HASHEMITE KINGDOM OF JORDAN
MINISTRY OF ENERGY AND MINERAL RESOURCES
and
JORDAN ELECTRICITY AUTHORITY

JORDAN ENERGY AND ELECTRICITY INFORMATION AND ADVISORY CENTER

Technical Assistance Report
AUGUST 1986

U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT
Amman, Jordan
Project 278-0260
Indefinite Quantity Contract
OTR-0000-I-00-3505-00
Work Order No. 3

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In Reply Refer to:

MCC-401-86-TA
October 29, 1986

Mr. William Riley
U.S. Agency for International Development
Amman, Jordan

Subject: Final Report for the Jordan Energy & Electricity Information & Advisory Center Technical Assistance Task [Project 278-0260, under IQC OTR-0000-1-00-3505-00, Work Order No. 3]

Dear Mr. Riley:

Enclosed are the final copies of the subject report. This report incorporates all comments received from USAID/Amman and the Jordan Ministry of Energy and Mineral Resources on our previously submitted draft. This submittal completes our effort on this task.

Our Project Team reported great pleasure and satisfaction in working with you on developing the capabilities of Jordan's Energy and Electricity information and Advisory Center. We believe that the Ministry of Energy and Mineral Resources has implemented a very worthwhile program which will have a positive impact on the economy of Jordan.

Please forward the additional enclosed copies of this report to our Ministry counterparts, along with our best wishes for the continuing success of this important project. We look forward to working with you and the Ministry again in the near future.

Sincerely,
MERIDIAN CORPORATION

Deepak Kenkeremath
Director, Technology Applications Group

Enclosures

cc: Frank Young, USAID/Washington ANE/PD/MNE (2 copies)
USAID Reference Center, Washington (2 copies)

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ACKNOWLEDGEMENTS

The Project Team sincerely appreciates the interest in and support for this project expressed by His Excellency, Dr. Hisham Khatib, Minister of Energy and Mineral Resources. The suggestion for a first Jordanian Energy Conservation and Personal Computers Expo is one example of the many valuable contributions towards the long-term development of the EEIAC and its programs made by His Excellency. We thank also Dr. I. Badran, Under Secretary of the Ministry, and Engineer M. Arafa, Director General of the Jordan Electricity Authority, for their support.

In addition, we would also like to acknowledge the guidance and assistance of Dr. Ali Anani, our Ministry Project Manager, and Mr. William Riley, our USAID Project Manager. We also recognize our colleagues in the EEIAC, Engineers Adel Abbasi, Suhail Kiwan, and Hani Nofal and Ms. Sahar Joudeh, for their roles in helping to make this project a successful learning experience for all of us. In addition, we would like to acknowledge the contribution of Mr. Fakher Anshasi, Computer Manager for the Jordan Electricity Authority, who arranged for the local personal computer dealers to provide microcomputers for the Expo.

JORDAN ENERGY AND ELECTRICITY INFORMATION AND ADVISORY CENTER

EXECUTIVE SUMMARY

OBJECTIVES

The Energy and Electricity Information and Advisory Center (EEIAC) was established by the Ministry of Energy and Mineral Resources (MEMR) and the Jordan Electricity Authority (JEA) in order to heighten public and business awareness of Jordan's rising energy costs and to encourage energy conservation. The Center provides services, consultation and on-site inspections for public and private organizations as well as for the public in general.

The U.S. Agency for International Development, Amman, Jordan contracted with Meridian Corporation under Work Order No. 3 of Indefinite Quantity Contract No. OTR-0000-I-00-3505-00 to provide technical assistance to the Ministry's initiative. In this report, the efforts of Meridian Corporation to assist in further development of EEIAC are described. The three work areas defined under this contract were: organizational development; public education functions; and conservation engineering. In addition, two major practical exercises for staff development were planned and implemented during the course of the project: (1) energy audits of a residence and of a major commercial facility and (2) the first Energy and Personal Computers Exposition in Jordan.

BACKGROUND

The Hashemite Kingdom of Jordan is an energy importing nation with no indigenous energy sources other than from renewables. Since the preponderance of Jordan's energy is derived from imported fuels, it is becoming especially important that Jordan take measures to use its energy efficiently.

The Government of Jordan is concerned that energy consumption is affecting the balance of foreign exchange of the Kingdom and that moneys which should be used for development of other national interests are being needlessly spent for fuel. Even with the reduction in fuel prices, still a substantial sum of money could be redirected by efficient uses of energy. To help support such aims, the Ministry of Energy and Mineral Resources (MEMR) has undertaken development of programs in renewable energy, conservation and energy management.

PROJECT FOCUS

Meridian's technical assistance effort kept two people in-country during July and August of 1986 for a six week period, and one more for a

concurrent period of four weeks. All of the personnel were based at the EEIAC facility, where they performed a variety of tasks. These have been categorized below.

Organizational Development. The central goals of this task included development of an organizational structure and a budget for the EEIAC. This included a review of EEIAC objectives and proposed activities, organizational structure, staffing patterns, and training needs. It also included work in organizational design, budget development, office administration, and innovative funding arrangements. It further included information processing and computer hardware requirements analyses for the EEIAC.

Extension Service Functions. This task area focused on information collection and dissemination activities. It included identification of mechanisms and procedures to include and utilize the private sector and business community in energy conservation programs and activities, assistance in the design and development of the information center and the public outreach program, and assistance in the identification and selection of equipment and materials required to meet the center's objectives.

Conservation Engineering. The primary objectives of this task included identification of specific conservation needs and the appropriate technical focus for the EEIAC, training of local personnel, and assistance in selecting suitable technical information materials for use on the project. This involved extensive communication with consumers regarding their needs as well as an evaluation of the existing building stock and other major categories of energy users served by the project. One commercial energy audit and one residential energy audit were completed for training purposes.

OBSERVATIONS

Most of Meridian's technical assistance effort involved direct, hands-on training of the EEIAC and Ministry personnel. During the course of this work, the team made a number of pertinent observations about the central issues affecting the Center's development, and their implications for future progress. These observations, along with summaries of the more important accomplishments during the mission, are organized by task area below.

Organizational Development

Funding. The project team evaluated the feasibility of charging for EEIAC's services in order to cover the Center's operating expenses, and determined that EEIAC almost certainly will continue to be a user rather than a creator of funds. As such, it will of necessity depend upon grants and government budgeting. The essence of continued funding is the ability to produce programs and operations which have measurable results and the ability to demonstrate and communicate with grantors and international development programs.

Information Processing Requirements Analysis. As the Energy and Electricity Information and Advisory Center's name implies, the nature of the EEIAC is that it is a very information intensive operation. To this end, a number of computer applications were developed for the center including data base systems, spreadsheets, basic programs, graphics presentations, desk-top publishing for newsletters and reports, and logs for visitors and complaints.

Training. There are a variety of training issues central to the successful development of EEIAC as an institution. The project team worked closely with the Ministry Advisor and the EEIAC manager to provide assistance in training for (1) managing and operating the Center, (2) making presentations and being persuasive, (3) performing energy audits and technical analysis, and training others to do this work. Additional training is required and discussed in the recommendations.

Extension Service Functions

Public Education. EEIAC's public education functions comprise a variety of information collection and dissemination activities. The Meridian team helped identify mechanisms and procedures to include and utilize the private sector business community in energy conservation programs and activities, describe actions taken regarding the design and development of the information center and public outreach program, and identify equipment and materials required to meet the Center's objectives.

Information Center. The EEIAC facility serves several important roles. It functions as an exhibit space, a library, a computer analysis location, a venue for conferences and seminars, a headquarters for EEIAC field staff, and a focus for VIP visits. The project team worked with the EEIAC staff to develop management checklists and identify materiel needs for each of these functions.

Outreach Programs. One of the most important public education activities is to bring energy conservation information to the people rather than simply waiting for them to seek it at the Center. Such outreach programs include presentations, demonstrations, and exhibits at schools, universities, government facilities, private businesses, professional organizations, and other places where people gather. They also include competitions and other means for directly reaching people. Initial contacts with many of these organizations were made during the project team's stay.

Media Programs. In order to keep energy conservation issues highly visible in the public eye, a coordinated media program was developed. There are two components to this program: event publicity and information dissemination, which play a critical part in determining the success of other public education and conservation engineering functions.

Computers and Energy Conservation Exposition. On July 28th, 29th and 30th, 1986, EEIAC held an exposition ("EXPO") focusing on computers and energy conservation. This event served as a training vehicle for EEIAC and Ministry staff, providing them with a hands-on opportunity to learn conference management and presentation techniques, to prepare for VIP visits, to develop exhibits and computerized storyboards, and to coordinate publicity. The stated objectives of the EXPO were to (1) inform the interested communities of consumers, merchants, and professionals about methods and opportunities for energy management and conservation, (2) publicize the newly opened EEIAC and encourage visitors, (3) promote effective and efficient implementation of technology applications, and (4) focus attention on personal computer potential in energy management. The program for the EXPO included energy conservation exhibits, displays of personal computers and graphics by local dealers, with energy software supplied by EEIAC, and presentations by EEIAC, MEMR, JEA, and Meridian staff members on a regular basis throughout the three days.

Private Sector Involvement. The Project Team, working closely with the EEIAC, made private sector involvement a special interest item for the assistance visit. Ministry staff recognized that the EEIAC could act only as a catalyst in promoting conservation activities, and that most real action had to occur in the private sector. Visits were made to private institutions, for example, presenting shared savings concepts as an investment opportunity as well as an opportunity to contribute to a national goal.

Conservation Engineering

Energy Analysis. EEIAC uses several types of computerized energy analysis tools such as rough sizing and economic analysis programs to help consumers decide whether to invest in energy conservation projects. In order to develop the Center's analytical capabilities, programs were developed by the EEIAC staff during the Consultant Team's visit including programs for solar water heater sizing and economic analysis; solar swimming pool sizing; lighting load and conservation; heating and cooling load; and insulation program

Energy Audits. Energy auditing is a service that EEIAC and the Ministry desire to provide to the public. They send engineers to visit facilities, evaluate energy conservation opportunities, and make prioritized energy conservation investment recommendations for the users of these facilities. The Meridian team provided training in this area to the EEIAC and MEMR staff.

Residential Audits. A residential audit was performed for training with EEIAC and MEMR staff members. Input forms for data collection were computerized; an automated analysis capability for the audit data is being refined from a generalized US program.

Commercial Audits. During the period of August 3-14, 1986 the EEIAC and Meridian Corporation performed an energy audit on the Holiday

Inn of Amman, Jordan. The audit was part of the "on-the-job" energy conservation training exercise for energy engineers at EEIAC and MEMR. The resultant recommendations are summarized in the table below:

MEASURE	PAYBACK PERIOD (MONTHS)
Boiler Insulation	< 1
Flue Vent Dampers	4 - 5
Relamping (old/new)	
Incandescent/ Fluorescent (26mm)	4 - 6
Fluorescent/ Fluorescent (26mm)	9 - 10
Incandescent/ Fluorescent (PL)	11 - 13
Incandescent/ Fluorescent (SL)	14 - 16
Window Shading	20 - 24
Window Weatherstripping	22 - 26
Replace Room Air Conditioners	60 - 70

CONCLUSIONS AND RECOMMENDATIONS

This project has been in itself a technology transfer program to help further develop the Jordanian technology transfer program, the EEIAC. The indications are at this time that at least some technology transfer has successfully taken place; however there is a substantial amount of work remaining for the EEIAC staff for the Center to become established as a national center of recognized excellence and engineering resources. To this end, the Project Team makes the following additional recommendations, categorized by general task area, but not in order of priority:

Organizational Development

- Establish a longer term technical advisor position for assistance for the EEAIC.

- Consider identification of an Executive Director to oversee all of EEIAC functions and relationships, especially outside activities.

- Establish an interns program to provide educational and training opportunities for students of other nations who in turn bring to Jordan advanced skills. Seek external funding and scholarships.

- Establish a reporting procedure to manage milestone progress for such events as 20 residential and one commercial audits per month.

- Continue training for staff members, especially with advanced energy management systems and intensive audit work to create a varied background among the staff.

- Provide U.S. based managerial and program development training for the Ministry advisor providing executive oversight including Public Administration, Current Directions, Funding Strategies, Conservation & Efficiency Standards Development, Materials and Equipment Testing and Certification, Incentives Development, Design Competitions, Shared Savings, Site Visits.

- Provide U.S. based "trainer" training for the key staff and manager of the Center including Classroom Technical Training, Energy Audits, Installations, Computer Training, Training Program Development, Advertising Techniques, Outreach Programs, Conference Management, Conservation and Efficiency Standards Development, Materials and Equipment Certification and Testing, Incentives, Design Competitions, Shared Savings, and Site Visits

- Establish a quality control program for review of audits, publications, and training which would include participation of outside consultancies and agencies.

- Expand physical facilities for conference, training, and seminar rooms and for additional workspace for staff and visitor discussions.

Extension Service Functions

- Continually use data base program files to publicize Center programs and capabilities to make private sector concerns aware of business development opportunities in energy management.

- Develop data bases for Jordan for traders, design and other professionals, and owners of larger facilities for Center mailings and analysis.

- Establish procedures for making personal calls to help establish the name and capabilities of the Center as a resource for energy management assistance.

- Make use of EEIAC leesons learned to begin work to establish similar facilities such as with Irbid District Electric Company (IDECO) and in other regions. Encourage private development of such centers by energy management services companies.

- Expand the public outreach programs to include a newsletter and one-page descriptions of outstanding energy management projects.

- Design and implement an Energy Bus for mobile presentation capabilities.

- Develop a data base of programs which would encourage energy

program implementation through low cost loans for procurements of specific country of origin equipment, eg, the USAID Commodities Import Programs.

- Establish on-line services to assist in subscriber education in conjunction with JEPCO.

- Develop data bases for energy engineering equipment specifications.

- Establish a liaison person with industry and commercial operations for energy awareness.

- Establish a public and engineer information base of periodicals, trade publications, and reference books and track availability and usage by a data base procedure.

- Establish a software library for energy analysis and presentation of written and graphical data. Make the contents available for evaluation by other government agencies and serve as a Jordanian Center of Excellence for personal computer applications and development.

Conservation Engineering

- Establish a Training Center for training of design professionals, technicians, engineers, traders, and consumers.

- Establish training and operational procedures to perform on-site inspections for energy management and consumption.

- Establish a lighting research project for municipalities.

- Implement demonstration projects which provide a starting point for effective evaluation of new technologies in Jordan. Examples include heat pumps, heat recovery chiller, evaporative cooling, biogas cogeneration, renewable energy hybrid system (Ice Making, Television Repeater Station, and Desalination)

- Implement a program for Standards and Incentives Development including information dissemination work with parallel efforts in incentives and imperatives, or standards development.

EEIAC and the Ministry of Energy and Mineral Resources are encouraged to act on these recommendations according to their own perceived priorities. Items requiring substantial resources should be included in the Ministry's budgets and long range plans, and funding sources should be identified. Other items should be set down as milestones by which to measure the progress of the EEIAC staff in establishing the Center.

USAID is encouraged to continue supporting EEIAC within Jordan by providing materiel, in-country technical assistance, and US training for

members of the EEIAC staff. In addition, USAID Amman may wish share the innovative concept of an energy information center with other USIAD missions located in energy importing countries via circulation of a summary of EEIAC's activities.

1.0 INTRODUCTION

The Hashemite Kingdom of Jordan is an energy importing nation with no indigenous energy sources other than from renewables. Since the preponderance of Jordan's energy is derived from imported fuels, it is becoming especially important that Jordan take measures to use its energy efficiently.

Energy consumption has been increasing at an average rate of 17 percent per annum and without the programs introduced by the Ministry would be expected to continue increasing with both increasing standards of living and population increases. Recent analysis has shown, for example, a statistically significant correlation between peak electricity demand and ambient air temperature, which would imply an increasing demand for air conditioning in Jordan's commercial and residential facilities.

The Government of Jordan is concerned that energy consumption is affecting the balance of foreign exchange of the Kingdom and that moneys which should be used for development of other national interests are being needlessly spent for fuel. Even with the reduction in fuel prices, still a substantial sum of money could be redirected by efficient uses of energy. To help support such aims, the Ministry of Energy and Mineral Resources (MEMR) has undertaken development of programs in renewable energy and industrial energy resource management.

The Energy and Electricity Information and Advisory Center (EEIAC) was established by MEMR and the Jordan Electricity Authority (JEA) in order to heighten public and business awareness of Jordan's rising energy costs and to encourage energy conservation. The Center provides services, consultation and on-site inspections for public and private organizations as well as for the public in general.

In this report, the efforts of Meridian Corporation to assist in further development of EEIAC are described. Basically, the work areas of this contract were threefold: organizational development; public education functions; and conservation engineering. In addition, two major practical exercises for staff development were planned and implemented during the project: (1) energy audits of a residence and of a major commercial facility and (2) the first Energy and Personal Computers Exposition in Jordan. The report which follows provides summary activity reports and recommendations for these areas; appendices provide more detail such as energy audit documentation.

2.0 ORGANIZATIONAL DEVELOPMENT

The Consultant Team had several specific goals for its time at EEIAC. The most important of these was to contribute substantively to the organizational development of the Center. This process involved a review of EEIAC objectives, contributions to its organizational design, suggestions regarding the physical facility, budget, reporting systems, milestone development, funding, and analysis of its information processing requirements.

2.1 EEIAC OBJECTIVES

The Center's primary function is to serve as a public service facility, informing the public about energy conservation needs, ideas, techniques, and economics. Its specific Ministry mandate directs the staff to focus on exhibits, publications, conferences, mass media, energy audits, complaints, and international networking.

In addition to the important objectives mentioned above, the Consultant Team recommends that the EEIAC staff become involved in standards and incentives development activities related to energy conservation. Standards and incentives for energy conservation, in conjunction with informational activities, are often required to achieve a meaningful degree of public participation in conservation efforts.

The Center staff are ideally situated to serve as the focal point for government/industry/academic interchanges for formulating of standards for building thermal performance, minimum appliance efficiencies, and other conservation measures. They are also in a position to encourage discussion on incentives for energy conservation, such as efficient appliance rebates by the electric utilities, property tax credits for conservation retrofits, and shared savings programs.

2.2 ORGANIZATIONAL DESIGN

The organizational design tasks addressed here include (1) clarifying individual staff responsibilities, (2) determining additional staffing needs, and (3) structuring office operations.

Staff Responsibilities

Currently there are five full-time staff members present for work. Additional support is provided by staff members from MEMR and JEA who are participating in public education and conservation engineering both to assist in operations as well as to receive training.

The physical layout of the Center, the urgency of development of skills for public service, and the newness of the Center all contribute to a necessity for a great deal of interaction and teamwork among the staff. For example, the secretary-receptionist has become skilled at showing visitors around the Center while the Center manager is working to develop personal computer skills to design a bi-lingual English-Arabic filing system.

As the Center reaches equilibrium, specific assignment of duties and responsibilities will be necessary. One of the staff may be primary with someone else as backup, but specific task ownerships must be developed.

The Center manager has overall responsibility for the operation of the Center as a business entity, to see that its missions are accomplished, the public served, budgets followed, and gains in energy conservation and efficiency of consumption can be demonstrated. The manager must be active in publicizing the Center through media and through personal calls; likewise establishment and maintenance of a vigorous quality control and followup program for Center services is essential.

Center staff engineers are responsible for the actual execution of Center activities such as public presentations and audits. Engineers must constantly be active in developing new and updating old presentations for public education functions. They must assist the manager in identifying new audiences for EEIAC educational activities. They must also be active in the constant review of methodologies for energy management and conservation analyses. Engineers must participate actively in training programs both as recipient and as skilled trainers in order to keep the dynamism of the Center.

The secretary-receptionist, as in many such small offices, must be an adjunct member of the professional staff. The secretary must be able to manage phone calls independently, answering questions and taking requests and reports as needed. She also must be able to escort visitors around the Center and speak knowledgeably of demonstration materials, thus freeing the professional staff for field work and materials development. It is desirable that the secretary also be trained to serve as a member of the residential audit teams for those occasions where a team must have a female present to enter a household.

Additional Staffing Needs

As Center functions are developed and its capabilities become known, the current staffing levels are clearly insufficient. Additional engineers and technicians are required to implement full scale energy audit and training programs. Staff members with personal computer experience are needed to develop data bases and analytic systems.

Office Operations

In order to run the office smoothly and efficiently with the small number of people available, it is important to use computers to minimize

the number of repetitive, time consuming tasks occupying staff time. Tasks that should be computerized are listed below.

File Tracking System -- To be completed with Supercalc4.

Letter Tracking System -- To be completed with dBase III+. (Exhibit 2-1)

Inquiry Interest Log -- Completed with Supercalc4.

Mailing List -- Completed with dBase III+.

Staff energy audit, office duty, public education schedules.

Reporting Systems (See Section 2.6).

Milestone Tracking System (See Section 2.7).

2.3 EEIAC FACILITY

The Center as it is presently set up does not have adequate space for offices and meetings in addition to exhibits. During the EXPO, for example, it was necessary to open up an empty shop space downstairs and turn it into a temporary conference room. Further, during the Consultant Team's visit, there has not been enough office space for both staff and visitors to have permanent desk assignments. It is recommended that the space be expanded in order to accommodate future meetings, an increased staff, and regular visitors.

Opportunities for expansion that have been identified include the space directly above the Center, which could be connected to the current Center space by a spiral staircase; renovation of the kitchen and bathroom areas into office and meeting space; or covering over the patio area to make it functional year-round. One of these options should be implemented in the near future.

2.4 BUDGET

The budget for FY87 is described in Exhibit 2-2. A substantial portion of the budget during this start-up period is allocated to capital expenses. Once the staffing is increased, operational expenses should become stabilized.

2.5 CENTER CHARGES

As with any such new operation, one question is that of return on investment or how to establish a charging system to pay for services. An accountant would argue that charges should be based upon the average cost of service and that such factors as rent, utilities, staff, should be used to devise a scheme for energy audits, public education training and programs, and the right to exhibit. An economist would in turn

EXHIBIT 2-1

EEIAC INQUIRY INTEREST LOG

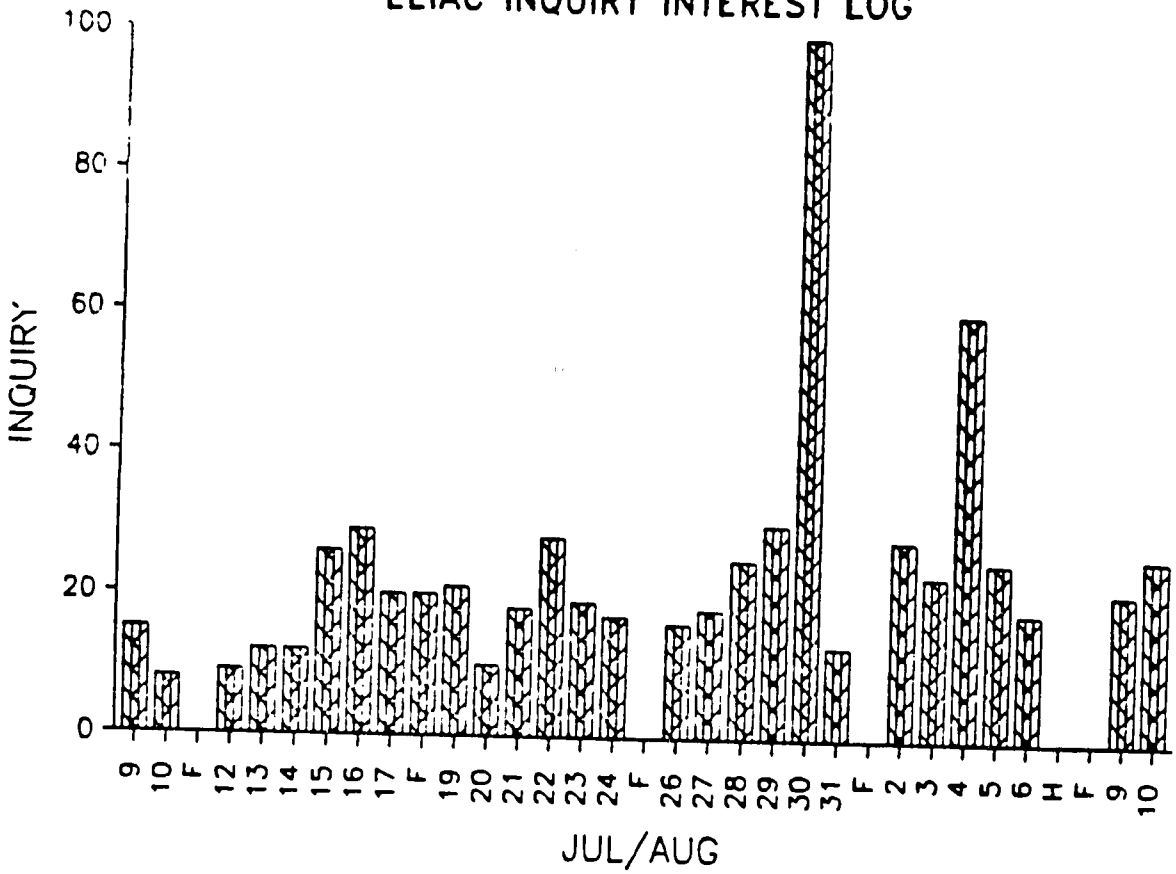


EXHIBIT 2-2
EEIAC BUDGET FOR FY87

		COST (JD)
CAPITAL COST ITEMS		
Equipment incl. Energy Bus & Computers		29000
Publications		3000
Center Renovation		10000
	SUBTOTAL	42000
OPERATING COST ITEMS		
Advertisements (Press/TV)		4000
Audit Equipment Maintenance		500
Center Operations		
Rent		7500
Office Supplies		1500
Utilities		500
Commercial Souvenirs (Pens,etc.)		1000
Consultancies		50000
EEIAC Journal (Monthly Issued)		1000
Energy Bus Operations		2000
Insurance		200
Periodical Publications		250
Petty Cash		600
Postage & Telephone		1200
Posters		1500
Professional Society Memberships		250
Salaries		
2 Existing Engineers		11700
2 Additional Engineers		7800
1 Secretary		1690
1 Data Entry Person		1950
1 Cleaner		250
	SUBTOTAL	95390
	TOTAL OF ABOVE	137390
IDECO Office		0
Zarqa Training Center		25000
	SUBTOTAL	25000
	TOTAL	162390

respond that charging systems should be used to induce behaviors and that in the near term certainly, charging for EEIAC services would generally turn potential consumers away until credibility is established. By that time, the Center will have become known for its free services.

The conclusion then is that a system for analysis of energy consumption overall and in particular for consumers who have received such EEIAC services as audits and training must be established. If it can be shown for example, that as a result of an energy audit that a commercial facility implemented recommendations costing some amount for implementation and resulting in some annual energy savings, then the EEIAC should be able to take credit for contributions for the services of implementation and the decrease in energy consumption. Aggregation of these for the year would produce an estimate of the value of the EEIAC for the national economy as a government service. More specifically, economic multipliers for energy conservation services must be estimated for developing countries. During the early stages of the EEIAC, the real impact of energy conservation measures on foreign exchange will be diminished until a production capability which reduces product imports is established in Jordan.

2.6 REPORTING SYSTEMS

A substantial capability for data analysis and graphics presentation is being developed within the EEIAC. Measures for reporting and evaluation must be implemented in order for Ministry, JEA, and other funding sources to assess the return on investment. In the near term, simplistic measures such as the numbers of visitors, numbers of complaints, etc, will be used. As public education programs are initiated, specific information about attendees such as name and address will facilitate followup to determine the impact of the EEIAC program. Followups of audits will also allow direct analysis of results for reporting and evaluation. It is crucial that data be collected from the inception of the Center for analysis and presentation.

The form of the report should be such that it is clearly understood, easily read, and can be circulated among other Ministries and funding agencies as required. It is crucial to the success of the Center to be able to present information supporting the continuation of the EEIAC based upon its real contribution; if such results are not forthcoming, then the Minister must know in a timely manner so that more detailed analyses may be undertaken to determine if the wrong measures are being presented or if there is no payoff and the EEIAC should be terminated.

2.7 SCHEDULE MILESTONES

A system of establishing milestones and schedules must be implemented whether using a chalkboard or computer spreadsheet with graphics. Progress towards these milestones must be included in the reporting

system as indicators of performance for the Ministry. For example, failure to meet some schedules could indicate a need for additional staff as well as the need to more closely monitor the activities of existing staff. Candidate activity targets include:

Monthly seminars on specific energy conservation topics;
Co-organize a conference w/another institution;
Implement bibliographic data base for library;
Make minimum of 5 presentation/month in traveling outreach program;
Make mailing to traders/ design professionals;
Arrange minimum of 1 newsworthy event/month;
Write 5 energy analysis programs for office/public PC's;
Conduct minimum of 100 residential energy audits to develop data base; 20 audits/month thereafter; and
Conduct minimum of 1 commercial audit/month.

2.8 FUNDING

The EEIAC almost certainly will continue to be a user rather than a creator of funds. As such, it will of necessity depend upon grants and government budgeting. The essence of continued funding is the ability to produce programs and operations which have measurable results and the ability to demonstrate and communicate with grantors and international development programs. A secondary element of continued funding is the ability to learn about which international programs are funding feasibility and definitional studies. For example, the Trade and Development Program might fund a definitional study to determine the market potential for heat pumps of US manufacture. Some of this information can be gained from on-line data base analysis of grants and foundation giving; others from searches of the international publications.

A second aspect of funding is the ability to produce good proposals and requests for assistance. With the desk-top publishing capability of the Center, and the graphics capabilities, the Center staff should be able soon to produce well documented case studies of EEIAC projects to show that past investments have had significant return, or that proposed projects, using analytic methods, can be reasonably expected to have positive payoff.

2.9 INFORMATION PROCESSING REQUIREMENTS ANALYSIS

The nature of the EEIAC is that it is a very information intensive operation. Its very success depends on its ability to receive, store, retrieve, analyze, and distribute information to a wide variety of audiences and in two languages. If all of the operational goals, from recording and tracking complaints to performing energy audits and developing a nationwide energy information system, are accomplished, then the Center will constantly be in a mode of data manipulation.

To this end, a number of computer applications were developed for the center including data base systems, spreadsheets, basic programs, graphics presentations, desk-top publishing for newsletters and reports,

and logs for visitors and complaints. All members of the Center staff are expected to be proficient in the use of several programs. The engineers are expected to be able to program and develop analytic procedures using Basic, dBase, and spreadsheets.

Hardware

With the requirements for development of analytic methods, performance of energy audits, and development and updating of public education materials, it is reasonable to expect that at least two machines will be in constant use. During the Project Team visit, as many as five machines were in use and people waiting often. The Project Team also observed that the speed and response of the 80286/IBM PC/AT or equivalent such as the MultiTech and Compaq was necessary for graphics and analytic work. System configuration for the PC/AT or equivalent includes a 30MB hard disc to support the data bases and applications programs, modem, extended memory for multiple task operations, and a color monitor.

Presentation development and quality of appearance is very important for maintaining a public image and establishing public confidence in work quality. Consequently it is necessary to use high quality, but not complex, systems such as a laser printer, plotter, and 35mm slide camera takeoff to produce the range of public presentation materials.

Telecommunications to access other computers such as JEPCO and JEA as well as international data bases for research is necessary for research into current conservation practices and data collection for customer inquiries and energy audit preparation.

Software

The software for the Center includes spreadsheet (SuperCalc4), data base management system (dBase III Plus), graphics applications (StoryBoard, EnerGraphics, FreeLance), utilities (Norton), statistics (StatGraphics), and telecommunications (CrossTalk XVI). The staff have already received training on all except FreeLance, Norton, StatGraphics, and CrossTalk which were not available during the visit. Applications such as the visitors logs, filing system, solar analysis, and public presentations have been developed for continued Center use during training.

2.10 IRBID DISTRICT ELECTRIC COMPANY

Discussions were held with the Irbid District Electricity Company (IDECO) concerning assistance from the Project Team and the Ministry for establishment of a similar Center in Irbid. IDECO was interested in establishing all of the capabilities of EEIAC plus creation of an automated tracking system for new subscriber applications, complaints, and inquiries. The Project Team agreed to write a paper describing the process for establishment of an EEIAC, which would be provided to IDECO at a later date. Other requests for assistance were to be forwarded to MEMR for consideration.

3.0 STANDARDS AND INCENTIVES DEVELOPMENT

The information collection and dissemination efforts of the Center are not enough alone to achieve effective energy conservation in Jordan. Accompanying this information work must be parallel efforts in incentives and imperatives, or standards development. That is, it is usually not enough to tell the horse where to go; one must also use a carrot and a stick to get real movement in the right direction.

EEIAC is a natural focal point for coordinating efforts to create standards and incentives for energy conservation. For example, the recently-enacted building insulation standard is being discussed, explained, and publicized via EEIAC's exhibits, presentations, and computer programs. As both lay and professional people come in to discuss the implications of the standard with the staff, new ideas surface, and possible revisions are recommended. Similar types of interchange are occurring in other areas.

The Consulting Team has met with members of the Engineering Association, the Royal Scientific Society, and the Ministry to discuss areas for potential cooperation on standards and incentives development. Members of the Energy Committee of the Engineering Association have expressed an interest in learning more about the ideas of (1) appliance and equipment efficiency standards, and (2) the "energy budget" approach to building performance specification.

The Royal Scientific Society (RSS) recently inaugurated a new, state-of-the-art solar test and certification facility in Amman. They are testing the performance of a variety of manufacturers' solar collectors and certifying their performance numbers. They plan to make the non-confidential test results available to the Ministry for publication in a buyers guide to solar collectors. EEIAC should work closely with RSS to develop this publication in a timely manner.

Other standards efforts proposed by the Consulting Team include (1) working with the Housing Corporation to include energy efficiency standards in the lending criteria for housing loans, (2) revising the customs duties on heating, ventilating and air conditioning equipment to discourage the importation and purchase of low efficiency equipment, and (3) working with the Gulf Standards Organization (GSO) to bring Jordanian standards into agreement with the GSO, and encourage the GSO to put more emphasis on energy efficiency. EEIAC and MEMR staff members are urged to follow up these ideas.

Incentives efforts recommended by the Consultant Team for consideration in Jordan include design competitions, cooperative financing arrangements with utility companies and other beneficiaries of energy conservation to promote rebates and purchase aids for efficient appliances, and shared savings schemes.

Certification of technicians and designers who have undergone training in conservation-related skills can also function as an incentive to seek that training.

4.0 PUBLIC EDUCATION FUNCTIONS

EEIAC's public education functions comprise a variety of information collection and dissemination activities. This report identifies mechanisms and procedures to include and utilize the private sector business community in energy conservation programs and activities, describes actions taken regarding the design and development of the information center and public outreach program, and identifies equipment and materials required to meet the Center's objectives.

4.1 INFORMATION CENTER

The EEIAC facility should serve several important roles. It should function as an exhibit space, a library, a computer analysis location, a venue for conferences and seminars, a headquarters for EEIAC field staff, and a focus for VIP visits.

Exhibits

The exhibit space at EEIAC is already well-equipped with samples of solar water heating, lighting, insulating, window, and space heating technologies useful for energy conservation and others. These items are accessible for visitors to look at and touch, and most of the items have identification labels. This good beginning should be built upon to include the following items:

(1) Passive solar design principles, including solar angles, external shading devices, and characteristics of thermal mass;

(2) Air conditioning technology information, stressing its energy intensiveness, and the concept for shopping for a unit with a high Coefficient of Performance;

(3) General energy production and consumption trends in Jordan and elsewhere;

(4) Computerized storyboard presentations on the entire spectrum of energy conservation activities;

(5) Conservation presentations using videotape, slide (transparency) and other media. A list of commercially available energy-related videotapes in English and Arabic has been left with the EEIAC staff.

Library

The library at EEIAC is being built into an information resource that will be useful not only for the staff of the Center, but to outside design professionals and others interested in energy conservation technology, economics, and issues. It is important to have an extensive, up to date library of books, reports, manufacturers' information, and other data on hand for (1) public access to this information, (2) technical data for accomplishing energy audits, and (3) to transfer the latest energy conservation technologies to professionals in the design community. The Consultant Team brought a number of publications with them for this library. They are listed in Attachment A.

A list of books required for the library has been prepared and submitted to the Ministry for inclusion in its budget and funding requests (see Attachment B). These books represent a minimum investment recommendation, and other books should be acquired as specialized needs are recognized.

Serial publications (monthly/quarterly magazines), including professional journals and trade publications, will be an especially important part of the library. These publications provide the most current information on technological developments in energy conservation, as well as reporting on successful (and unsuccessful) applications and projects. A budget for these items has been submitted to the Ministry, and a list of recommended publications is included below.

ASHRAE Journal (GA,USA)
Architectural Record (NY,USA)
Alternative Sources of Energy (WI,USA)
EPRI Journal (CA,USA)
Energy Management (OH,USA)
Energy User News (DC, USA)
Engineering News/Record (NY,USA)
HPAC/Refrigeration News (IL,USA)
Middle East Electricity (Bahrain)
PC News (NY,USA)
Progressive Architecture (NY,USA)
Renewable Energy News (NH, USA)
Solar Age (NH, USA)
Specifying Engineer (NY, USA)

Many of these publications are available at reduced rates through professional organizations. EEIAC should acquire membership in the following professional organizations in order to establish contact with others in these fields, to come up to date on recent developments, and to gain access to publications.

American Institute of Architects
Association of Energy Engineers
American Society of Heating, Refrigeration and Air Conditioning Engineers
American Society of Mechanical Engineers
American Society of Plumbing Engineers
Designers Software Exchange
Illuminating Engineering Society
Institute of Electrical and Electronic Engineers
International Solar Energy Society

Technical data from manufacturers, including equipment specifications, prices, and design guides, is a necessary part of the library. Many of the most important technical innovations are made by these manufacturers, and they supply the most complete and most up to date information on these new products. Most of this information is available free of charge from the local manufacturers' representatives. An initial list of manufacturers to contact is provided below.

Barber-Coleman, Inc.	Honeywell Controls, Inc.
Bell & Gossett, Inc.	Johnson Controls, Inc.
Carrier Air Conditioning Co.	Kohler, Inc.
Caterpillar, Inc.	Landis & Gyr, Inc.
Cleaver-Brooks, Inc.	Phillips Corp.
General Electric Corp.	Trane Company
Hitachi Corp.	Waukesha, Inc.
Honda Corp.	Westinghouse, Inc.

It is recommended that the library also include a listing of contractors doing energy conservation-related work in Jordan, and another list identifying suppliers of related equipment.

A computer tool that is vital for maintaining a well organized, accessible library is a bibliographic database. This program can be built in dBase III+ by the EEIAC staff, who have been familiarized with the basics of this package. This task has been included in the milestone schedule proposed for the EEIAC staff (see Section 2.6).

Computer Services

One of the most powerful teaching and analytical tools available at EEIAC is its personal computer. The consulting team and the EEIAC staff have already developed a number of informational programs aimed at the general public. These programs range from storyboards about specific energy conservation issues such as "Energy Use in Jordan", "Lighting", "Air Conditioning and Energy Efficiency", to analytical programs for sizing solar water and pool heaters, and calculating insulation U-values. The current library of programs is listed below, and an example is presented in Exhibit 4-1.

بسم الله الرحمن الرحيم

MINISTRY OF ENERGY AND MINERAL RESOURCES
JORDAN ELECTRICITY AUTHORITY
ENERGY & ELECTRICITY INFORMATION & ADVISORY CENTER

وزارة الطاقة والثروة المعدنية
سلطة الكهرباء الاردنية
مكتب خدمة الجمهور للطاقة والكهرباء

REF .....
DATE .....

الرقم : .....
التاريخ : .....

REIAC SWIMMING POOL SOLAR HEATER SIZING CALCULATION
Version 1.0 cja/sk Telephone (06) 678-457/8 DATE: 8/12/86

LOCATION Jordan Valley REQUESTOR: Leif Raven

This sizing calculation is provided as a public service by the Energy and Electricity Information and Advisory Center. These results are intended to be used for illustrative purposes only. Detailed system sizing & construction must be supervised by a licensed mechanical engineer.

STEP 1: DATA INPUT

POOL SIZE: 6METERS x 12METERS x 1.5METERS DEPTH

108CUBIC METERS

POOL TYPE: Covered, W/Heat Exchanger, No Freezing Danger

POOL CONSTRUCTION:5cm Plaster,20cm Concrete,15cm Gravel

OVERALL HEAT TRANSFER COEFFICIENT (U-VALUE): 2.31W/SqM-C

WATER TEMPERATURE 26C AIR TEMPERATURE: 32C

SUNLIGHT HOURS: 8Hours GROUND TEMPERATURE 24C

SOLAR INSOLATION 7kWh/SqM-Day

COLLECTOR EFFICNCY: .35 HEAT EXCHANGER EFFECTIVENESS: .85

STEP 2: ESTIMATION OF HEAT LOSS

Bryan Boiler Co. Rule of Thumb (0.25 C per hour): 98kWH/Day

Conductive/Convective Loss Calculation: 42kWH/Day

Average of the Two Methods 70kWH/Day

STEP 3: SOLAR HEATER SIZING: 34 SqM Array

NOTE: This array was sized assuming the existence of a conventional back-up heater for the pool, which permits the use of summer solar insolation values. The array will thus be fully utilized year-round, providing 100% of pool heating needs in summer, and a smaller fraction in winter.

P.O.Box: 2310 or 140027 - Tel: 678457 or 678458 Amman - Jordan ص.ب : ٢٣١٠ أو ١٤٠٠٢٧ - هاتف ٦٧٨٤٥٧ أو ٦٧٨٤٥٨ عمان - الأردن

Storyboards

EEIAC Overview
Energy Production & Consumption in Jordan
Choosing Among Energy Conservation Alternatives
Personal Computers & Energy Management
Computerized Energy Management & Control Systems
Energy Efficient Air Conditioning/Thermal Storage
Shared Savings
Street Lighting
Lighting
Windows

Analytical Programs

SWIM: Solar Swimming Pool Heater Sizing Program
SOLAR WATER HEATER: Sizing & Breakeven Analysis
SOLPUMP: Photovoltaic Powered Water Pumping Sizing & Economics
INSULATION: Determines insulation requirements for different construction types
LIGHTING: Performs Life-Cycle Cost Analysis of Lighting Alternatives
BIOGAS: System Sizing & Economics for Biogas Cogeneration
WIND1: Breakeven Cost Analysis for Wind Turbine
WIND2: Simulates Turbine Energy Output
HYBRID: Wind/PV/Battery/Diesel Hybrid System Sizer
LOAD: Determines heating and cooling load for building.

It is expected that additional programs will be developed in the coming months. The EEIAC staff are well trained in both storyboard development and analytical program design.

Conferences and Seminars

One of the best ways for collecting and disseminating information is to bring people together to share their knowledge. EEIAC should encourage this process by sponsoring conferences and seminars on a wide variety of energy conservation topics. The Computers and Energy Conservation EXPO, held at EEIAC and organized by the staff under the guidance of the Consultant Team, illustrates this mechanism (see Section 5.0 for discussion of the EXPO).

EEIAC should host, on a regular (monthly) basis, seminars on specific energy conservation subjects. These seminars will allow in-depth discussion of specific issues, will encourage private, non-EEIAC involvement in conservation work, and will help the EEIAC staff to identify outside experts and allies. A list of proposed seminar topics (drawn from the EXPO presentation topics) is provided below.

Appliance Efficiency Standards
Computerized Energy Management and Control Systems
Energy Conservation in Central Heating Plants
Energy Efficient Air Conditioning
Energy Load Management
High Temperature Solar Technology & Applications in Jordan
Insulation
Lighting
Passive Solar Heating & Cooling
Photovoltaic Energy Technology & Applications in Jordan
Shared Savings
Solar Water Heaters
Street Lighting
Thermal Energy Storage
Waste Heat Recovery
Wind Energy Technology & Applications in Jordan
Windows

One way to improve participation in conferences is to co-host them with other organizations. EXPO attendees included members of the Royal Scientific Society, Jordan University, Yarmouk University, the Engineering Association, and other institutions. All of these institutions would be suitable co-hosts for conferences, and they may also have access to funding sources and venues unavailable to EEIAC. A proposed schedule milestone is to organize at least one conference in partnership with another organization during this year.

The EXPO provided good hands-on training for the EEIAC staff for conference management. A conference management checklist was distilled from this experience for use in planning future conferences. This is contained in Attachment F.

VIP Visits

In order to accomplish its mission of achieving energy conservation within Jordan, EEIAC needs continuing support from decisionmakers and funding sources within and outside the Government of Jordan. This support provides not only funding and other resources for EEIAC, but also publicity for its messages. An important aspect of acquiring and maintaining support is an ability to smoothly handle "VIP" visits.

The EEIAC staff have already had experience with VIP's including HRH Crown Prince Hassan, and Mr. L.P. Reade, Director of USAID Jordan. A management checklist for VIP visits is presented in Attachment G, to summarize the types of preparations needed to ensure smoothly run, successful VIP visits.

JEPCO/JEA On-line Billing Information

An innovative way to attract consumers to EEIAC is to provide on-line billing information for JEPCO/JEA electricity customers at the

Center. This service is technically feasible and is being actively pursued by the Consulting Team, EEIAC/MEMR/JEA staff, and JEPCO personnel.

This service would allow consumers to receive explanations of the most important causes of their electricity usage, and would also give them the opportunity to voice complaints or to straighten out billing problems. In addition, it would provide staff energy auditors with historical electric consumption data for audit customers.

In order to bring this service into existence, a continuing and concerted effort must be made by EEIAC, MEMR, and JEA personnel to satisfy JEPCO's remaining concerns about the project. This is included in the proposed milestone schedule.

4.2 OUTREACH PROGRAMS

One of the most important public education activities is to bring energy conservation information to the people rather than simply waiting for them to seek it at the Center. Such outreach programs include presentations, demonstrations, and exhibits at schools, universities, government facilities, private businesses, professional organizations, and other places where people gather. They also include competitions and other means for directly reaching people.

Presentations/Displays/Exhibits

Several of the EXPO presentations are suitable for re-presentation before other audiences. More "stock" presentations should be developed to be repeated before a large number of different audiences throughout Jordan. A proposed schedule milestone is to give at least five presentations per month before a variety of lay audiences.

Specific equipment needed to make professional presentations is listed in Attachment D, which has been sent to the Ministry for inclusion in their budget. The largest single item requested is a minibus that can function both to transport energy auditors and audit equipment, and a presenter with a portable energy conservation display, to locations remote from EEIAC.

Three upcoming special events should have EEIAC outreach involvement: the Jordan Manufacturers' Exhibition, currently in progress, the RSS Solar Conference August 24, 1986, and the Computers in Jordan Exposition on November 2, 1986.

Competitions

Contests or competitions are often effective in focusing public attention on specific issues concerning energy conservation. However, competitions must be precisely targeted in order to be effective. It is recommended that professionals and homeowners be targeted separately.

Competitions among design professionals have been used for more than a decade in the U.S. to focus attention on energy conservation design issues for buildings. The most prestigious of these, the ASHRAE and Owens-Corning competitions, are held annually and are juried by nationally respected designers and academics. An energy conservation design competition in Jordan could be designed similarly, with a national/international jury evaluating submissions for buildings or systems that have been commercially designed and installed within Jordan.

Another type of competition, aimed at residential retrofits, should also be explored. This one should request submissions by homeowners and renters describing energy conservation measures that they themselves have implemented.

A third competition idea is already under study by the Energy Committee of the Engineering Association. This proposes to ask housewives (who spend the most time at home) to submit ideas to the Association, which will then choose the best ones and publish them. This idea should be supported by the Ministry, and the data made available by the competition should be shared.

The overall objects of competitions are to (1) publicize energy conservation ideas, (2) focus peoples' personal energy on conservation topics, (3) identify people who are interested in energy conservation activities, and to (4) encourage energy conserving design and implementation practices.

Mailing Lists

EEIAC should develop mailing lists of people with an interest in or relevance to energy conservation in Jordan. Activities such as conferences and competitions will generate some names, and others can be acquired from existing organizations and institutions. For example, EEIAC should ask for the membership roster of the Engineering Association, for the list of engineering graduates of the universities, and for the addresses of the firms listed in the Jordan Industries Book.

A computerized database for tracking this information has already been established at EEIAC using dBase III+.

4.3 MEDIA PROGRAMS

In order to keep energy conservation issues highly visible in the public eye, an intelligently coordinated media program must be developed. There are two components to this program: event publicity and information dissemination.

Event Publicity

Current news events capture both the eye and the imagination of the public, and can trigger energy conservation action on the part of individuals. Newsworthy events, such as VIP visits and conferences, should

be staged regularly, to maintain the visibility of the Center's activities. Carefully prepared press releases and other pre-publicity should accompany each event. The Ministry's Public Relations Office can provide some professional assistance with these efforts. A proposed schedule milestone is to arrange one newsworthy event every month.

Information Dissemination

Regular, formalized information dissemination is also a valuable media tool. EEIAC should initiate several efforts in this area, including:

- A monthly newsletter (which can be prepared on their computer after their laser printer is installed);

- Develop a variety of one page handouts on energy conservation subjects (based on sample Energy Fact Sheets provided by the Consultant Team) such as the brochure in Exhibit 4-2.;

- Develop general yet comprehensive publications for the general public. This can be the basis of a "Do-It-Yourself" home energy audit program which should be developed in the future.

- Publish longer reports such as those prepared by the Ministry on window infiltration and thermal insulation;

- Contribute regularly to newspapers with a weekly "Energy Conservation Tips" column, conservation word puzzles, home energy audit forms, and fill-in-the-blank calculations. Examples of some of these items were provided by the Consulting Team;

- Television and radio talk shows;

- Educational television programs;

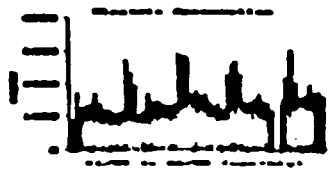
- Short television spots.

ON-SITE WORK

*EEIAC ENGINEERS AND TECHNICIANS WILL MAKE ON-SITE INSPECTIONS AND ADVISE THE PUBLIC ON SOLUTIONS TO ENERGY RELATED PROBLEMS.

*EEIAC WILL DOCUMENT AND CLASSIFY THESE PROBLEMS AND PUBLICIZE GENERALIZED SOLUTIONS.

*IN ADDITION EEIAC WILL DISSEMINATE THIS INFORMATION TO THE DESIGN AND CONSTRUCTION PROFESSIONALS.



USE HIGH EFFICACY LAMPS

COMPLAINTS

*TO RECEIVE COMPLAINTS AND INQUIRIES CONCERNING ENERGY FROM VARIOUS PARTIES.

*TO CLASSIFY AND DOCUMENT COMPLAINTS BY COMPUTER, AND TO CHANNEL THEM TO CONCERNED PARTIES. SOLUTIONS TO PROBLEMS WILL BE REPORTED BACK TO EEIAC WHICH WILL PUBLICIZE AND DISTRIBUTE RESULTS IN A SIMPLE MANNER AND TO RETRIEVE INFORMATION FOR FUTURE USES.

*TO RECEIVE SUGGESTIONS RELATING TO ENERGY CONSERVATION, STUDY THEM WITH CONCERNED DEPARTMENTS IN MEMR, JEA AND WITH OTHER EXPERTS AND TO MAKE USE OF THEM.

*TO RECEIVE COMPLAINTS DEALING WITH ELECTRICITY, ELECTRICAL SERVICES AND ENERGY EQUIPMENT, TRANSFER THEM TO CONCERNED DEPARTMENTS AND FOLLOW UP THEIR RESOLUTION

APPLICATION OF THERMAL INSULATION DECREASES HEATING AND COOLING COSTS.

COORDINATION WITH OTHERS

*TO COORDINATE WITH CONCERNED PARTIES DEALING WITH DESIGNS WHICH ENSURE ENERGY CONSERVATION, SUCH AS THE APPLICATION OF THERMAL INSULATION, BUILDING ORIENTATION, LIGHTING, ETC.

*TO CONTACT SIMILAR CENTERS WORLDWIDE TO OBTAIN LATEST INFORMATION ON PROMOTION OF ENERGY CONSERVATION MEASURES.

USING DOUBLE GLAZED WINDOWS DECREASES ENERGY LOSSES.

THE HASHEMITE KINGDOM OF JORDAN

MINISTRY OF ENERGY AND MINERAL RESOURCES

JORDAN ELECTRICITY AUTHORITY

GET MORE FOR YOUR MONERGY

ENERGY & ELECTRICITY INFORMATION & ADVISORY CENTER

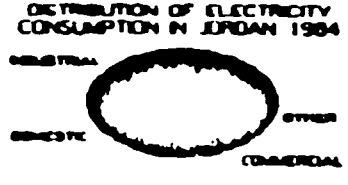
(EEIAC)

PROFESSIONAL UNION BUILDING
OPPOSITE TO:
MINISTRY OF INDUSTRY & TRADE
P.O.BOX 140927
TEL NO.676457/8
TLX.21280-JEASAR - 22270
JEA.

OBJECTIVES

*EEIAC WORK CONCENTRATES ON PROVIDING SERVICES TO PUBLIC, AS WELL AS TECHNICAL, ACADEMIC AND INDUSTRIAL INSTITUTIONS IN THE FOLLOWING SECTORS:

- *THERMAL INSULATION.
- *ENVIRONMENTAL DESIGN (BUILDING-ORIENTATIONS)
- *SOLAR HEATING
- *CENTRAL HEATING
- *LIGHTING
- *ELECTRICITY & ELECTRICAL EQUIPMENT.
- *ELECTRICAL SERVICES



STANDARDS

*TO DISTRIBUTE JORDANIAN STANDARDS (JSS) DEALING WITH ENERGY & ELECTRICITY IN COOPERATION WITH THE JORDANIAN DIRECTORATE OF STANDARDS & METROLOGY OF THE MINISTRY OF INDUSTRY AND TRADE.

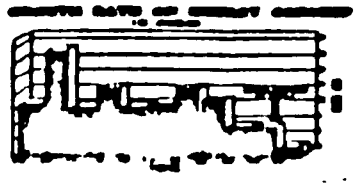
*TO ADVISE THE PUBLIC ABOUT ENERGY SAVING EQUIPMENT, ESPECIALLY THE LOCALLY MADE PRODUCTS WHICH COMPLY WITH JSS, BY EXHIBITING THEM IN THE EEIAC SHOW ROOM.

*TO ADVISE THE PUBLIC ABOUT HOW TO INSTALL THIS EQUIPMENT.

*DO NOT HESITATE TO CONTACT EEIAC.

STUDIES & RESEARCH

*TO PRESENT RESULTS OF TECHNICAL STUDIES CONDUCTED BY MEMR AND JEA IN A SIMPLE FORMAT AND DISTRIBUTE THEM TO CONCERNED PARTIES.



*TO COLLECT STUDIES AND TECHNICAL RESEARCH DEALING WITH ENERGY FROM VARIOUS SOURCES, CHECK AND DISCUSS THEM WITH CONCERNED PARTIES AND DISTRIBUTE RESULTS IN A SIMPLIFIED AND READILY ACCESSIBLE MANNER .

*TO HOLD SPECIALIZED SEMINARS.

*TO PREPARE PERIODICAL PUBLICATIONS.

PUBLICITY

*TO CLARIFY THE IDEAL MODES AND THE MINIMUM COST APPROACHES FOR USING ENERGY AND ELECTRICITY.

*TO USE ADVERTISEMENTS, SEMINARS, TELEPHONE OR MAIL.

*TO DISTRIBUTE INFORMATION RELATING TO ENERGY CONSERVATION INVESTMENTS PREPARED BY MEMR, JEA, ELECTRIC UTILITIES, JORDAN REFINERY COMPANY, AND OTHER INSTITUTIONS.

*TO PROMOTE ENERGY AWARENESS BY USING POSTERS, PRESS, RADIO AND TV RELEASES, AND TRAINING COURSES, AND SEMINARS.

TURN OFF ALL EQUIPMENT, WHEN YOU LEAVE.

5.0 COMPUTERS & ENERGY CONSERVATION EXPOSITION

On July 28th, 29th and 30th, 1986, EEIAC held an exposition ("EXPO") focusing on computers and energy conservation. This event served as a training vehicle for EEIAC and Ministry staff, providing them with a hands-on opportunity to learn conference management and presentation techniques, to prepare for VIP visits, to develop exhibits and computerized storyboards, and to coordinate publicity.

The stated objectives of the EXPO were to (1) inform the interested communities of consumers, merchants, and professionals about methods and opportunities for energy management and conservation, (2) publicize the newly opened EEIAC and encourage visitors, (3) promote effective and efficient implementation of technology applications, and (4) focus attention on personal computer potential in energy management.

The program for the EXPO included energy conservation exhibits, displays of personal computers and graphics by local dealers, with energy software supplied by EEIAC, and presentations by EEIAC, MEMR, JEA, and Meridian staff members on a regular basis throughout the three days. The schedule and outlines for the presentations are contained in Attachments H and I.

The intensive activities preceding and during the EXPO catalyzed both the staff and the Consultant Team into extremely productive information exchange. A large number of the staff learned to use computer spreadsheets, graphics packages, and storyboards. Several also learned technical subjects to which they had not been previously exposed. Those who made presentations also learned to adjust the content and length of their talks to the expected audience.

Many of the EXPO presentations were of sufficient quality to be developed further. They can form the nucleus of a library of "stock" presentations that should be repeated regularly as part of the outreach program. See Attachment J for a sample storyboard presentation.

6.0 CONSERVATION ENGINEERING

The Consultant Team reviewed EEIAC's objectives and their current engineering activities with four goals in mind: (1) to develop familiarity with the current efforts, (2) to evaluate the scope of these efforts and planned work, (3) to introduce state-of-the-art engineering techniques and methodologies, and (4) to recommend a focus for current and planned work.

There are two main categories of engineering work being done at EEIAC: energy analysis and energy audits. Energy analysis aims at answering generalized or "what if?" questions about conservation technologies, designs, and energy use in buildings. Energy audits, on the other hand, focus on evaluating the energy conservation opportunities available at specific buildings.

6.1 ENERGY ANALYSIS

EEIAC needs several types of computerized energy analysis tools. First, it needs to have rough sizing and economic analysis programs to help consumers decide whether to invest in energy conservation projects. These programs can be written in BASIC and Supercalc4 by the EEIAC staff. Examples of programs that have already been developed by the EEIAC staff during the Consultant Team's visit include a solar water heater sizing and economic analysis program, a solar swimming pool sizing program, an insulation program, and others. See Exhibit 4-1 for sample outputs.

It is recommended that EEIAC develop additional energy analysis programs. Programs that are proposed for the milestone schedule include (1) life-cycle costs for lighting system alternatives, (2) life-cycle cost analysis of air conditioning systems with various efficiencies, (3) life-cycle cost analysis of insulation investments, (4) tradeoff analysis for central heating system control strategies (i.e., temperature setbacks), and (5) electricity bill disaggregation analysis.

Another important category of analysis tools is design programs for engineers and other design professionals. The EEIAC staff are developing some of these in-house (a building thermal analysis program, for example); however, others are too complex to develop independently, or are already available elsewhere at reasonable prices. It is recommended that EEIAC purchase selected packaged programs for use by the staff and visitors. A list of recommended purchases is contained in Attachment E.

6.2 ENERGY AUDITS

Energy auditing is a service that EEIAC and the Ministry want to provide to the public. They want to send engineers to visit facilities, evaluate energy conservation opportunities, and make prioritized energy conservation investment recommendations for the users of these facilities. At the present time, a number of industrial and large commercial audits have been performed.

The Consultant Team has reviewed previous audits and has suggested alternative methodologies for conducting commercial and residential energy audits. A sample commercial audit and a sample residential audit have been performed with EEIAC and Ministry staff. The audit was performed for technical training and the reports prepared will serve as a basis for future analyst reports. See Attachments L and M for the sample audit reports.

The methodologies that have been developed involve extensive analytical work in addition to the facility walk-through. They are accomplished most efficiently with the use of computers for (1) statistical correlations, (2) energy accounting, (3) system performance simulations, and (4) life-cycle cost analysis of energy conservation options.

Residential Audit

The residential audit methodology used is derived from a packaged program brought from the U.S. by the Consultant Team. This program is in the process of being adapted to Jordanian conditions by the EEIAC staff.

One of the most important parts of this adaptation process is the development of a data base characterizing the residential building stock, appliances, operating patterns, and energy consumption within Jordan. This data base can be built by performing a large number (>100) of detailed energy audits of homes, and by adapting data from the Ministry's and the Engineering Association's current studies of household energy consumption. The data base will provide a sound basis for estimating constants required for streamlining energy analysis calculations in the program and for developing rules of thumb about residential energy consumption patterns and potential conservation measures in Jordan, both of which are essential for an effective audit program.

An important schedule milestone is to accomplish at least 100 detailed residential energy audits to build the data base. A secondary milestone will be to conduct a minimum number (20-30) of audits each month thereafter, as part of a routine operation.

Once the packaged residential energy audit program has been adjusted for Jordanian conditions, a self-audit, or mail-in audit program should be established. Based on samples provided by the Consultant Team during their visit, the staff can develop a form to be sent out and/or published in the newspaper for wide dissemination.

Commercial Audit

The EEIAC and Ministry staff have spent a great deal of time during the Consultant Team's visit developing the computer software to accompany the commercial energy audit methodology used in the sample commercial audit. This software, most of which has been prepared in spreadsheet form, fixes the methodology in place, and will be extremely useful on future audits.

Several staff members have been familiarized with both computer spreadsheet analysis and commercial energy audit methodologies, and should be able to independently and competently execute future audits. See Attachment K for the recommended audit methodology.

A packaged commercial energy audit program has also been brought by the Consultant Team. The program must be modified based on conditions in Jordan. It should prove to be a useful tool for streamlining the commercial energy audit process once it has been revised.

7.0 TRAINING

There are a variety of training issues central to the successful development of EEIAC as an institution. These can be divided into two categories: EEIAC staff training, and energy conservation training for other Jordanians working in related fields.

7.1 EEIAC STAFF TRAINING

The members of the EEIAC staff are responsible for (1) managing and operating the Center, (2) making presentations and being persuasive, (3) performing energy audits and technical analysis, and (4) training others to do this work.

Training in these areas within Jordan is limited to degree programs at the Universities, and formal administrative training at vocational schools. It is recommended that the administrative staff be given the opportunity to benefit from courses aimed at improving typing, word processing and accounting skills.

Persuasiveness training courses on videotape can be rented from U.S. and other foreign producers for use by the staff of the Center. When suitable courses have been identified, they should be provided to the Center staff.

EEIAC will also derive great benefit from a program of training in the United States for its key staff members. In order to be more effective at their jobs, these people need to develop a variety of specialized skills not found in Jordan. They need to gain first-hand experience in the design, implementation,management, and evaluation of energy conservation programs; this can only be done in a place with an extensive existing energy conservation infrastructure such as that found in the U.S.

Two categories of training are needed: (1) managerial and program development training for the Ministry advisor providing executive oversight, and (2) "trainer" training for the key staff and manager of the Center. A program for each of these training categories is outlined below.

7.2 TRAINING FOR THE MINISTRY ADVISOR

Duration: 2 Weeks

The Ministry advisor for the Center is responsible for ensuring that EEIAC has a clear, realizable mission, adequate resources, a skilled and responsive staff, a coherent overall plan of action, means

of evaluating its performance, and ties to both the Jordanian and international energy communities. The role of the training program is to focus the abilities of an already skillful manager on the unique aspects of energy conservation activities and to bring him up to date on the state-of-the-art in this specialized field. The training program for the Ministry Advisor should include the following components:

Public Administration

This subject should include elements of program design, program implementation and institutionalization, program management, and program evaluation specifically applicable to energy conservation programs. This should be accomplished by providing a detailed review of U.S. national and regional conservation and renewable energy programs, and extensive discussions with current program managers in these areas at the U.S. Department of Energy (USDOE) and other agencies.

Current Directions

In order to ensure that Jordan directs its energy conservation efforts effectively, the Ministry advisor should be informed of the current emphasis of relevant U.S. programs. This should be accomplished by arranging for detailed discussions with USDOE officials, the National Laboratories, and relevant interagency committees, a review of current federal and state government funding trends, and case studies.

Funding Strategies

The Ministry advisor is responsible for securing the financial viability of the Center. His training in this area will focus on several items, including :

- Bilateral Funding Institutions (such as USAID) and Multilateral Funding Institutions (such as World Bank), the availability of grants, credits and loans, and the details of the mechanisms involved.

- US government funding mechanisms (such as the State Energy Conservation Plan and Energy Extension Service Programs) that may have have relevance as examples to be followed by the Government of Jordan.

- Private sector funding sources and mechanisms, including (among others) shared savings as described below.

- Government/Industry/University interactions.

Conservation & Efficiency Standards Development

Effective energy conservation in Jordan requires not only the informational efforts of the Center, but also that a set of "imperatives" and incentives be put in place. The Ministry advisor has a natural role as a leader in encouraging the implementation of

"imperatives", or standards within Jordan. The object of this section will be to introduce him to standards-setting organizations and processes in the energy conservation field in the U.S. It should include a review of current and past federal efforts, such as the Building Energy Performance Standards and other work at the USDOE and National Bureau of Standards, as well as California's exemplary Title 19 and Title 24 programs. It should also include discussions with professional organizations such as ASHRAE and AIA about their extensive involvement in standards development, and visits with local enforcement officials to provide a look at the implementation process.

Materials & Equipment Testing & Certification

Critical to all standards-setting and informational efforts is the development of a timely and reputable means for certifying and testing equipment and materials related to energy conservation. This section should include a review of current U.S. efforts, and discussions with appropriate officials at the USDOE, US Dept of Commerce, and other organizations.

Incentives Development

In parallel with the informational and imperatives efforts in Jordan, there should also be an effort to develop a set of institutionalized incentives to promote energy conservation. The Ministry advisor should be in the forefront of their development in Jordan. U.S. training to prepare him for this role should include a review of existing U.S. incentives, and discussions with U.S. federal government officials, selected state government officials, and utility companies about each of their programs.

Design Competitions

One very successful tool for focusing the attention of the construction industry on energy conservation issues has been the use design competitions and annual awards for conservation-conscious construction. This section should review current efforts by the U.S. government and the professional organizations, and should include meetings with appropriate representatives of these organizations.

Shared Savings

Private sector involvement in energy conservation activities has included increasing use of the "shared savings" mechanism. This idea may be feasible in Jordan, and The Ministry advisor should be familiarized with both the contractual/financial as well as the technical aspects of shared savings approaches, via hands-on experience with a successful shared savings firm.

Site Visits

A final, important component of the training should include site visits to operating energy conservation centers and demonstration

projects in the United States. A few significant sites should be selected that will have particular relevance to the concerns of EEIAC in Jordan.

7 3 ENGINEER/AUDITOR TRAINER TRAINING

Duration: Two Months

The operating staff at EEIAC also require specialized training in the U.S. to enable them to competently perform energy conservation services. These engineers have a tripartite responsibility: first, to disseminate technical information in an understandable way to the general public; second, to provide technical auditing and consulting services to building owners and design professionals; and third, to train other engineers to perform similar work. Their training should include the following components, some of which have already been mentioned above:

Classroom Technical Training

The trainees are all degreed engineers; therefore, the brief period of classroom training should focus on case studies and applications, rather than theoretical basics. Subjects covered should include heating, ventilating & air conditioning design calculations, thermal analysis of buildings, lighting systems, solar systems, insulation, and computerized energy management systems and temperature controls.

Energy Audits

The training should include hands-on participation in residential and commercial building energy audits. The aim of this will be to provide practical engineering experience under time-constrained, field conditions.

Installations

Direct participation in the installation of energy saving measures, particularly of computerized energy management and control systems, should be included in the training. This will provide the engineers with first-hand knowledge of the implementation process and the difficulties involved.

Computer Training

The trainees, who already have a significant degree of computer fluency, should be given hands-on training in three areas of microcomputer applications: energy analysis, management accounting, and graphics/presentations. The object should be to improve existing skills in each of these areas, and to fill in gaps any individual might have. Software currently in use at the Center includes Multimate Advantage, PC Storyboard, Energraphics, Supercalc4, dBase III+, and BASIC.

Training Program Development

Since these engineers will be training others, they should learn how to teach successfully. They should receive formal instruction in (1) training needs analysis, (2) identification and design of materials and syllabi for classroom and self-instructional training, (3) teaching techniques, (4) resource requirement estimation, and (5) evaluation techniques.

Advertising Techniques

This section should include a review of techniques for advertising effectively in a variety of media, including newspapers, posters and graphic media, radio, and television.

Outreach Programs

Conservation programs existing in the U.S. should be reviewed, and visits should be arranged to allow the EEIAC staff to understand how these outreach programs are designed and operated.

Conference Management

Conference management techniques, including computer tools used in actual conferences, and checklists to aid in planning and management, should be reviewed and discussed with the EEIAC staff.

Other Topics

These subjects, which were mentioned above under the Ministry Advisor's training program, should also be included in the program for the EEIAC engineers. The focus for them should be on the technical and implementation-related aspects of these topics:

> Conservation & Efficiency Standards Development, Materials & Equipment Certification & Testing, Incentives, Design Competitions, Shared Savings, and Site Visits

7.4 ENERGY CONSERVATION TRAINING FOR JORDANIAN PROFESSIONALS

Facilities should be developed within Jordan to provide training for (1) engineers and architects, (2) designers of mechanical and electrical systems for buildings, and (3) technicians and installers of energy consuming equipment and building components. This training should introduce energy conservation ideas and practices, improve installation and design skills, and provide a certification mechanism to identify qualified professionals in the field.

For engineers and architects, contacts at Jordan University and Yarmouk University report that the universities are beginning to offer courses focusing on energy conscious design practices. The Engineering Association has established an Energy Committee that offers practicing

professionals a chance to come up to date on energy conservation ideas. The Consulting Team also broached the idea of certification and continuing education with them. This idea needs further local follow-up.

For technicians and installers, the Zarqa training center run by JEA/MEMR should be able to provide training in applied energy conservation skills. Resources for this center deserve high priority in the next Ministry budget. Military training centers are also a suitable venue for applied energy conservation training.

8.0 PRIVATE SECTOR INVOLVEMENT

A necessary condition in establishment of governmental services is close examination for alternative means of providing the service through the private sector. In many cases, this is of course not possible. But private as well as public emergency teams, schools, and other standard public services exist because people have demonstrated a willingness to pay for service which can be differentiated because of timeliness, quality, prestige, or other similar reasons.

Private sector involvement supplants public service when the provider has determined a way to provide an equal or better service at less or equal "cost" for the consumer. Such "cost" differential may involve sooner response for an energy audit, more sophisticated equipment, or other such differentials.

The benefit to society overall is that jobs are created, taxes are paid, and the economy is strengthened.

The Project Team, working closely with the EEIAC, has made private sector involvement a special interest item for the assistance visit. Visits have been made to private institutions, for example, presenting shared savings concepts as an investment opportunity as well as an opportunity to contribute to a national goal.

8.1 ENGINEERING ASSOCIATION

The Engineering Association has been developing standards for training and implementation of energy conservation systems. The Project Team met with the President and several senior members from various industries in Jordan to discuss cooperation for such EEIAC proposed projects as design and implementation competitions.

8.2 IN-KIND SUPPORT FOR THE EEIAC

A number of local traders and manufacturers have provided materials for display in the EEIAC. While these may appear only to taking advantage of the free showroom space, they are also watching the Center to determine its success in distribution of information. As the Center becomes more successful, these same providers will be bringing their clients to the Center for impartial training and presentations. In addition, those traders dealing in several products will begin to provide their own energy audit services as a prelude to selling complete systems and support.

8 3 FINANCIAL INSTITUTIONS

Discussions were held with the Housing Bank and the Arab Bank concerning both energy conservation measures for their offices as well as energy conservation implementation as investment opportunities. Additional workshops need to be held for financial investors to discuss more completely the mechanics of such programs as "shared savings".

8.4 ENERGY MANAGEMENT COMPANIES

Companies which sell energy management systems and services such as Honeywell have also indicated interest in the Center; they too benefit from increased awareness by building owners that something can be done to improve energy management and reduce operating costs.

9.0 DEMONSTRATION PROJECTS

An effective and highly visible way to introduce innovative energy conservation approaches to design professionals is with demonstration projects. These projects demonstrate the feasibility and economic viability of new technologies in actual practice.

The rationale for government funding of demonstration projects is that the initial investment in a new technology is too risky for individual private sector investors. Further, the national goals of energy independence and improved balance of foreign trade will both be served by the successful introduction of energy conserving measures.

Several ideas for demonstration projects are proposed below. Each of them focuses on a different energy conservation or renewable energy idea.

9.1 HEAT PUMP DEMONSTRATION PROJECT

Heating and cooling of commercial and institutional buildings consumes a significant fraction of Jordan's energy use, and the building stock that is currently under construction will be in place for many decades. The introduction of new, efficient technologies for use by the heating, ventilating, and air conditioning (HVAC) industry within Jordan is of paramount importance in ensuring that efficient energy use is built into these structures.

One recent innovation that has gained wide acceptance by HVAC designers in the U.S., Europe and Japan is the heat pump. There are many potentially beneficial applications for heat pumps within Jordan, but these have been only minimally explored by the local design community. A demonstration project by MEMR of heat pump applications would encourage more widespread commercial use of this energy-conserving technology within Jordan.

What is a Heat Pump?

A heat pump is a mechanical/electrical device that uses a standard Carnot refrigeration cycle to move heat energy from a cold place to a warm place, against natural entropic tendencies. It accomplishes this by using a refrigerant fluid such as freon in a loop with a condenser, evaporator, expansion valve, and compressor. This fluid begins as a gas, its normal condition at ambient temperature, absorbs heat via the evaporator coil, is compressed into a hot gas by a mechanical compressor, releases its heat via the condenser coil to become a liquid, and then expands to become a gas again at the expansion valve.

What Types of Heat Pumps Are There?

There are three basic types of heat pumps: air-to-air, water-to-air and water-to-water. The air-to-air heat pump transmutes low quality (i.e., low temperature) heat from the outside air into high quality (i.e.,high temperature) heat for the inside air of a building during the winter. During the summer it performs as an air conditioner by rejecting heat from the inside of the building to the outside. Both the evaporator and condenser of the heat pump exchange heat directly with air.

The water-to-air heat pump withdraws heat from a circulating water loop and injects into the air inside of a building during the winter. During the summer it cools by extracting heat from the air inside of a building and rejecting to the circulating water loop.

The water-to-water heat pump withdraws low-quality heat from one circulating water loop, such as a chiller condenser loop, and injects high quality heat into another loop, raising the temperature of the water loop to the point where it is useful for hydronic space, domestic water, or process heating.

What Is the Current Status of Heat Pumps in Jordan?

There are more than fifty air-to-air heat pump installations in Jordan, according to the local representatives for two of the leading heat pump manufacturers. Most of these units are small (<10 tons) and are in use for small commercial and residential buildings. This branch of the technology seems fairly well established within Jordan.

There are apparently no commercially operating water-to-air or water-to-water heat pump installations in Jordan. There is also very little awareness of these types of systems among local HVAC designers and vendors. There is some experimental work in progress at the Royal Scientific Society, Jordan University, and Yarmouk University using these types of units.

The Proposed Demonstration Project

It is proposed that the Ministry use a section of its new building as the site for a demonstration project for water-source heat pump technology. The project would provide a functional demonstration of the feasibility of using water-source heat pump technology for space heating and cooling.

In lieu of installing the planned radiators and pumped hot water heating system, a water-to-air heat pump system will be installed in a section of the building. A water-to-air heat pump will be installed in each temperature control zone in this part of the building, and all of the units will be connected by a circulating water loop. A small closed circuit cooling tower and a boiler water heat exchanger will also be included in the loop.

This type of system has several useful features:

- it allows individual control over both the scheduling and temperature of each zone;
- it provides both heating and cooling to the space using a single piece of equipment;
- it functions extremely efficiently in a temperate climate like that found in Amman;
- it is particularly compatible with office buildings that operate primarily during the daytime and thus do not require nighttime (i.e., low ambient temperature) heating;
- it is quite useful for moving heat from where it is not wanted (on the south side of the building, or in the computer room) to where it is needed (the north side of the building);
- it can use solar-heated water for tempering of the circulating water loop during the winter months;
- it allows the use of several different manufacturers' equipment (including experimental Jordanian units) within a single system;
- it can be easily equipped with automatic, computer-based monitoring equipment to allow detailed, accurate, and cost-effective operational analysis and performance evaluation.

An important part of this demonstration project would be an extensive period of on-site training and participation in the design process by MEMR and other Jordanian engineers. The project would begin with a brief presentation of water-source heat pump design concepts and case studies by a foreign technical expert. This expert would then lead, in conjunction with an experienced Jordanian consulting/counselling engineer, a design team composed of MEMR staff and outside local consultants.

Part of the design process will include the development of a detailed, computerized simulation of the performance of the building with the heat pump system, for purposes of equipment sizing and as a measure for evaluating the completed system's operating performance. This computer program would be available for use in designing subsequent projects.

The project will then progress through schematic and detailed design, equipment procurement and installation contracting, installation and construction supervision, start-up, operator and maintenance training, performance monitoring and evaluation. The final result will include both an operating demonstration system and a cadre of Jordanian engineers experienced in the design of such systems.

9.2 HEAT RECOVERY CHILLER DEMONSTRATION PROJECT

Air conditioning of buildings is becoming increasingly prevalent in Jordan. Air conditioning systems consume large amounts of electrical energy; in fact, in many countries, air conditioning is the primary contributor to peak electrical demand. In Jordan, the peak electrical

demand already correlates well with maximum ambient temperature, indicating that air conditioning is a significant component of electrical demand (ref. JEA Load Research & Management Study, 6/86).

The air conditioning systems currently under construction will be in place for the rest of this century. It is critical that new, efficient technologies available on the world market be introduced to the Jordanian design & construction communities now, to ensure that these air conditioning systems use electricity efficiently.

Heat recovery chillers are an energy-efficient adaptation of traditional chiller designs used in central system air conditioning for large buildings. During the last decade they have enjoyed widespread use in new buildings worldwide. However, within Jordan, their use has been only minimally explored, primarily because of local unfamiliarity with the new technology. A demonstration project by MEMR of a heat recovery chiller application would encourage more widespread commercial use of this energy-conserving technology within Jordan.

What is a Heat Recovery Chiller?

A heat recovery chiller is a traditional water chiller with a modified condenser. A traditional water chiller rejects low quality (i.e., low temperature) heat into the condensing water to be discharged, or wasted by a cooling tower. A heat recovery chiller rejects this heat at a much higher and more useful temperature, enabling it to be recovered and used for space heating, domestic water heating, or other process requirements.

What is Their Availability in Jordan?

All of the major manufacturers of refrigeration equipment worldwide produce heat recovery chillers. Many of them are represented locally. Those that were contacted reported that they had technical literature and specifications available for these units, and could procure the equipment.

The Proposed Demonstration Project

It is proposed that the Ministry sponsor a modification to the air conditioning system currently being installed at the new Water Authority building located in Shmiesani near the Marriott Hotel. The modification would consist of upgrading the currently-specified water chiller to a heat recovery chiller, modifying the domestic hot water heater to accept water pre-heated by the heat recovery package, installing micro-processor controlled monitoring equipment, and developing an active display or exhibit at the new building showing the operation of the heat recovery system.

The project would be designed and implemented by MEMR and other Jordanian engineers, with guidance from a foreign technical expert familiar with heat recovery chiller systems. This expert would initially present relevant design concepts and case studies in a classroom

setting, and then lead the design team, in conjunction with an experienced Jordanian consulting/counselling engineer, through the design and construction process.

The outcome of this demonstration project will include not only a functional, highly visible heat recovery system, but also the hands-on training of MEMR and private sector Jordanian engineers in the application of this energy-efficient technology.

9.3 EVAPORATIVE COOLING DEMONSTRATION PROJECT

Air conditioning is becoming a desirable building feature for many Jordanians. They are demanding year-round comfort in both their residences and their workplaces. However, the advent of widespread air conditioning has serious implications for the capacity expansion plans of the electric utilities, as well as a potential macroeconomic impact on Jordan's balance of trade, given that most air conditioning equipment is imported.

A highly energy-efficient space cooling technology that has been neglected in recent years is evaporative cooling. Unlike the currently popular carnot-cycle compressor-driven refrigeration system, which consumes a great deal of electrical energy, evaporative cooling uses almost no electricity for operation.

What is Evaporative Cooling?

Evaporative coolers function by running water over an outside-air-to-inside-air heat exchanger located in the outside air supply duct to a building. This water evaporates into the outside air and cools the inside air by withdrawing the latent heat required for vaporization from the inside air.

What are the Applications for Evaporative Cooling?

In a dry climate like that found in most of Jordan, a significant temperature reduction in the supply air can be achieved using evaporative cooling. While this temperature reduction is not usually adequate for completely cooling a commercial building with significant internal loads, it can dramatically reduce both the operating and initial capital costs of central air conditioning systems. This is achieved by installing the evaporative cooler preceding the standard chilled water/refrigerant cooling coil in the outside air supply air duct for the building. For residential applications, the evaporative cooler alone may provide adequate cooling.

Evaporative coolers find their most economical applications at restaurants, hospitals, laboratories and other buildings requiring 100 percent outside air in their HVAC systems.

The Proposed Demonstration Project

It is proposed that the Ministry sponsor the installation of an evaporative cooling system at an existing restaurant, hospital, or similar suitable building to demonstrate to the local design community the effectiveness of this technology in minimizing air conditioning costs. The ideal candidate building would have at least two parallel outside air intake/cooling coil arrangements, one of which could be adapted to include an evaporative cooler, while the other would be left untouched to provide a comparison.

The project would be designed by MEMR engineers under supervision of an experienced Jordanian consulting/counselling engineer, with technical assistance from a foreign expert familiar with such installations. The project would include a brief presentation of design concepts and case studies by the foreign consultant, as well as the installation of an extensive monitoring system to allow detailed comparison of both the evaporative cooling and conventional systems serving the building. The monitoring system and the cooler installation would be set up as a highly visible, accessible demonstration of this technology application.

This project would not only demonstrate the viability of this technology as a pre-cooling technique for commercial/institutional air conditioning applications, but it would also train local and MEMR engineers in the design and installation of evaporative cooling systems. Further, unlike conventional air conditioning technology, most of which must be imported, evaporative coolers can be fabricated within Jordan.

9.4 BIOGAS COGENERATION DEMONSTRATION PROJECT

Self-generation of electricity by large facilities, industrial plants, and remote mining/agricultural operations has been common for decades in Jordan. Self-generation has benefited the electric utilities by reducing electricity demand by large consumers, and it has benefited the users by providing a local, reliable source of electricity. In remote areas, self-generation is often the only form of electricity available. However, the most common self-generation technology, the traditional diesel or gas-fueled engine-generator, does not efficiently utilize the energy of the fuel; about 65% of this energy is wasted via the engine's exhaust and cooling systems.

Many of the sites undertaking self-generation of electricity also have significant concurrent process heating requirements. An innovative way to increase the utilization efficiency of the fuel in the engine-generator while simultaneously meeting these heating needs is to do cogeneration.

Agricultural sites often have renewable biomass energy resources locally available. For example, a poultry farm can generate methane gas by anaerobically digesting droppings. This methane can be used to fuel an engine-generator, or a cogenerator.

What is Cogeneration?

Cogeneration is the simultaneous production of electricity and useful heat. Two generic system types exist: topping and bottoming systems. Topping-cycle cogeneration involves electricity generation followed by recovery of waste heat from the combustion/generation process. An example of a topping system is a diesel engine-generator with heat recovery from the exhaust gas and the engine jacket coolant.

Bottoming-cycle cogeneration produces heat for process use, and then uses a waste heat boiler to produce steam for electricity generation. Bottoming systems are usually associated with large industrial facilities having significant process heating requirements.

The Proposed Demonstration Project

It is proposed that the Ministry sponsor a project demonstrating biogas production and topping cogeneration technology at a remote agricultural site in Jordan. This site, a poultry farm, would be equipped with an anaerobic digester to (1) produce biogas (methane), and (2) render the chicken droppings innocuous and convert them into fertilizer. The biogas produced would be scrubbed to remove excess corrosive sulfur compounds, and it would be fed into an engine-generator to produce local electricity and process heat for hot water.

This biogas cogeneration system would demonstrate the feasibility of cogeneration at remote sites, using materials currently available in Jordan. The project would be managed by MEMR engineers with the assistance of a foreign technical expert familiar with these systems.

The project would begin with a presentation of design concepts and case studies by the foreign expert. A detailed resource and energy requirements assessment by MEMR staff would follow, after which detailed design, equipment procurement and installation would occur. The completed system would be equipped with monitoring equipment to aid in understanding its operation and in evaluating its performance. The foreign expert would assist in the design process and in the system start-up and performance evaluation processes. The objectives of the project would be to create an operational demonstration of biogas cogeneration technology, and to train Jordanian (MEMR) engineers in the resource assessment, design, implementation, and evaluation processes related to this technology.

9.5 RENEWABLE ENERGY HYBRID SYSTEM DEMONSTRATION PROJECTS

Reliable electric power supplies for remote locations have become increasingly important in many parts of the world. The need is greatest in developing countries, such as Jordan, where an extensive national electric grid is not yet available. Extending the national grid for a few small remote applications is very expensive and often times not practical. Such power supplies are commonly supplied by diesel generators. Although diesel generators have been successful and cost

effective in remote power applications, and will continue to be the primary source for providing such power in the near future, alternative sources must be developed.

Renewable energy systems, utilizing local wind and solar resources, have recently become an important substitute for supplying electric power to remote locations. Some of the many remote applications currently powered by diesel generators for which wind and photovoltaic systems are good substitutes are: small village electrification; cathodic protection; desalination; telecommunications/repeater stations; refrigeration/ice making. Such wind and photovoltaic powered systems have been successfully tested in various countries throughout the world.

The major drawback to a remote power application relying solely on a renewable resource is the intermittent nature of that resource. If a remote load does not require power which is 100% available, then a wind or photovoltaic system operating alone will suffice. However, loads such as telecommunications/repeater stations require "on-demand" power. For such loads an overdesigned wind or photovoltaic system with a significant amount of battery storage must be used to assure that power is always available. Battery storage is very expensive, and providing enough storage to assure power availability is uneconomical, especially when compared with a diesel generator.

Power system designers concerned with remote power applications have been trying to combine the best features of all possible remote application power sources into one "hybrid" system. Such a system can be composed of the following components: 1) wind-pv-diesel-battery; 2) wind-diesel-battery; 3) pv-diesel-battery; or 4) wind-pv-battery. The various components in a hybrid power source are integrated so as to produce power at a lower cost than any of the power sources operating alone. Although the initial cost is relatively high, its operating cost is much lower and reliability much higher than any of its components operating alone.

What is the Current Status of Hybrid Systems?

Hybrid power systems have been receiving increasing attention because of their relatively low operating cost and higher reliability than conventional stand alone power sources. Numerous studies are now being performed in over 15 countries to analyze system behavior, predict performance and define critical research needs. The technologies involved in hybrid systems have each been proven independently. Integrating these technologies together has not been a problem. The only important consideration for the successful hybrid system is that each of the component technologies are sized properly for a given application.

There are no hybrid systems in operation or demonstration in Jordan. However, the significant renewable resource and technology base developed by the Royal Scientific Society and the Ministry of Energy and Mineral Resources provides a strong foundation from which to demonstrate hybrid power systems. There are many applications which would benefit

from a hybrid power system. By developing a number of hybrid power system demonstration projects the importance, potential applications and replicability of these power systems can be shown.

Proposed Demonstration Projects

Hybrid power systems offer a reliable source of power for many remote applications. The basic concepts of system design and operation are the same for any type of remote application. It is proposed that the Ministry demonstrate hybrid system design and operation for three distinct remote power applications; 1) Television Repeater Station, 2) Desalination, and 3) Ice Making. Each of these applications is important in remote areas.

1) TV Repeater Station

The need exists to install a reliable power source for a TV Repeater Station in Rabad Castle, located near Irbid. The power demand for the station has been estimated to be about 15 kWp for 8-14 hours per day. This power requirement is ideally suited for a hybrid system. Whether or not a diesel engine is required is dependent upon the wind and solar resources in the area.

2) Desalination

Adequate potable water supplies are essential in remote areas, whether for drinking, irrigation or industrial processes. The cost of piping or trucking water long distances is often prohibitive. For such needs a local water purification plant is an attractive alternative. Such a plant, when operated by a hybrid power source, can often supply water for less than the cost of piping or trucking it. It is proposed that the Ministry select a small village currently lacking adequate water supplies and demonstrate the design and operation of a small (50 cu.m. per day) water desalination plant powered by a hybrid system.

3) Refrigeration/Ice Making

Preservation is another problem in remote areas. Food spoils quickly because of a lack of ice. Vaccines from local clinics spoil and are useless unless kept cold. These are just two of the many needs for refrigeration or ice making in remote areas. Ice must often be trucked in to meet a villages preservation needs. This is expensive and often unreliable. It is proposed that a small (5 kg per day) hybrid powered ice making plant be designed, installed and operated in a remote village.

Important objectives of such demonstration projects would be to :

- Demonstrate the viability of hybrid systems, and analyze the performance of the various alternative designs for future application in Jordan.

- Demonstrate the operation and maintenance requirements and costs for a three types of hybrid system designs.

- Demonstrate system start-up requirements.

- Demonstrate system design procedures.

- Develop, through training, a working capability in Jordan to design, procure, install, operate, maintain and analyze the performance of the different types of hybrid systems.

- Identify modifications that should be made in replicated systems in other remote locations in Jordan.

10. CONCLUSIONS AND RECOMMENDATIONS

This technical assistance effort for further development of the Energy and Electricity Information and Advisory Center was requested by His Excellency, the Minister of Energy and Mineral Resources. Project objectives included development and training for organization structure, public education capabilities, and conservation engineering methodologies.

The program adopted for the duration of the study included a number of areas of emphasis for staff, organizational and capabilities development. Computer work for example provided new software development for both administrative and energy analysis, adaptation of existing software for Jordanian conditions, and training on commercially available packages for the EEIAC staff.

Organizational work included budget planning, staffing plans, training, and extensive infrastructure development for the EEIAC operations.

Public education programs included planning and implementation for the first Jordanian Energy Conservation and Personal Computers Exposition. Other educational programs development included preparation of a number of graphics presentations on energy conservation which are now available for further use with only minimal preparation by the staff.

Conservation engineering work included the adaptation of US energy analysis software for Jordan and performance of residential and commercial energy audits for training staff engineers.

His Excellency, the Minister, has indicated during discussions his concerns about the necessary changes to make technology transfer programs successful. This project has been in itself a technology transfer program to help further develop the Jordanian technology transfer program, the EEIAC. The indications are at this time that at least some technology transfer has successfully taken place; however there is a substantial amount of work remaining for the EEIAC staff for the Center to become established as a national center of recognized excellence and engineering resource. To this end, the Project Team makes the following additional recommendations:

- Expand physical facilities for conference, training, and seminar rooms and for additional workspace for staff and visitor discussions.

- Develop data bases for Jordan for traders, design and other professionals, and owners of larger facilities for Center mailings and analysis.

- Establish a liaison person with industry and commercial operations for energy awareness.

- Establish procedures for making personal calls to help establish the name and capabilities of the Center as a resource for energy management assistance.

- Establish a longer term technical advisor position for assistance for the EEAIC.

- Consider identification of an Executive Director to oversee all of EEIAC functions and relationships, especially outside activities.

- Continue training for staff members, especially with advanced energy management systems and intensive audit work to create a varied background among the staff.

- Begin work to establish similar facilities such as with Irbid District Electric Company (IDECO) and in other regions. Encourage private development of such centers by energy management services companies.

- Expand the public outreach programs to include a newsletter and one-page descriptions of outstanding energy management projects.

- Design and implement an EnergyBus for mobile presentation capabilities.

- Develop data bases for energy engineering equipment specifications.

- Develop a data base of programs which would encourage energy program implementation through low cost loans for procurements of specific country of origin equipment, eg, the USAID Commodities Import Programs.

- Establish an interns program to provide educational and training opportunities for students of other nations who in turn bring to Jordan advanced skills. Seek external funding and scholarships.

- Establish on-line services to assist in subscriber education in conjunction with JEPCO.

- Establish a lighting research project for municipalities.

- Continually use data base program files to publicize Center programs and capabilities to make private sector concerns aware of business development opportunities in energy management.

- Establish a reporting procedure to manage milestone progress for such events as 20 residential and one commercial audits per month.

- Establish a public and engineer information base of periodicals, trade publications, and reference books and track availability and usage by a data base procedure.

- Establish a software library for energy analysis and presentation of written and graphical data. Make the contents available for evaluation by other government agencies and serve as a Jordanian Center of Excellence for personal computer applications and development.

- Establish a Training Center for training of design professionals, technicians, engineers, traders, and consumers.

- Establish training and operational procedures to perform on-site inspections for energy management and consumption.

- Implement demonstration projects which provide a starting point for effective evaluation of new technologies in Jordan.

- Milestones for EEIAC continued development have not been reiterated here from their respective sections.

The Project Team is convinced the future for energy management and the EEIAC in Jordan is bright. There is a lot of work to be done before there will be stability and large measures of conservation payoff but the management perspective is positive and will certainly contribute to the success of this major undertaking.

ATTACHMENTS

ATTACHMENT A.
PUBLICATIONS DELIVERED TO EEIAC BY MERIDIAN CORPORATION FIELD PERSONNEL
8/15/1986

AEE	Energy Management, February 1982.
AIA	Bookstore Catalog, 1986.
ASHRAE	ASHRAE Journal, June 1986.
ASHRAE	ASHRAE Standards 100 and 90.75.
ASHRAE	Publications Catalog, 1986-1987.
ASPE	Plumbing Engineer, June 1986.
Baron, S.	Manual of Energy Saving in Existing Buildings and Plants, Vol.182, 1982.
Business News Publ.,	The HVAC News, June 16, 1986.
California, State of,	California Energy Commission Energy Watch, March 1986.
CAD Systems,	Manufacturers Literature, various.
Conference Announcements, various.	
Conference Book Service,	Books & Journals on Display at 8th World Energy Engineering Congress, Oct.1985.
Constr.Ind.Mfgrs.Assoc.	Energy Conservation Techniques: Walk-Thru Audit Checklist, 1981.
CRC Press,	Physics, Chemistry & Engineering Book Catalog, 1986.
Electric Pwr Res Inst.	Communications Resource Catalog, June 1985.
Electric Pwr Res Inst.	Energy Researcher fact sheets, various, 1982-1986.
Electric Pwr Res Inst.	EPRI Journals, various, 1985-1986.
Electric Pwr Res Inst.	Transferring Technology reports, various, 1983-1986.
Fairchild Pub.	Energy User News, various 1985-1986.
Gas Research Institute	Catalog of Technical Reports Supplement, Sept.1985.
Gas Research Institute	Fact Sheets, various, 1983-1986.
Gas Research Institute	GRID Digest, Fall 1985.
Georgia Power Company	Consumer Tips folders, various, 1986.
Government Institutes, Inc.	Current Books Catalog, Summer 1986.
Info.Svc.Inc.	DIALOG On-Line Information Services, 1986.
IEES/Univ.Georgia	Energy Conservation Book Catalog, 1984.
IEES/Univ.Georgia	Technical Briefs, various, 1983-1985
Institute of Gas Tech.,	Staff Publications, 1984-1985.
International Energy Agcy	Design Tool Survey, May 1985.
McGraw-Hill Pub.,	Engineering News-Record, June 26, 1986.
McGraw-Hill Pub.,	International Construction Week Index, 1985.
Meridian Corporation	Building Energy Analysis Software Catalog, 1985.
Meridian Corporation,	Energy Conservation Bibliography, June 1986.
Meridian Corporation,	Guidebook for Technology Transfer Managers, 1986.
Meridian Corporation,	Wind Energy Briefings, 1986.
PEPCO	How to Reduce Energy Costs in Your Building, Dec.1985.
Product Literature,	Energy Conservation Equipment Manufacturers, various.
Public Utilities Rep.	Public Utillities Fortnightly, March 20, 1986.
Reed Publishing,	Specifying Engineer Magazine, June 1986.
Rhode Island, State of,	Energy Extension Service Plan, 1986-1987.
Rhode Island, State of,	State Energy Conservation Program, 1986-1987.
Sandia Nat'l Lab	Evaluation of International Photovoltaic Projects (Meridian Rep.) June 1986.
Simon & Schuster Publ.,	Coronet International Video & 16mm Film Catalogs, 1986.
Tennessee Valley Authority	Comm. & Ind. Follow-Up Response Study: Factors Impacting on EnerCon Opps, 1984.
Tennessee Valley Authority	Conservation Report 1984.
US Dept of Energy,	Conservation & Renewable Energy Inquiry & Referral Service, various publications, 1986.
US Dept of Energy,	Conservation & Renewables Office, Bldg Energy Retrofit Res.: Multi-Family Sector, 1985.
US Dept of Energy,	Conservation & Renewables Office, DOE State & Local Assistance Programs, 1985.
US Dept of Energy,	Conservation & Renewables Office, Building Energy Performance Standards, 1979.
US Dept of Energy,	CORECT Financing for U.S. Renewable Energy Exports (Meridian Rep.), May 1986.
US Dept of Energy,	CORECT International Data Base for the U.S. Renewable Energy Industry (Meridian Rep.), May
US Dept of Energy,	Energy Information Administration, Annual Report to Congress, 1985.
US Dept of Energy,	Energy Information Administration, Directory of EIA Model Abstracts, 1985.
US Dept of Energy,	Energy Information Administration, Directory of Energy Data Collection Forms, 1985.
US Dept of Energy,	Energy Information Administration, Energy Conservation Indicators, 1983.
US Dept of Energy,	Energy Information Administration, Publications Directory: A User's Guide, 1985.
US Dept of Energy,	Energy Information Administration, Publications/New Releases, 1986.
US Dept of Energy,	Energy Information Administration, Quarterly Tracking System, Home EnerCon, 1978.
US Dept of Energy,	Energy Information Administration, various Fact Sheets, 1986.
US Dept of Energy,	Energy Information Administration, various Information Sheets, 1986.
US Dept of Energy,	Geothermal Technologies Division, Update & Assessment of Geothermal Models, May 1985.
US Dept of Energy,	Office of Scientific & Technical Information, Buildings Energy Conservation Bulletin, 9-30
US Dept of Energy,	Office of Scientific & Technical Information, Energygrams Compilation, 9-30-85.
US Dept of Energy,	State & Local Prog., Practical Publications for Energy Mgmt, March 1980.
US Dept. of Hlth/Hum.Svc.	Low Income Home Energy Assistance Program FY1983.
World Bank,	Catalog of Staff Working Papers, 1985.
World Bank,	New Publications, Spring 1986.
World Bank,	Research News, Winter 1985-1986.
Ziff-Davis Pub.	PC Week, April 22, 1986.

ATTACHMENT B
PUBLICATIONS REQUIREMENTS LISTING

ASHRAE	ASHRAE Energy Conservation Package	ASHRAE, Atlanta GA	01/01/86	30.00
ASHRAE	ASHRAE Handbook, Applications (SI)	ASHRAE, Atlanta GA	01/01/86	80.00
ASHRAE	ASHRAE Handbook, Fundamentals (SI)	ASHRAE, Atlanta GA	01/01/85	80.00
ASHRAE	ASHRAE Handbook, Refrigeration Systems and Applications (SI)	ASHRAE, Atlanta GA	01/01/86	80.00
ASHRAE	ASHRAE Handbook, Systems (SI)	ASHRAE, Atlanta GA	01/01/84	80.00
ASHRAE	ASHRAE Product Specification File	ASHRAE, Atlanta GA	01/01/86	40.00
ASHRAE	Air Quality, Vol 1., No. 1, Order TOB 6	ASHRAE, Atlanta, GA.	01/01/86	16.00
ASHRAE	Energy Performance Analysis & Calculations, Vol. 1, No. 3, Order TOB 18	ASHRAE, Atlanta GA.	01/01/86	25.00
ASHRAE	Hydronic Systems: Variable Speed Pumping and Chiller Optimization, Vol. 1, No. 7, Order TOB 42	ASHRAE, Atlanta GA.	01/01/86	10.00
ASHRAE	Procedure for Determining Heating & Cooling Loads for Computerizing Energy Calculations...	ASHRAE, Atlanta GA	01/01/76	40.00
AmSocPlumbingEngineers	ASPE Data Books, Vol.I & II	ASPE, Sherman Oaks CA	01/01/84	8.00
Anderson,B. & M.Wells	Passive Solar Energy: The Homeowners Guide to Natural Heating & Cooling	BrickHouse, Andover MA	01/01/81	20.00
Baron,Stephen, P.E.	Manual of Energy Savings in Existing Buildings & Plants, Vol.I & II	PrenticeHall,EnglewdClfNJ	01/01/82	100.00
Baumeister, T. et al	Marks' Standard Handbook for Mechanical Engineers	McGrawHill, New York	01/01/82	100.00
Brown,H.,Hamel & Hedman	Energy Analysis of 108 Industrial Processes	Fairmont Press, PA	01/01/85	40.00
Chart.Inst.Bldg.Svcs	CIBS Building Construction Standards (Insulation)	CIBS, London SW, UK	01/01/86	500.00
Constr.Ind.Mfgrs.Assoc.	Energy Conservation Techniques: A Walk-Through Audit Checklist	CIMA, Milwaukee WI	01/01/80	10.00
Development Sciences,Inc.	Hotel Manager's Energy Conservation Manual	DSI, Sagamore MD	01/01/81	10.00
Duvigneau,J.C.&R.N.Prasad	Guidelines for Calculating Financial & Economic Returns for DFC Projects,W.B.Tech.Paper #33	World Bank,Wash.D.C.	01/01/84	10.00
Flavin, C.	Electricity for a Developing World: New Directions	Worldwatch Institute	01/01/86	20.00

ATTACHMENT B
PUBLICATIONS REQUIREMENTS LISTING

Gas Research Institute	No.179,PB84-237791, Procedure to Estimate the Installation Cost of Advanced Energy Recovery Systems	NTIS, Springfield VA	01/06/84	17.00
Gas Research Institute	No.179,PB84-237791, Procedure to Estimate the Installation Cost of Advanced Energy Recovery Systems	NTIS, Springfield VA	01/06/84	17.00
Gas Research Institute	No.23,PB85-156966, Biological Gasification of Renewable Resources (Institute of Gas Technology)	NTIS, Springfield VA	01/11/84	20.00
Gas Research Institute	No.29,PB84-237775,GRI-8410078, Biogasification of Wood (University of Florida)	NTIS, Springfield VA	01/04/84	14.00
Gas Research Institute	No.35,PB84-178409,GRI-8310057, Methiane from Biomass and Waste (University of Florida)	NTIS, Springfield VA	01/12/83	17.00
Gas Research Institute	No.38,PB85-149847, The Effect of Water Quality on Residential Water Heater Life Cycle Efficiency	NTIS, Springfield VA	01/10/84	14.00
Gas Research Institute	No.39, PB85-126316, Research on Heat Exchanger Corrosion (Battelle Columbus Labs)	NTIS, Springfield VA	01/09/84	29.00
Gas Research Institute	No.42,PB85-100931,GRI-84/0080, Phase I Dev of a Kinematic Stirling/Rankine Comm Gas Heat Pump System	NTIS, Springfield VA	01/07/84	14.00
Gas Research Institute	No.52,PB85-100956, Thermal Energy Storage for Commercial Cogeneration Systems	NTIS, Springfield VA	01/03/84	15.50
Gas Research Institute	No.56,PB84-192004, The Development of a High-Efficiency,Gas-Fired, Heat Pipe,Warm-Air Heating System	NTIS(Springfield VA	01/01/84	12.50
Gas Research Institute	No.58,PB84-174713, High-Efficiency Commercial Water Heater Development (Adv.Mech.Tech.Inc.)	NTIS, Springfield VA	01/01/84	14.00
Gas Research Institute	No.65,PB84-198480, Development of Advanced Residential Cooktop Burner with Low NOx Emissions	NTIS, Springfield VA	01/11/83	17.00
Gas Research Institute	No.70,PB84-237726, NaturalGas I.C.Engine Heat Pump Study (Goergia Tech.Research Institute)	NTIS, Springfield VA	01/04/83	15.50
Gas Research Institute	No.75,PB85-101475, Open Cycle Vapor Compression Heat Pump (ThermoElectron Corp.)	NTIS, Springfield VA	01/05/84	14.00

ATTACHMENT B
PUBLICATIONS REQUIREMENTS LISTING

Gas Research Institute	No.80,PB84-207869, High Temperature Metallic Recuperator (Solar Turbines Inc.)	NTIS, Springfield VA	01/12/83	21.50
Gas Research Institute	No.83,PB84-215425, Survey of Flue Gas Condensation Heat Recovery Systems Research (Cotrell Tech.Inc)	NTIS, Springfield VA	01/12/81	38.00
Gas Research Institute	No.84,PB85-135275,GRI-8410206, Air Infiltration and Heat Exchange (Institute of Gas Technology)	NTIS, Springfield VA	01/12/84	14.00
Georgia EnerCon Center	Automatic Boiler Blowdown	Georgia Inst. Tech., Atl.	01/01/86	20.00
Georgia EnerCon Center	Energy Efficiency in Water and Wastewater Treatment Plants	Georgia Inst. Tech., Atl.	01/01/86	10.00
Georgia EnerCon Center	Improving Steam Boiler Operating Efficiency, 202 pg.	Georgia Inst. Tech., Atl.	01/01/81	10.00
Georgia EnerCon Center	Microwave Heating and Drying	Georgia Inst. Tech.,Atl.	01/01/86	20.00
Georgia EnerCon Center	Waste Heat Recovery	Georgia Inst. Tech,Atlant	01/01/86	20.00
Government Institutes,Inc	Energy Audits Manual	Government Institutes,Inc	01/01/86	49.50
Honeywell Corporation	Design Manual for Temperature Control Systems	Honeywell,Minneapolis MN	01/01/85	15.00
Honeywell Corporation	Energy Conservation with Comfort: The Honeywell Energy Conserver's Manual & Workbook, Third Edition	Honeywell,Minneapolis MN	01/01/80	15.00
Hutton Company	Building Products Catalog - International	Hutton, New York	01/01/86	10.00
Johnson, Ralph J.	Traditional Energy Efficient Home Designs	NAHB Research Foundation	01/01/86	30.00
Johnson, T.E.	Solar Architecture: The Direct Gain Approach	McGraw-Hill, New York	01/01/81	40.00
Kern	TBD	TBD	01/01/86	50.00
Kreider,H.F.& Kreith	Solar Energy Handbook	McGraw-Hill, New York	01/01/81	100.00
Merritt, F.S.	Building Design & Construction Handbook, Fourth Edition	McGraw-Hill, New York	01/01/82	100.00
Pita	Air Conditioning	John Wiley Sons,New York	01/01/80	60.00
SolarRating&CertifCorp	Presenttion of Thermal Performance Ratings for Solar Collectors Certified by the SRCC	SRCC, Wash,DC	01/01/81	25.00
TBD	Handbook of Air Conditioning, Heating, and Ventilating	TBD	01/01/86	85.00
TBD	Industrial Energy Conservation Manuals	TBD	01/01/86	22.00

ATTACHMENT B
PUBLICATIONS REQUIREMENTS LISTING

	Manual for Improving Boiler and Furnace Performance	TBD	01/01/86	49.00
[illegible]	Waste Heat Recovery Handbook	TBD	01/01/86	55.00
Tennessee Valley Authorit	Commercial & Industrial Follow Up Response Study: Factors Influencing Implementation of Enercon Opps	TVA, Chatanooga TN	01/01/84	20.00
Trane Company	Trane Air Conditioning Manual	Trane Co.,Lacrosse WI	01/01/79	25.00
Trenschel,D.&P.Goetze	Test Results from Testing & Inspection Program for Solar Equipment (TIPSE)	Calif.EnergyComm,Sac.CA	01/01/81	15.00
Turner, W.C.	Energy Management Handbook	John Wiley Sons, New York	01/01/82	50.00
US Congress, OTA	Residential Energy Conservation, Vol.I	US Congress, OTA, WashDC	01/01/86	20.00
Wade, Alex	A Design & Construction Handbook for Energy Saving Houses	Rodale Press, Emmons PA	01/01/80	30.00
Westinghouse Corporation	Lighting Handbook	Westinghouse,Bloomfield IL	01/01/78	50.00
*** Total ***				2598.50

EEIAC COMPUTER EQUIPMENT
8/12/1986

		Qty	MFR Unit	BUBG Extended	Est Offer
Hardware	Compaq D286/2 30mb drive, 8mhz, 512kb ram 1.2mb floppy, keyboard colour monitor, CGA card	1	7200	7200	5556
Hardware	Ameer Arabic English hardware	1	600	600	600
Hardware	Intel 80287 math chip	2	295	590	527
Hardware	Aa-Bb switch box	1	149	149	149
Hardware	AST Rampage with 256KB	2	695	1390	880
Hardware	HP 7475a plotter	1	1995	1995	1886
Hardware	Starter kits for plotter	1	145	145	145
Hardware	HP LaserJet Plus printer	1	3995	3995	3995
Hardware	Toner cartridges	5	115	575	575
Hardware	HP Arabic Cartridge	1	331	331	331
Hardware	Cables	6	35	210	160
Hardware	Microsoft (bus) mouse	2	195	390	342
Hardware	Modem internal 300/1200	1	395	395	395
Hardware	Polaroid PC slide maker	1	1995	1995	1995
Software	Bulletin board software	1	150	150	134
Software	Crosstalk XVI Vsn 3.6	1	195	195	171
Software	IBM Dos 3.1	1	85	85	85
Software	Energraphics 2.0	1	595	595	522
Software	Freelance	1	595	595	522
Software	Interword Arabic	2	495	990	842
Software	HP LaserControl 100	1	150	150	150
Software	A-T Multimate Advantage Upgrade	1	150	150	131
Software	Norton Utilities	1	100	100	88
Software	ProDesign	1	300	300	263
Software	Microsoft Quick Basic	1	100	100	88
Software	STSC Statgraphics	1	795	795	698
Software	IBM StoryBoard	1	250	250	250
Software	SuperCalc 4	1	495	495	434
	Hardware total			19960	17535
	Software total			4950	4379
	Hardware shipping			1996	1754
	Software shipping			495	438
	Total price, US $			27401	24106

ATTACHMENT D
EEIAC EQUIPMENT REQUIREMENTS LISTING
8/12/1986

CATEGORY	ITEM	MANUFACTURER	QTY	UNIT COST (JD)	TOTAL COST (JD)
Computer	PC-AT	IBM	2	3000	6000
Computer	Software	IBM al	2	1500	3000
Computer	Local Area Network	IBM al	1	1000	1000
Display	Overhead Proj.	TBD	1	200	200
Display	35mm Slide Proj.	Kodak Ektagraphic	1	150	150
Display	Microfiche RDR/PTR	TBD	1	400	400
Display	16mm Movie Proj.	TBD	1	200	200
Display	Portable Display	TBD	1	400	400
Engineering	Light Meter	Westinghouse	2	50	100
Engineering	Watt-Hr Meter	Dranetz	1	300	300
Engineering	Flue Gas Analyzer	Bacharach Instr.	1	170	170
Engineering	Digital Thermometer	Amprobe Instr.	2	350	700
Engineering	Thermal Video System	Hughes	1	5000	5000
Engineering	Ind.Climate.Anal.	Breuel & Kjaer	1	300	300
Engineering	Surface Pyronometer	Omega Eng.	1	400	400
Engineering	Infrared Pyronometer	Mikron Instr.	1	400	400
Engineering	Optical Pyronometer	Pyronometer Instr.	1	400	400
Engineering	Sling Psychrometer	Bacharach Instr.	2	150	300
Engineering	Ammeter	Amprobe Instr.	2	100	200
Engineering	Voltmeter	Amprobe Instr.	2	100	200
Engineering	Air Velocity Meter	Alnor Instr.	1	200	200
Engineering	Solar Site Selector	Lewis & Assoc	2	20	40
Engineering	Draft Gauge	Bacharach Instr.	1	100	100
Engineering	Smoke Tester	Bacharach Instr.	1	40	40
Office	Multi-Line Phone	TBD	3	200	600
Office	Telephone Answering Machine	Sears	1	100	100
Vehicle	Minibus	Chevrolet	1	8000	8000
					28900 JD

ATTACHMENT E.
RECOMMENDED ENERGY ANALYSIS SOFTWARE PURCHASES

Designers Software Exchange

MICROLITE 1.0: Daylighting analysis.

ASEAM: Thermal analysis of buildings & HVAC system evaluation.

SOLPAS: Passive solar design aid.

AESOP: Exterior shade optimization design tool.

Trane Company

LOAD-DESIGN: Detailed (compressed hourly) thermal analysis tool for large buildings.

TRACE ECONOMICS: Detailed economic analysis of building envelope and HVAC design options for large buildings.

University of Wisconsin

TRNSYS: HVAC systems analysis for buildings.

FCHART THERMAL: Solar heating and water heating system design tool using monthly average weather data.

FCHART PV: Photovoltaic energy system design tool using monthly average weather data.

U.S. Department of Energy

DOE2.1/PC VERSION: Detailed hourly building thermal analysis, HVAC system simulation, central plant simulation, and economic analysis tool for large buildings.

ATTACHMENT F.
CONFERENCE MANAGEMENT CHECKLIST

1) Develop theme, date, times, venue.
2) Identify and get initial commitments from sponsors, presenters, exhibitors, and potential attendees.
3) Prepare advance publicity and preliminary schedule.
4) Make travel/hotel/food arrangements.
5) Make initial equipment arrangements (chairs, overhead & slide projectors, etc.) and order long lead time items (posters, brochures, etc.).
6) Follow up sponsors, presenters and exhibitors to verify readiness.
7) Publish final schedule.
8) Initiate full-scale publicity and advertising effort.
9) Gather household supplies (pencils, paper, refreshments, soap, toilet paper, etc.).
10) Prepare and reproduce banners, posters, flyers, brochures, handout sheets/conference proceedings, schedule poster, directional arrows and signs.
11) Gather audio-visual equipment and test their operation (projectors, video cassette players, computers, monitors, extension cords, adapters, etc.).
12) Visitor registration cards and box.
13) Assure that presenters are ready and on time.
14) Make introductions.
15) Greet visitors.
16) Coordinate and relay information on last minute changes.
17) Carry out conference.
18) Write report on lessons learned, update checklist, and record suggestions for next conference.

ATTACHMENT G.
VIP VISIT MANAGEMENT CHECKLIST

1) Arrange formal invitation for VIP (Very Important Person).
2) Identify Ministry/JEA host of suitable rank.
3) Coordinate with host and VIP to establish time, date and duration of visit.
4) Determine size of party.
5) Circulate proposed agenda and detailed timetable for visit.
6) Provide office of VIP with detailed directions and schedule.
7) Prepare overview presentation; adapted to focus on special interests of VIP.
8) Prepare other agenda items and presentations.
9) Rehearse the visit.
10) Verify schedule and remind participants of imminent visit.
11) Clean Center.
12) Revise/update exhibits.
13) Arrange refreshments.
14) Be in place early on day of visit.
15) Write report on lessons learned, update checklist, and record suggestions for next visit.

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ATTACHMENT H.

ENERGY & ELECTRICITY INFORMATION & ADVISORY CENTER
Ministry of Energy & Mineral Resources / Jordan Electricity Authority

COMPUTERS & ENERGY CONSERVATION EXPOSITION

- Personal Computer Demonstrations
- Energy Conservation Exhibits
- Seminars on Energy Conservation & Computer Subjects

TIME	MONDAY 28 JULY	TUESDAY 29 JULY	WEDNESDAY 30 JULY
	GENERAL PUBLIC	PROFESSIONALS	PROFESSIONALS
9:00		OVERVIEW OF EEIAC	OVERVIEW OF EEIAC
9:30		NEED FOR ENERGY CONSERVATION IN JORDAN	NEED FOR ENERGY CONSERVATION IN JORDAN
10:00		ENERGY CONSERVATION IN CENTRAL HEATING PLANTS	WINDOWS
10:30		THERMAL ENERGY STORAGE	SOLAR WATER HEATERS
11:00	OPENING CEREMONY	WASTE HEAT RECOVERY	PERS COMPUTERS, GRAPHICS & ENERGY MANAGEMENT
11:30	OVERVIEW OF EEIAC	PASSIVE SOLAR HEATING AND COOLING	ENERGY EFFICIENT AIR CONDITIONING
12:00	NEED FOR ENERGY CONSERVATION IN JORDAN	LIGHTING	ENERGY LOAD MANAGEMENT
12:30	WINDOWS	COMPUTERIZED ENERGY MANAGEMENT SYSTEMS	STREET LIGHTING
1:00	(LUNCH BREAK)	(LUNCH BREAK)	(LUNCH BREAK)
1:30	(LUNCH BREAK)	(LUNCH BREAK)	(LUNCH BREAK)
2:00	(LUNCH BREAK)	(LUNCH BREAK)	(LUNCH BREAK)
2:30	(LUNCH BREAK)	(LUNCH BREAK)	(LUNCH BREAK)
3:00	HOW TO DO A HOME ENERGY AUDIT	INSULATION	PASSIVE SOLAR HEATING & COOLING
3:30	CHOOSING AMONG ENERGY CONSERVATION ALTERNATIVES	PHOTOVOLTAIC TECH & APPLICATIONS	WASTE HEAT RECOVERY
4:00	LIGHTING	HIGH TEMP SOLAR TECH & APPL	THERMAL ENERGY STORAGE
4:30	SOLAR WATER HEATERS	WIND ENERGY TECH & APPL	LIGHTING
5:00	PASSIVE SOLAR HEATING AND COOLING	STREET LIGHTING	SHARED SAVINGS
5:30	ENERGY USE IN YOUR OWN HOME	ENERGY LOAD MANAGEMENT	INSULATION
6:00	INSULATION	PERS COMPUTERS, GRAPHICS & ENERGY MANAGEMENT	APPLIANCE STANDARDS COMPARATIVE ANALYSIS
6:30	OVERVIEW OF EEIAC	SHARED SAVINGS	COMPUTERIZED ENERGY MANAGEMENT SYSTEMS
7:00	CLOSING	CLOSING	CLOSING

ATTACHMENT I.
OUTLINES FOR EXPO PRESENTATIONS

TOPIC: NEED FOR ENERGY CONSERVATION IN JORDAN
TIME: 20 MIN
TIME/DAY: 7/28/86-12:00 7/29/86-9:30 7/30/86-9:30
PERSON: ENG. SUHAIL KIWAN

OUTLINE:
- PAST TRENDS
- PRESENT TRENDS
- FUTURE TRENDS WITH AND WITHOUT ENERGY CONSERVATION
- SECTORAL BREAKDOWN OF ENERGY CONSUMPTION
- NEED FOR AND BENEFITS OF ENERGY CONSERVATION
    - NATIONAL GOALS
    - BALANCE OF TRADE
    - DEVELOPMENT OF NEW INDUSTRY (EMPLOYMENT OPPORTUNITIES)
    - SAVINGS FOR CONSUMER
    - BUSINESS OPPORTUNITIES FOR LOCAL BUSINESSES
- GENERAL PUBLIC EDUCATION

TOPIC: OVERVIEW OF EEIAC
TIME: 30 MIN
TIME/DAY: 7/28/86-11:30 7/29/86-9:00 7/30/86-9:00
PERSON: ENGR. ADEL ABBASI

OUTLINE:
- WHY WAS THE CENTER STARTED?
- HOW OLD IS IT?
- NUMBER OF INQUIRIES TO DATE?
- OBJECTIVES AND GOALS OF CENTER?
- WHAT CAN THE CENTER DO FOR YOU?
- FUTURE PLANS?
- PROCEDURES TO REQUEST ASSISTANCE FROM CENTER
    - CONTACT CENTER
        - PHONE
        - WALK IN TO CENTER
        - LETTERS/POSTCARDS
    - INFORMATION REQUEST
        - CENTER CALLS CUSTOMER TO DISCUSS INTEREST
    - ENERGY AUDIT
        - CENTER CALLS CUSTOMER FOR APPOINTMENT
        - AUDITOR PERFORMS AUDIT
            - DESCRIBE AUDIT PROCEDURE (BRIEF)
        - FIELD DATA TAKEN TO OFFICE AND ENTERED INTO COMPUTER PROGRAM
        - COMPUTER REPORT GENERATED AND MAILED TO CUSTOMER
        - CUSTOMER CONTACTED WITHIN 3 WEEKS TO DISCUSS AUDIT RESULTS AND PROCEDURES FOR IMPLEMENTATION

TOPIC: WASTE HEAT RECOVERY
TIME: 20 MIN
DAY/TIME: 7/29/86-11:00 7/30/86-3:30
PERSON: ENG. HANI NOFAL

OUTLINE:
- CONCEPTS AND PRINCIPALS
- APPLICATIONS
  - RESTAURANTS
  - HOTELS
  - HOSPITALS
  - COMMERCIAL BUILDINGS
- SYSTEM DESIGN AND SAVINGS POTENTIAL
  - HEAT EXCHANGER (AIR-TO-AIR, WATER-TO- WATER, WATER-TO-AIR)
- DESIGN EXPERTISE AT CENTER

TOPIC: THERMAL ENERGY STORAGE
TIME: 30 MIN
DAY/TIME: 7/29/86-10:30 7/30/86-4:00
PERSON: ENG. CLINTON ANDREWS

OUTLINE:
- DEFINITION AND CONCEPTS
- HEAT STORAGE VS. COOL STORAGE
- HEAT STORAGE MEDIA
- COOL STORAGE MEDIA
- BENEFITS
  - LOAD SHIFTING
  - DEMAND REDUCTION
- STORAGE SYSTEM DESIGNS

TOPIC: ENERGY CONSERVATION IN CENTRAL HEATING PLANTS
TIME: 30 MIN
DAY/TIME: 7/29/86-10:00
PERSON: ENG. ROBERT RUSSO

OUTLINE:
INDUSTRIAL PROCESS VS. SPACE HEAT
- TEMPERATURES AND PRESSURES
-TYPES OF COMMERCIAL AND INDUSTRIAL BOILERS
- DISTRIBUTION SYSTEM/COMPONENTS
  -ONE-PIPE, TWO-PIPE, ETC.
- CONSERVATION MEASURES
  - BOILER/FURNACE
  - DISTRIBUTION SYSTEM
- CENTER'S ACTIVITIES

TOPIC: STREET LIGHTING
TIME: 15 MINUTES
DAY/TIME: 7/29/86-5:00 7/30/86-12:30
PERSON: ENG. RISHNAWI

OUTLINE:
- TYPES
- PRESENT ENERGY DEMAND
- CONSERVATION OPPORTUNITIES
  - PHOTOCELLS/TIMERS
  - PV/BATTERY SYSTEMS
- POTENTIAL SAVINGS

TOPIC: WINDOWS
TIME: 15 MIN
DAY/TIME: 7/28/86-12:30
PERSON: ENG. SUHAIL KIWAN

OUTLINE:
- HEAT LOSS/GAIN THROUGH WINDOWS VS. REST OF HOUSE
- TYPES OF WINDOWS
- ADVANTAGES/DISADVANTAGES OF EACH
- RELATIVE COSTS VS. SAVINGS
- CENTER'S INVOLVEMENT AND EXPERTISE

TOPIC: WINDOWS
TIME: 20 MIN
DAY/TIME: 7/30/86-10:00
PERSON: ENG. SUHAIL KIWAN

OUTLINE:
- HEAT LOSS/GAIN THROUGH WINDOWS
  - CALCULATION OF U-VALUES
- TYPES OF WINDOWS
- ADVANTAGES/DISADVANTAGES OF EACH
- THERMAL PERFORMANCE CHARACTERISTICS OF EACH
- INSTALLATION PROBLEMS AND TECHNIQUES OF EACH
- CENTER'S INVOLVEMENT AND EXPERTISE

TOPIC: STANDARDS - COMPARATIVE ANALYSIS
TIME: 15 MIN
DAY/TIME: 7/30/86-6:00
PERSON: ENG. ADEL ABBASI

OUTLINE:
- STANDARDS-WHAT ARE THEY?
- WHY ENERGY PERFORMANCE STANDARDS?
- NEED FOR ENERGY PERFORMANCE STANDARDS IN JORDAN
  - HOUSEHOLD APPLIANCES
  - LARGE EQUIPMENT (AC, BOILERS, AUTOS, ETC.)
- REVIEW OF EXISTING STANDARDS
- BENEFITS
  - COMPARISON SHOPPING
  - CHEAPEST LIFE-CYCLE COST
  - ENERGY SAVINGS TO END USER

TOPIC: INSULATION
TIME: 20 MIN
DAY/TIME: 7/29/86-3:00 7/30/86-5:30
PERSON: ENG. FAISAL ABU ALLAN

OUTLINE:
- PURPOSE OF INSULATION
- DEFINITION OF R/U VALUE
- TYPES OF INSULATION
  -ADVANTAGES/DISADVANTAGES OF EACH
- INSTALLATION PROCEDURES
- WHERE TO GET MATERIALS
- CENTER'S ACTIVITIES

TOPIC: INSULATION
TIME: 15 MIN
DAY/TIME: 7/28/86-6:00
PERSON: ENG FAISAL ABU ALLAN

OUTLINE:
- PURPOSE OF INSULATION
- PLACES TO BE INSULATED
- CAULKING
- WEATHERSTRIPPING
- WHERE TO BUY INSULATING MATERIALS
- CENTER'S ACTIVITIES

TOPIC: SOLAR WATER HEATERS
TIME: 30 MIN
DAY/TIME: 7/30/86-10:30
PERSON: DR. MOHAMMAD AMR

OUTLINE:
- TYPES OF SYSTEMS
- OPERATING CONCEPTS
- APPLICATIONS
  - POOL
  - HOT WATER
- SYSTEM COMPONENTS
- SIZING METHODOLOGIES
  - COMPUTER PROGRAMS
  - MANUAL METHODS
- SERVICES AVAILABLE AT CENTER

TOPIC: SOLAR WATER HEATERS
TIME: 15 MIN
DAY/TIME: 7/28/86-4:30
PERSON: DR. MOHAMMAD AMR

OUTLINE:
- INTRODUCTION TO SOLAR ENERGY
- APPLICATION OF SOLAR TO WATER HEATING
- OPERATING CONCEPTS
- SYSTEM COSTS AND SAVINGS
- CENTER'S ACTIVITIES

TOPIC: ENERGY EFFICIENT AIR CONDITIONING
TIME: 30 MIN
DAY/TIME: 7/30/86-11:30
PERSON: ENG. CLINTON ANDREWS

OUTLINE:
- PURPOSE OF AC
- TYPES OF SYSTEMS AND COMPONENTS
  - VAPOR COMPRESSION
  - ABSORPTION
- GROWTH OF AC IN JORDAN AND EFFECT ON JEA CAPACITY
  - NEW CONSTRUCTION WITH AC
  - ESTIMATE OF ADDITIONAL JEA POWER REQUIRED TO RUN AC
- NEED FOR ENERGY EFFICIENT AC
- REDUCE JEA CAPACITY EXPANSION REQUIREMENTS
- REDUCE ENERGY AND DEMAND CHARGES FOR CUSTOMERS
- DEFINITION OF EER
- NEED FOR HIGH EER EQUIPMENT

TOPIC: LIGHTING
TIME: 20 MIN
DAY/TIME: 7/29/86-12:30 7/30/86-5:00
PERSON: ENG. ADEL ABBASI

OUTLINE:
- TYPES OF LIGHTING
- TYPES OF CONTROLS
- LIGHTING CONTRIBUTION TO TOTAL BUILDING LOAD
- TYPES AND BENEFITS OF LIGHTING ECOS
  - RELAMPING
  - DELAMPING
  - CONTROLS
- TYPICAL PAYBACKS

TOPIC: LIGHTING
TIME:15 MIN
DAY/TIME: 7/28/86-4:00
PERSON: ENG. ADEL ABBASI

OUTLINE:
- TYPES OF LIGHTING
- TYPICAL LIGHTING TYPES IN JORDAN
- ENERGY REQUIREMENTS OF LIGHTS IN COMPARISON TO TOTAL BUILDING LOADS
- BENEFITS OF RELAMPING/DELAMPING/CONTROLS
  - ENERGY/COST SAVINGS
  - REDUCTION IN HEAT GENERATION
- RECOMMENDATIONS FOR NEW LIGHTS
- CENTER'S INVOLVEMENT

TOPIC: PASSIVE SOLAR HEATING/COOLING
TIME: 20 MIN
DAY/TIME: 7/28/86-5:00
PERSON: ENG. MAHER HIJAZEN

OUTLINE:
- WHAT IS IT?
- HEATING
  - HOW DOES IT WORK
  - TYPES OF SYSTEMS
  - APPLICATIONS
  - ENERGY SAVINGS
- COOLING
  - HOW DOES IT WORK
  - TYPES OF SYSTEMS
  - APPLICATIONS
  - ENERGY SAVINGS
- CENTER'S INVOLVEMENT

TOPIC: PASSIVE SOLAR HEATING/COOLING
TIME: 30 MIN
DAY/TIME: 7/29/86-11:30 7/30/86-3:00
PERSON: ENG. MAHER HIJAZEN

OUTLINE:
- WHAT IS IT?
- HEATING VS. COOLING SYSTEMS
  - SYSTEM COMPONENTS
  - OPERATION
  - REQUIRED MATERIALS
- SYSTEM BENEFITS
- ADVANTAGES/DISADVANTAGES OF EACH SYSTEM
- CENTER'S ACTIVITIES

TOPIC: ENERGY LOAD MANAGEMENT
TIME: 30 MIN
DAY/TIME: 7/29/86-5:30 7/30/86-12:00
PERSON: FAWZI KHARBAT

OUTLINE: OBTAIN FROM KHARBAT

TOPIC: PERSONAL COMPUTERS/GRAPHICS AND ENERGY MANAGEMENT
TIME: 30 MIN
DAY/TIME: 7/29/86-6:00 7/30/86-11:00
PERSON: DR. KENNETH HAMILTON

OUTLINE:
- INTRO TO PERSONAL COMPUTER/GRAPHICS
- USE OF PERSONAL COMPUTERS/GRAPHICS FOR ENERGY MANAGEMENT
- ENERGY ACCOUNTING
- ENERGY ANALYSIS
- UP-TO-THE-MINUTE STATUS OF BUILDING PERFORMANCE

TOPIC: COMPUTERIZED ENERGY MANAGEMENT SYSTEMS
TIME: 15 MIN
DAY/TIME: 7/29/86-12:00 7/30/86-6:30
PERSON: ENGR. CLINTON ANDREWS

OUTLINE:
- PURPOSE OF EMS
- TYPES OF SYSTEMS
  - SIMPLE CONTROLLERS
  - LARGE EMS
- TYPES OF FUNCTIONS
  - UP-TO-THE-MINUTE BUILDING STATUS
  - HISTORICAL RECORDS
  - CENTRALIZED POINT OF BUILDING/PLANT OPERATION
  - CONTROL/MONITOR PROCESSES, LIGHTING, HVAC, ETC...
- BENEFITS
  - COST EFFECTIVENESS
  - SAVE ENERGY/DEMAND
  - ENERGY OPTIMIZATION

TOPIC: SHARED SAVINGS
TIME: 20 MIN
DAY/TIME: 7/29/86-6:30 7/30/86-4:30
PERSON: ENGR. ROBERT RUSSO

OUTLINE:
- CONCEPT
- PARTICIPANTS
  - BUILDING OWNER/OPERATOR
  - EQUIPMENT OWNER/INSTALLER
  - INVESTOR/THIRDPARTY
- SHARED VS. GUARANTEED SAVINGS
- BASELINE CALCULATIONS
- BENEFITS
- CONTENTS OF SHARED SAVINGS CONTRACT

TOPIC: PRIORITIZING ENERGY INVESTMENT
TIME: 15 MIN
DAY/TIME: 7/29/86- 7/30/86-
PERSON: ENGR. CLINTON ANDREWS

OUTLINE:
- PURPOSE OF ENERGY CONSERVATION OPPORTUNITY
- DETERMINE BENEFITS
  - SIMPLE PAYBACK
  - DISCOUNTED PAYBACK
- PRIORITIZE BASED ON LIFE-CYCLE COST/PAYBACK
- DETERMINE INVESTMENT PRIORITIES

TOPIC: PRIORITIZING ENERGY INVESTMENT OPPORTUNITIES
TIME: 15 MIN
DAY/TIME: 7/29/86- 7/30/86-
PERSON: ENGR. CLINTON ANDREWS

OUTLINE:
- PURPOSE OF ENERGY CONSERVATION OPPORTUNITIES
- DETERMINING WHICH ARE BEST
    - PAYBACK
    - LIFE-CYCLE COST

TOPIC: HOW TO DO A HOME ENERGY AUDIT
TIME: 30 MIN
DAY/TIME: 7/28/86-
PERSON: ENGR. ROBERT RUSSO

OUTLINE:
- WHAT IS A HOME ENERGY AUDIT?
- HOW IS IT PERFORMED
    - EQUIPMENT NEEDED
    - DATA COLLECTED
    - RESULTS (PRIORITIZED)
- ENERGY SAVINGS OPPORTUNITIES ANALYZED
    - CLOCK THERMOSTAT
    - INSULATION
        - ENVELOPE
        - WATER TANK
        - PIPE
    - CAULKING
    - WEATHERSTRIPPING
    - STORM DOORS/WINDOWS
    - HEATING/COOLING SYSTEM MODIFICATIONS/ ADJUSTMENTS
    - PASSIVE SOLAR MEASURES

ATTACHMENT J

STORYBOARD DEMONSTRATION

Effective use of graphics is important in development of EEIAC capabilities in presentation of their story to many audiences of varying degrees of understanding and technical background. To this end, the Consultant Team used several IBM personal computer graphics packages which are commercially available. These included SuperCalc 4, EnerGraphics 2.0, GraphLink, and the IBM StoryBoard package.

With only introductory training, the EEIAC staff was able very quickly to begin preparing presentations for the Personal Computers and Energy Conservation Expo. Even custom graphics for special purposes such as a world map with the USAID logo for a VIP presentation were skillfully prepared by the Center engineers.

This attachment includes printouts of one of the less complex presentations prepared for the EXPO.

HOW TO DO A HOME "ENERGY AUDIT"

PURPOSE

DETERMINE HOW ENERGY IS BEING USED IN *YOUR HOME*

RESULT

** DEVELOP ENERGY CONSERVATION PROGRAM

** PRIORITIZED MEASURE

REQUIRMENTS :-

* STRUCTURAL CHARACTERISTICS
* NUMBER OF PEOPLE/OCCUPANCY PATTERNS
* APPLIANCES
* HEATING/COOKING FUEL
* INSULATION LEVELS
* WINDOWS/DOORS
* FURNACE EFFICIENCY

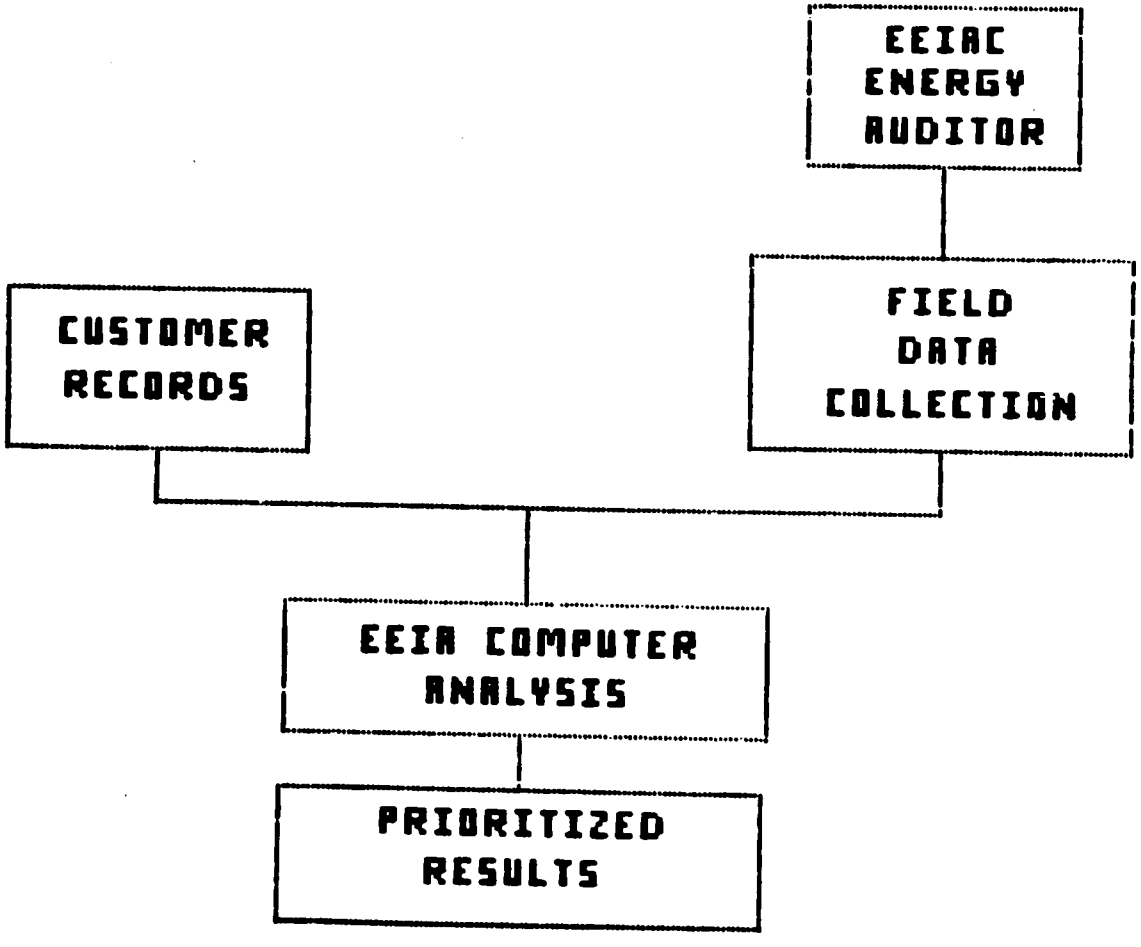
TOOLS

* FURNACE EFFICIENCY TESTER
* DRAFT GAGE
* TAPE MEASURE
* COMPASS

POTENTIAL CONSERVATION MEASURES

* CLOCK THERMOSTAT
* WATER TANK INSULATION
* FLUE VENT DAMPER
* CEILING INSULATION
* WALL INSULATION
* FLOOR INSULATION
* CAULKING
* WEATHER STRIPPING
* PIPE/DUCT INSULATION
* STORM WINDOWS
* THERMAL WINDOWS
* STORM DOORS
* ACTIVE & PASSIVE SOLAR

STEPS IN THE ENERGY AUDIT



ATTACHMENT K.
ENERGY AUDIT METHODOLOGY

FORM LETTER TO REQUEST INFORMATION
NECESSARY FOR ENERGY AUDIT

Ministry of Energy and Mineral Resources
Energy and Electricity Information
Advisory Center
P.O. Box 140027
Amman, Jordan

August 7, 1986

ADDRESS

Subject: EEIAC Energy Audit

Dear XXXX:

Thank you for your interest in the Energy and Electricity Information and Advisory Center's (EEIAC) commercial energy audit program. The Ministry of Energy and Mineral Resources (MEMR) recently established the EEIAC to promote energy awareness within public and private agencies. Part of the Center's responsibility is to assist commercial buildings in establishing effective and comprehensive energy management programs.

As I'm sure you're aware, energy costs are continually escalating, placing a greater burden on your building's operating budget. One way to minimize these increasing energy costs is to undertake a comprehensive energy management program. Such a program, as the term implies, is a systematic, ongoing strategy for controlling a building's fuel consumption patterns in such a manner as to reduce the waste of energy and money to the absolute minimum permitted by the local climate and building condition, including age, occupancy patterns and comfort requirements.

Energy auditing is the first and most important step in the development of a comprehensive energy management program. It is a feasibility study which begins with a detailed step-by-step analysis of the building's energy-use factors and costs, such as insulation values, occupancy schedules, boiler efficiencies, lighting levels, equipment types and operating schedules, and historical energy consumption patterns. The energy audit includes an overview of how energy is currently being consumed in the building and the identification of specific conservation opportunities, along with cost-benefit analyses, for reducing current consumption. It will provide you with a thorough and detailed

basis for deciding how to conserve energy and money in your building. The energy audit generally involves these steps:

1) Select team members, consisting of energy auditors and building personnel.

2) Perform preliminary walk-through of building to familiarize team with the building.

3) Obtain historical fuel consumption records (for at least one year) and building blueprints, including schedules of all equipment.

4) Analyze historical energy use patterns and building blue prints.

5) Develop statistical correlations of energy consumption with other site variables.

6) Perform second walk-through audit to obtain missing data required for detailed analyses.

7) Develop list of applicable Energy Conservation Opportunities (ECOs).

8) Perform cost-benefit analyses of ECOs.

9) Prioritize ECOs in order of payback.

10) Make explicit recommendations in a report.

11) Explain report to client.

12) Follow up on report at a later date to evaluate degree of implementation of recommended ECOs.

In order to ensure that the energy audit performed on your building is as comprehensive as possible, we ask that you have the following information available before an EEIAC energy engineer comes to your building: 1) gas, oil/diesel, water and electricity bills for the past year (two years if possible); 2) equipment schedules, and mechanical, electrical and architectural drawings for the building. Once you have obtained all of the required information please contact EEIAC at 678457/8 to set up an appointment with one of our engineers.

Sincerely,

ATTACHMENT L.
EEIAC RESIDENTIAL ENERGY AUDIT

EEIAC NO:
AUDITOR :
ACCOUNT NO:
DATE PREPARED:

SAMPLE AUDIT REPORT
DR. ALI ANANI

THIS REPORT IS DIVIDED INTO FIVE SECTIONS, EACH WITH A SPECIFIC PURPOSE.

SECTION I -SUMMARY OF AUDIT RECOMMENDATIONS

- OVERVIEW OF RECOMMENDED ENERGY CONSERVATION AND RENEWABLE RESOURCE MEASURES, INCLUDING FIRST YEAR JD SAVING AND THE COST OF INSTALLING THE MEASURE.

SECTION II-ENERGY CONSERVATION PRACTICES

- LOW COST,NO COST ACTIONS WHICH YOU CAN TAKE TO REDUCE ENERGY.

SECTION III- SPECIFIC RECOMMENDATIONS

- DETAILED EXPLANATIONS OF THE INSTALLATION OF RECOMMENDED ENERGY CONSERVATION AND RENEWABLE RESOURCE MEASURES.

SECTION IV- RESIDENTIAL PROFILE AND BASIS FOR ESTIMATE.

- ASSUMPTIONS AND INFORMATION USED IN PROCESSING THIS AUDIT.

SECTION V- OPERATING COST SUMMARY

- THE COST OF HEATING AND COOLING YOUR HOME.

EEI/C RESIDENTIAL ENERGY AUDIT
SECTION I
SUMMARY OF AUDIT RECOMMENDATIONS.

LISTED BELOW ARE RECOMMENDED ENERGY CONSERVATION AND RENEWABLE RESOURCE MEASURES FOR YOUR HOME, INCLUDING THE SAVINGS WHICH CAN BE REALIZED AND THE APPROXIMATE COSTS OF INSTALLING THE MEASURES. THE SAVING AND COST FIGURES ARE BASED ON ASSUMPTIONS FROM RESIDENTIAL ENERGY AUDITS PERFORMED IN WASHINGTON, DC, USA.

THESE RECOMMENDATIONS ARE LISTED IN ORDER OF PAYBACK . THE RECOMMENDATION WITH THE QUICKEST PAYBACK IS LISTED FIRST. PAYBACK CALCULATIONS ARE BASED ON ESTIMATED ANNUAL SAVINGS, ANNUAL MAINTENANCE AND CONTRACTOR INSTALLED COSTS EXCEPT FOR WEATHERSTRIPPING, CAULKING AND WATER THANK INSULATION. PAYBACK CALCULATIONS FOR THESE MEASURES ARE BASED ON ESTIMATED SAVINGS AND DO-IT-YOURSELF COSTS.

RECOMMEND MEASURE	FIRST YEAR OPERATING SAVING	INSTALLATION COST	
		CONTRACTOR RANGE	DO-IT-YOURSELF RANGE
CAULKING	JD 3 TO 5	JD 15 TO 20	JD 5 TO 7
FLUE VENT DAMPER	JD 10 TO 20	JD 50 TO 75	NOT SUITED
CLOCK THERMOSTAT	JD 8 TO 15	JD 50 TO 75	JD 40 TO 60
WEATHER-STRIPPING	JD 1 TO 3	JD 45 TO 60	JD 15 TO 25
STORM/THERMAL DOORS.	JD 4 TO 7	JD180 TO 220	JD120 TO 160

FOR SPECIFICS ON THESE RECOMMENDATIONS, SEE SECTION III OF THIS AUDIT REPORT.

SOME OF THESE MEASURES REQUIRE ANNUAL MAINTENANCE COSTS IN ORDER TO KEEP THE MEASURE EFFICIENT AND EFFECTIVE. SECTION III OF THIS REPORT LISTS ESTIMATED ANNUAL MAINTENANCE COSTS FOR APPROPRIATE MEASURES.

ENERGY SAVINGS CRITERIA

IT MUST BE REMEMBERED THAT THE TOTAL ENERGY COST SAVINGS FROM THE INSTALLATION OF MORE THAN ONE PROGRAM MEASURE MAY BE LESS THAN THE SUM OF EVERY COST SAVINGS IF EACH MEASURE WAS INSTALLED INDIVIDUALLY. THE ACTUAL INSTALLATION COSTS YOU INCUR AND ENERGY SAVINGS YOU REALIZE FROM INSTALLING THESE MEASURES MAY BE DIFFERENT FROM THE ESTIMATES CONTAINED IN THIS AUDIT REPORT. ALTHOUGH THESE ESTIMATES ARE BASED ON MEASUREMENTS OF YOUR HOUSE, THEY ARE BASED ON ASSUMPTIONS WHICH MAY NOT BE TOTALLY CORRECT FOR YOUR HOUSEHOLD.

EEIAC RESIDENTIAL ENERGY AUDIT
SECTION I
SUMMARY OF AUDIT RECOMMENDATIONS

THE FOLLOWING MEASURES WERE EVALUATED DURING YOUR AUDIT AND WERE FOUND TO MEET RECOMMENDED STANDARDS, WERE NOT APPLICABLE, OR THE ANNUAL ESTIMATED SAVINGS ARE LESS THAN JD 1.000

PIPE INSULATION
DUCT INSULATION
REPLACE OIL BURNER UNIT
ENLARGE WINDOW AREA
SOLAR POOL HEATER
SOLAR AIR PANELS
WATER WALL - SOLAR
TROMBE WALL - SOLAR
GREENHOUSE - SUNSPACE
THERMOSTAT SETTING
FLOOR INSULATION
WALL INSULATION
CEILING INSULATION
WATER TANK INSULATION
REPLACE HEATING SYSTEM
STORM WINDOWS

EEIAC RESIDENTIAL ENERGY AUDIT
SECTION II
ENERGY CONSERVATION PRACTICES

THE FOLLOWING ACTIONS YOU CAN TAKE HAVE LITTLE OR NO COST AND YET CAN BE MOST EFFECTIVE IN REDUCING YOUR ENERGY USE. THE ITEMS THAT ARE LISTED BELOW ARE APPLICABLE TO YOUR HOME. IT IS RECOMMENDED THAT THESE PRACTICES BE IMPLEMENTED BEFORE THE INSTALLATION OF ANY ENERGY CONSERVATION OR RENEWABLE RESOURCE MEASURE.

1. GAS AND OIL FURNACES NEED TUNE-UPS TO RUN EFFICIENTLY. A PROFESSIONAL SHOULD CLEAN AND PERFORM COMBUSTION EFFICIENCY ADJUSTMENTS AT LEAST ONCE A HEATING SEASON.

2. LOWER THE THERMOSTAT SETTING IN THE HEATING SEASON TO 18 DEGREES CENTIGRADE.

3. LOWER THE THERMOSTAT SETTING FOR THE FURNACE IN THE HEATING SEASON TO A MAXIMUM OF 13 DEGREES CENTIGRADE DURING SLEEPING HOURS. AVERAGE SAVINGS ARE 1% PER DEGREE SETBACK PER 8 HOUR PERIOD. A CLOCK THERMOSTAT CAN SET BACK AUTOMATICALLY.

4. CONTROL THE FLOW OF WATER IN YOUR SHOWER HEADS AND FAUCETS BY USING EITHER FLOW CONTROLLERS OR BY REPLACING EXISTING SHOWER HEADS AND FAUCETS WITH FLOW CONTROLLING DEVICES.

5. REDUCE THE WATER HEATER THERMOSTAT SETTING TO 50 DEGREES AND USE COOLER WATER FOR CLOTHES WASHING. (NOTE - MOST DISHWASHERS REQUIRE 60 DEGREE WATER, UNLESS THE UNIT HAS A HOT WATER BOOSTER.)

6. IN WINTER, WHENEVER YOUR HOME IS EMPTY FOR FOUR OR MORE HOURS , TURN THE THERMOSTAT DOWN TO 13 DEGREES.

7. PLUG GAPS AROUND PIPES, DUCTS, FANS OR OTHER ITEMS WHICH ENTER YOUR ATTIC OR BASEMENT WITH INSULATION SCRAPS. ONLY FIREPROOF INSULATION BAN BE USED AROUND CHIMNEY AND FLUE PIPES.

8. USE AWNING, SHADES OR DRAPES TO:
   A. BLOCK THE SUNLIGHT FROM ENTERING YOUR HOME IN THE COOLING SEASON,
   B. ALLOW THE SUNLIGHT TO ENTER YOUR HOME DURING THE WINTER HEATING SEASON, AND
   C. COVER YOUR WINDOWS AT NIGHT DURING THE HEATING SEASON.

EEIAC RESIDENTIAL ENERGY AUDIT
SECTION III
SPECIFIC RECOMMENDATIONS

THIS SECTION EXPLAINS IN MORE DETAIL THE MEASURES SUMMARIZED IN SECTION I. EACH MEASURE INCLUDES APPLICATION GUIDELINES, ESTIMATED MAINTENANCE COSTS AND YEARS PAYBACK.

THE RECOMMENDED MEASURES ARE DIVIDED INTO FIVE MAJOR SECTIONS: THERMAL ENVELOPE MEASURES; HEATING AND COOLING SYSTEM MEASURES; ACTIVE SOLAR MEASURES; PASSIVE SOLAR MEASURES; AND SPECIFIC AUDITOR COMMENTS. ALL SECTION MAY NOT BE LISTED SINCE YOUR HOUSE MAY NOT HAVE RECOMMENDATIONS IN EVERY AREA.

********** THERMAL ENVELOPE MEASURES **********

THE FOLLOWING RECOMMENDATIONS EXPLAIN IN MORE DETAIL THE THERMAL ENVELOPE MEASURES SUMMARIZED IN SECTION I. SOME RECOMMENDATIONS MAY INCLUDE INSTALLING INSULATION. THE EFFECTIVENESS OF ALL INSULATION APPLICATIONS DEPENDS PRIMARILY ON THE TYPE AND AMOUNT OF INSULATING MATERIAL USED. THE TERM COMMONLY USED TO MEASURE THIS EFFECTIVENESS IS R-VALUE. THE HIGHER THE R-VALUE, THE GREATER THE RESISTANCE TO HEAT FLOW AND THE BETTER THE INSULATING VALUE. TWO DIFFERENT INSULATING PRODUCTS WITH THE SAME R-VALUE WILL PROVIDE THE SAME INSULATING VALUE, DESPITE THEIR DIFFERENT THICKNESS, CHARACTERISTICS OR PRICES.

MEASURE	RECOMMENDATION
*******	**********
STORM DOORS	INSTALLATION OF TIGHT FITTING STORM DOORS WILL REDUCE HEATING COSTS IN WINTER AND COOLING COSTS IN THE SUMMER.

- INSTEAD OF A STORM DOOR, YOU CAN CONSIDER AN INSULATED THERMAL DOOR AS A REPLACEMENT FOR AN EXISTING DOOR WHICH IS WARPED, CRACKED OR DOES NOT FIT PROPERLY.

- ESTIMATED ANNUAL MAINTENANCE COSTS: JD 0

- YEARS PAYBACK : OVER TWENTY YEARS.

MEASURE	RECOMMENDATION
*******	**********
CAULKING	INSTALL A FLEXIBLE, DURABLE COMPOUND ON ALL SURFACES LISTED BELOW.

- CAULKING SHOULD BE APPLIED WHEREVER TWO DIFFERENT OUTSIDE PARTS OF YOUR HOME MEET, WHENEVER DIFFERENT MATERIALS JOIN

AND WHENEVER THERE ARE CRACKS AND HOLES. THESE AREAS INCLUDE AROUND WINDOWS AND DOORS, WHERE FOUNDATION MEETS SIDING, WHERE CHIMNEY MEETS SIDING, AND WHERE PIPES OR WIRES ENTER THE HOME.

- EVEN IF YOU HAVE CAULKED IN RECENT YEARS, YOU MUST REINSPECT PERIODICALLY, BECAUSE CAULKING WEARS OUT AND LOSES ITS EFFECTIVENESS.

- ESTIMATED ANNUAL MAINTENANCE COSTS: JD 0

- YEAR PAYBACK: ONE TO TWO YEARS (DO-IT-YOURSELF)

MEASURE	RECOMMENDATION
*******	**********
WEATHERSTRIPPING	INSTALL WEATHERSTRIPPING TO SEAL AIR LEAKS AROUND MOVABLE JOINTS OF WINDOWS AND DOORS.

- WEATHERSTRIPPING SHOULD BE PLACED AROUND ALL SLIDING GLASS DOORS, WINDOWS AND DOOR THRESHHOLDS. DO NOT NEGLECT ACCESS DOORS TO UNHEATED BASEMENTS AND ATTICS, AND BASEMENT WINDOWS. ALSO, DO NOT FORGET ATTACHED GARAGE DOORS, BECAUSE AN ATTACHED GARAGE PROVIDES A BUFFER BETWEEN YOUR HOME AND THE OUTSIDE.

- ESTIMATED ANNUAL MAINTENANCE COSTS: JD 0

- YEARS PAYBACK: SEVEN TO TWELVE YEARS (DO-IT-YOURSELF)

********** HEATING AND COOLING SYSTEM MEASURES **********

INEFFICIENT HEATING AND COOLING SYSTEMS USE MORE FUEL THAN THEY SHOULD, COSTING MORE IN ENERGY BILLS. THE MEASURES LISTED BELOW CAN INCREASE THE OVERALL EFFICIENCY OF YOUR HEATING OR COOLING SYSTEM. ADDITIONALLY, EEIAC RECOMMENDS THAT YOU HAVE YOUR SYSTEMS SERVICED REGULARLY.

MEASURE	RECOMMENDATION
*******	**********
CLOCK THERMOSTAT	REMOVE THE EXISTING THERMOSTAT AND INSTALL SINGLE SET BACK HEATING AND COOLING CLOCK THERMOSTAT

- ONE OF THE SIMPLEST WAYS TO REDUCE HEATING AND COOLING BILLS

IS TO LOWER THE THERMOSTAT IN THE WINTER AND RAISE IT IN THE SUMMER. THIS IS ESPECIALLY IMPORTANT WHEN NO IS AT HOME AND AT NIGHT. ADJUSTMENTS CAN BE MADE BY HAND OR A CLOCK THERMOSTAT TO CHANGE TEMPERATURES.

- THE SAVINGS LISTED IN THE SUMMARY REPORT FOR THE CLOCK THERMOSTAT ASSUMES YOUR EXISTING THERMOSTAT IS CONSTANTLY SET AT 20 DEGREES IN THE WINTER AND 26 DEGREES IN THE SUMMER.

- ESTIMATED ANNUAL MAINTENANCE COSTS: JD 0

- YEARS PAYBACK: FIVE TO SEVEN YEARS.

MEASURE	RECOMMENDATION
*******	**********
FLUE VENT DAMPER	INSTALL A FLUE VENT MODIFICATION VENT DAMPER ON YOUR GAS HEATING SYSTEM.

- ESTIMATED ANNUAL MAINTENANCE COSTS: JD 2

- YEARS PAYBACK: THREE TO FIVE YEARS.

********** ACTIVE SOLAR ENERGY MEASURES **********

ACTIVE SOLAR SYSTEMS USE HARDWARE AND MECHANICAL EQUIPMENT TO COLLECT, STORE AND CIRCULATE THE HEAT GAINED FROM THE SUN FOR USE IN YOUR HOUSE. SOLAR RADIATION IS FIRST ABSORBED BY A COLLECTOR, PLACED INTO A STORAGE UNIT AND THEN DISTRIBUTED TO THE POINT OF USE. THE PERFORMANCE OF EACH OPERATION IS MAINTAINED BY AUTOMATIC OR MANUAL CONTROLS.

DURING THE AUDIT OF YOUR HOME, THE AUDITOR HAS DONE A PRELIMINARY ANALYSIS AND HAS DETERMINED THAT THERE IS NO POTENTIAL FOR USING SOLAR ENERGY TO HEAT YOUR HOT WATER OR PROVIDE SPACE HEATING.

EEIAC RESIDENTIAL ENERGY AUDIT
SECTION IV
RESIDENTIAL PROFILE AND BASIS FOR ESTIMATE

IN ESTIMATING SAVINGS AND COSTS OF VARIOUS IMPROVEMENTS, A NUMBER OF CALCULATIONS WERE MADE. THE RESULTING FIGURES ARE BASED ON AVERAGE COSTS FOR MATERIAL,LABOR AND ENERGY AT THE TIME THE AUDIT WAS MADE. EEIAC CANNOT GUARANTEE THESE SAVINGS AND COST PROJECTIONS AND WILL ASSUME NO LIABILITY FOR DISCREPANCIES IN ESTIMATES VERSUS ACTUAL FIGURES.

THE GENERAL INFORMATION WITH RESPECT TO THE SPACE HEATING AND AIR CONDITIONING SYSTEMS IS AS FOLLOWS:

1. THE HEATING CALCULATIONS HAVE BEEN BASED ON A NORMAL HEATING SEASON FOR THE WASHINGTON D.C. (USA) AREA OF 4,200 HEATING DEGREE DAYS (FAHRENHEIT).

2. SPACE HEATING SYSTEM EFFICIENCIES ARE ASSUMED TO BE TYPICAL (75%).

FOLLOWING IS A LISTING OF CHARACTERISTICS OF YOUR HOME AS DETERMINED BY OUR AUDITOR. THIS DATA HAS BEEN USED IN SUGGESTING IMPROVEMENTS AND ESTIMATING COSTS AND SAVINGS.

1. GENERAL DATA
   - A. LOCALE: AMMAN
   - B. DATE BUILT: 1980-1985
   - C. STYLE: MULTIFAMILY
   - D. BASEMENT: NONE
   - E. SIZE OF LIVING AREA: 180 SQ. M.
   - F. CEILING HEIGHT: 2.4 METERS
   - G. CAULKING CONDITION: LARGE CRACKS/GAPS
   - H. WEATHERSTRIPPING CONDITION: POOR
   - I. SOUTH WALL ORIENTATION: 0 TO 15 DEGREES FROM SOUTH

2. DOMESTIC WATER CONSUMPTION
   - A. ENERGY USED: DIESEL
   - B. NUMBER OF UNITS: 1
   - C. SUMMER/WINTER HOOK UP: YES
   - D. STORAGE: 175 LITERS

3. SPACE HEATING SYSTEM
   - A. ENERGY USED: DIESEL
   - B. TYPE: HYDRONIC
   - C. DATE INSTALLED: 1980-1985
   - D. NUMBER OF UNITS: 1
   - E. STEADY STATE EFFICIENCY: 75%

4. AIR CONDITIONING SYSTEM
   - A. TYPE: NONE

EEIAC RESIDENTIAL ENERGY AUDIT
SECTION IV
RESIDENTIAL PROFILE AND BASIS FOR ESTIMATE

5. STRUCTURAL CHARACTERISTICS

	TYPE	R VALUE OR STORM PROTECTION	AREA SQ. M.
A.	DOORS (METAL)	NO	9.8
B.	WINDOWS		
	SLIDING GLASS (METAL)	NO	8.4
	CASEMENT (METAL)	NO	0.5
C.	WALLS (SOLID MASONRY)	0.0	104.00
D.	CEILINGS		
	NONE		
E.	FLOORS		
	NONE		

EEIAC RESIDENTIAL ENERGY AUDIT PROGRAM
SECTION V
OPERATING COST SUMMARY

ANNUAL HEATING AND COOLING COSTS:

ACTUAL SPACE HEATING COST: JD 286
ACTUAL SPACE COOLING COST: JD 0

HASHEMITE KINGDOM OF JORDAN
MINISTRY OF ENERGY AND MINERAL RESOURCES
and
JORDAN ELECTRICITY AUTHORITY

JORDAN ENERGY AND ELECTRICITY INFORMATION AND ADVISORY CENTER

ATTACHMENT M
ENERGY AUDIT REPORT FOR HOLIDAY INN, AMMAN, JORDAN
AUGUST 1986

U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT
Amman, Jordan
Project 278-0260
Indefinite Quantity Contract
OTR-0000-I-00-3505-00
Work Order No. 3

Prepared by

Kenneth L. Hamilton
Clinton J. Andrews
Robert V. Russo

MERIDIAN CORPORATION
5113 Leesburg Pike, Suite 700
Falls Church, Virginia 22041 USA
(703) 998-0922
TELEX 469248

ENERGY AUDIT REPORT
FOR
HOLIDAY INN
AMMAN, JORDAN

AUGUST 1986

Submitted by

ENERGY AND ELECTRICITY INFORMATION
AND ADVISORY CENTER
[Ministry of Energy and Mineral Resources
and
Jordan Electricity Authority]
Box 2310, Amman, Jordan
(962-6)-678458/7
TELEX 23270

and

MERIDIAN CORPORATION
5113 Leesburg Pike, Suite 700
Falls Church, Virginia 22041 USA
(703) 998-0922
TELEX 469248

Meridian Corporation

In Reply Refer to:

MCC-402-86-TA
October 29, 1986

Mr. Ramzi Nozzal
Director of Operations
Holiday Inn
Amman, Jordan

Subject: Results of EEIAC Training Energy Audit

Dear Mr. Nozzal:

Enclosed you will find an energy audit report detailing the findings of our study of Holiday Inn Amman.

During this audit, we have attempted to provide a thorough analysis of Holiday Inn energy consumption systems and patterns. However, the major reason for the audit was training for Ministry of Energy and Mineral Resources and EEIAC staff members. This required us to proceed more slowly and thus analyze only a few energy conservation opportunities (ECOs). As a result, we were not able to make our normal detailed analysis. EEIAC energy engineers are now sufficiently familiar with the energy auditing process and are able to provide further assistance at your request.

We believe that the EEIAC engineering staff has done an excellent job in analyzing a number of ECOs available for the hotel. Implementing these measures will result in significant energy and money savings.

I would like to thank you and your staff for your cooperation and hospitality during our site visits. If you have any questions about the results of your audit, engineers at EEIAC will be happy to help. The Center's phone numbers are 678457 or 678458.

Sincerely,

MERIDIAN CORPORATION

Robert W. Russo
Senior Engineer

cc: William Riley, USAID, Amman, Jordan
Ali Anani, MEMR
Adel Abbasi, EEIAC

5113 Leesburg Pike • Suite 700 • Falls Church, Virginia 22041 • (703) 998-0922 • Telex 469248

ar

PROPRIETARY INFORMATION RELEASE

FIGURES WHICH MAY BE VIEWED AS SENSITIVE BY THE MANAGEMENT AT THE HOLIDAY INN HAVE BEEN DELETED FROM THIS REPORT. A COPY OF THE REPORT WHICH INCLUDES THE DELETED INFORMATION CAN BE OBTAINED DIRECTLY FROM HOLIDAY INN, AMMAN, JORDAN.

EXECUTIVE SUMMARY

During the period of August 3-14, 1986 the Energy and Electricity Information Advisory Center (EEIAC) and Meridian Corporation (MC), an energy management firm from the United States working in Jordan under the auspices of the US Agency for International Development (USAID), performed an energy audit on the Holiday Inn of Amman, Jordan. The audit was part of an "on-the-job" energy conservation training exercise for energy engineers at EEIAC.

Time constraints permitted the audit team to analyze only ten energy conservation measures in detail, six of which appear to be cost-effective: (1) install flue vent dampers, (2) insulate boilers, (3) replace guest room air conditioning units, (4) relamp with more efficient lamps, (5) install window weatherstripping, and (6) install window shading. Energy savings from these measures are detailed in the report and are summarized in the table below:

MEASURE	SAVINGS FROM MEASURE (JD/YR)	PAYBACK PERIOD (MONTHS)
Boiler Insulation	67	< 1
Flue Vent Dampers	420	4 - 5
Relamping (old/new)		
Incandescent/ Fluorescent (26mm)	2,556	4 - 6
Fluorescent/ Fluorescent (26mm)	105	9 - 10
Incandescent/ Fluorescent (PL)	11,256	11 - 13
Incandescent/ Fluorescent (SL)	8,990	14 - 16
Replace Room Air Conditioners	15,900	60 - 70
Variable:		
Window Shading	34/room	20 - 24
Window Weatherstripping	19/room	22 - 26

The estimates of savings above are not independent. The total savings will be somewhat less than the sum of the individual measures' savings.

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TABLE OF CONTENTS

TABLE OF EXHIBITS

1 INTRODUCTION

Energy costs consume a significant portion of a building owner's operating budget. One way to minimize these energy costs and provide the building owner with a "larger" operating budget is to undertake a comprehensive energy management program. Such a program, as the term implies, is a systematic, on-going strategy for controlling a building's fuel consumption patterns in such a manner as to reduce the waste of energy and money to the absolute minimum permitted by the local climate and building conditions, e.g., age, occupancy patterns and comfort requirements.

The importance of an organized and on-going energy management program, with clearly defined goals and spheres of responsibility, cannot be overemphasized. It is only through such a programmatic approach to energy conservation, as opposed to a once-over-lightly analysis of a building's energy use patterns, that the full potential of energy conservation can be realized. Such a program involves the participation of trained energy auditors as well as the following key building personnel; owner/manager, chief engineer, and chief accountant.

Energy auditing is the first and most important step in the development of a comprehensive energy management program. It is a feasibility study which begins with a detailed step-by-step analysis of the building's energy-use factors and costs, such as insulation values, occupancy schedules, boiler efficiencies, lighting levels, equipment types and operating schedules, and historical energy consumption patterns. The energy audit includes an overview of how energy is currently being consumed in the building and the identification of specific conservation opportunities, along with cost-benefit analyses, for reducing current consumption. It will provide the building owner/operator with a thorough and detailed basis for deciding which measures to implement and the magnitude of savings to be expected.

The energy audit generally involves these steps:

1) Select team members, consisting of energy auditors and building personnel.

2) Perform preliminary walk-through of building to familiarize team with the building.

3) Obtain historical fuel consumption records (for at least one year) and building blueprints, including schedules of all equipment.

4) Analyze historical energy use patterns and building blue prints.

5) Develop statistical correlations of energy consumption with other site variables.

6) Perform second walk-through audit to obtain missing data required for detailed analyses.

7) Develop list of applicable Energy Conservation Opportunities (ECOs).

8) Perform cost-benefit analyses of ECOs.

9) Prioritize ECOs in order of payback.

10) Make explicit recommendations in a report.

11) Explain report to client.

12) Follow up on report at a later date to evaluate degree of implementation of recommended ECOs.

The Ministry of Energy and Mineral Resources (MEMR) and the Jordan Electricity Authority have recently established the Energy and Electricity Information and Advisory Center (EEIAC) to promote energy awareness within public and private agencies. Part of the Center's responsibility is to assist commercial buildings in establishing effective and comprehensive energy management programs. These energy management skills are being developed by energy engineers at EEIAC as part of a contract between MEMR, the U.S. Agency for International Development and Meridian Corporation, a U.S. energy management firm located in Falls Church, VA.

As part of this technical training program, the Holiday Inn in Amman was chosen as the commercial building on which to perform a EEIAC staff training audit. This report details the results and recommendations of the Meridian/EEIAC energy audit. The report is divided into five sections; 1) Introduction, 2) Description of Existing Conditions, 3) Audit Methodology, 4) Description of Recommended ECOs, and 5) Results and Conclusions.

Significant time constraints permitted only a limited number of ECOs be analyzed. The measures that were analyzed are presented in Section 4.

2. DESCRIPTION OF EXISTING CONDITIONS

The Holiday Inn consists of 216 guest rooms, a night club, restaurants, offices, shops and a large lobby area. Total occupancy during 1985 amounted to 43067 guests, or an average of 118 per day. This represents an average annual occupancy rate during 1985 of approximately 46 per cent (41 per cent during the winter and 52 per cent during the summer). The average daily number of employees at the hotel is 200.

The building's air conditioning system consists of 7 packaged units serving the top floor and 14 split systems serving the ground floor and mezzanine. The top floor consists of a night club, meeting rooms, a kitchen and the royal suite. Guest rooms are cooled by individual 10,000 BTUH units, 216 in all. The building's heating system consists of two 2,678,000 BTUH diesel fired boilers, one of which is operated in a stand-by mode. These boilers provide space heating to the the ground floor, mezzanine and top floor of the hotel via forced air. The boilers also provide hot water for domestic use in the guest rooms, and kitchen and laundry operations. This requires that one of the boilers be run at part load during the summer months to meet the hot water load. Space heating in the guests rooms is by electric resistance coils located in each AC unit, rated at 15 amps. Lighting in the hotel consists of two basic types; incandescent and fluorescent. The guest rooms contain 240 watts of incandescent lighting, while the hallways, lobby, offices, shops, etc. contain the fluorescent type.

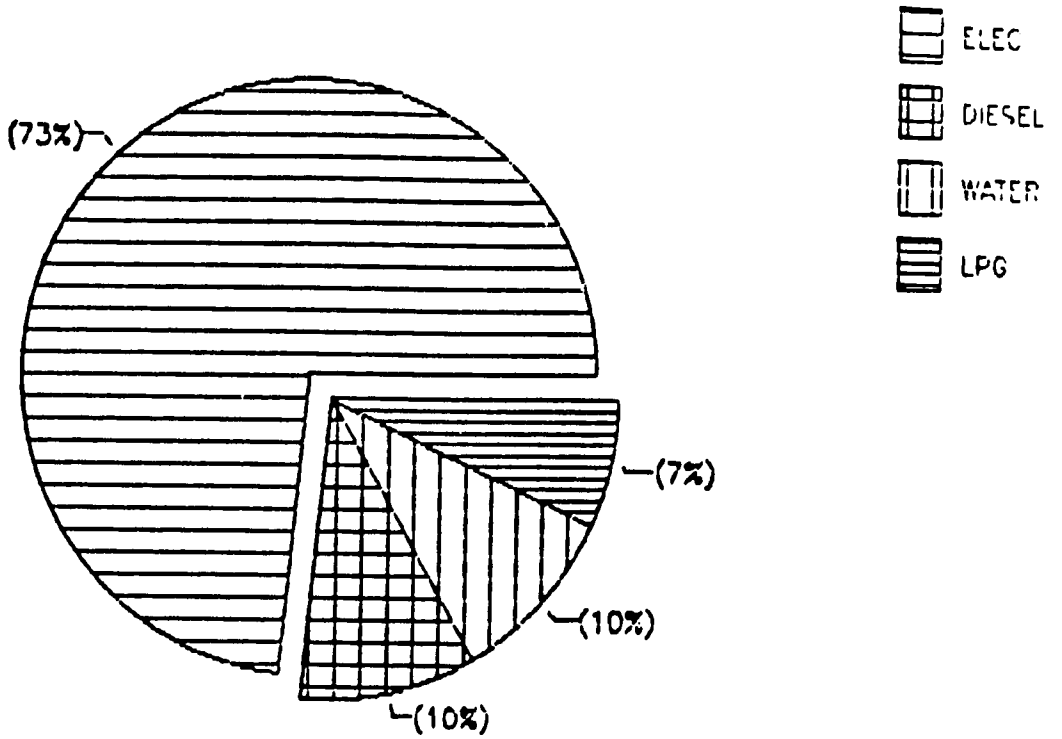
Appendix A provides an equipment inventory as determined from blue prints, the building survey and information provided by the building's chief engineer, Mr. Mario Carasco. The equipment inventory is separated by functional categories; i.e., air handler units, lighting, heating, etc. For each category, estimated operational loads and energy consumption requirements were determined from available data. The following pages summarize the results of these analyses.

ENERGY PERFORMANCE

For the twelve months ending in December 1985, the Holiday Inn spent over JD 108,000 on utilities, including electricity, water, diesel fuel and LPG. As shown in Exhibit 1, electricity consumption during 1985 accounted for over 70 per cent of the hotel's annual utility bill, or 1,702,230 kWh. Diesel fuel and water consumption were the second two largest components, amounting to a combined 20 per cent of the annual utility bill. This translates to 163,836 liters of diesel fuel and 2.03×10^7 liters of water consumed during 1985. LPG accounted for only 7 per cent of the annual utility bill, or 47,839 kg.

EXHIBIT 1

COST OF UTILITIES 1985



ANNUAL ENERGY COST JD

Since electricity consumption is by far the hotel's largest component of annual utility expenses, it is important to understand were the electricity is being used. Exhibit 2 represents the historical electrical energy consumption data obtained from the hotel's Chief Accountant Mr. Al-Hussein. The information shows the total monthly consumption for all of 1985 and part of 1986. As shown, there is a significant rise in electricity consumption during the summer months, most probably resulting from increased air conditioning loads. If we analyze electricity consumption even further (Exhibit 3) we can see that 20 per cent goes to building lighting, 29 per cent for air conditioning, 27 per cent for space heating, 3 per cent for exhaust fans, 2 per cent for air handler and ventilation units, and 19 per cent for miscellaneous items such as kitchen equipment, laundry equipment, elevators, televisions, computers, etc.

Along with understanding where electric energy is being used within a particular building, it is helpful to understand how a building is performing with respect to similar buildings. This is most commonly done by looking at the building's energy utilization index (EUI) or electric energy consumption per unit area per year. For the Holiday Inn the EUI has been determined to be 98 kWh/sq m-yr. EUIs for similar buildings in the United States range from 220-3000 kWh/sq m-yr. No direct comparison between these numbers can be made, since the United States has different climatic data and building construction techniques. Also similar hotels in the United States have much higher air conditioning loads than the Amman Holiday Inn, significantly increasing the EUI. However, the low EUI determined for the Holiday Inn indicates the the building is operated fairly well, but there is still room for improving its energy consumption characteristics, as detailed in this report.

Similar to electricity consumption, it is important to know how diesel fuel is being consumed in order to make effective energy conservation recommendations. Exhibit 4 details were the 163,386 liters of diesel fuel consumed in 1985 went; 9 per cent for heating water for use in the kitchen, 14 per cent for heating water for use in the laundry, 72 per cent for space heating in the mezzanine and ground floor, and 5 per cent for heating water for use in guest rooms.

In a hotel there are many different factors which can affect energy consumption. The most obvious is the number of guests. However, climate and the number of employees can also affect energy consumption. The Holiday Inn has, on the average, a larger number of employees per day than guests. Hence it is important to draw some conclusions, based on statistical analysis of all data, as to what affects energy consumption the most. If the number of employees "drives" energy consumption, then the most cost-effective energy conservation program will be low cost/no cost employee education and incentive programs. However, if the number of guests "drives" energy consumption, then the most comprehensive and effective energy management program will require some capital expenditure, since hotel guests cannot be asked to modify their behavior on behalf of the hotel's conservation efforts. If we eliminate weather effects on annual electricity consumption by normalizing to the severity of the heating and cooling seasons, we can see whether the number of

EXHIBIT 2

HISTORICAL ELECTRIC ENERGY CONSUMPTION

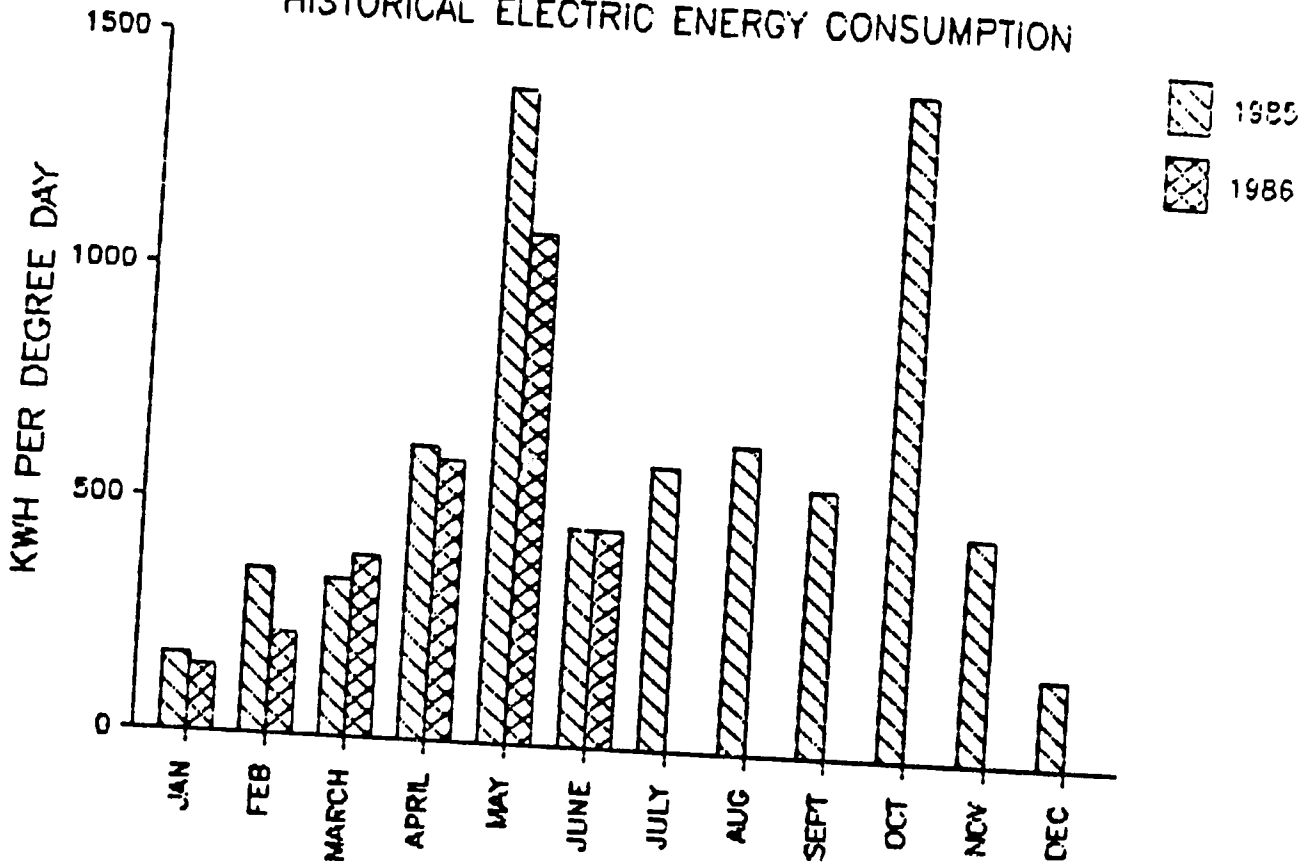
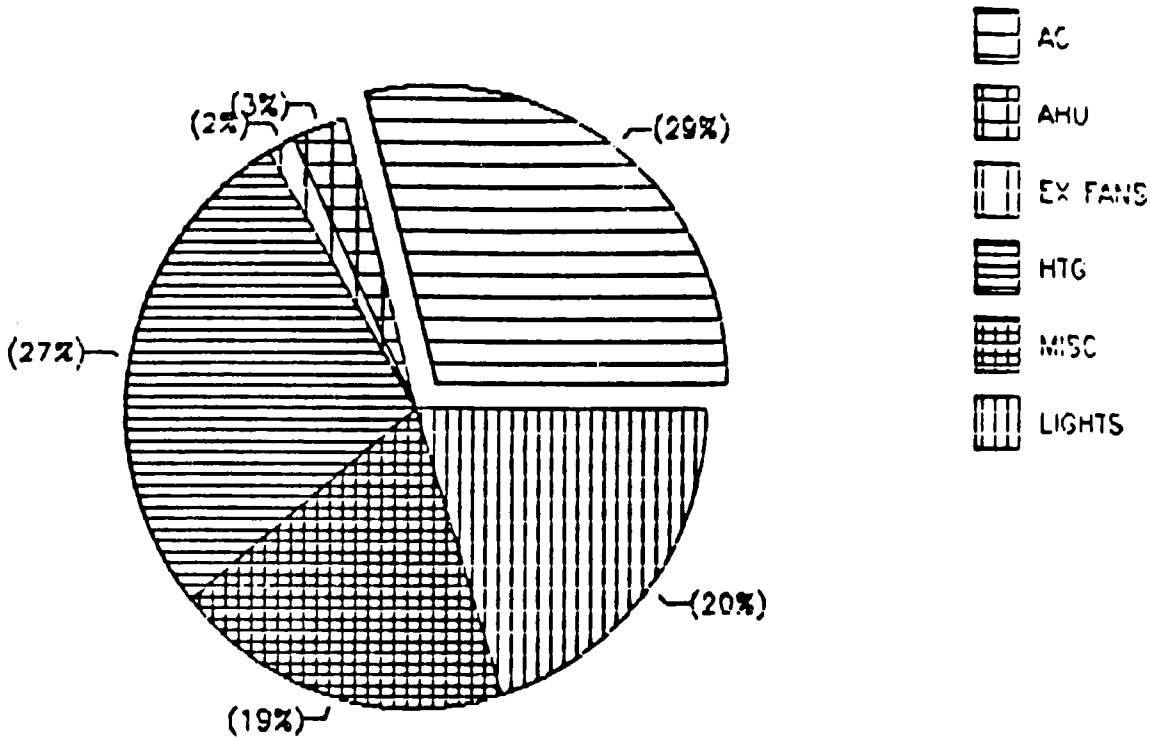


EXHIBIT 3

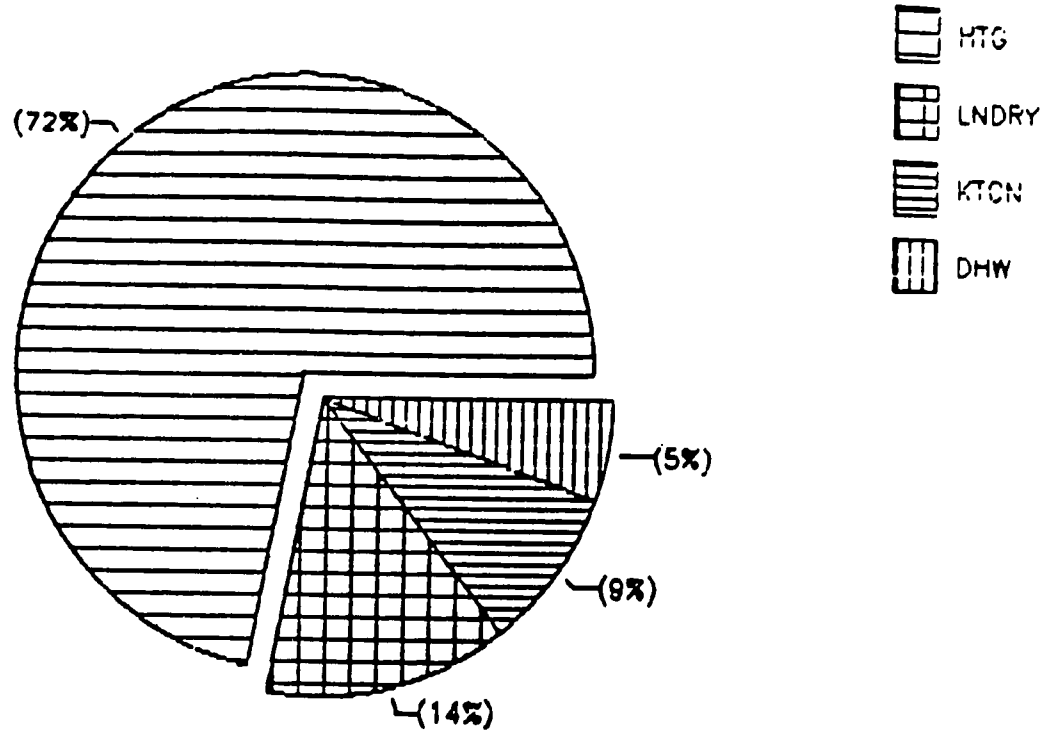
ELECTRICITY CONSUMPTION



ANNUAL ELECTRICITY CONSUMPTION KWH

EXHIBIT 4

DIESEL FUEL CONSUMPTION



ANNUAL DIESEL CONSUMPTION LITERS

guests affects electrical energy consumption more than the number of employees. This is done in Exhibits 5 and 6, which plot kWh per degree day (the normalized electricity consumption per month) against the number of guest-days and employee-days per month respectively. As seen, there is a fairly strong linear relationship between electricity consumption and number of guests, as might be expected. Surprisingly, Exhibit 6 indicates that the employees do not contribute much to the hotel's energy consumption, indicating a very strong employee awareness of energy conservation.

EXHIBIT 5

ENERGY CONSUMPTION VS GUEST-DAYS

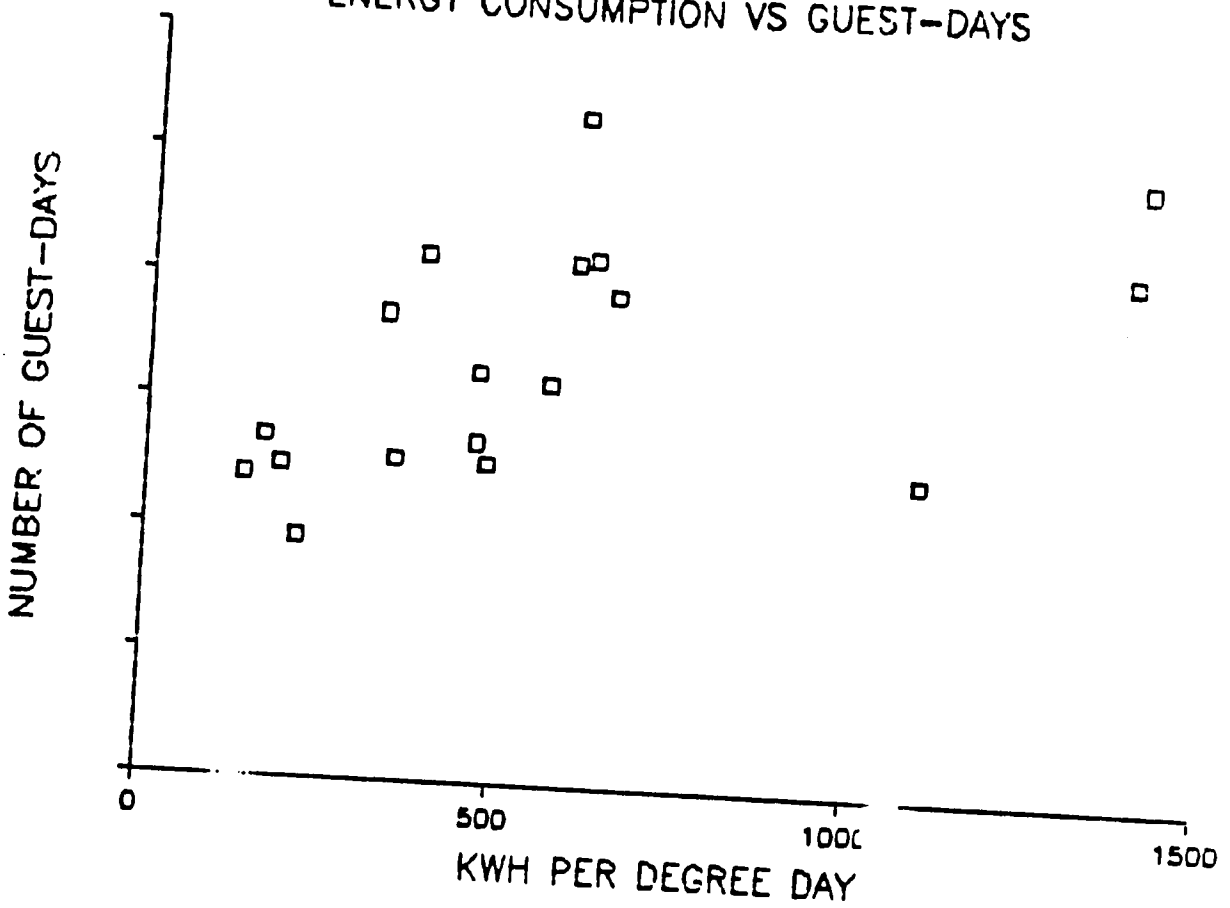
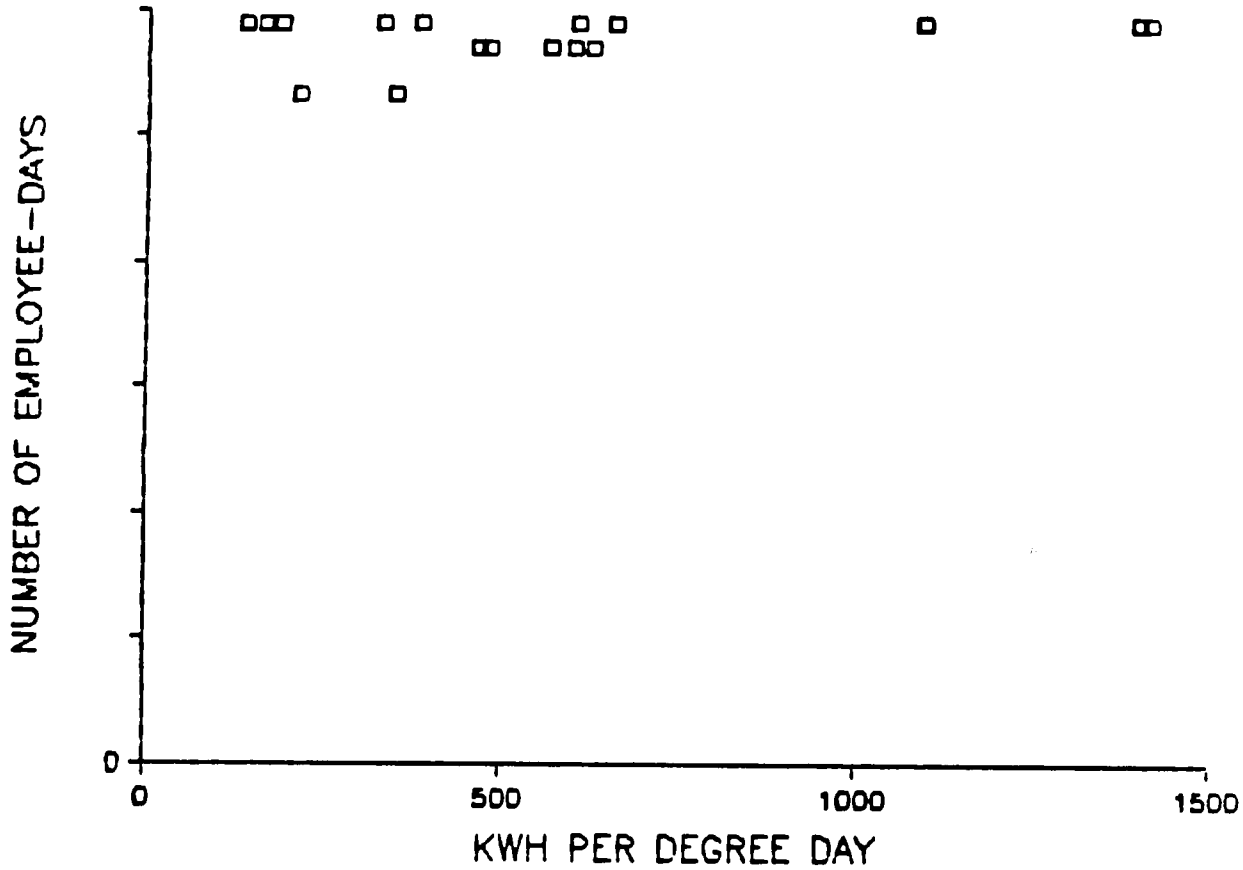


EXHIBIT 6

ENERGY CONSUMPTION VS EMPLOYEE-DAYS



3. AUDIT METHODOLOGY

The audit methodology outlined in the Introduction allowed the audit team to efficiently identify potential ECOs. Those measures which were identified by the audit team during the preliminary building analysis phase (preliminary energy conservation opportunities or PECOs) are listed below:

- solar domestic hot water
- vent damper for boiler exhaust
- aerators/flow controllers in faucets and showers
- boiler insulation
- replacement of room AC units with heat pumps
- relamping with energy efficient lamps
- reduce lighting levels
- using economizer cycle for air conditioning
- install conventional water heater instead of operating boiler at part load during summer
- weatherstrip windows
- window shading devices
- heat recovery systems
- boiler tune-up
- roof insulation
- room motion sensors for AC and lighting control
- automatic shut-off faucets in kitchen
- computerized energy management system
- power factor controllers

The second phase of the data collection and analysis procedure concentrated on eliminating those ECOs with minimal savings or long payback periods, or which are not applicable at the Holiday Inn. Those which were eliminated are listed below:

Solar Domestic Hot Water systems are attractive water heating alternatives in Jordan. However, they are often impractical for large applications because of the large area needed for collectors. If a solar system was to be installed at the Holiday Inn it would require extensive ground or roof area to mount the collectors - more than available at the Holiday Inn. Although solar systems can make economic sense if sufficient area exists for the collectors, it will not be analyzed in this report because of the lack of available space at the Holiday Inn.

Delamping: Lighting level measurements taken in both the office and guest areas at the facility showed that minimum recommended lighting levels have already been achieved. Further reductions might affect the safety and comfort of both guests and employees.

Economizer Cycles use cool outside air when available to meet a building's air conditioning load. Unfortunately, the large number of small air handler units, which introduce fresh air into the building, makes the payback period for an automatically controlled economizer cycle well over 50 years. Hence they are not analyzed in detail in this report.

Installing Conventional Water Heater: Running the boiler at part load during the summer to heat water is very inefficient. Adding a separate boiler for domestic water heating makes more efficient use of available boiler capacity. However, the large water heater required to meet the hotel's domestic hot water needs would be too expensive to make economic sense. Hence this measure is not considered in detail in this report.

Heat Recovery: Heat recovery systems were analyzed with respect to boiler exhaust, laundry room exhaust and kitchen exhaust. All applications were found to have exhaust temperatures too low to consider the application of waste heat recovery systems.

Boiler Tune-up: Efficiency tests taken on the hotel's primary boiler indicates a combustion efficiency of 86%. This efficiency is very good, indicating that the boilers are well maintained. Hence, no boiler tune-up is recommended.

The following measures were identified by the audit team as having good application at the hotel. However, time did not allow for sufficient data collection and analysis to make any recommendations for these measures. These measures should be analyzed in more detail in the future.

- aerators/flow controllers
- roof insulation
- motion sensors in guest rooms for cooling/heating and lighting
- automatic shut off faucets in kitchen
- computerized energy management system
- power factor controllers

The following ECOs are analyzed in detail in the next section:

- flue vent damper
- boiler insulation
- replace room AC units with heat pumps
- relamping
- weatherstrip windows
- window shading

Appendix B contains detailed information on these and other ECOs applicable to commercial buildings in Jordan.

4. DESCRIPTION OF RECOMMENDED ECOs

This section contains detailed information on each of the recommended options. The information includes an explanation of the recommended option, its energy savings and probable payback. Appendix C contains details on the calculation logic for each of the measures.

A) FLUE VENT DAMPER

The existing hotel boilers have an open exhaust leading directly to the outdoors. When the boiler is cycled off this open exhaust serves as an energy "hole", exhausting conditioned air from the basement to the outdoors. This requires the boiler to cycle often to make up for this lost heat. Installing a vent damper in the open flue will prevent this loss of heated air and increase the seasonal efficiency of the boiler. Energy savings resulting from the installation of a flue vent damper is estimated to be 6,383 liters of diesel fuel per year, with a resultant payback of 4-5 months.

B) BOILER INSULATION

The existing boiler is not insulated. Significant thermal losses are occurring through the walls of the boiler. It is not practical to insulate the entire boiler because of piping, controls and the burner. However, the back side of the boiler can be insulated with no problem. The audit team recommends installing 1.77 sq. m. of 25 cm thick rockwool insulation on the back side of each boiler. This will save approximately 67 JD per year and have a payback of less than 1 month.

C) REPLACE ROOM AC UNITS WITH HEAT PUMPS

The air conditioning units located in the guest rooms are very inefficient. Their energy efficiency ratio (EER), a measure of air conditioning efficiency, was determined to be 5.73. This compares poorly with similar units of the same size having average EERs of 7.0 (the higher the EER the more efficient the air conditioning unit). Many manufacturers of small room air conditioning units are claiming EERs of 9.0 and higher. Hence, the units located in the guest rooms are very inefficient. These same units provide for space heating in the winter by electric resistance coils. This is the most inefficient way to heat. Hence, it appears that significant amounts of energy can be saved by replacing these heating/cooling units with more efficient systems.

A heat pump is a mechanical/electrical device that uses a standard refrigeration cycle to provide both heating and cooling. In the summer it acts like a conventional air conditioner. In the winter it serves to increase the temperature of the outside air, through a reverse refrigeration cycle, to provide space heating. Heat pumps are very efficient air conditioning systems, having EERs above 9.0. During the winter they are very efficient heating systems, providing 270% more heat than electric resistance coils for the same energy input. This high heating and cooling efficiency makes them very attractive to the Holiday Inn. Replacing all of the room units with 1 ton heat pumps will save approximately 15,900 JD per year and have a payback of 5.4 years.

D) RELAMPING

Relamping is the process of replacing inefficient lamps with new, more efficient lamps that produce the same amount of light output.

With fluorescent lamps, this means replacing existing 38mm tubes with new 26mm diameter tubes. The payback for replacing the existing fluorescent lamps at the Holiday Inn is estimated to be 9.5 months, for a savings of 105 JD per year.

For incandescent lamps, there are a variety of alternatives:

First, incandescents could be replaced by 26mm diameter fluorescent tubes. This option requires changing the existing fixtures. The costs provided in Appendix C include the costs of tubes, ballasts, starters, and ordinary (new) fluorescent fixtures. The total savings in this case would be approximately 2,556 jd per year and the payback period would be five months.

Second, incandescents could be replaced with a new miniature fluorescent lamp, commercially called "PL", which have special caps. In this case the luminaires would have to be modified to suit the new lamps' accessories. The installation prices in Appendix C include tubes, ballasts, and lampholders. The total savings would be 11,256 JD per year and the payback period is 12 months.

Third, existing incandescents could be replaced with a new type of compact fluorescent lamps, commercially known as "SL". The total savings for this option (in conjunction with replacing fluorescents) is 8,990 JD per year, for a payback period of 15 months.

E) WEATHERSTRIPPING AND WINDOW SHADING

The air infiltration through many windows at the Holiday Inn is too high - in some cases it reaches 97 cubic feet per hour for foot length of window perimeter. This contributes to both the cooling and heating load. Weatherstripping reduces the amount of infiltrated air to the space which reduces the cooling and heating required inside the space. One linear foot of weatherstripping costs about 1.25 JD. The shading of

south windows also reduces the cooling load by a significant amount. The savings for window weatherstripping is 15 JD per room per year with a 22-26 months payback. The savings for window shading is 34 JD per room per year with a 20-24 month payback.

5. RESULTS AND CONCLUSIONS

The information presented in this report provide a basis for the Holiday Inn to develop a comprehensive energy management program. The small number of ECOs analyzed are representative of the potential for energy conservation at the hotel. Each ECO can provide the Holiday Inn with a positive investment opportunity, if implemented. The specific measures analyzed and their effect on energy consumption is summarized in Exhibits 7 and 8.

Each of the recommended ECOs have a simple payback period ranging from less than one month to just over four years. Those with the lowest payback periods are the most cost effective investments for the Holiday Inn. For example, boiler insulation, because of its low capital cost, begins to payback almost immediately.

It is recommended that the hotel work with EEIAC to obtain more information about each of the recommended options, as well as to perform an analysis of the items which time did not permit the audit team to evaluate.

EXHIBIT 7

EFFECTS OF ENERGY CONSERVATION ON UTILITY BILLS

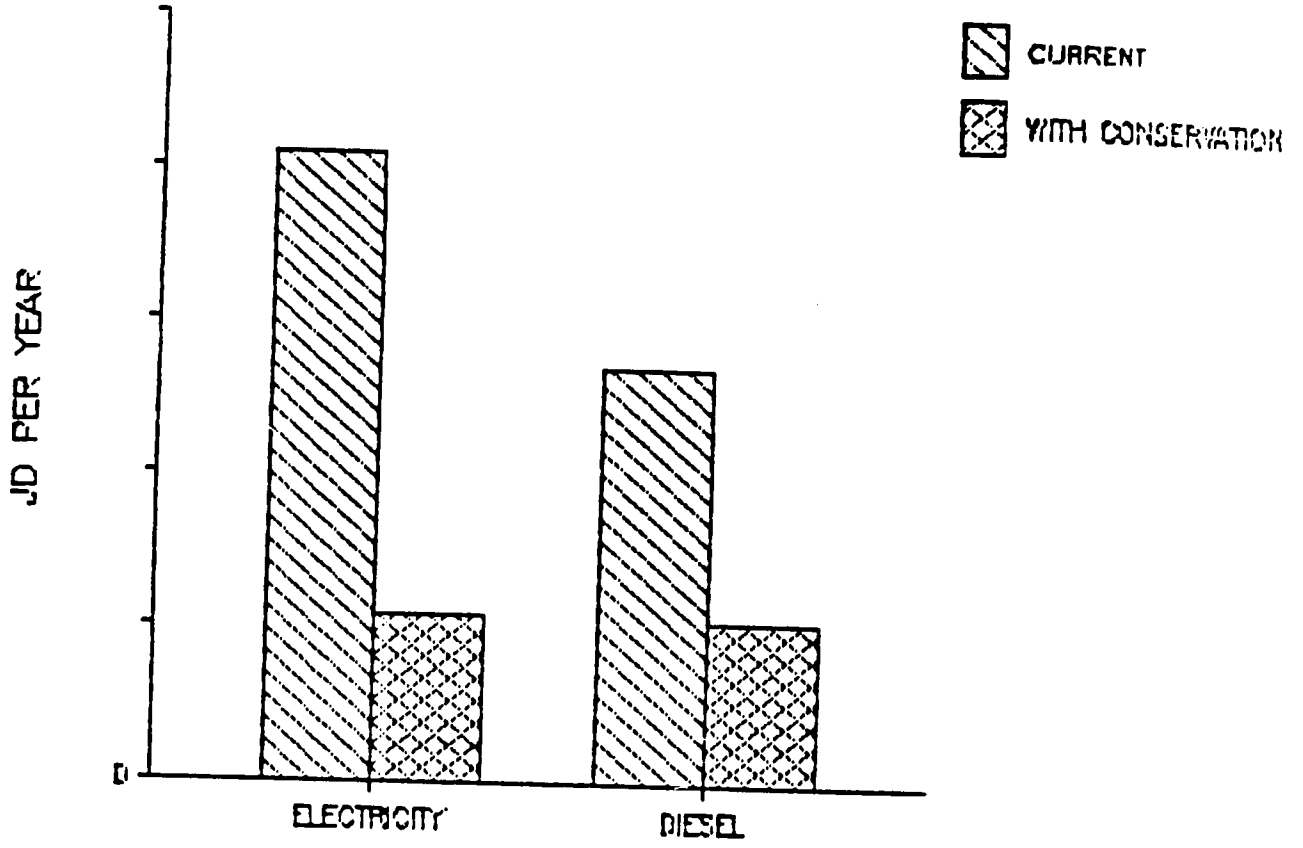


EXHIBIT 8

SUMMARY OF ENERGY CONSERVATION RECOMMENDATIONS

ECO	ENERGY SAVINGS: DIESEL FUEL LITERS/YR	ENERGY SAVINGS: ELECTRICITY KWH/YR	SAVINGS JD/YR	PAYBACK MONTHS
FLUE VENT DAMPER	6,383		420	4-5
BOILER INSULATION	1,016		67	<1
REPLACE ROOM AC UNITS		660,441	15,900	60-70
WEATHERSTRIPPING PER WINDOW		616/ROOM	15/ROOM	22-26
WINDOW SHADING PER WINDOW		1411/ROOM	34/ROOM	20-24
RELAMPING				
FLUORESCENT WITH 26mm FLUORESCENT		4,363	105	9-10
(1) INCANDESCENT WITH 26mm FLUORESCENT		106,272	2,556	4-6
(2) INCANDESCENT WITH SL FLUORESCENT		374,518	8,990	14-16
(3) INCANDESCENT WITH PL FLUORESCENT		442,230	11,256	11-12
TOTALS	7,399	1,073,178	26,615	

NOTE:
TOTALS DO NOT INCLUDE PER ROOM SAVINGS FOR WEATHERSTRIPPING AND WINDOW SHADING. THE AVERAGE OF OPTIONS 1, 2, AND 3 IS USED FOR INCANDESCENT REPLACEMENT.

APPENDIX A

EQUIPMENT INVENTORY

AIR CONDITIONING UNITS

AREA SERVED	ITEM	SUB ITEM	TON OF REF.	CFM	NUMBER	O A CFM	Hp	VOLTAGE	AMPERAGE RATED	AMPERAGE OPR.	KW	HRS/MO	KWH/YR
TOP FLOOR	ACU(PACKAGED		24.00	8820	1	2400		380	22.50	18.00	12	56.00	8624.78
	ACU(PACKAGE)		14.70	4420	2	2500		380	19.25	15.40	20	56.00	14757.96
ROYAL SUITE	PACKAGED UNIT		2.00		3			220	16.40	13.12	6	20.00	844.27
MEETING ROOMS	PACKAGED UNIT				1			380	25.00	20.00	6	20.00	741.00
ROOMS	WINDOW TYPE		.80		216			220	8.00	6.40	139.90	80.00	165494.84
MEZZANINE													
AND GROUND FLOOR													
**MEETING ROOMS	UNIT#1		15.20		1			380	54.00	43.20	28	105.00	38811.52
**SHOP	UNIT#2		2.70		1			380	9.60	7.68	5	105.00	6899.83
**MEETING ROOM	UNIT#3		15.20		1			380	54.00	43.20	28	105.00	38811.52
**SHOP	UNIT#4		2.70		1			380	9.60	7.68	5	105.00	6899.83
**MEETING ROOM	UNIT#5		15.20		1			380	54.00	43.20	28	105.00	38811.52
**SHOP	UNIT#6		2.70		1			380	9.60	7.68	5	105.00	6899.83
**HALLWAY	UNIT#7		5.00		1			380	14.00	11.20	7	105.00	10062.25
**OFFICE	UNIT#8		12.80		1			380	45.00	36.00	24	105.00	32342.93
**RESTAURANT	UNIT#9				1			380	29.00	23.20	15	105.00	20843.22
**RESTAURANT	UNIT#10				1			380	29.00	23.20	15	105.00	20843.22
**RESTAURANT	UNIT#11				1			380	29.00	23.20	15	105.00	20843.22
**COFFEE SHOP	UNIT#12		12.80		1			380	45.00	36.00	24	105.00	32342.93
**LAUNDRY	UNIT#13		17.80		1			380	54.00	43.20	28	105.00	38811.52
**DUKE BAR	UNIT#14		5.70		1			380	14.00	11.20	7	105.00	10062.25
	SUM												493748.41

AIR HANDLER UNITS & VENTILATION

AREA SERVED	ITEM	SUB ITEM	NUMBER	CFM	BTUH	O A CFM	Hp	VOLTAGE	AMP RATED	AMP CPR.	KW	HRS/WK	KWH/YR
MEZZANINE	AHU#1		1	3000	127700	2100	.94				.74	168.00	3240.97
AND	AHU#2		1	1560	22700	0	.49				.39	168.00	1685.31
GROUND FLOOR	AHU#3		1	2550	121000	2100	.80				.63	168.00	2754.83
	AHU#4		1	1200	16800	0	.38				.30	168.00	1296.39
SAME AS AC UNITS	AHU#5		1	2550	121000	2100	.80				.63	168.00	2754.83
	AHU#6		1	1260	18500	0	.40				.31	168.00	1361.21
	AHU#7		1	2500	420000	250	.79				.62	168.00	2700.81
	AHU#8		1	4020	115100	1800	1.27				.99	168.00	4342.90
	AHU#9		1	2000	79800	1000	.63				.49	168.00	2160.65
	AHU#10		1	1750	67200	900	.55				.43	168.00	1890.57
	AHU#11		1	1520	63900	900	.48				.38	168.00	1642.09
	AHU#12		1	4050	107600	1100	1.28				1.00	168.00	4375.31
	AHU#13		1	10130	149600	850	3.19				2.51	168.00	10943.68
	AHU#14		1	1080	67900	1080	.34				.27	168.00	1166.75
	AHU#15		1	1560	22700	0	.49				.39	168.00	1685.31
	AHU#16		1	1500	64000	1500	.47				.37	168.00	1620.49
TOP FLOOR	19.2 TON UNIT												.00
	14.7 TON UNIT		1	4900	76900	250	1.57				1.23	56.00	1789.74
	24 TON UNIT		1	4400	123500	2500	1.39				1.09	56.00	1591.68
			1	8820	201600	2400	2.78				2.18	56.00	3176.15
MEZZANINE	TRANSFER FAN												.00
	TRANSFER FAN		1	2100			.66				.52	168.00	2268.68
			1	10200			3.21				2.52	168.00	11019.31
TOP FLOOR	TRANSFER FAN												.00
			1	4000			1.26				.99	56.00	1440.43
	SUB				1589500								52179.66

EXHAUST FANS

AREA SERVED	ITEM	SUB ITEM	NUMBER	CFM	RATE Btuh	O A CFM	Hp	VOLTAGE	AMPERAGE RATED	AMPERAGE OPR.	KW	HRS/WK	KWH/YR
GF KITCHEN	EF #1		1	11100			1.75				1.37	168.00	9593.28
TF KITCHEN	EF #2		1	4900			.77				.61	168.00	4234.87
TOILETS	EF #3		1	4040			.64				.50	168.00	3491.61
TOILETS	EF #4		1	3240			.51				.40	168.00	2800.20
	EF #5		1	7580			1.19				.94	168.00	6551.09
	SUM												26671.04

HEATING

AREA SERVED	ITEM	SUB ITEM	NUMBER	CFM	RATE Btuh	O A CFM	Hp	VOLTAGE	AMPERAGE RATED	AMPERAGE OPR.	KW	HRS/WK	KWH/YR
GRND FLR & MZN	BOILER FEED PUMPS	AIR HANDLERS	2				10.00	380			15.71	140.00	28583.58
DOMESTIC DHW	FEED PUMPS		2				1.50	380			2.36	140.00	4287.54
GUEST ROOMS	ROOM HEATERS		216					220	15.00	12.00	296.52	140.00	431780.11
SUM													464611.22

MISCELLANEOUS EQUIPMENT

AREA	ITEM	SUB ITEM	NUMBER	HP	VOLTAGE	AMPERAGE RATED	AMPERAGE OPR	KW	HRS/WK	KWH/YR
KITCHEN		COMPRESSOR MOTOR	1	3	380			.00	140	0.15
		FAN MOTOR	1	.40	220			.00	140	1.31
		HEATER	1	4.02	220			.00	140	10.92
LAUNDRY									140	.00
	WASHING MACHINE	WASH MOTOR	3		380	3.5	2.8	6.91	56	5031.12
		SPIN MOTOR	3		380	3.5	2.8	6.91	56	5031.12
	DRYER	DRYER MOTOR	3		380	3.5	2.8	6.91	56	5031.12
		ROLLER MOTOR	1		220	4	3.2	.00	56	640.64
KITCHEN	DEEP FREZER	COLD FOOD FRIDGE	1		220	5	4	1.10	140	.00
		JUICE FRIDGE	1		220	4	3.2	.00	140	2002.80
		DISPUSE FRIDGE	1		220	4	3.2	.00	140	1601.60
		MEAT FRIDGE	1		220	4	3.2	.00	140	1601.60
		EGGS FRIDGE	1		220	4	3.2	.00	140	1601.60
		OTHERS	1		220	6	4.8	1.32	140	2402.40
	DEEP FREZER	COMPRESSOR	1		380	12	9.6	2.64	140	4804.80
						9	7.2	5.92	140	10780.98
		HEATERS	3	1.34				.02	140	
	WALK IN COOLER	R1	1		220	8.5	6.8	1.87	40	31.20
		R2	1		380	17.5	14	11.52	140	6006.80
		R3	1		380	9.7	7.76	6.38	140	41926.02
	DISH WASHER	WATER PUMP	2		380	6.1	4.88	4.01	140	23238.99
		BOOSTER HEATER	1		380	36	28.8	23.69	140	14614.21
	ELEVATORS				380	50	40	32.91	140	86247.82
	MISCELLANEOUS				380	40	32	26.33	140	119788.63
SUM										95830.91
										429833.95

APPENDIX B

ENERGY CONSERVATION OPPORTUNITIES IN COMMERCIAL BUILDINGS

LIGHTING

In commercial buildings lighting is a significant source of energy waste. Most buildings are either overlit, leave lights burning during unoccupied periods or use lighting inefficiently. Areas closest to windows will generally have enough daylight during part of the day that either no lights or only dimmed lights are required. Lights not required for security or work should be turned off at night.

Lighting Controls

There are a number of ways to reduce energy consumption from lighting loads. One is to install photocell controls to control the lighting near windows. When the ambient light reaches a pre-set level, the controls will automatically turn off the lights. A more sophisticated type of control is a combination dimmer-photocell. This will dim the lights near windows in accordance with the level of ambient light. The advantage is that the lighting change is imperceptible. While the savings from these dimmer-photocells might be expected to be considerably larger since they react to every light change, the actual savings are not proportional to the reduction in the light level. A 50 percent reduction will save 25 percent of the electricity, a 30 percent reduction 9 percent and a 20 percent reduction 4 percent. For areas which are used irregularly, such as motel and hotel rooms or restrooms an effective way to save energy is by installing controls which turn off the lights when no one is in the room. These controls sense the presence of people by motion ,sound or heat and instantaneously turn the lights on whenever someone enters. Once everyone has left they turn them off again after a predetermined time period. These controls are also available with heating and cooling controls as well as security systems.

Task Lighting

A common characteristic of commercial establishments is that they provide uniform lighting in each area. The lighting requirements however, often vary considerably. To save energy without affecting productivity, the general lighting level can be lowered by providing additional lights at work stations as needed. If one task requires more

light than the general work area, a portable lamp, such as a desk lamp, should be used. When feasible, tasks which require more light should be grouped together. The Table below illustrates the wide variation in lighting levels recommended for different areas.

Recommended Lighting Levels (footcandles)

Accounting offices	80
Secretarial pools	60
Over filing cabinets	30
Conference tables	30
Area between work stations	20
Waiting rooms	10-15

A typical office which maintains a lighting level of 60 footcandles can often reduce this overall level by 50 percent by using desk lamps, resulting in a net saving of 40 percent in lighting costs. Further savings are possible if the work-stations requiring more light are placed near windows.

Relamping

In recent years a variety of energy saving lamps have been developed which look like the most commonplace lighting types; i.e., incandescent. These new types of lights give either the same or imperceptibly less light, yet use less electricity. The most common alternative to incandescents, fluorescent lights, require 10 to 20 percent less wattage, yet provide similar lighting levels. When installing energy efficient fluorescents, replacing existing ballasts with energy efficient units is recommended. A number of more efficient ballasts have recently been developed which can further reduce energy use by about 9 percent. These ballasts have the additional advantage of lasting about twice as long as conventional ones. The efficient ballasts are designed to be used with the high-efficiency fluorescents and are not always compatible with standard fluorescents. When used with the high-efficiency fluorescents, the energy savings may be as much as 25 percent. The table below lists efficiencies for different lighting types in lumens per watt, or light output per energy input.

Maximum Lumens per Watt

Incandescent	15
Fluorescent	70
Mercury Vapor	50
Metal Halide	100
High Pressure Sodium	120
Low Pressure Sodium	160

Replacing an incandescent light with another type obviously saves energy. There are also differences within some types of lamps, the new efficient ones delivering 10 to 20 percent more lumens per watt than the standard ones. The most efficient light is the low pressure sodium, which is mainly used for street lighting, outdoor areas and security lighting. Since this light distorts colors, it has limited applications. The high pressure sodium, which has a characteristic golden white light, is often recommended to replace mercury vapor lights outdoors. When making this replacement, the ballasts designed for the high pressure sodium lamps must be used. When color is important, the metal halide may be recommended to replace the mercury vapor. The newer metal halide lamps provide a light very similar to incandescents. Again, a special ballast must be used. In addition to saving energy, the high efficiency lights will reduce lighting costs as a result of their longer life. The average life of the high and low pressure sodium and the mercury vapor lights is about 10 times that of incandescent lights. This is particularly important for outdoor lights where the cost of changing lights is usually higher than indoors.

Exterior Lighting

There are a number of ways to reduce the energy used for exterior lighting by controlling the operating time. Buildings which have a number of different exterior lights, all of which are activated by one switch, should consider adding more manual switches. This will allow the activation of only those lights needed during required hours. Another alternative is to install time-clock or photocell controls as detailed above.

BUILDING ENVELOPE

Energy loss through a building's envelope (walls, ceilings, floors, doors and windows) is a significant part of the building's total energy consumption. Construction techniques in Jordan limit the application of thermal insulation to ceilings and floors. Solid masonry walls are very expensive to insulate. When wall insulation is installed it is usually added to the exterior of the building, and is often unsightly. Other ECOs which reduce energy loss through the envelope are caulking, weatherstripping and solar shading devices.

Ceiling Insulation

The benefit of insulating your ceiling is not only that it will reduce the heat loss in the winter, but also the heat gain during the summer, particularly for metal roofs. Recommended insulation levels in Amman is for ceiling's to have an overall heat transfer coefficient (U-value) of .32 W/sq.m-K. The cost of insulating your ceiling depends on the type of roof construction. If the building has a roof with an attic or a crawl space between the ceiling and the roof, or if there is a dropped ceiling, either loose fill insulation can be blown in, or, if there is sufficient space for workers, batt or blanket insulation can be added. This insulation is usually made of fiberglass, mineral wool or

cellulose. This will be the least expensive way to insulate. If the ceiling is part of the roof structure, it is possible to insulate the interior or the exterior. For interior insulation, if the ceiling is higher than needed, it is possible to install a dropped ceiling using insulating ceiling tiles. These tiles are generally made of polystyrene or fiberglass and have a vapor barrier on the bottom side. If a dropped ceiling is not feasible, it may be possible to either spray on the insulation or to use a composite board of gypsum with polystyrene, polyurethane, or fiberglass. Adding exterior insulation to roofs is the most expensive way to insulate. Roofing must be removed, and rigid foam board attached to the sheathing and new roofing placed over it. The rigid foam board is typically made of polystyrene, polyurethane, fiberglass, or fiberboard. This option is only cost effective when reroofing. No insulation will be effective if it is wet. The roof should therefore be examined for any indication of leakage before insulating and necessary repairs made. To prevent condensation there must also be adequate ventilation. The recommended amount of ventilation is one square foot of opening for each 14 square meters of area.

Floor Insulation

While many people believe that, since hot air rises floors need not be insulated, this is a fallacy. Heat always moves toward the cold, and its movement through floors is exactly the same as through walls and ceilings. The rate of heat loss will depend on the temperature difference above and below the floor and the resistance to heat transfer of the floor itself. It is this resistance to heat transfer which is improved by insulating. For slab-on-grade floors, there is little heat lost from the center of the floor because the earth acts as an insulator. Heat loss occurs mainly around the perimeter. These floors are therefore usually insulated at the outside edge of the floor, where the insulation is placed vertically extending about two feet below the floor level. Rigid board or foam can be used. Floors over an unheated area such as a basement or crawl space, should be insulated on the ceiling of the basement or the underside of the floor of the crawl space. They can be insulated with batts or blankets, foam, or rigid insulation. The recommended heat transfer coefficient for such floors is .48 W/sq.m-K. Insulating floors does not reduce the cooling load since the temperature differential between a basement or crawl space and the conditioned areas is very small in the summer.

Wall Insulation

Walls normally comprise the largest part of the building. Most buildings in Jordan are constructed with solid masonry walls which are difficult and expensive to insulate. Insulation can be added to the outside or to the inside surface of these walls. For insulating walls outside, prefabricated insulating panels are generally used. These may contain fiberglass, polyurethane or polystyrene. The insulation must be weather-proofed and vapor sealed. For insulating walls on the inside, insulating panels may be used or insulation can be sprayed on. When adding insulation either to the outside or inside wall, the treatment of all breaks in the wall, such as windows and doors, must be considered.

Caulking

Caulking windows, doors and building corners will not only save energy but may also save larger repair bills later on. Cracks tend to become larger if not sealed and may allow water to enter the walls causing rot and the deterioration. There are a large variety of sealants available. The most durable and versatile is silicone. It will generally last 20 or more years, will not shrink and has a high resistance to moisture. Other excellent sealants are polysulfide and polyurethane. For metal-to-masonry, butyl rubber sealants are often used. They will last 7 to 10 years and have somewhat more shrinkage than the others mentioned. For very wide gaps polybutane cord or rope is sometimes used. However this will only last 1 or 2 years and should therefore be used only for temporary repairs. To be effective, caulking must be done on a clean area with the old sealant and chipped paint removed.

Weatherstripping

Weatherstripping doors and windows can save considerable energy and make your building more comfortable at a relatively small cost. While it is virtually impossible to estimate the savings resulting from weatherstripping with any accuracy, since this depends on the amount of wind at the specific location, the size and shape of the crack, the pressure inside and outside the building and the amount of traffic, weatherstripping will always be cost-effective. There are a variety of different types of weatherstripping available. The most durable is spring metal, which is not visible when doors or windows are closed While the metal is durable, the spring often is not. If you currently have spring metal weatherstripping, it may be possible to regain its effectiveness by bending out the unfastened side with a wide- bladed tool like a putty knife. Other types of weatherstripping available include plastic, rubber, and felt, which are easier to install but not as durable. For metal casement windows, a vinyl gasket with a deep groove is available which fits the four edges of the frame. For gliding windows it is best to use spring metal for the side channel which receives the movable sash and vinyl or rubber gaskets at the top, bottom and outer edge of the gliding sash. When weatherstripping doors, be sure that the door is properly hung so that it opens and closes smoothly with a uniform space between the edge and the jamb. If the springy metal V strip is used, it will be attached to the jamb. Other types, such as wood, metal or plastic strips which are edged with plastic tubing or foam attached to the door frame. For the bottom of the door there are a variety of special door sweeps available. If the threshold of the door is worn or weathered, it should be replaced when the door is being weatherstripped.

Doors

Storm and thermal doors save energy in two ways, by reducing heat loss in the winter and heat gain in the summer through the door and by reducing infiltration. While storm doors are popular for residences they are less common for commercial buildings. Thermal doors, have a

special insulating case such as urethane foam or polystyrene and a thermal break to retard heat loss or gain. While this will save a small amount of energy, most of the energy saved is through the reduced infiltration from a well fitting door. Wooden doors tend to expand and contract with temperature and humidity changes more than metal thermal doors. Thus the thermal doors will have less cracks as the seasons change. When purchasing a storm or thermal, the primary concern should be that it is properly installed. Make sure that it opens and closes properly and that the crack is even from top to bottom. Also check the threshold and the caulking around the door frame. Revolving doors reduce the amount of warm air lost in the winter and cold air lost in the summer in buildings with much traffic. For example if 600 people enter through a swinging door each hour, the infiltration rate will be 472 l/s, with a revolving door it will be 142 l/s, a 70 percent reduction. In addition to saving considerable energy, revolving doors will also frequently increase the amount of area that can be used since they reduce the drafty area near the door. A revolving door can be installed in place of an existing door. However, a hinged door must also be provided in order to carry large objects in and out and for handicapped people. In buildings with heavy traffic, a foyer can reduce the amount of infiltration considerably. The foyer should be sufficiently long for the outer door to close before the inner door opens. For very heavy traffic, doors which open and close automatically may be cost effective. Assuming an average of 600 passages per hour, a foyer will reduce the infiltration rate from 492 l/s, to 330 l/s, a 30 percent reduction. In addition, the area near the entrance will become much less drafty, thereby increasing the usability of this space. A foyer can be built either inside or outside the building, depending on the available space.

Loading docks are often the largest source of heat loss in a building since they allow large amounts of unconditioned air to infiltrate the building whenever the dock area is used. To reduce this infiltration, dock door seals are recommended. These will be particularly effective in a building where the loading dock area is conditioned or not sealed off from the conditioned areas. The actual savings you realize will depend on the number of hours the dock area is used as well as the size of the gap to be sealed.

Windows

Windows lose heat faster per square meter than any other part of the building envelope. Storm or thermal windows save twice as much heat per square meter as insulating ceilings or walls. In addition, storm windows will reduce the amount of infiltration around the perimeter of the windows. There are a number of different types of storm windows available. The most popular are those that mount outside the window. These usually have an aluminum frame which is sometimes clad with vinyl. For many commercial buildings, these ready-made storm windows are not appropriate, either because of the type and size of the window or for aesthetic reasons. An alternative is an interior storm window, which can be made of acrylic or glass. These will generally be more expensive since they are custom-made. For windows which can be opened, an inside storm window, generally made of glass, can be fit in the inner window

frame, about 1.3 cm from the primary window. This offers all the advantages of a thermal window, with the added advantage that there is no seal to be broken. It does not, however reduce the infiltration, and should only be considered if the primary window is in good condition. If the window need not be opened very often an acrylic window can be mounted on the window frame. There are various mounting techniques, including magnetic strips, opening plastic rails and velcro, which permit the removal and storage of the storm window when not needed as well as the opening of the windows for emergencies. For windows which need not be opened, acrylic windows can be permanently attached to the window frame.

Thermal windows are recommended in lieu of storm windows when the primary window is in poor condition or when storm windows would not be appropriate for aesthetic reasons or are not feasible. Because they are relatively expensive, the payback is longer than for most other "insulating" recommendations. However, in a building with a large amount of single glazing, the installation of thermal windows is essential to reduce the energy use for both heating and cooling. Aside from the energy saved, thermal windows will add to the value of the building as well as to the comfort of the occupants. An alternative to thermal windows is a replacement window built with an interior storm window. This is somewhat less expensive, will save slightly more energy because the width of the airspace is usually larger, and looks exactly like a thermal window. Its greatest advantage is that, since there is no seal, there is no risk that the window will have to be replaced when the seal breaks. Unfortunately, these windows are not available in all sizes.

Insulating shades reduce heat loss more effectively than storm or thermal windows. There are two types available, interior and exterior. While interior ones are mainly used in residences, apartments and motels, exterior ones are often used in commercial buildings. Exterior roll blinds can be used in the winter to provide insulation and in the summer to provide shading. If the winter heat loss is of prime concern, roll shades are available with air pockets built into the slats to increase the insulating value. In addition to saving energy, roll blinds protect against vandalism and are frequently used for store-front windows. For an interior shade to be effective in reducing heat loss, it must create a dead air space between the shade and the window. A number of manufacturers have developed insulating shades which achieve this through side and bottom rails or other devices that seal the sides and bottom of the shade to the window sill. These shades will reduce the heat loss through single glazed windows by as much as 80 percent. The chief disadvantage of thermal shades is that they have to be lowered and raised each day. To facilitate this, shades are available which automatically open and close, either at a preset time or according to the amount of ambient light.

APPENDIX C

CALCULATIONS AND SUPPORTING MATERIAL

FLUE VENT DAMPER

Energy savings (Seasonal efficiency improvement * current energy consumption)/current seasonal efficiency

Seasonal efficiency improvement- New seasonal efficiency with improvements-current seasonal efficiency

1) Current steady state efficiency - 86%
2) Current seasonal efficiency @ 86% (STDY ST)-77%
3) based on rules of thumb used in numerous commercial energy audits, new seasonal efficiency - 80%
4) Current energy consumed in boiler (1985)-163,836 DIESEL LITERS/YR * 1 GAL/3.785 LITERS * 144,000 BTU/GAL
   - 6.23 * 10 **9 BTU/YR

Energy savings - (80-77) * 6.23 * 10 **9 * .77
- 24.3 * 10 **7 BTU/YR
- 6,383 DIESEL FUEL LITERS /YR
- 421 JD/YR

Installed cost- @ 150 JD

Simple payback - 150 JD /421 JD/YR - .36 YEARS (4-5 MONTHS)

BOILER INSULATION

Heat loss through the backside of the boiler

Area = 1.77 sq m

q = 1.31(T-Ta) **(4/3) + 56.7 * 10 **-9 * e * (T **4-Ta **4)

where: q = the quantity of heat lost (w/sq m)
T = temp of the boiler surface
Ta = ambient temp (20 C)
e = emissivity

q = 1.31(140-20) **4/3 + [(56.7 * 10 **-9) * .81(413 **4-293**4)]
= 1770 w/sq m

Q = q * area
= 1760 * 1.77
= 3133 w

Heat loss after installing .25 m rockwool insulation

q' = (t-ta)/((s/k)+ (1/8.51))

where q' = quantity of heat loss after insulation
t = temp of boiler surface
ta = ambient temperature
s = insulation thickness
k = thermal conductivity of insulation = 0.069 w/m-C

q' = (140-20)/((.25/.058)+(1/8.51))
= 27 w/sq m

Q' = q'* A
= 27 * 1.77
= 50w

Energy savings after insulation

Q-Q' =3115-50
=3065 w
=2642 kcal/hr
=2642 kcal/hr * 6000 hrs/yr * .5 = 7.9 * 10 **6 kcal/yr

where 6000 hr/yr is the operation hours of boiler and .5 is a factor to account for part load performance.

Annual energy savings = 7.9 * 10 **6/(.86 * 10130 * 1000)

= 0.91 tons of diesel/yr

= 67 JD/yr

Where 0.86 is the boiler efficiency

10130 kcal/kg is the heat content of diesel fuel

Insulation cost= @ JD 3

Payback = 3 JD/67 JD/yr

= less than one-half month.

120

WEATHERSTRIPPING

The cooling load for a typical guest room - 0.84 TON
10122 BTU/HR

The cooling load for the room of the windows are weatherstripped:

- 0.75 TON
- 8967 BTU/HR

The saving in the cooling load - 1155 BTU/HR

The annual saving per room

where 140 - HOURS/WEEK
.5 - CAPACITY FACTOR
26 - WEEKS/YR

- 1155/3413 * 140 * 0.5 * 26
- 616 KWH
- 14.784 JD/YR

The cost of weatherstripping per room - 30 JD

The payback - 30/15 - 2 YEARS

OUTSIDE SHADI' :

The cooling load fo' this room if outside shaded - 0.62 TON
- 7475 BTU/HR

The saving - 2650 BTU/HR

The annual saving - 2650/3413 * 140 * 0.5 * 26 - 1411 KWH
- 33.8 JD/YR

Outside shading cost - 60 JD

The payback - 60/33.8 - 1.8 YEAR.

ROOM AIR CONDITIONER REPLACEMENT WITH HEAT PUMPS

Cooling load - 10,000 BTU/HR
Heating load - 7,000 BTU/HR

Electrical energy consumption in winter, per room - 1.37 KWH

By replacing the room units with heat pumps OF 2.7 COP, for the heating season, the electrical energy consumed for room heating - 0.76 KW

The saving per unit - (1.37 - .76) - 0.61 KW

The saving per unit per winter - 1110.2 KWH/YR

Energy consumed per unit in summer - 0.40 KW

By replacing the room units, the COP of the conditioner will be improved by 1.57.

The saving per unit per summer - 0.23 KW

Total saving - (0.23 + 0.61) * 216 ROOMS * 140 * 0.5 * 52
- 660,441 KWH/YR
- 15,900 JD/YR

Total cost - 86,400 JD

PAYBACK - 5.43 YEARS.

COOLING LOAD CALCULATION

		DIRECTION	QUANTITY	X FACTOR	= SENSIBLE HEAT Btuh
OUTSIDE WALLS		N	sq.Ft	3	0
		NE,E,SE	sq.Ft	3	0
		S	sq.Ft	2	0
		SW,W,NW	sq.Ft	3	0
		N	sq.Ft	1	0
INSIDE WALLS			sq.Ft	3	0
ROOF OR CEILING TABLE 2			sq.Ft	3	0
FLOORS TABLE 3			sq.Ft	0	0
OUTSIDE AIR-SENSIBLE		TOTAL OF TABLE 4			1280
PEOPLE TABLE 5 SENSIBLE		3		195	585
APPLIANCES-SENSIBLE					1170
WINDOWS		S	115	35	4025
		?	sq Ft		0
		?	sq Ft		0
		?	sq Ft		0
		TOTAL SENSIBLE LOAD			7065
OUTSIDE AIR LATENT					0
PEOPLE LATENT		2		205	410
APPLIANCES-LATENT					0
TOTAL LATENT LOAD					410
TOTAL COOLING LOAD (SENSIBLE+LATENT)					7475
TONS OF COOLING					.62

*THE ABOVE CALCULATIONS IS FOR A ROOM WITH OUSIDE SHADING

COOLING LOAD CALCULATION

		DIRECTION	QUANTITY	FACTOR	SENSIBLE HEAT Btuh
OUTSIDE WALLS		N	sq.Ft	3	0
		NE.E.SE	sq.Ft	3	0
		S	sq.Ft	3	0
		SW.W.NW	sq.Ft	3	0
		N	sq.Ft		0
INSIDE WALLS			sq.Ft	3	0
ROOF OR CEILING TABLE 2			sq.Ft	3	0
FLOORS TABLE 3			sq.Ft	0	0
OUTSIDE AIR-SENSIBLE		TOTAL OF TABLE 4			132
PEOPLE TABLE 5 SENSIBLE		3		195	585
APPLIANCES-SENSIBLE					1170
WINDOWS		S	115	56	6670
		?	sq Ft		0
		?	sq Ft		0
		?	sq Ft		0
		TOTAL SENSIBLE LOAD			8557
OUTSIDE AIR LATENT					0
PEOPLE LATENT		2		205	410
APPLIANCES-LATENT					0
TOTAL LATENT LOAD					410
TOTAL COOLING LOAD (SENSIBLE+LATENT)					8967
TONS OF COOLING					.75

*THE ABOVE CALCULATIONS IS FOR A ROOM WITH WEATHERSTRIPPING

COOLING LOAD CALCULATION

	DIRECTION	QUANTITY	FACTOR	SENSIBLE HEAT Btuh	
OUTSIDE WALLS	N	sq.Ft	3	0	
	NE.E.SE	sq.Ft	3	0	
	S	sq.Ft	3	0	
	SW.W.NW	sq.Ft	3	0	
	N	sq.Ft		0	
INSIDE WALLS		sq.Ft	3	0	
ROOF OR CEILING TABLE 2		sq.Ft	3	0	
FLOORS TABLE 3		sq.Ft	0	0	
OUTSIDE AIR-SENSIBLE		TOTAL OF TABLE 4		1287	
PEOPLE TABLE 5 SENSIBLE		3	195	585	
APPLIANCES-SENSIBLE				1170	
WINDOWS	S	115	58	6670	
	?	sq Ft		0	
	?	sq Ft		0	
	?	sq Ft		0	
	TOTAL SENSIBLE LOAD			9712	
OUTSIDE AIR LATENT				0	
PEOPLE LATENT		2	205	410	
APPLIANCES-LATENT				0	
TOTAL LATENT LOAD				410	
TOTAL COOLING LOAD (SENSIBLE+LATENT)				10122	
TONS OF COOLING				.84	

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LAMPS REPLACEMENT

The following figures are obtained from the Lighting Form.

1) Replace 38mm fluorescents with 26mm tube fluorescents

Payback - (141 fixtures * 0.2 JD per fixture) +
(182 fixtures * 0.3 JD per fixture) / (2.44 + 6.29) JD/MO

- 9.5 Months

2) Replace incandescents with with 26mm tube fluorescents

Payback - (300 fixtures * 3.5 JD per fixture) / 213 JD/MO

- 5 months

3) Replace incandescents with PL fluorescents

Payback - (2569 fixtures * 4.5 JD/fixture) / 937.9 JD/MO

- 12.3 months

4) Replace incandescents with SL fluorescents

Payback - (2569 fixtures * 4.25 JD/fixture) / 749.04 JD/MO

- 14.6 months

LIGHTING FIRM

DATE 8/13/96 JOB :HOLLIDAY INN HOTEL /00000 SHEET NO. (0001)

TARIFF 24 Files/Kwh FLUORESCENT LAMPS

INSTALLED											ALTERNATIVE										
TYPE	POWER: WATT:	NO.	OPER. hr/D	DAYS/YR	MONTHLY Kwh	E.COST/YR: JD	LAMP PRICE: JD	LAMP LUMENS	RATED LIFE: hrs	TYPE	POWER: WATT:	NO.	OPER. hr/D	DAYS/YR	MONTHLY Kwh	E.COST/YR: JD	LAMP PRICE: JD	LAMP LUMENS	RATED LIFE hrs	E.SAVINGS Kwh/YR	E.SAVINGS JD/YR	PAY BACK MONTHS
39mm	28:	141:	12.00:	30:	1015.2:	24.36:	.20:	1750.00:	5000:	26mm	18:	141:	12:	30:	913.68:	21.93:	.20:	1450.00:	5000:	101.52:	2.43:	12:
DIA.	40:	102:	12.00:	30:	2620.8:	62.90:	.30:	3200.00:	5000:	DIA.	36:	102:	12:	30:	2358.72:	56.61:	.30:	3450.00:	5000:	262.08:	6.29:	9:
	65:	0:	12.00:	30:	0:	.00:	.05:	5200.00:	5000:		58:	0:	12:	30:	0:	.00:	.05:	5400.00:	5000:	0:	.00:	0:

INCANDESCENT LAMPS

INSTALLED											ALTERNATIVE 1										
TYPE	POWER: WATT:	NO.	OPER. hr/D	DAYS/YR	MONTHLY Kwh	E.COST/YR: JD	LAMP PRICE: JD	LAMP LUMENS	RATED LIFE: hrs	TYPE	POWER: WATT:	NO.	OPER. hr/D	DAYS/YR	MONTHLY Kwh	E.COST/YR: JD	LAMP PRICE: JD	LAMP LUMENS	RATED LIFE hrs	E.SAVINGS Kwh/YR	E.SAVINGS JD/YR	PAY BACK MONTHS
INCAND.	25:	193:	12.00:	30:	1737:	41.69:	.15:	270.00:	1000:	SL	9:	193:	12:	30:	625.37:	15.01:	4.25:	475.00:	5000:	1111.68:	26.68:	31:
	40:	976:	12.00:	30:	13334.4:	320.03:	.15:	430.00:	1000:		9:	976:	12:	30:	3000.24:	72.01:	4.25:	475.00:	[illegible]	7334.16:	240.02:	16:
	60:	850:	12.00:	30:	18360:	440.64:	.15:	730.00:	1000:		10:	850:	12:	30:	5540:	132.19:	4.25:	900.00:	5000:	12952:	308.45:	12:
	75:	0:	12.00:	30:	0:	.00:	.15:	960.00:	1000:		18:	0:	12:	30:	0:	.00:	4.25:	900.00:	5000:	0:	.00:	0:
	100:	300:	12.00:	30:	10800:	259.20:	.15:	1390.00:	1000:		2*18:	600:	12:	30:	3888:	93.31:	4.25:	1800.00:	5000:	6912:	165.89:	15:
	150:	0:	10.00:	30:	0:	.00:	.25:	2220.00:	1000:		2*25:	0:	10:	30:	0:	.00:	4.25:	2400.00:	5000:	0:	.00:	0:
	200:	0:	12.00:	30:	0:	.00:	.35:	3150.00:	1000:		3*25:	0:	12:	26:	0:	.00:	4.25:	3600.00:	5000:	0:	.00:	0:

ALTERNATIVE 2										ALTERNATIVE 3										
TYPE	POWER: WATT:	MONTHLY: Kwh	E.COST: JD/YR	LAMP PRICE: JD	LAMP LUMENS	RATED LIFE: hrs	E.SAVINGS Kwh/YR	E.SAVINGS JD/YR	PAY BACK MONTHS	TYPE	POWER: WATT:	NO.	OPER. hr/D	DAYS/YR	MONTHLY Kwh	E.COST/YR: JD	LAMP PRICE: JD	LAMP LUMENS	RATED LIFE: hrs	E.SAVINGS Kwh/YR	E.SAVINGS JD/YR	PAY BACK MONTHS
PL	5:	347.4:	8.34:	4.5:	250:	5000.00:	1389.60:	33.35:	26:	FLUOR.	0:	0:	0:	0:	0:	.00:	.00:	.00:	0:	0:	.00:	0:
	7:	2133.5:	56.00:	4.5:	400:	5000.00:	[illegible]000.00:	264.02:	16:		0:	0:	0:	0:	0:	.00:	.00:	.00:	0:	0:	.00:	.0:
	9:	2754:	66.10:	4.5:	600:	5000.00:	15606.00:	374.54:	10:		0:	0:	0:	0:	0:	.00:	.00:	.00:	0:	0:	.00:	0:
	11:	0:	.00:	4.5:	900:	5000.00:	.00:	.00:	0:		10:	0:	12:	30:	0:	.00:	3.50:	1450.00:	5000:	0:	.00:	0:
	2*9:	1944:	46.66:	4.5:	1200:	5000.00:	8856.00:	212.54:	13:		10:	300:	12:	30:	1944:	46.66:	3.50:	1450.00:	5000:	8856:	212.54:	5:
	2*11:	0:	.00:	4.5:	1800:	5000.00:	.00:	.00:	0:		36:	0:	12:	30:	0:	.00:	3.50:	3450.00:	5000:	0:	.00:	0:
	3*11:	0:	.00:	4.5:	2700:	5000.00:	.00:	.00:	0:		36:	0:	12:	30:	0:	.00:	3.50:	3450.00:	5000:	0:	.00:	0:

*YOU SHOULD REDISTRIBUTE THE LAMPS.
*YOU NEED TO CHANGE THE FIXTURE.

AVERAGE ELECTRICAL ENERGY CONSUMPTION FOR LIGHTING.

JOB:. HOLLIDAY INN HOTEL DATE: 8/13/86

TYPE	POWER: WATT:	NO.	OPER. : HR/I :	DAYS/M :	MONTHLY : Kwh :
FL. 38mm DIA.	20:	141:	12.00:	30:	1015.20:
	40:	182:	12.00:	30:	2620.80:
	65:	0:	.00:	0:	.00:
FL. 26mm DIA.	18:	0:	.00:	0:	.00:
	36:	132:	16.00:	30:	2280.96:
	58:	0:	.00:	0:	.00:
	:	:	:	:	:
INCAND.	7:	36:	16.00:	30:	120.96:
	25:	193:	12.00:	30:	1737.00:
	40:	926:	12.00:	30:	13334.40:
	60:	850:	12.00:	30:	18360.00:
	75:	0:	12.00:	30:	.00:
	100:	300:	12.00:	30:	10800.00:
	150:	0:	10.00:	30:	.00:
	200:	0:	12.00:	30:	.00:
	:	:	:	:	:
FL	5:	0:	.00:	0:	.00:
	7:	0:	.00:	0:	.00:
	9:	0:	.00:	0:	.00:
	11:	0:	.00:	0:	.00:
	:	:	:	:	:
SL	9:	0:	.00:	0:	.00:
	9:	0:	.00:	0:	.00:
	18:	59:	14.00:	30:	446.04:
	25:	50:	14.00:	30:	525.00:
	:	:	:	:	:
OTEHERS	:	:	:	:	:
MERCURY	250:	12:	56.00:	4.5:	756.06:
	:	:	.00:	0:	.00:
	:	:	.00:	0:	.00:
	:	:	.00:	0:	.00:
	:	:	.00:	0:	.00:
ENERGY CONSUMPTION FOR LIGHTING/MONTH (Kwh/M):					51996.42: