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THE CARICOM BEEP

A Regional Programme Document with Operational Guidelines

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Caribbean Community (CARICOM) Secretariat

Turkeyen, Guyana

December 2017

Prepared by Miguel Quinones in collaboration with the CARICOM Secretariat and the Regional Organization for Standards and Quality (CROSQ) with funding from Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.

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PREFACE

Energy is essential to enable the activities that are to be delivered and supported in buildings worldwide. It is needed to provide power to operate a range of devices and equipment in various building types. Within the Caribbean, two of the most important elements are the cooling technologies, such as air conditioning and refrigeration systems, and the electrical appliances, including the lighting system.

The primary means of supplying energy to Caribbean countries is through fossil based hydrocarbon fuels, which is generally expensive and subject to the volatilities in global market prices. A consequence of this is that for most commercial (including public) buildings, energy use is the single largest operating expense, representing approximately one-third of typical operating budgets. By becoming more energy efficient, building owners and operators can reduce operating expenses and stretch operating budgets much further. This is especially beneficial for public buildings, as many of our Governments continue to struggle to find the financial resources that are necessary to efficiently and effectively provide the required public services obligations, such as healthcare and education, to its citizens.

In the majority of CARICOM countries, energy consumption within the buildings sector has been growing faster than GDP. This is due to several factors, including overall population growth, an increased penetration rate of energy-consuming technologies, and higher energy consumption levels of various technologies. Residential, commercial and industrial buildings account for nearly 80 per cent of the total electrical energy consumption within the Caribbean. On the mesoscale, energy savings in buildings could, potentially, save significant amounts of oil imports and save foreign exchange that is required for the fuel import bill. Critically, the aggregated savings from buildings can reduce the rate of increase in electricity demand in many countries, thereby delaying the investment timetable for generation expansion, and reduce the peak demand for electricity in many countries, which would reduce the use of expensive peaking generators. Reducing fuel use also lowers the emission of carbon dioxide and other

greenhouse gases that contribute to climate change. Energy efficiency has emerged a crucial strategy within the CARICOM Energy Policy, as well as the national energy policies for the respective countries.

Already, through a joint initiative between the CARICOM Secretariat and the CARICOM Regional Organisation for Standards and Quality (CROSQ) to address the design of energy efficient buildings, recognising that this relies on a selection of appropriate techniques that complement the local climate, a Regional Energy Efficiency Building Code (REEBC), as well as Minimum Energy Performance Standards (MEPS) for air conditioning, refrigeration and lighting technologies, is being established. The CARICOM BEEP is a complementary initiative, which seeks to address the efficiency with which energy is accessed and used in public buildings, utilising the energy management practices and principles of the ISO 50001 as its framework.

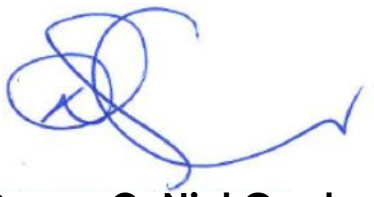
The aim of the BEEP is to significantly cut regional energy use by supporting public buildings to become as best practice cases that can encourage the industrial and commercial buildings sectors to continually improve their energy efficiency. The experiences of two organisations in which the BEEP was piloted – the CARICOM Secretariat in Georgetown, Guyana and the OECS Commission in Castries, Saint Lucia – were instrumental in the development of an Operational Document for the BEEP.

The energy management practices and principles, promoted by the BEEP, represents a significant opportunity for organisations to reduce their energy use while maintaining or boosting productivity. We envision that organisations, depending on their functions, can reduce their energy use by as much as 40 per cent through effective implementation of the BEEP. This operational document is intended to pave the way for wider adoption of the energy management practices and principles, by helping stakeholders to design programmes that better prepare their workplaces to successfully implement and manage these systems. In particular, it is intended that the document will help stakeholders to recognise that a committed and knowledgeable energy team, drawn from all

relevant divisions across their organisation (including management), is a precursor to successful implementation. By producing this operational document, the CARICOM Secretariat is seeking to expedite the successful use of the BEEP throughout the region to continuously improve energy performance in buildings.

This document has been produced with support from the Renewable Energy and Energy Efficiency Technical Assistance (REETA) Programme, which is being financed by the German Federal Ministry of Economic Cooperation Development (BMZ) and the CARICOM Secretariat. The REETA Programme is being implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (or the German Agency for International Cooperation, which is better known as "GIZ") and we are extremely grateful for their support as well as the contributions from the many actors involved in the preparation of the document. It is our hope that this document will serve as an extensive guide to stakeholders within the Caribbean Community, who wish to become part of the regional alliance, which is implementing the energy management practices and principles promoted by the BEEP within their respective organisations. It is our hope too that, ultimately, the BEEP will function as a proactive energy strategy that forms part of the overall strategy of the public and private organisations alike.

More generally, it is envisioned that this document will give you a deeper understanding of the important role that energy efficiency can play within economic development and social advancement of our Region, in an environmentally benign way.



Devon O. Niel Gardner
Programme Manager, Energy
CARICOM Secretariat

December 2017

EXECUTIVE SUMMARY

This document was developed to assist organisations with the implementation of projects within the framework provided by CARICOM's Regional Programme for Building Energy Efficiency Projects [BEEPs]. The BEEP falls under the umbrella of the Caribbean Sustainable Energy Roadmap and Strategy [C-SERMS], one of the components of CARICOM Energy Policy, designed to build on existing efforts in the Region and to provide CARICOM Member States with a coherent strategy for transitioning to sustainable energy.

The CARICOM Regional BEEP will benefit from a larger economy of scale to help incorporate more efficient technology which is often seen as expensive, riskier, and harder to maintain and operate; implement capacity-building to support facility managers and building operators; and aggregate building energy performance information; and coordinate with external institutions to secure financing and/or up-front capital.

The objectives and methodology lay out a standardised BEEP deployment process for current and potential candidate buildings. The proposed continuous improvement process is consistent with the Plan, Do, Check, Act, cycle described by ISO 50001.

The two BEEP pilot projects that have been implemented since the beginning of 2015 have proved to be very successful and have achieved significant energy and cost savings. The implementation of Performance Improvement Measures [PIMs] has resulted in:

15% **Energy savings and reduction of greenhouse emissions[1]**

27% **Lower energy expenditures[2]**

The pilot project PIMs included air-conditioning equipment upgrades, installation of energy-use monitoring, and low cost operational changes such as air conditioning distribution and thermostat adjustments, building envelope sealing, and better it system power management have allowed for the facilities to capture and sustain the savings, reinvesting them to achieve continued and accelerated energy performance improvements.

[1] Savings against pre-implementation baseline.

[2] Ibid.

ENERGY MANAGEMENT SYSTEM BENEFITS

1. ***Improve*** *asset utilisation, reduce waste, and improve reliability;*
2. ***Promote*** *and* ***support*** *Member States in making better use of their limited resources. Integrate the practices as part of the investment mechanism for energy development throughout the Region;*
3. ***Reduce*** *operational costs. Bridge the gaps between accounting, maintenance, and operation by monitoring, measuring, and managing energy consumption;*
4. ***Promote*** *leading edge technologies. Become an early adopter of new products, services, concepts, and practices that can help develop a low-carbon economy in the future;*
5. ***Promote*** *environmental performance and reduce greenhouse gas (GHG) emissions.*
6. ***Reduce*** *emissions and pollution, reduce resource consumption (e.g., consumption of fuels, water, etc.), and reduce greenhouse emissions;*
7. ***Meet*** *mandatory and voluntary requirements and other GHG emission reduction legislations. Advance toward environmental goals from the National Sustainable Development Goals: 7, ensuring access to affordable, reliable, sustainable and modern energy for all; 11, make cites and human settlements inclusive, safe, resilient and sustainable; 12, ensure sustainable consumption and production patterns; and 13, taking urgent action to combat climate change and its impacts;*
8. ***Make*** *energy a top management priority. Treat energy performance as a key performance metric for organisational success;*
9. ***Document*** *and organisational energy policy and objectives. Provide resources for unbiased decisions, energy management integrity, and the transition to an energy aware organisational culture;*
10. ***Integrate*** *energy management with other management systems.*
11. ***Align*** *the EnMS with encompassing organisational goals for leverage;*
12. ***Improve*** *Energy Resilience. Mitigate the risk exposure associated with volatile fossil fuel pricing and distribution;*
13. ***Commit*** *to new solutions. Create competitions, offer incentives, and engage stakeholders in the development of new technologies, products, or services that can help the advancement of sustainable development;*
14. ***Fiscal*** *and performance accountability. Document, measure and verify, track, benchmark, and report on the outcomes the projects. Lead Member States on how to meet their INDCs through accountability.*
15. ***Promote*** *organisational integrity. Provide open platforms to educate stakeholders on the importance of managing energy use and generation.*

This programme document elaborates the concept and processes for the deployment of the BEEP programme at two different levels: the CARICOM Regional BEEP Programme as described in Chapter 1, and elaborates on the implementation of an energy management system in buildings, using the experiences from the two pilot BEEPs as described in Chapter 2.

Acknowledgements

This document was built on the countless hours and previous reports from a vast network of valuable collaborators.

First, we would like to thank the Caribbean Community (CARICOM) Secretariat, and the German Agency for International Cooperation (GIZ) for their continued support of this programme.

We would also like to thank the CARICOM and GIZ staff, in particular Devon Gardner, Programme Manager for Energy and Head of the Energy Unit of CARICOM; and his colleague Nadia Mohammed, Project Officer for Energy; as well as Glynn Morris, Programme Leader of the GIZ Renewable Energy and Energy Efficiency Technical Assistance (REETA) Project; and his colleague Amanda Harris-Logie, Energy Efficiency Project Officer, for their invaluable guidance, assistance, and encouragement.

Many more individuals and groups dedicated time and effort to supporting this project and deserve gratitude.

Miguel Quinones, Sustainability Project Manager
St. Thomas
November 2017

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Chapter 1

CARICOM REGIONAL BEEP OBJECTIVES

The overall goal of this regional initiative is to reduce the demand for imported petroleum-based primary energy that is required for energy service needs in buildings in the Caribbean. This outcome is to be achieved within the C-SERMS framework using an energy management system that is based on the international standard, ISO 50001 – and interventions such as improved operational measures, as well as investments in energy efficiency and on-site (and distributed) renewable energy electricity generation infrastructure. The individual project savings will be aggregated to meet national goals and in hand advance toward regional targets.

The BEEP is the implementation component of the energy efficiency approach in buildings. The empirical data collected will aid with the establishment and validation benchmarks to be included in the Regional Energy Efficiency Building Code [REEBC] and the Minimum Energy Performance Standards [MEPS]. It is expected that the information harnessed from the BEEP can be integrated into the REEBC/MEPS. The data findings, best practices, and energy management systems will in turn direct the financial component of energy efficiency in buildings *via* the Integrated Utility Services Model [IUSM].

The regional effort is supported by localised deployment at organisational level. At the national level, the BEEP will help organisations improve their operational performance and lower their environmental footprint. The BEEP relies on a continuous improvement process which will ensure that energy and water savings are sustained. The BEEP process consists of the following high-level actions:

1. **Determining** potential savings that can be achieved after completing a comprehensive energy audit;
2. **Developing** a mechanism for investment which senior management can utilise to attract finance for the continuous implementation of energy efficient solutions;
3. **Working** toward a concrete and structured method for the implementation of the National SDGs in buildings;
4. **Encouraging** employee engagement in implementing energy efficiency at work, extending to the residential and commercial sectors;
5. **Promoting** energy efficient behaviour to allow for the development of "energy efficient status" and a means for benchmarking for further improvement;

6. Implementing a facility energy management system that includes a measurement and verification system which periodically reports energy efficiency and savings in real time as well as storing it on a data base;
7. Providing capacity building for staff by offering training in ISO 50001.

BEEP PARTICIPATION REQUIREMENTS

The basis for an organisation initiating and implementing a BEEP project are the following:

1. The organisation's management (a manager/energy champion) must be committed and allocate the role and responsibility for energy management (and be the primary recipient of training and capacity building) along with a vibrant energy efficiency committee;
2. The organisation must be responsible for payment of utility bills and be authorised to make building modifications and make investment decisions;
3. The organisation must make the documentation of the BEEP experience available to the public to enable sharing and mutual learning by other BEEP and other interested parties; and
4. The organisation must be willing to implement recommendations from the developed Minimum Energy Performance Standards and Regional Energy Efficiency Building Code during the execution of the BEEP.

REGISTRATION PROCEDURE

To register a BEEP with the Energy Unit in the CARICOM Secretariat and be eligible for technical assistance under the GIZ REETA project, the organisation must:

1. Comply with the BEEP PARTICIPATION REQUIREMENTS;
2. Collect energy consumption and billing for at least the past twelve (12) months to develop the energy consumption baseline;
3. Management must send a formal request (email or letter) to the Programme Manager for Energy in the CARICOM Secretariat[3];
4. Complete registration form Program Application form included in Appendix B; and
5. Respond to any queries from the CARICOM Secretariat.

[3] Programme Manager for Energy, Energy Unit, Caribbean Community Secretariat, P.O. Box 10827, Turkeyen, Greater Georgetown, Guyana or energy@caricom.org

BEEP COMMENCEMENT

Once the REGISTRATION PROCEDURE has been completed, the Energy Unit will schedule an induction session with the organisation's Building Energy Efficiency Committee, the Energy Champion and the head of the organisation or a designate.

INDUCTION SESSION

The induction session, a preliminary meeting where the Energy Unit and GIZ will review the forms and together with the organisation's BEEP project team will outline the BEEP work plan for the next three (3) years with greater focus on the first twelve (12) months. The work plan outline is illustrated in Figure 1 BEEP Gantt Chart.

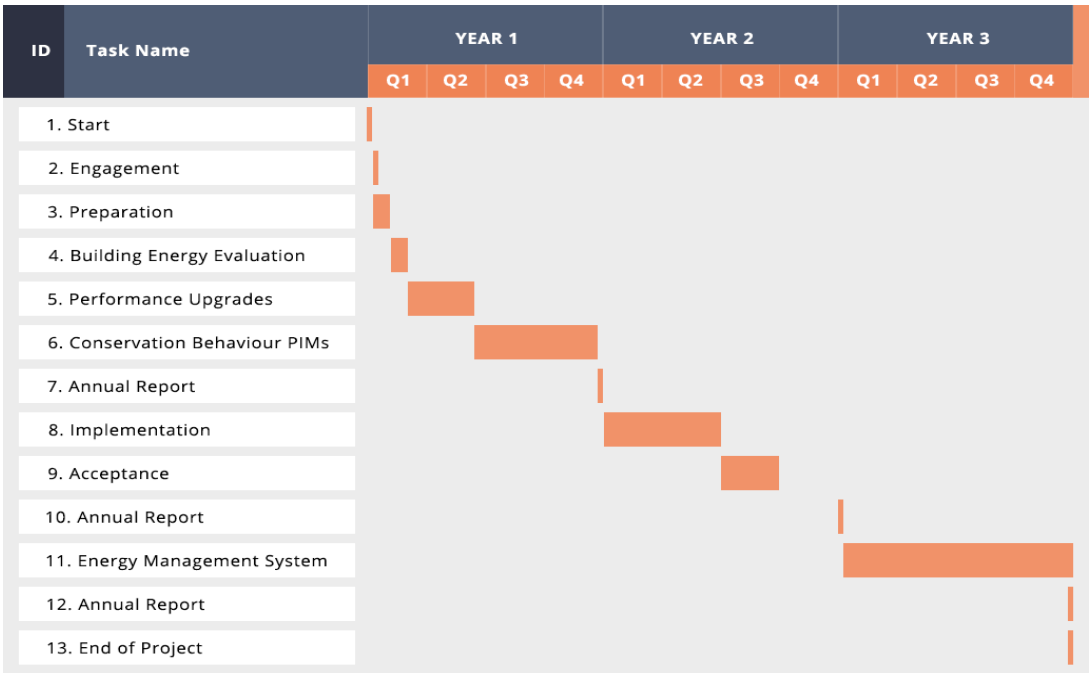


Figure 1 BEEP Gantt Chart

Following this outline of the work plans, a date will be identified and agreed on for the completion of the Energy Audit and the finalised/customised BEEP work plan to be submitted by the Energy Champion. These activities should be completed within the first three (3) months of the BEEP. The baseline will be established using the data submitted with the Programme Application form.

Participants will be briefed on using the "New ISO 50001 publication to help smaller firms break energy barrier" written by Liam McLaughlin[4].

BEEP WORK PLAN

The BEEP work plan will encompass the seven (7) steps described in the BEEP TASKS section. The recommended timeframe for the BEEP completion is highlighted in Figure 1 BEEP Gantt Chart and in the remainder of this subsection.

Year 1

The report submitted to CCS and GIZ at the end of the first year will provide a comparison of the previous 24 months of data identifying significant trends and comparisons between the base line and the no/low cost PIMs. The report will also specify what new measures will be implemented over the next six (6) to twelve (12) months and highlight was the major contributors to the expected reduction in energy consumption were. After the first year, the Energy Manager will obtain training to become a certified energy manager. The Energy Manager will also complete training in ISO Energy Management Systems before the end of the second year.

1. **Prepare** and **submit** monthly energy monitoring reports to CCS and GIZ for the first twelve (12) months in an excel spread sheet that will be distributed and discussed during the induction training. (The UNEP excel format).
2. **Complete** the items described in the ENGAGEMENT section within the first (1st) month after the BEEP INDUCTION SESSION.
3. **Complete** the items described in the PREPARATION section within the second (2nd) month after the BEEP INDUCTION SESSION.
4. **Complete** the items described under the BUILDING ENERGY EVALUATION section within the third (3rd) month after the BEEP INDUCTION SESSION.
5. The PERFORMANCE UPGRADES report will include recommendations for no/low cost Performance Improvement Measures [PIMs] to be implemented. These no/low cost PIMs will mostly consist of energy efficient behaviours and awareness programmes.
6. During the first three (3) months after the BEEP INDUCTION SESSION the Building Energy Efficiency Committee members and the Energy Champion will obtain training in ASHRAE Level 1, 2 and 3 energy audits.

[4] L. McLaughlin, "ISO 50001 - Energy management systems - A practical guide for SMEs", ISO, 2015

7. During the first twelve (12) months after the BEEP the Building Energy Efficiency Committee members and the Energy Champion will obtain training in Financial Analysis for energy projects.
8. **Building** Energy Efficiency Committee and CCS/GIZ must perform quarterly review meetings.

Year 2

It is expected that during the second year that some more significant energy efficient measures (medium to high cost) will be implemented and reports will be submitted at the end of year two (2).

1. **Complete** the tasks described in the IMPLEMENTATION section within the first twenty-four (24) months after the BEEP INDUCTION SESSION.
2. **Complete** the tasks described in the ACCEPTANCE section within the first twenty-four (24) months after the BEEP INDUCTION SESSION.
3. During the first twenty-four (24) months after the BEEP INDUCTION SESSION the Energy Champions, Energy Managers, and Assistants will obtain training in ISO 50001 Energy Management Systems.
4. **Prepare** and **submit** annual energy monitoring reports to CCS and GIZ in an excel spreadsheet according to the requirements set in the Reports; and
5. Post Implementation Roles section.

Year 3

During the third year one key output will be to implement distributed/renewable energy supply for the buildings which will be funded from the savings gained from implementing EE measures. The energy committees will be challenged to develop innovative and creative sustainable energy efficiency solutions.

The final report at the end of year 3 should reflect on the savings that were derived from the various energy efficiency initiatives – from applying energy conservation to installing energy efficient devices.

ROLES AND RESPONSIBILITIES MATRIX

The Responsible, Accountable, Consult and Inform [RACI] Matrix is below

Table 1 Roles and Responsibilities Matrix

Tasks and subtasks	CCS	GIZ	BEEP Applicant Organization
Meet BEEP Participation Requirements	I	I	R
Submit Request for BEEP	A	I	R
Approve BEEP	R	C	I
Induction Session	R	C, I	A
Develop and Complete BEEP Work Plan	A	C, I	R
Execute Engagement Tasks	A	C, I	R
Procure and Complete Building Energy Evaluation	A	R	C, I
Complete Performance Upgrades Tasks	A	R	C, I
Develop and Complete Training & Workshops	R	R	A
Implement no/low cost PIMs	A	I	R
Procure and Complete Implementation Tasks	A	C, I	R
Complete Acceptance Tasks	A	C, I	R
Complete and submit monthly and other periodic reports	A	C, I	R
Complete Energy Management System Tasks	A	C, I	R
Monthly Meetings	R	C, I	A

Throughout the project there will be meetings convened (usually online). The first meeting will be the Induction Meeting. The induction meeting will consist of:

1. A full overview of the project.
2. A general outline on the expectations.
3. The present state of the energy performance.
4. Key steps identified in the INDUCTION SESSION section for moving forward.

Monthly Progress Update Meetings will be held with the Energy Manager, CARICOM and GIZ. Semi-annual meetings will be convened for the first year with CARICOM and Senior/Executive Management to follow up on strategic plans.

All formal communication must be in writing *via* email and when necessary on an official letter head of the respective party. Monthly meetings minutes must be recorded. The Building Energy Efficiency Committee and Energy Champion will also participate in verbal telephone communication for follow-ups and information requests.

In an event that the BEEP is not providing the expected outcomes, the project will be reassessed, and a meeting convened between CCS and the senior management. As for those projects that will yield exceptional results, every effort will be made to publish and share these achievements *via* the CARICOM Energy Portal, the CARICOM Energy Quarterly, social media networks and energy week activities.

The Programme Managers, CCS and GIZ, will review the outcome of the ongoing BEEPs and determine how to improve the procedures to allow for innovation and creativity. Such decisions will be communicated to the group and the rules of engagement clearly defined at that time.

BEEP RESOURCES

CARICOM and GIZ are committed to the success of BEEPs and are prepared to offer technical support through hosting training sessions, workshops, meetings, engaging regional and international donors, and creating a centralised framework for the sharing of information and best practices.

Training

The BEEP will allow for training in the following areas:

Training	**Proposed Participants**	**Duration**	**Proposed Time**
Energy Auditors *Level 1* *Level 2* *Level 3*	BEEP Committee Members	 1 Day 2 Days 2 Day	 Month 1 to 3 Month 1 to 3 Month 1 to 3
Financial Analysis in RE and EE	Energy Managers, Financial Managers	5 Days	Month 1 to 12
ISO 50001	BEEP Energy Champions/ Energy Managers & Assistants	5 days	Month 12 to 24

Workshops

It is expected that the BEEP will facilitate workshops among BEEP stakeholders, including personnel, senior ministers and representatives from the CARICOM Energy Unit, the Bureaux of standards, Donor Agencies, Regional Institutions and other stakeholders. These workshops will seek to enable a platform where by participants share best practices and simultaneously create a community of practice for ongoing project development and integration into the MEPS/EEBC.

Below are the workshops proposed by BEEP:

Workshops	**Purpose of Workshop**	**Duration**	**Proposed Time**
Energy Efficiency Building Code & Minimum Energy Performance Standards	To familiarise and Create synergies and awareness between the BEEP and the EEBC and MEPS.	2 Days	Month 6 to 8
BEEP Best Practices	To share among BEEP participants challenges and best practices on executing the BEEP.	2 Days (can be done Virtually)	Month 4 to 5 Month 10 to 12 Month 18 to 20 Month 29 to 32
The BEEP and the Integrated Utility Services Model	To establish how the BEEP will impact the IUSM and allow for synergies between the BEEP, EEBC/MEPS and the IUSM.	3 Days	Month 32 to 36

BEEP TASKS

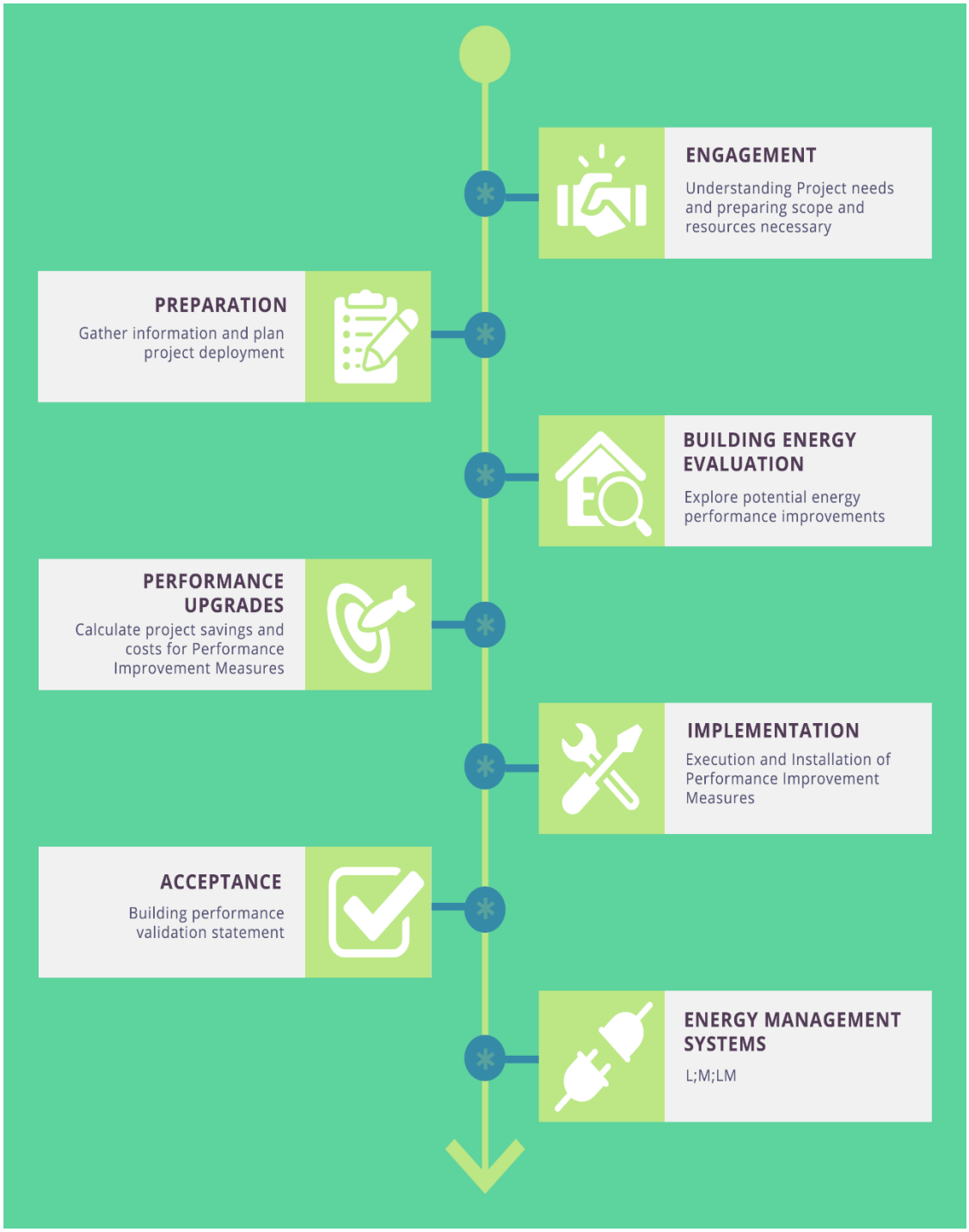


Figure 2 BEEP SEOP Steps

The first six steps serve to improve the organisation's energy performance by:

1. **Preparing** for the project by gathering building information and historical energy use;
2. **Evaluating** equipment conditions and user practices;
3. **Developing** a plan to upgrade equipment and embracing more efficient business practices;
4. **Implementing** the plan to upgrade equipment and put into practice efficient policies and procedures; and
5. **Validating** the results of the implementation against the plan.

The role of the seventh step, the implementation of an Energy Management System [EnMS], is to ensure that those hard-earned savings and performance improvements are preserved and expanded over time. The EnMS is a continuous improvement cycle that involves: setting policies, goals, and targets; executing action plans; and consistently fine tune operations for better results.

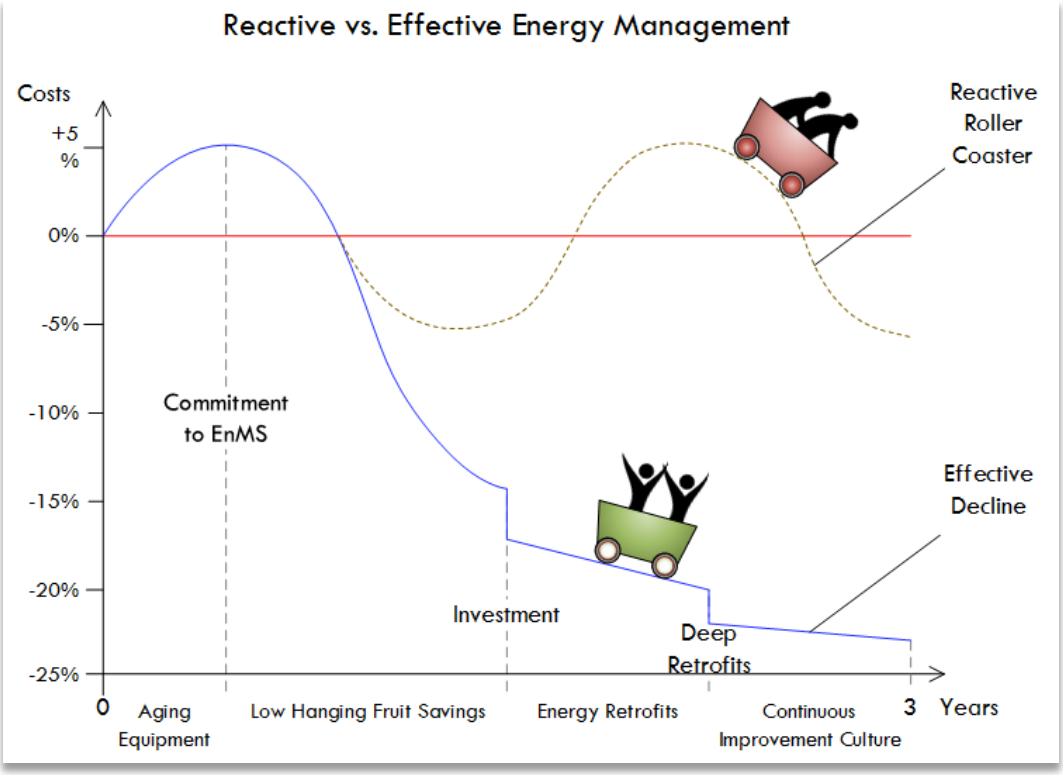


Figure 3 Advantage of an Energy Management System

EXPANDED TASKS DESCRIPTION

ENGAGEMENT

Process Overview

Operational energy expenditures in buildings associated to equipment use and occupant behaviours is often the second or third largest expenditure for organisations in the Caribbean. The only path toward a sustainable organisation is to prioritise and commit to continuous energy performance improvements. The process defined here is designed to address any business activity.

Project Launch

Meeting the Organisation's Needs

In most cases energy projects are driven by high operational costs, but there are other aspects worth considering such as:

- Building and equipment improvements;
- Occupant comfort;
- Indoor environmental quality;
- Daylighting;
- Water use;
- Organisational and regulatory concerns.

Lower energy costs come from the implementation of Performance Improvement Measures [PIM][5], delivering better or comparable quality of services at reduced operational costs.

Plans that will bring operational improvements but will not reduce energy use are considered Facility Improvement Measures [FIM].

[5] The term Performance Improvement Measure [PIM] was used in lieu of other terms like Energy Conservation Measures, Energy Efficiency Measures, Energy Management Efficiency Opportunities, or Energy Management Opportunities because the goal proposed is to improve operational and productivity performance by affecting occupant behaviours, energy use, maintenance practices, management policies, purchasing and leasing criteria, renewable energy generation, and water use.

Assembling a Team

The selection, guidance, and commitment of the team is vital for the success of the venture. The first step is considering setting aside time and resources to support an Energy Champion to lead the project and be the point of contact. Given the size of the project and the organisation's operation the team can be scaled up.

Meeting Preparation

In preparation for the inception meeting, gather all the information that can help the Energy Services Providers meet the organisation's energy goals:

- Building and equipment information;
- Construction drawings or building layout;
- Twenty-four (24) months of utility information;
- Operations and Maintenance information;
- Commissioning reports;
- Additional supporting information.

In addition to gathering information you should start thinking about the definition of the scope; boundaries; savings and sustainability targets will play an important role on the type of building evaluation to be performed, magnitude of the budget, level of staff commitment, project completion timeframe. The most important goal setting goals is that they are Specific, Measurable, Achievable, Realistic, and Time bound [SMART]. Goals fall under the following categories:

- Lowering costs;
- Occupancy comfort;
- Improved reliability and efficiency;
- Safety;
- Property transactions;
- Procurement;
- Regulatory compliance, and
- Sustainability goals.

Project Inception Meeting

The main purpose of the meeting is to state the organisation's expectations for the project and discuss the preliminary goals identified previously and the Energy Services Provider's ability to deliver the types of services required for the project.

Discuss Energy Services Provider qualifications 1F[6] to perform:

- American Society of Heating, Refrigerating and Air-Conditioning Engineers [ASHRAE] Level 2 or Level 3 audits;
- ISO 50001 implementation;
- Commissioning;
- Retro-commissioning;
- Measurement and Verification;
- Financial Analysis; and
- Highlight the different funding mechanisms for the project and agreed on preferred mechanism.

[6] Detailed descriptions of the qualifications mentioned in this paragraph will be explained in detail in later sections.

PREPARATION

The second step, preparation, incorporates the facility information with the findings from a preliminary site evaluation to develop a draft a scope and action plan in line with the organisation's needs.

Preliminary Building Energy Evaluation

Ideally, the inception meeting can be followed up by a quick tour around the facility for the Energy Service Providers to get a better sense of the operating conditions of the organisation. They will probably take some pictures and ask the staff about comfort, practices, and the operation of equipment during their standard operation. The time allotted for the evaluation will depend on the size of the facility, for smaller buildings it should take only a few hours, larger building might take half day.

Evaluation Focus

Initially, the focus will be on capturing a snapshot of the operations and inventory equipment which is responsible for energy use, allowing or generating heat within the occupied space, use water, or impacts the indoor environment quality.

It's important that all the systems and operation of the major systems are covered: building envelope, chiller systems, boilers, air conditioners, air handlers, lighting systems, appliances, and office equipment.

Preliminary ECM listing

While touring the site, the evaluator will record models, observations, and take pictures of potential PIMs and FIMs. FIMs on the other hand will not improve performance but may be important to consider as they can improve safety, security, or quality of services provided. Ideally the low/no cost PIMs could be implemented immediately if they don't negatively affect other aspects of the operation and provided the organisation possesses the resources to do so.

Some low/no cost PIMs are:

- Adjusting equipment running times;
- Adjusting lighting timers;
- Calibrating thermostats;
- Replacing air conditioner filters, and
- Adjusting temperature setpoints and night setbacks.

It important to understand how the different system components work together, for example the lighting with natural day lighting or air-conditioned spaces with heavy traffic to the exterior of the building.

Benchmarking

Benchmarking, consists of establishing a reference measurement or baseline against which the building's performance can be compared. The facility can also be compared against facilities of similar use normalised for size and weather. The comparison serves as an indicator of the overall health of the system. The metrics are essential in that the building performance baseline will be valuable for future efforts to quantify and verify energy savings, energy intensity reduction, and greenhouse gases emissions reduction to name a few. The most common metric for benchmarking is the Energy Use Index [EUI]: an expression of building energy use per year in terms of net energy divided by gross floor area (kWh/m^2). The accuracy provided by monthly consumption data is sufficient for the preparatory stages of the project. As the project moves forward it's essential that real-time metering be deployed at the equipment level or at minimum for the entire facility. CARICOM is committed to support the hosting and standardisation of building metrics across the Region to have more robust performance metrics. In the meantime, there are other tools available which can be used to document monthly energy and water consumption for further analysis.

Benchmarking Tools

Energy Star Portfolio Manager

Interactive resource management tool created by the U.S. Environmental Protection Agency that allows you to track the energy and water use across the organisation's entire portfolio of buildings. It can be used for: setting baselines, set performance goals for individual buildings or groups of buildings, present graphics, and monitor progress toward those goals.

Portfolio Manager scores buildings based upon their energy consumption, weather, type of building, location, and changes over time as building practices become more stringent.

Building Performance Database [BPD]

Tool created by the U. S. Department of Energy that allows you to explore the data across real estate sectors and regions, and compare various

physical and operational characteristics to gain a better understanding of market conditions and trends in energy performance.

Building Energy Asset Score [Asset Score]

Tool also developed by the U.S. Department of Energy for evaluating the physical and structural energy efficiency of commercial and multifamily residential buildings. The scoring tool stores the data and generate an asset score and system evaluation for the building envelope and mechanical and electrical systems. The tool will also identify cost-effective upgrade opportunities and help you gain insight into the energy efficiency potential of the building.

Energy Use Analysis

The two years of energy use and billing information provided to the Energy Services Provided will be analysed to:

- Better understand building energy use by the different building systems;
- Determine current and historical energy demand and consumption trends;
- Ensure all aspects that impact energy usage such as weather, time, and changes in building operations and occupancy are taken into consideration.

The EUI is a good indicator, when normalised for the climate, it allows for the building's energy consumption to be compared against buildings of different sizes, geographic location, construction type, age, building purpose, hours of operation, and occupancy.

The EUI, consumption, demand, and costs graphs will simplify the identification of historical trends and energy use spikes. The analysis can also be used to estimate future use and costs.

In addition to the EUI, the analysis will also yield global energy rates, calculated from the baseline year energy expenditures divided by energy consumption. These rates will be used in savings calculations, PIMs and FIMs cost calculations. The comparison of the rates of multiple energy sources will help you identify the most cost-efficient alternatives for the different building systems, for example replacing electric equipment for solar thermal.

The calculated rates are not the same as the utility rates. Utility rate structures, vary from one jurisdiction to the next, from flat usage rates to time of use rates.

The analysis of current rate structures may reveal alternative rates which are more favourable for you.

The following areas provide starting points to understanding utility rate structures.

Energy Consumption Charges

Monthly energy usage charges recorded by the utility meter, may include other charges such as customer, demand, power factor, and miscellaneous charges.

Demand Charges

Demand charges are based on the peak electricity usage of a customer during a billing period. Demand is usually measured on 15-minute intervals.

Power Factor Charges

Charges billed for poor use of the installed electrical system capacity.

Block Charges

Energy use is billed at different rates based upon set usage intervals called blocks. In some cases, the rates are escalating to promote energy conservation, and in other jurisdictions the prices step down to promote more consumption.

Ratchet Demand Charge

Demand rates are set based upon demand spikes where utilities can set future demand charges as a fraction of the maximum recorded level.

Time-of-Use Rates

Time-of-use pricing [TOU] applies to usage over broad blocks of hours: on-peak, off-peak.

Energy Use Allocation

One of the most complex aspects of benchmarking is the allocation of energy use to the different building systems. In some extraordinary cases the systems are metered separately, but in most cases energy consumption and demand is measured at the main meters for the building.

Having a clear picture of which building system is responsible for the consumption allows to focus more resources on the large ticket items and designing PIM's to

reduce the consumption. Energy Services Providers estimate the energy use allocation using industry best practices, site evaluations, and computer energy modelling. The models must be validated for accuracy against recorded consumption. The data is presented in pie charts for a powerful representation of all the systems adding up to 100%.

Allocation Calculation Methodology

There are three different methods to calculate energy consumption for the allocation and listed below in order of accuracy:

Estimate

The Energy Services Provider uses equipment information and baseline energy consumption to estimate how much energy is used by each system. Generally, accurate for lighting systems with rigid schedules. As equipment use or external conditions vary the calculation becomes less accurate.

Energy Model

Energy models have the advantage that not only can they be used to calculate energy consumption, but also interior temperature distribution, artificial and daylighting patterns, and more. The most useful feature of energy models is the ability to account for the interaction among PIMs, for example how the installation of LED lights will lower air conditioning loads so a smaller air conditioning unit would be able to cool the space efficiently.

Modelling simple buildings with simple systems is quite straightforward and accurate to around 10% error, as complexity increases accuracy needs to be validated and modelling costs spike. They can be used for existing or new buildings, the later can't be validated against real energy use.

Measured

This method requires deploying sub meters or dataloggers for the building systems in question. The measurements should be taken over time for statistically valid results. The measurements are very accurate if all the elements of a building system are measured.

Trends in Energy Use

In most cases, building energy use varies over time and the causes vary from changes within the organisation to changes from equipment upgrades. Energy use is tracked over time to have a more detailed grasp of current and future events effects on energy consumption.

The small variations of the Caribbean climate don't affect energy consumption as markedly as in regions with large seasonal variations, but none the less energy consumption will increase in summer due to the warmer temperatures. In some cases, there might be increases caused by occupancy changes, equipment failures, or situations where manually operated equipment is left on for days at a time.

BUILDING ENERGY EVALUATION

We have used the term building energy evaluation because it better describes the activity. Other terms are often used in lieu of building energy evaluation: energy audits, energy assessments, energy survey, investigation, etc. The main purpose of the building energy evaluation is to explore potential PIMs and FIMs. The Energy Services Provider will examine the building systems and their operation. They will also consider building occupancy.

Levels of Effort

The American Society of Heating, Refrigerating and Air-Conditioning Engineers [ASHRAE] has defined three levels of evaluation based upon the level of effort necessary to complete them:

Level 1, Walk-Through Building Energy Evaluation

Level 1 is the type of evaluation performed during the preparation stage to understand the building's energy cost and efficiency. Energy use is analysed, and calculations should be supported by a quick building energy evaluation. This level will help identify low-cost/no-cost measures, highlight, and prioritise PIMs and FIMs from Level 1 evaluations are not as accurate as Levels 3 and 4.

Level 2, Detailed Building Energy Evaluation

Level 2 evaluations differ from Level 1 in that the energy savings calculations and cost analyses for PIMs and FIMs in Level 2 are much more accurate those of Level 1. The recommended measures must meet the organisation's constraints and economic criteria, along with proposed changes to operation and maintenance [O&M] procedures.

Level 3, Detailed Energy Model

Level 3 improves over Level 2 in that it includes a computer simulation of the facilities' energy use and expenditures. The energy modelling may also perform lighting and daylighting distribution simulations. It provides detailed project cost and savings calculations with a high level of confidence sufficient for major capital investment decisions.

It often goes beyond the economic analysis of a Level 2 PIMs should be prioritised based the lowest life-cycle cost analysis 2F[7][LCCA] and the highest Savings to Investment 3F[8][SIR].

Table 2 Building Energy Evaluation Tasks

Process	Level		
	1	2	3
Conduct Preliminary Energy Analysis	☐	☐	☐
Conduct walk-through evaluation	☐	☐	☐
Identify low-cost/no-cost recommendations	☐	☐	☐
Identify capital improvements	☐	☐	☐
Review mechanical and electrical [M&E] design and condition and O&M practices		☐	☐
Measure key parameters		☐	☐
Analyse capital measures (savings and costs, including interactions)		☐	☐
Meet with owner/operators to review recommendations		☐	☐
Conduct additional testing/monitoring			☐
Perform detailed system modelling			☐
Provide schematic layouts for recommendations			☐

[7] Life-cycle Cost Analysis is the sum of all recurring and one-time (non-recurring) costs over the full life span or a specified period of a good, service, structure, or system. In includes purchase price, installation cost, operating costs, maintenance and upgrade costs, and remaining (residual or salvage) value at the end of ownership or its useful life.

[8] Savings to Investment Ratio is the total energy savings over the lifetime of the improvement divided by the upfront cost of the investment.

Report	Level		
	1	2	3
Estimate savings from utility rate change	☐	☐	☐
Compare EUI to EUIs of similar sites	☐	☐	☐
Summarise utility data	☐	☐	☐
Estimate savings if EUI were to meet target	☐	☐	☐
Estimate low-cost/no-cost savings		☐	☐
Calculate detailed end-use breakdown		☐	☐
Estimate capital project costs and savings		☐	☐
Complete building description and equipment inventory		☐	☐
Document general description of considered measures		☐	☐
Recommend Measurement and Verification [M&V] method		☐	☐
Perform financial analysis of recommended PIMs		☐	☐
Write detailed description of recommended measures			☐
Compile detailed PIM cost estimates			☐

Planning

The plan for the site evaluation will be developed based upon the findings from the meeting and the energy use analysis. The focus will be on the aspects which use the most energy, equipment that is near the end of life, or other priorities.

The building systems should be evaluated in operation to diagnose apparent inefficiencies. Equipment measurements are necessary for big energy users. Proper planning is required for data logging, the recording of measurements for a limited timeframe. Data logging needs include quantity, location, and type of data to record: energy consumption, demand, occupancy, carbon monoxide or dioxide levels, humidity, temperature, and light levels.

Other tools that might be used during the evaluation are air balancing hoods, indoor air quality meters, power analysers, water meters, thermal imagers, and others. The Energy Services Providers should be qualified to use the field equipment at hand. A licensed electrician should be the one to install measurement equipment on electrical circuits.

Data Gathering

Planning will prove valuable when scheduling site visits with Energy Services Providers. The evaluation will gather information about all the building systems:

Table 3 Building Systems to be evaluated

Building Information

- Conditioned floor area by space function;
- Occupancy schedule;
- Mechanical equipment schedules;
- Lighting schedules;
- Utility service;
- Building use;
- Summary of systems.

Building Envelope

- Main structure types (drawings, structure layer description);
- U-factors of walls, roof, floors;
- Window and door types, window and door areas by orientation;
- Condition of sealing/infiltration;
- Roof condition and type (reflectance).

Table 4 Building Systems to be evaluated continue

Cooling

- Chiller types/capacities;
- Chiller sequencing
- Chilled-water flow (constant/variable);
- Condenser-water flow (constant/variable);
- Pumping capacities and sequence;
- Chiller part-load method.

Unitary Cooling

- Equipment type/capacity;
- Control sequence;
- Unit schedules;
- Equipment efficiency.

Lighting

- Inventory of equipment/type;
- Record of existing lighting levels;
- Controls (e.g., photocells, occupancy sensors, manual switching, timers).

Plug Loads

- Inventory of computers/ servers/monitors;
- Office equipment type and density;
- Vending machines.

Air Handling

- Inventory of equipment/type;
- Supply airflow;
- Cooling capacity;
- Ventilation/exhaust rates;
- Zone controls;
- Ventilation rates in typical spaces.

Domestic Water

- System type (boiler/water heater);
- Storage capacity;
- Recovery rate;
- Recirculation type;
- Pumping capacities and sequence.

Controls

- Trending capability;
- Controlled points/equipment/zones;
- Pneumatic versus direct digital control (DDC) equipment.

Other/Miscellaneous

- Electric distribution schematic;
- Uninterruptible power supply (UPS)/transformers;
- Backup power;
- Cogeneration on site;
- Thermal storage;
- Renewable generation;
- Vertical transport (elevators, escalators);
- Kitchen equipment.

Building Schedule

Equipment scheduling is generally provided by the maintenance staff.

- Occupied/unoccupied hours in each controlled zone;
- Cool down periods;
- Unoccupied override conditions and timers;
- Flow control resets (e.g., fan static pressure with VAV box dampers);
- Equipment operating temperature resets (e.g., chiller with outdoor air);
- Cooling tower condenser water resets.

Building Setpoints

Some of the setpoints are set by design and controlled by automated systems while others can be manually controlled or an indirect product of other setpoints. The Energy Service Provider should validate the following setpoints:

- Space temperature;
- Space humidity;
- Space lighting levels;
- Minimum outdoor airflow rates;
- Carbon dioxide levels;
- Economiser limits;
- Boiler temperature;
- Chiller temperature;
- DHW storage and delivery temperatures;
- Fan system flow control static pressure;
- Water loop system flow control static pressures;
- Cooling system enable conditions.

Building Thermal Load

Equipment loading and load calculation has a significant impact on energy use and energy costs. In the case of cooling loads, it could also affect indoor environmental quality. Loads should be verified for accuracy for the current application.

Existing Building Commissioning Activities

Many buildings have been occupied without the proper commissioning; the verification of the subsystems for mechanical (HVAC), plumbing, electrical, fire/life safety, building envelopes, interior systems (example laboratory units), co-generation, utility plants, sustainable systems, lighting, wastewater, controls, and building security to achieve the owner's project requirements as intended by the building owner and as designed by the building architects and engineers. Regardless of the status of commissioning, it might be productive to perform the appropriate checks and balances to ensure that the building is operating as intended to satisfy the current needs. This involves investigating cooling, electricity, and domestic water distribution. If problems are found, their fixes can be integrated as PIMs or FIMs.

PIM & FIM PRIORITY

The product of the building energy evaluation is to add detail to the preliminary list of PIMs and FIMs. Each PIM/FIM proposed must include description, savings information and supporting information, cost estimates for all aspects, implementation plan, and measurement and verification methodology.

The results should be summarised in a table listing al PIMs and FIMs in preparation for the detailed costs analysis in the Performance Upgrades section.

PERFORMANCE UPGRADES

The Energy Services Provider will perform a detailed savings and costs calculations for the PIMs and FIMs in preparation for the implementation for the project.

Cost and Savings Calculation

All costs associated with the implementation of a PIM, FIM, or group of measures should be documented in detail together with supporting assumptions and data sources that are used for financial calculations.

Detailed estimates of energy savings, cost savings, operations and maintenance savings, and environmental impacts associated with the implementation of PIMs and FIMs should also be documented in detail.

Recommendations Report

In addition to the costs/savings calculations the recommendations report should must also include the following information for each PIM/FIM:

- A table listing all PIMs and FIMs summarising costs, SIR, simple payback; LCCA, savings, and greenhouse gas emissions reduction;
- Implementation strategy, costs, and schedule;
- Project funding mechanisms;
- Graphs illustrating the before and after energy used scenarios;
- Commissioning strategy;
- Operations and Maintenance Requirements;
- Measurement and Verification protocol.

Approval

After reviewing the proposed recommendations, you can make an informed decision on whether PIMs or FIMs should be implemented and in which order and timeframe.

IMPLEMENTATION

After the financial and technical aspects of the project have been evaluated, and a project scope has been developed, the implementation phase can be scheduled. The implementation phase is subdivided in planning, PIMs/FIMs installation, construction management, and measurement & verification. As in previous steps, the assignment of roles and responsibilities is essential for the success of the project.

Planning

The final plan for the installation of PIMs and FIMs should be an updated version of the ECM/FIM Report from the Performance Upgrades developed by the Energy Services Provider to reflect the organisation's concerns and meet the organisation's goals. After the final approval, the Energy Services Provider makes additions and revisions to the Report and finalises the document. This last set of updates should include:

- Final project timelines;
- Additional elements or changes;
- Updated pricing, financial calculations, and savings estimates;
- Roles and responsibilities for PIM/FIM implementation and oversight;
- Preliminary tasks and schedule for commissioning and measurement and verification.

PIMs/FIMs Installation

The construction phase may require external design, engineering, construction, and project management support depending on the scope of the project.

Bidding design services may be necessary in case the Energy Service Company is unable to prepare the documentation for complex projects which will require more detailed documentation; construction drawings, specifications, and complying with local permitting requirements. The project documentation can then be used to bid construction tasks. There are various alternatives for project delivery:

Design, Bid, Build

A third-party designer prepares the documentation necessary to prepare a bid and secure a contractor. The contractor will complete the work as described in the bid. The Energy Services Provider works with the designer to validate changes to the original plans.

Design, build

The entire project is packaged and bid as a turnkey project. The design/build does not guarantee savings, rather the proper installation of the equipment. The project should be supported by an Energy Services Provider to ensure the energy and cost savings goals are met.

Performance contracting

This delivery method is applicable for very large projects with external project financing where performance contractors guarantee certain amount of cost savings supported by energy savings calculations.

Construction Management

To achieve the goals stated on the previous sections of the project it's vital to follow through with proper project management and tentatively allocate the construction management roles and responsibilities as defined in Table 2 Construction Roles & Responsibilities.

Table 5 Construction Roles & Responsibilities

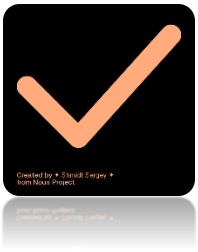
Management	• Make final decisions regarding the implementation of PIMs/FIMs. • Oversee the work of the Energy Services Provider and the Construction Manager. • Works with the Energy Services Provider to outline changes in O&M practices for facilities staff.
Energy Services Provider	• Acts as the commissioning agent or works with third party commissioning agent. • Communicates with the Construction Manager regarding changes to PIMs/FIMs. • Reviews proposed changes to PIM/FIM design with the client.

Construction Manager	• Oversee the work of subcontractors. • Maintains communication with the Energy Services Provider regarding changes to PIM/FIM design. • Ensures that construction remains on schedule and budget.

Measurement and Verification

Although the commissioning process is designed to ensure the installed equipment operates as intended, the measurement and verification process will validate that the systems installed deliver the anticipated savings. The Energy Services Provider should verify that the measurement and verification equipment is installed and calibrated according to manufacturer recommendations.

ACCEPTANCE



The Energy Services Provider issues a statement of verification that the project delivers the desired level of building performance post implementation. Final summaries, documentation, resources, and operations and maintenance manuals are prepared by Energy Services Provider and delivered to you.

Reports

- The documents to be handed off to you are:
- Commissioning reports
- As-built documentation
- Warranties
- Building Owner's Manual
- Reliability Centred Operations and Maintenance Manual

Post Implementation Roles

- Operations and Maintenance activities to ensure savings are preserved
- Staff training and continuous improvement plan
- Measurement and Verification reporting

ENERGY MANAGEMENT SYSTEM

In an environment where Caribbean nations are actively battling climate change it's essential to better manage energy in all its forms, electricity, fuels, steam, heat, compressed air and renewable, which can be purchased, stored, treated, used in equipment or in a process, or recovered.

The role of an Energy Management System [EnMS] is to enable the organisation to improve its energy performance in a systematic approach. The EnMS cycle is a variation of the PDCA cycle, specific to energy performance, helping organisations improving energy performances.

PLAN

Plan→Do→Check→Act Cycle

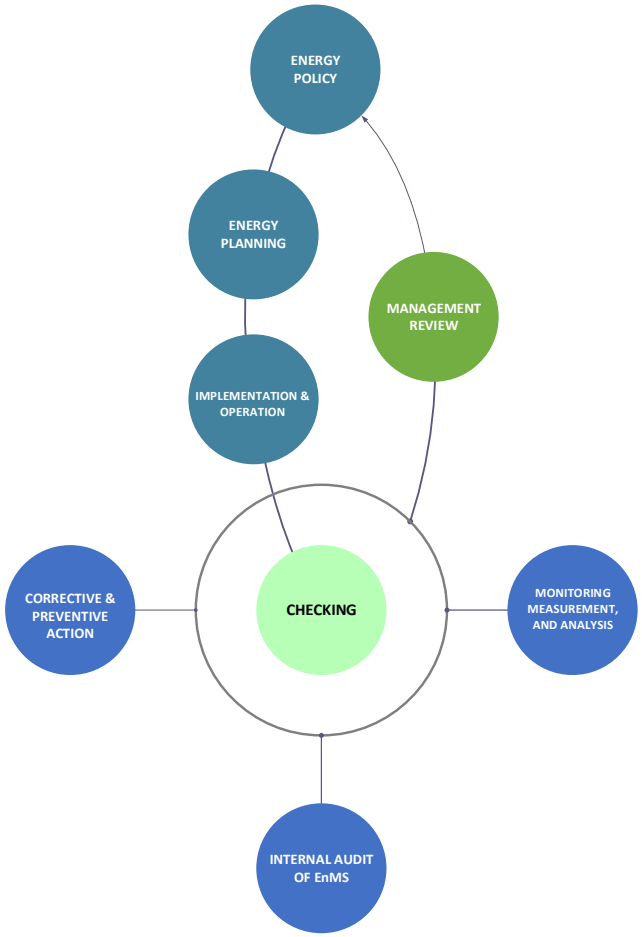


Figure 4 Energy Management System Process

PLAN – engage with policy, define SMART objectives and targets

Management Roles and Responsibilities

Identify top management delegate willing to champion the process and support the continuous improvement of energy performance Assign energy manager to communicate with the wider organisation and oversee the completion of the project and supporting the continuous improvement process.

CARICOM has completed this process and assigned duties as illustrated on Figure 2 BEEP Organisational Structure.

Energy Policy

Next, declare a statement of commitment in a published energy policy document that is communicated throughout the organisation. The policy should describe:

1. The role of top management in monitoring energy improvement performance;
2. Commitment to continual improvement in energy performance;
3. Compliance with applicable legal requirements; and
4. Create a framework for setting and reviewing energy objectives and targets.

Energy Planning

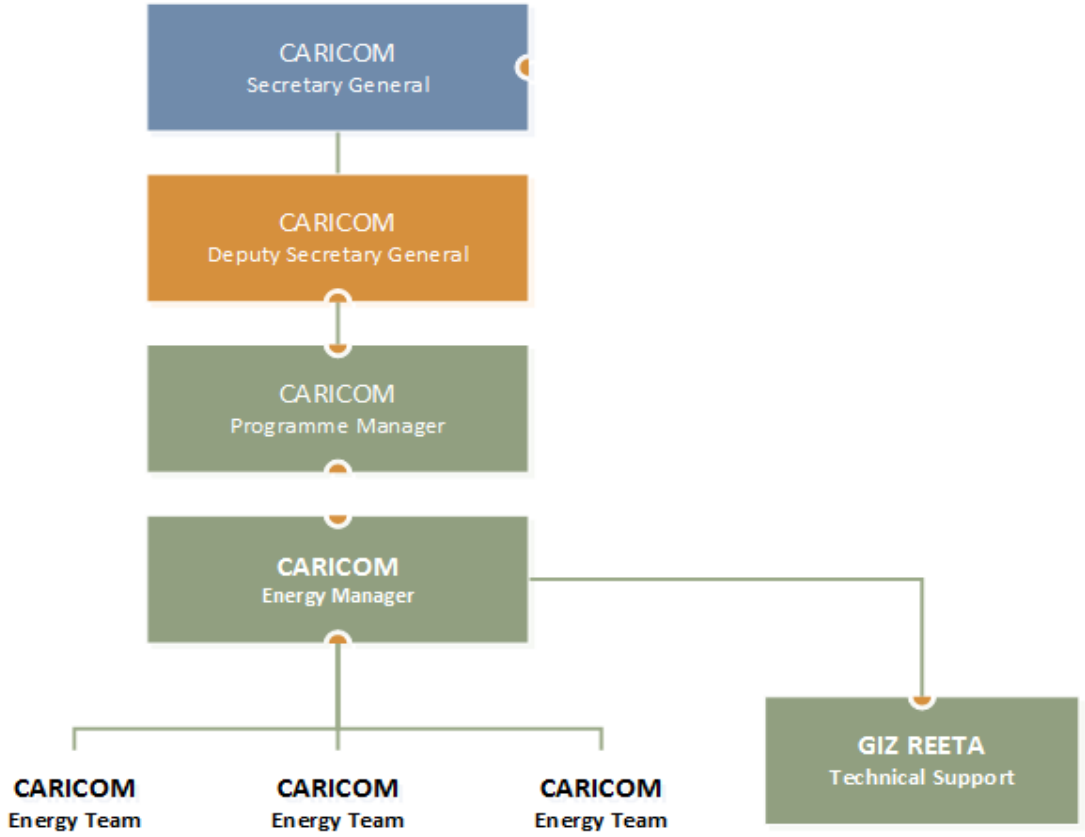


Figure 5 BEEP Organisational Structure

The energy manager must develop an energy management plan with progress indicators and advance in stages using a comprehensive approach to the organisation's energy and water system demands to promote improvements in energy performance.

Legal, Technical, and Other Requirements

An energy management plan should be supported by legal experts versed on:

1. Regional Building Energy Efficiency Codes, Labelling, and Minimum Energy Performance Standards;
2. Equipment Minimum Energy Performance Standards and Labelling Programmes;
3. Cradle to Cradle design;
4. Indoor air quality and thermal comfort;
5. Products and raw material transportation; and
6. Personnel transportation including commuting.

Applicable legal regulation and standards potentially relevant, such as:

1. Construction regulations;
2. Occupational safety regulations;
3. Environmental requirements;
4. Additional regulation dealing with employee health and environmental.

Energy Review

A qualified energy auditor must develop a data and documents repository to track energy performance and address record deficiencies, fill record gaps, and forecast EnMS performance. The information can be used to prioritise energy performance improvements.

Energy Baseline

Use the information from the energy review to define the historical and situational narrative and establish an accurate and reliable energy reference against which future performance will be benchmarked.

Energy Performance Indicators

Specify Energy Performance Indicators (EnPIS) for monitoring and measuring energy performance. Set and review EnPIS so they can help improve energy performance in cost effective manner. EnPIS must be often compared to the energy baseline.

Energy Objectives, Targets and Action Plans

Establish, implement, review, and maintain documented specific, measurable, achievable, realistic, and time bound energy objectives and targets at the relevant functions, levels, processes, or facilities within the organisation.

DO – Change the Culture

Although the BEEP programme counts with sufficient resources for the implementation of an EnMS, there might be some cases where resources are scarce or the complexity of the problems at hand might require a different approach altogether. While examining what elements are fuelling the problematic situation, there is a strategy that might help find deeper root causes imbedded in the system. There is an urgent need to examine more deeply the root causes of unsustainability. The notion of the leverage points arose from finding instances where small changes can affect mayor changes in the whole system.

Leverage Points expose complex interconnected variables and how to address issues of complex economic, social, and environmental systems.

Table 6 Points of Organisational Leverage

#	Point of Organisational Leverage	Description
12	Constants, parameters, numbers (such as subsidies, taxes, standards)	
11	The sizes of buffers and other stabilising stocks, relative to their flows	Adequately sizing equipment, inventories, storage, personnel.
10	The structure of material stocks and flows (such as transport networks, population age structures)	Making changes to physical structure is costly and time consuming unless it's done at inception. Proper energy system design is always preferable to retrofits.
9	The lengths of delays, relative to the rate of system change	Adjust the communication signal to get timely response, i.e. thermostats, faucets, dimmers.
8	The strength of negative feedback loops, relative to the impacts they are trying to correct against	Implement proactive maintenance, install monitoring systems, and allow for control systems to do their intended job, i.e. open windows while the air conditioning is working.

#	Point of Organisational Leverage	Description
7	The gain around driving positive feedback loops	Identify the resource(s) being unequally distributed and balance the distribution. Disconnect the two reinforcing structures so they are not dependent on the allocation of shared resource(s).
6	The structure of information flows (who does and does not have access to information)	Provide relevant and timely information about the process or system, i.e. install an energy meter display, visible water meter, etc.
5	The rules of the system (such as incentives, punishments, constraints)	Review social and absolute rules to validate applicability, exceptions, etc., i.e. utility and environmental regulation, duties, fees, etc.
4	The power to add, change, evolve, or self-organise system structure	Insist in diversity, promote experimentation, invest in R&D.
3	The goals of the system	Change the goals or leadership (indirectly affecting goals) of the system.
2	The mindset or paradigm out of which the system — its goals, structure, rules, delays, parameters — arises	Highlight the failures of the old paradigm, and work to promote the new paradigm and find the support of people with the same views.
1	The power to transcend paradigms	Embrace adaptability, flexibility, and open mindedness.

Competence, Training and Awareness

Assess staff competence to identify energy skills gaps, and then provide suitable training. Energy operating personnel should be reviewed frequently and systematically to confirm alignment with policy and goals.

Communication

Integrate energy-related process and procedure requirements into the organisation's communications and messaging.

Internal communication within CARICOM should be planned and resourced as part of the overall energy planning. The proposed communication strategy is intended to improve energy performance. Use the energy planning output to develop an energy performance improvement communications plan.

COMMUNICATION PLAN

Should discuss the following:

Table 7 Communication Plan Requirements

1. **BEEP background**
2. Energy policy and the purpose of conveying the importance of energy performance and the EnMS:
   - Personnel should be groomed from awareness to action and start by developing the business case for improved energy performance;
   - Empower employees to embrace the energy efficiency culture and help them understand why improved energy performance is win/win;

3. Evaluation of CARICOM's communications culture;
4. Identify internal stakeholders for improving energy performance;
   - The communication plan shall identify roles and responsibilities for all internal and external target audiences affected by the EnMS. We recommend creating message packages intended to reach different target audiences *via* the appropriate mix of channels for each specific situation. Develop a communications timeline, identify baseline metrics, and develop an evaluation plan to assess the communication effectiveness;

5. Formalised goals and objectives of energy performance-improvement activities;
6. Types of audiences;
7. Key messages to be communicated;
8. Available communication channels within the organisation:
    - Effective communication channels for generating awareness should utilise written or oral communication without dialogue. Examples include:
        - Social media;
        - Broadcast e-mail;
        - Brief announcement letters or memos;
        - Websites;
        - All-hands meetings;
        - Heads-up messages (e.g., invitations);
        - Company newspapers;
        - Company daily newsletters;
        - Company video networks;
        - Detailed letters and memos;
        - Web content with hyperlinks view/test materials;
        - Large group meetings with facilitated dialogue;
        - Video conferencing with two-way communication;
        - Interactive training sessions;

9. Communication products to be developed:
    - Communications package that top management can use to deliver their messages. The communication package should include:

        - Standardised overview of the organisation's energy performance;
        - Energy improvement snapshot and briefing notes;
        - Improvement summary and schedule;
        - Questions and answers;
        - Answer the question, "What does this mean to me?"
        - Specific actions required from personnel;

10. Communication activities to be implemented;
11. Evaluation of communication effectiveness.

Documentation and Control

Record information that describes the core elements of the EnMS, including initial drafts, schedules, data, reports, meeting minutes. Documents can be maintained electronically. The size and organisation operations will dictate the documentation necessary. Management should define the criteria for the review and update of energy-related documents.

Operational Control

Determine, plan, communicate internally, effectively operate and provide proper maintenance for operations with significant energy use:

- Significant energy consumption, cost, or energy-related impacts;
- Reliance on fossil fuels;
- Change the rate of energy use in comparison to previous periods; this is essential to production of goods and services;
- Have high potential for energy performance improvements.

Design

For future facilities, or any changes to existing facilities, equipment, systems, and processes with significant impact on energy performance, the design should consider energy sources, technology options, operational and maintenance costs that will have an impact on the energy baseline as well as well an impact on the EnMS.

Procurement of Energy Services, Products, Equipment and Energy

Develop procurement, bidding, and purchasing criteria aligned with the organisation's energy objectives and targets. Inform vendors and customers of the criteria that will be part of the process used to select products and suppliers.

CHECK and ACT – Measurement Review and Improvement

The energy management system is an evolving organism which needs to be reviewed frequently and consistently for the life of the building. Staff will commit to energy policies and goals which are perceived as valuable and as relevant to the business.

Monitoring and Measurement

Monitor the success of the plan and actions by:

1. Familiarise with the Energy Objectives and Targets
2. Understand the Energy Review;
3. Revisit the Energy Baseline;
4. Determine how to implement the desired EnPIS;
5. Write a performance metrics plan that considers the purpose, approach, implementation costs, and operational improvements for each performance metric;

6. Perform a lifecycle cost assessment for the energy system;
7. Secure management support, review, and approval for the implementation of the energy system;
8. Implement the metrics per the approved plan;
9. Enforce procedures stay on course.

Evaluation of Compliance

Include applicable milestones in the objectives, targets, and action plans to ensure compliance with legal and other requirements. Set periodic revisiting schedules to stay current with ever changing regulation.

Internal Audit

Conduct internal audit to evaluate performance of the EnMS to determine applicability, validity, relevance, enforcement, compliance, effectiveness, costs, and understand leverage points for the next revision of the EnMS.

It's essential that auditors selected are objective and impartial.

Non-conformities, Correction, Corrective and Preventative Action

Establish, implement, and maintain procedures for dealing with actual and potential nonconformities by making corrections, taking corrective actions and/or preventive action.

Procedures should include criteria that allows the organisation to:

1. Review nonconformities and potential nonconformities and determine their causes;
2. Evaluate the need for action to ensure that nonconformities do not occur or reoccur;
3. Determine and implement the appropriate action needed.

Control of Records

Define storage medium, access protocols, and types of EnMS records to be maintained to demonstrate the energy performance results achieved as well as conformity to the requirements of its EnMS.

Management Review

Engage top management to consistently and systematically review the energy management system at planned intervals to evaluate the performance of the EnMS. The management review should allocate the time and resources to consider all aspects related to the EnMS

APPENDIX A: BEEP Application Form

CARICOM

Programme Application
Building Energy Efficiency Project [BEEP]

Energy Team	
Organization	
Organization Representative	Address
Email	
Energy Efficiency Champion	Address
Email	

Building Energy Efficiency Committee Members	
Name	Designation

Programme Expectations
Reasons for participating in the programme:

Expectations from the programme
Months 1 thru 1
Months 6 thru 12
Months 12 thru 24
Months 24 thru 36

1 of 2

Facility Information	
Historical Energy Use (12 months)	
Monthly Energy Use (kWh)	Monthly Energy Expenditures
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	

General Building Information	
Name	Wall Material
Occupied Area	Occupied Hours (day)
Number of Light Fixtures	Type of Use/Function
Air Conditioning Capacity	Number of Occupants
Energy Efficiency Policy	

Signature

Date

2 of 2

Chapter 2 Case Studies

CARICOM SECRETARIAT BEEP CASE STUDY

This report intends to support the Building Energy Efficiency Project [BEEP] objectives by synthesising the previous documents and lay out a standardised BEEP deployment process for current and potential candidate buildings. The proposed continuous improvement process is consistent with the Plan, Do, Check, Act, Do Cycle described by ISO 50001.

The BEEP has made significant advances towards meeting the programme objectives:

1. **Determining** potential savings that can be achieved after completing a comprehensive energy audit;
2. **Developing** a mechanism for investment which senior management can utilise to attract finance for the continuous implementation of energy efficient solutions;
3. **Working** toward a concrete and structured method for the implementation of the National SDGs in buildings;
4. **Encouraging** employee engagement in implementing energy efficiency at work, extending to the residential and commercial sectors;
5. **Promoting** energy efficient behaviour to allow for the development of "energy efficient status" and a means for benchmarking for further improvement;
6. **Implementing** a facility energy management system that includes a measurement and verification system which periodically reports energy efficiency and savings in real time as well as storing it on a data base;
7. **Providing** capacity building for staff by offering training in ISO 50001.

In meeting the BEEP objectives, CARICOM has realised significant and consistent energy and operational cost savings.

Cumulative Energy Savings to April 2017	Cumulative Energy Cost Savings to April 2017	Cumulative Energy CO_2 Emissions Savings to April 2017
548,725 kWh	$296,773	386 Metric tonnes of carbon dioxide [CO_2]

The energy savings allowed for the investment in the following building energy upgrades:

- ***The replacement of eight 30 tonne air conditioning systems that have been purchased with savings made from the inception of the programme;***
- ***The procurement of two 10 tonne air conditioning units; and***
- ***The installation of an Energy Monitoring System.***

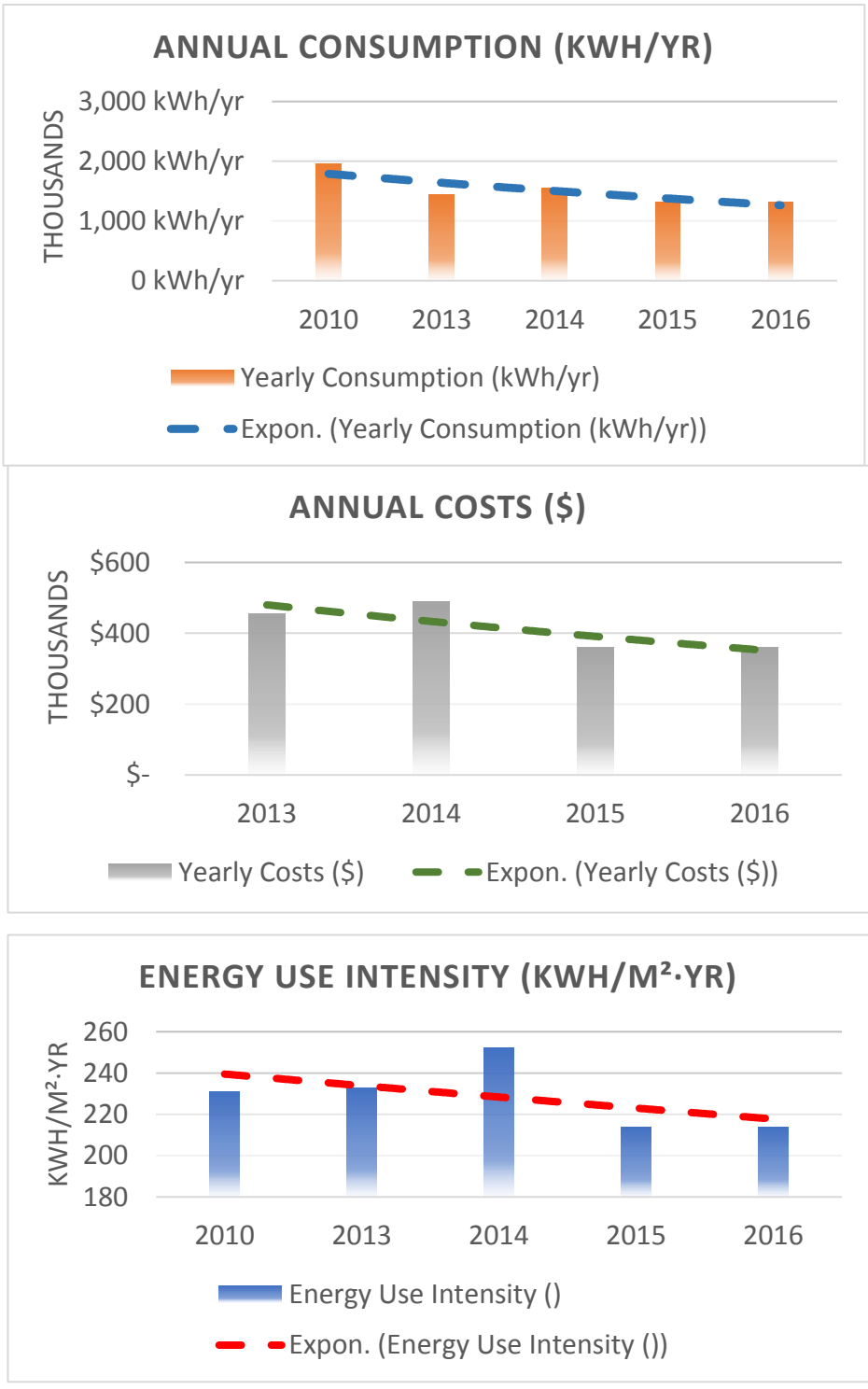


Figure 6 Energy Consumption, Energy Demands, and Energy Cost Trends for CARICOM buildings 2014-2016

BACKGROUND

The gestation of the BEEP started with the "Energy Audit Report of the CARICOM Secretariat" (2010), which described in detail the facility, its' energy operations, and a series of recommendations to help reduce the energy consumption. This report was updated in 2015 with the intent to serve as a basis and establish the baseline for the CARICOM Secretariat's pilot BEEP. The findings and recommendations from the report were incorporated in this document. The project was intended to be a 'learning by doing' initiative aimed at reducing energy used in buildings in the Caribbean Region. It was implemented within the framework of the C-SERMS of the CARICOM Secretariat and with technical assistance by the GIZ REETA project.

The overall goal of this initiative is to reduce the demand for imported petroleum-based primary energy that is required for energy service needs in buildings. This outcome is to be achieved within an energy management system *via* the use of international standard, ISO 50001 – and interventions such as improved operational measures as well as investments in energy efficiency and on-site (and distributed) renewable energy electricity generation infrastructure.

The BEEP is the implementation component of the energy efficiency approach in buildings. The empirical data collected will aid with the establishment and validation benchmarks to be included in the Regional Energy Efficiency Building Code [REEBC] and the Minimum Energy Performance Standards [MEPS]. It is expected that the information harnessed from the BEEP can be integrated into the REEBC/MEPS. The data findings, best practices, and energy management systems will in turn direct the financial component of energy efficiency in buildings *via* the Integrated Utility Services Model [IUSM].

SCOPE

The scope is intended to improve operational and productivity performance by affecting occupant behaviours, energy use, maintenance practices, management policies, purchasing and leasing criteria, renewable energy generation, and water use. The BEEP scope includes the following Performance Improvement Measures [PIMs] but is not limited to:

COMMERCIAL

Heating/Ventilation/Air Conditioning (HVAC)

- Heat pump replacement;
- Fan motor efficiency;
- Resizing of chillers;
- Heat pipe retrofits in air conditioning units;
- Dehumidifiers;
- Variable speed drive on fan motor;
- Solar assisted HVAC including ventilation, chillers, heat pumps, and desiccants;
- HVAC piping insulation;
- HVAC ductwork insulation;
- Boiler insulation;
- Automatic night setback;
- Automatic economiser cooling;
- Outside air control;
- Hot and cold deck automatic reset;
- Reheat system primary air optimisation;
- Process heat recovery;
- Deadband thermostat;
- Timeclocks on circulating pumps;
- Chiller system;
- Increase condensing unit efficiency;
- Coil cleaning;
- Separate make-up air for exhaust hoods;
- Variable air volume system;
- Direct tower cooling (chiller strainer cycle);
- Multiple chiller control;
- Evaporative roof surface cooling;
- Cooling tower flow control;
- Ceiling fans;
- Evaporative cooling;
- Direct expansion cooling system;
- Heat recovery ventilation (water and air-source);
- Set-back controls for cooling;
- Make-up air control;
- Manual fan switches;
- Energy saving exhaust hood;
- Night flushing;
- Terminal regulated air volume control scheme;
- Variable speed motors for HVAC system;
- Waterside economisers;
- Airside economiser;
- Gray water systems;
- Well water for cooling;

Building Envelope

- Wall insulation;
- Floor/slab insulation;
- Roof insulation;
- Window and door upgrades, replacements, and films (to reduce solar heat gains);
- Passive solar design;
- Earth berming;
- Shading devices and tree planting;
- High reflectivity roof coating;
- Evaporative cooling;
- Infiltration reduction;
- Weatherstripping;
- Caulking;
- Reflective windows;
- Replace glazing with insulated walls;
- Thermal break window frames;
- Tinted glazing;
- Vapor barrier;
- Vestibule entry.

Lighting

- Delamping;
- Reflectors;
- Occupancy sensors;
- Daylighting with controls;
- Photovoltaic lighting;
- LED exterior lighting;
- LED exit signs;
- Manual selective switching;
- Daylighting construction;
- Cathode cutout ballasts;
- Outdoor light timeclock and photocell.

Refrigeration

- Refrigerator replacement;
- Freezer replacement;
- Optimise heat gains to refrigerated space;
- Optimise defrost control;
- Refrigeration pressure optimisation control;
- High efficiency compressors;
- Anti-condensate heater control;
- Floating head pressure;
- Hot gas defrost;
- Parallel unequal compressors;
- Variable speed compressors;
- Water cooler controls;
- Waste heat utilisation;
- Air doors on refrigeration equipment;
- Sizing.

Water Heating

- Electric water heating upgrades/replacements;
- Electric water heater wraps/blankets;
- Pipe insulation;
- Solar heating and/or pre-heat units;
- Geothermal heating and/or pre-heat units;
- Circulating pump control;
- Point-of-use water heater;
- Heat recovery domestic water heater (DWH) system;
- Chemical dishwashing system;
- End-use reduction using low-flow fittings;
- Other end-uses and miscellaneous;
- Energy management control systems for building operations;
- Onsite power generation based on photovoltaic, solar thermal, biomass, wind, and geothermal resources;
- Energy efficient office equipment;
- Customer-owned transformer upgrades and proper sizing.

INDUSTRIAL

Motors

- Retire inefficient motors and replace with energy efficient motors, including the use of electronic adjustable speed or variable frequency drives;
- Rebuild motors to operate more efficiently through greater contamination protection and improved magnetic materials;
- Install self-starters;
- Replace improperly sized motors;
- Variable Frequency Drives.

Lighting

- Installation of reflectors
- Daylighting with controls
- Occupancy sensors
- Delamping
- Photovoltaic lighting
- Replace fixtures/lamps with LED fixtures/lamps

Heating/Ventilation/Air Conditioning (HVAC)

- Heat pump replacement/ upgrade;
- Furnace upgrade/replacement;
- Fan motor efficiency;
- Resizing of chillers;
- Heat pipe retrofits on air conditioners;
- Variable speed drive on fan motor;
- Solar assisted HVAC including ventilation, chillers, heat pumps and desiccants.

Industrial Processes

- Upgrades in heat transfer equipment;
- Insulation and burner upgrades for industrial furnaces/ovens/ boilers to reduce electricity loads on motors and fans;
- Insulation and redesign of piping;
- Upgrades/retrofits in condenser/ evaporation equipment;
- Process air and water filtration for improved efficiency;
- Upgrades of catalytic combustors;
- Solar process heat;
- Customer located power based on photovoltaic, solar thermal, biomass, wind, and geothermal resources;
- Power factor controllers;
- Utilisation of waste gas fuels;
- Steam line and steam trap repairs/upgrades;
- Compressed air system improvements/repairs;
- Industrial process heat pump;
- Optimisation of equipment lubrication or maintenance;
- Resizing of process equipment for optimal energy efficiency;
- Use of unique thermodynamic power cycles.

Building Envelope

- Insulation of ceiling, walls, and ducts;
- Window and door replacement/upgrade, including thermal energy barriers;
- Caulking/weatherstripping;
- Water Heating;
- Electric water heater upgrades/replacements;
- Electric water heater wraps/blankets;
- Pipe insulation;
- Low-flow showerheads and fittings;
- Solar heating and pre-heat units;
- Geothermal heating and pre-heat units;
- Other End-uses and miscellaneous;
- Refrigeration system retrofit/replacement;
- Energy management control systems and end use metering;
- Customer-owned transformer retrofits/replacements and proper sizing.

AGRICULTURAL

Space Conditioning

- Building envelope measures;
- Efficient HVAC equipment;
- Heat pipe retrofit on air conditioners;
- System and control measures;
- Solar assisted HVAC including ventilation, chillers, heat pumps, and desiccants;
- Air-source and geothermal heat pumps replacement/upgrades.

Water Heating

- Upgrades/replacements;
- Water heater wraps/blankets;
- Pipe insulation;
- Low-flow showerheads and fittings;
- Solar heating and/or pre-hear units;
- Geothermal heating and/or pre-heat units.

Lighting

- Delamping;
- Reflectors;
- Occupancy sensors;
- Daylighting with controls;
- Photovoltaic lighting;
- Outdoor lighting controls.

Pumping/Irrigation

- Pump upgrades/retrofits;
- Computerised pump control systems;
- Irrigation load management strategies;
- Irrigation pumping plants;
- Computer irrigation control;
- Surge irrigation;
- Computerised scheduling of irrigation;
- Drip irrigation systems.

Motors

- Retire inefficient motors and replace with energy efficient motors, including the use of electronic adjustable speed and variable frequency drives;
- Rebuild motors to operate more efficiently through greater contamination protection and improved magnetic materials;
- Install self-starters;
- Replace improperly sized motors.

Other end uses

- Ventilation fans;
- Cooling and refrigeration system upgrades;
- Grain drying using unheated air;
- Grain drying using low temperature electric;
- Customer-owned transformer retrofits/replacements and proper sizing;
- Programmable controllers for electrical farm equipment;
- Controlled livestock ventilation;
- Water heating for production agriculture;
- Milk cooler heat exchangers;
- Direct expansion/ice bank milk cooling;
- Low energy precision application systems;
- Heat pump crop drying;
- Specialty Timers.

GOVERNMENT SERVICES SECTOR

Streetlighting

- Replace incandescent and mercury vapor lamps with Night Sky compliant LEDs;
- Specialty Timers.

Other

- Energy efficiency improvements in motors, pumps, and controls for water supply and waste water treatment;
- District heating and cooling measures derived for cogeneration that result in electricity savings.

SUPPLY-SIDE MEASURES

Generation Efficiency

- Heat rate improvement programs;
- Availability improvement programs;
- Turbine improvements;
- Boiler improvements;
- Control improvements, including artificial intelligence and expert systems;
- Distributed control local (real-time) versus central (delayed);
- Equipment monitoring;
- Performance monitoring;
- Preventive maintenance;
- Additional or improved heat recovery;
- Sliding/variable pressure operations;
- Adjustable speed drives;
- Improved personnel training to improve man/machine interface.

Transmission and Distribution Efficiency

- High efficiency transformer switchouts using amorphous core and silicon steel technologies;
- Low-loss windings;
- Innovative cable insulation;
- Reactive power dispatch optimisation;
- Power factor control;
- Primary feeder reconfiguration;
- Primary distribution voltage upgrades;
- High efficiency substation transformers;
- Controllable series capacitors;
- Real-time distribution data acquisition analysis and control systems;
- Conservation voltage regulation.

RENEWABLE ENERGY GENERATION MEASURES APPLICABLE FOR THE CONSERVATION AND RENEWABLE ENERGY RESERVE PROGRAM BIOMASS RESOURCES

- Combustible energy-producing materials from biological sources which include: wood, plant residues, biological wastes, landfill gas, energy crops, and eligible components of municipal solid waste.

Solar Resources

- *Solar thermal systems and the non-fossil fuel portion of solar thermal hybrid systems*
- Grid and non-grid connected photovoltaic systems, including systems added for voltage or capacity augmentation of a distribution grid.

Wind Resources

- *Grid-connected and non-grid connected wind farms;*
- Individual wind-driven electrical generating turbines.

OBJECTIVES

ENGAGEMENT

Process Overview

Operational building energy expenditures associated to equipment use and occupant behaviours is often the second or third largest expenditure for organisations in the Caribbean. The only path toward a sustainable organisation is to prioritise and commit to continuous energy performance improvements. The process defined here is designed address any business activity.

The first six steps serve to improve the organisation's energy performance by: preparing for the project, by gathering building information and historical energy use; evaluating equipment conditions and user practices; developing a plan to upgrade equipment and embracing more efficient business practices; implementing the plan to upgrade equipment and put into practice efficient policies and procedures; validate the results of the implementation against the plan.

The role of the seventh step, the implementation of an Energy Management System [EnMS], is to ensure that those hard-earned savings and performance improvements are preserved and expanded over time. The EnMS is a continuous improvement cycle that involves: setting policies, goals, and targets; executing action plans; and consistently fine tune operations for better results.

Project Launch

Meeting the Needs

In most cases energy projects are driven by high operational costs, but there might be other aspects worth considering such as: building and equipment improvements, occupant comfort, indoor environmental quality, daylighting, water use, organisational, or regulatory concerns.

Lower energy costs come from the implementation of Performance Improvement Measures [PIM][9], delivering better or comparable quality of

[9] The term Performance Improvement Measure [PIM] was used in lieu of other terms like Energy Conservation Measures, Energy Efficiency Measures, Energy Management Efficiency Opportunities, or Energy Management Opportunities because the goal the proposed approach is to improve operational and productivity performance by affecting occupant behaviours, energy use, maintenance practices, management policies, purchasing and leasing criteria, renewable energy generation, and water use.

services at reduced operational costs.In cases where the plan was to make changes to the buildings, equipment, or operations that will bring operational improvements but not reduce energy use; these would be considered as Facility Improvement Measures [FIM].

Assembling a Team

The selection, guidance, and commitment of the team is vital for the success of venture. The first step is considering setting aside time and resources to support an energy champion to lead the project and be the point of contact. Given the size of the project and operation, the team can be scaled up.

Meeting Preparation

In preparation for the meeting, gather all the information that can help the Energy Services Providers meet the organisation's energy goals: building and equipment information, construction drawings or building layout, 24 months of utility information, Operations & Maintenance information, commissioning reports, etc.

In addition to gathering information, start thinking about the definition of the scope; boundaries; savings and sustainability targets will play an important role on the type of building evaluation to be performed, magnitude of the budget, level of staff commitment, project completion timeframe. The most important part of setting goals is that they are Specific, Measurable, Achievable, Realistic, and Time bound [SMART]. Goals fall under the following categories: lowering costs, occupancy comfort, improved reliability and efficiency, safety, property transactions, procurement, regulatory compliance, and sustainability goals.

Project Inception Meeting

The main purpose of the meeting is to state expectations for the project and discuss the preliminary goals identified previously and the Energy Services Provider's ability to deliver the types of services required for the project.

Identify Energy Services Provider qualifications to perform: ASHRAE Level 2 and Level 3 audits, ISO 50001 implementation, Commissioning, Retro-commissioning, Measurement & Verification, and Financial Analysis.

Financing

Identify internal or external sources of funding for the project. Review financial investment options and targets before committing to long term financing.

Preparation

The second step, preparation is intended to use the facility information together with the findings from a preliminary site evaluation to develop a draft a scope and action plan in line with the organisation's needs.

Preliminary Building Energy Evaluation

Ideally, the meeting can be followed up by a quick tour around the facility for the Energy Service Providers to get a better sense of the operating conditions of the organisation. They will probably take some pictures and ask the staff about comfort, practices, and the operation of equipment during their standard operation. The time allotted for the evaluation will depend on the size of the facility, for smaller buildings it should take only a few hours.

Evaluation Focus

Initially, the focus will be on capturing a snapshot of the operations and inventory equipment which is responsible for energy use, allowing or generating heat within the occupied space, use water, or impacts the indoor environment quality.

It's important that all the systems layout and operation of the major systems are covered: chiller systems, boilers, roof mounted air conditioners, indoor air handlers, lighting systems, appliances, and office equipment.

Preliminary ECM Listing

While touring the site, the evaluator will record models, observations, and take pictures of potential PIMs and FIMs. FIMs on the other hand will not improve performance but may be important to consider as they can improve safety, security, or quality of services provided. Ideally the low/no cost PIMs could be implemented immediately if they don't negatively affect other aspects of the operation and provided resources are available to do so. Some low/no cost PIMs are: adjust equipment running

times, adjust lighting timers, calibrate thermostats, replace air conditioner filters, and adjustment of temperature setpoints and night setbacks.

Understanding how the different system components work together, for example the lighting with natural daylighting or air-conditioned spaces with heavy traffic to the exterior of the building is key to identifying potential PIMs.

Benchmarking

Now, the energy use and expenditures, together with maintenance expenditures should be shared with the Energy Services Provider so the data can be analysed. Benchmarking, consists of comparing the building's performance against facilities of similar use normalised for size and weather. The comparison serves as an indicator of the overall health of the system. The metrics is essential in that the building performance at the time of the benchmark can be used as a reference for future efforts to quantify and verify energy savings, energy intensity reduction, and greenhouse gas emissions reduction to name a few. The most common metric for benchmarking is the Energy Use Index [EUI]: an expression of building energy use per year in terms of net energy divided by gross floor area (kWh/m^2). The accuracy provided by monthly consumption data is sufficient for the preparatory stages of the project. As the project moves forward it's essential that real-time metering be deployed at the equipment level or at minimum for the entire facility. CARICOM is working to support the hosting and standardisation of building metrics across the Caribbean to have more robust performance metrics. In the meantime, there are other tools available which can be used to document monthly energy and water consumption for further analysis.

Benchmarking Tools

Energy Star Portfolio Manager

This is an Interactive resource management tool created by the U.S. Environmental Protection Agency that allows the organisation to track the energy and water use across the entire portfolio of buildings. It can be used for: setting baselines, set performance goals for individual buildings or groups of buildings, present graphics, and monitor progress toward those goals.

Portfolio Managers score buildings based upon their energy consumption, weather, type of building, location, and changes over time as building practices become more stringent.

Building Performance Database (BPD)

This is a tool created by the U.S. Department of Energy for organisations to explore the data across real estate sectors and regions, and compare various physical and operational characteristics to gain a better understanding of market conditions and trends in energy performance.

Building Energy Asset Score (Asset Score)

This is a tool that was also developed by the U.S. Department of Energy for evaluating the physical and structural energy efficiency of commercial and multifamily residential buildings. This scoring tool stores data and generates an asset score and system evaluation for building envelope and mechanical and electrical systems. This tool will also identify cost-effective upgrade opportunities and help gain insight into the energy efficiency potential of a building.

ENERGY USE ANALYSIS

The two years of energy use and billing information is provided to the Energy Services Provider for the analysis. The data will be used for the energy use analysis which will serve to understand building energy use by the different building systems; determine current and historical energy demand and consumption trends; and ensure all aspects that impact energy usage such as weather, time, and changes in building operations and occupancy are taken into consideration.

The EUI is a good indicator, when normalised for the climate, it allows for the building's energy consumption to be compared against buildings of different sizes, geographic location, construction type, age, building purpose, hours of operation, and occupancy.

In addition to the EUI, the analysis will also yield global energy rates, calculated from the baseline year energy expenditures divided by energy consumption. These rates will be used in savings calculations, PIMs and FIMs cost calculations.

The EUI, consumption, demand, and costs graphs will simplify the identification of historical trends and energy use spikes. The analysis can also be used to estimate future use and costs.

Basic Procedure
Fuel Source Multipliers
Additional Considerations
ANNUAL ENERGY BALANCE
Four-Step Process
Energy Model Development
Estimating Use and Allocating Loads
Working with Campuses
Analysing the "Miscellaneous" Category
HISTORICAL ENERGY USAGE
Annual Usage Profile
Long Term Usage Trend
Consumption Correlation Analysis
PROJECT PROPOSAL
Implementation Plan
EnMS Scope EBCx Scope

BUILDING ENERGY EVALUATION

DATA COLLECTION

- Measurement and Verification Protocol
- Measurement / Data Logging Plan
- Methods and Sources
- Occupancy Profile
- Building Schedule
- Building Setpoints
- Follow-Up Visits

EBCX ACTIVITIES

- Investigative Test, Adjust, Balance
- Equipment Performance Testing

PIM & FIM PRIORITY

- PIMs/FIMs
- Further Revision
- Ranking and Filtering

PERFORMANCE UPGRADES

COST AND SAVINGS CALCULATION

- Evaluating Construction Costs
- Calculating Financial Feasibility
- O&M Savings
- Energy Model Calibration
- Savings Statement

ENVIRONMENTAL ATTRIBUTES

- Calculation of Positive Environmental Impacts
- GHGs Impact Statement

RECOMMENDATIONS

- Implementation Schedule
- Detailed ECM/FIM Report
- Detailed EBCx Scope

THE CASE FOR THE PROJECT

- ECMs/FIMs
- EBCx
- GHGs
- Project-Level Financial Analysis
- Project Buy-In

IMPLEMENTATION

PLANNING

- Best Practices
- ECMs/FIMs and EBCx
- Measurement and Verification
- Optional Initiatives

CMS/FIMS

- Final Preparation
- Construction Administration
- Installation Checks

EBCX ACTIVITIES

- Final Preparation
- Execution

FINE TUNNING

INSTALLING M&V EQUIPMENT

ACCEPTANCE

EBCX ACTIVITIES

- Final Testing
- Commissioning Reports

DOCUMENTATION

- As-Built Documentation
- Warranties
- Standard Operating Procedures
- RCM O&M Manual

RCM OPERATIONS AND MAINTENANCE

- Roles and Responsibilities
- Staff Training

MEASUREMENT AND VERIFICATION

- Annual Reports
- Energy Model Review

PLAN

***PLAN** – engage with policy, define SMART objectives and targets*

Management Roles and Responsibilities

Identify a top management delegate willing to champion the process and support the continuous improvement of energy performance. Assign an energy manager to communicate with the wider organisation, oversee the completion of the project and support the continuous improvement process.

CARICOM has completed this process and assigned duties as illustrated on Figure 5.

Energy Policy

Next, declare a statement of commitment in a published energy policy document that is communicated throughout the organisation. The policy should describe:

1. The role of top management in monitoring energy improvement performance;
2. Commitment to continual improvement in energy performance;
3. Compliance with applicable legal requirements;
4. Create a framework for setting and reviewing energy objectives and targets.

Energy Planning

The energy manager must develop an energy management plan with progress indicators and advance in stages using a comprehensive approach to the organisation's energy and water system demands to promote improvements in energy performance.

Legal, Technical, and Other Requirements

An energy management plan should be supported by legal experts versed on:

1. Building Energy: Codes, Labelling, and Minimum Energy Performance Standards;
2. Equipment Minimum Energy Performance Standards and Labelling Programs;
3. Cradle to Cradle design;
4. Indoor air quality and thermal comfort;
5. Products and raw material transportation;
6. Personnel transportation including commuting.

Applicable legal regulation and standards potentially relevant, such as:

1. Construction regulations;
2. Occupational safety regulations;
3. Environmental requirements;
4. Additional regulation dealing with employee health and environmental;

Energy Review

A qualified energy auditor must develop a data and documents repository to track energy performance and address record deficiencies, fill record gaps, and forecast EnMS performance. The information can be used to prioritise energy performance improvements.

Energy Baseline

Use the information from the energy review to define the historical and situational narrative and establish an accurate and reliable energy reference against which future performance will be benchmarked.

Energy Performance Indicators

Specify Energy Performance Indicators (EnPIS) for monitoring and measuring energy performance. Set and review EnPIS so they can help improve energy performance in cost effective manner. EnPIS must be often compared to the energy baseline.

Energy Objectives, Targets and Action Plans

Establish, implement, review, and maintain documented specific, measurable, achievable, realistic, and time bound energy objectives and targets at the relevant functions, levels, processes, or facilities within the organisation.

DO *– Change the Culture*

Although the BEEP programme counts with sufficient resources for the implementation of an EnMS, there might be some cases where resources are scarce or the complexity of the problems at hand might require a different approach altogether. While examining what elements are fuelling the problematic situation, there is a strategy that might help find deeper root causes imbedded in the system. There is an urgent need to examine more deeply the root causes of unsustainability. The notion of the leverage points arose from finding instances where small changes can affect mayor changes in the whole system.

Leverage Points expose complex interconnected variables and how to address issues of complex economic, social, and environmental systems.

#	Point of Organisational Leverage	Description
12	Constants, parameters, numbers (such as subsidies, taxes, standards)	
11	The sizes of buffers and other stabilising stocks, relative to their flows	Adequately sizing equipment, inventories, storage, personnel.
10	The structure of material stocks and flows (such as transport networks, population age structures)	Making changes to physical structure is costly and time consuming unless it's done at inception. Proper energy system design is always preferable to retrofits.
9	The lengths of delays, relative to the rate of system change	Adjust the communication signal to get timely response, i.e. thermostats, faucets, dimmers.
8	The strength of negative feedback loops, relative to the impacts they are trying to correct against	Implement proactive maintenance, install monitoring systems, and allow for control systems to do their intended job, i.e. open windows while the air conditioning is working.
7	The gain around driving positive feedback loops	Identify the resource(s) being unequally distributed and balance the distribution. Disconnect the two reinforcing structures so they are not

#	Point of Organisational Leverage	Description
		dependent on the allocation of shared resource(s).
6	The structure of information flows (who does and does not have access to information)	Provide relevant and timely information about the process or system, i.e. install an energy meter display, visible water meter, etc.
5	The rules of the system (such as incentives, punishments, constraints)	Review social and absolute rules to validate applicability, exceptions, etc., i.e. utility and environmental regulation, duties, fees, etc.
4	The power to add, change, evolve, or self-organise system structure	Insist in diversity, promote experimentation, invest in R&D.
3	The goals of the system	Change the goals or leadership (indirectly affecting goals) of the system.
2	The mindset or paradigm out of which the system — its goals, structure, rules, delays,	Highlight the failures of the old paradigm, and work to promote the new paradigm and find the support of
1	The power to transcend paradigms	Embrace adaptability, flexibility, and open mindedness.

Competence, Training and Awareness

Assess staff competence to identify energy skills gaps, and then provide suitable training. Energy operating personnel should be reviewed frequently and systematically to confirm alignment with policy and goals.

Communication

Integrate energy-related process and procedure requirements into the organisation's communications and messaging.

Internal communication within CARICOM should be planned and resourced as part of the overall energy planning. The proposed communication strategy is intended to improve energy performance. Use the energy planning output to develop an energy performance improvement communications plan.

Communication plan

Should discuss the following:

1. BEEP background;
2. Energy policy and the purpose of conveying the importance of energy performance and the EnMS:
   - Personnel should be groomed from awareness to action and start by developing the business case for improved energy performance;
   - Empower employees to embrace the energy efficiency culture and help them understand why improved energy performance is a win/win;
3. Evaluation of CARICOM's communications culture;
4. Identify internal stakeholders for improving energy performance:
   - The communication plan shall identify roles and responsibilities for all internal and external target audiences affected by the EnMS. We recommend creating message packages intended to reach different target audiences *via* the appropriate mix of channels for each specific situation. Develop a communications timeline, identify baseline metrics, and develop an evaluation plan to assess the communication effectiveness;
5. Formalised goals and objectives of energy performance-improvement activities;
6. Types of audiences;
7. Key messages to be communicated;
8. Available communication channels within the organisation:
   - Effective communication channels for generating awareness should utilise written or oral communication without dialogue. Examples include:

     - Social media;
     - Broadcast e-mail;
     - Brief announcement letters or memos;
     - Websites;
     - All-hands meetings;
     - Heads-up messages (e.g., invitations);
     - Company newspapers;
     - Company daily newsletters;
     - Company video networks;
     - Detailed letters and memos;
     - Web content with hyperlinks view/test materials;

        - Large group meetings with facilitated dialogue;
        - Video conferencing with two-way communication;
        - Interactive training sessions;
    9. Communication products to be developed:
        - Communications package that top management can use to deliver their messages. The communication package should include:
            - Standardised overview of the organisation's energy performance;
            - Energy improvement snapshot and briefing notes;
            - Improvement summary and schedule;
            - Questions and answers;
            - Answer the question, "What does this mean to me?"
            - Specific actions required from personnel;
    10. Communication activities to be implemented;
    11. Evaluation of communication effectiveness.

Documentation and Control

Record information that describes the core elements of the EnMS, including initial drafts, schedules, data, reports, meeting minutes. Documents can be maintained electronically. The size and organisation operations will dictate the documentation necessary. Management should define the criteria for the review and update of energy-related documents.

Operational Control

Determine, plan, communicate internally, effectively operate, and provide proper maintenance for operations with significant energy use.

- Significant energy consumption, cost, or energy-related impacts;
- Reliance on fossil fuels;
- Change the rate of energy use in comparison to previous periods; this is essential to produce goods and services;
- Have high potential for energy performance improvements.

Design

For future facilities, or any changes to the existing facilities, equipment, systems, and processes with significant impact on energy performance the design should consider energy sources, technology options, operational and maintenance costs that will have an impact on the energy baseline as well as an impact on the EnMS.

Procurement of Energy Services, Products, Equipment and Energy

Develop procurement, bidding, and purchasing criteria aligned with the organisation's energy objectives and targets. Inform vendors and customers the criteria that will be part of the process used to select products and suppliers.

CHECK and ACT – Measurement Review and Improvement

The energy management system is an evolving organism which needs to be reviewed frequently and consistently for the life of the building. Staff will commit to energy policies and goals which are perceived as valuable and relevant to the business.

Monitoring and Measurement

Monitor the success of the plan and actions by:

1. Familiarise with the Energy Objectives and Targets;
2. Understand the Energy Review;
3. Revisit the Energy Baseline;
4. Determine how to implement the desired EnPIS;
5. Write a performance metrics plan that considers the purpose, approach, implementation costs, and operational improvements for each performance metric;
6. Perform a lifecycle cost assessment for the energy system;
7. Secure management support, review, and approval for the implementation of the energy system;
8. Implement the metrics per the approved plan;
9. Enforce procedures stay on course.

Evaluation of Compliance

Include applicable milestones in the objectives, targets, and action plans to ensure compliance with legal and other requirements. Set periodic revisiting schedules to stay current with ever changing regulation.

Internal Audit

Conduct internal audit to evaluate performance of the EnMS to determine applicability, validity, relevance, enforcement, compliance, effectiveness, costs, and understand leverage points for the next revision of the EnMS.

It's essential that auditors selected are objective and impartial.

Non-conformities, Correction, Corrective and Preventative Action

Establish, implement, and maintain procedures for dealing with actual and potential nonconformities by making corrections, taking corrective action and/or preventive action.

Procedures should include criteria that allows the organisation to:

1. Review nonconformities and potential nonconformities and determine their causes.
2. Evaluate the need for action to ensure that nonconformities do not occur or reoccur.
3. Determine and implement the appropriate action needed.

Control of Records

Define storage medium, access protocols, and types of EnMS records to be maintained to demonstrate the energy performance results achieved as well as conformity to the requirements of its EnMS.

Management Review

Engage top management to consistently and systematically review the energy management system at planned intervals to evaluate the performance of the EnMS. The management review should allocate the time and resources to consider all aspects related to the EnMS.

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