ENERGY CONSERVATION SYMPOSIUM

SAUDI ARAMCO

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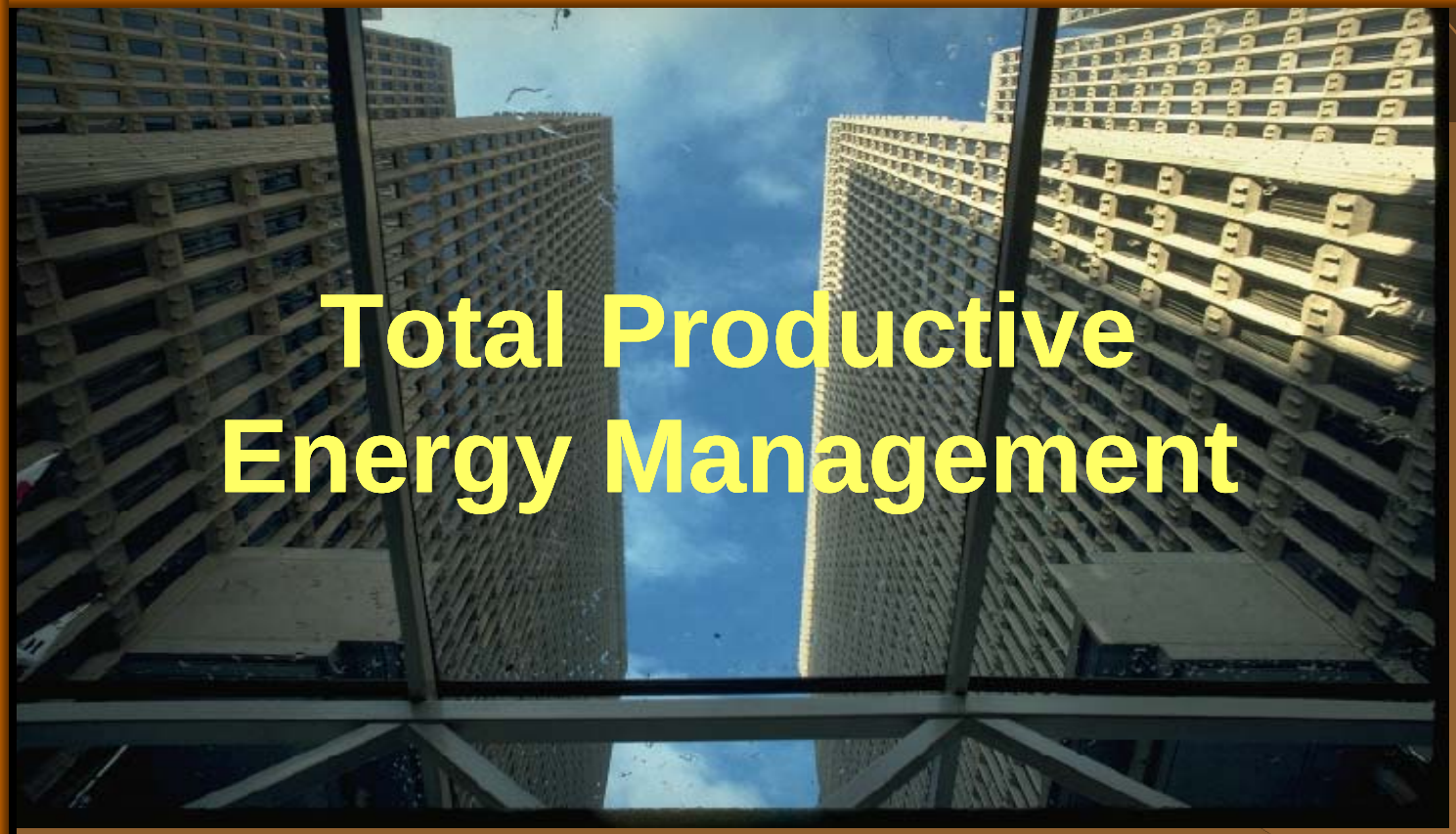

Total Productive Energy Management

إدارة الطاقة الشاملة

TPEM Approcah

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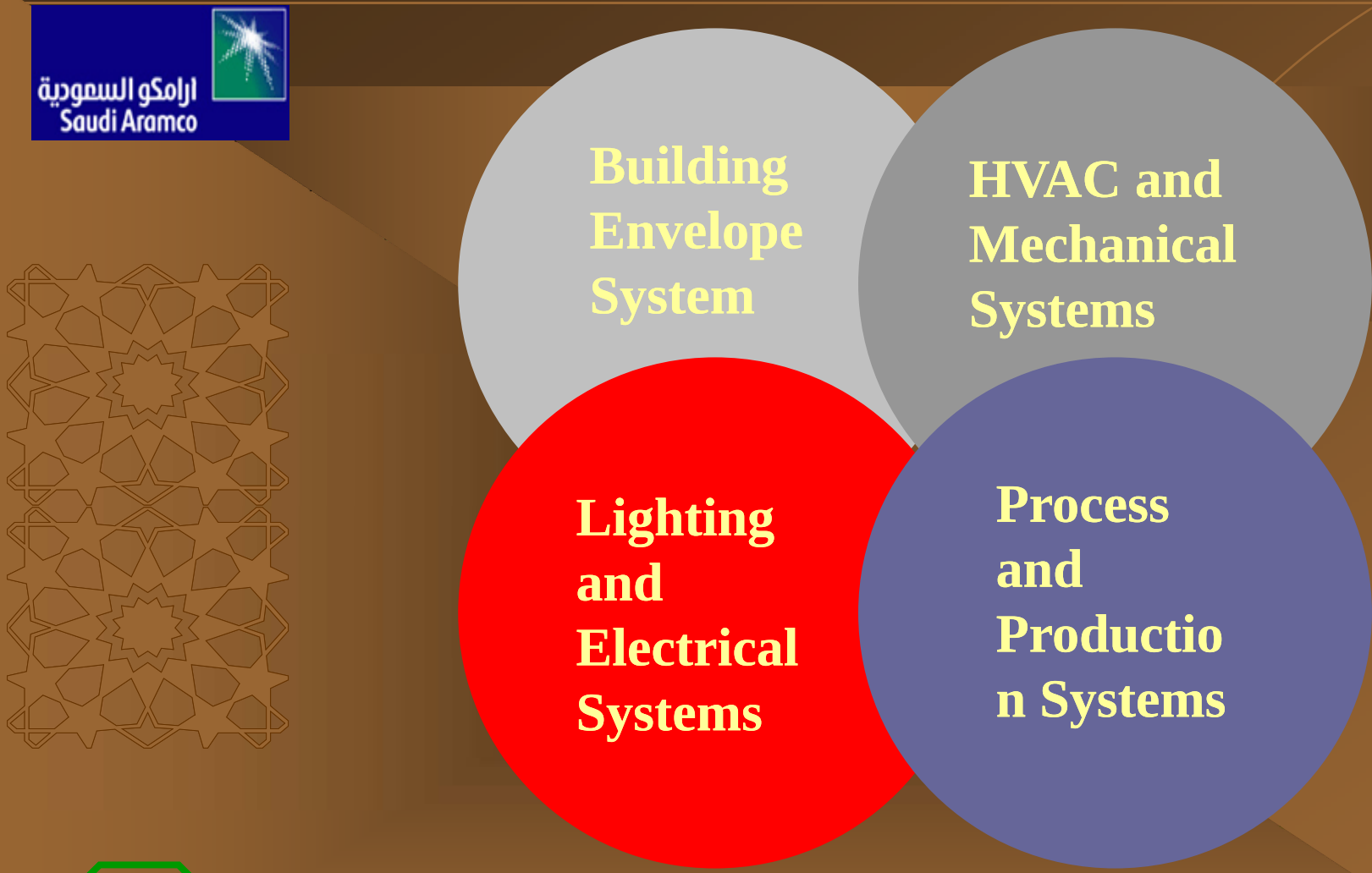
Introduction

- Contemporary facilities house a lot of complex systems, most of which require power to operate.
- This places the operators and users of these facilities in competitive roles with regard to their respective share of available energy, a fact that can no longer be ignored.
- The various energy systems in a facility interact to achieve the desired environment and/or process

- The performance of such systems is reflected on the quality of the environment, productivity and long-term economics of the facility.
- A total systems approach of energy management is critical in achieving the desired objectives of energy management programs.
- Operation and maintenance of such systems will also have a great impact on their energy use.
- It is these day-to-day operations that have the greatest impact on energy consumption.



Facility Energy Systems Interaction

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Objectives

To introduces the concept of Total Productive Energy Management (TPEM) which is meant to involve all individuals in a facility in managing energy systems under their control, the aim being retained quality environment/product at reduced operating costs.

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What is Energy Conservation ?

Energy conservation means using less energy to achieve the same task. There are two aspects of energy conservation:

- ***Energy efficiency***
- ***Energy conservation involving user sacrifice***

What is Energy Conservation ? (cont.)

"Energy efficiency and/or energy conservation efforts should not be equated with discomfort, nor should they interfere with the primary function of the organization or facility. Energy conservation activities that disrupt or impede the normal functions of workers and/or processes and adversely affect productivity constitute false economies" [ASHRAE]

- Energy conservation technical measures alone are not enough. Without proper management, these efforts might result in false economies.

What is Energy Management ?

Many definitions exist for energy management, all of which agree on the same objective of *achieving the same task for less energy use without sacrificing the quality of the environment and/or products through the employment of capital, technology and management skills*.

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What is Energy Management ? (cont.)

1. **Principle of Saving Natural Resources**

2. **Economic Benefits**
   - 5-15% savings can be achieved with little or no capital expenditure
   - 15-30% is a common energy saving, and
   - 30-50% savings can be obtained with capital investment.

3. **Protection of the Environment**

4. **Customer Satisfaction and National Good**

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The Role of Operation and Maintenance in Energy Management

- Operation and maintenance (O&M) related decisions start in the design stage of the facility.
- Operation and maintenance personnel involvement in the design process is essential.

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- Operators report failures, inefficiency, and misuse and may be involved in maintenance aspects related to energy conservation in their workspace

- Poor maintenance and facility operation in a use-until-it fails mode or only following complaints might result in short-term reduced maintenance costs. However, long-term costs might be considerable.

- The problem is that the economics of O&M activities are difficult to evaluate and savings hard to quantify.

- However, it is important not to ignore the economics of quality.
- Behavioral based management aspects related to the operation of facility energy systems can have a significant impact on energy consumption.
- Savings ranging from 10% for thermostat settings to 50% for lighting management have been reported. These measures require no capital investment other than proper O&M and user participation.

The behavior of facility operators/users can not be ignored in any energy conservation campaign.

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Relevant Terms

Total Quality Management (TQM)

An approach to doing business with the objective of maximizing the competitiveness of an organization through continuous improvement of the quality of its people, products, services, processes and environments.

Total Productive Maintenance (TPM)

Productive maintenance with all employees participating through small-group activities.

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TPEM Approach

- Facility TQM is based on the principle that front-line employees should have the authority to make changes and other decisions at the lowest operating levels.
- Total productive maintenance (TPM) means that operators are responsible for the maintenance of the equipment they operate.
- TPM focuses on the equipment users (input side) of production as compared to TQM which focuses on the quality of the product (output side).

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- Can the concepts of TQM and TPM, applied successfully to the manufacturing processes, be applied to energy management?

- They can if unified objectives and enough motivation and teamwork with limited barriers between departments and employees exist.

- In a similar combined approach to that of TPM and TQM, the concept can be extended to total productive energy management (TPEM) where the employees of an organization become responsible for managing energy systems in the space(s) they occupy and/or equipment they operate.

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TPEM Objectives

- The objective of the proposed TPEM approach is to motivate all those involved in the operation/use and maintenance of a facility to achieve the same tasks with minimum use of available energy resources.
- TPEM requires an optimum use of required energy inputs to produce the required quality outputs (physical products or services).
- TPEM requires feedback from O&M on failures and inefficiencies to the design, engineering and production teams.

TPEM Objectives (cont)

- TPEM aims at improved quality of the working environment at decreased cost through the management of energy resources and increased equipment efficiency.

- TPEM focuses on formulating scattered behavioral-based energy conservation activities in an organization in a structured framework integrated with effective energy systems through people involvement and shared responsibilities.

TPEM main objectives can be achieved by:

- changing corporate culture to maximize the overall effectiveness of facility energy systems;
- involving the various departments through continuous feedback and exchanged experiences;
- the participation of every employee in the organization;
- the promotion of TPEM through motivation management and through group activities supported by awareness, training, and financial and social incentives.

To achieve these objectives, the need for the following should be realized:

- Strategic planning based on a scientific approach
- Economics of quality. Quality requires an economic perspective with long-term thinking
- Established targets
- Unified objectives, a sense of belonging to the facility (one family, limited barriers, conservation is everyone's job)

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- Top management commitment
- Long-term commitments
- Encouragement of informal teamwork and cooperation
- Involvement of employees in decision making; operators know more about their space needs and efficient equipment operation (seek their input and get them involved)

- Making managing energy resources a habit; managing behavior requires changing habits
- Making conservation of energy part of the production process
  (integrate energy management with O&M)
- Reporting achievements
- Adapting performance measures
- Rewarding success makers

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- Continuous education and training
- Continuous improvement

The aim is:

Total energy management not just conservation

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TPEM Implementation

- Most of the basic principles of TPEM are just good management techniques.
- The challenge comes in implementing these techniques involving people with different backgrounds, different needs, and different expectations.
- It will be up to the management not only to initiate TPEM but more important to maintain it active.

Steps for TPEM Implementation

Initiation Stage:

- Establish top management commitment to TPEM implementation;
- Announce top management decision to introduce TPEM;
- Establish TPEM promotion staff and form TPEM promotion teams;

Steps for TPEM Implementation (Cont.)

Initiation Stage (Cont.):

- Launch an awareness and education campaign to familiarize people with TPEM;
- Formulate TPEM organization-wide development and implementation plan;
- Establish TPEM policies and goals by analyzing existing conditions;

Steps for TPEM Implementation (Cont.)

Implementation stage:

- Preliminarily implement TPEM on selected groups and/or departments and assess preliminary results;
- Develop an energy management program based on employees involvement, set productivity measures, dedicate responsibilities, and establish accountability;
- Improve energy effectiveness of energy consuming equipment and systems in the facility;

Steps for TPEM Implementation (Cont.)

Implementation stage (cont.):

- Set equipment/systems energy efficiency as an operation and maintenance criterion;
- Conduct education and training programs to raise energy awareness;
- Evaluate results and announce achievements;

Steps for TPEM Implementation (Cont.)

Implementation stage (cont.):

- Motivate O&M personnel, employees and end users and seek their feedback;
- Implement TPEM fully, increase TPEM levels, and set higher targets.

It is important to recognize that employee motivation for active participation in the program is a major ingredient to TPEM.

Means of Motivation

- Commitment and set examples from top management;
- Understand the psychology of employees to know how to motivate them;
- Relate to the principles of saving natural resources;
- Relate conservation to human well being, health, environment, as well as economics;

Means of Motivation (Cont.)

- Dedicate responsibilities for certain actions at certain times;
- Hold every individual or group of individuals accountable for the management of energy systems/equipment in their area of work ;
- Provide incentives to satisfy employees needs (financial and social);

Means of Motivation (Cont.)

- Conduct continuous in-house and outside training for employees;
- Solicit employee ideas for more efficient use of energy;
- Respond to these ideas and never ignore them;
- Establish TPEM prizes (annual) on the organization level as well as the national level.

Conclusions

- The concept of total productive energy management has been introduced.
- TPEM aims at involving employees in all levels of an organization in effectively operating the energy systems of the facility they occupy.
- TPEM will help implant the seeds of energy awareness and effective management of energy resource habits in employees
- Energy savings through day-to-day wise use/operation and maintenance practices can be more feasible to implement than those achieved through major retrofits.

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Conclusions (cont.)

- Negative attitudes toward energy conservation can be overcome through the implementation of TPEM by involving all concerned in daily use/operation and maintenance of the facility.
- Implementation of TPEM approach needs to be conducted and savings to be quantified for an appreciation of its effectiveness.
- A successful TPEM program requires all involved to understand and appreciate the answers to some questions of concern.

Facility Energy Management: Questions of Concern

Facility Energy Management

What?

Optimize energy resources and to achieve the same tasks with less energy.

Why?

- **Principle**
- **Economics**
- **Environmental**
- **National good**

When?

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Facility Energy Management: Questions of Concern

When?

- **Design stage**
- **Operation and maintenance stage**

Who?

All concerned. Facility:

- **Designers**
- **Top management**
- **Maintainers**
- **Operators**
- **Employees**
- **End users**

How?

- **Established targets**
- **Efficient design**
- **Efficient equipment/systems**
- **Commitment**
- **Effective Management**
- **Team work**
- **Motivation**
- **Reporting results**
- **Continuous improvement**

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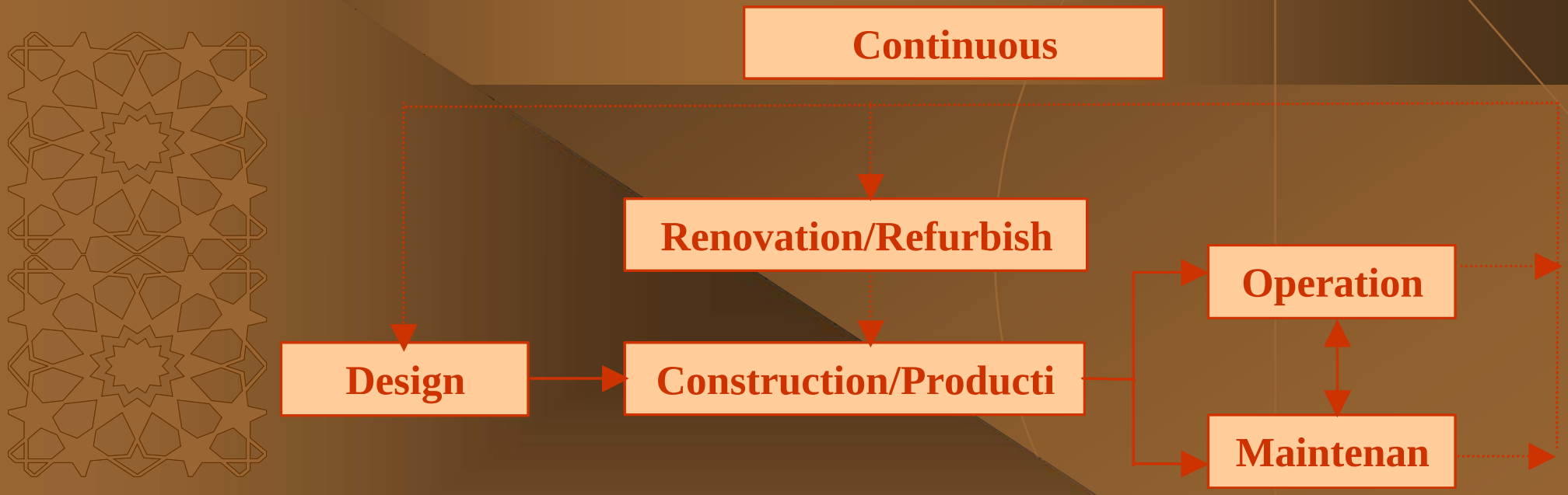

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ارامكو السعودية
Saudi Aramco

Thank You

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