings	$ 13,940

	Total energy use (MMBtu/yr)	Electric energy use (kWh/yr)	Electric energy cost, Year 1, ($/yr)	Electric demand* (kW/yr)	Electric demand cost, Year 1, ($/yr)	Natural gas use (MCF/yr)**	Fuel Costs Year 1 ($/yr)	Other energy use (CCF/yr)**	Other energy cost, Year 1 ($/yr)	Total Energy and water cost, Year 1 ($/yr)	Other energy-related O&M costs, Year 1 ($/yr)	Total costs, Year 1 ($/yr)
Baseline use												
Post installation use												
Savings						1,153.0	13,940			$0		$0

ECM 23 window to other AC methods

Existing Model Numbers

Tons	132
Quanity	1
Original EER:	12.0
btu cooling	1,587,040
Rated nominal Watts	132,253
Nominal KWh	132.3
Gas Fired Burner Efficiency	

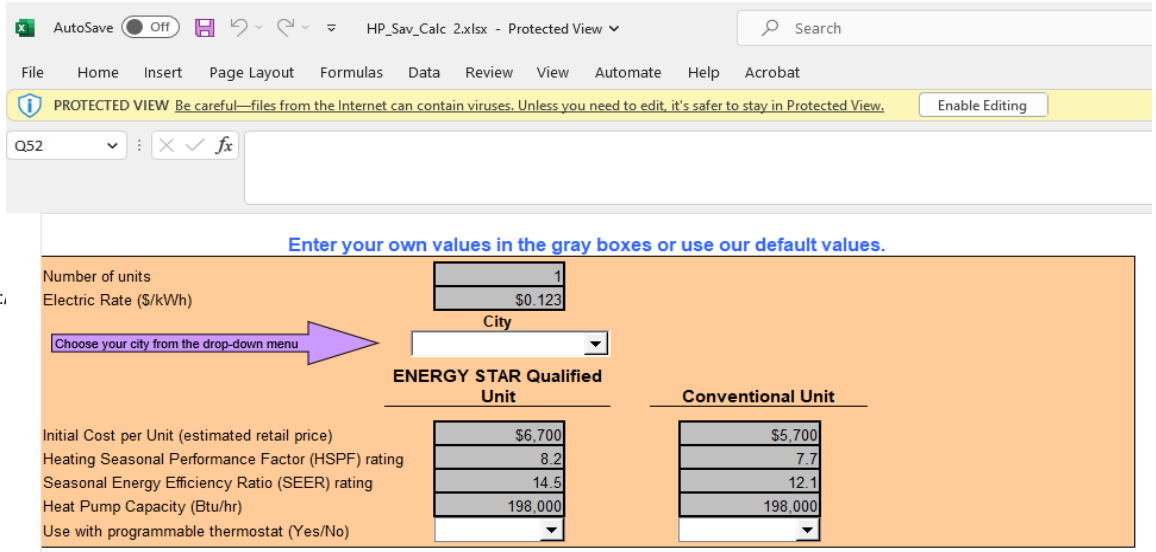
New RTU Models

Tons	132
New EER:	14.5
btu cooling	1,587,040
Rated nominal Watts	109,451
Nominal KWh	109
Gas Fired Burner Efficiency	

Savings Calculations (Air Conditioning)

AC Usage hours (EFLH)		1198.9
Existing KWH		158,553
New KWH		131,216
Price per KWh	$	0.11689
Cooling Savings	$	3,195
KWH savings		27,337

https:



	Total energy use (MMBtu/yr)	Electric energy use (kWh/yr)	Electric energy cost, Year 1, ($/yr)	Electric demand* (kW/yr)	Electric demand cost, Year 1, ($/yr)	Natural gas use (MCF/yr)**	Fuel Costs Year 1 ($/yr)	Other energy use (CCF/yr)**	Other energy cost, Year 1 ($/yr)	Total Energy and water cost, Year 1 ($/yr)	Other energy-related O&M costs, Year 1 ($/yr)	Total costs, Year 1 ($/yr)
Baseline use												
Post installation use												
Savings		27,337	$ 3,195							$0		$0

ECM 25 DSC 55

Utility Data Range:			Jan-21 to Dec-21				
Month	CDD	kW	kWh	Cost $	Non Clg base load	Cooling Cost	$/kwh
Jan-21	0		499,918	58,435			0.11689
Feb-21	0						
Mar-21	5						
Apr-21	18.4						
May-21	91.2						
Jun-21	228.7						
Jul-21	241						
Aug-21	290.1						
Sep-21	108.2						
Oct-21	34.2						
Nov-21	0.4						
Dec-21	0						
Annual Total	1,017	0.0	499,918	58,435			

- Total
2,922 Dollars
24,996 KWH

Control Savings
5%

Utility Data Range:			Jan-21 to Dec-21			
Month	HDD	MCF	$/MCF	Cost $	Non Htg base load	Heating cost
Jan-21		4,560	12.09	55,130		
Feb-21						
Mar-21						
Apr-21						
May-21						
Jun-21						
Jul-21						
Aug-21						
Sep-21						
Oct-21						
Nov-21						
Dec-21						
Annual Total	0	4,560	12.09	55,130		

55,130 Total
2,757 Dollars
228 MCF

Control Savings
5%

	Total energy use (MMBtu/yr)	Electric energy use (kWh/yr)	Electric energy cost, Year 1, ($/yr)	Electric demand* (kW/yr)	Electric demand cost, Year 1, ($/yr)	Natural gas use (MCF/yr)**	Fuel Costs Year 1 ($/yr)	Other energy use (CCF/yr)**	Other energy cost, Year 1 ($/yr)	Total Energy and water cost, Year 1 ($/yr)	Other energy-related O&M costs, Year 1 ($/yr)	Total costs, Year 1 ($/yr)
Baseline use												
Post installation use												
Savings		24,996	2,922			228	2,757			$0		$0

ECM 26 Replace chillers

Existing Model Numbers

Tons	150
Quanity	2
Original EER:	9.0
btu cooling	1,800,000
Rated nominal Watts	200,000
Nominal KWh	200.0
Gas Fired Burner Efficiency	

New RTU Models

Tons	150
New EER:	16.5
btu cooling	1,800,000
Rated nominal Watts	109,091
Nominal KWh	109
Gas Fired Burner Efficiency	

Savings Calculations (Air Conditioning)			From Bills
AC Usage hours (EFLH)		1198.9	
Existing KWH		239,771	357,083
New KWH		130,784	
Price per KWh	$	0.08141	
Cooling Savings	$	8,873	
KWH savings		108,987	

	Total energy use (MMBtu/yr)	Electric energy use (kWh/yr)	Electric energy cost, Year 1, ($/yr)	Electric demand* (kW/yr)	Electric demand cost, Year 1, ($/yr)	Natural gas use (MCF/yr)**	Fuel Costs Year 1 ($/yr)	Other energy use (CCF/yr)**	Other energy cost, Year 1 ($/yr)	Total Energy and water cost, Year 1 ($/yr)	Other energy-related O&M costs, Year 1 ($/yr)	Total costs, Year 1 ($/yr)
Baseline use												
Post installation use												
Savings		108,987	$ 8,873							$ 8,873		$ 8,873

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

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.

The energy output range is based on analysis of 30 years of historical weather data, 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

281,596 kWh/Year*

System output may range from 266,474 to 287,538 kWh per year near this location.

Month	Solar Radiation (kWh / m^2 / day)	AC Energy (kWh)
January	2.95	16,844
February	3.95	20,083
March	4.61	25,078
April	5.67	28,224
May	6.08	30,381
June	5.96	28,289
July	6.37	30,745
August	5.41	25,971
September	5.30	25,407
October	3.96	20,771
November	3.01	15,865
December	2.45	13,938
Annual	**4.64**	**281,596**

Location and Station Identification

Requested Location	625 Cherry Street, Reading, PA 19602.
Weather Data Source	Lat, Lng: 40.33, -75.94 0.9 mi
Latitude	40.33° N
Longitude	75.94° W

PV System Specifications

DC System Size	222.3 kW
Module Type	Standard
Array Type	Fixed (roof mount)
System Losses	14.08%
Array Tilt	20°
Array Azimuth	180°
DC to AC Size Ratio	1.2
Inverter Efficiency	96%
Ground Coverage Ratio	0.4%
Albedo	*From weather file*
Bifacial	No (0)

Monthly Irradiance Loss	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

Performance Metrics

DC Capacity Factor	**14.5%**

ECM 28 standard 208 chiller

Existing Model Numbers

Tons	150
Quanity	2
Original EER:	11.0
btu cooling	1,800,000
Rated nominal Watts	163,636
Nominal KWh	163.6
Gas Fired Burner Efficiency	

New RTU Models

Tons	150	
New EER:	13.8	Guess to get lower value
btu cooling	1,800,000	
Rated nominal Watts	130,435	
Nominal KWh	130	
Gas Fired Burner Efficiency		

Savings Calculations (Air Conditioning) From Bills

AC Usage hours (EFLH)		1198.9			
Existing KWH		196,176	357,083		
New KWH		156,372			
Price per KWh	$	0.07415			
Cooling Savings	$	2,951			
KWH savings		39,804		$ 45,271.00	88%

	Total energy use (MMBtu/yr)	Electric energy use (kWh/yr)	Electric energy cost, Year 1, ($/yr)	Electric demand* (kW/yr)	Electric demand cost, Year 1, ($/yr)	Natural gas use (MCF/yr)**	Fuel Costs Year 1 ($/yr)	Other energy use (CCF/yr)**	Other energy cost, Year 1 ($/yr)	Total Energy and water cost, Year 1 ($/yr)	Other energy-related O&M costs, Year 1 ($/yr)	Total costs, Year 1 ($/yr)
Baseline use												
Post installation use												
Savings		39,804	$ 2,951							$0		$0

Heating Savings

ECM-30 alt heating DSC building 55 Boiler replacement

System Change

			BTU/sq ft		
Heating	Square ft	39,676	30	1,190,280	

Existing Steam boiler plant

		EFLH (Heating)		Mmbtu needed
1,190,280	Btu/hr	1589	=	
Set back thermostat	No	1589	=	1,891.35

Cost per MCF	12.09
Boiler Eff	60%
MMBTU burned	3,152.26
MCF	3,040

Future Heating plant

		EFLH (Heating)		Mmbtu with set back	Electric
1,190,280	Btu/hr	1589			NG
Set back thermostat	Yes	1430.1	=	1,702.22	

Cost per MCF	12.09
Boiler Eff	82%
MMBTU burned	2,075.88
MCF	2,002
MCF saved	1,038
Annual Savings	$ 12,549

	Total energy use (MMBtu/yr)	Electric energy use (kWh/yr)	Electric energy cost, Year 1, ($/yr)	Electric demand* (kW/yr)	Electric demand cost, Year 1, ($/yr)	Natural gas use (MCF/yr)**	Fuel Costs Year 1 ($/yr)	Other energy use (CCF/yr)**	Other energy cost, Year 1 ($/yr)	Total Energy and water cost, Year 1 ($/yr)	Other energy-related O&M costs, Year 1 ($/yr)	Total costs, Year 1 ($/yr)
Baseline use												
Post installation use												
Savings						1,038.0	12,549			$0		$0

ECM-31 Steam traps

Project: PA GESA
Date: 4/10/2023
Sheet: Savings Summary

Project Summary by ECM										
ECM	Baseline	Post - Retro	Savings			Annual Cost Reduction				
	Water/Sewer		Water/Sewer	Thermal	Electricity	Water/Sewer	Thermal	Electricity	O&M	Total
	(Kgal/yr)		(Kgal/yr)	(MMBtu/ yr)	(kwh/yr)	($/yr)	($/yr)	($/yr)	($/yr)	($/yr)
Steam Trap Retrofit				208						
Totals	-	-	-	**208**	-					

Steam Trap Retrofit										
Facility/Building	Baseline	Post - Retro	Savings			Annual Cost Reduction				
	Water/Sewer		Water/Sewer	Thermal	Electricity	Water/Sewer	Thermal	Electricity	O&M	Total
	(Kgal/yr)		(Kgal/yr)	(MMBtu/ yr)	(kwh/yr)	($/yr)	($/yr)	($/yr)	($/yr)	($/yr)
Scranton				-						
Reading				-						
NWOB				208						
-				-						
Totals	-	-	-	**208**	-					

	Total energy use (MMBtu/yr)	Electric energy use (kWh/yr)	Electric energy cost, Year 1, ($/yr)	Electric demand* (kW/yr)	Electric demand cost, Year 1, ($/yr)	Natural gas use (MCF/yr)**	Fuel Costs Year 1 ($/yr)	Other energy use (CCF/yr)**	Other energy cost, Year 1 ($/yr)	Total Energy and water cost, Year 1 ($/yr)
Baseline use										
Post installation use										
Savings						200.7	4,820			$0

Corporate Headquarters
6800 Eastland Rd
Middleburg Hts, OH 44130

Columbus
6037 Frantz Rd, Ste 105
Columbus, OH 43017

Dayton/Xenia
1400 Brush Row Rd
Wilberforce, OH 45384

Little Rock
1301 Westpark Dr
Little Rock, AR 72204

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