TEN2202-Green and Sustainable Technologies (2C)

ISO 9001, Energy Audits, Energy Economics

Topics covered in this session:

- **Energy Management ✔**
- **ISO 9001**
- **Energy Audits**
- **Energy Economics**

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What is a Quality System?

- A quality system is formally described as **"the organizational structure, responsibilities, procedures, processes and resources for implementing the management of quality".**

What is the ISO 9000 Standards Series?

- ISO 9000 is defined as a set of international standards on quality management and quality assurance developed to help companies effectively document the quality system elements needed to maintain an efficient quality system.
- They are not specific to any one industry and can be applied to organizations of any size.

- ISO 9000 can help a company satisfy its customers, meet regulatory requirements, and achieve continual improvement.
- It should be considered to be a first step or the base level of a quality system.
- ISO 9000 is a series, or family, of quality management standards, while ISO 9001 is a standard within the family.
- The ISO 9000 family of standards also contains an individual standard named ISO 9000. This standard lays out the fundamentals and vocabulary for Quality Management Systems.

9000

Describes the standards for a quality management. Called Vocabulary and Fundamentals.

9001

The requirements for compliance with the standard. This is what organizations certify in.

9002

Identical to 9001, but focused on existing production lines. Obsolete.

9003

Quality assurance in final inspection and test. Obsolete

9004

Guidelines for long-term success of an organization. Obsolete. Now covered by 9000:2015.

1987

ISO 9000 series of standards released

1994

Revision focuses on quality assurance, less on quality inspection.

2000

Rewrite recognizes importance of process management and stakeholder needs.

2008

Added ISO 9004:2009, "Managing for sustained success."

2015

25th anniversary of ISO 9000. Focus on PDCA at all levels of organization—systems management.

Why ISO 9001?

- This standard is based on a number of quality management principles including a strong customer focus, the motivation and implication of top management, the process approach and continual improvement.
- Using ISO 9001 helps ensure that customers get consistent, good-quality products and services, which in turn brings many business benefits.

Introduction

0.1 General

- The adoption of a quality management system is a strategic decision for an organization that can help to improve its overall performance and provide a sound basis for sustainable development initiatives.

- The potential benefits to an organization of implementing a quality management system based on this International Standard are:

  a) the ability to consistently provide products and services that meet customer and applicable regulatory requirements;

  b) facilitating opportunities to enhance customer satisfaction;

  c) addressing risks and opportunities associated with its context and objectives;

  d) the ability to demonstrate conformity to specified quality management system requirements.

- This International Standard can be used by internal and external parties.
- The QMS requirements specified in this International Standard are complementary to requirements for products and services.
- This International Standard employs the process approach, which incorporates the PDCA cycle and risk-based thinking.
- The process approach enables an organization to plan its processes and their interactions.
- The PDCA cycle enables an organization to ensure that its processes are adequately resourced and managed, and that opportunities for improvement are determined and acted on.

- Risk-based thinking enables an organization to determine the factors that could cause its processes and its quality management system to deviate from the planned results, to put in place preventive controls to minimize negative effects and to make maximum use of opportunities as they arise.
- Consistently meeting requirements and addressing future needs and expectations poses a challenge for organizations in an increasingly dynamic and complex environment.
- To achieve this objective, the organization might find it necessary to adopt various forms of improvement in addition to correction and continual improvement, such as breakthrough change, innovation and re-organization.

0.2 Quality Management Principles

- This International Standard is based on the quality management principles described in ISO 9000.
- The descriptions include a statement of each principle, a rationale of why the principle is important for the organization, some examples of benefits associated with the principle and examples of typical actions to improve the organization's performance when applying the principle.

- The quality management principles are:
  - ✔ customer focus;
  - ✔ leadership;
  - ✔ engagement of people;
  - ✔ process approach;
  - ✔ improvement;
  - ✔ evidence-based decision making;
  - ✔ relationship management.

0.3 Process Approach - 0.3.1 General

- This International Standard promotes the adoption of a process approach when developing, implementing and improving the effectiveness of a quality management system, to enhance customer satisfaction by meeting customer requirements.
- Specific requirements considered essential to the adoption of a process approach are included.
- Understanding and managing interrelated processes as a system contributes to the organization's effectiveness and efficiency in achieving its intended results.

- This approach enables the organization to control the interrelationships and interdependencies among the processes of the system, so that the overall performance of the organization can be enhanced.
- The process approach involves the systematic definition and management of processes, and their interactions, so as to achieve the intended results in accordance with the quality policy and strategic direction of the organization.
- Management of the processes and the system as a whole can be achieved using the PDCA cycle with an overall focus on risk-based thinking aimed at taking advantage of opportunities and preventing undesirable results.

- The application of the process approach in a quality management system enables:
  - ✔ understanding and consistency in meeting requirements;
  - ✔ the consideration of processes in terms of added value;
  - ✔ the achievement of effective process performance;
  - ✔ improvement of processes based on evaluation of data and information.

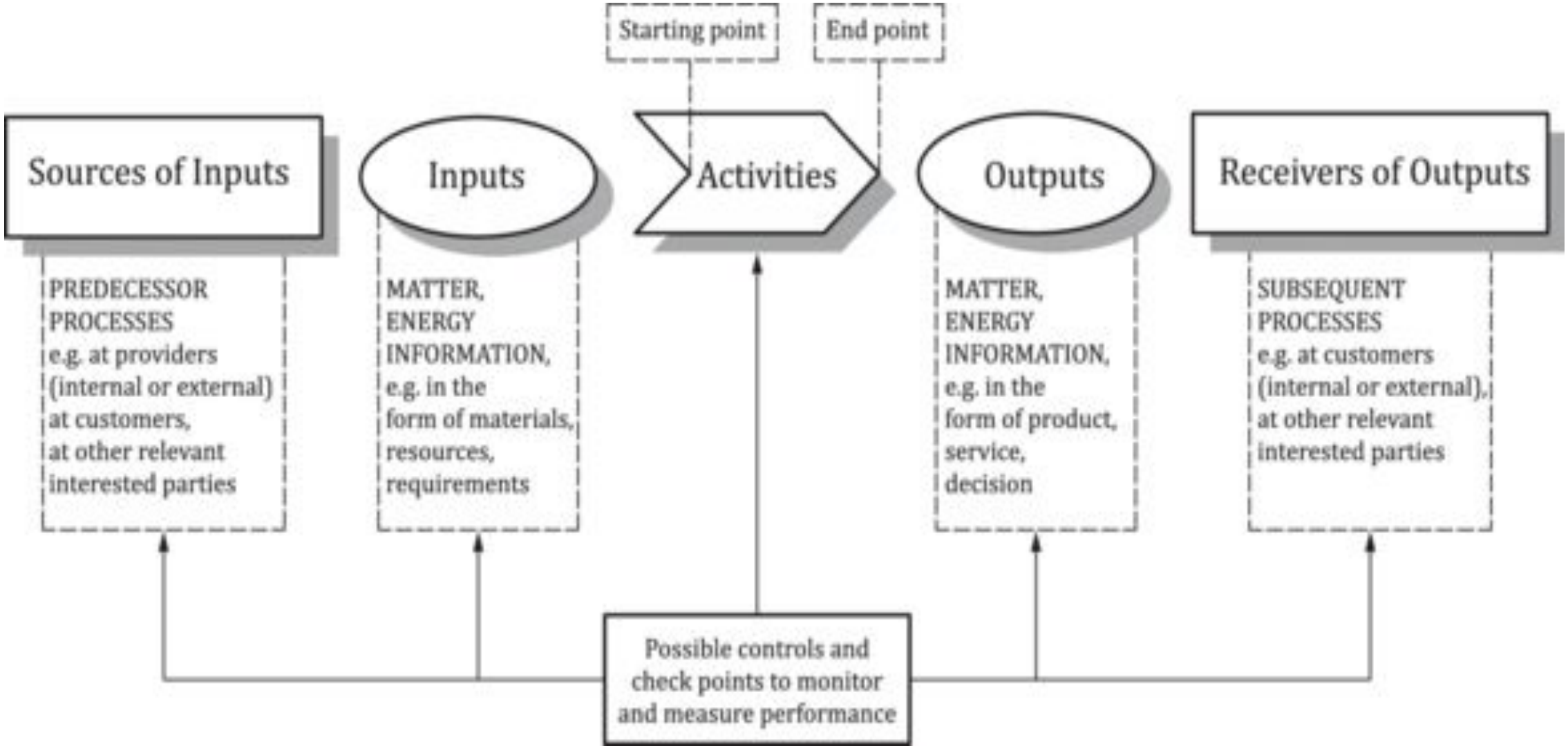
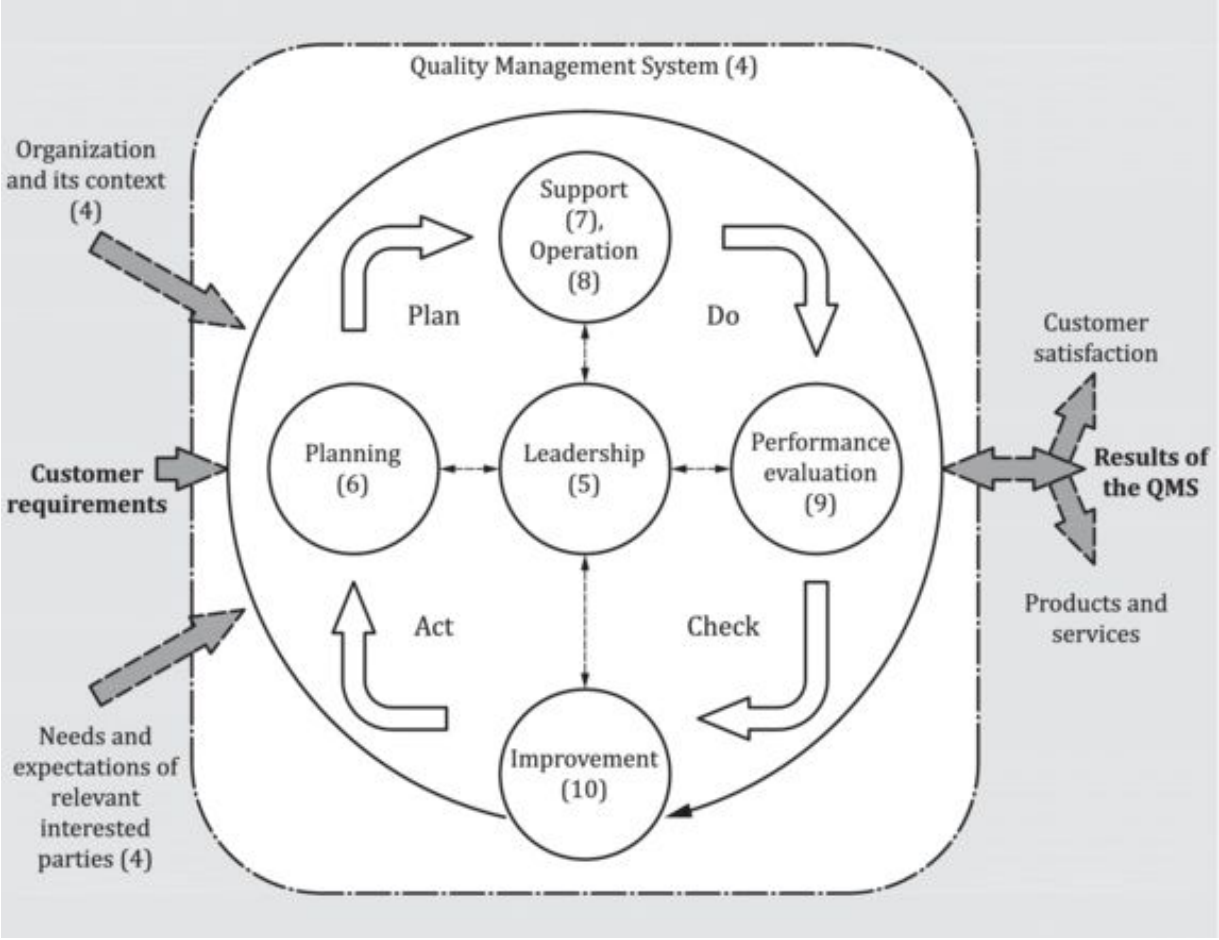


Figure 1- Schematic representation of the elements of a single process

0.3.2 Plan-Do-Check-Act cycle

- The PDCA cycle can be applied to all processes and to the quality management system as a whole.



- The PDCA cycle can be briefly described as follows:
  - ✔ **Plan**: establish the objectives of the system and its processes, and the resources needed to deliver results in accordance with customers' requirements and the organization's policies, and identify and address risks and opportunities;
  - ✔ **Do**: implement what was planned;
  - ✔ **Check**: monitor and (where applicable) measure processes and the resulting products and services against policies, objectives, requirements and planned activities, and report the results;
  - ✔ **Act**: take actions to improve performance, as necessary.

0.3.3 Risk-Based Thinking

- Risk-based thinking is essential for achieving an effective quality management system.
- To conform to the requirements of this International Standard, an organization needs to plan and implement actions to address risks and opportunities.
- Addressing both risks and opportunities establishes a basis for increasing the effectiveness of the quality management system, achieving improved results and preventing negative effects.

- Opportunities can arise as a result of a situation favorable to achieving an intended result.
- Actions to address opportunities can also include consideration of associated risks.
- Risk is the effect of uncertainty and any such uncertainty can have positive or negative effects.
- A positive deviation arising from a risk can provide an opportunity, but not all positive effects of risk result in opportunities.

0.4 Relationship with Other Management System Standards

- This International Standard relates to ISO 9000 and ISO 9004 as follows:
  - ✔ ISO 9000 Quality management systems - Fundamentals and vocabulary provides essential background for the proper understanding and implementation of this International Standard;
  - ✔ ISO 9004 Managing for the sustained success of an organization - A quality management approach provides guidance for organizations that choose to progress beyond the requirements of this International Standard.

1) Scope

- This International Standard specifies requirements for a quality management system when an organization:

  a) needs to demonstrate its ability to consistently provide products and services that meet customer and applicable regulatory requirements, and

  b) aims to enhance customer satisfaction through the effective application of the system, including processes for improvement of the system and the assurance of conformity to customer and applicable statutory and regulatory requirements.

- All the requirements of this International Standard are generic and are intended to be applicable to any organization, regardless of its type or size, or the products and services it provides.
- NOTE 1 In this International Standard, the terms “product” or “service” only apply to products and services intended for, or required by, a customer.
- NOTE 2 Statutory and regulatory requirements can be expressed as legal requirements.

2) Normative References

- The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application.
- For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.
- ISO 9000:2015, Quality management systems — Fundamentals and vocabulary

Energy Audits

What is the Energy Audits?

- Energy Audit is the key to a systematic approach for decision-making in the area of energy management.
- It attempts to balance the total energy inputs with its use, and serves to identify all the energy streams in a facility.
- It quantifies energy usage according to its discrete functions. Industrial energy audit is an effective tool in defining and pursuing comprehensive energy management program.

As per the Energy Conservation Act, 2001, Energy Audit is defined as ***"the verification, monitoring and analysis of use of energy including submission of technical report containing recommendations for improving energy efficiency with cost benefit analysis and an action plan to reduce energy consumption".***

Need for Energy Audit

- In any industry, the three top operating expenses are often found to be energy (both electrical and thermal), labor and materials.
- If one were to relate to the manageability of the cost or potential cost savings in each of the above components, energy would invariably emerge as a top ranker, and thus energy management function constitutes a strategic area for cost reduction.
- Energy Audit will help to understand more about the ways energy and fuel are used in any industry, and help in identifying the areas where waste can occur and where scope for improvement exists.

- The Energy Audit would give a positive orientation to the energy cost reduction, preventive maintenance and quality control program which are vital for production and utility activities.
- Such an audit program will help to keep focus on variations which occur in the energy costs, availability and reliability of supply of energy, decide on appropriate energy mix, identify energy conservation technologies, retrofit for energy conservation equipment etc.

- It is the translation of conservation ideas into realities, by lending technically feasible solutions with economic and other organizational considerations within a specified time frame.
- The primary objective of Energy Audit is to determine ways to reduce energy consumption per unit of product output or to lower operating costs.
- Energy Audit provides a " bench-mark“ (Reference point) for managing energy in the organization and also provides the basis for planning a more effective use of energy throughout the organization.

Principles of Energy Audit

- Eliminate unnecessary energy usage.
- Improve efficiency of energy usage.
- Buying energy at low cost.
- Adjusting operations to allow purchasing energy at low prices.
- Control the cost of energy not the BTU.
- Control energy as a product cost.
- For same energy higher production.
- Energy saved is the money earned which can be used in the other productive means.

Type of Energy Audit

- The type of Energy Audit to be performed depends on:
  - Function and type of industry
  - Depth to which final audit is needed, and
  - Potential and magnitude of cost reduction desired
- Thus Energy Audit can be classified into the following two types.

1) Preliminary Audit

2) Detailed Audit

1) Preliminary Energy Audit Methodology

Preliminary energy audit is a relatively quick exercise to:

- Establish energy consumption in the organization
- Estimate the scope for saving
- Identify the most likely (and the easiest areas for attention
- Identify immediate (especially no-/low-cost) improvements/ savings
- Set a 'reference point'
- Identify areas for more detailed study/measurement

2) Detailed Energy Audit Methodology

- A comprehensive audit provides a detailed energy project implementation plan for a facility, since it evaluates all major energy using systems.
- This type of audit offers the most accurate estimate of energy savings and cost.
- It considers the interactive effects of all projects, accounts for the energy use of all major equipment, and includes detailed energy cost saving calculations and project cost.
- In a comprehensive audit, one of the key elements is the energy balance.

- This is based on an inventory of energy using systems, assumptions of current operating conditions and calculations of energy use.
- This estimated use is then compared to utility bill charges.
- Detailed energy auditing is carried out in three phases: Phase I, II and III.

Phase I - Pre Audit Phase

Phase II - Audit Phase

Phase III - Post Audit Phase

Ten Steps Methodology for Detailed Energy Audit

Step No	PLAN OF ACTION	PURPOSE / RESULTS
	Phase I –Pre Audit Phase	
Step 1	• Plan and organise • Walk through Audit • Informal Interview with Energy Manager, Production / Plant Manager	• Resource planning, Establish/organize a Energy audit team • Organize Instruments & time frame • Macro Data collection (suitable to type of industry.) • Familiarization of process/plant activities • First hand observation & Assessment of current level operation and practices
Step 2	• Conduct of brief meeting / awareness programme with all divisional heads and persons concerned (2-3 hrs.)	• Building up cooperation • Issue questionnaire for each department • Orientation, awareness creation

Step 3	Phase II –Audit Phase • Primary data gathering, Process Flow Diagram, & Energy Utility Diagram	• Historic data analysis, Baseline data collection • Prepare process flow charts • All service utilities system diagram (Example: Single line power distribution diagram, water, compressed air & steam distribution. • Design, operating data and schedule of operation • Annual Energy Bill and energy consumption pattern (Refer manual, log sheet, name plate, interview)
Step 4	• Conduct survey and monitoring	• Measurements : Motor survey, Insulation, and Lighting survey with portable instruments for collection of more and accurate data. Confirm and compare operating data with design data.
Step 5	• Conduct of detailed trials /experiments for selected energy guzzlers	• Trials/Experiments: - 24 hours power monitoring (MD, PF, kWh etc.). - Load variations trends in pumps, fan compressors etc.

		- Boiler/Efficiency trials for (4 – 8 hours) - Furnace Efficiency trials Equipments Performance experiments etc
Step6	• Analysis of energy use	• Energy and Material balance & energy loss/waste analysis
Step 7	• Identification and development of Energy Conservation (ENCON) opportunities	• Identification & Consolidation ENCON measures • Conceive, develop, and refine ideas • Review the previous ideas suggested by unit personal • Review the previous ideas suggested by energy audit if any • Use brainstorming and value analysis techniques • Contact vendors for new/efficient technology

Step 8	• Cost benefit analysis	• Assess technical feasibility, economic viability and prioritization of ENCON options for implementation • Select the most promising projects • Prioritise by low, medium, long term measures
Step9	• Reporting & Presentation to the Top Management	• Documentation, Report Presentation to the top Management.
	<u>Phase III –Post Audit phase</u>	
Step10	• Implementation and Follow-up	Assist and Implement ENCON recommendation measures and Monitor the performance • Action plan, Schedule for implementation • Follow-up and periodic review

Energy Economics

- Energy economics studies energy resources and energy commodities, and includes: forces motivating firms and consumers to supply, convert, transport, use energy resources, and to dispose of residuals; market structures and regulatory structures; distributional and environmental consequences; economically efficient use.

- It recognizes: (a) energy is neither created nor destroyed but can be converted among forms; (b) energy comes from the physical environment and ultimately returns there.
- Humans harness energy conversion processes to provide energy services.
- Energy demand is derived from preferences for energy services and depends on properties of conversion technologies and costs.
- Energy commodities are economic substitutes. Energy resources are depletable or renewable, and storable or non-storable.

- Human energy use other than for food is predominantly depletable resources, particularly fossil fuels.
- Market forces may guide a transition back to renewable resources.
- Intertemporal optimal depletable resource extraction paths include an opportunity cost, or rent.
- World oil prices remain above pre-1973 levels and remain volatile as a result of OPEC market power. Oil supply disruptions of the 1970s led to economic harm.

- Environmental damages from energy use include climate change from greenhouse gases, primarily carbon dioxide.
- Environmental costs not incorporated into energy prices (externalities) lead to overuse of energy and motivate policy interventions.
- It takes into account market structures, regulatory frameworks, and environmental impacts.
- It also analyses demand drivers and demand patterns highlighting preferences and changes in consumer behavior resulting from technological, regulatory, and general socioeconomic and environmental factors.

- It will examine the environmental objectives influencing energy policies and decision making in global energy markets.
- The debate on environmental priorities recognizes the difference in socioeconomic realities between developed and developing countries in terms of access to energy resources and different stages of economic development.
- It also highlights that in recent years environmental goals are no longer considered to be an obstruction to economic development but part of the solution.

- The changes taking place in global energy markets are analyzed, including the impact of oil prices, energy availability, and increase in government regulation, as well as the concern over energy security and emission reduction, which are shaping some of these changes.

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THANK YOU
RENEWAB LE ENERGY