STRATEGY FOR ENERGY EFFICIENCY DEVELOPMENT IN THE BAHAMAS

Request for Proposals: Anatol Rodgers High School Energy Retrofits

The Ministry of Environment and Housing

(the "Ministry")

Date: 9th May 2018

NOTICE

This Request for Proposals ("RFP") has been prepared by the Government of the Commonwealth of The Bahamas (the "Government") and is being delivered to parties ("Bidders") who may potentially submit a proposal further to the published Notice for RFP dated 1st February 2018.

This RFP is not a prospectus and does not constitute or form part of any offer or recommendation to submit a proposal nor shall it or any part of it form the basis of or be relied upon in any way in connection with any contract relating to any participation in the RFP process. The issuance of this RFP does not constitute any form of commitment on the part of the Government.

The information contained in this document is selective and does not include a description of any risks. It does not purport to contain all information that the Recipients may require and is subject to updating, expansion, revision and amendment. By accepting or reviewing this document, each Recipient agrees to the conditions established herein. This includes the requirement that the Recipient will use this RFP for the sole purpose of evaluating its potential to provide a cost- effective solution for the energy efficiency retrofit for Anatol Rodgers High School, located on the Island of New Providence, in The Bahamas. The goal of the Retrofit is to decrease annual energy demand and improve comfort.

Persons to whom this RFP is provided are required to inform themselves about and observe any restrictions regarding the issuance of this document. This RFP is and will remain the property of the Government. The Government reserves the right to require the return of this RFP (together with any copies or extracts thereof) at any time.

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Except where otherwise indicated, this RFP speaks as of the date hereof. The Government has no obligation to update, expand, revise or amend any information or to correct any inaccuracies contained in this RFP or provide the Recipients with any additional information.

The contents of this RFP are not to be construed as legal, financial, or tax advice. Each Recipient should consult his, her or its advisors. The Recipients are required to conduct their own due diligence and seek their own advice prior to making any decision to participate in this RFP. The Government reserves the right, in its sole and absolute discretion, at any time and in any respect, with or without notice or reason to any Bidder to (i) amend or substitute any written material furnished to the Bidder, (ii) amend or terminate any of the procedures and timing of events set forth herein or in any other communication, (iii) negotiate with any one or more Proposers, and (vii) abandon the process. Neither the Government nor any of its agents, officials, employees, affiliates, representatives or advisors has any obligation or liability to any person in respect of the process disclosed herein and/or in any other communication or any proposals from any person, rejection of such proposals or discussions relating thereto.

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List of abbreviations

Abbreviation	Meaning
AHJ	Authority having jurisdiction
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
BPL	Bahamas Power and Light
CAD	Computer aided design
CM	Construction Manager
CWR	Carbone War Room
CxA	Third party Commissioning Agent
DHW	Domestic hot water
DNV GL	DNV KEMA Renewables, Inc.
ECM	Energy conservation measures
GC	General Contractor
GPM	Gallons per minute
HVAC	Heating, ventilating, and air conditioning
ICEA	Insulated Cable Engineers Association
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
IFC	Issue-for-construction
IPP	Independent power producer
LED	Light emitting diode
MCA	Mutual Confidentiality Agreement
NBFU	National Board of Fire Underwriters
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NESC	National Electrical Safety Code
NETA	International Electrical Testing Association
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
NTP	Notice to proceed
O&M	Operations and maintenance
OMP	Operations and Maintenance Plan
PV	Photovoltaic

Q&A	Question and Answer
RCSC	Research Council for Structural Connections
RFP	Request for Proposals
SoQ	Statement of qualifications
UBC	Uniform Building Code
UL	Underwriters Laboratory
WGD	Warranties and Guarantees document

1 INTRODUCTION

The Government of the Commonwealth of The Bahamas (the "Government") is issuing this Request for Proposals (RFP) to solicit competitive proposals from qualified companies (Bidders) to provide a cost-effective solution for the energy efficiency retrofit (Retrofit) for Anatol Rodgers High School, located on the Island of New Providence, in The Bahamas. The goal of the Retrofit is to decrease annual energy demand and improve comfort.

The desired outcome of this RFP is the successful negotiation and execution of a design-build contract, as described herein.

1.1 Project background

Implementing energy conservation measures (ECM) is one of the strategic objectives of the Government to help fulfil commitments to supporting a low-carbon economy. The Anatol Rodgers High School (the School) on New Providence Island has been targeted as one of the most suitable facilities on New Providence for a retrofit due to energy use and solar power potential. Installing specific ECMs, including a rooftop solar PV array, at the School is expected to reduce the energy demands of the building, which will have an immediate and measurable impact, while improving comfort of students and faculty in the facility. Note, prior to preparation of this RFP, an energy audit was performed by Azimuth Energy and is attached in Exhibit A for reference and additional information.

1.2 Overview of Anatol Rodgers High School

Anatol Rodgers High School is located on the southern side of New Providence. Originally completed in 2012, the School offers two magnet programmes in Pre-Engineering and Information Technology. In addition, the School has a programme focused on Hospitality and Consumer Education including a classroom containing commercial kitchen equipment and a mock-up hotel room for students to gain the experience necessary to become future managers of hotels in The Bahamas. The School is the only public school on New Providence that provides education to both junior high and senior high school students. The School serves approximately 1,250 students and has a faculty of approximately 90 teachers. The building is fully occupied during the school year (September through June); however, summer classes and administrative activities keep many areas of the school open year-round.

The School building is approximately Fifty Thousand (50,000) square feet consisting primarily of unconditioned classroom spaces and conditioned administration areas. Other space types include: a gymnasium, computer aided design (CAD) classrooms, a cooking and hospitality area, a pump house, and a staff lobby. Installation of ECMs at the School should be coordinated with the pre-engineering faculty to take full advantage of any opportunities to use the energy efficiency retrofit as a learning experience for the school's future engineers.

Figure 1-1 Front of Anatol Rodgers High School

1.3 Energy use at the School

The School's annual energy use has varied widely from year to year since its opening. This is likely based primarily on control issues and/or systems which were on or offline during a period of time, or in a given year. Monthly energy use trends show a similar pattern throughout the year and are shown in the chart below. The high use in September and October is assumed to be related to activities related to the kick-off of the school year, coupled with running of air conditioning and fans while school is in session during the summer heat.

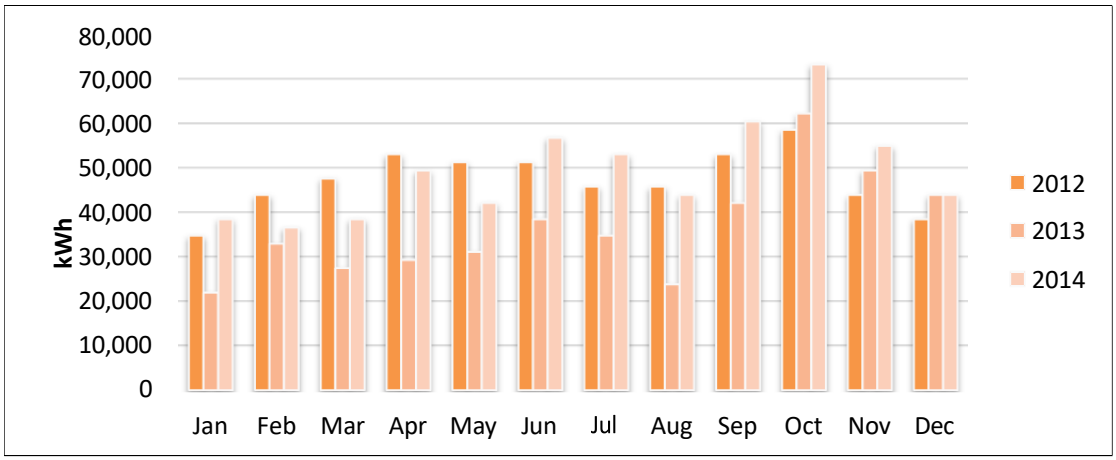

Figure 1-2 Monthly energy use - Anatol Rodgers High School

1.4 Energy conservation measures

This RFP includes the requirement for the selected bidder to design, supply and install the following ECMs:

Anatol Rodgers High School:

1. 250 kW-DC rooftop solar PV array
2. Robust exterior lighting control system
3. Vacancy sensors in all classrooms, computer labs, and lounges to control lights and ceiling fans
4. Louver sensor interlock at gymnasium
5. Programmable thermostats throughout the school
6. Low-flow lavatory aerators
7. Re-zone interior lighting system at entrance
8. Re-organize refrigerant lines from condensing units
9. Commissioning and retro-commissioning

2 RFP OVERVIEW AND GENERAL INFORMATION

2.1 Execution of design-build contract

The scope of this RFP is for design-build contracting services for ECMs at Anatol Rodgers High School. The Project will be delivered to the Government.

The contractual structure of the agreement is a design-build approach whereby the General Contractor (GC) is responsible for design, supply, delivery, installation, and handover to the Government as well as administration of warranty for all ECMs at the School and Gardens. The GC is responsible for work and safety of all trades and subcontractors.

Before construction, all designs shall be reviewed and approved by the Government.

During construction, regular construction administration and progress meetings shall be held which shall include the appropriate members of the relevant Ministries. Final project completion will be signed off by the Government.

2.2 Project schedule

Bidders shall provide a high-level supply schedule as part of the bid package to support the milestones. The major milestones for the RFP and Project are listed in Table 2-1 below.

Table 2-1 Proposed project schedule

Date	Event
9 May 2018	RFP released to potential bidders
23 May 2018	Receipt confirmation deadline
13 June 2018	Mandatory site visit conducted
22 June 2018	Request for clarification submission deadline
29 June 2018	Final responses to request for clarification
23:59 hrs 13 July 2018	Proposal submission deadline
7 August 2018	Shortlist notification
14 August 2018	Interviews (if required)
22 August 2018	Award notification and contract negotiations
12 September 2018	Contract execution and notice to proceed (NTP) granted
TBD	Guaranteed Project Completion

2.3 Proposal instructions

2.3.1 Guidelines

Bidder shall provide a comprehensive proposal for the full scope of supply in accordance with the instructions and submittal requirements provided herein.

2.3.2 Submission of proposals

All proposals shall be delivered electronically via minofenvironmentandhousing@bahamas.gov.bs and rford.contractor@rmi.org and must be received by the proposal deadline as listed in Table 2-1 above. Proposals received after this date will not be considered. It is the responsibility of the Bidder to ensure that the bid has been received prior to the deadline. Proposals shall include all proposal deliverables described in Section 4. All files shall be organized in a folder called "Anatol Rodgers High School Energy Efficiency Retrofits *Bidder Name,"* where "*Bidder Name"* is the name of the company submitting the proposal.

No Bidder may modify or amend its Proposal after the Proposal Submission Deadline Date.

Each Bidder shall complete and submit the Schedule of Pricing Bid Form, Exhibit B, with its technical proposal for all services.

2.3.3 Binding offer

Proposals submitted in response to this RFP shall constitute binding offers and must be signed by a duly authorized representative of the Bidder.

2.3.4 Proposal validity period

Proposals submitted in response to this solicitation shall state that the proposal is valid for a minimum period of ninety (90) days beyond the proposal deadline.

2.3.5 Bidder expenses

Bidders are solely responsible for their own expenses in preparing responses and for subsequent negotiations with the Government, if any. The Government will not be liable to any Bidder for any claims, whether for costs or damages incurred by the Bidder in preparing the response, loss of anticipated profit about any final contract, or any other matter whatsoever.

2.3.6 Acceptance of responses

This RFP is not an agreement to purchase goods or services. The Government is not bound to enter a contract with any Bidder. Responses will be assessed considering the proposal review criteria and other factors. The Government will be under no obligation to receive further information, whether written or oral, from any Bidder.

2.3.7 Modification of terms

The Government reserves the right to modify the terms of this RFP at any time at its sole discretion. The Government also reserves the right to cancel this RFP at any time.

The Government reserves the right to request additional information from any or all Bidders.

2.3.8 Ownership of responses

All proposals and other documents submitted to the Government become the property of the Government. Responses will be treated with confidentiality. Responses may be shared with DNV GL and CWR for the purposes of assistance in evaluating proposals, managing a Question and Answer (Q&A) log, communicating with Bidders, and similar activities related to the RFP process.

The Government of The Bahamas shall determine the timing and content of any and all announcements or public statements relating to any part of this RFP process. No Bidder shall make any public statements or release any information regarding this process without the prior approval in writing of the Government.

2.3.9 Omitted

2.3.10 Receipt confirmation

Bidders are requested to acknowledge receipt of this solicitation by responding via box.com to minofenvironmentandhousing@bahamas.gov.bs and rford.contractor@rmi.org by the deadline for receipt confirmation. This response should include primary and secondary (if applicable) points of contact for all future RFP-related communication. Please include "Anatol Rodgers High School Energy Efficiency Retrofits RFP RSVP" in the subject line. All subsequent information regarding this RFP, including changes made to this document, addenda, responses to questions, and any notifications will be directed only to Bidders who acknowledge receipt of this RFP.

2.3.11 Site visit

Mandatory site visits will be held during the week of 11 June 2018 Details regarding the site visit are to be determined. Updated site visit information will be emailed only to Bidders who complete the receipt confirmation and declare intention to attend the site visit.

2.3.12 Proposal review

All proposals will be reviewed by the Government's proposal review committee. The review committee will be solely responsible for the final Bidder selection and contract award.

2.3.13 Q&A log

DNV GL and CWR will manage a Q&A log for the benefit of Bidders. Please submit questions to minofenvironmentandhousing@bahamas.gov.bs and rford.contractor@rmi.org; include "Anatol Rodgers High School Retrofit Q&A" in the subject line.

Responses to questions will be sent periodically to all Bidders who have confirmed receipt of the RFP, as described above, with the identity of the Bidder remaining anonymous. Responses shall not be construed as in any way amending, modifying or altering the meaning and intent of this RFP, unless the RFP is amended in accordance with Section 2.3.7 above.

2.3.14 Language

All proposal deliverables, confirmations, requests for clarification, and other communications associated with this RFP shall be in the English language.

2.3.15 Anti-Corruption

Bidders shall make no overtures, gifts, commission payments or any other form of inducement, whether pecuniary or non-pecuniary, direct or indirect, in an effort to gain an advantage in this process, or seek any information on the status of the process or their bid, to any officer or official of the Government of The Bahamas, or any professional advisor to the Government of The Bahamas on any matter related to the process outlined herein.

Any breach or attempt to breach this clause will result in immediate disqualification from further participation in this RFP process. The Bidder must not, either within its Proposal or otherwise in any correspondence, conversation, meeting or otherwise, disclose to the Proposal Review Committee, any official of or advisor to the Government, any information regarding the amount which the Bidder is prepared to commit, except as required within that process. Any such disclosure will result in disqualification of the Bidder's Proposal.

3 SCOPE OF SERVICES

3.1 General

The Bidder scope of supply shall include all materials and services for the supply and installation of ECMs as defined within this RFP at the Anatol Rodgers High School on New Providence Island, Bahamas. The Project shall be implemented through a design-build contract with the GC having the role to guarantee completion of the ECMs meeting an agreed schedule and budget. The GC shall be responsible for the performance of all subcontractors.

3.2 Energy efficiency measures and technical requirements at the School

The following sections provide specifications for proposed ECMs at the School.

3.2.1 | 250 kW rooftop solar PV system

The solar PV system shall comprise photovoltaic modules from a top tier manufacturer capable of a minimum efficiency of 17%. The top tier manufacturer will be selected in accordance with the 'Bloomberg New Energy Finance PV Module Maker Tiering System' dated 22nd February, 2017. Due to the high demand for renewable energy on the island, preference will be given to solar panels with rated efficiency greater than 20%. Panels, racking, wiring, inverters, connection t o grid/main power supply, meters, waterproofing, and all equipment associated with the PV system shall be provided by the Bidder as part of the design-build scope. The complete PV system shall meet the following requirements:

- Designed and constructed to withstand without damage all applicable environmental conditions as defined by the local building codes appropriate for the Project area, including but not limited to wind loads, corrosion, precipitation, flooding, and temperature and humidity extremes. The Selected Bidder is responsible for ensuring the buildings and roofs have structural integrity to support the additional weight and other forces of the rooftop PV system.
- UL-listed and IP-66 labelled for wet location use, protected against powerful water jets.
- Total system size shall be 250 kW-DC and shall be distributed among all roofs at the School with good solar access that do not contain skylights.
- Sloping of PV modules shall be optimized to produce the most kWh per year based on the climate's annual insolation, while maintaining resistance to hurricane-force winds often experienced in the region. Bidders shall provide output file(s) demonstrating estimated annual kWh production for the proposed PV system (included as a proposal deliverable – see Section 4.5).
- Any PV modules with differing tilts or solar azimuth shall be connected to separate inverters to ensure maximum output per kW of PV located at the site.
- Inverter design to minimize impact of shading on annual energy production.
- Metering: Selected Bidder shall install metering system so that energy produced by the PV system can be broken down from energy used by building.
- All structures shall be designed in accordance with applicable local codes. (BPL uses IEEE 1547-2018)
- The complete generating system, support structure, and ancillary structures shall comply with Category IV hurricane (157 mile per hour design wind speed) or greater requirements of the local building code requirements.

- The structure shall resist both static and dynamic wind loading without damage due to resonance or fatigue. The structures shall be designed to withstand gravitational loads and combined loads as required by applicable codes. The structures shall consider expected thermal expansion and contraction and thermal cycling.
- The Selected Bidder will be required to provide structural details in engineering drawings stamped by a licensed structural engineer as part of the design and permitting process. Structural details include but are not limited to the PV module mounting fasteners, support structures, material specifications, grades and finishes, inverter pads, Bahamas Power and Light (BPL) and independent metering sections, monitoring and disconnect facilities, and array layout drawing.
- Conductor size is to be determined in accordance with the local code (IEEE 1547-2018) or approved equivalent, including conditions of use with particular consideration of temperature rise due to solar exposure, terminal ratings, and consideration of over-current protection and all possible current sources.
- PV modules installed shall conform to the manufacturer's published data sheet(s).
- The average of the power ratings of all modules shipped, based on the manufacturer's flash test data, shall be greater than or equal to the nominal rating of the module as specified in the published data sheet.
- Modules shall be tested and listed to Underwriters Laboratory (UL) or International Electro-technical Commission (IEC) standards for the application.
- Utility disconnect switch shall be located at or near the utility point-of-connection.
- The PV modules shall be warranted by the manufacturer for this application for a minimum of 20 years.
- The inverter shall be warranted by the manufacturer for this application for a minimum of 10 years.
- The entirety of the PV system shall be performance tested and commissioned prior to handover to the Government.
- PV arrays shall be fixed. Tracking systems will not be considered for this project.
- The design and installation shall meet BPL Grid Interconnection requirements, see EXHIBIT E

The Selected Bidder shall work with the Government and the local utility company, BPL, to ensure no interconnection issues occur. Both the Government (URCA) and BPL shall be given opportunity to review and approve construction plans/documents prior to construction and review installation of inverters and solar panels prior to final sign-off.

This proposed ECM system will be evaluated based on the following evaluation criteria (see Section 5):

- Capital cost
- Price per kWh delivered per year
- Quality of products specified
- System design

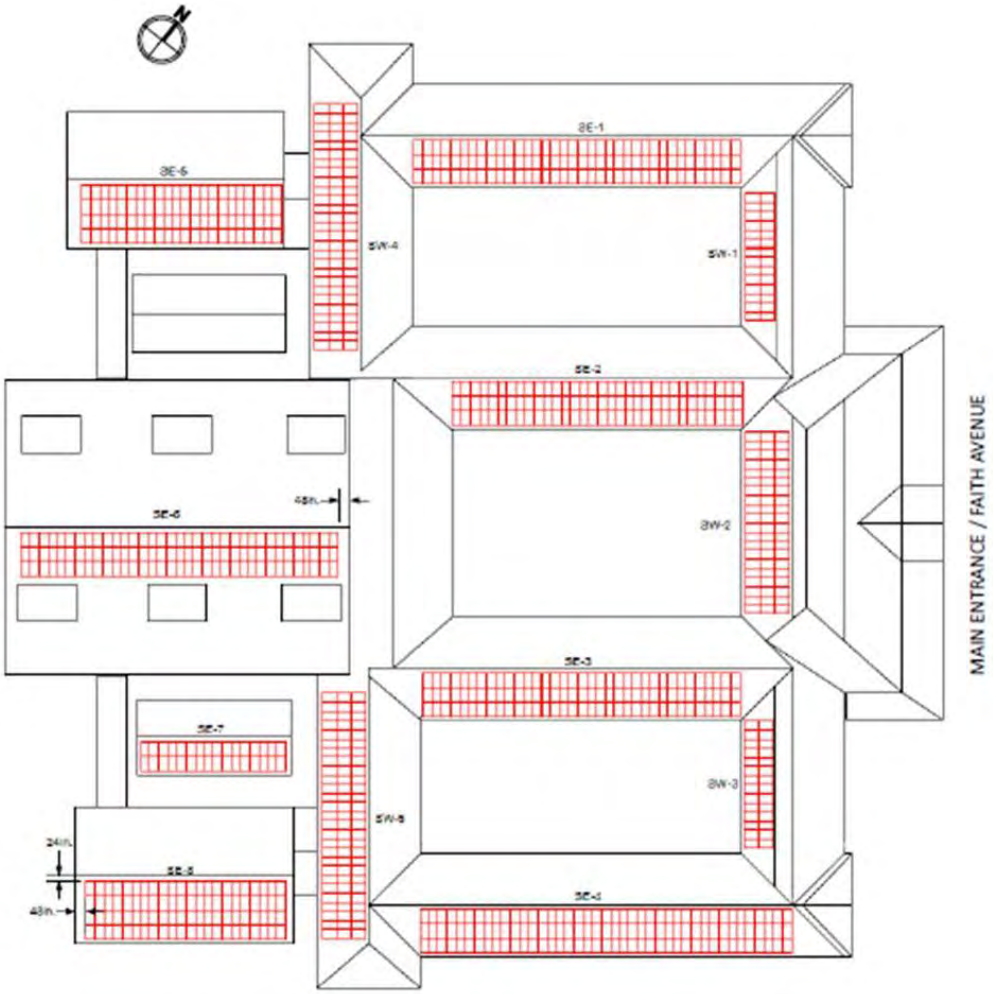

Figure 3-1. Conceptual layout for rooftop PV systems

3.2.2 Exterior lighting control system

The current exterior lighting control system has malfunctioned such that exterior lighting is left on during daylight hours and is sometimes off at night, decreasing safety in the area. It is assumed that the malfunction is due to failed photocells; however, the cause is not entirely clear. The lighting control system shall be replaced with a robust 8,760 hour, timer-based, web-enabled system with a warranty of a minimum of 5 years.

Night Safety Lighting: The Selected Bidder shall work with the Ministry and other local code agencies to determine the locations and absolute minimum amount of exterior lighting that shall be on at night for safety reasons. This lighting shall be on during all night-time hours, designated to turn on at the sunset and turn off at sunrise.

Event Exterior Lighting: Other exterior lighting meant for use during occupied, night-time hours and school events shall be separately circuited or controlled by a timed switch controlled from the administration office with timer options for keeping the lights on for 1 to 6 hours.

Preference will be given to a lighting system that can be controlled via web interface; however, price and reliability are more important factors.

The facility manager shall be trained on the lighting control system to ensure any malfunctions that occur can be resolved in a timely manner to avoid a repeat of the current operational issues.

This proposed ECM system will be evaluated based on the following evaluation criteria (see Section 5):

- Capital cost
- Quality of products specified
- Maintenance-free system design
- Expected annual energy savings

3.2.3 Install vacancy sensors in classrooms and administrative areas

Lights and ceiling fans in classroom and administrative areas are currently controlled by switches in each room. Sometimes, these switches are left in the 'on' position when rooms are vacant, resulting in wasted energy. Bidder shall install vacancy sensors in each classroom and administrative area so that the lights, fans, and air conditioning systems (if the room is conditioned) turn off when no movement has been detected in the room for 10 minutes.

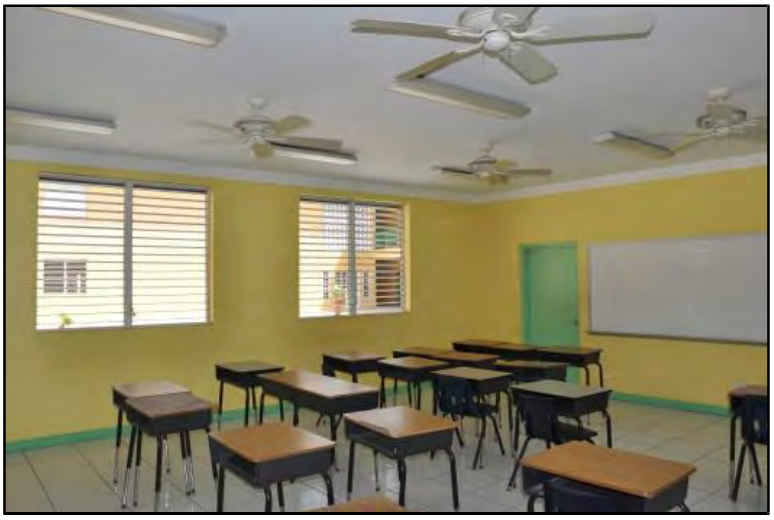

Figure 3-2 Typical Classroom

Vacancy sensor control methodology is critical. The vacancy sensor should never turn equipment on when sensing movement. Instead, the vacancy sensor shall function like a sleep timer on a computer. After 10 minutes of no movement, equipment turns off. If the user wants the equipment back on, they must manually switch it back on. Other requirements include:

- Vacancy sensor shall be in a location such that it sees movement in the normally occupied space. In some instances, this will not be where the switch is located.
- Vacancy sensor shall not inhibit the ability to segregate switched control of lights/air conditioning/fans.

- Products supplied shall be from a single manufacturer that has been continuously involved in manufacturing of vacancy sensors for a minimum of five (5) years. Mixing of manufacturers shall not be allowed.
- All components shall be UL listed, offer a five (5) year warranty, and meet all applicable local code requirements.
- Products shall be manufactured by an International Standards Organization (ISO) 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.
- Wall switch products must be capable of withstanding the effects of inrush current. Submittals shall clearly indicate the method used.
- Wall switch sensors shall be capable of detection of vacancy at desktop level up to 300 square feet, and gross motion up to 1000 square feet.
- Wall switch sensors shall accommodate loads from 0 to 800 watts at 120 volts; 0 to 1200 watts at 277 volts and shall have 180° coverage capability.

This proposed ECM system will be evaluated based on the following evaluation criteria (see Section 5):

- Capital cost
- Quality of products specified
- Expected annual energy savings

3.2.4 Re-zone entrance lighting system and add switch

The entrance lobby for the school is well lit by natural daylight during daytime hours; however, three (3) lights in a neighbouring corridor are connected to the same lighting circuit. As such, the lobby lights are currently on to provide light in the aforementioned dark corridor.

Bidder shall add a switched circuit and segregate the corridor lighting from the entrance lobby lighting circuit. There are two (2) corridor lights on the circuit that need to be segregated.

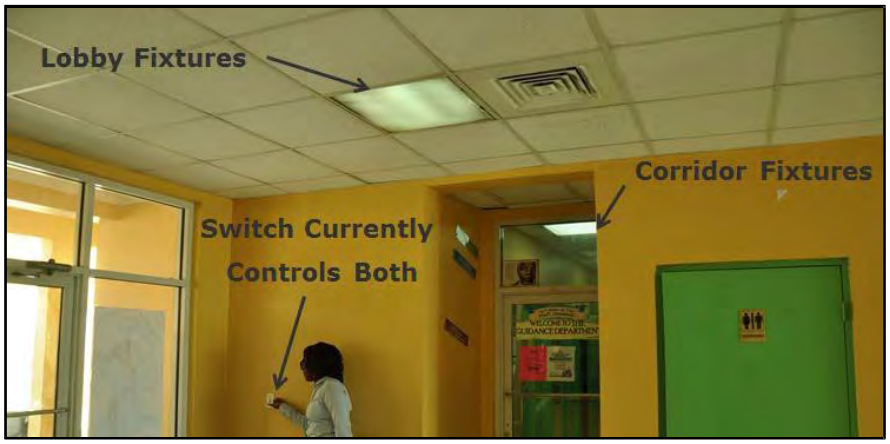

Figure 3-3. Lobby lighting zone issue

3.2.5 Increase cooling performance of condensing units

As noted in the Azimuth Energy Audit (Exhibit A):

> *There are about 28 air-cooled condensing units (ACCUs) installed on wall-mounted brackets on the exterior walls. These are all only about 4″ to 6″ from the wall surface, and some of them have coils of refrigerant tubing stuffed behind them and even discarded bottles and other trash.*
>
> *These units take in air from the back (the wall side) and exhaust through the front. Any restriction in airflow decreases their efficiency. The equipment installation specifications typically call for 6″ to 12″ of ventilation clearance. An immediate improvement in efficiency would occur if the ACCUs were moved as far as possible from the wall on the existing brackets, move the coiled tubing from the ventilation space and attach to the bottom of the bracket (or somewhere else), and remove the trash in that space.*

Bidder shall remove obstructions, adjust ACCUs to furthest point on existing wall brackets, and adjust coiled tubing so that maximum airflow through the ACCU can be realized.

Figure 3-4. Inefficient condensing unit examples

This proposed ECM system will be evaluated based on the following evaluation criteria (see Section 5):

- Capital cost

3.2.6 Install new programmable thermostats and implement night-time setback schedule

While most of the building is not air conditioned, the spaces that are have analogue-type thermostats which are locked behind plastic boxes and incapable of being set on a schedule. Bidder shall install new programmable thermostats capable of hourly, daily, weekly, monthly, and annual control.

Bidder shall work with the facility manager to implement scheduling for all thermostats so that the facility manager has familiarity with the product. Thermostat requirements include:

- Common wire power with battery backup

- Capable of controlling split-system heat pumps and/or larger rooftop packaged heat pump units (such as those which supply the gym.)
- Capable of controlling inverter-driven units with 3-speed interior fans
- Temperature setting minimum: (40-90°F heating, 50-99°F cooling)
- Operating ambient temperature: 0-120°F

Figure 3-5. Non-programmable thermostat examples

This proposed ECM system will be evaluated based on the following evaluation criteria (see Section 5):

- Capital cost
- Quality of products specified
- Expected annual energy savings

3.2.7 Add louver sensors to gymnasium and interlock with HVAC system

The gymnasium utilizes the largest heating, ventilating, and air conditioning (HVAC) equipment on the site and is often running while the louvers at the gymnasium are open. There is significant energy inefficiency when operating large rooftop equipment while louvers are open. Bidder shall install low voltage dry-contact type window sensors on each louver bank in the gym that disables the rooftop unit compressors unless the louvers are closed. This will allow the unit to continue to operate in economizer mode if the louvers are open, but will ensure the air conditioning is not wastefully being supplied to a space with open louvers.

This proposed ECM system will be evaluated based on the following evaluation criteria (see Section 5):

- Capital cost
- Quality of products specified
- Expected annual energy savings
- Maintenance-free system design

3.2.8 Install lavatory aerators throughout

Current lavatories do not include low-flow aerators, which wastes water whenever sinks are used in the building. In the Bahamas, where most water is processed through a desalination plant, water savings equals energy savings. Low-flow aerators are a very cost-effective way to save water without needing to replace fixtures in the building. The selected Bidder shall install low-flow aerators on all lavatories throughout the facility to save water. Low-flow aerators shall reduce flow to a maximum equivalent of 0.5 GPM (gallons per

minute) or 0.03 litres per second.

Figure 3-6. Typical sink at Anatol Rodgers High School

This proposed ECM system will be evaluated based on the following evaluation criteria (see Section 5):

- Capital cost
- Quality of products specified

3.3 Commissioning and retro-commissioning

Commissioning of all new systems and retro-commissioning of existing systems shall be required for the School ECMs.

Retro-commissioning of existing systems and commissioning of new systems shall be performed for all HVAC, domestic hot water (DHW), interior lighting, exterior lighting, renewable energy, and cooking equipment on site. To perform these tasks, the GC shall hire an independent, third party Commissioning Agent (CxA), with selection approval by the Government. The Scope of Work of the CxA shall generally be in compliance with American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Guide 1-1996.

Commissioning will be required during the Construction Documents phase to ensure proper design as well as the Construction Administration phase. The services required during each phase are outlined below.

3.4.1.1 Construction documents services

The CxA shall begin work on the project when the construction documents reach 95% completion and work shall include the following responsibilities. The percent completion shall be determined at the sole discretion of the Government.

- Review 95% construction documents and submit comments.
- Develop a draft construction phase commissioning plan.
- Coordinate a controls integration meeting where the electrical and mechanical engineers and the CxA discuss integration issues between equipment, systems and disciplines to ensure that integration issues and responsibilities are clearly described in the specifications.
- Develop full commissioning specifications for all commissioned equipment and systems. Coordinate with and integrate into the specifications produced by the architect and engineers. Anticipate commissioning sections in Divisions 1 (General Requirements), 15 (Mechanical), and 16 (Electrical), plus a standalone commissioning section (typically Div. 17). The following document(s) can be used as a guide for content, rigor and format:
    - The HVAC Commissioning Process, ASHRAE Guideline 1-1996, a copy of the ASHRAE

document can be obtained by contacting ASHRAE at +1-404-636-8400.

- The commissioning specification and the relevant equipment specifications will include a detailed description of the responsibilities of all parties, details of the commissioning process; reporting and documentation requirements, including formats; alerts to coordination issues, deficiency resolution; construction checklist and start-up requirements; the functional testing process; specific functional test requirements, including testing conditions and acceptance criteria for each piece of equipment being commissioned and detailed training requirements for the components and systems.
- Conduct a commissioning specification review meeting with the School, the Ministry and Project Design Team.
- Perform a review of the design, drawings and specifications during the contract document phase prior to issuing the contract documents for construction.

3.4.1.2 Construction phase services

The primary tasks of the CxA will be during the construction phase and include the following responsibilities:

- Coordinate and direct the commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation (web-based data base and electronic submittal collection, operations and maintenance (O&M) manuals and issues resolution in one central system is preferred), clear and regular communications and consultations with all necessary parties, frequently updated timelines and schedules and technical expertise.
- Coordinate the commissioning work and, with the Construction Manager and Contractors, ensure that commissioning activities are being scheduled into the master schedule.
- Plan and conduct commissioning meetings as needed and distribute minutes.

- Request and review additional information required to perform commissioning tasks, including O&M materials, contractor start-up and checkout procedures. Before start-up, gather and review the current control sequences and interlocks and work with contractors and design engineers until sufficient clarity has been obtained, in writing, to be able to write detailed testing procedures.
- Review start-up and initial systems checkout plans developed by contractors for selected equipment and systems.
- As necessary, observe component and system installations.
- Review construction meeting minutes for revisions/substitutions related to the commissioning process. Assist in resolving any discrepancies.
- Witness HVAC piping pressure test and flushing, sufficient to be confident that proper procedures were followed. Include testing documentation in the Commissioning Record.
- Witness any ductwork testing and cleaning sufficient to be confident that proper procedures were followed. Include documentation in the Commissioning Record.
- Document start-up and start-up checkout plans completion by reviewing completed construction checklists and by selected site observation.
- Approve air and water systems balancing by spot testing and by reviewing completed reports and by selected site observation.
- With necessary assistance and review from installing contractors, write the functional performance test procedures for equipment and systems. This will include manual functional testing, energy management control system trending and may include stand-alone data-logger monitoring. Submit to Construction Manager (CM) for review and approval if required.
- Analyse functional performance trend logs and monitoring data to verify performance.
- Coordinate, witness, and document manual functional performance tests performed by installing contractors. Coordinate retesting as necessary.
- Review of the as built drawings produced by the contractors
- Maintain a master issues log and a separate record of functional testing (web-based is preferred). Report all issues as they occur directly to the Facilities Manager.
- Oversee and approve the training of the O&M personnel.
- Review and approve the preparation of the O&M manuals for commissioned equipment.
- Compile a Commissioning Record, which shall include:

  - A brief summary report that includes a list of participants and roles, brief building description, overview of commissioning and testing scope, and a general description of testing and verification methods. For each piece of commissioned equipment, the report should contain the disposition of the CxA regarding the adequacy of the equipment, documentation and training meeting the contract documents in the following areas:

    - Equipment meeting the equipment specifications;
    - Equipment installation;
    - Functional performance and efficiency;
    - Equipment documentation; and
    - Operator training.

  - A list of all outstanding non-compliance items shall be specifically listed. Each non-compliance issue shall be referenced to the specific functional test, inspection, trend log, etc. where the deficiency is documented.

- Recommendations for improvement to equipment or operations, future actions, commissioning process changes, etc. shall also be listed.

- Also included in the Commissioning Record shall be the issues log, commissioning plan, progress reports, submittal and O&M manual reviews, training record, test schedules, construction checklists, start-up reports, functional tests, and trend log analysis.
- Develop a Systems Energy and Management Manual
- Generate the final operating procedures for the building systems or components as agreed during the preliminary design process. Earlier drafts of these procedures shall be generated such that they can be used in the training program.

This proposed service will be evaluated based on the following evaluation criteria (see Section 5):

- Company experience and expertise
- Price

3.5 Mechanical requirements

All components, structures, hardware, conduits, wire management, enclosures, shade structures and the like shall be protected from corrosion due to known or expected atmospheric conditions local to the project area. Consideration shall be given to humidity, salinity, acidity, condensation, air particulates, or other conditions likely to cause or accelerate corrosion of materials.

Contact of dissimilar metals and finishes shall be avoided or intentionally managed to prevent premature galvanic corrosion.

Aluminium shall not be in direct contact with concrete or copper.

Areas of exposed ferrous metals (i.e., cuts, field welds, butt ends, and similar) shall be aggressively treated with multiple applications of an appropriate corrosion protection coating.

Mechanical wire and cable management shall be provided to prevent all opportunities for strain, abrasion, disconnection, accidental grounding, and similar avoidable hazards. Mechanical wire management components shall be rated for long-term sunlight exposure.

3.6 Disconnects

Disconnects shall be listed to the appropriate UL standard for the application.

Disconnects shall be provided at locations required by the NEC (or approved equivalent).

3.7 Design and applicable codes

The GC shall be fully responsible for the sufficiency of the work. The GC shall be responsible for the complete design as well as code compliance.

At a minimum, fifty percent (50%), ninety five percent (95%), issue-for-construction (IFC), and as-built design documents shall be prepared by the GC and submitted to the Government for approval.

- 50% design documents shall be provided as a single comprehensive submittal. To the extent possible, all PDFs shall be combined into a single file. These documents shall include (at minimum):
    - Design basis
    - Electrical package
    - Mechanical package
    - Structural package
    - Civil package
- 95% design documents shall represent a nearly complete design package for final approvals prior to being issued for permit approval. These documents shall be provided as a single comprehensive submittal. 95% design documents shall include (at minimum):
    - An updated version of the 50% design documents with revisions and additional detail where applicable;
    - Equipment ratings for all power systems equipment, bus work, enclosures, protective devices, etc.; and
    - All detailed information required to obtain all necessary construction permits from the authority having jurisdiction (AHJ).
- IFC design documents shall be intended to provide all required information for subcontractors to construct the Project. IFC design documents shall be provided as a single comprehensive submittal. IFC design documents shall include, at minimum, complete and fully detailed submittals (all applicable drawings and calculations) for the following:
    - An updated version of the 95% design documents with revisions and additional detail where applicable.
    - All completed test results such as pile uplift and lateral resistance testing
    - Any responses/comments from the AHJ
- As-built design documents shall be intended to reflect design changes after the release of the IFC design documents and to document the design of the as-constructed facility.

All designs shall be in accordance with all applicable laws, standards, permits, and electrical industry practices. Any departure from the referenced codes shall be fully described and submitted for the Government's review.

The designs shall meet or exceed the minimum requirements of the applicable sections of the most recent following codes and standards (or approved equal) in effect at the time of the agreement:

- American National Standards Institute (ANSI).
- American Society of Mechanical Engineers (ASME) Performance Test Guidelines.
- American Society for Testing and Materials (ASTM).
- Local Building Codes.
- Local Utility Guidelines.
- Institute of Electrical and Electronic Engineers (IEEE).
- Insulated Cable Engineers Association (ICEA).
- International Building Code (IBC).
- International Electro-technical Commission (IEC).
- National Board of Fire Underwriters (NBFU).
- National Institute of Standards and Technology (NIST).
- National Electrical Code NFPA-70 (NEC).

- National Electrical Manufacturers Association (NEMA).
- National Electrical Safety Code (NESC).
- National Fire Protection Association (NFPA).
- InterNational Electrical Testing Association (NETA).
- Research Council for Structural Connections (RCSC).
- Underwriters' Laboratories (UL).
- Uniform Building Code (UBC).

3.8 Warranties and guarantees

Upon award notification and prior to execution of the final engineer/procure/construct (EPC) contract between the GC and Government, the Bidder shall prepare and submit to Government for review/approval a comprehensive Warranties and Guarantees document (WGD). The approved WGD shall be included as an exhibit to the EPC contract. At a minimum, the WGD shall include warranties and guarantees for materials, workmanship, and long-term performance of all major components of the systems, including, but not limited to:

- Solar panels (20 years minimum)
- Inverters (10 years minimum)
- Mounts and hardware (10 years minimum)
- Lighting controls (5 years minimum)

3.9 Technical support and training

Upon award notification and prior to execution of the final contracts between the selected Bidder and Government, the Bidder shall prepare and submit to the Government for review/approval a comprehensive Operations and Maintenance Plan (OMP). The approved OMP shall be included as an exhibit to the supply contract. At a minimum, the OMP shall include the following:

- Number of staff typically required to perform O&M activities and schedule of activities.
- Quantities and description of spare parts required and whether the parts are included in the cost proposal.
- Quantities and descriptions of special tools required and whether the tools are included in the cost proposal.

4 PROPOSAL DELIVERABLES

This section outlines the requirements for the Proposal submission. Bidders are requested to use a folder structure aligned with the following subsections and sort the bid reference documentation accordingly.

4.1 Binding offer

Bidders shall include a cover letter signed by a duly authorized representative of their respective company. The letter shall clearly identify the company and its contact person for future communications regarding their proposal.

4.2 Confidential information

During the term of this RFP, Bidder may receive or have access to data and information that is confidential and proprietary to the Government, BPL, DNV GL or CWR (the Parties). All such data and information (Confidential Information" made available to, disclosed to, or otherwise made known to Bidder about this RFP shall be considered the sole property of the Parties. Confidential Information may be used by Bidder only for the purposes of performing the obligations of the Bidder hereunder. Bidder shall not disclose Confidential Information to any third party without the prior written consent of the Parties. Bidder shall not use or duplicate any proprietary information belonging to or supplied by the Parties except as authorized by the Parties. These obligations of confidentiality and non-disclosure shall remain in effect for a period of five years following the expiration or earlier termination of this RFP. The Bidder agrees that this RFP and any response and discussion related thereto shall be considered Confidential Information.

4.3 Prequalification form

Bidder shall provide a statement of qualifications (SoQ) which includes the following information, at minimum:

a) Company overview/description
b) 2016/2017 revenues (whole company and renewables)
c) Number of solar projects/MW installed – Caribbean
d) Number of solar projects/MW installed – Outside Caribbean
e) Number of solar projects/MW currently under construction
f) Number of similar building/mechanical projects installed – Caribbean
g) Number of similar building/mechanical projects installed – Outside Caribbean
h) Number of similar building/mechanical projects currently in construction
i) Project references
j) Years in operation – Caribbean (whole company and renewables)
k) Years in operation – Outside Caribbean (whole company and renewables)
l) Size of solar/renewables team
m) Size of mechanical team
n) Safety plan/safety record
o) Quality plan/quality record
p) Sample project organization chart
q) Description of O&M services capabilities
r) Any legal issues or ongoing litigation

4.4 Technical information

Bidders shall provide the following technical information with their proposal (at a minimum):

- Specification sheets for all proposed components including, but not limited to:
  - Solar PV panels
  - Inverters

- Vacancy sensors
- Programmable thermostats
- Lighting replacements

- UL listing from the manufacturer for all proposed components (if not included in the specification sheets).
- System/component warranty and guarantee information.

4.5 Project summary execution plan

Bidder shall provide a Project Summary Execution Plan for the full scope of services to be provided, including but not limited to the following:

- Organizational chart with roles and responsibilities. This chart shall show lines of authority and responsibility. Number of personnel to be utilized on the job shall be indicated in appropriate organizational elements. If significant changes in the organization are expected to occur during the life of the Project or phases of construction, these shall be described.
- Key personnel with resumes.
- Major subcontractors.
- Construction workforce, number of crew, vehicles, and equipment.
- Basic construction sequence description.
- Overall Project schedule with key design, EPC, and commissioning milestones.
- Typical start-up plans.
- Conceptual site layout. The conceptual site layout should include consideration for all Project requirements.
- Conceptual single-line diagram for proposed solar power systems.
- Estimated energy production for proposed solar power systems (i.e., output file(s) demonstrating estimated annual kWh).
- Specification sheets for major equipment.
- Equipment warranties.
- Security plan.
- Safety plan.
- Environmental compliance plan.
- Quality control and assurance plan.
- Project management plan.

4.6 Schedule of pricing

Itemized Schedule of Pricing forms shall be submitted as part of the proposal, consistent with the format provided in Exhibit B. The approved/executed Schedule of Pricing forms shall also be included as an exhibit to the contract.

Additional options being offered by the Bidder should be included where relevant, clearly identified as such. Pricing assumptions, exclusions, or limitations should be clearly identified where relevant. All prices shall be valid for a period of 90 days or greater as detailed in the binding offer letter.

4.7 Employment practices

Bidders shall provide a comprehensive description of the employment practices of their business and how they comply with applicable labour laws.

4.8 Form of contract

The form of contract agreement to be used between the Government and Bidder is currently under preparation and will be provided to Bidders via Addendum.

Bidder shall provide a red-line to the agreement and to any exhibits which the Bidder wishes to modify. Bidder is encouraged to provide a brief term sheet summarizing any changes made to the agreement and/or exhibits.

Bids shall be priced to include, and will be expected to comply with, the requirements in all the Project contracts, agreements, and documentation included herein and attached hereto. This includes but is not limited to: permits, product manuals, and any un-modified terms to the agreement and associated exhibits, and the Q&A log.

4.9 Credit worthiness

To evaluate credit-worthiness, the Bidder shall provide an annual financial statement for the most recent fiscal year, the current quarterly financial statements with a Banking Reference and the most recent audited financial statements of the Company.

4.10 Conflicts of interest

The Bidder shall disclose any known or potential conflicts of interest.

4.11 Key project risks

The Bidder shall identify key risks that may impact the project and propose measures to mitigate said risks.

4.12 Proposal checklist

The Bidder shall provide a completed checklist of the proposal deliverables. The checklist is provided in Exhibit C.

5 EVALUATION CRITERIA AND SELECTION PROCESS

5.1 Proposal selection process

All proposals will be reviewed to determine whether they are responsive or non-responsive to the requisites of this RFP. Proposals that are determined to be non-responsive will be rejected. The remaining proposals will be evaluated and rated based on the evaluation criteria prescribed below. The Government reserves the right to conduct site visits and/or interviews and/or to request that Bidders make presentations and/or demonstrations, as appropriate. Bidders may be requested to clarify the contents of their Proposal. Other than as provided, no Bidder will be allowed to alter its Proposal or add new information after the Proposal due date.

5.2 Interviews

In the process of evaluating the responses, presentations or interviews may be required by teleconference. Scheduling of any such interviews will be performed at the discretion of the Government. A minimum notice of three (3) business days will be given.

5.3 Notice of award

Upon conclusion of the evaluation process and any subsequent negotiations, all Bidders will be notified of the outcome.

5.4 Evaluation criteria

Proposals will be evaluated on the criteria noted in the evaluation criteria table below and noted throughout the technical description.

Table 5-1 Evaluation criteria

COMPANY 15%	PROJECT COST 50%
• Prequalification form • Relevant experience and references • Financial stability and credit worthiness • Organizational effectiveness • Safety record	• Schedule of pricing • Level of detail provided • Cost risk assessment and contingency planning
PROJECT PROPOSAL 30 %	**EMPLOYMENT PRACTICES 5%**
• Bid quality and completeness • Contract terms and conditions • Demonstration of understanding of scope based on submitted documents • Technical information and specifications of products/materials proposed • Project risks and mitigation measures	• Bahamian[1] labour inclusion • Positive labour relationship

[1] Government to determine the quantitative and qualitative measures for this sub-category

EXHIBIT A – ANATOL RODGERS HIGH SCHOOL ENERGY AUDIT

Energy Performance Assessment
(ASHRAE Level-I Audit)

Prepared for

Anatol Rodgers High School

August 11, 2014

AzimuthEnergy.net

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EXECUTIVE SUMMARY

Azimuth Energy prepared this abbreviated Energy Performance Report and Solar Site Assessment to enable the project team to identify opportunities to improve energy performance through energy efficiency and solar energy projects. A description of the program is provided in the BACKGROUND section that follows.

The renewable energy projects will focus on solar-photovoltaic (PV) for generation of electricity as well as solar-thermal for production of hot water, where deemed beneficial. Depending on site conditions, these assessments also might recommend the Owner consider small wind turbines or ground-source heating/cooling.

This facility is a good candidate for a solar-PV system installation. The combination of electricity prices, available sunlight, and policy/incentives makes this project viable and favourable. The solar energy project identified by this analysis has been analysed to a preliminary level so that initial cost and long-term performance can be evaluated.

Based on the utility bills for the last 12 months, the electricity rate for this facility is approximately $0.42/kWh. That is the fully burdened rate that includes fuel surcharges and other variable, usage-related fees. This rate is expected to increase by 3% per year. Although under the 2018 Amendments to the EA the basic rate is fixed for the next three years; price volatility can occur due to fluctuations in the fuel charge.

The client expressed a goal of offsetting 100% of the electricity usage with renewable energy combined with energy efficiency measures. We are recommending a phased approach to achieve this goal. The Phase-1 PV System outlined in this report delivers electricity at a cost of approximately $0.12/kWh; a rate that will stay constant for the service life of the system.

The roof of the building could support a solar-PV array of approximately 250 kW. This would produce approximately 370,000 kWh/year, which is approximately 37% of the annual energy usage for the facility. Follow-up phases consisting of ground-mount and canopy arrays, could increase the total system size to 680 kW, producing approximately 1,000,000 kWh/year.

There are some missing data that will require analysis prior to starting a project, but those are normally considered part of the engineering phase. This includes a structural engineering evaluation to ensure the building structure can support the installed equipment under the required wind regime.

The Energy Efficiency Measures (EEMs) identified through this audit are conceptual, due to the nature of the audit. The most viable opportunity lies in one or more lighting upgrades. These include:

- Interior lighting fixtures, lamps, and controls
- Exterior lighting fixtures and lamps.

In addition to these upgrade opportunities, there are no- and low-cost measures and operational changes that can save energy with no significant investment of capital or expense dollars. These apply to:

- Lighting usage.
- Ventilation usage.
- Water usage.

Further analysis can range from simple spreadsheet calculations (for a lighting upgrade) or advanced computer modelling (for HVAC or building envelope improvements). From those exercises, the implementation budget would be based on local construction costs; the changes to energy consumption would be based on the analysis; and the expense savings would be based on the utility tariffs and usage statistics.

It should be noted that energy upgrade decisions aren't always made on financial performance alone. In addition to the financial statistics, we recommend evaluating the EEMs based on additional criteria, such as public & staff visibility; occupant comfort; serviceability; life safety / code / regulatory; executive priority; environmental benefit; and marketing / PR value.

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The results of this financial and non-financial evaluation taken together can form the basis for energy-investment guidance and decision making. We recommend the various decision makers and stakeholders agree on the criteria and their relative importance, and then rank the proposed EEMs. That will result in a prioritized list that fits the Owner's overall organizational goals and can support both short-term and long-term capital planning efforts.

Project finance may be a key part of this program. Efficiency and renewable energy projects may have outstanding financial performance, but if the owner cannot manage the first cost of construction, the project cannot be undertaken. By utilizing third-party finance options, project partners can assist in getting projects completed so the owner can realize the range of operational improvements. It also may be possible to establish a program with the local utility to finance and own the PV systems on this building and elsewhere in their service territory.

BACKGROUND

The goals of this program are to reduce energy usage, utility expenses, and time and effort required for operating and maintaining systems. The measures should meet these criteria.

- The financial performance should be compared against the underlying business' Internal Rate of Return (IRR) and the cost of borrowing money for company operations, ensuring the financial outcome is a benefit to the organization.
- Reduction of utility electricity consumption has a 3-4 times impact on source fuel reduction, magnifying the benefit of the projects. In other words, if we reduce 100 kWh of energy at the building, that means 300-400 kWh of source fuel need not be burned to supply the load.
- Projects that improve lighting and ventilation result in proven improvements in working conditions, health, morale, and productivity.
- This work delivers marketing benefits and promotes environmental leadership.
- Provide opportunities to develop outreach and education programs for building occupants, visitors, and staff.

The audit process followed for this project included an analysis of utility data and a site assessment. The ASHRAE standards for a Level-1 walkthrough audit are to identify no- and low-cost EEMs and other measures that might require greater study and analysis. In addition, a major focus of this project is to define a feasible and readily developed solar energy project.

In general, there is a wide range of projects that can be implemented to achieve improved energy performance. These include constructed improvements as well as changes to the way the building is operated. Figure 1 can be used as a guide to illuminate the potential investment required for a range of performance improvements.

This shows a conceptual energy reduction strategy and potential costs for those improvements. By way of interpretation, achieving a 10% energy cost reduction probably will require an investment on the order of $1 per square foot. The greater the reduction targeted, the higher the level of investment and the more the reliance on renewable energy technologies.

There usually are five types of building systems addressed by an audit: Lighting; Heating Ventilation Air Conditioning (HVAC); Water Heating; Plug and Process Loads (business equipment plugged into an outlet or equipment used for manufacturing or industrial process); and Building Envelope.

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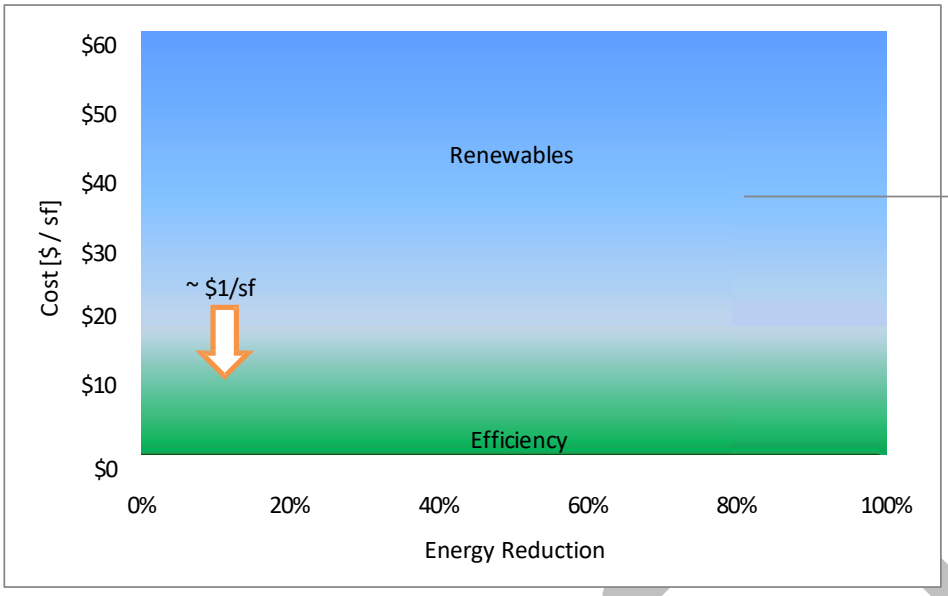

Figure 1: Potential Energy Reduction Target Costs

For any of these systems, the EEMs usually will be a mix of no- or low-cost measures (either operational changes or very simple upgrades/alterations), lighting and other upgrades that are straightforward to analyse and implement with relatively short payback, and more analytical and complex upgrades to HVAC or other systems that require detailed engineering and financial/technical modelling.

The most common EEMs pursued to achieve a 10% reduction in energy consumption are lighting upgrades and operational changes. These require the lowest level of analysis and a favourable return on investment.

RENEWABLE ENERGY OPPORTUNITIES – PV SYSTEMS

The objective of this part of the project is to identify "distributed generation" renewable energy opportunities for the facility. This includes assessing what technologies might be deployed, what energy generation potential is possible, how that would benefit the energy cost and performance for the facility, the benefits to the environment, and a picture of the project financials. In addition, it is important to understand the interconnection and tariff policy for the utility.

"Distributed Generation" refers to generating energy at the point of end use rather than at a central utility plant. These typically take the form of electricity or useable heat, through solar-thermal or heat recovery.

Distributed Generation can have a significant impact on the useable work done by an energy source. First, there are no losses from burning fossil fuels – in a utility plant, that is about 65% of the fuel energy lost "up in smoke". Then, there are no losses in transmission – another 3% typically. That means Distributed Generation avoids the loss of about 68% of the fuel energy by locating the electricity production source at the point of end use.

Combining distributed generation renewables with energy efficiency results in an even greater improvement in end-use energy effectiveness. By reducing the "building losses", by 10-20%, a combined renewables and efficiency strategy can reduce the "source energy" usage by 70% or more. That translates directly into reduction in greenhouse gasses, reduction in fossil fuel consumption, and lessening of related environmental impacts.

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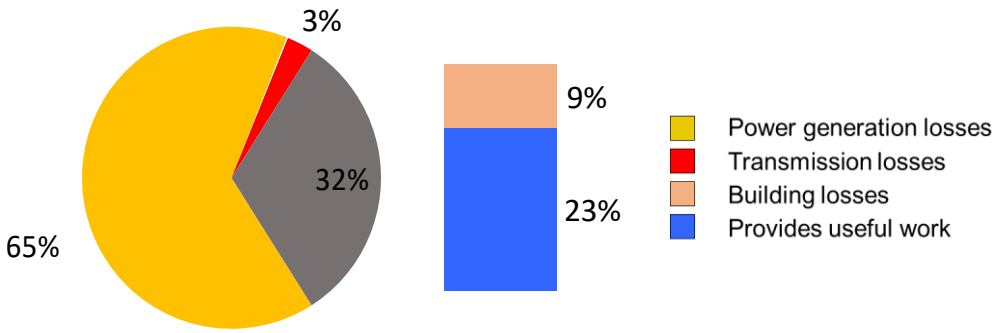
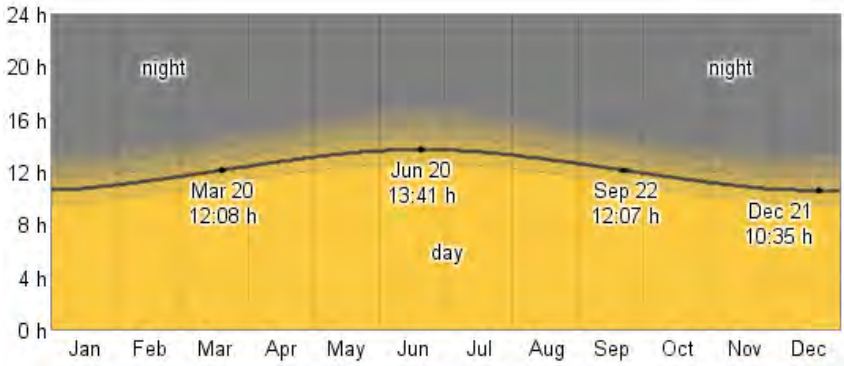


NATIONAL & LOCAL BACKGROUND

The project site is in Nassau on New Providence Island in the Bahamas, an archipelago of hundreds of islands stretching over 500 miles in the northern Caribbean Basin. There are two utilities in the Bahamas, although the primary company, the Bahamas Power and Light (BPL) Company serves all New Providence and the Family Islands.

Solar Resource

The solar resource on New Providence and all The Bahamas is fairly consistent throughout the year. The hours of daylight range from about 10 ½ hours/day on the winter solstice to 13 ½ hours/day on the summer solstice [1]. Overall these conditions result in a "yield" like the Florida Cays and much of the Caribbean. Yield is the energy production per unit of power capacity [2]. For an array with an azimuth (the direction it is pointed) of 180°, the yield in the Bahamas is approximately 1,500 kWh/kW. That means a 100kW PV system should produce about 150,000 kWh/year. Varying away from a south azimuth, the yield for a southeast or southwest azimuth are both approximately 1,460 kWh/kW.



The sun path is important to the feasibility of different solar array installation options. The sun path varies with latitude. At this latitude, the sun is south of east for about 80% of the prime sun energy window of 9am to 3pm. That is defined by the heavy black dashed line on the Sun Path Chart, below. That means solar panels will produce the most energy with an azimuth as close to south as possible, but they still will produce abundant electricity when pointed north of east.

In the Bahamas, the optimal tilt angle for maximum annual solar production is 25°; the same as the locale latitude. Achieving that tilt angle is practical for either a ground mounted array or for a roof array if the roof has that same slope (corresponding to a 5:12 to 6:12 roof pitch).

However, a 25° tilt is not a practical tilt for a solar parking structure or canopy, because the height above the ground would be significantly different from the low side to the high side. For a parking structure or canopy, due to the wind, aesthetics, and ground clearance underneath, it is usually a better engineering compromise to use an array tilt of 5° to 15°. In this hurricane zone, we recommend that any roof mount be constructed parallel to the roof surface and not tilted or canted to a different plane.

Installation	Tilt
Flat roof	5° to 10°
Pitched roof	Same as the roof surface
Ground mount	15° to 25°
Canopy	5° to 10°

[1] Graph from WeatherSpark.com, statistics based on interval from 1974 to 2012.

[2] Note the difference between "power" and "energy". Power is like the speedometer of a car, and energy is like the odometer. Energy or work is the application of power over a certain period. Also, a solar array with the same power rating (in kW) will produce a different amount of energy (in kWh) depending on site conditions and location on the earth.

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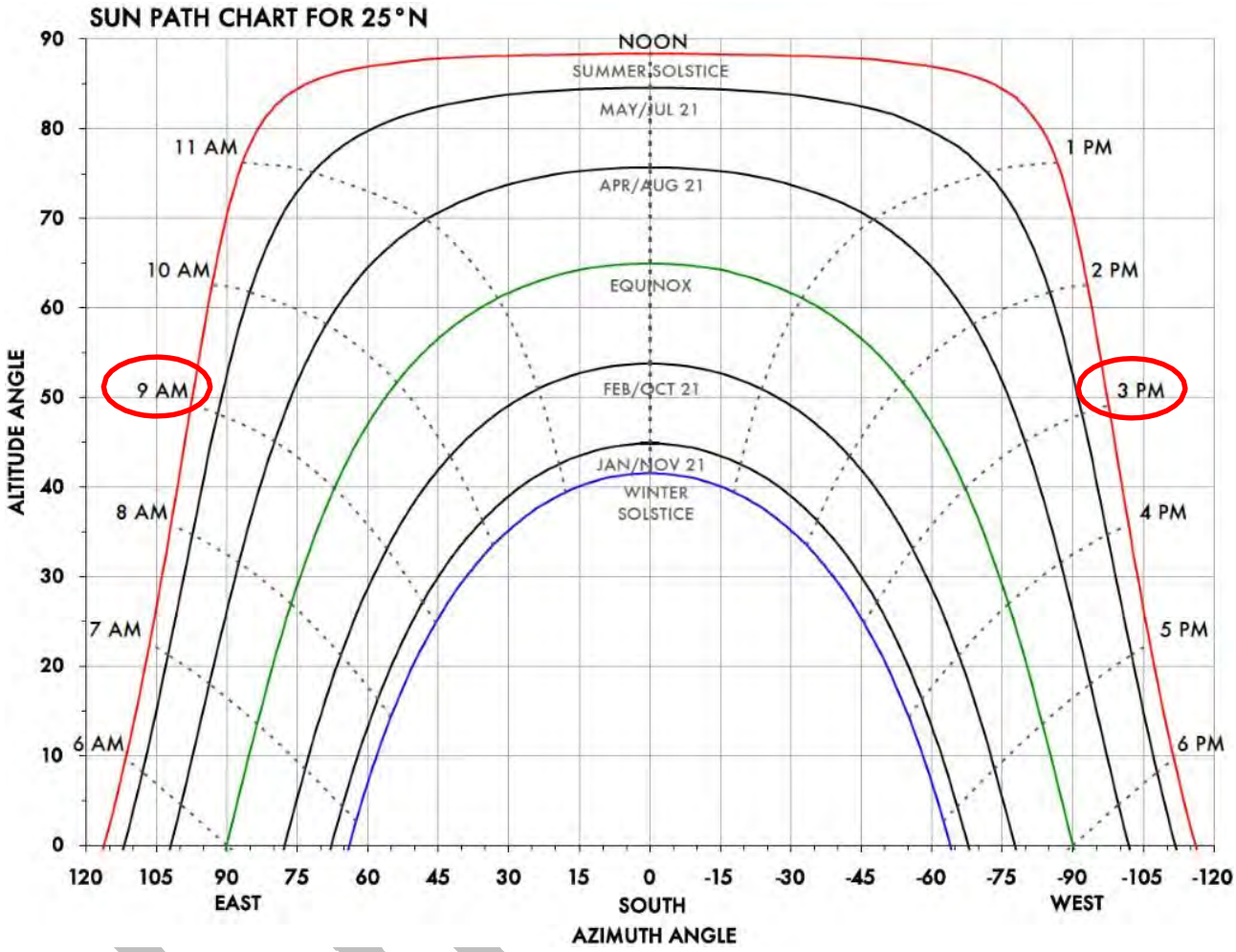
Panel manufacturers recommend that panels not be installed with a flat tilt. In some cases, that will void the panel warranty, but in all cases, it will result in panels that get soiled faster and lose power capacity due to the accumulated dust, sand, and other particles. Even a tilt of 2° to 3° will provide for water drainage and better performance.



Interconnection Policy & Billing

There are several steps to take to enable the use of renewable energy in a market served by a public or private utility.

- ✓ Permission to interconnect and operate in parallel with the utility, based on interconnection standards and safety protocols.

  Permission to feed excess electricity back to the utility distribution system.

  Provisions to be reimbursed by the utility for the excess electricity at their avoided cost, or wholesale rate (termed "net billing").

  Provisions to be reimbursed by the utility for the excess electricity at their retail rate (termed "net metering").

Presently Bahamian law is interpreted to allow interconnection of solar energy systems to the Bahamas Power and Light (BPL) Company grid. However, BPL does not allow the customer-generator to feed electricity back to the BPL grid.

There are exceptions to this position for various BPL customers on New Providence Island as well as some of the Family Islands. Growth of a renewable energy market in the Bahamas will require adoption of at least the first two bullets or more.

Other Local Considerations

WIND RATING

The Bahamas is in the hurricane region of the Caribbean. Thus, the design wind speed is 150 mph; sufficient to withstand a Category-3 hurricane. This precludes using a ballasted racking system, whether on a building roof or the ground (one that relies on the weight of the system plus concrete blocks to hold it in place during a design wind event). That means PV systems will be mechanically attached to the roof structure, and not just the metal or wood sheathing, or anchored in the ground using concrete piers, auger screws, or helix piles.

Additionally, ground mount systems should be designed with two rows of column supports and not only one. That increases the wind resistance and decreases the required foundation strength.

CORROSION

In addition to hurricanes, salt-air corrosion is a significant design factor for this region. This will affect the solar module frames, electrical grounding components, inverters, and racking systems. Our recommendations in this locale are as follows.

- Modules with high grade aluminium frames or no frames (frameless).
- Inverters that are either completely sealed or are installed inside closed buildings that will protect from wind-driven water spray.
- Racking made of aluminium with stainless steel components; if galvanized is necessary, aim for a G-120 galvanizing coating and nothing thinner.

ELECTRICAL & BUILDING CODE

The Bahamas has an electrical code that is silent on many solar design and installation points. The law states that if the code is silent, the Canadian Electrical Code is to control the situation.

The Bahamian and Canadian electrical codes are somewhat absent of adequate provisions for safety of solar-PV systems. Azimuth recommends that the US National Electrical Code be followed for solar-PV projects. That is more stringent than the Bahamian or Canadian code, and will provide a more enduring level of safety and long-term performance viability for PV systems.

PV System Architecture

PV systems in this locale typically are one of three configurations: (1) “grid-interactive”, (2) islanded; or (3) hybrid, meaning capable of grid-interactive or islanding. The difference lies in the ability of the inverters to sense and synchronize with an existing utility voltage curve and frequency. Typically, we recommend a grid-interactive PV system, or possibly a hybrid system, in locations where there is an existing utility service. The difference would lie in the reliability and power quality available from the utility – if the reliability is low and/or the quality poor, a hybrid system might be more favourable.

Architecture	Another source	Storage	Operation without Utility	Comments
Grid-Interactive	Yes	No	No	Another source can be onsite generator
Islanded	No	Yes	Yes	Cannot be connected to grid
Hybrid	No	Yes	Yes	Can connect to grid or generator

A Grid-Interactive system requires another generation system to create the background voltage and frequency, whether that is a utility or a genset installed at the facility. The Islanded and Hybrid systems can create their own voltage and frequency reference, and do not need a utility or generator.

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The energy storage increases the first capital cost for a hybrid or islanded system a significant amount over a grid-interactive system, although the long-term cost of ownership, or "levelized cost of energy", or LCOE, may be lower [3].

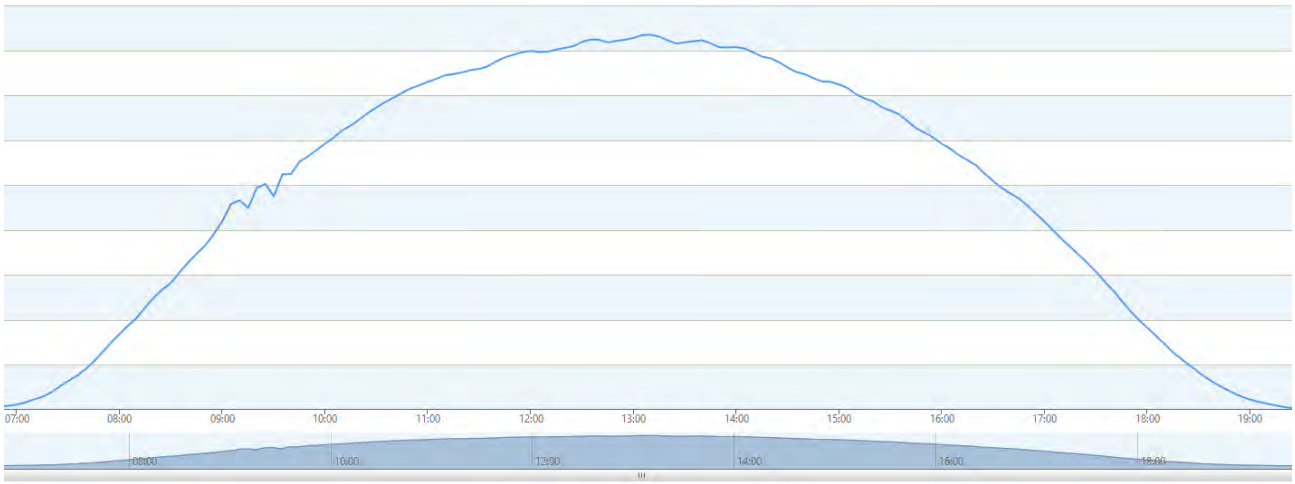
The inverters and controls for all commercially manufactured PV systems abide by standards for safety and performance. The primary standard, IEE-1547 and its associated UL listing, UL-1741, ensure both safety and performance. Any inverter should comply and be listed to UL-1741, and that is usually printed on the product data sheet.

UL-1741 ensures that a PV system will NOT produce electricity when connected to the grid if there is a failure of the grid. Any time the grid voltage or frequency go outside of typical normal ranges, such as when there is a utility outage or damage to local distribution (a car accident or a storm, for instance), the PV electronics will immediately s t o p producing electricity in less than 2 seconds. This is primarily for safety reasons; when there is an outage, the utility line crews will be working to restore service and must be assured there are no customer co-generation systems operating at the same time, possibly energizing the lines they are working to repair. This is the same standard required for stand-alone backup generators that are connected to the grid.

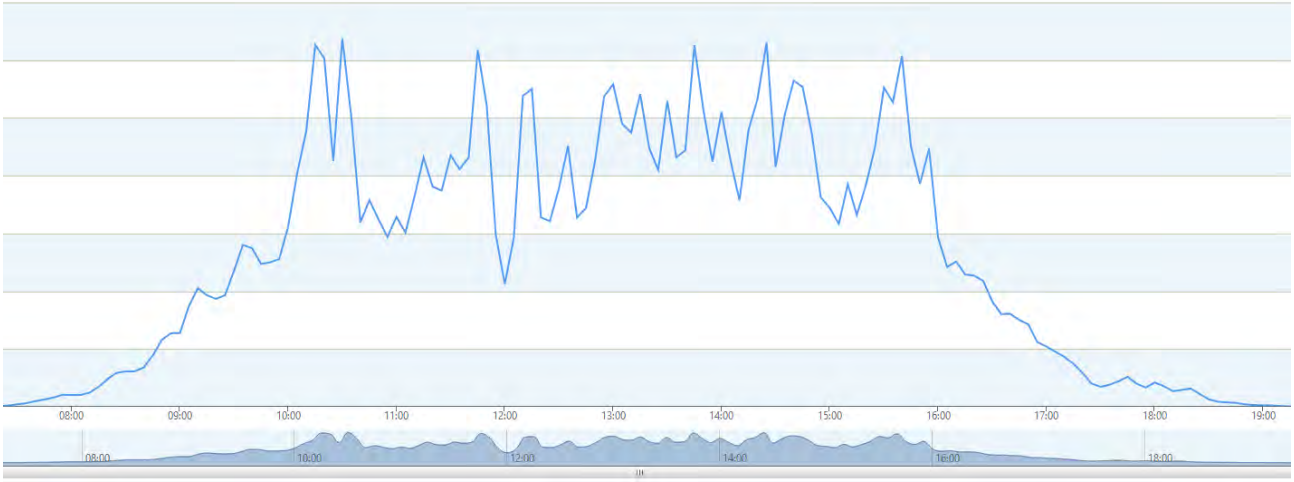
General Solar Production Profile

The electricity production from a PV array corresponds directly to the sunlight, and to a lesser extent, the inverse of temperature. More sun results in more PV electricity, but higher temperatures result in less PV electricity. Below are two curves that both show PV system power production and sunlight versus time of day.

The difference between the curves is cloudiness, and the resulting change in PV power output, termed "intermittency". The clouds also result in voltage fluctuations from the PV system, which is of concern to the utility and important for proper operation of all electrical equipment at the facility.



[3] "Levelized Cost of Energy", or LCOE, is calculated as the net present cost of the system divided by the time-discounted quantity of energy produced during the system's service life.



The analysis provided in the Recommendations, below, are based on two sets of conditions:

- The daily analyses are based on a typical sunny day and peak performance.
- The annual analyses are based on average annual conditions over a long period that represent expected annual performance of the site and the PV system.

SITE-SPECIFIC RECOMMENDATIONS

Based on the background and site conditions, be believe solar-electric, or photovoltaic, "PV" for electricity generation would be a viable and reliable option for the facility [4].

The total annual electricity consumption is estimated at 1,000,000 kWh, based on an estimated floor plan of 50,000 square feet (sf) and a typical energy use intensity of 20 kWh/sf/yr [5]. It is possible to ultimately produce 100% of the electricity demand using onsite PV systems, combined with energy efficiency measures. This would result in significant reduction of utility expenses, making the school more cost efficient and self-sustaining.

For this facility, we recommend a "grid-interactive" system operating in parallel with the BPL grid. The utility distribution is already in place and operational, and our understanding is the reliability is good. A grid-interactive system would be the most cost effective solution with the best performance outcomes.

Given the stated goal of 100% offset, we recommend a phased approach to this program in coordination with accomplishing some of the EEMs in this report [6]. This will serve several objectives.

- ✓ Start with a smaller PV project that is still large enough to achieve pricing economies of scale and be large enough to capture the interest and attention of the public.
- ✓ Keep project investment to the lowest possible unit cost by installing on roof first, then moving to the more complex ground mounts for later phases.

[4] Solar-thermal water heating is not recommended due to the non-continuous nature of demand for hot water in the facility and the overall low demand for hot water. Solar-thermal hot water could be used for space cooling, although with current chiller technology, that is a costly option and not recommended.

[5] See Efficiency and Utility analysis sections, below.

[6] These are based on the US Department of Energy PV-Watts online modelling application and estimated utility bills, respectively.

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- ✓ The first phase roof mount will be easier to estimate and construct, minimizing contingency and risk (and corresponding cost) for the trade labour.
- ✓ A smaller first phase project will be more agreeable to BPL, and pave the way for the later phases that would require more collaboration with BPL.

The phases we recommend for consideration are shown below.

Phase	Description	Azimuth	Capacity	Energy (est)	%-age of Demand
1	Rooftop arrays	SW and SE	256 kW	371,997 kWh	37%
2	Ground-mount north of main building	South	98 kW	146,250 kWh	14%
3	Carport canopies	SW and SE	335 kW	486,880 kWh	48%
		TOTAL	688 kW	1,005,000 kWh	105%

The proposed Phase-1 system would be mounted entirely on the roofs of the school. There would be 8 sub-arrays oriented to the southeast, and 5 oriented to the southwest. These would lengthen the time of day that solar electricity is being used to offset grid electricity, although it results in a 5% reduction in annual energy production.

The layouts shown on the next page are considered the maximum the building roofs could support. This still provides adequate clearance on the roof for fire-fighters to work and provide vertical ventilation for fires, if required. These layouts also observe International Fire Code clearances for rooftop equipment as well as best practice clearance for the pitched roofs.

The roof is 6 years old and in very good condition. Depending on the brand and installation, it should have a 20-year service life. Only one of the pitched roof surfaces has any obstructions, and those are plumbing vents that can be cut and covered or relocated.

Working on the roof would be done using common construction techniques: a scissor lift for moving men and equipment to the roof, and harnesses with hard-point anchors for the men when working on the roof.

Depending on when the work is taking place, equipment could be stored in the northwest shed with the roll-up garage door. Otherwise, if classes are in session or that space is unavailable, a set of portable containers could be used for storage and staging.

Warranty and Service Life

A well-engineered and constructed solar-PV system using high quality equipment is expected to have a service life exceeding 30 years, based on existing track record of older equipment. High quality solar panels have a performance guarantee of 25 years and a workmanship guarantee of 10 years. Inverters (electronics) and racking systems have a 10-year warranty.

There are inverters on the market that are a higher performing technology, called “microinverters”, which provide a 25-year warranty. There are several manufacturers, but Enphase Energy ™ is the industry leader. They are a very well adapted product for the Caribbean market, although they have a cost premium associated with them. This is offset by higher energy harvest, lower maintenance, easier serviceability, better monitoring and other benefits. This equipment selection can be reviewed if the project goes to a further review step.

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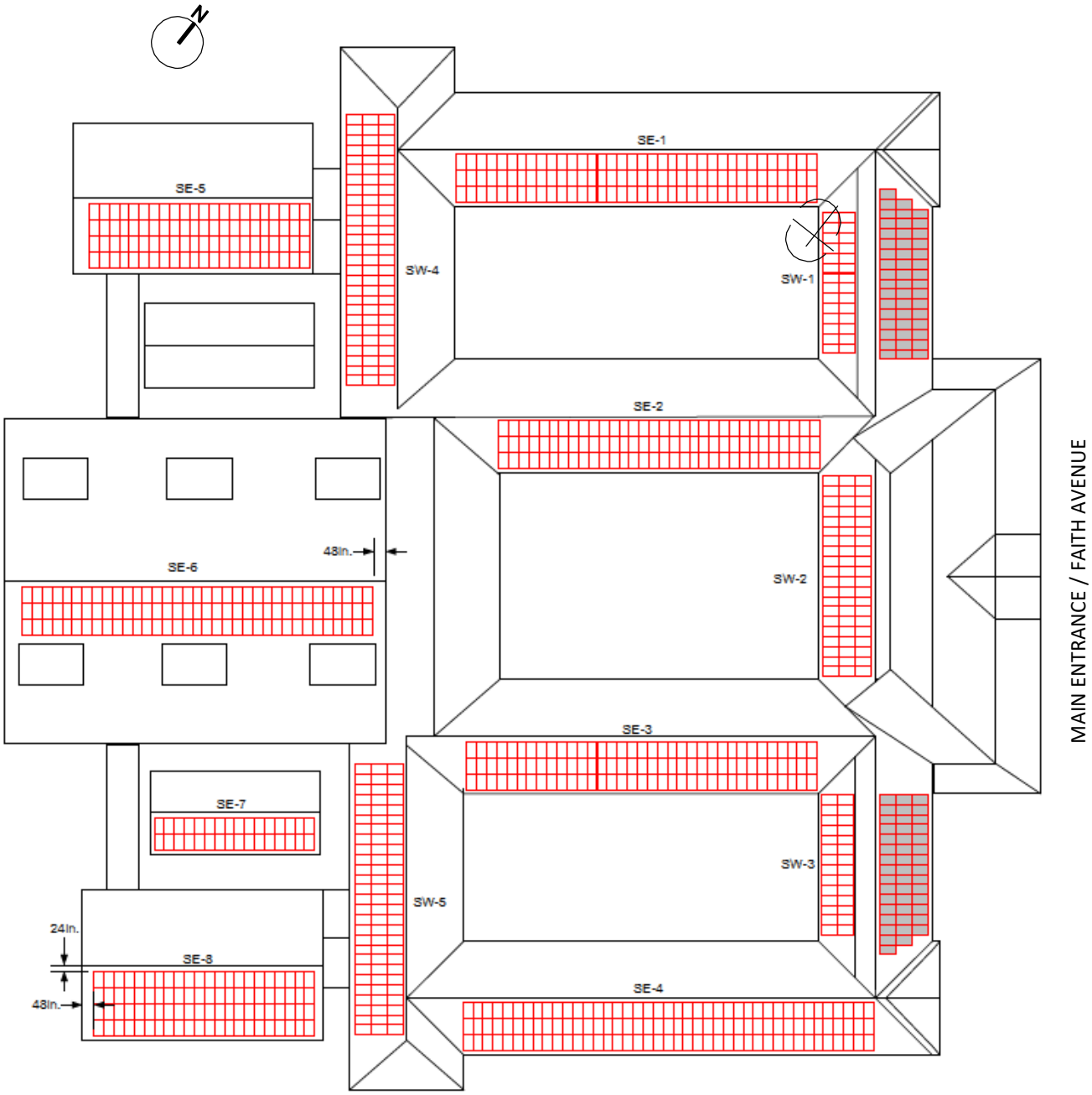
CONCEPTUAL LAYOUT OF ROOFTOP ARRAYS



The grey shaded sub-arrays on the front roof surfaces (right side) are not included in the Phase-1 table or calculations. They are pointed to the northeast and not optimally performing, but are highly visible to the public.

These are discussed later in this section.

TABLE 1
CONCEPTUAL ARRAY DETAILS

Rooftop Arrays

Sub-Array	Module Count L	Module Count W	Total Modules	Power [kW]	Azimuth	Energy [kWh/yr]
SE-1	36	3	108	27	135	39,232
SE-2	32	3	96	24	135	34,872
SE-3	35	3	105	26	135	38,142
SE-4	41	3	123	31	135	44,680
SE-5	22	4	88	22	135	31,966
SE-6	35	3	105	26	135	38,142
SE-7	16	2	32	8	135	11,624
SE-8	22	4	88	22	135	31,966
SW-1	14	2	28	7	225	10,210
SW-2	20	3	60	15	225	21,879
SW-3	14	2	28	7	225	10,210
SW-4	27	3	81	20	225	29,536
SW-5	27	3	81	20	225	29,536
		TOTALS	1,023	256		371,997

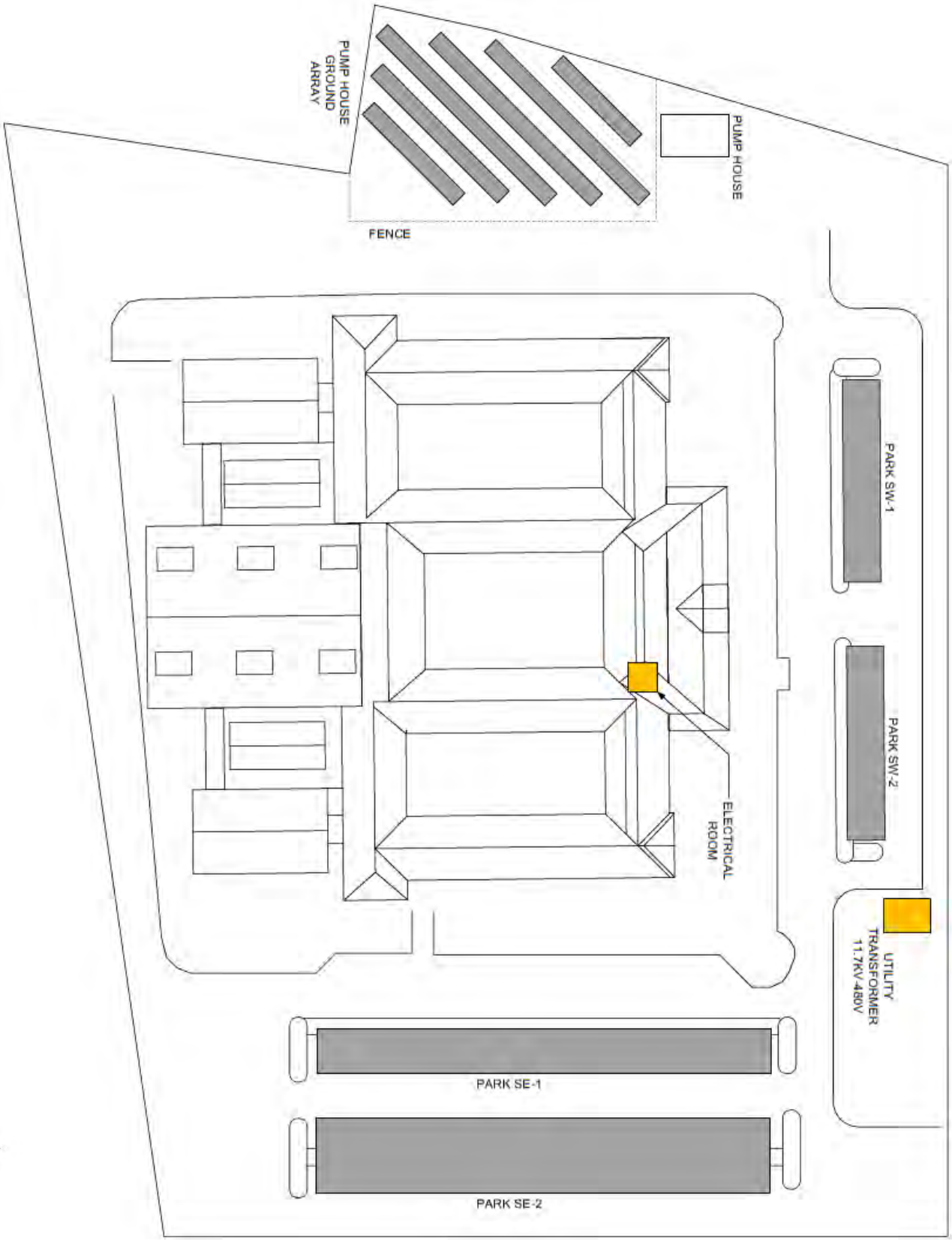
Ground Mounted Arrays

Sub-Array	Module Count L	Module Count W	Total Modules	Power [kW]	Azimuth	Energy [kWh/yr]
Pump House	195	2	390	98	180	146,250
Park SW-1	38	4	150	38	225	54,697
Park SW-2	36	4	144	36	225	52,509
Park SE-1	87	4	349	87	135	126,849
Park SE-2	87	8	696	174	135	252,825
		TOTALS	1,729	432		633,130

Module size		250 W DC STC
Azimuth	Southeast	Southwest
Yield [kWh/kW]	1,453	1,459

TOTAL SITE POWER **688 kW**
TOTAL SITE ENERGY **1,005,127 kWh/yr**

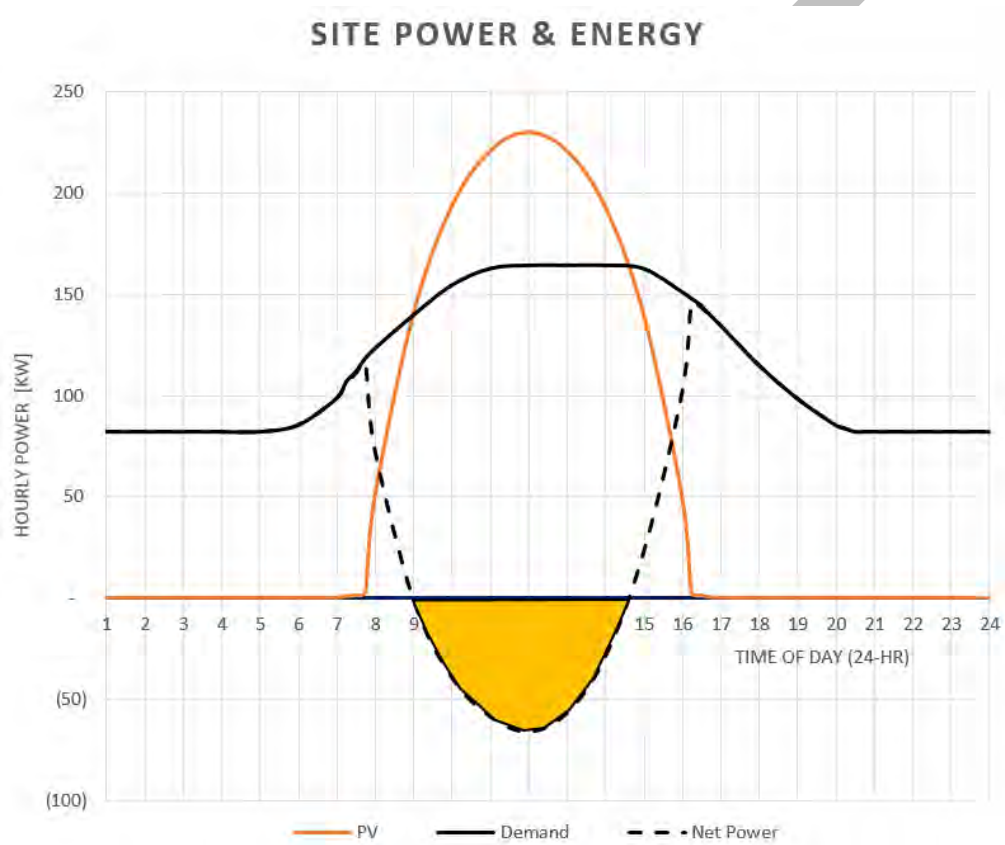
PHASE 2 & 3 – PROPOSED LAYOUTS



Analysis

The graph, below, shows a simplified power performance relationship on a sunny day with the proposed 256kW Phase-1 project operational [7]. The PV system would reduce the utility power used, and as the PV system output increases in the morning, the power used from BPL will be reduced to zero and then start flowing in the opposite direction.

The orange shaded sector shows the excess energy that would be pushed back on to the BPL grid. For this typical day, that totals over 200 kWh. BPL electric meters do not register "reverse rotation", nor do they reimburse in any way for electricity fed back to their grid. So, under current laws and policies, any excess production would be given back to BPL with no compensation.



The total daily PV energy produced will be less than the total energy used during the school day, but because of the timing, there are several hours when the array will produce more than what the school can use.

If the Phase-1 project will over-produce during some hours, clearly these phased systems are expected to produce more than the facility demand on sunny days with school in session. On the weekends, with the power usage r e d u c e d , the PV system will produce even more excess electricity. However, on cloudy days, it is likely the PV system may not meet the power demand. Please refer to the section, above, addressing daily and annual performance expectations.

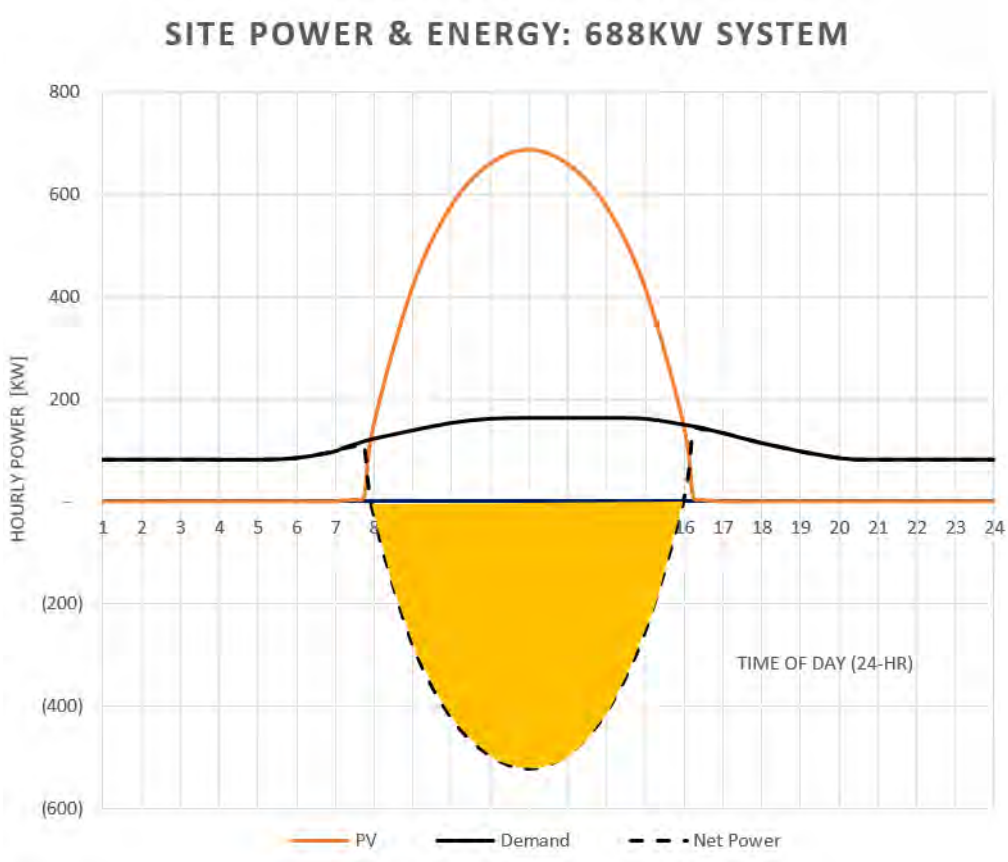
[7] This is for an array with a South azimuth, with one power peak occurring at noon. The Phase-1 project is oriented partly to the southeast and partly to the southwest, so the curve would be more complicated than this graph. For the sake of clarity in the report, this simpler graph is shown. The more complex graph is provided in Appendix

If this over-production condition is undesirable and needs to be avoided due to BPL restrictions, there are several options that can be implemented to avoid it.

1. Reduce the size of the Phase-1 project and do not build any additional capacity until BPL's policies and tariffs are changed. That reduction would take the Phase-1 project down to about 170kW [8].
2. Install an energy management system that curtails inverter output based on the power demand on the utility feeder to the building.
3. Install a battery-based energy storage system that will capture the excess energy for use during the hours when the sun is not shining.
4. Install electric vehicle charging stations that can be used by faculty, staff, students, or others for a small fee, once EVs become prevalent on the island.

Azimuth has considerable experience with options 2, 3, and 4, above. Options 2 or 3 could be explored if desired by the client. They are, however, outside the basic scope of this project.

The simplified graph, below, depicts a 688kW total system size (Phase 3), and the shaded area represents the 2,900 kWh that would be lost every sunny day without either a net billing, net metering, or energy management/storage system. (Note the appearance is like the graph above, but the vertical scale is much different.)



[8] This reduced phase-1 size would be smaller than a full container of panels. A full container is approximately 190kW. However, if this was necessary, the excess could be saved as replacements into the future, or used on another project for the school district at another site.

Installation Details

Here are some images of typical rooftop systems on similar pitched roofs with composite shingle roofing, as proposed for Phase 1 of the program. The installation on this roof would be straightforward and easily waterproofed.

The most important factors are wind resistance and waterproofing. Stainless steel lag bolt anchors into the wood rafters provide the necessary resistance to wind displacement, and engineered flashing kits ensure there will never be a roof leak at one of the flashed penetrations. Conduits running across the roof or penetrating the roof also should use the same flashing kits.

The Phase-1 project as proposed also includes a sub-array on the roof of the gym building. This roof is corrugated metal. Pictures are provided, below, as the waterproofing is different than for a shingle roof. This requires penetrations of the metal decking and attachment to the structural steel members below. In the case of the gym, those screws go into the structural z-purlins.

The picture on the right shows a mounting foot that spans the top of a metal rib. This actual penetration is on top of the rib and is more protected from water and the possibility of leakage. These are the mounting feet we would recommend for the metal roof sub-array.

PHASE 1 – PITCHED ROOF OF SCHOOL BUILDING

PHASE 1 – SHINGLE ROOF FLASHING

PHASE 1 – CORRUGATED METAL ROOF ATTACHMENT

Next are typical ground mount installations, using the dual legged racking systems that perform best for high wind projects. This is as proposed for Phase 2 of the program. This would require trenching from the array to the electrical point of connection.

A ground-mount array would require a perimeter fence, at least 8' high, for isolation of the electrical components from the public. This is depicted in the overall site plan, below.

The last set of pictures are for the proposed Phase-3 carports. These are dual function structures, as they provide shelter and shade for vehicles as well as generating electricity. Again, trenching would be required to the point of connection.

Should the District want to do the EEM for parking lot lighting upgrade, this could be combined with the parking structures. The picture below shows LED lighting installed under the solar parking canopy.

PHASE 2 – GROUND MOUNT ARRAY ON NORTH OPEN LAND

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PHASE 3 – CARPORT OPTIONS

An additional option for consideration is to install PV panels on the front roof surfaces. These would be oriented north of east, resulting in about a 14% reduction in electricity production. However, they would be highly visible to the public from Faith Avenue. A rendering of this option is provided, below.

RENDERING OF PV PANELS ON FRONT ROOFS OF THE SCHOOL

ELECTRICAL DETAILS

The utility transformer is in the above-ground shed by the main entrance. From there, the electrical supply goes underground into the school to a 2000A Main Distribution Switchboard (MDS) at 480VAC. There are smaller electrical rooms in the gym, some of the school wings and out buildings.

There are two options for making a 3-phase electrical connection for the proposed PV arrays: a 480V connection in the main electrical room or utility shed, or a 208V connection to a step-down transformer. It also is possible that a combination of the two would be a better fit.

In any case, it will be beneficial to use the same brand of inverter for all sub-arrays. That will enable online monitoring on one manufacturer's platform without additional cost.

Should the full system size proposed be installed, the connection at 480VAC would require capacity of almost 800A. That exceeds the capacity of the MDS, so a supply-side connection would be required to provide the Point of Common Coupling (POCC). The POCC could be either in the main electrical room or the electrical shed on Faith Avenue. It would require intercepting the main power conductors from the utility transformer to the MDS, and landing them on a dual terminal junction box. This work would require a building shutdown for at least half a day, so it would be best done during a holiday period or summer vacation.

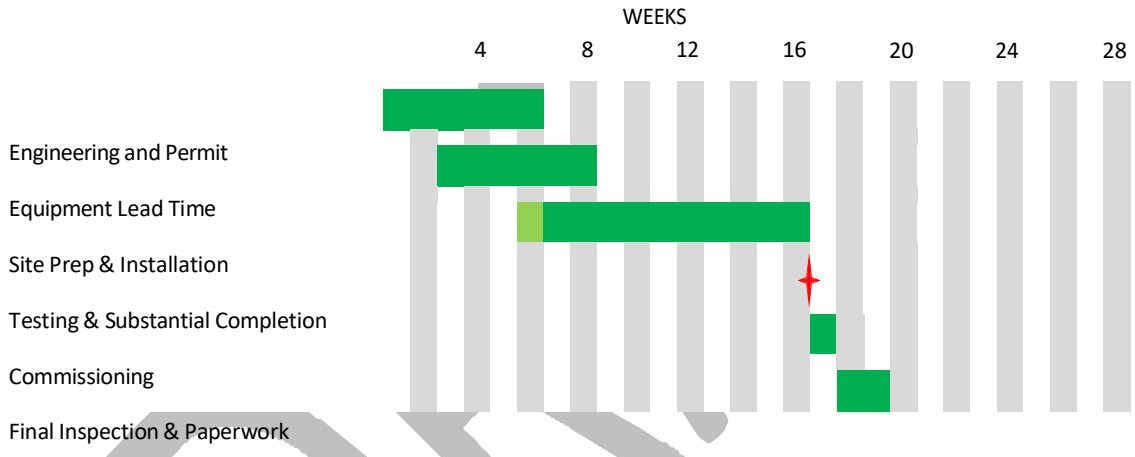
Environmental Benefits

The three conceptual phases would have these combined environmental benefits, using conventional parameters.

Environmental Measure	Phase 1	Phase 2	Phase 3	Total
CO2 emissions reduced annually [lbs]	682,000	272,000	894,000	1,848,000
Lifetime CO2 emissions reduction [tons]	9,534	3,794	12,485	25,813
Gas not burned in cars annually [gal]	30,000	12,000	39,300	81,300
Miles not driven annually	600,000	240,000	786,000	1,626,000
Mature hardwood forest [acres]	341	136	447	924
Urban park area [acres]	852	340	1,117	2,309

Schedule

The Phase-1 project should be able to achieve a substantial completion status in 16 weeks from kick-off.



Potential Educational Programs

This energy program also could incorporate an education, training, and public outreach component. The work will take several months to accomplish, and this could be incorporated into the curriculum in science, engineering, or business classes.

- Curriculum focused on renewable energy and developed by a globally recognized public institution. This program can be integrated into the curriculum of the schools on New Providence or the Family Islands.
- Vocational technical training for local electricians.
- An educational kiosk that can be in the school lobby, highlighting efforts and PV system performance.

ENERGY EFFICIENCY OPPORTUNITIES

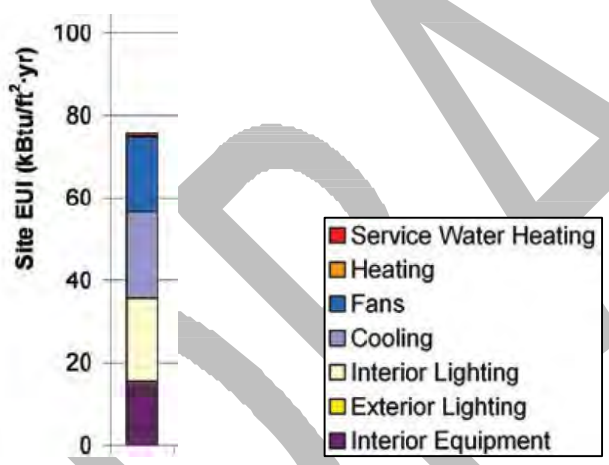
The goal of this part of the scope of work is to identify opportunities to save energy, reduce energy expense, improve reliability, reduce power demand, and reduce maintenance effort. This Level-1 audit aims to identify different types of Energy Efficiency Measures (EEMs).

- No-cost or low-cost that should be done quickly without a major investment of time because they are easily justified.
- Controls and operational changes.
- Capital upgrades that require greater analysis and evaluation prior to decision making.

Azimuth strives to assist the client to turn an audit into a capital planning tool. This is help ensure the audit serves a useful and forward-looking purpose rather than being tabled without action. To achieve this objective, we have included a master planning table in the Appendices, which we will furnish in electronic format upon request. This can be used among the decision makers to track and plan capital expenditure on energy upgrades in the future.

In general, the building systems are fairly straightforward and well designed. The climate does not have a heating season, and the temperature differential between indoor comfort and ambient outside is not a large range. Hence the identified EEMs are mostly limited to lighting, plug loads, and operational changes, with some air conditioning and ventilation opportunities included.

The American Society of Refrigeration and Air Conditioning Engineers (ASHRAE) reports school energy use in this climate zone to be approximately as shown in the figure, below [9].



To paraphrase the graph, most of the energy use is expected to be fans, cooling, interior lighting, and interior equipment (plug loads), with the total annual energy used onsite expected to be approximately 22 kWh/sf/year. The potential EEMs recommended for consideration are summarized below.

No- / Low-Cost Measures

These include operational changes; that would have an immediate payback.

- Lamp wattage reduction and delamping.

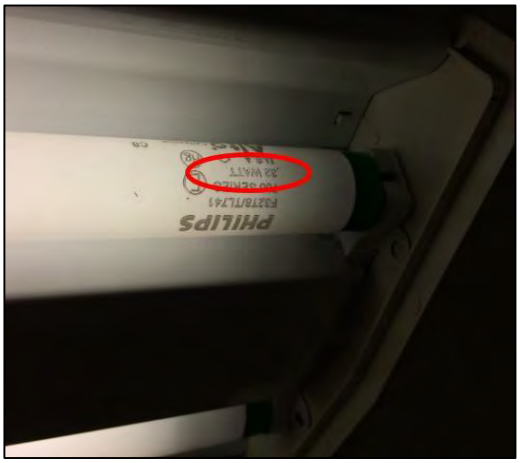
  The ceiling fixtures are all fitted with 32W T8 fluorescent lamps. These result in a higher level of lighting on the working surface than industry standards, particularly when combined with natural daylighting. By reducing the lighting wattage, the school can save energy and still maintain standard light levels.

  Switch to lower wattage, 25W T8 lamps. This change can be done gradually, as lamps begin to fail and are replaced. As an additional step, consider "delamping" the fixtures, meaning remove one of two lamps, to

[9] ASHRAE Advanced Energy Design Guide, p. 26, 2008.

reduce energy consumption and still maintain an adequate lighting level in accordance with industry standards.

These changes can be tested, using a handheld light level meter to measure the foot-candles on the working surface with the new lamps or delamped fixtures. These tests should be done during the day and during night hours.



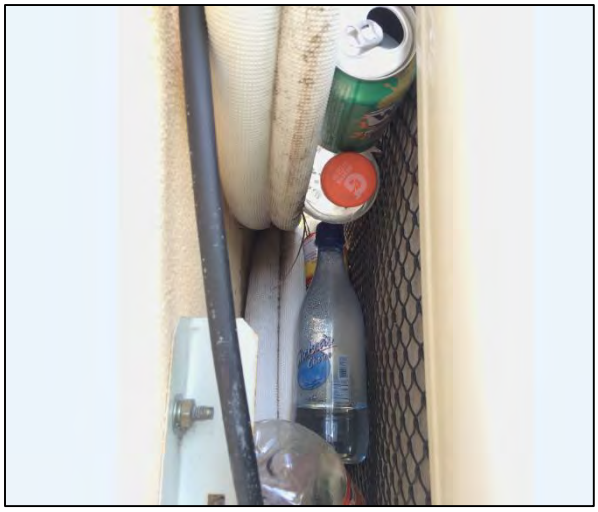
NEXT STEPS: District procurement checks pricing on different lamps. Install test lamps and check illumination levels. Compare lamp pricing to energy savings.

- Increase cooling performance by improving airflow through the exterior air conditioning units.

  There are about 28 air-cooled condensing units (ACCUs) installed on wall-mounted brackets on the exterior walls. These are all only about 4" to 6" from the wall surface, and some of them have coils of refrigerant tubing stuffed behind them and even discarded bottles and other trash.

  These units take in air from the back (the wall side) and exhaust through the front. Any restriction in airflow decreases their efficiency. The equipment installation specifications typically call for 6" to 12" of ventilation clearance.

  An immediate improvement in efficiency would occur if the ACCUs were moved as far as possible from the wall on the existing brackets, move the coiled tubing from the ventilation space and attach to the bottom of the bracket (or somewhere else), and remove the trash discarded in that space.



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NEXT STEPS: Check installation documentation for condensing units. If clearance is inadequate, evaluate moving on the existing brackets or evaluate the cost of replacing the brackets. At the least, remove trash and relocate coiled refrigerant tubing.

- Turn off ceiling fans and lighting when rooms are unoccupied.

  Our team visited the school twice, both when classes were not in session. On both visits, many classrooms were noted as being unoccupied with all the lights turned on and many with all the ceiling fans also on.

  Ideally this is an operational change accomplished through a school-wide outreach program. Depending on how widespread and persistent this habit, it is also feasible to remedy it with simple occupancy controls that would turn off lights and fans when rooms were unoccupied.

NEXT STEPS: Discuss procedures with staff and faculty. Consider posting signs at switches and doors to remind occupants to turn off lights and fans.

- Develop procedures for turning off building systems when space usage changes.

  Many buildings that have manual controls for lighting, air conditioning, and other systems rely on building staff to turn on, off, or adjust these systems when the building or space is no longer being used. This use change can occur when class is over, when the school day is over, at the beginning of a holiday weekend, or at the beginning of summer break.

  This information can be written into checklists in an Operations Manual for the school. These can be in each room, laminated in plastic, and can help to ensure that efficient operations are easy to follow.

  This information usually is possessed by building staff as "institutional knowledge". But when those staff members are not on duty or are no longer employed at the school, that knowledge often is lost.

NEXT STEPS: As noted.

Controls Changes

These usually apply to building automation or manual controls.

- Repair thermostats for the gym rooftop units (RTUs) and operate RTUs in cooling mode only with windows closed.

  There are thermostats for each of the RTUs in the gym. These are disabled and/or jumpered to not work at all. Thus, the RTUs are either turned off or continuously on. While we were visiting, the RTUs were on during a basketball game while the jalousie windows also were open.

  There are options that could be considered for this situation. (1) Turn the RTUs to ventilate-mode only while windows are open. (2) Install supplementary fans (see next section).

New thermostats could be equipped with one-hour activation switches, and keep the thermostats protected from tampering and damage by locking covers. That would allow teachers to push a button and get an hour of ventilation only or an hour of air conditioning, after which the RTUs would shut off. They could be turned on again by activating the switch again. But that would ensure the RTUs were turned off when the space was no longer being used.

NEXT STEPS: Discuss options with District maintenance personnel and school staff to determine best options.

- Install programmable thermostats in all air-conditioned spaces.

  The building is not completely air conditioned, but the spaces that are conditioned have conventional analogue thermostats, as shown. These are protected from tampering by locking covers.

  The thermostats are adjustable only when the covers are open. As a result, building staff do not adjust them back at the end of a school day. This daily "setback" can save a good deal of electricity by increasing the setpoint from 76F during the day to 80F at night, for instance. This same setback should be considered for weekends or other unoccupied times, again, written into the Operations Manual for the school.

  Our recommendation is to install digital, programmable thermostats for all the conditioned rooms. This will allow better control of temperature and energy usage, and address occupancy schedule such as weekends and holidays. The thermostats we recommend are digital readout with at least 2 time settings per daily period, with separate settings available for each day of the week. These are very common and reasonably priced. The digital readout eliminates the uncertainty related to knowing exactly what temperature is set – instead of trying to accurately read an analogue needle indicator like the unit shown below in the Administrative Offices.

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NEXT STEPS: District procurement and maintenance staff compare thermostat options and pricing. Manufacturers can provide cost models for comparing thermostat cost to energy savings.

- Use power strips for work stations, and controllers for vending machines in the Tuck Shop.

  Typically, 10-25% of the electrical load in a non-conditioned building consists of plug loads. These include office machines, computers, vending machines, refrigerators, freezers, and anything else with a wall plug providing power.

  Should the school decide to develop an Operations Manual, this could describe how office equipment should be powered down when not in use.

  Additionally, there is an opportunity in both the kitchen and the Tuck Shop to reduce electricity use in the refrigerators and freezers. These appliances were on and fully cooled even though school was not in session. Further, except for the residential refrigerator in the picture, below, they all were empty.

  Operational procedures could describe temperature and power settings for non-school hours. As an additional measure, the glass-front coolers in the Tuck Shop could be equipped with Cooling Misers ™ which automatically set back the cooling temperatures based on usage. The beverages and food inside are still kept cool, but the unit is not overly cooled because it "knows" the doors are not going to be opened at night, for instance. The lighting in the machines also can be turned off by the same device when outside of school hours.

NEXT STEPS: The leading company in this market, EnergyMisers, can provide cost model for comparison of cost and energy savings.

- Install occupancy and daylight dimming controls for lighting that is on all day.

  The building and classrooms are designed to have very good natural daylighting. Even when closed, the jalousie windows let in enough daylight so that all the lights in the classrooms do not need to be turned on to have adequate light in the space.

  One or two daylight dimming sensors and controllers in each classroom could control the lights by dimming them to provide standard illumination on desks and work surfaces. Occupancy sensors can be integrated into those same controls to turn off the lights when the rooms are not occupied.

NEXT STEPS: Consult with lighting distributor to cost options and estimate savings.

- Aerators on the bathroom sinks to reduce water (and energy) consumption. Evaluate installation of proximity-sensor faucets.

The sinks in the bathrooms are all high-flow units that waste a lot of water. While this water is not heated, this wasted water still represents a loss of energy to the school and the community in general.

Installing aerators on the faucets would represent a small cost and would save more than half the water used. Additionally, with a greater investment, the faucets could be replaced with proximity faucets that turn on automatically when being used.

NEXT STEPS: Install several aerators as test samples. Evaluate performance and measure water reduction. Estimate savings and compare to replacement cost.

System Upgrades and Capital Improvements

These EEMs typically have higher first cost and/or deliver longer term savings.

- Achieve comfort conditions in the gym without air conditioning by installing Big-Ass-Fans ™.

  Comfort conditions are a combination of factors, with ventilation being one of the factors (see Appendix). Right now, the only way to ventilate the gym is to turn on the RTUs, since there are no fans.

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The Big Ass Fan ™ Company manufactures a line of effective and efficient, very large diameter overhead fans (8' to 24' diameter) that work well in warehouses, gyms, theatres, and other large spaces. They improve comfort without using air conditioning. The Azimuth staff have installed these at baseball stadiums and school gyms like Anatol Rodgers.

In this application, the fans may require screens around them to avoid damage from balls and other objects.

NEXT STEPS: Consult with fan manufacturer to cost options and estimate savings.

- Replace existing T8 lamps with LED direct-replacement tubes.

  This potential EEM retains the existing T8 fixtures and replaces the fluorescent lamps with equally sized LED strip replacements. The alternative is to replace the entire fixture, but that usually is more costly and results in hundreds of scrap fixtures that may end up in the landfill.

  This potential EEM should be evaluated concurrently as the controls upgrade for interior lighting listed above. The two EEMs are not necessarily mutually exclusive, but typically the controls upgrade will decrease the benefit resulting from the LED upgrade. Assuming the interior lights are on for more than 6 hours a day with these energy rates, the financial viability may favour the LED upgrade.

NEXT STEPS: Review the construction documents reflected ceiling plan to determine how many fixtures and lamps are in the building. Consult with lighting distributor to cost options and estimate savings. Azimuth recommends Phillips Lighting products, as they are highly reliable and have a reputable company behind them to back a product warranty.

- Retrofit the 400W metal-halide fixtures in the gym to quad T5-HO fixtures. Install tubular skylights in the gym and daylight dimming controls for the fluorescent fixtures.

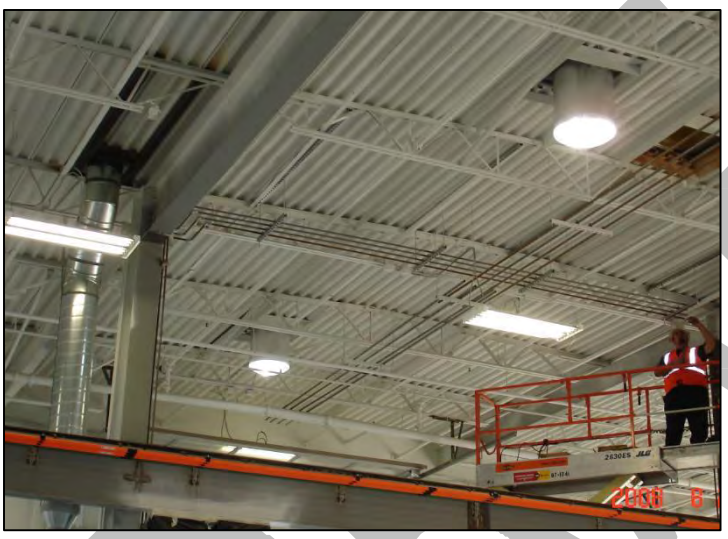
  There are 36 x 400W metal halide High-Intensity Discharge (HID) fixtures in the gym. When turned on, these lights consume over 15kW of power (including a typical 10% overhead loss in the fixture). Additionally, these lamps burn out fairly quickly, on the order of 5,000 hours, depending on brand and operating conditions. Replacing these lamps is a difficult task in the gym, as evidenced by the several that are burned out in this picture, above.

Replacing these with Quad-T5 HO fixtures would cut the power by 50-75%, depending on the new fixtures selected, and increase life expectancy by 50-100%. The replacement should keep the same electrical distribution and pendant locations to minimize project cost.

Further improvement can be achieved using tubular skylights and daylight dimming sensors for the new fixtures.

Below is a picture of an installation managed by Azimuth engineers, where tubular skylights were installed in a metal deck roof similar to the Anatol Rodgers gym roof. These are 21" diameter Solotubes ™ and quad-T5 HO fixtures with daylight dimming ballasts. This space is used for 12 hours a day, and the EEMs paid for themselves in less than 2 years. It is evident from the picture that the tubular skylights put out as much if not more light than the fixtures.

Last item to note for this entry is that the lighting controls are a safety issue for the school. Presently when faculty want to turn on lights or air conditioning in the gym, they go into the electrical room and switch the circuit breakers on the 480V electrical panel. The wiring and buswork in that panel is exposed, and represents a safety hazard to those untrained faculty. We recommend those panels be closed with their designated dead front covers (see below, right).



NEXT STEPS: Consult with lighting distributor to cost options and estimate savings. Discuss application with one or two tubular skylight manufacturers, such as Solatube and Velux.

- Retrofit the 250W metal-halide fixtures in the parking lot and athletic field with LED fixtures using the same mounting poles.

  There are 60-70 of the single- and dual-head cobra poles in the parking lot and athletic fields. It is our understanding that they presently are on timers to run from dusk to dawn.

  Typical LED replacement cobra heads for these light standards would reduce power consumption by approximately 100-150W per fixture. That is 6-10kW of potential savings for the annual operating cycle of the lights. Additionally, if the timers fail (which does happen with some regularity), the electricity lost during the times when the lights are unnecessarily on will be reduced.

NEXT STEPS: Consult with lighting distributor to cost options and estimate savings.

- Investigate roof insulation and attic ventilation. Provide adequate ventilation for attic space and consider supplemental insulation to achieve industry recommended ratings.

  It is expected that the ceiling is insulated in the attic, although that could not be confirmed due to lack of access. That deck insulation should be R-30 for the pitched-roof wings of the school and R-19 for the metal roof deck of the gym [10]. In all likelihood, the insulation doesn't meet those standards, and increasing insulation would improve energy performance as well as occupant comfort. An insulation contractor could estimate the savings with their quote to assist the school in deciding whether to pursue this EEM. The roof of the gym represents the largest and easiest roof to insulate and probably also is not meeting the R-19 standard.

  In addition to the insulation, we recommend investigating the ventilation of the attic spaces. As is visible in the left picture, below, there are soffit vents into the attic. These are to allow air to circulate into the attic for cooling, when air is exhausted from the attic through vents in the eaves or ridges of the roof. There are soffit vents around the entire perimeter of the building, the same as shown below. However, there are only a few vents in the eaves and no vents in the ridges. The reason for the lack of vents is probably for appearance and that the hip roofs do not provide a place for eave vents. If this is an accurate observation, it essentially means there is no ventilation of the attic space. This will result in exceedingly high temperatures in the attic, impacting energy performance and occupant comfort.

  There are a few potential remedies for this situation, again, if our observations are correct and there are no attic exhaust vent points.

  1. Establish adequate ventilation pathways for the attic by installing ridge vents or properly spaced can or hat vents.
  2. Consider sealing the attics by closing off the soffit vents and insulating the underside of the roof deck, effectively conditioning the attic space.

  Either of these solutions can be effective. Neither is a low-cost project, so the advice of an architect or building specialist should be solicited.

[10] This rating is based on the ASHRAE Advanced Energy Design Guide for K-12 Schools, 2008.

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NEXT STEPS: Discuss conditions and options with the original architect and engineer of the building.

- Retrofit the 1 gallon-per-flush (gpf) urinals with 1 pint-per-flush urinals to reduce water usage.

  Again, water is energy and utility expense. For every 100 male students and faculty, assuming 2 flushes per day, this change would reduce water usage by 1,300 gallons per week. Building staff could prepare this cost-savings analysis based on actual student count and the cost of water and the new urinal valves.

NEXT STEPS: Consult with plumbing distributor to cost options and estimate savings. Install one or two test samples for evaluation.

- Construct a vestibule at the front and back doorways to the main lobby.

  These appear to be the entrances that are used the most by students and staff. The lobby was noticeably warmer than the Administrative Office, and that probably is because the doors are opened so often.

  It probably would be architecturally feasible to construct a vestibule on the front and back doorways so that opening the doors would result in much less loss of conditioned air (and cooling energy and expense). An architect could be consulted to evaluate this EEM and estimate the savings opportunity.

NEXT STEPS: Discuss conditions and options with the original architect and engineer of the building.

- When energy system equipment is purchased or replaced, specify high efficiency replacement equipment.

  It probably is not cost effective to replace existing equipment with new, high efficiency equipment since the building and systems are only 7 years old. However, as equipment wears our and needs replacement, there should be a specification in place for that new equipment.

  Azimuth has developed purchasing specifications for a variety of clients targeting higher energy performance. The easiest way to do that is to require the purchase of Energy Star © appliances, and that lighting, w a t e r heating, and air conditioning equipment meet the performance standards set out in the ASHRAE Advanced Energy Design Guide (AEDG).

NEXT STEPS: Review information on the Energy Star web site. There is guidance on development of procurement policy.

Lastly, while not related to energy performance, consider purchasing a fluorescent bulb grinder to put at the school. This can be used to safely dispose of spent lamps for the school and possibly other sources. Current practice in Nassau is to dispose of fluorescent lamps with ordinary trash, which goes to the municipal (unlined) landfill. Ultimately the mercury in the lamps ends up in the soil and water table.

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NEXT STEPS: Discuss whether this is a priority of the program. There is no payback, but it will have a small but positive environmental benefit.

NEXT STEPS

The most important next step is to *do something*. It is our goal to help the Owner understand the renewable energy opportunities and the EEMs and how to move forward with the ones that make sense on their merits.

Making next steps is not difficult; many of the no- and low-cost measures can be done quickly and painlessly for immediate returns. Each of the priority EEMs has a description of potential next steps, so that the management team can decide how to proceed with each one.

Azimuth can assist the Owner in further in the evaluation of any of the EEMs, and can even serve as the Owner's Agent for the implementation of them – acting as a construction manager and temporary extension of staff, except with construction expertise that the Owner doesn't necessarily keep on staff or retainer internally.

FINANCIAL INCENTIVES

There are no utility or governmental incentives published that would apply to these projects.

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EXHIBIT A – PV SYSTEM PERFORMANCE

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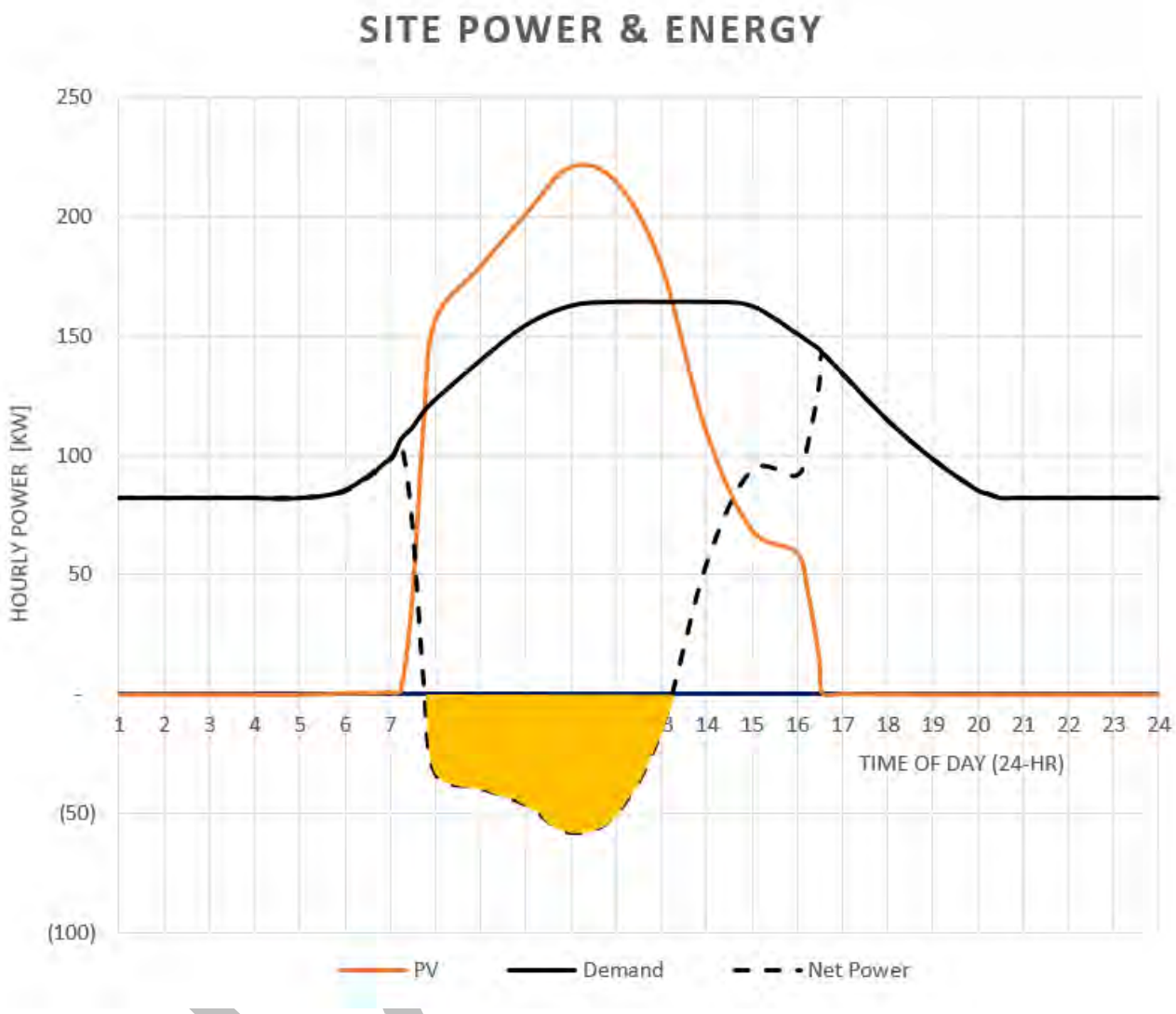
PROJECT PERFORMANCE SUMMARY: PV System Only

Anatol Rodgers High School

Bahamas Power and Light (BPL) Service Area

Design-Build Delivery Central Inverter

Graph of expected daily power production, given the proposed Phase-1 southeast and southwest orientation of sub-arrays on the school roof.



Orange shading indicates energy more than site demand that would be pushed back on to the utility grid.

APPENDIX B – FACILITY DESCRIPTION

General Information
The Anatol Rodgers High School was put into service in 2008. They are now in their 9th school year, serving grades 7 through 12.

The building footprint is approximately 50,000 square feet, mixed between single-story and two-story construction. The envelope is conventional concrete block and wood framing with a composite asphalt shingle pitched roof.

Use and Occupancy
The building is an educational occupancy[11], and is occupied normally during the school year. During the summer months, school is not in session, although staff are working throughout the summer months. Most of the building space and systems are "mothballed" during the summer, such as the kitchen, classrooms, and bathrooms.

Cooling
The building is cooled by three different types of air conditioning systems in addition to natural ventilation.

The gym has 6 Rooftop Units (RTUs) that are combined cooling and heat rejection units, typically called "DX" (for "Direct Expansion") HVAC (Heating Ventilation and Air Conditioning). The common term for reference are "RTUs". There is no ductwork in the gym.

The air-conditioned classrooms and other spaces are all "split systems", meaning the cooling unit is inside the cooled space and there are refrigerant pipes going to the heat rejection unit located outside the building. The classrooms have small split systems with the condensing units mounted on brackets on the outside wall.

The air-conditioned office and administrative spaces have larger split systems, with the condensing units ground mounted outside the building.

Heating
There is no space heating in the building.

Air Side & Ventilation
There is no outside air ventilation in the air-conditioned classrooms, since the split systems do not have air side ductwork outside the building. Ventilation occurs through the "leaky" envelope and the louvered windows.

Ventilation for the gym is accomplished by the rooftop air handlers, or Rooftop Units (RTUs). They have an outside air damper that can be partially open position. It was not possible to access the units due to their location on the roof.

It was not possible to make CO2 measurements, since school was not in session and there was no CO2 load to measure. But we suspect the unforced ventilation is sufficient to keep CO2 concentrations below any significant level. If there is concern for air quality, Azimuth could revisit the school when it is in session later this year.

HVAC Controls
There are individual thermostats in the conditioned rooms. They all are setpoint devices only and are not programmable. The thermostats that the team observed all had locable enclosures.

Domestic Hot Water (DHW)
There is water heating only for the kitchen. There is an 80-gallon electric water heater serving the kitchen. All other water is ambient temperature.

[11] Building importance III from the perspective of structural analysis.

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Lighting
Interior lighting is all T8 fluorescent, fitted with 32W lamps, with some compact fluorescent (CFL). The gym is furnished with (30) 400W metal halide fixtures. Exterior lighting is (60-70) 250W metal halide lamps on single or double cobra-head posts.

Each room has a light switch. There are no other occupancy or daylight dimming controls.

Utilities & Electrical Distribution
Electricity is the only energy source on the facility, provided by a utility connection to Bahamas Power and Light Company (BPL). The campus is supplied from an 11kV, 1500 kVA step-down transformer that delivers 277Y/480VAC to a 2000A Main Distribution Switchboard (MDS) in the main electrical room adjacent to the Administrative Offices.

Typical utility rates in Nassau, the estimated variable rate for electricity is $0.42/kWh, including fuel and service surcharges. That is the rate used for financial modelling in this report.

APPENDIX C – EEM CATALOG

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ANATOL RODGERS H.S. EEM AUDIT / UPGRADE TRACKER

ID	Space	Description	First Cost	Net Present	Cost/NPV	Visibility	Comfort / IEQ	Rel. / survivability	Life safety / Code	Executive priority	Env benefit	Marketing / PR	SCORE	Status	Notes
			5	4	[illegible]	2	3	4	5	5	1	2			
1	All	Turn off lights and fans when rooms unoccupied	4			2	1					1	29		
2	All	Bulb grinder for fluorescent lamps	2			3	2					3	28		
3	All	T8 lamp wattage reduction, delamping	4			1	1					1	27		
4	All	Airflow improvements for wall-mounted ACCUs	4			1	1					1	27		
5	All	Building shut-down procedures	4			1	1					1	27		
6	Office	Front entrance vestibule	1			3	3					3	26		
7	Gym	Big-Ass Fans ™ for the gym	1			3	3					3	26		
8	All	Programmable thermostats	2			3	2					2	26		
9	All	Occupancy and daylight sensors for T8 lighting	2			3	2					2	26		
10	All	T8 to LED replacement	1			3	2					3	23		
11	Gym	400W MH replacement to T5HO	1			3	2					3	23		
12	Gym	Tubular skylights and daylight dimming controls	1			3	2					3	23		
13	All	Energy Star procurement policy	3			1	1					1	22		
14	Tuck Shop	Cooling Misers for Tuck Shop	2			2	1					2	21		
15	Bathrooms	Bathroom sink aerators, proximity sensor faucets	2			3	1					1	21		
16	All	Attic insulation and ventilation	1			1	3					2	20		
17	Exterior	250W MH replacement to LED	1			3	1					3	20		
18	Gym	Gym ventilation improvements; fix stats, operate in vent mode	2			1	2					1	20		
19	Bathrooms	Retrofit to 1 pint flush urinals	2			2	1					1	19		
20	All	Power strips to turn off plug loads	2			1	1					1	17		

APPENDIX D – DEFINITIONS & UNITS

Heat Transfer & Occupant Comfort
Human comfort is a combination of air temperature, heat transfer, humidity, and ventilation. Engineering standards define an envelope of conditions that result in comfortable conditions for occupancy. Heat transfer is an important part of this formula, and it occurs through 3 mechanisms: conduction (heat passing directly from one solid to another; convection (a moving fluid carrying heat, such as air pushed by fans or air rising when heated); and radiation (one body transmits heat to another based on the difference in their temperature, whether in a vacuum or in air).

R-Value Thermal resistance
Rating varying from R-1 (for a pane of glass) up to R-40 or higher (for a highly insulated roof assembly). The higher the R-value, the better the insulation performance. More is not always better, and the ASHRAE Advanced Building Design Guide provides recommendations for the R-Value for all building elements for this climate zone.

SHGC Solar Heat Gain Coefficient
A scale from 0 to 1 defining how much of the radiant heat is transmitted through a window, as a fraction where 1 equals 100%. A typical single pane of glass with no tint has a SHGC of 0.85 or higher. To keep sun heat out of a building, lower numbers are better. To allow the sun to heat the room, higher SHGC is better.

SRI Solar Reflectivity Index
A measure of the building surface's ability to reflect sunlight; typically, a roof, or paving. The scale is from 0 for a black roof to 100 for a white roof. The higher the number, the cooler the surface and subsurface will be in direct sunlight.

U-Value Overall Heat Transfer Coefficient
This is the inverse of the R-Value, and is a measure of the heat transfer through glazing in a window or door. Windows typically have a U-value from 0.2 to 1.0. Lower numbers mean lower heat transfer through conduction.

UNIT CONVERSION
"M" as a prefix means 1 million, and "k" as a prefix means 1 thousand.

POWER
"Kilowatt" is the primary unit for power, "kW".
"Horsepower", or "HP", is almost as large as a kW.
1 kW = 1.34 HP
1 HP = 0.746 kW
"Btu per hour", or "Btu/hr" is smaller than a kW.
1 kBtu/hr = 0.293 kW
1 kW = 3.41 kBtu/hr

ENERGY
"Kilowatt-hour" is the primary unit for electrical energy, "kWh".
"Btu" is very small, and is usually measured in kBtu or MBtu.
1 MBtu = 293 kWh
1 kWh = 3.41 kBtu
"Therm" is the primary unit for natural gas energy, and is a large unit.
1 Therm = 29.3 kWh = 100 kBtu

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EXHIBIT B – SCHEDULE OF PRICING

EXHIBIT B SCHEDULE

OF PRICING

Anatol Rodgers High School Energy Retrofits and
Nassau Botanical Gardens Solar PV

To (Government): Ministry of Environment and Housing

From (Bidder):

Pursuant to and in compliance with the Request for Proposal (RFP) titled "Anatol Rodgers High School Energy Retrofits and Nassau Botanical Gardens Solar PV" (dated xx xxx 2018), the undersigned offers to design, furnish and install all materials and supplies necessary or incidental to the above referenced project, complete in every respect, in strict accordance with the RFP documents and to perform all other obligations imposed by the contract agreement, for the pricing indicated in the following Schedule of Pricing:

Location: Anatol Rodgers High School, New Providence Island, Bahamas

Bid Item	Description	Estimated Quantity	Unit	Unit Price ($USD)	Total Amount ($USD)
1	250 kW-DC rooftop solar PV system	Job	Lump sum		
2	Exterior lighting control system	Job	Lump sum		
3	Vacancy sensors in all classrooms, computer labs, and lounges to control lights and ceiling fans	[TBD]	Per sensor		
4	Louver sensor interlock at gymnasium	Job	Lump Sum		
5	Programmable thermostats throughout	[TBD]	Per thermostat		
6	Low-flow lavatory aerators	[TBD]	Per aerator		
7	Re-zone interior lighting system at entrance	Job	Lump Sum		
8	Re-organize refrigerant lines from condensing units	[TBD]	Per condensing unit		
9	Commissioning & retro-commissioning	Job	Lump Sum		
10	Other (see Note A)	Job	Lump Sum		
	BID TOTAL for School Retrofits				

Location: Nassau Botanical Gardens, New Providence Island, Bahamas

Bid Item	Description	Estimated Quantity	Unit	Unit Price ($USD)	Total Amount ($USD)
11	6 kW-DC solar PV system	Job	Lump sum		
12	Pavilion structure	Job	Lump sum		
13	Commissioning & retro-commissioning	Job	Lump Sum		
14	Other (see Note A)	Job	Lump Sum		
	BID TOTAL for the Gardens				

Notes:

A. Includes all other work not specifically included in another Bid Item but required to complete the work, as specified (e.g., engineering, plans/submittals preparation, mobilization, demobilization, permitting, admin, etc.).

Receipt of the following addenda is hereby acknowledged:

Addendum No._____ Date Received: _____

Addendum No._____ Date Received: _____

Addendum No._____ Date Received: _____

Addendum No._____ Date Received: _____

The undersigned Bidder understands that the quantities of work as shown herein are only approximate and are subject to increase and decrease, and agrees to enter a Contract to work at the unit prices stated in the Schedule of Pricing whether the quantities are increased or decreased. In addition, the undersigned Bidder agrees that the Bid is valid for 90 or more days after the Bid due date.

Dated this_____day of_____2017

Signed Name_____

Printed Name_____

Title_____

Duly authorized to sign Bid for and on behalf of

_____
COMPANY NAME (IN BLOCK CAPITALS)

_____
Business Address of Bidder

_____
Telephone Number of Bidder

EXHIBIT C – PROPOSAL CHECKLIST

Proposal requirement number	Required content with bid submittal	RFP section reference	Check if Included
1	Receipt confirmation and notice of site visit	2.4.12	☐
2	Binding offer cover letter	4.1	☐
3	Mutual confidentiality agreement	4.2	☐
4	Statement of qualifications	4.3	☐
5	Technical information	4.4	☐
6	Project Execution Summary Plan	4.5	☐
7	Schedule of pricing	4.6; Exhibit B	☐
8	Employment practices	4.7	☐
9	Red-line to contract agreement; brief term sheet summarizing any changes made to the agreement and/or exhibits	4.8	☐
10	Credit worthiness (financial statements)	4.9	☐
11	Conflicts of interest	4.10	☐
12	Key project risks	4.11	☐
13	Proposal checklist	4.12; Exhibit C	☐

EXHIBIT D – EXISTING DRAWINGS

Existing drawings for the School in PDF and DWG format will be provided at the Mandatory Site Bid Walk.

EXHIBIT E – BPL GRID INTERCONNECTION REQUIRMENTS

Bahamas Power & Light

RENEWABLE ENERGY POWER PURCHASE/INTERCONNECTION AGREEMENT

This Renewable Energy Interconnection Agreement ("the Agreement") is made this ____ day of _____, 20__ between:

1. The Bahamas Power & Light Company Ltd. ("BPL"), a statutory corporation in the Commonwealth of The Bahamas established by Electricity Act, Chapter 194, and

2 The Customer-Generator described in Appendix B.

Whereas:

A. BPL is charged with the primary duty to secure the supply of electricity at reasonable prices within its area of supply and to purchase, generate, transmit, transform, distribute and sell energy either in bulk or to individual consumers pursuant to the Act.

B. The Customer-Generator is a customer of BPL and wishes to sell electrical energy to BPL from the Customer-Generator's Small-Scale Renewable Generation

System ("SSRG system"), specified in Appendix B.

C. The Customer-Generator qualifies for the SSRG Program and its SSRG system meets the eligibility requirements in the Requirements for Grid Interconnection of Renewable Generation Systems.

Therefore:

A. For the duration of the Agreement, BPL will purchase all electrical energy that the Customer-Generator supplies to the Grid from the approved SSRG system, as described in Appendix B.

B. The Agreement is effective for a term of 15 years commencing …… [Insert date] and ending …….. [Insert date].

C. BPL will compensate the Customer-Generator for electrical energy at the Feed-in Tariff.

D. BPL and the Customer-Generator agree to the Standard Conditions in Appendix A, which form part of the Agreement.

E. The Agreement includes the following additional appendix, which also form part of the Agreement: Appendix B: Particulars of the Agreement

IN WITNESS WHEREOF the undersigned have executed the Agreement on the year and day hereinbefore mentioned.

Customer-Generator	*The Bahamas Power & Light Company, Ltd.*
Signed By: _____	*Signed By:_____*
Title:_____	*Title:_____*
Print Name:_____	*Print Name:_____*
Witness	*Witness*
Name:_____	*Name:_____*
Address:_____	*Address:_____*
Calling or Description:_____	*Calling or Description:_____*

Appendix A: Standard Conditions

1 Interpretation

1.1 Definitions

The following capitalized terms used herein shall have the meanings set forth below:

"Feed-in Tariff" means the rate at which BPL will purchase electricity that the Customer-Generator supplies to the Grid. URCA will set and revise this rate from time to time, per its power under Section 27(5) of the Electricity Act, 2015.

"Force Majeure Event" means:

I. hurricane, earthquake, flood, tidal wave, or other act of God;

II. fire, strike, malicious damage, labor disturbances;

III. war, terrorism, civil war, rebellion, riot;

IV. any other cause beyond the control of a Party which was not reasonably foreseeable or if foreseeable could not have been prevented.

"Grid" means the power system, inclusive of transmission and distribution, by which electric energy is distributed by BPL to its customers.

"Grid Tied" means a connection that in any way links the supply from the SSRG system to BPL's supply, whether the connection is before or after the meter (i.e. internal or external to the Customer's installation) is considered to be interconnected with BPL's Grid.

"Metering System" means all meters and metering devices or equipment owned by BPL and used to measure the delivery and receipt of electricity.

"Nameplate Gross Power Rating" means the SSRG system manufacturer's alternating current nameplate capacity.

"Parties" means BPL and the Customer-Generator together and "Party" means either one of them.

"Points of Delivery" means the interconnection point or physical point where the SSRG system and the Grid are electrically connected for metering purposes.

"Small-Scale Renewable Generation System" (SSRG system) means systems with the ability to generate their own energy from acceptable renewable acceptable sources using approved technologies.

"Customer-Generator" means a means the person or entity who is a customer of BPL and who has entered into a contract with BPL for the electricity account associated with the Renewable Generation System.

"The Small Scale Renewable Generation Application" (Customer-Generator) means the application submitted by the customer for approval to acquire and install renewable energy system.

"Service" means energy and power supplied to the Customer-Generator by BPL.

"Standard Electricity Tariff" means the tariff under which the Customer-Generator is charged by BPL.

1.2 Entire Agreement

The Agreement and the accompanying appendices together with the other documents to be delivered under the Agreement represent the entire contract between the Parties with respect to the subject matter of the Agreement and supersedes all previous agreements, arrangements, understandings, negotiations, and discussions, whether oral or written, between the Parties in relation to the interconnection of the Customer-Generator's SSRG system with BPL's Grid.

1.3 Headings

Clause headings contained in the Agreement are included solely for convenience and are not intended to be a full accurate description of the content of any clause and shall not be part of the Agreement.

1.4 Statutory Instruments

Any reference in the Agreement to any law, regulation, order, act or statute of any governmental body or other regulatory body shall be construed as a reference to those as amended or re-enacted from time to time or as a reference to any successor to those.

1.5 Words

Unless the context otherwise requires, words denoting the singular shall include the plural and vice versa.

2 SSRG System Interconnection Requirements

2.1 Installation, Design, and Maintenance

The Customer-Generator shall design, install, operate, and maintain the SSRG system, and all ancillary facilities on the Customer-Generator's side of the Point of Delivery, specified in Appendix B, in accordance with the Requirements for Grid Interconnection of Renewable Generation Systems and all governmental laws and regulations which may be applicable from time to time.

2.2 Insurance, Licenses, and Permits

The Customer-Generator shall obtain and maintain all required insurance coverage, governmental authorizations, permits, licenses and approvals from all governmental authorities, local agencies, commissions and authorizes required for the installation and operation of the SSRG system.

2.3 Safety and Performance

The SSRG system shall meet all applicable safety and performance standards, including the codes and standards described in the Requirements for Grid Interconnection of Renewable Generation Systems. BPL may, from time to time, reasonably prescribe additional requirements, to be implemented at the Customer-Generator's sole expense, which in BPL's judgment are necessary for ensuring the safety of the grid and/or the public. BPL shall provide the Customer-Generator with written notice of any additional requirements to be implemented pursuant to this clause and the Customer-Generator shall have fourteen (14) days from the date of the notice to implement the change to the satisfaction of BPL. If not possible within 14 days the customer may request in writing an additional 14-day extension. Failure to carry out the required changes in the prescribed period will result in

I. The Customer-Generator having to isolate their SSRG system from the grid and have the isolation point locked off by BPL until the corrections are made;
II. Having their SSRG system's electrical supply disconnected from the grid until the correction is made;
III. Be subject to penalties under the regulations until the corrections are made; or
IV. any combination of the above.

2.4 Requirement for Initial Inspections

The Customer-Generator shall not commence any interconnection to BPL's grid or parallel operation of the SSRG system until all required inspections have been passed and written approval to do so has been given by BPL.

Approval of a SSRG system only applies directly to the system itself, indicated in the application, to

be acquired by the applicant. Approval of a Customer-Generator application does not in any way supersede or negate the need for the installation to pass the relevant inspections by BPL and other Governmental agencies prior to Grid connection. Acquisition of a system other than that detailed in the application automatic rescinds the initial application approval.

3. Customer-Generator's Obligations

3.1 Customer-Generator's Obligations

The Customer-Generator shall:

I. upon receipt of approval from BPL to interconnect the SSRG system in Appendix B and installed at the address specified in Appendix B (the "Service Address"), and on execution of the Agreement, immediately connect the SSRG system to BPL's Grid, unless the Customer-Generator obtains BPL's written approval to postpone the interconnection;

II. at all times operate and maintain (or engage services of qualified technician and/or engineer as may be required to operate and/or maintain) the SSRG system in accordance with all applicable BPL and Governmental standards and requirements and the instructions of the manufacturers of the equipment used to construct the various components of the SSRG system;

III. at all times comply with BPL's standards and requirements relating to the parallel operation of the SSRG system which may be in effect from time to time;

IV. promptly notify BPL of any malfunction or breakdown of any component of the SSRG system that could constitute a foreseeable safety hazard or which could reasonably be expected to cause disturbance or damage to the Grid;

V. not operate or allow the SSRG system to be operated so as to generate electricity at a rate greater than 110% of the SSRG system Nameplate Gross Power Rating specified in Appendix B;

VI. not add to or modify or allow any addition or modification to the SSRG system without the prior written consent of BPL;

VII. not alter, modify or tamper or allow any alteration, modification or tampering with the SSRG system connection to BPL's Grid without BPL's prior written consent;

VIII. not relocate or interconnect or allow any relocation or interconnection of the SSRG system to BPL's Grid at any location other than the Service Address without BPL's prior written consent;

IX. promptly comply or ensure compliance with all requests from BPL to interrupt the service of SSRG system, reduce the output from the SSRG system and disconnect the SSRG system from the Grid;

X. Not to impede but at all times allow BPL reasonable access to the SSRG system; and

XI. make all payments required to be made by it to BPL on or before the due date for payment

4 BPL's Obligations

4.1 Duty to Interconnect

Subject to the terms and conditions of the Agreement BPL will interconnect with the SSRG system located at the Service Address and supply electricity to and accept delivery of electricity from the Customer-Generator

(if applicable) at the Point of Delivery specified in Appendix B.

4.2 Duty to Act with Promptness

BPL will act with reasonable promptness to perform any inspections and give any approvals that it is authorized or required to give under the Agreement. BPL will not unreasonably withhold or delay the giving of its consent in any case where its consent is required.

5 BPL's Rights

5.1 Right to Require Customer-Generator to Interrupt Supply

BPL shall have the right to require the Customer-Generator to interrupt (including, if so specified by BPL, by means of physical disconnection or lockout) or reduce the SSRG system whenever:

I. BPL in its sole judgment deems such action necessary to permit BPL to construct, install, maintain, repair, replace, remove, investigate, or inspect any of its equipment, any part of the Grid, any of the Customer-Generator's installation and/or equipment; or

II. BPL in its sole judgment determines that curtailment, interruption, or reduction of the Customer-Generator's electrical generation is otherwise necessary due to emergencies, forced outages, a Force Majeure Event, safety hazards, possible damage to or disturbance of the Grid, or compliance with prudent electrical practices.

5.2 Right to Interrupt Supply from the SSRG System

Notwithstanding the provisions on Clause 5.1 or any other provision of the Agreement, BPL shall have the right to:

I. require the Customer-Generator to immediately disconnect the SSRG system from BPL's Grid; and

II. immediately by itself to effect the disconnection of the SSRG system from BPL's Grid if the Customer-Generator is either, in BPL's reasonable belief, not available to make the disconnection or if the Customer-Generator is available but refuses to act and the disconnection is deemed necessary by BPL.

5.3 Advance Notice

Whenever feasible BPL will give the Customer-Generator reasonable advance notice that an interruption or reduction in output from the SSRG system may be required or that disconnection of the SSRG system from BPL's Grid may be required. However, the failure of BPL to give such notice shall not invalidate any action taken by BPL under Clauses 5.1 or 5.2 of the Agreement or cause or account for any breach of the Agreement between the parties.

5.4 Indemnity

If any of the following scenarios occurs:

I. BPL, using its sole discretion, requires the Customer-Generator to interrupt or disconnect the SSRG system from BPL's Grid;

II. BPL, using its sole discretion, decides to effect the interruption or disconnection of the SSRG system from its Grid (as provided in Clause 5.1 and 5.2 respectively of the Agreement);

III. Such interruption occurs as a result of suspension or termination of service to the Customer-Generator in accordance with the provisions of the Electricity Act, Rules and Regulations in force at that time or the Requirements for Grid Interconnection.

Then, except to the extent caused by the willful misconduct or gross negligence of BPL, its directors, employees, and/or agents, BPL and its agents shall not be liable to the Customer-Generator for any loss or damage whatsoever resulting from the exercise of such rights by BPL.

5.5 Right to Enter Premises

BPL shall have the right to enter the Customer-Generator's premises at the Service Address at all reasonable hours, without notice to the Customer-Generator, to inspect the protection devices installed at the SSRG system and to read, inspect and test meters, or to effect disconnection of the SSRG system as provided in section 6.2 of the Agreement. Nothing in the Agreement shall limit or otherwise affect any rights of entry to the Customer-Generator's premises that BPL may have under the Electricity Act, Rules and Regulations or the Requirements in force at that time for Grid Interconnection or any other agreement with the Customer-Generator.

5.6 Right to Disconnect Service

BPL reserves the right to disconnect the electricity supply to the Service Address without notice and without incurring any liability whatsoever if the Customer-Generator fails to comply with the requirements of the Agreement or for any other reason relating to safety and/or reliability of the Grid.

5.7 Right to Collect Data

BPL shall have the right to demand, promptly obtain, review and copy the SSRG system operations and maintenance records, logs, or any information considered necessary by BPL such as unit availability, maintenance outages, circuit breaker operation requiring manual reset, relay targets and any unusual events pertaining to the SSRG system and/or its interconnection with BPL's Grid.

5.8 BPL Property

All equipment owned by BPL which is affixed to the Customer-Generator's premises for the purpose of facilitating the interconnection of the Customer-Generator's SSRG system with BPL's Grid, including all equipment installed by BPL which is required for the purpose of metering and billing, shall remain the property of BPL.

6 Billing

6.1 Metering

BPL shall install meters capable of recording energy flows in both directions and will utilize a net billing methodology for billing purposes. Under the net billing arrangement, BPL will bill the Customer-Generator at the Standard Electricity Tariff for only the electricity the Customer-Generator uses from the Grid. The Customer-Generator will receive a credit for excess electricity that the Customer-Generator sells to the grid (that is, the electricity generated from the Customer-Generator's SSRG system that the Customer-Generator did not use).

6.2 Account Credit

BPL shall credit the Customer-Generator's account for all energy (kWh) (within the capacity limits stipulated) supplied to the Grid at the Feed-in Tariff

6.3 Tariff for Service to the Customer-Generator

Service (energy and power) supplied to the Customer-Generator by BPL will be billed in accordance with BPL's applicable tariff for the type of service provided the Customer-Generator.

6.4 Billing

At the end of each billing period, if the Customer-Generator's account is in debit after the renewable charges have been applied, the balance due will be billed and payable. If the account is in credit, the amount will be carried forward to the next billing period. Upon request, BPL will promptly refund the Customer-Generator on a quarterly basis, if the Customer-Generator's account is $100.00 or more in credit. Any account credit available at the time of account finalizing would be paid to the customer. Should the customer finalize the account BPL will refund any credit remaining on the customer's account.

7 Representations and Warranties

7.1 Representations and Warranties

The Customer-Generator represents and warrants that:

I. it has complied with and will continue to comply with the terms, conditions and obligations under the Agreement and all applicable laws of the said Commonwealth;

II. it has obtained and will maintain all required insurance policies and those policies have been duly endorsed in accordance with the requirements of the Agreements;

III. it has obtained all required permits, licenses and approvals required by all government authorities, local agencies, commissions and Service (energy and power) supplied to the Customer-Generator by BPL authorities with jurisdiction over the Customer-Generator and the SSRG system to allow it to enter into the Agreement;

IV. its SSRG system meets and will continue to meet all applicable safety and performance standards that now exists and which BPL may from time to time prescribe and/or any amendment laws, rules and regulations which the Government may from time to time enact;

V. it is the owner of, or authorized tenant of the premises located at the Service Address; and

VI. it is the owner of the SSRG system and is duly authorized to enter into the Agreement and operate the SSRG system.

8 Indemnity

The Customer-Generator shall fully and effectually indemnify and hold harmless BPL, its affiliates, directors, officers, agents and employees from and against any and all losses, liabilities, costs, claims, charges, actions, proceedings or investigations which BPL may incur or which may be made against it in connection with the interconnection of the SSRG system and with BPL's Grid or any breach or alleged breach of any of the representations and warranties of the Agreement by the Customer-Generator or in respect of BPL's exercise of its rights, discretions, authorities and obligations under the Agreement. BPL will not honor any damage claims submitted with respect to the SSRG system itself or any electrical or electronic equipment connected at the premises.

9 Termination

9.1 Termination by the Customer-Generator

The Customer-Generator shall have the right to terminate the Agreement by giving BPL thirty (30) days prior

written notice of its intention to terminate the Agreement.

9.2 Termination by BPL

BPL shall have the right to terminate the Agreement:

I. where the Customer-Generator is in default of any of its obligations under the Agreement and such default, is not corrected within thirty (30) days after written notice of the default has been given to the Customer-Generator by BPL. BPL shall exercise its right to terminate the Agreement for such default by giving ten (10) days written notice of termination to the Customer-Generator. The foregoing shall not affect any rights of suspension, interruption or disconnection that BPL may have under the Agreement or the Standard Electricity Tariff under which the Customer-Generator is currently receiving electric service;

II. immediately and concurrently with the termination of electric service to the Customer-Generator under any of the rate schedules identified under paragraph 1 of the Electricity Act, Rules and Regulations; and

III. immediately and concurrently on termination of the Agreement.

10 Resolution of Disputes

10.1 Settlement by Mutual Discussions

If any dispute or difference of any kind whatsoever arises between the Parties in connection with, or arising out of, the Agreement, the Parties shall within thirty (30) days after the date that the dispute arose attempt to settle such dispute in the first instance by mutual discussions between the Parties.

10.2 Settlement by Arbitration

If a dispute between the Parties is not settled within thirty (30) days as provided in Clause 10.1 of the Agreement the Parties shall attempt to settle the dispute by alternative means of submission of the same to a mutually agreed arbitrator, for resolution by binding arbitration according to Commonwealth of the Bahamas's Arbitration Act 2009 and Rules of Arbitration. In so agreeing the Parties expressly consent and agree to waive their right to a jury trial, if any, on these issues and further agree that the award of the arbitrator shall be final and binding upon them as though rendered by a court of law and shall be enforceable in any court having jurisdiction over the same.

11 Extension of Term

11.1 Customer-Generator May Apply to Extend the Term of the Agreement

The Customer-Generator may apply to BPL in writing for an extension of the term at least three (3) months before the ending date.

11.2 BPL Has Discretion to Extend the Agreement

BPL may in its sole discretion extend the term of the Agreement under the same terms and conditions outlined in the Agreement or as modified by BPL and for such period as BPL deems fit.

12 Miscellaneous Provisions

12.1 Variations in Writing

Save and except for an extension of the term provided for under Clause 11 of the Agreement, any additions, amendments or variations to the Agreement shall be binding only if in writing and signed by a duly authorized representative of BPL and the Customer-Generator.

12.2 Prohibition against Assignment

The Customer-Generator shall not assign the Agreement or any of its rights or duties hereunder without the prior written consent of BPL. Any such assignment or delegation made without BPL's written consent shall be null and void.

12.3 Waivers

No waiver by BPL of any default by the Customer-Generator in the performance of any of the provisions of the Agreement shall:

I. operate or be construed as a waiver of any other or further default whether of a like or different character; or

II. be effective unless in writing duly executed by an authorized representative of BPL.

The failure by BPL to insist on any occasion upon the performance of the terms, conditions or provisions of the Agreement or time other indulgence granted by BPL to the Customer-Generator shall not thereby act as a waiver of such breach or acceptance of any variation.

12.4 No Third-Party Beneficiaries

The Agreement is intended solely for the benefit of the Parties. Nothing in the Agreement shall be construed to create any duty to, standard of care with reference to, any liability to or any right of suit or action in, any person who is not a Party to the Agreement.

Appendix B: Particulars of the Agreement

1. Customer-Generator: _____

Address of Customer-Generator_____

2. Account Name:_____

Account Number:_____

Service Address:_____

SSRG System Technology:_____(solar, wind, or hybrid of solar and wind)

SSRG system Nameplate Gross Power Rating: [ ] (kW)

Approved Gross Power Output to Grid: [ ] (kW)

Point of Delivery:_____