



Department of Minerals and Energy Pretoria

Capacity Building in Energy Efficiency and Renewable Energy

Report No. – 2.3.4-24

Building Energy Audit Training Project – Closure Report

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November 2004



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Report no.	2.3.4-24
Issue no.	1
Date of issue	25 September 2004

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Abbreviations and Acronyms

BEE	Black Economic Empowerment
CaBEERE	Capacity Building in Energy Efficiency and Renewable Energy
CB	Capacity Building
CEF	Central Energy Fund
DANIDA	Danish International Development Assistance
DDG	Deputy Director-General
DEAT	Department of Environmental Affairs and Tourism
DK	Kingdom of Denmark
DKK	Danish Kroner
DME	Department of Minerals and Energy
DTI	Department of Trade and Industry
EE	Energy Efficiency
ESETA	Energy Sector Education Training Authority
FIDIC	International Federation of Consulting Engineers
IDC	Industrial Development Corporation of South Africa
IPM	International Project Manager
NT	National Treasury
NER	National Electricity Regulator
NGO	Non-Governmental Organisation
PDI	Previously Disadvantaged Individual
PM	Project Manager
PQ	Pre-qualification
PSC	Project Steering Committee
PTT	Project Task Team
QA	Quality Assurance
RE	Renewable Energy
RSA	Republic of South Africa
SA	South Africa/South African
SALGA	South African Local Government Association
SANGOCO	South African Non-Governmental Organisations' Committee
SARS	South African Revenue Services
SMME	Small, Medium and Micro Enterprises
SP	Service Provider
ST	Short Term Adviser
TA	Technical Assistance
TOR	Terms of Reference
VAT	Value Added Tax
ZAR	South African Rand

1 Executive Summary

It is the intention of the Department of Minerals and Energy to “lead by example” through undertaking a programme of energy audits in building under the control of National Government. This project forms part of the Danish funded programme DME-DANIDA Capacity Building in Energy Efficiency and Renewable Energy (CaBEERE).

The immediate objective of the assignment is to achieve building energy audits that are undertaken to a consistently high standard and quality. In order to deliver energy efficiency recommendations for the Public and Commercial Buildings sector which are integral to the Energy Efficiency Strategy for South Africa, it has been decided to ensure that capacity exists at national, provincial and local levels to undertake comprehensive building energy audits of consistently high standard.

NYATHI has been commissioned to undertake the assignment “Building Energy Audit Training”, to design and develop unit standards, training material for auditors, supervisory engineers, training of trainers, and a marketing plan for assessing the market conditions for implementation.

The capacity building program includes these two courses, one directed at prospective energy auditors, and the other at supervising engineers who would act on behalf of the building owners to implement and respond to audits.

Recognising that buildings are complex and that a complete understanding of building systems cannot be developed in a matter of a few days, these courses focus on the auditing methodology and the efficiencies that can be achieved in building systems through technological and operational measures; of necessity, the courses assume considerable prior knowledge of the underlying mechanical and electrical principles that pertain to building systems.

The rationale for the development and the design of the training modules for the auditors and supervisory engineers has also been informed by the positive interactive participation between NYATHI, the DME representatives, and a group of aspiring and established auditors and supervisory engineer. The group participated in a 4 day training workshop held on the 21- 24 June 2004.

The unit standards have been developed, submitted and approved by the Energy Seta.

The Trainer's Guidebook enables the instructor by:

- Providing background information on approaches to adult learning principles,
- Describing the structure of the courses and the rationale for the design,
- Providing planning script for each topic in the course,
- Providing some initial direction on the evaluation of the learning.

The marketing plan gives recommendations on the following:

- the demand and supply dynamics,
- marketing mediums that can be utilised,
- budget formulation, and
- implementation plan

2 Introduction

The DME Buildings Audit Training curriculum consists of four elements:

1. A **Building Energy Audit Course**, to develop the skills and knowledge required of individuals carrying out energy audits in designated government buildings;
2. A **Supervising Engineers Course**, to develop the skills and knowledge required of engineers who will act on behalf of the building owners to monitor the audit programme;
3. A **Trainer's Guidebook**, to support the delivery of these two courses by training providers.
4. A **Marketing Plan**, to support the marketing initiative of the programme.

The following describes the content and structure envisioned for these four program elements.

2.1 The Building Energy Audit Course

2.1.1 Trainee Profile

Trainee auditors will have completed tertiary education at, as a minimum, the technologist level in a mechanical, electrical or other building systems discipline. They will have prior knowledge of operations and maintenance of generic building systems, including building envelope, HVAC, refrigeration plant, heating and boiler plant, domestic hot water systems, lighting, motors, pumps and other driven loads, electrical plug loads, and building control systems.

2.1.2 Course Overview

The Building Energy Auditing course is designed to maximize its flexibility so that it can be delivered in a number of formats, such as a full-time intensive course, or on a modular basis. The total time required for instruction is nominally 30 hours, although the training provider may choose to expand this significantly to allow more time for practice and hands-on exercises. It is anticipated that the theory course described below will be supplemented with extensive related practical experience provided by the trainee's employer or sponsor.

The course outline below provides details of the course content;

Module 1: A Context for Building Energy Audits

- 1.1 The Context for Building Audits
- 1.2 Good Practice in Building Operations

Module 2: Basic Principles of Energy

- 2.1 Energy and Its Various Forms
- 2.2 Units of Energy
- 2.3 Electricity Basics
- 2.4 Thermal Energy Basics
- 2.5 Heat Transfer - How Heat Moves
- 2.6 Energy Estimation Calculations

Module 3: Overview of Building Energy Audits

- 3.1 A Systems Approach to Energy Auditing
- 3.2 Defining the Energy Audit – from Walk-through to Detailed Audit
- 3.3 Planning and Implementing the Audit
- 3.4 The Steps in the Audit

Module 4: Historical Energy Assessment

- 4.1 Measurement and Data Collection
- 4.2 Instrumentation for Energy Audits
- 4.3 Historical Data Analysis - Analysing the Energy Tariff
- 4.4 Comparative Analysis

Module 5: Analysing the Demand Profile

- 5.1 Introduction
- 5.2 Obtaining a Demand Profile
- 5.3 Interpreting the Demand Profile

Module 6: Energy Assessment - Load Inventory

- 6.1 The Electrical Load Inventory
- 6.2 Thermal Load Inventory

Module 7: Energy Assessment - EMOs

- 7.1 A Three Step Approach to EMO Identification
- 7.2 Assessment of the Costs and Benefits

Module 8: Energy Efficiency in Electrical Building Systems

- 8.1 Applicable building performance standards
- 8.2 The Building as an Energy System
- 8.3 Energy Efficient Lighting
- 8.4 Plug Loads
- 8.5 Motors, drives and driven equipment
- 8.6 Compressed Air Systems

Module 9: Energy Efficiency in Building Thermal Systems

- 9.1 Energy Efficiency in the Building Envelope
- 9.2 Heating, ventilating and air conditioning systems
- 9.3 Building Control Systems

Module 10: Interpreting the Business Case

- 10.1 Investment Appraisal
- 10.2 Investment Criteria
- 10.3 Life Cycle Costing
- 10.4 Risk and Sensitivity Analysis

Module 11: Reporting for Implementation

- 11.1 Introduction
- 11.2 Some General Principles for Good Audit Report Writing
- 11.3 A Template for the Audit Report

2.2 Supervisory Engineer Course

2.2.1 Trainee Profile:

Supervising engineers will be qualified professional engineers in a mechanical, electrical or other building systems discipline. They will have prior knowledge covering the same scope as the trainee auditors, plus facilities management and/or design knowledge, and project management experience.

2.2.2 Course Overview:

There are separate issues that fall within the purview of the Supervising Engineers; these, together with the broad understanding of the audit process developed in the foregoing modules, comprise the Supervising Engineers Course. This Course is designed for delivery as an intensive one-day Workshop; however, it is also flexible in design and can be broken out into its three separate modules for delivery as a series of shorter sessions.

Module 12: Audit Quality Assurance

- 12.1 DME Audit Guidelines
- 12.2 Quality Assurance

Module 13: Project Development Cycle

- 13.1 Step 1: Project Definition and Scope
- 13.2 Step 2: Technical Design
- 13.3 Step 3: Financing
- 13.4 Step 4: Contracting
- 13.5 Step 5: Implementation and Performance Monitoring

Module 14: Savings Verification

- 14.1 An Overview of Measurement and Verification (M&V)
- 14.2 A Statistical Basis for M&V
- 14.3 A Framework for Verification
- 14.4 Verification Applied
- 14.5 Case Study: IPMVP Option C—Whole Building Multiple ECM Project
- 14.6 M & V Checklists

2.3 Trainer's Guidebook.

2.3.1 Trainer Profile

Trainers for the Energy Auditing program will be energy service providers, consultants, or practical educators with significant buildings auditing and/or management experience. They will have prior knowledge covering the same scope as the trainee auditors and supervising engineers, as well as experience and competence in delivering workplace training.

2.3.2 Guidebook Overview

The Trainer's Guidebook is designed to provide an overview of adult learning processes, the objectives and learning itineraries for the two courses, and a planning tool for the delivery of training. The topics covered are listed below.

1.0 Introduction to the Trainer's Guidebook

- 1.1 Purpose of the DME Building Energy Auditing Courses
- 1.2 Purpose of the Instructor's Guide

2.0 Facilitating Adult Learning

- 2.1 Some important principles of adult learning – what works for you?
- 2.2 Being an Effective Trainer

3.0 Design of the Course and Certification Process

- 3.1 The Trainees
- 3.2 The Course Structure

4.0 Module-by-Module Scripts

- 4.1 Purpose and Format of the Scripts
- 4.2 The Building Energy Audit Course
- 4.3 The Supervising Engineers Course

2.4 Marketing Plan.

2.4.1 Target market Identification: Demand Side

NYATHI recommends that the established registered Energy Service Companies (ESCO's) and Consulting Engineering Firms be directly contacted. Contact details have been provided. A firm geographical footprint of the registered ESCO's is presented, with 80% being Gauteng based, 8% KwaZulu Natal based, 6% Port Elizabeth based, and 1% being Western Cape Based.

2.4.2 Training Authorities: Supply Side

A list of contacted tertiary institutions has been provided. This represents national Universities and Technikons. The Energy Seta will play a crucial role in:

- Copyrighting the developed training material
- Accreditation of training institutions

2.4.3 Marketing Mediums

The viable and effective marketing mediums recommended are:

- Breakfast Seminars; and
- Direct mail.

2.4.4 Budget Development

The budget developed for the implementation of the marketing plan is **R 113,200.00** and is broken down as follows:

- **Breakfast seminars: R 34,000.00**
- **Support Staff: R 79,200.00**

2.4.5 Implementation

Activities	Marketing Implementation Plan: Time Frame														
	September			October				November				December			
Announcement of Audit Training Qualification Programme															
Accreditation of Trainers															
National Registration															
First Course Delivery															
First Full Qualification															
Breakfast Seminars															
Solicit Sponsorship															
Secure Venue															
Secure Spokespersons															
Invitation of News Agencies															
Invitation of ESCO's & SAACE members															
Prepare Communication Brief															
Prepare Information Packages															
Delivery Announcement															
Debrief and Interview Session															
Direct Email															
Formalize Link With SAACE and ESCO Association															
Distribute Announcement															

