# LAUNCH OF PROFESSIONAL CADRE OF ENERGY MANAGERS AND AUDITORS IN PAKISTAN

**Submitted by**

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| | |
|---|---|
| ACGR | Annual Compound Growth Rate |
| APTMA | All Pakistan Textile Mills Association |
| EMC | Energy Management Cell |
| ENERCON | National Energy Conservation Center |
| ESCOs | Energy Service Companies |
| GAT | General Aptitude Test |
| GTZ | Deutsche Gesellschaft fur Technische Zusammenarbeit |
| GWh | Giga Watt-hour |
| HEC | Higher Education Commission |
| IESCO | Islamabad Electric Supply Company |
| IPP | Independent Power Produced |
| KESC | Karachi Electric Supply Company |
| MW | Mega Watt |
| NPO | National Productivity Organization |
| NTS | National Testing Service |
| SMEDA | Small and Medium Enterprises Development Association |
| TEVTA | Technical Education and Vocational Training Authority |
| TOE | Tons of Oil Equivalent |
| WAPDA | Water and Power Development Authority |

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## ABSTRACT

The rapid development of Pakistan's economy has lead to a significant growth in energy consumption. The current energy crisis has been caused primarily by technical inefficiencies and the absence of a dedicated energy management framework. Building and industrial sectors are the major culprits in energy waste. Pakistan must seek to overcome institutional barriers and develop a professional cadre of energy managers and auditors, which would deliver a wide range of benefits including mass employment, identification and rectification of energy waste, economic benefits, reduced pollution and improved infrastructure. A great deal of foundational work has already been done but a structured regime promoting an energy efficient culture has to be established. Activities such as energy audits categorize the focal areas and highlight the importance of energy management. For the launch of such a cadre, interdepartmental and interprovincial collaboration is necessary for the identification of sectoral needs and the provision of technical and managerial manpower for the successful completion activities.

# INTRODUCTION

## Energy Scenario

The amount of electricity consumed is considered an indicator to modern economic development (Jamil, 2010) . Pakistan's economic growth has been particularly strained due to energy sector issues throughout the 2009-10 fiscal years, with increasing oil prices contributing to shortages of electricity and gas and the accumulation of circular debt. The increasing costs of petroleum, power generation, and transportation and distribution prices reflected in the nationwide electricity and gas shortages. Pakistan's energy situation can be presented with an overview of installed electricity capacity and consumption:

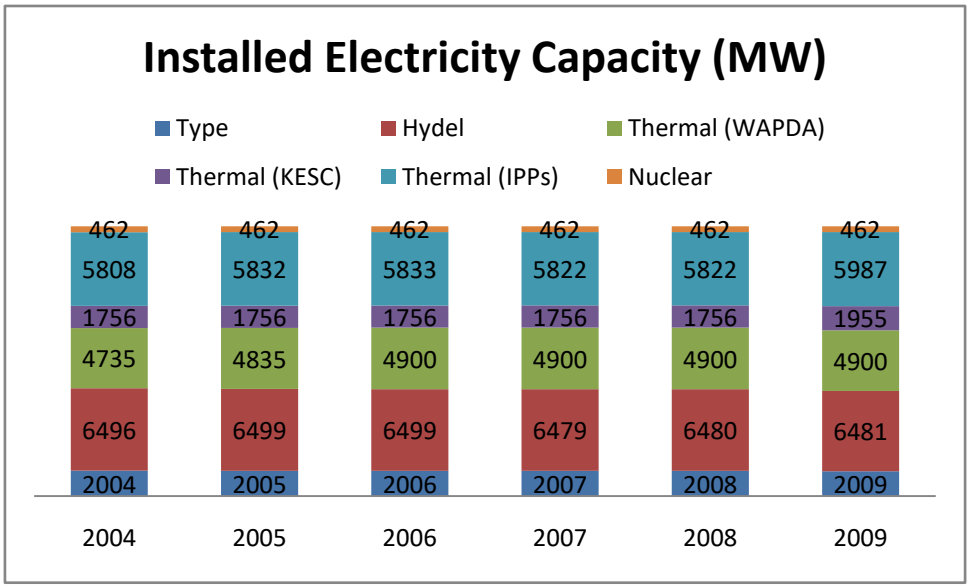



**Figure 1 Installed Electricity Capacity by Type ((HDIP), 2009)**

Pakistan is almost solely dependent on Hydel and thermal power, with IPPs significantly increasing production during 2008-09 because of the burgeoning energy crisis. Hydel and nuclear power are the only sources of alternative energy providing electricity on a national scale.

Overall, Pakistan's primary energy supply has experienced a gradual rise from 1998-2008 and then a marked decrease to 2009-10.

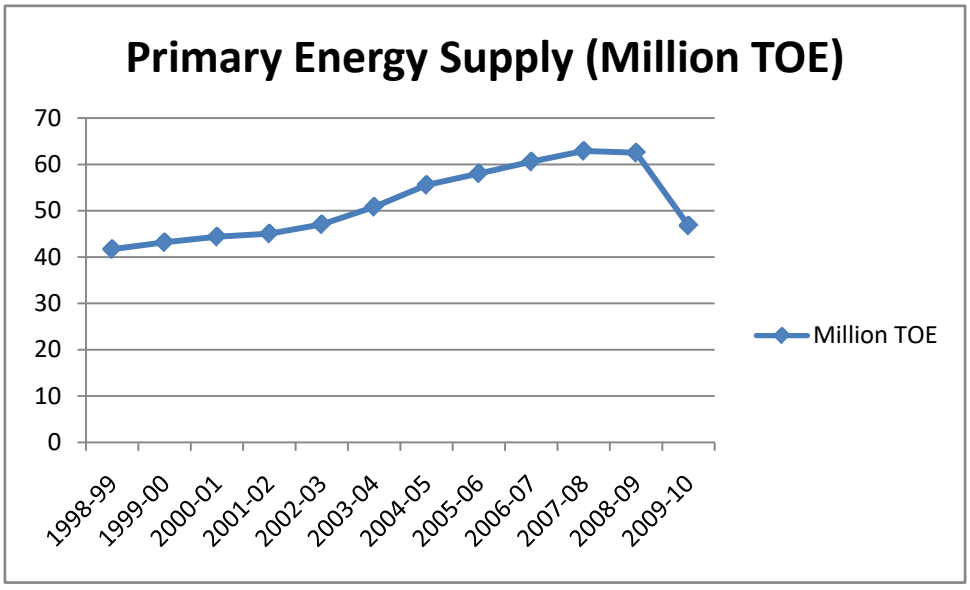



**Figure 2 Primary Energy Supply in TOE ( (Hub M. , 2009-2010)**

**Table 1 Energy Consumption by Sector**

| Sector | Electricity Consumption (GWh) 2003-04 | 2008-09 | ACGR |
|---|---|---|---|
| **Domestic** | 25,846 | 32,282 | 4.5% |
| **Commercial** | 3,689 | 5,252 | 7.3% |
| **Industrial** | 17,366 | 19,330 | 2.2% |
| **Agriculture** | 6,669 | 8,795 | 5.7% |
| **Street light** | 262 | 430 | 10.4% |
| **Traction** | 9 | 5 | -10.4% |
| **Bulk Supplies** | 3,603 | 4,177 | 3.0% |
| **Other Govt.** | 46 | 101 | 16.8% |
| **Total** | 57,491 | 70,371 | 4.1% |

((HDIP), 2009)

## Employment Scenario

Pakistan's estimated population of 170 million by the August 18, 2010 (PCO) with an annual growth rate of 2.05% (Nizami, 2010). The labor force is estimated at 53.72 million on the basis of a participation rate of 32.8 percent, as per the latest Labor Force Survey 2008-09. Of the total labour force, 50.79 million are employed while 2.93 million persons are unemployed, resulting in an unemployment rate of 5.5 percent. Industry remains the primary employment sector:

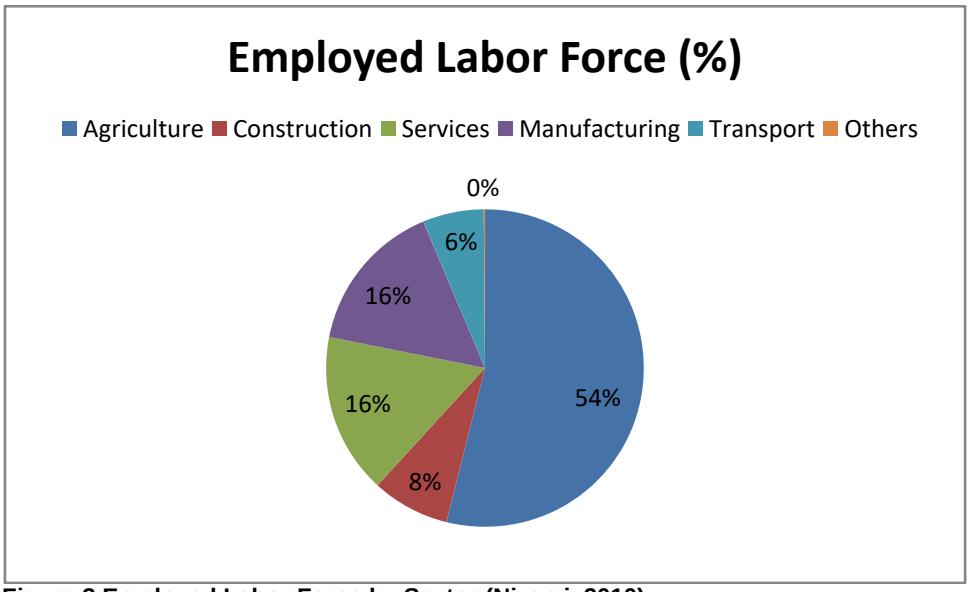



**Figure 3 Employed Labor Force by Sector (Nizami, 2010)**

Clearly, there is a significant deficiency of skilled industrial people in the workforce.

## Energy Management in the Building Sector of Pakistan

Globally, buildings account for about 40% of energy consumption, with a resulting carbon footprint exceeding that of the transportation sector (WBCSD, 2009). The building sector is decidedly complex with a great number of factors affecting energy use. The application of climate responsive design has declined over the years with the rapid dependence on electric power. It is also difficult to quantify the amount of energy expended in a building, as a single

resident will be using electricity, natural gas and some form of fuel (e.g. kerosene) in varying quantities throughout the year. (Clarke, 2001) Energy use in buildings has continued to increase in the last 20 years with increased need of temperature control, increased number of computers and computerized equipment and an electricity dependant lifestyle. Energy conscious architecture is slowly coming back in style, but the damage been done. (DoD, 2005)

As an energy profligate country, Pakistan must reduce its dependence on fossil fuel and aim for self-sufficiency with methods like energy management. Energy management is a new specification but its application in industrial, commercial, residential and the building sector will is developing in the face of our current energy and economic requirements.

## Importance of Energy Management

Energy management may be defined as the judicious and effective use of energy to maximize profits (minimize costs) and enhance competitive positions (Capehart, 2003)

The primary reason for employing energy management in any venture is economics. Every new industry or commercial activity is judged based on the economic advantage of the country. Energy management proves to be cost effective in every way. Even if energy efficient technologies are not employed, simple changes to energy consuming behavior and minor process changes reduce the overall product cost of an item.

Besides plant wide economic benefit, the country's current energy condition is enough to promote any activity that reduces our dependence on imported fuel and energy. Imported electricity supply has increased from 17,418 TOE in 2003-04 to 54,266 TOE in 2008-09 ((HDIP), 2009). While all our energy supplies have shown a marked increase over the years, the dependence on imported electricity is a great concern.

In comparison with alternate energy technologies, energy management does not have the risk of establishing a new technological base and retrofitting old equipment. Because of this, it can

provide a window in which process improvements can take place alongside energy reduction without having to rely on potentially risky technologies.

## Project Objective:

The purpose of the project was to demonstrate Pakistan's need of a professional energy management and auditing cadre to secure our energy and employment future and propose a series of steps required to identify and fill the gaps for establishing a working energy management regime. Pakistan's achievements in developing a basic groundwork for the cadre are discussed in the light of the current energy and economic scenario.

# LITERATURE REVIEW

## Energy Consumption in Pakistan

About 70% of all housing units of Pakistan and all commercial and industrial units of Pakistan have electricity. Although natural gas distribution is rapidly increasing it is still limited to major cities and towns of the country. The use of electricity and natural gas are increasing at an annual rate of 13.7% and 11% and the building sector uses 42% of all electricity and 29% of natural gas. During the summer seasons, 40% of all supplied electricity goes for space cooling or air conditioning. Natural gas use rises in the winters for space heating (Jamy G. N., 1991).

## Politics of the Energy Sector

Any inquiry into a country's energy issues shows the inseparable relationship between energy supply and politics. As energy supply is the cornerstone of all economic issues, politicians seek for quick solutions for economic improvements. However, the blame does not rest solely on the political sector, as civilians are also reluctant to change their behavior and practices for the betterment of the country. Improvements in energy politics can only occur with improvement in public demeanor.

Besides the political organization of the country, the politics within an organization or entity is also important. Energy issues of an organization connect all the employees at every level and for an energy policy and energy management program to be successful, the senior management must participate and be actively involved at every step of the way. It is impossible to conduct energy management activities in a country or facility without the support of the governmental offices. (Beggs C. , 2009)

## Energy Consumption in the Commercial Sector

While the amount of energy consumed in the commercial sector is easily quantifiable as a whole, important factors such as energy consumption decisions of commercial energy

consumers remain unanswered. In Pakistan, the commercial sector was responsible for 5,252 GWh of electricity out of 70,371 GWh for the year 2008-09 ((HDIP), 2009). There are a number of theories explaining why there are few energy sector investments from the commercial sector:

1. Neo-classical economics that argue that the potential risks and uncertain returns involved in investing in long term energy solutions is too great. The decision maker has all the required information at hand, yet he chooses to decline the energy investment as he does not have appropriate ways of mitigating the risk involved
2. Behavioral economics argues that the existence of a number of market barriers prevent the consumer from making an energy efficient decision. A decision maker
3. is aware that he is presented with incomplete information, and makes a decision based on the first (not the best) option that meets all his requirements
4. Organizational theory analyses the decision making process within an organization and argues that inter-organizational issues such as assignment of tasks, resource budgeting and inter-tier communication create the 'efficiency gap' that affect positive energy management decisions

While a dearth of literature is available on industrial and residential energy consumption patterns and remediation measures, the consumption mechanism of the commercial sector has been ignored, although energy auditing and management activities can be applied rapidly with faster rates of returns in comparison with the industrial sector. (Payne C. , 2006)

## Factors Affecting Energy Consumption in Buildings

Most of Pakistan's urban population lives in arid and semi-arid climatic zones. The style of building architecture shifted away in the past years from the climate responsive trend and has become entirely dependent on electric temperature control. Urban heat islands have formed because of an increased number of concrete and glass buildings and metalled roads. The new

closed and thermally inefficient buildings increasingly depend on space cooling throughout the year. (Jamy G. N., 1991)

## Features of Energy Management Standard

1. Strategic plans requiring measurement, management, and documentation for continuous improvement for energy efficiency
2. cross-divisional management team under an energy coordinator who reports directly to management and is responsible for supervision of implementation of the strategic plan
3. policies and procedures for all aspects of energy purchase, use, and disposal
4. Demonstrative projects for continuous improvement in energy efficiency
5. Energy Manual that evolves over time as energy saving projects and policies are undertaken and documented
6. Identification of performance indicators that are tracked to measure progress
7. Periodic progress reports to management based on these measurements

(Price L. , 2008)

## Achievements of Pakistan Concerning Energy Management

### Policy Sector

Strategic Prime Minister Policy Directives obtained in 2008 that include a number of directions to for the improvement of the energy and environment condition of Pakistan. The directives included:

1. Provisions for enabling a legal environment for codes, standards, energy reporting, labeling, testing, mandatory audits, fines and incentives and a monitoring and compliance mechanism at all levels of operation
2. Energy Conservation plans and audits of major industries
3. Correction of energy intensive processes in the industries

4. Transport energy audits
5. Energy audits of all commercial, governmental and community buildings

The latest priority directive of the Prime Minister Syed Yousaf Raza Gilani, also included in the many directives of the two-day energy summit beginning on April 19, 2010, states that a senior officer or person shall be designated as energy conservation manager in public or private establishments for monitoring energy conservation. A single comprehensive framework of viable actions is required for the successful implementation of all energy related strategic directives.

The Draft Building Energy Code 2009 was developed with the intent of making the building sector as energy efficient and environmentally conscious as possible. The code provides minimum energy conservation guidelines to be applied to building envelopes, mechanical systems, equipment, including HVAC systems, water heating, lighting, and electrical power and motors. The Code is applicable to existing buildings and voluntarily for new structures. (ENERCON, 2009)

The National Energy Conservation Policy seeks to mitigate the effects of climate change, sustainable development promotion, poverty alleviation, enhancement of economic productivity and promotion of gender equality by developing energy management programs in all economic sectors.

The Pakistan Energy Efficiency and Conservation Bill of 2009, is a milestone in Pakistan's energy front. Besides promoting capacity building of key organizations and institutions involved in developing energy efficiency culture in Pakistan, it will also make activities like energy audits and management mandatory for industrial entities. The Bill is a well rounded document including details on proper functioning of Pakistan Energy Conservation Council (PECC), ENERCON and

the scope of activities starting from initiation of energy conservation programs to documentation and information dissemination.

## Capacity Building

### *National Productivity Organization (NPO)*

National Productivity Organization (NPO) took the initiative in 2005 to sign an agreement with GTZ to perform energy audits in the textile sector under the Renewable Energy & Energy Efficiency framework to enhance productivity and quality. NPO has also conducted a training session on Energy Management and Auditing Techniques at Multan and generated a number of progress reports on the results of energy audits of spinning and processing sectors. The following table clearly reveals the advantages of best energy practices at the processing sectors of four textile mills:

**Table 2 Energy Audits in Processing Sectors of 4 Textile Mills (Mill names held due to confidentiality)**

| | **A** | **B** | **C** | **D** |
|---|---|---|---|---|
| Total Energy Loss | Rs. 29 million/yr | Rs. 28 million/yr | Rs. 9.2 million/yr | Rs. 21 million/yr |
| Total Implementation Cost | Rs. 7.0 million | Rs. 9.0 million | Rs. 17.2 million | Rs. 4.7 million |
| Total Savings | Rs. 27.0 million/year | Rs. 27.0 million/year | Rs. 11.85 million/year | Rs. 17.9 million/year |
| Payback Period | 3 months | 4 months | 1.5 years | 3.5 months |
| **% Savings** | **30** | **34** | **8.5** | **20** |

(NPO, 2010)

### *Deutsche Gesellschaft fur Technische Zusammenarbeit (GTZ)*

Understanding the need of trained experts in the fields of energy auditing and energy management, GTZ has made significant contributions to helping Pakistan in various training exercises. They have held independent short courses on energy management and efficiency training in thermal and electrical utilities, and training sessions in collaboration with Small and Medium Enterprises Development Authority (SMEDA) on energy conservation. The short training courses on energy management included:

1. Introduction to fuels, with calorific values and other typical specifications,
2. Technical details on boilers and fluid heaters (greatest energy consumers in industries)
3. Methods of boiler performance assessments
4. Water Treatment methods
5. Energy Efficiency and conservation opportunities
6. Steam distribution and utilization
7. Insulation
8. Cogeneration
9. Waste Heat recovery
10. Implementation of Energy Management System
11. Implementation of Energy Management Program
12. Implementation of Energy Information System
13. Case Studies
14. Study exercises/quizzes

The trainings covered a comprehensive range of subjects that drew on the participants existing knowledge as engineers or plant/process managers and equipped them with knowledge to apply energy management principles. (GTZ, 2010)

### *All Pakistan Textile Mills Association (APTMA)*

All Pakistan Textile Mills Association (APTMA) is the largest organization in Pakistan for the representation of spinning, weaving and composite textile mills in Pakistan. They are the only organization to actively implement energy management measures in Pakistan, with the assistance of Deutsche Gesellschaft fur Technische Zusammenarbeit (GTZ), Small and Medium Enterprises Development Authority (SMEDA) and National Productivity Organization (APO). Besides answering questions related to manufacture, trade and commerce of the member textile mills, APTMA has also applied its efforts to energy management in the mills following the industries' concerns of inconsistent fuel supplies and rising energy prices. APTMA has accomplished:

1. Energy audits of member mills with the assistance of GTZ, SMEDA and APO
2. Development and application of Energy Management Systems in 25 selected mills with the assistance of GTZ and SMEDA
3. Establishment of Energy Conservation Cell at APTMA

Energy audits of the participating mills were conducted largely through third party consultation firms. (APTMA, 2010)

<u>Implementation of Energy Management Systems in Textile Mills</u>

The procedure adopted by the consulting energy audit firms was as follows:

1. Baseline data collection of:
    a. Annual Production (2009-2010)
    b. Annual Utility Consumption (Electricity, Natural Gas)
    c. Motors Measurements at Different Sections (kW, PF, A, V)
    d. Humidification Units (kW, PF, A, V, fan air velocities)
    e. Compressors Specifications (kW, PF, V, A, loading pattern)
    f. Stack Analysis of Gas Power Generators

g. Lighting System

2. Data Analysis and Documentation of energy practices, issues and recommendations presented to the mills
3. Involvement of the mill's Chief Executive in all aspects of the energy management system
4. Development and approval of comprehensive energy policy by the Chief Executive
5. Development of energy management committee to ensure involvement of senior management
6. Detailed description of processes with process flow diagram and power sharing of process
7. Documentation of recommendations for energy conservation

(APTMA, 2010)

## Higher Education

Energy Management has been introduced into the higher education system:

Master in Energy Management at COMSATS Institute of Information Technology (CIIT), Department of Management Sciences: The program's main objective is to provide the students with a comprehensive and in-depth practical knowledge of energy management. The main objectives of the course are to prepare the future energy managers to:

1. Understand the energy sector
2. Develop skills in planning, strategy formulation
3. Promote investment in the energy sector
4. Strengthen the liaison between academia and industry

The scheme of studies have a management and economics concentration as the candidates are expected to have a background in at least one of the following: Business Administration,

Computer Science, IT, Economics, Engineering, Natural Sciences, Public Administration and Policy, and Development Studies. The courses include:

1. Financial Reporting and Analysis
2. Marketing Strategies
3. Managing Organizations
4. Managerial Finance
5. Energy Fundamentals
6. Energy Economics
7. National Energy Policy and Planning
8. Renewable Energy
9. World Energy Outlook
10. Energy Conservations and Environment
11. Energy Dialogue/Seminar
12. Corporate Finance Management
13. Restructuring Energy Utilities and Utility investment Planning
14. Energy Project Management
15. Household Energy

The faculty comprises almost entirely of experienced electrical or mechanical engineers who provide the students with an extensive familiarity with technical, social and managerial concepts vital for effective functioning as energy managers. (Haider)

However, the course is management and finance intensive, with very little focus on the technical aspects of energy managers. The faculty has a strong academic background in the engineering aspect but there is no indication on their prowess on dealing with the kind of managerial and social courses of this degree. Although such expertise is also required in our industrial setting, it needs to be coupled with technical familiarity and the graduate energy managers may need to

undertake the energy management training curses before they can be qualified to recommend energy management activities,

## Energy Audit

The purpose of conducting an energy audit of a building is to find out how efficiently energy is used in a building and for the identification of opportunities for improvement. (Francis, 1998)

### Purpose of Energy Audits

Energy audits are conducted for the collection of comprehensive energy data before any energy saving measures can be adopted. Before energy targets and monitoring programs are established, it is necessary to set up baseline of energy consumption, work practices, condition of building and equipment and the energy management practices that are applicable for energy and cost reduction.

### Types of Energy Audits

The types of energy audits conducted depend on the degree of detail, depth of analysis, and the facility of concern. There are three main types of energy audits by this differentiation:

1. Preliminary energy audits establish the quantity and cost of energy expended in a facility and are quick to be completed. Much of the data of preliminary audits can be taken from energy invoices and meter readings. Most preliminary audits form the basis of later, detailed energy audits.
2. Targeted energy audits usually follow preliminary audits and consist of detailed energy use analysis of targeted processes or equipments, such as lighting or space cooling systems. These audits also usually involve energy saving recommendations
3. Comprehensive energy audits provide detailed energy flows within a facility and may involve computer simulation models for future energy use. Comprehensive energy audits

are almost always completed by third party organizations specializing in energy services and are also the most expensive of all energy audits.

In Pakistan, comprehensive audits are for technical installations such as textile mills, as the process complexities, energy flows intricacies and the specific energies of products increase the level of expertise required for a successful audit.

### Reasons for Energy Waste

Poor building design as a result of low cost structural design that results in high quantities of energy wasted for space cooling or heating

1. Poorly designed ventilation systems with inappropriate flow rates that increases operation costs without fulfilling their purpose
2. Absent or inadequate control systems for temperature control
3. Poor maintenance practices of dilapidated equipment that consume excessive electricity
4. Poor working behavior resulting in the use of utilities when nobody is in the facility to benefit from them

Energy wastage therefore arises from poor strategic management, a lack of energy efficiency culture and organizational structures that result in the bill-payers being completely removed from the designers and the plant managers. While good housekeeping practices are essential for reducing energy costs, lasting energy savings cannot be expected without the constant and strong involvement and support of the senior management. (Beggs C. , 2009)

## Economic Costs of Power Outages

Economic losses occur nationwide due to electricity and gas outages. However, the costs incurred consist of direct losses such as spoilage of material or production delays, and adjustment costs made by the firms for recovering some of the output. The direct costs consist

of the cost of spoiled raw material wasted and the value added costs of the output. The adjustment costs include the costs of overtime put in by the workers following ‘idle time’ and the repair and maintenance of machinery that suffer because of power fluctuations. While the outages may not present a high direct cost, multiplier effects present the losses as at least 1.8% of the GDP and warrant targeted action by the government with investments in energy management programs. (Pasha, 1989)

## Energy Management and Global Warming

Industry and building have already been pegged as the major culprits in energy waste and promotion of global climate change. Improving energy use in both sectors increase economic gain and reduce net carbon emissions. The possible improvements in energy efficiency in the residential/commercial sector can be categorized into the building envelope itself, lighting, temperature control systems and domestic/office appliances. Work on passive heating and cooling of buildings reveals that significant savings in building energy demands can be achieved by adopting architectural measures like correct orientation, solar shading, utilizing thermal mass, light colored surfaces and heat-reflective windows. Secondly, lighting and temperature control take up much of the energy demand. These can be reduced by correct placement of windows (while reducing thermal heating), lighter shades within the building and proper insulation and seals to prevent leaks while cooling or heating is performed by the systems. Sensors can also be judicially applied to switch off lights if the rooms are unoccupied. Refrigeration, ironing and boilers are the major energy consumers in residential and industrial settings. Whenever possible, they should be replaced with new models that are far more energy efficient. Reducing the use of power guzzling equipment will automatically reduce the amount of fuels burnt and consequently reduce emissions and global climate change. (Kamal, 1996)

# METHODOLOGY

A preliminary energy audit was performed for the purpose of this study, to highlight the importance of developing a professional cadre of energy managers and auditors in Pakistan.

## 1. Collection of Preliminary Data:

Name of institution: Bahria University

Address: Bahria University, Shangrilla Road, E-8, Islamabad

Name of Building: Ground Floor, Nallah and Central Block, Bahria University

City, State, Zip: Islamabad, Islamabad Capital Territory, 44000

Date of Audit: August 9, 2010

Type of Institution: Semi governmental

Architects: Abbasy and Associates (Consulting Architects and Engineers)

Electric Utility: Islamabad Electric Supply Company (IESCO)

The floor of interest consists of:

1. Eight classrooms
2. Main entrance lobby
3. Laboratory
4. Two faculty rooms
5. Toilets for boys and girls

The basic geographic data of the building in question and its location relative to other buildings was taken. The location and orientation of the building was located using Google Earth:

Elevation: 1850 ft

Location: Situated over Nallah flowing through Bahria Campus grounds, located in a north west direction behind the principal campus buildings.


**Figure 4 Map of Bahria University Displaying Nallah and Central Campus**

## 2. Collection of Local Weather Data of Audit Area:

Ambient Air Temperature: 27°C at 0900 local time (Pakistan Meteorological Department)

Equipment: Panel Mount Thermometer Module and Ambient Air Alcohol Thermometers provided by Pakistan Environmental Protection Agency's (Pak EPA) Central Laboratory for Environmental Analysis (CLEAN).

**Table 3 Temperature Values of Central Campus on August 9, 2010 at 1400 hours**

| Location | Temperature (°C) | |
|---|---|---|
| | Digital Reading | Alcohol Thermometer |
| **Outside Campus near Steps** | 35.3 | 36 |
| **Classrooms (without cooling)** | 30.1 | 31.5 |

Humidity: 89% at 0900 local time

As Islamabad is present in the climate Zone IV, with subtropical continental and lowlands sub-humid characteristics, the mean annual temperature changes are between 10.1-31.1°C (Nicola, 1999). Therefore, the buildings have to deal with space heating, cooling and humidity control.

### 3. Electricity Bill of Audit Area:

Electricity bill of audit area could not be obtained as the building is relatively new and utility bills have not been received and metering has not yet been established. However, campus specific metering will be carried out before the building starts functioning at maximum capacity.

### 4. Site Walk Through and Checklist Completion

**Table 4 Energy Audit Checklist (Adapted from Energy Auditor Checklist, Washington State University Energy Program 2003)**

| | DOES THE PROBLEM EXIST? | | RECOMMENDED | | N/A |
|---|---|---|---|---|---|
| **BUILDING ENVELOPE** | **YES** | **NO** | **YES** | **NO** | |
| Alignment and operation of windows | | ✓ | | | |
| Maintenance or sealing of windows | | ✓ | ✓ | | |
| Proper functioning of automatic doors | | | | | ✓ |
| Repair faulty gaskets | | ✓ | | | |
| Door resizing in case of energy leaks | | ✓ | | | |
| Functioning of central temperature control | | ✓ | | | |
| Weather stripping and caulking | | ✓ | ✓ | | |
| Condition of wind screens (if present) | | | | | ✓ |
| Doors between conditioned and unconditioned areas left open | | ✓ | ✓ | | |
| Excessive expanses of glass on exterior walls | ✓ | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Curtains, drapes and blinds | | ✓ | ✓ | | |
| Insulation between conditioned and unconditioned areas | | | ✓ | | |
| Reflective films on windows | | ✓ | | | |
| Inadequate ceiling insulation | | ✓ | | | |
| Energy saving efforts by floor personnel | | ✓ | | | |
| **BUILDING OCCUPANCY** | | | | | |
| Off-hour activities extend operating hours | | ✓ | | | |
| Rescheduling custodial and cleaning activities during working hours | | ✓ | | | |
| Automated energy management system controlling energy usage according to building occupancy | | | ✓ | | |
| Presence of laboratories/computer rooms | ✓ | | | | |
| **COOLING/HEATING** | | | | | |
| HVAC system | | ✓ | | | |
| Independent air conditioning units | ✓ | | | | |
| Cooling/heating in passageways | | ✓ | | ✓ | |
| Appropriate temperature setting | | ✓ | | | |
| **WATER TEMPERATURE** | | | | | |
| Excessive water temperatures | | ✓ | | | |
| Water leaks are evident | | ✓ | | | |
| **LIGHTING** | | | | | |
| Incandescent lamps | ✓ | | | ✓ | |
| Unclean lamp fixtures | | ✓ | | | |
| Group re-lamping of burnt fixtures | | ✓ | | | |
| Day light not used effectively | | ✓ | ✓ | | |
| Work stations located near illumination | | ✓ | ✓ | | |
| Decorative lighting | | ✓ | | ✓ | |
| Re-lamping with efficient light fixtures | | ✓ | | | |
| Lights on in day light | | ✓ | | | |
| Lights on in unoccupied areas | | ✓ | | | |
| Dedicated switches | | | ✓ | | |
| Manual outdoor lighting | | ✓ | ✓ | | |

## 5. Building Characteristics:

a) Gross floor area: 1672. 99794 sq m

b) Conditioned floor area: 793.0181 sq m

**Table 5 Conditioned Floor Area of Central Campus**

| Room | Area (sq m) |
|---|---|
| **Laboratory** | 217.5639 |
| **Classroom 1** | 55.88699 |
| **Classroom 2** | 58.42053 |
| **Classroom 3** | 62.59342 |
| **Classroom 4** | 59.25472 |
| **Classroom 5** | 63.32503 |
| **Classroom 6** | 54.5457 |
| **Classroom 7** | 48.91345 |
| **Classroom 8** | 52.31022 |
| **Faculty Room 1** | 58.42358 |
| **Faculty Room 2** | 61.78052 |
| **Total** | **793.0181** |

c) Unconditioned floor area: 879.97984 sq m

Floor areas were calculated from the site map provided by the Director Planning, Mr. Misbah Bukhari, Bahria University

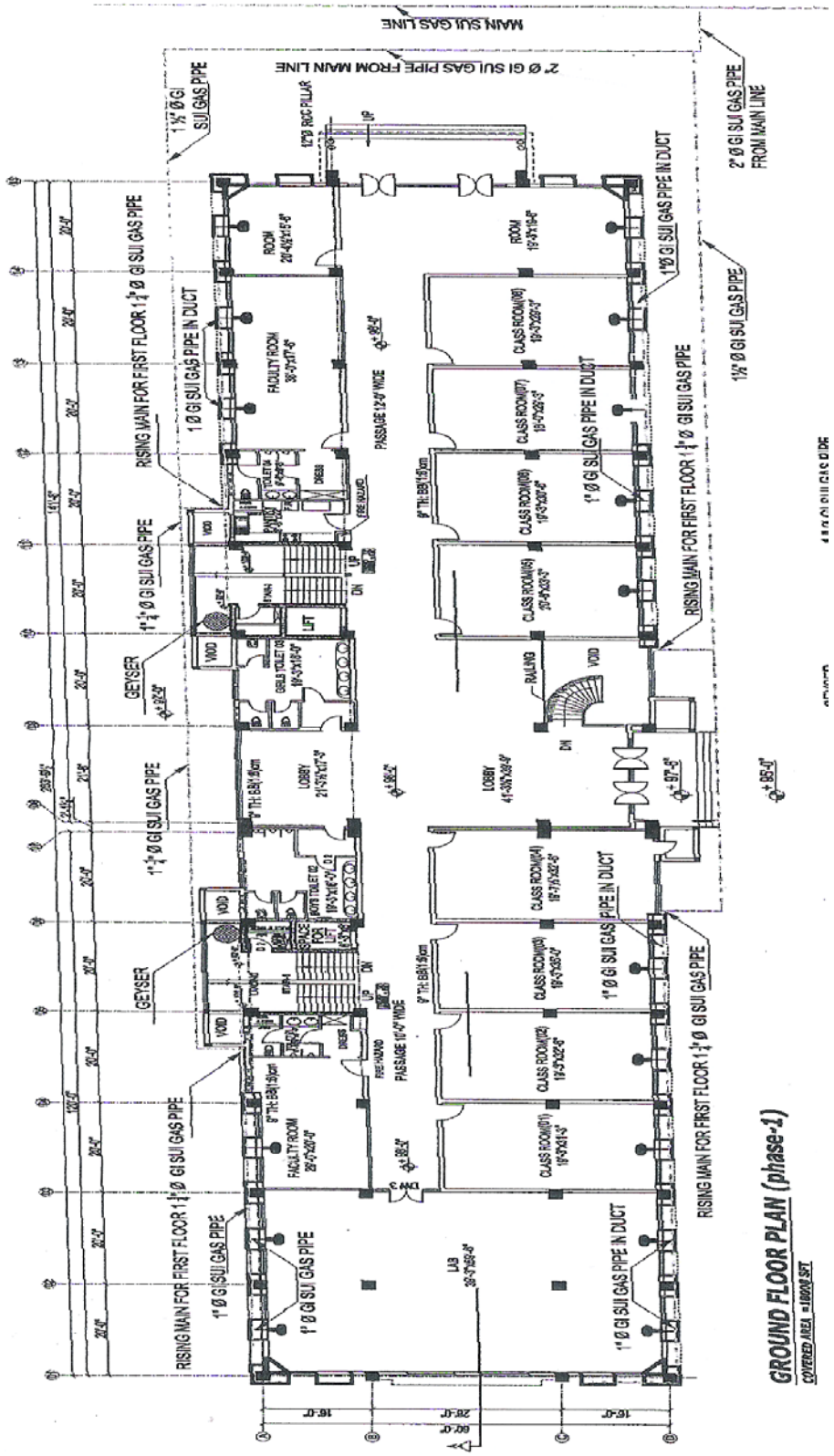



**Figure 5 Site Map: Central Campus, Ground Floor Bahria University**

## 6. Lighting Analysis

Lights: Phillips Life Max 18W tubes

**Table 6 Lighting in Ground Floor Central Campus**

| Location | Number of Lights | Watts |
|---|---|---|
| **Entrance Lobby** | 40 | 720 |
| **Corridor** | 152 | 2736 |
| **Classrooms** | 128 | 2304 |
| **Central Lobby** | 120 | 2160 |
| **Laboratory** | 64 | 1152 |
| **Faculty Rooms** | 52 | 936 |
| **Washrooms** | 24 | 432 |
| **Total** | **580** | **10440** |

## 7. Cooling System Analysis

**Table 7 Cooling System Analysis Ground Floor Central Campus**

| Location | Number | Cooling Capacity | | Capacity (Btu) |
|---|---|---|---|---|
| **Classrooms** | 16 | 3.5 ton | 42,000 Btu | 672,000 |
| **Laboratory** | 5 | 4 ton | 48,000 Btu | 240,000 |
| **Faculty Rooms** | 4 | 3.5 ton | 42,000 Btu | 168,000 |
| **Total** | **25** | | | **1,080,000** |

Conditioning: 1361.88586 Btu/sq m.

Average usage: Approximately 5 hours/day

Total consumption: 272.37 Btu/sq m/hr

## 8. Wall mounted fans

**Table 8 Fan system on ground Floor Central Campus**

| Location | Number |
|---|---|
| **Main Lobby** | 3 |
| **Central Lobby** | 5 |
| **Rooms** | 50 |
| **Total** | **58** |

## 9. Building Occupation Profile

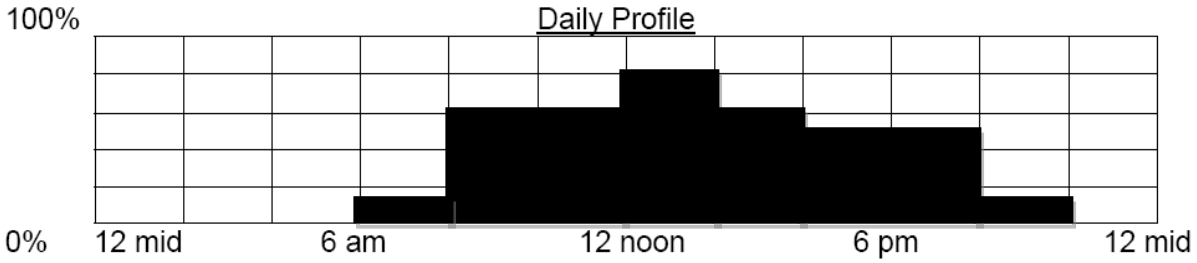



**Figure 6 Daily Building Occupancy Profile**

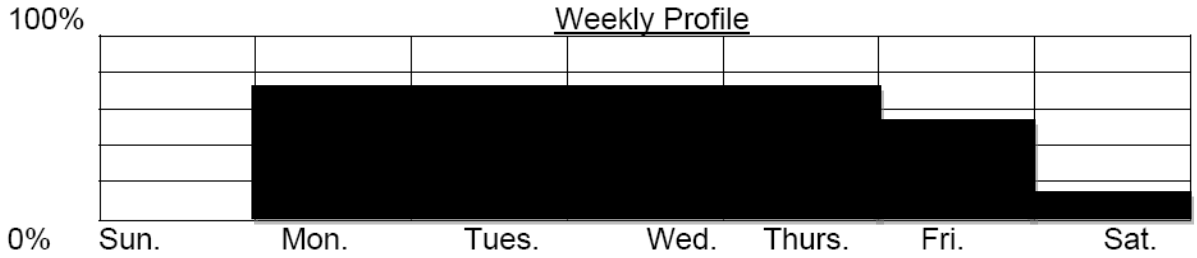



**Figure 7 Weekly Building Occupancy Profile**

(Adapted from (Workbook, 2003))

The lobbies and passageways are both open and unconditioned. Significant smaller amount of energy is wasted in this campus because no HVAC system is installed and the space cooling process is achieved by split air conditioners in classrooms and faculty rooms.

### 10. Conservation Measures Already Implemented:

a. Air conditioning usage only during days of extreme heat and humidity
b. No cooling of open passageway and lobby areas
c. Lights of passageway and lobby only switched on after evening
d. Constant housekeeping by staff, switching off lights and air conditioning when not in use

## RESULTS

Alignment of doors and windows is in correct orientation with solar heating and allows for maximum day lighting, which reduces lighting use in the passageways and classes. In some classrooms, the glazed windows are permanently sealed to prevent cooling and heating loss and the doors are kept closed as often as possible to retain the cool temperatures. As the lobbies and passageways are at a suitable temperature with white color and tiled flooring, temperature control is not a major issue and is compensated by wall-mounted fans. Outdoor shading is also present to prevent direct solar contact with the walls and windows.

Lighting is used infrequently as the passageways, corridors and workstations in classrooms are well lit during the day by sunlight. Re-lamping will be accomplished after a few months of operation and will be done by energy saving lights.

Air conditioning units are turned on two or three hours before midday and maintained at 26-28°C by the floor staff and doors are kept closed to prevent loss to the passageways.

From the preliminary walk through energy audit, it can be seen that various avenues for energy conservation exist within a building. Energy conservation measures identified after the audit are as follows:

1. Solar shading for prevention of direct heating
2. Solar outdoor lighting
3. Automatic lighting and cooling control
4. Vestibules or automatic doors at building entrances
5. Maintenance program for sealing thermal leaks
6. Replacement of lighting system with compact fluorescents
7. Installation of efficient insulation
8. Metering of each level of the campus

As the energy expended in the ground level is very less, the conservation measures will show improvements in the long term once metering and sub metering is done. As an energy invoice or meter reading was not available, economic cost could not be determined. However, the building is more energy efficient than the previous two campuses and has a smaller building occupancy profile, which also leads to a smaller expenditure of energy. This should be maintained by excellent housekeeping by the dedicated staff and rigid maintenance of the cooling equipment, windows and doors.

A detailed and comprehensive energy audit should be conducted in the entire campus during the Fall or Spring semester to calculate energy use with maximum occupancy of the building.

## DISCUSSION

In addition to direct economic improvements, increases in process efficiencies and providing large scale employment, energy management will also:

1. Improvement of ambient air quality
2. Reduction of release of carbon dioxide
3. Reduction of ozone depleting substances
4. Increase indigenous technical man power
5. Increase competitiveness in global marketplace

Development of a professional cadre of energy managers and energy auditors is crucial concerning Pakistan's current energy and employment status.

In accordance with Sections 8 (xviii), (xix), Section 11 (i) and Section 12 (i) of the Pakistan Energy Efficiency and Conservation Bill 2010, when approved would require energy use assessments for the projects before their initialization and energy audits for any entity to identify energy usage and corrective energy measures. For such large scale energy audits and management, the existing fragmented structures of private consulting companies are grossly insufficient.

Such a major development requires:

1. Effective national energy policy
2. Training institution/organization for specialized energy management/auditing education
3. Graduate or diploma courses with engineering concentrations
4. Institution/organization for certification

5. Development of industry specific Energy Management Systems guidelines
6. Effective, centralized monitoring and record keeping system
7. National information dissemination system
8. Training seminars and workshops with a broad target audience

# RECOMMENDATIONS

The main solution to the energy and employment crisis in Pakistan is to launch a cadre of professionals that deal with energy management at all levels of the economy, solving immediate and long term energy needs.

## Short-term Implementation

Pakistan needs a collection of trained and experienced energy managers and auditors to answer the provisions of the Building Energy Code and the Energy Efficiency Bill.

Short term vocational training courses at district level will provide experienced plant managers and engineers with the familiarity with industrial energy conservation.

Effective training requires a strong academic and professional background as:

a) A graduate Engineer (Bachelor of Engineering form an HEC recognized university) with three years of work experience involving use of energy in operation, maintenance, planning,
b) A diploma Engineer (Associate Engineer from a recognized polytechnic institute) six years of work experience involving use of energy in operation, maintenance, planning
c) A graduate in Physics or Electronics or Chemistry (with Physics and Mathematics at graduation level) with three years of work experience involving use of energy in operation, maintenance, planning,

While targeted tertiary education is a necessity, in the meantime, it is important to fulfill the market's demand. The best candidates for the short term solution are:

a. Plant manager
b. Production manager
c. Energy manager
d. Facility manager
e. Maintenance consultant
f. Process engineer

As they already have technical and managerial skills, complementing their experience and knowledge with energy conservation concepts will enable to immediately improve the energy economic situation of their respective entities.

## Long term Implementation

While the vocational training temporarily fulfills the institutional gaps, tertiary education must be developed with dedicated energy management and auditing degrees at all major UETs.

Criteria of courses:

1. Primarily engineering based
2. Provision of solid managerial and financial skills
3. Inclusion of industrial application of concepts as degree completion requirement
4. HEC approved faculty

Pre-qualification of tertiary degrees:

1. Minimum of sixteen years schooling (or equivalent) in a relevant subject: Business Administration, Computer Science, IT, Economics, Engineering, Natural Sciences, Public Administration and Policy, and Development Studies.
2. High mathematic NTS GAT score or 5 years industrial experience

3. Excellent communication and managerial skills

As employment of fresh graduates is a challenge in the country, the National Internship Program of the Ministry of Youth Affairs can be commissioned to ensure proper job placement of prospective energy managers and auditors so they get the requisite industrial experience. Industries and other energy consuming entities should be encouraged to hire fresh graduates as well.

A candidate qualifying as Certified Energy Manager as well can be considered for appointment or designated as Energy Manager by the designated energy consumers.

### ENERCON as Focal Federal Entity

ENERCON, under the provisions of the Energy Efficiency and Conservation Bill 2010, shall be the focal federal entity for initiating the launch and subsequent coordination of the cadre. They already have the power of selecting desired technical staff and establishing policies, procedures, standards and regulations, they are in the perfect position of coordinating other governmental departments for efficient resource management. Targeted capacity building of ENERCON is proposed in the form of a dedicated Energy Management Cell that will coordinate with industry specific energy managers and their cells across the nation.

Besides designing a national energy management framework based on the requirements of the existing policies and the strategic directives, ENERCON will also be responsible for designating the training and certifying authorities and monitoring the technical needs of the industrial and commercial sector, to tailor the curriculum accordingly.

## Ownership of Management

The primary factor for effective management of all energy manager activities is the ownership of management. Primary activities of the managing department or entity are:

1. Routine evaluation and updating of the energy management and auditing curriculum to ensure that it responds to industrial and commercial needs
2. Ensuring that a requisite number of managers and auditors are being trained
3. Provision of industry specific management training
4. Maintaining close associations with industries for energy manager performance feedback and integrate suggestions for improvement
5. Promotion of this occupation through industrial connections and focused media campaign
6. Interaction and evaluation of energy management consultants and increasing ease of access to relevant industries
7. Efficient and up to date record keeping of all managerial activities

## Curriculum Development

Training guidelines provided by ENERCON's specialists, Universities of Engineering and Technology and HEC should be commissioned for curriculum development. The curriculum will have a focus on energy efficiency and conservation and strategic management practices in each study module. The curriculum will contain a minimum of:

1. Basic reference text providing foundation material on energy, energy efficiency and conservation, equipment management and retrofitting instructions
2. Presentation slides for the purpose of the training workshops figures and charts to visually describe the concepts
3. Practical exercises for a hands-on application of theoretical concepts

4. Trainers guides characterizing the activities and optimal times for all the activities
5. Examination or quiz sessions for assessing comprehension

Analysis and evaluation of the results of the training sessions is essential to identify weaknesses in the curriculum or the implementation process. All changes made to the curriculum must also be fully documented with reasoning prompting the change.

## Training

Vocational training activities should be handled by TEVTA at district level. Training progress and results should be monitored by ENERCON through locally appointed officials and bi-annual training progress reports should be generated, analyzed and documented.

Training of the trainers is an integral part of the training process, as they have to work in close association with the participants. In trainers, the quality and level of their knowledge and experience is equally as important as their skill in imparting this experience to the audience who come from varied academic and professional backgrounds. Therefore, the procedure of selecting and training the trainers is an important factor before the training can even begin.

UET, with the collaboration of HEC will develop the trainer profiles being careful as to how the trainers must develop the skills of teaching conventional engineering concepts and integrating them with practical industrial applications of energy efficiency and management. In this case, the trainers can be faculty members of universities or practicing industrial experts who can be trained to overcome any shortcomings in their abilities. Foreign experts who may be practicing energy managers can also to train trainers.

Training cost will be dependent on the contents of the curriculum, total contact hours of the trainers and facilities provided such as rooms and equipment. Cost must be subsidized and sponsored by the participants own organizations as much as possible.

## Examination

The system for testing and examination for the managers and auditors should be handled by NTS under the supervision of HEC who already have significant experience of conducting national level examinations in Pakistan and are therefore well versed in all aspects of examination, especially confidentiality and record keeping. HEC must play a guiding and advisory role to maintain the educational integrity of the examinations.

## Online Energy Management Services

Considering the importance of the Internet, an online database or web portal is crucial for the development of the training and certification program. Online availability of services reduces the need of procedural paperwork and streamlines the entire process:

1. Online registration for certification of prospective candidates
2. Availability of pre-requisites and curriculum for certification examination
3. Preferred energy management and auditing manuals and handbooks
4. Rules and regulation for examination
5. Minimum percentages for qualification
6. Dates and venues of examinations
7. Database of profiles of qualified energy managers
8. Detailed certification process
9. Duties and responsibilities of energy managers and auditors
10. Complete text of Pakistan's Energy Efficiency and Conservation Bill 2010

## Proposed Actions for Launch of Professional Cadre

The launch of a working cadre is imperative, following the Honorable Prime Minister's strategic directive stating that a senior officer or person shall be designated as energy conservation manager in public or private establishments for monitoring energy conservation.

There is a vast potential for developing the cadres as nationwide institutional gaps have to be filled. Mass employment will be one of the direct results of the cadre development. Foundational work in the form of functioning Energy Service Companies (ESCOs) and fragmented energy management work across the economic sectors is already in place but the primary deficiency is the lack of a certification regime. Certified personnel will identify the technical inefficiencies leading to energy waste and provide constant guidance and technical help to the designated consumers.

The policy directives have already categorized the energy needs, but the institutional gaps pertaining to education, awareness and ownership have to be filled to develop a strong energy efficiency culture which involves the following actions:

**Action 1:** Development of streamlined energy management policy framework by ENERCON. Time frame: 1 month

**Action 2:** Development of Energy Management Cell within ENERCON with Chiefs of departments and Energy Supervisor. The Energy Supervisor's proposed qualification and background:

2. No prior affiliation with ENERCON or Ministry of Environment
3. Graduate degree in Engineering or Energy Management from an HEC recognized or foreign technical university of repute
4. Minimum of 6 years practical industrial experience in any of the following capacities:
    a. Plant manager
    b. Production manager
    c. Energy manager
    d. Facility manager
    e. Maintenance consultant

f. Process engineer

Appointment of Supervisor should be accomplished by:

1. Advertisement of post in major English newspapers of Pakistan
2. Clear definition of criteria
3. Selection based on academic qualification, experience and will to contribute to Pakistan's energy future

Responsibilities of Energy Supervisor:

1. Communicating directly with on-site appointed energy managers
2. Identifying major institutional gaps in partner organization with EMC members
3. Suggesting and developing strategies for energy conservation activities
4. Identifying possible funding sources

Functions of Energy Management Cell:

1. Coordinating energy management activities in Pakistan
2. Evaluating energy management efforts by energy management cells in industries and other sectors
3. Identifying private sector energy management efforts
4. Encourage certification of private energy managers
5. Collate energy management efforts of Pakistan

Time frame: 1 month

**Action 3:** Commissioning HEC, in collusion with, UETs, GTZ and ENERCON for developing training course curriculum. Time frame: 1 month

**Action 4:** Nationwide, intensive awareness building program with a focus on provincial capitals and industrial cities by departmental communications, lectures and newspaper notices about energy management training programs. Time frame: 2 months

**Action 5:** Launch of short-term vocational training courses by TEVTA, using uniform curriculum developed at district level. Time frame 6 months. Qualifications for participating in training courses:

d) A graduate Engineer (Bachelor of Engineering form an HEC recognized university) with three years of work experience involving use of energy in operation, maintenance, planning,

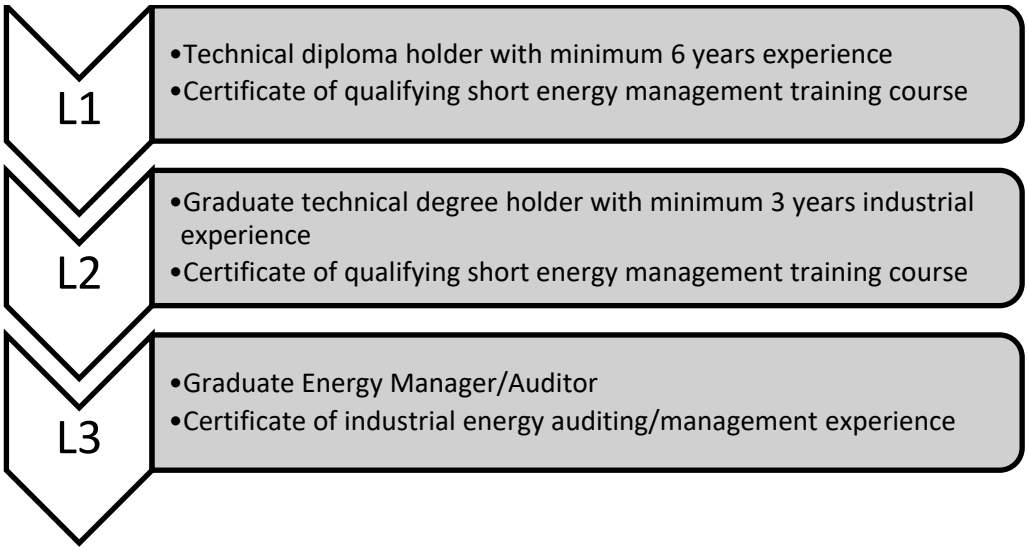
e) A diploma Engineer (Associate Engineer from a recognized polytechnic institute) six years of work experience involving use of energy in operation, maintenance, planning

f) A graduate in Physics or Electronics or Chemistry (with Physics and Mathematics at graduation level) with three years of work experience involving use of energy in operation, maintenance, planning,

**Action 6:** Development of uniform and generalized examination system by HEC and NTS, to be conducted in the same locations as the training programs Time frame: 1 month

**Action 7:** Identification of Certifying Agency that may be PSQCA (who currently only have product certification) Time Frame: 1 month, Action by: ENERCON

**Action 8:** Establishing certification levels by certifying agency and EMC of ENERCON. Time Frame: 1 month. Proposed levels:



**Action 9:** Development of tertiary education degree courses at major UETs by HEC. Time frame: 6 months

Criteria of courses:

5. Primarily engineering based
6. Provision of solid managerial and financial skills
7. Inclusion of industrial application of concepts as degree completion requirement
8. HEC approved faculty

Pre-qualification of tertiary degrees:

4. Minimum of sixteen years schooling (or equivalent) in a relevant subject: Business Administration, Computer Science, IT, Economics, Engineering, Natural Sciences, Public Administration and Policy, and Development Studies.
5. High mathematic NTS GAT score or 5 years industrial experience
6. Excellent communication and managerial skills

**Action 10:** Appointment of Certified Energy Managers and Auditors in major industries by Ministry of Industries and other relevant entities (i.e. APTMA for textile mills) who report to senior management of industries and EMC of ENERCON. Time Frame: 1 month

Responsibilities of on-site energy managers:

Planning and Organization:

1. Preparation of a Facility Energy Plan
2. Review and monitor energy-use trends and patterns
3. Tracking progress toward meeting on-site or ENERCON energy goals
4. Monitoring utility bills and meters
5. Identification and monitoring of high energy-use processes
6. Organization an installation Energy Management Team
7. Preparation of an energy contingency plan

Budgeting and Project Programming:

1. Preparation of an installation energy budget
2. Calculation of avoided energy costs
3. Tracking energy projects funding status

Administrative:

1. Establishing base energy policies
2. Preparation of annual paper for facility energy program
3. Preparation of an energy award program
4. Encouraging and evaluating energy suggestions from technicians

Record keeping

1. Maintaining complete energy record with utility bills, retrofits, audit reports, etc
2. Communicating process changes and annual reports to EMC ENERCON
3. Establishing online database of energy management system

**Action 11:** Inclusion and periodic updating of database of energy managers and auditors with EMC of ENERCON.

**Action 12:** Analysis of training results and reports by industrial appointed energy managers for identification of knowledge gaps. Action by: EMC ENERCON and HEC

**Action 13:** Development of online database of Energy Management, with content control and monitoring done by EMC ENERCON

**Action 14:** developing draft legislation to include in existing environmental and energy legislation. Action by: Ministry of Environment, Planning & Development

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