Industrial Energy Management Assessment Centers for Latin America and the Caribbean

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Abstract
In the last decades, far more so than in previous generations, the levels at which the world is using energy have increased dramatically, surpassing sometimes power generation capabilities. This encompasses the generation of a myriad of environmental problems, all associated with our energy consumption and usage. As a consequence there is a dramatic call to explore new zero-pollution power generation technologies. However, the newly developed techniques are too expensive with low efficiency and the energy and environmental problems our society creates in a daily basis are increasing dramatically with slim tendencies of suppression. We believe that the solution passes through a society that can become more energy efficient and/or practice energy conservation.

In this work we show an International Industrial Energy Management (IIEM) program that is currently ongoing at the University of Florida (UF). The program consists of creating Industrial Energy Assessments Centers in Engineering Colleges in Universities in Latin America and the Caribbean. The goals of the program are to help local midsize manufacturing facilities to become more energy efficient by performing comprehensive energy, waste and productivity assessments. The benefits for participating Universities, their students, faculty, local industry, and the current status of the program with participating countries will be shown. The program is based on our 14 year's of experience as an Industrial Assessment Center program sponsored by the US Department of Energy. The University of Florida IIEM provides the technical support, the know how of the auditing process, the daily operation of the centers, database, training, etc.

Keywords
Industrial Assessment Center, Energy Management

1. Introduction

In today's' energetic world energy saving through a thorough energy management policy is becoming an everyday task. Facilities that usually were not concerned on their energy consumption now pay close attention to it and dedicate time and effort to reduce it. Federal buildings are not an exemption. Some countries like the United States have already start reduction on their federal buildings energy consumption (for example, the US Executive Order 13123 mandates by year 2005 the reduction of 20% of their energy

consumption as of 1990, and by 25% by 2010). In the chain of energy usage, energy savings are affecting our lives and our environment. Precisely, each time that energy is being consumed, some fuel has been burned, or a resource used, so to provide us with such energy. As a consequence, some pollutants are put into the atmosphere, or some environmental issues stressed. These pollutants, whatever their origin and concentration, that are moved around the globe to the atmosphere by jet streams, do not exclude countries, rather they affect the planet. For some year's now, research has shown an increase in the amount of acid rain, and has proved the effect of some pollutants to produce depletion in the ozone layer, which protects us from being burned by the ultraviolet rays coming from the sun. The increase in pollution can be of catastrophic consequences, and is a continuous threat to our presence in the planet.

Saving energy has additional benefits. It certainly allows for economic competitiveness as production costs are reduced, as is the intensity in industrial energy. Moreover, energy efficiency allows for fuel independence by reducing oil imports, for example, which in turn reduces a countries dependence on energy imports and vulnerability to oil embargos. In addition, it reduces negative balance of trade as imported oil bills are also reduced, directly affecting the balance of payments.

Much can be done in business, industries, and government facilities to reduce energy consumption, but there is much more that should be done, without affecting the quality of the products and services provided. This does not mean that as a consequence investments will decline in these areas: on the contrary, they should increase as we become more energy efficient and comply with environmental regulations. This is certainly another issue that should be tackle in depth, as today the world has a global economy. Namely that, if countries in Latin America and the Caribbean wants to export manufactured goods to other (mostly developed) countries, they will have to first comply with stringent environmental regulations, as they should.

Energy has to be consumed in order to produce the goods and services that we need. We can certainly imagine that our facilities can continue their process with less, more efficient energy consumption through the use of energy management, this is, reduce energy costs and pollution. Among all possibilities for energy savings, two extreme types of facilities in the energy conservation framework can be considered, and they do exist. On one end, is the somehow appealing choice for some companies to do nothing about it. Reasons argued are: no time (too busy), no qualified technical in-house personnel to perform an energy audit, or no funds available to hire the services of an external consultant. The other end is represented by well known companies that have made tremendous changes in their energy consumption, with teams of energy managers. These teams suggests measures that allows them to continue manufacturing their goods, with the same high quality, but with the minimum energy consumption, this is, they use the energy in the most efficient way saving resources that positively impacts the bottom line of these companies. Needless to say, the savings obtained by implementing the ideas recommended by the energy management team have highly exceeded their salaries. Unfortunately, this second type of facility is not very common.

The way to achieve this does not seem to be elementary, as much needs to be done in new technology through research and development. Partnership between academia, the government and facilities (industrial or federal) is very appealing. In this regard Latin American and Caribbean governments should become more and more involved as a partner with academia and industry for energy conservation and the environment.

We now show a simple estimate of the cost effectiveness of the centers through a simple payback calculation of such a project (center). The figures are based on those of the University of Florida Industrial Assessment Center for audits performed during 2004, with a total of 25 assessment days. The recommendations made reached a total value of more than 7 million dollars:

- Annual Operating Costs: $200,000
- Proposed Recommendations: $7,000,000/year
- Implemented Recommendations: 10% (real is 20%) = $700,000/year
- Simple Payback Period: ~ **0.3 years**

The amount of electricity consumed in the majority of the region gives an idea of the potential for savings and benefits of this program. This values are shown in Table 1.

Table 1. Electric energy consumed in Latin America as of 2002 (units are GigaWatts per hour)
(source: IEA Energy Statistics. This is 2004 copyrighted material by the OECD/IEA)

Flow	**Energy (*GWh*)**
Production from:	
- coal	24,280
- oil	83,476
- gas	99,014
- biomass	17,278
- waste	0
- nuclear	19,658
- hydro	539,047
- geothermal	2,324
- solar PV	47
- solar thermal	0
- other sources	373
Total Electricity Production	**784,522**
Imports	47,026
Exports	-48,572
Domestic Supply	**782,976**
Statistical Difference	864
Total Transformation	**0**
Heat Plants	0
Energy Sector	**23,648**
Distribution Losses	130,241
Total Final Consumption	**629,951**
Industry	289,646
Transport	2,355
Agriculture	0
Commerce and Public Services	0
Residential	0
Other Non-Specified	337,950
Non-Energy Use	0

Moreover, the benefits and cost effectiveness of the local assessment center of participating universities include a better and closer relation with the industry. In addition is the graduation of new generations of engineers with a better background not only in industrial energy management, but also in manufacturing and production issues, project development, consulting, etc.

We believe that this is a great motivation to participate in the program. The operating costs can be reduced by the participating university by simply charging to its clients a given amount for its industrial energy management services. Worth to mention is the fact that the local IAC will become a noticeable

public very knowledgeable institution that could suggest more global energy and environment conservation regulations.

We believe that a unified and centralized work on reducing energy consumption in Latin America and the Caribbean will certainly help the region to become energy efficient, and their industries will certainly become more competitive. In this work we call for the creation of Local (each country) Industrial Energy Management Assessment Centers in the region. As we shall discuss later, we propose that this be university based centers, located in Colleges of Engineering. This fulfills, among others, educational and research goals, not to mention better Industry-University relations. This program effort for the region is led by the University of Florida College of Engineering (UF-COE).

In the next section we describe the University of Florida International Industrial Energy Management Program. The program set-up is discussed in section 3. The associated benefits to the participating country industries and Local Universities are described in the fourth section. The fifth section suggests the organization and operation plan of the Local University IAC (LU-IAC). In section number 6 we discuss the University of Florida IIEM qualifications as Program Manager. The training required by the LU-IAC, and that will be provided by the UF-IIEM, is explained in section 7. Finally, we draw our concluding remarks in section 8, where we discuss the stage of the program and its future.

2. The International Industrial Energy Management Program

The University of Florida Industrial Assessment Center (UF-IAC) is an existing program with an established record of quality performance. During the past 14 year's, the UF-IAC has cost-effectively improved the energy efficiency, waste minimization and operations efficiency of over 360 small and medium-sized manufacturing plants in Florida, Southern Alabama, and southeast Georgia.

The Department of Industrial and Systems Engineering at the University of Florida proposes to assist in initiating IAC's at local universities in Latin America and the Caribbean. This assistance will be in the form of providing the necessary training and continuing support to establish the local IAC. The project also calls for a strengthening of current academic relations between local universities and the University of Florida. The new center (each country can have one or more than one IAC, or partner with other Local University) will assess local manufacturing facilities in the located country, so to identify opportunities for becoming more competitive in the global manufacturing marketplace. To accomplish this, the Local University (LU) Industrial Assessment Center (LU-IAC) will be established at the LU campus. The LU-IAC will perform 12 assessment days of effort at properly sized manufacturers during its first year of operation, increasing to 15 or more assessment days in the following and subsequent years. An assessment day being defined as a one on-site day visit. Each assessment of a selected manufacturing facility will include a thorough analysis of all forms of energy consumption, waste generation and productivity and preparation of specific Assessment Recommendations (AR's) of identified opportunities for improvement.

The major focus of the LU-IAC will be to serve the needs of manufacturers in their city and country. These needs relate chiefly to energy, waste and productivity associated with the manufacturing processes as well as other aspects of a manufacturer's operations and housekeeping. This will be accomplished through plant site visits, and by analyzing the operating characteristics and energy, waste, and productivity efficiency of manufacturing facilities; identify, quantify, and recommend specific opportunities to conserve energy, reduce waste, and improve productivity; and report the findings to the manufacturer in writing, together with estimates of their savings, implementation costs, and payback periods. Students will participate in all phases of data collection, analysis and report preparation, with the IAC director being responsible for the quality of the reports produced.

The plant is requested to supply a complete set of cost and quantity of consumption records for all of the forms of energy and water used at that location. In addition, information on utility rate structures is obtained for electric, gas, other energy sources as well as water and sewage utility services. Rates for any other supplies/services, such as solid waste disposal, are also obtained. In some cases the plant allows the necessary information to be obtained from their utility or other supplier. Other information obtained in advance of the site visit includes: a sketch of the plant layout; the plant operations schedule showing operating hours and shift information; a general description of the manufacturing operations; and, if available, a list of the major processes and equipment. Charts of the plant consumption and costs are prepared to display trends in usage.

2.1 The Auditing Process

In this section we briefly describe the auditing process. As the audit begins, an introductory session takes place where the preliminary information gathered on the plant is verified. Utility costs and consumption are discussed at this time and possible reasons for any noted apparent anomalies are sought. Also, the assessment team gives several documents to the plant representatives to identify the LU-IAC and a brief description of the assessment process to be followed. Additional services will be made available to the client such as web sites, challenge programs, software tools, etc. We shall discuss these issues later on this work.

Following the introductory discussion of plant operation and existing concerns, one or more manufacturer's representatives guide the assessment team on a walk-through of the plant to observe the operations performed at the plant, to determine the flow of materials from receiving, through processing, and finally to shipping.

After the initial plant walk-through, the assessment team secures their measuring equipment and proceeds to take and record quantitative information to characterize the equipment and processes in the plant. Plant maintenance people are requested to accompany the assessment team and work with them to obtain the necessary measurements.

- An inventory of major equipment is compiled.
- Amperages of large motors and motor-driven equipment are measured when there is reasonable and safe access to power conductors. Single-phase or three-phase measurements are taken as appropriate to obtain efficiencies and power factors. Similar measurements are taken when safe and practical for all other large electrically powered equipment. Examples of such equipment include arc furnaces, electrolytic cells, and infrared or induction heaters.
- Material flows, required temperatures, allowed variations of key parameters, on-line quality control measures are recorded.
- Combustion efficiency is measured for all major fuel-burning equipment. At the minimum, excess oxygen and stack temperature are measured in oil and gas boilers.
- Other factors that affect energy consumption are measured including process temperatures, equipment temperatures, and working temperatures in various plant and office areas. Light levels are measured in selected areas of the plant and offices. Air flow and ambient temperature are measured to determine efficiencies of HVAC systems and duct losses throughout the plant.
- Waste generation, recycling and disposal are quantified. Sources of losses, equipment condition and apparent maintenance requirements, such as compressed air leaks, are noted.

A primary underlying objective throughout the data-gathering phase is to identify ideas for potential improvement of operations. If questions arise about how, why and when certain operations are performed these are noted and answers are sought from plant personnel. This is where the experience of the professional staff of the IAC - the director and/or the assistant director/ technical manager - makes a major impact on the quality of the assessment results. Knowledge of manufacturing processes, equipment,

and operating procedures is necessary to spot the areas where energy conservation, waste reduction, and productivity improvements can be made. Inefficient process heating equipment, low-efficiency motors, large quantities of wasted heat, poor match of fuel forms to process needs, poor process or personnel scheduling, and inefficient scheduling of large electrical loads are only some of the areas where highly experienced personnel can make significant differences in the potential opportunities for improvement identified.

After the measurements and other data taking have been completed, the LU-IAC assessment team members compile their data, perform preliminary analyses, and identify possible opportunities for improvement of the manufacturing operations. Using the information collected on-site as well as the information collected in preparation for the site visit, the assessment team identifies potential recommendations to reduce the energy, waste, and productivity-related operating costs of the plant.

Following the team progress review, the team meets with plant representatives for an informal discussion of the assessment findings and observations to date. The resulting discussions typically prompt plant management along with operating and maintenance personnel to suggest ideas that they have been considering but have not had the time or personnel to pursue feasibility. Often plant management will reveal concerns and plans that can greatly influence the likelihood of implementation of recommendations as well as expansion opportunities for study.

After the on-site visit, the LU-IAC staff conducts additional research on processes and equipment to identify technological products or processes that could help make the particular plant's operation more efficient and cost-effective. The IAC staff then analyzes the identified opportunities and prepares Assessment Recommendations as we describe below.

2.2 Documentation and Reports

The LU-IAC prepares and archives several documents associated with each assessment, that will give rise to the Assessment Recommendations and ultimately to the Assessment Report.

As a result of each analysis, the LU-IAC prepares reports of recommendations for technologies and potential improvement opportunities - known as Assessment Recommendations (AR's) - for inclusion in the formal assessment report that is submitted to plant management. The primary focus of these AR's is for improvements to the plant's manufacturing operations. Equipment modifications and replacements are considered, as well as potential changes in the plant operating schedule or operational procedures. Each AR is explained together with the supporting assumptions used and the calculations made. Each of the energy, waste and productivity recommendations includes estimates of energy conserved as well as costs and benefits. Implementation (equipment, installation, and training) costs and operating costs are stated separately, so that cost savings can be clearly computed and a simple payback period can be determined.

A formal Assessment Report is written for every assessment conducted. These reports are based on the data acquired and analysis made before, during and following the assessment visit. Each assessment report consists of: (1) the data and other information derived from historical records and measurements made during the assessment; and (2) the assessment team's specific recommendations as described below. The completed Assessment Report is sent to the manufacturer and to the acting field manager for review and possible recommendations for revision. We shall return to this issue later on.

2.3 Electronic Submission to the UF-IIEM Database

Within 60 days following completion of the assessment, key data are electronically transferred to UF-IIEM program database. The data include, among other: geographic location, product manufactured, energy consumption, recommendations made, etc. The LU-IAC compiles and displays a running total of

its AR implementation rate, its energy savings in BTUs, and its cost savings in dollars. These summary results are displayed in the LU-IAC office and are potentially made available on a LU-IAC Website for members only review.

The Assessment Report and information specific to each manufacturing company are considered sensitive information and are not disclosed publicly in association with the client's name or other identifying features without the consent of the client.

When the LU-IAC receives requests for additional technical assistance from manufacturers whom it has served, the LU-IAC attempts to provide as much additional technical information and analysis as possible within the budget limits of LU-IAC's contractual agreement. However, neither the LU-IAC nor the UF-IIEM provide any engineering design services and/or offer performance guarantees for its analyses or recommendations.

2.4 Implementation Survey

Follow-ups are made to provide formal documentation of the energy and monetary savings that are due to the services of the LU-IAC. Approximately six months after the Assessment Report has been sent, to determine which recommendations have been or are scheduled to be implemented, which are still under consideration, and why no implementation is planned for the others. For recommended measures that have been implemented, the plant representative is asked to provide implementation cost data and savings data projected or obtained so far.

Information on what recommendations have been implemented by each client and the bottom-line cost and savings data are compiled and reported to the field manager by up-loading to the UF-IIEM Database at the level of detail and according to the format requested.

The LU-IAC will encourage manufacturing companies to continue their association with the LU-IAC. Follow-ups on recommendations that have implementation costs of over US$10,000 should be continued for multiple years or until the recommendation is implemented. This may include additional site visits and additional assistance within the capability of the IAC to help facilitate the implementation of the AR.

These post-assessment follow-up contacts with client manufacturing companies are considered an extremely important part of the operation of the LU-IAC. There are several benefits to this client follow-up: it helps insure that a client company understands the recommendations, and it shows that the IAC is truly interested and concerned with the economic health and competitiveness of its client.

3. The IIEM Program Set Up

3.1 First Phase: Visits from the University of Florida to the Local University

The first phase would involve an extended site visit by University of Florida International Industrial Energy Management Program (UF-IIEM) principal investigators to Local University (LU) to learn about their infrastructure for working with manufacturing firms, utility companies, vendors for energy-based projects, plus local and national government agencies. We would spend some time introducing our successful program of 14 year's, and providing the necessary training with the needed modifications for its successful adoption in the country. Following this it would be a site visit to a local manufacturing facility to perform the first LU-IAC audit. More training will take place after the audit whose focus will be mainly regarding the writing of the reports and its recommendations.

3.2 Second Phase: Visits from Local University to the University of Florida

The second phase would involve two or three graduate students (and a post-doc), or directors from LU-coming to study in the University of Florida Industrial & Systems Engineering Department to work closely with the UF-IAC and UF-IIEM principal investigators. They would be the foundation for helping to continuously translate new ideas back to help establish a more robust university-based IAC.

3.3 Third Phase: Local University Continuation of Activities

The final phase would involve the evaluation of remaining infrastructure necessities, such as sustained funding from local or other entities (local Ministry of Energy, the Electric utility company, etc.), development of an energy product vendor base, and ongoing administration of the program. The UF-IIEM will assume the position of field manager for the first to the second year of operation. The LU-IAC is encouraged to find additional funds. This will be determined in the early phases of the project.

4. Benefits to the Participating Country Industries and Local Universities

First and foremost, we anticipate substantial energy savings for the participating country manufacturing companies that participate as customers for LU-IAC. In the US, the UF-IAC typically create recommendations that save 20% - 40% energy savings (or $55,000 per audit day as a minimum) with immediate or up to two-year payback. We feel that this is more than reasonable to expect in any country in the region as the UF-IAC is working with fairly energy-aware companies that have often implemented the most obvious savings prior to our assessments. Additionally, waste reduction and productivity improvement suggestions are recommended by the UF-IAC as a part of their audits. By involving LU, we feel there will be a good foundation to sustain the IAC activities over a long period of time.

4.1 New Courses and Local Policies

The diversity offered by a major research center, such as LU-IAC, can be called upon to address various technological and political hurdles unique to each country. They can also develop energy management courses to students or business professionals, which will help to propagate the program throughout the country and the region. This will be developed by UF and participating LU- faculty.

4.2 Communication Between UF-IIEM and Participating Institutions

The LU-IAC director maintains close communication with the UF-IAC field management staff. This professional communication allows the LU-IAC to respond quickly and thoroughly any questions or suggestions from the UF-IIEM field management staff. In particular, the close communication links are important to receive feedback on the Assessment Reports submitted for review and comment to the written critiques of Assessment Reports that are suggested by the UF-IIEM field management staff.

4.3 Program Evaluation

The LU-IAC director and/or the Technical Manager will attend the annual meetings with the UF-IIEM field managers, and the other international Universities with IAC programs. The LU-IAC operates in a manner to meet the highest professional standards set for the IAC's. Client company satisfaction is one of the highest priority goals of the LU-IAC. The LU-IAC director cooperates fully with the UF-IIEM field management staff to set up visits to the client manufacturing companies served by the LU-IAC.

5. The LU-IAC Organization and Operation Plan

The plans for continuing to perform energy, waste and productivity assessments are described below. The LU-IAC will use proven, successful IAC operation/management methods and continuously seek new ways to improve the efficiency and effectiveness of its operations.

5.1 Organization and Operation Plan

The LU-IAC management organization includes a director, an assistant director and/or a technical manager and lead student engineers. The organizational structure that has been instituted inherently provides the necessary flexibility for accommodating part time student assistants and yet maintains continuity and responsibility of information flow. Figure 1 shows an organizational diagram. The director, assistant director and/or technical manager are in charge of each site visit, the final assessment analysis and report. The assessment team leader is responsible for organizing the site visit, collecting data, and preparations of the assessment report, under the direct supervision of the LU-IAC director, assistant director and/or technical manager. At least three students assist in conducting each site visit, performing the energy analysis, developing the AR's, and preparing the reports. The technical manager provides advice on various manufacturing processes and has the responsibility of supervising the teams of student assistants and coordinating the activities of preparing reports. The directors, technical manager and lead student engineers meet each other week to review the status of assessment projects and LU-IAC managerial issues.

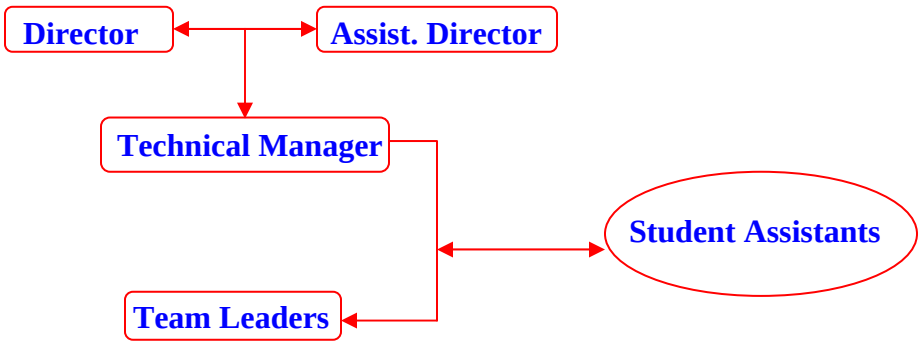

Figure 1. The Local University IAC management organization diagram.

5.2 Resources Available

The LU-IAC has the necessary resources in-place to conduct the planned activities: an office; assessment guides and instruction manuals specifically prepared to assist students in the assessment analysis; instruments for data taking, computers and software tools for data analysis and report preparation; a library of information on energy, waste, and productivity; secretarial and clerical support services; telephones and fax machines. We shall give more details about this later on when we discuss the operational issues on the actual UF-IAC.

5.3 Student Assistant Recruiting

The LU-IAC multiple disciplines student assistant positions and qualification requirements should be advertised throughout the College of Engineering. Interested students are encouraged to call or drop-in the LU-IAC office for additional information on the benefits of working in the LU-IAC as well as the goals and operations of the IAC program.

In addition, it is recommended that applicants must complete and submit an application form which requests general background information about them. The Local University director(s) should set-up a set of requirements to be fulfilled by the applicants (GPA, courses taken, work and academic experience, computational skills, and available time (all students must be able to work between 10 and 20 hours biweekly). A one-page resume should also be required. Finally, a short test is given to the applicant designed to evaluate the candidate's skills in problem solving. Training is then started on energy, waste, and productivity management as well as IAC procedures. Training to LU-IAC students should be given by LU-IAC management.

5.4 Recommended Assessment Team Participation

Each assessment team is composed of one faculty member, a lead student engineer as team leader and two or three engineering students. A flexible assessment team student leadership/membership should be used for each client assessment. A Lead Student Engineer and at least two other IAC student assistants are selected during the weekly management meeting to form an "Assessment Team" for a given client. The Lead Student Engineer (also known as the Assessment Team Leader) has the responsibility to assist with: arrangement of the site visit, preparation of the project notebook, management of information gathered, assignment of team member duties in preparation for the client plant site visit. All members of the assessment team must go on the site visit. The Assessment Team Leader is responsible for the initial review of the AR's developed as well as preparation of drafts of the Assessment Report. Final analysis and reporting is the responsibility of the director or assistant director.

5.5 Student Assistant Training

Training is essential to effective utilization of student assistants in performing the industrial assessments. The director, assistant director and/or technical manager must provide training sessions/workshops to enhance the capabilities of the student assistants in performing assessments. Outside speakers should also be invited to give talks on any energy conservation related topics.

The LU-IAC may plan to expand on several creative approaches to further enhance the IAC program's main goals of providing practical technical training and industrial efficiency to industry to improve the efficiency and competitiveness of manufacturers in its service region.

5.6 Identification and Selection of Clients

The LU-IAC will perform around 15 (up to twenty) industrial assessment days per year (starting with ten the first year) to small and medium-sized manufacturing companies. It is expected that the finding of clients to the LU-IAC will be fairly simple . Some additional clients can be found by those with existing contacts with LU or are identified through a variety of sources: Directories of Manufacturers, City Directories, Public Works/Energy Extension Service/County or State Energy Office, State Inspector Offices, Economic Development Organizations, Industrial Plant Databases, Phone Book, Telephone Solicitations, Mailings/Brochures, Press Releases/Articles in Industrial Journals, Web Site, word-of-mouth referrals, etc.

Once a company is identified as a potential client, its qualifications for receiving IAC services are checked for having met at least three of the following general borderline criteria (the first one being the most important one):

- Have a minimum equivalent to US$75,000 per year in utility costs at the plant.
- Lack in-house personnel expertise in energy use and energy conservation at the plant to be served
- The client should be preferably a manufacturing facility. Distribution centers, military and government facilities are eligible but not preferred. Commercial buildings should be excluded.

The companies selected for assessments are expected to cooperate fully with the LU-IAC in providing information on utility usage and costs, plant operating data, and other factors necessary to insure that a quality assessment is accomplished, and a high quality Assessment Report can be prepared. In addition, clients may be asked to allow the IAC program to develop materials such as case studies, and to use the firm's name, in order to promote industry efficiency. All proprietary manufacturing information related to clients is, however, strictly protected and all clients are given an opportunity to review materials that contain information which identifies the plant.

5.7 Electronic Information Management

The LU-IAC participates in the operation of an electronic mail system, which provides communications among the UF-IAC field manager, and all other international IAC offices. A server located in the UF-IAC office is dedicated to the IAC program data and information management efforts. The LU-IAC will create, and dedicate a Web site which publicizes the IAC program and provides a public virtual library of links to assessment recommendations. A private access (participating IAC directors only) section will be included with daily IAC operations. Databases of previous assessments and archives of assessments are maintained for internal reference and use in performing assessments. It is expected that the LU-IAC will have a number of desktop and portable PC's dedicated to data collection and plant site work.

6. The University of Florida IIEM as Program Manager

The University of Florida Industrial Assessment Center and the International Industrial Energy Management Program qualifications are described in this section. The University of Florida is a land grant institution of over 48,000 students. The University has 20 colleges and schools, and more than 100 interdisciplinary research, education and service centers, bureaus, and institutes. The College of Engineering is the largest professional school in the university and has thirteen, four-year ABET accredited undergraduate programs.

The University of Florida Industrial Assessment Center operates under the academic and administrative control of the Industrial and Systems Engineering (ISE) Department. The UF-IAC office includes a 700 sq.ft. room which contains equipment used in assessment site visits, library materials for energy management, industrial assessments and research projects, a server, desktop and laptops computers, printers, peripherals, and work areas to complete assessment reports and research projects.

The UF-IAC is centrally located to the State of Florida and southeast Georgia which is its service area. For plant sites within approximately 150 miles of the UF-IAC office, one day site visits are performed. For plant sites such as in Pensacola Florida, multi-site visits are performed that include overnight stays to cover the area of Pensacola and East of the Alabama state.

6.1 The UF College of Engineering

The College of Engineering is an integral part of the University of Florida institutional structure and has more than 5,000 students. The college grants approximately 750 undergraduate engineering degrees and 500 graduate degrees annually. During the College of Engineering's 2000 accreditation review and visitation, all thirteen undergraduate programs (including Industrial and Systems Engineering) received the highest ratings of a six year period until the next accreditation visit.

6.2 UF IAC and IEEM Management Qualifications

The **UF-IAC director** is Dr. Diane Schaub, is a faculty member in the Industrial & Systems Engineering (ISE) Department. She has a BS in Metallurgical Engineering, MS in Business Administration, and Ph.D. in Industrial and Management Engineering. Dr. Schaub has over 13 years of full-time employment in the steel and aerospace industries. Her extensive industrial experience in Quality Engineering, has proven beneficial in the assessment of manufacturing processes. She also has expertise in energy management which she instructs and helps the students to look for potential savings opportunities, and performed an energy audit to Kennedy Space Center (NASA). She also has professional certification as an Energy Manager, Compressed Air, Quality Manager and Quality Engineer, and is a certified Thermographer. She is the ISE undergraduate coordinator, and teaches and directs graduate research. She is the UF-IIEM co-director.

The **UF-IAC assistant director** is Dr. S.A. Sherif, a professor from Mechanical and Aerospace Engineering Department. He holds B.Sc. (Honors, 1975) and M.Sc. (1978) degrees from Alexandria University and a Ph.D. (1985) from Iowa State University, all in Mechanical Engineering. He has been a tenured faculty at the University Florida since 1991. Dr. Sherif, has over 25 years of academic and industrial experience related to HVAC process analysis, design and improvement. He has directed energy audits conducted by the UF-IAC. He Is also the Founding Director of the Wayne K. and Lyla L. Masur HVAC Laboratory at UF. He served as a consultant to seven engineering and law firms and four academic and research institutions. Furthermore, he is a Faculty Fellow of NASA-Marshall Space Flight Center (Alabama), NASA-Kennedy Space Center (Florida), Argonne National Laboratory (Illinois), the Air Force Office of Scientific Research (Washington, D.C.), and the Arnold Engineering Development Center (Tennessee).

The **UF-IAC technical manager** is Dr. Cristian Cardenas-Lailhacar, a faculty member in the Industrial and Systems Engineering Department. He has a Masters degree in Chemistry from University of Chile (1989), and a Ph.D. in Computational Chemistry, and an additional certificate in Chemical Physics, both from the University of Florida (1998). He has in-depth knowledge of process engineering and provides advice on various manufacturing processes. He has participated in more than 140 energy audits to manufacturing facilities in the US and in Latin America, and performed an energy audit to Kennedy Space Center (NASA). He has the responsibility of supervising the teams of student assistants and coordinating the activities of preparing technical reports and publishes technical papers. He is also the instructor of the Department of Industrial Systems Engineering course in industrial energy management and the UF-COE course on international industrial energy consulting, in the at the University of Florida. He is the founding director of the University of Florida International Center Engineering Program in Energy Management. He is also a certified Thermographer, and is the UF-IIEM co-director.

This combination of expertise and experience from the departments of Industrial and Systems Engineering and Mechanical and Aerospace Engineering greatly enhances the strength and quality of the UF-IAC, and of the UF-IIEM Program.

6.3 Relevant University/Industrial Work

The University of Florida College of Engineering, has an extensive history of involvement with local and regional manufacturing industries.

- The University of Florida Industrial Assessment Center has performed over 360 assessments for small to medium size manufacturing facilities, in Florida, southeast of Georgia and Alabama.
- The College of Engineering is the base of FEEDS, the Florida Engineering Education Delivery System, which provides graduate engineering instruction for Florida's industries.

- The University of Florida operates the Energy Extension Service through a joint operation of the Institute for Agricultural Sciences and the Department of Agricultural and Biological Engineering.
- The Southern Technology Applications Center fosters technology transfer between industry and individual departments and faculty.
- A significant amount of interdisciplinary research is conducted through centers such as the Center for Solid and Hazardous Waste Management, the NASA Space Grant Consortium, to the Engineering Research Center for Particle Science and Technology and the Transportation Research Center.
- Advisory councils provide industrial contacts both at the college and departmental levels.

The UF-IAC experience plus interactions with on-campus research centers provides a rich resource for reviewing and recommending technologies to industries served by the UF-IAC.

6.4 Student Participation

There are currently 15 engineering student assistants in the UF-IAC. And, over the past 14 years, there have been 180 plus student assistants in the UF-IAC program. At least three students assist in conducting each site visit, performing the energy analysis, developing the assessment recommendations, and preparing reports. In addition, students carry out spin-off projects based on the UF-IAC program. For example, just completed is a Total Quality Management project (TQM) of the UF-IAC process for increasing manufacturing client interest in having assessments. Other honors projects have included developing databases, preparing case studies, software development, improving UF-IAC operations and management, etc. Class projects, master thesis and doctoral dissertations have used the UF-IAC information resources as a basis to research and develop recommendations for energy efficiency, waste minimization, and productivity improvement.

6.5 Extension Services and Utilities

The Agricultural Extension Offices in the region served by the UF-IAC serve as regional contact points for any companies calling and asking for help on energy efficiency, waste, or productivity cost control. The UF-IAC has cultivated working relationships with the electric and gas utilities. Utility representatives and account managers are invited with the consent of the manufacturer to participate in each of the site visits. The UF-IAC assessment report analysis and assessment recommendations are accepted by local utilities to qualify client companies for energy savings and demand reduction financial incentives as is the tax on electricity.

We note that the Agricultural Extension Offices in the region served by the UF-IAC serve as regional contact points for any companies calling and asking for help on energy efficiency, waste, or productivity cost control. For example, a reduction in the sales tax on electricity used in manufacturing, special hiring programs according to manufacturer's structure, geographic location, etc., might be available. Participating LU-IAC should be aware of such alternatives and recommend its clients to take advantage of such programs. The energy balance in the UF-IAC assessment report is accepted as the basis to qualify a company for the manufacturing electricity state sales tax exemption, for example.

7. Training to be Provided

The following is a description of the many benefits that the LU-IAC would acquire from the training to be provided by the University of Florida International Industrial Energy Management program (UF-IIEM). In what follows we summarize the training and benefits, which will provide additional opportunities to the users according to their needs and interest.

7.1 Training

The Co-Directors of the UF-IIEM, this is the UF-IAC Director and UF-IAC Technical Manager, and any other technical personnel considered essential (like team leaders), will deliver training in a wide variety of areas pertinent to the start-up plus operation of an LU-IAC. Training will be given for daily operations and reporting, and use of data bases as well. The field managers will participate in the first LU-IAC audit so to assist in all the Modus Operandi of the site visits. The training sections are listed and described below. Training regarding the structure of the reports to be written (mainly consisting of 7 to 8 Chapters) will be provided in order to create a useful and effective report.

7.2 Data Gathering

Detailed training on procedures regarding data collection before, during, and after the audit will be provided. They include:

- **Checklists:** For collecting equipment data and measurements to be taken for lights, lights intensity, motors, current, process layout, temperatures, Infrared cameras use, software, etc. in order to calculate paybacks and returns on investment.
- **Operational Equipment Data:** How does the geographic location affect your data and equipment performance? Air conditioning, temperature and humidity influence on equipment and in energy savings.
- **Energy Audit Instrumentation (tools) Usage:** Use of Equipment for Air Leaks detection, light intensity levels (light meter), Ammeters, Temperature readings, Combustion analyzers (boilers efficiency), Anemometer for Air velocity, Pressure measurement, Humidity, etc. Also included is the use of special equipment such as Infrared Camera (hand-held units usage including theory and calibration, reliability of measurements, use of software, data handling, IR-reports preparation, etc.).
- **Software in Energy Audit:** Extensive training in the use of software will be provided in the following areas: Motors, Pumps, Compressed Air, Steam System, Energy Balance Software developed by our research group, etc.
- **Energy Bills Analysis:** The analysis of energy bills include a number of energy sources, and in depth analysis of their components and additional information that can be taken from them. They include: electricity (power factor, overall facility efficiency, energy and power costs, taxes, etc.), natural gas, nitrogen, fuel oils, etc. This section goes further in depth and discusses issues on comparing the different energy sources, their reliability, comparative costs, etc. Power generation technologies including their in-house generation are also studied in depth.

7.3 Templates for Assessment Recommendations

As part of our program, templates for all the parts of the auditing process and checklists are provided. In addition, reports writing and templates are provided as a data base. This data base includes among others: Vendors, costs templates, recommendations templates, technical papers written, and much more.

In addition, constant technical support and training is provided by our group. Moreover, constant future training (beyond the second year of collaboration) work with the University of Florida Industrial Assessment Center is provided and available. In addition, there will be Annual LU-IAC's Directors Meetings held at the University of Florida. Finally, an Annual US-Latinamerica Industrial Energy Management Conference, organized by UF, will follow the directors meeting where they are expected to present research on Industrial Energy Management related topics.

8. Concluding Remarks

We have presented the University of Florida International Industrial Energy Management Program, with emphasis to Latin America and the Caribbean. The impact that this program will have in the region is straight forward. Today's global economy will require countries that want to export goods to others that stringent regulations be enforced, as are the environmental ones. As a consequence a big player will be the energy efficiency of the plant, an issue usually disregarded. We discussed the motivation of the program in terms of its benefits for participating universities, the local industries they will serve, the associate simple payback of the program, operational issues, and of course those related to the formation of the new generations of engineers. We believe that the UF-IAC faculty experience, in conjunction with partner faculty at local universities will unequivocally generate un-precedent benefits to the industry, environment, and people of Latin America and the Caribbean.

References

The International Energy Agency: www.iea.org/

The University of Florida Industrial Assessment Center: www.ise.ufl.edu/iac/

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