

## Guidelines GB 5.0 – Existing buildings Energy Efficiency Improvement Program

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## Introduction

The Green Building Department of the Environment, Health and Safety- TRAKHEES as a competent authority and regulatory arm of Dubai World Business Units under the Ports, Customs and Free Zone Corporation (PCFC) for all Green Building activities has developed this ‘Existing Buildings – Energy Efficiency Guidelines’ for the purpose of assisting the stakeholders in improving the efficiency of their building/ facilities..

## Scope

This general guideline is applicable to all the existing plot owners/ buildings / facilities within Dubai World business units under the Ports, Customs and Free Zone Corporation (PCFC). This is also applicable to the energy assessors and Green Building consultants working on the green building projects within the jurisdiction who may potentially offer these services for the clients.

## Aim

The aim of this document is to highlight the importance of improving the energy efficiency of existing stock of buildings and to familiarize the stakeholders with the processes and sequence of activities involved in the Energy Efficiency Improvement Program (EEIP). The document provides an understanding of the role played by independent energy auditors / energy management firms that offer the subject services and the deliverables that are generally expected. It is intended to equip the

facility owners with the required tools in order to enable them to align the concept of existing building efficiency program specifically to their facilities and its operations and accordingly make an informed decision on deploying a suitable program

## Background

Energy Efficiency and sustainability is widely talked about in the present day scenario owing to the enormous benefits they offer to ALL the stakeholders. Several sustainability / green building codes are already in practice and have been satisfactorily followed for NEW constructions at international, federal and local levels. The infrastructure for facilitation of the green building regulations / guidelines for New Construction have developed to a satisfactory level and the awareness has spread to a stage where there is keenness on the part of the developers and other stakeholders to embrace sustainability on new constructions.

However, there is a window of opportunity in relation to existing stock of buildings / facilities that have not been tapped as yet to the full potential. It is universally recognized that Existing stock of buildings and resources conservation hold the key to Environmental sustainability and is expected to play a key role in climate change adaptation. There are several existing facilities that serve as a large reserve for potential energy and peak demand saving.

It is against this backdrop that this document has been developed.

## Purpose

The purpose of carrying out energy improvements on existing facilities is multi fold. Besides helping the facility to reduce its operational costs it has several other benefits that can be briefly spelt out as under:

- 1) Identify opportunities for energy conservation specific to the organization / facility
- 2) Establishing an energy management program based on the valuable data generated by the program.
- 3) Maintain an efficient balance between a building's annual functional energy requirements and its annual actual energy consumption.
- 4) Reduce wastage of resources
- 5) Increasing profitability
- 6) Reduction in carbon footprint and contributing to environmental sustainability.
- 7) Creating awareness to other stakeholders
- 8) Demonstrating the commitment to the environment by conserving the resources (CSR)

## Process

The Energy Efficiency improvement program for an organization / facility is an elaborate and well-structured process that comprises series of activities predominantly comprising the following phases:

- 1) Auditing
- 2) Implementation
- 3) Measurement & Verification (M&V) also referred to as Monitoring

A brief explanation of these activities has been provided below while a detailed description is provided later.

Auditing also referred to as Stage-1 of the program, is the starting point of the program and comprises the activities carried out on the facility that is subject to energy efficiency improvement program. It includes data collection, analysis and reporting of the information to the client / stakeholders INCLUDING Energy Conserving measures (ECM), financial calculations, feasibility etc. Further explanation is provided under the methodology section.

Implementation is referred to as Stage-2 of the program and refers to the actual work of taking forward the recommendations of the auditing to a practical level. This process comprises several activities such as planning, bidding, award of contract, procurement, installation and commissioning if applicable to specific systems. Management of the implementation is a key process that is included in the above phase.

Monitoring phase refers to tasks involving actual monitoring of the implemented energy conservation measures and ascertaining if they are yielding the desired results. This stage can be treated as the benchmark of the efficacy of the Energy Conservation Measure (ECM) and the overall program. This is stage-3 of the program.

## Methodology

### Auditing

The energy audit is the first task to be performed in the accomplishment of an effective energy efficiency cost control program. An energy audit consists of a detailed examination of how a facility uses energy, what the facility pays for energy, and finally, a recommended program for changes in operating practices or energy-consuming equipment that will cost effectively save on utility bills.

An energy audit brings new opportunities to light. It can reveal undetected weaknesses in the function of the building/facility, and provides the owners with options that save money. In addition to enhancing the current building performance, an energy audit will serve as a valuable tool in planning and budget preparation for future improvements.

The process begins with a qualified engineer, who performs an onsite review of the facility's energy-consuming components comprising all of but not limited to:

- a) HVAC equipment – including chillers, boilers, and the air-handling system.
- b) Lighting.
- c) Building automation.
- d) Domestic hot-water system.
- e) Process loads (if any).

The proposed auditing methodology includes two major activities for conducting a successful energy audit:-

- A) Energy Analysis also called the Assessment program; and
- B) Energy Audit Report

#### **A) Energy Analysis (Assessment Program)**

The Analysis stage is divided into two phases depending on the nature and size of the facility:-

##### **1. Establishment of the “Energy Committee”.**

The facility’s management will establish an energy committee representing the facility and an independent energy auditing company. The committee may include the Administration, Finance, Production, and Engineering/ Maintenance departments of the client underlying the integrative approach. The Committee Leader is chosen by the facility management to act as a liaison between the facility management and the Energy Auditing Company, fully authorized to coordinate and manage the project effectively.

In addition to carrying out the energy analysis as per the basic Audit requirement, the scope of Energy auditing Company may extend beyond such as to oversee the implementations, to assist the project in establishing an energy mandate / Corporate Energy Policy, as a tool to transfer the management’s energy efficiency commitment to the facility’s operators and personnel.

The committee’s role would be:-

- a) Review and follow up the action plan set for the project.
- b) Provide and facilitate data required for the Energy Audit.
- c) Follow up the project’s progress/results presented in the committee’s periodic meetings.

d) Management should support the Energy Committee, follow up, and recognize the Committee's achievements and results.

## 2. Implementation of a systematic energy use management process.

From the very beginning of any energy study, and for the purpose of a proper review of designs, a systematic energy - related costs analysis is performed. All aspects of hypothetical energy related consumption are verified, value being determined by building a model based on new proposed activities, partially based on current behaviour, and patterns of consumption in similar facilities.

Model consumption's will be verified, analyzed and compiled using established, proven analysis software or similar other standard computing methods.

This exercise enables the establishment of a "reference year", for the energy consumption which will serve as a benchmark for assessing savings in the future.

Such a detailed Energy efficient study is divided into three main sections:

- (2a) Analysis of each facility's operational characteristics
- (2b) Evaluation of Energy Uses by equipment / sector and
- (2c) Preparation of a summary and Energy Balance

These are further explained in the section below.



## (2.a) Analysis of Each Facility's Operational Characteristics

This activity allows the analysis of the facility's operational characteristics in terms of energy consumption.

The facility's operational characteristics are analyzed based on the details provided such as drawing plans and equipment specifications. Additional surveys, measures taken on site and discussions with those in charge of operating the facilities permit a more accurate evaluation.

The first step is to collect and analyze the information, which is directly related to energy consumption. To do so, the following subjects are addressed:

- I. Identification of each facility sector
- II. Service Schedule
- III. Characteristics are fine tuned

## (2.b) Evaluation of Energy Uses by Equipment / Sector

The establishment of an energy consumption reference year, as well as the identification of adjustment factors that might affect the consumption may also be included in the study.

The energy consumption reference year for each facility gives a picture of energy consumption before the implementation of the Energy Conservation Program and allows further monitoring. This activity consists of an energy consumption identification, which

is linked to equipment and operating methods. Information on the level of operation is also included in the definition of this reference year. In summary, the reference year provides the details on energy that will be spent for each category of the energy consumption in the buildings.

To determine precisely the savings resulting from the implementation of an Energy Conservation Program, it is necessary to adjust the reference year in the light of factors affecting consumption.

These factors include, among others the level of activities and establishment of adjustment factors which make the reference year dynamic and allow adjustments on the basis of monthly conditions.

### **(2.c) Establishment of the Energy Balance**

The above two activities allow the establishment and the understanding of the relationship between the pattern of operation of the energy consuming equipment and the energy bill.

The collected data will be used to design a model representing energy consumption in the facility.

The model will simulate the energy bill under different influencing factors such as; temperature, occupancy, working hours, etc., and compare results with past energy bill to validate data adopted in the study. This will be shown as a graph called the Energy

Balance, which verifies the actual electricity consumption of the facility as against the one that is charged by the utility.

## **B) Energy Audit Report (Results)**

The following details the items to be included in the Energy Audit Reporting activity.

### **1. Identification of appropriate energy saving measures**

This activity represents the core of the study. It includes the selection of conservation measure and the formulation of technical and financial parameters for each of these measures.

The measures to be evaluated come from different sources that will be considered during the audit process. The Energy Auditing Team should have an in depth knowledge of conservation measures relating to building services, and follows closely the development of new technologies.

Calculation tools used to evaluate savings will be chosen on the basis of the scope and type of planned measures.

The Energy Auditing Company should have a solid expertise in the use of building simulation software. The format of calculation results is also very important to future management of the program results.

Unlike normal energy auditing practices, which supply only annual results, the specialized energy auditing company should calculate conservation measures in a way to identify, on a monthly basis, expected variation in all parameters affecting energy savings. This method guarantees a more

precise calculation of savings and also makes it easier to verify, on a monthly basis, whether anticipated results will be achieved or not.

All the expected savings in demand and consumption are computable in the computer 'Energy Model' in order to prepare results monitoring. Savings are calculated on a monthly basis using the 'reference year' as a starting point, and using a cascade method taking into account the exact rate structure.

The profitability of each measure will be evaluated individually, based on savings, implementation costs, expected rises of energy rates, and the starting month of the Energy Conservation Program.

All the low cost/ no cost measures will be addressed and tabulated in the same table.

## 2. Preparation of the “Energy Audit Report”

During this activity, results of the various energy conservation measures selected for implementation are consolidated. Every measure is analyzed to determine whether it presents significant possibilities for reducing energy consumption. The most promising measures are then subject to a detailed cost benefit analysis based on the following criteria:-

- Annual Savings
- Percentage of Energy Conservation
- Monetary Savings
- Cost of Implementation
- Payback period

Where several options for one measure are considered, each scenario is evaluated. A complete pay back scenario for all selected measures is also produced.

Finally, the energy balance showing the reference year and the forecast year is supplied in the form of a table and a graph.

### **3. Presentation to the Management of the facilities and establishment of the Action Plan**

A preliminary report is prepared and presents, as precisely as possible, the expected energy savings versus the implementation cost of each measure.

Each energy saving measure will be provided with its standard Monitoring & Verification (M&V) method. This will be identified and proposed. The monitoring and verification method details how savings are verified for savings calculation purposes.

### **4. Establishment of the Financial Calculations**

A preliminary financial calculation sheet detailing; the “Total Cost of Implementation-TCI”, generated savings and the payback period shall be prepared in the form of a “cash flow” table, showing a forecast of investment stages and how savings will pay back the investment.

## **Other Details**

The Energy Audit Report should address the following details as a minimum in the appendix.

### **1. Building Name and details**

2. Built up area
3. Electricity Billing Strategy: Land lord/ Tenant
4. Air conditioned area: Landlord and tenant
5. Annual Energy Consumption in KwHrs and AED
6. Factor kWhrs/ m2 for total area and air conditioned area.
7. Energy Conservation Program Implementation plan.

## Implementation

This is the 2nd stage of the overall energy conservation objective and consists of those activities that are crucial to translating the audit findings and recommendations of the Energy Audit Report to a structured and visible set of action plans.

Implementation is generally facilitated by the implementation team created by the management to follow through the Energy Audit Report. The nature, size and composition of the team depend on the type of the project, the type of ECMs proposed to be implemented and the budget allocated for the objective. Depending on the type of contract, the Energy auditor/audit team may be hired to implement the ECMs identified to achieve the objectives of energy savings. This includes the task of overseeing all the activities of the implementation phase of the program so that there is a seamless transition from the auditing to implementation scenario. In other words, this minimizes the potential gaps that spring up while attempting to put the audit report into practice

It is also possible that the client's in-house team decide to implement themselves, the recommendations of the Audit report.

The implementation stage starts with Planning of the activities involved in implementing the Energy conservation Measures of the audit report and comprises the following tasks

- I. The team should check the nature of the recommendations in relation to the project and if required complete the design activities required for smooth installation.
- II. Check if adequate staff resources would be available and if not employ an audit consultant to do the detailed design and specification for the works required;
- III. Identify the roles and responsibilities of the facilities management personnel and the other members of the implementation team
- IV. Give a general briefing session to members to create a good understanding and awareness of the audit objectives including providing them copies of relevant sections of the audit report as appropriate;
- V. Organize meetings for the monitoring of Energy conservation measure implementation (Setting up of an ad-hoc committee for overall coordination and better understanding)
- VI. Consider ideas and comments from parties involved on the proposed Energy conservation Measures, as there may be areas that the audit team has not properly addressed during the audit phase or there may be some areas or ECMs with constraints that the audit team has overlooked in the audit;

- VII. Recognize the fact that considerable portions of the implementation tasks may have to be carried out outside office hours, in order to minimize disruptions to routine building operation
- VIII. Being aware that creating awareness of the entire initiative is a key challenge that has to be faced in the process of obtaining the support and assistance of the stakeholders, primarily the end users of the facility

In line with the above, the implementation team would then proceed to undertake the following activities

- I. Consolidate all the “After Audit” findings, reassess the proposed Energy Conservation Measures, make adjustments or even delete if necessary and amend relevant capital cost involved.
- II. Work out a revised list of Energy Conservation Measures with energy savings, capital cost and remarks on parties involved and specific attentions for implementation.
- III. Prepare a revised program of Energy Conservation Measures implementation, which should address the time required to procure the services/ products, the constraints that are not yet resolved such as the agreement by end-users to carry out the works in their working areas.

The program would comprise

- a) Start of Implementation
- b) End of Implementation



c) Key Milestones and deliverables

- IV. Prepare a rough estimate of the time expected in resolving the constraints
- V. Refer the Energy Conservation Measures with unresolved administration constraints to the management for comment and decision.
- VI. Obtain final endorsement from the Client of the proposed program if necessary; and
- VII. Obtain endorsement of the revised program from the Client.

Experience has pointed out that communication with end-users involved, Facility Management team, O&M personnel and the building owner/tenant is very important to the success of ECM implementation. Whilst the Energy audit team may take much effort and time to convince these parties that the proposed program will contribute to energy savings, which means less expenditure to the building, the Energy audit team should carry out their work more efficiently by having a harmonious relationship with them. The management concept of “partnership” among all parties concerned will streamline the implementation process

To ensure that the Energy Conservation Measures (ECM) are implemented properly, the Energy audit team has to monitor the works and participation of parties concerned. The Energy Audit team may need to exercise control and adjust procedures from time to time, such as further negotiation with end-users on permitted working hours, settling site work conflicts with O&M personnel, processing payments to contractors, etc. depending on the nature of its agreements.

As an alternative to implementation of Energy Conservation Measures the building management can employ a performance contracting service provider to do the work. The concept of Performance Contracting is that the service provider will design and implement the Energy Conservation Measures at a cost of a certain percentage of the total savings resulted from implementation of these Energy Conservation Measures. This contract approach should extend to the entire energy audit.

## Monitoring

This is the last leg of the Energy Efficiency Program and is that phase that seeks to validate the activities of the Audit and the implementation phase. In other words, it is this phase that brings into view, the benefits of having undertaken the energy efficiency improvement program and sets the stage for creating a long term energy management program for the client/owner.

To verify the amount of energy savings through the implementation of Energy Conservation Measures, especially those that were with investments, Measurement and Verification (M&V) are essential.

Measurement and Verification (M&V) is a measurement approach that allows building owners and property managers to VERIFY savings from any energy project they've undertaken by measuring and comparing the performance of an old system against the new system's results.

Measurement and Verification of the results associated with energy efficient project upgrades is an important consideration for property owners who want to confirm that these projects are performing successfully

Very often, the Energy Auditing companies offer M&V for tracking the efficiency of the newly implemented systems. This service is available as part of any performance package and is an essential consideration for building owners and operators who are concerned with truly measuring the improvements they make to their bottom line through energy efficiency

Not all energy efficiency projects are created equally. Hence it may be a good practice to work with the energy efficiency services provider / energy assessors/Auditors upfront to understand all options available for measurement and verification of results. For a relatively simple lighting retrofit project, a relatively simple M&V approach may make sense. For a complex infrastructure upgrade project involving multiple energy conversion and distribution systems, M&V is likely to be a more complex issue. M&V includes a range of techniques depending on the complexity of the system and the nature of ECMs undertaken in those systems and accordingly vary from simple meter readings and data loggers placed on existing systems, to engineering modelling, and to sophisticated real-time metering and control installations for new systems. It is important that the clients work closely with the service providers so as to structure the right M&V approach that balances costs and benefits.

During energy audit, the building management might have installed some meters to monitor energy consumption for certain equipment/systems. Whilst some of them will be removed after the audit, some could be remained as part of the equipment/ systems. There may be also areas that meters

could not be installed, due to site constraints or operational constraints. As an activity of the Energy Management Program, the building management should install meters (permanent type) or make provisions for ready connection of meters for each main system, its sub-systems and its associated components.

## Conclusion

As a part of Dubai's Sustainability and Green Building initiatives, all existing building owners are strongly encouraged to participate and implement an Energy Efficiency Improvement Program (EEIP) in the buildings to ensure that the Energy is utilized efficiently with minimum environmental impacts.

At a starting level, an Energy Audit within their facility would provide a reasonable picture of the existing efficiency of their facility comprising the buildings and the building systems, based on which a suitable course of action could be designed

The above guideline provides a broad outline of the elements involved in a typical facility's Energy Efficiency Improvement Program (EEIP) and is intended purely to familiarize the user to the common terms used in the process. This guideline should however not be construed as a scope that is specifically required by PCFC- Trakhees towards compliance.