Presentation on Energy Management and Audit

Submitted by:

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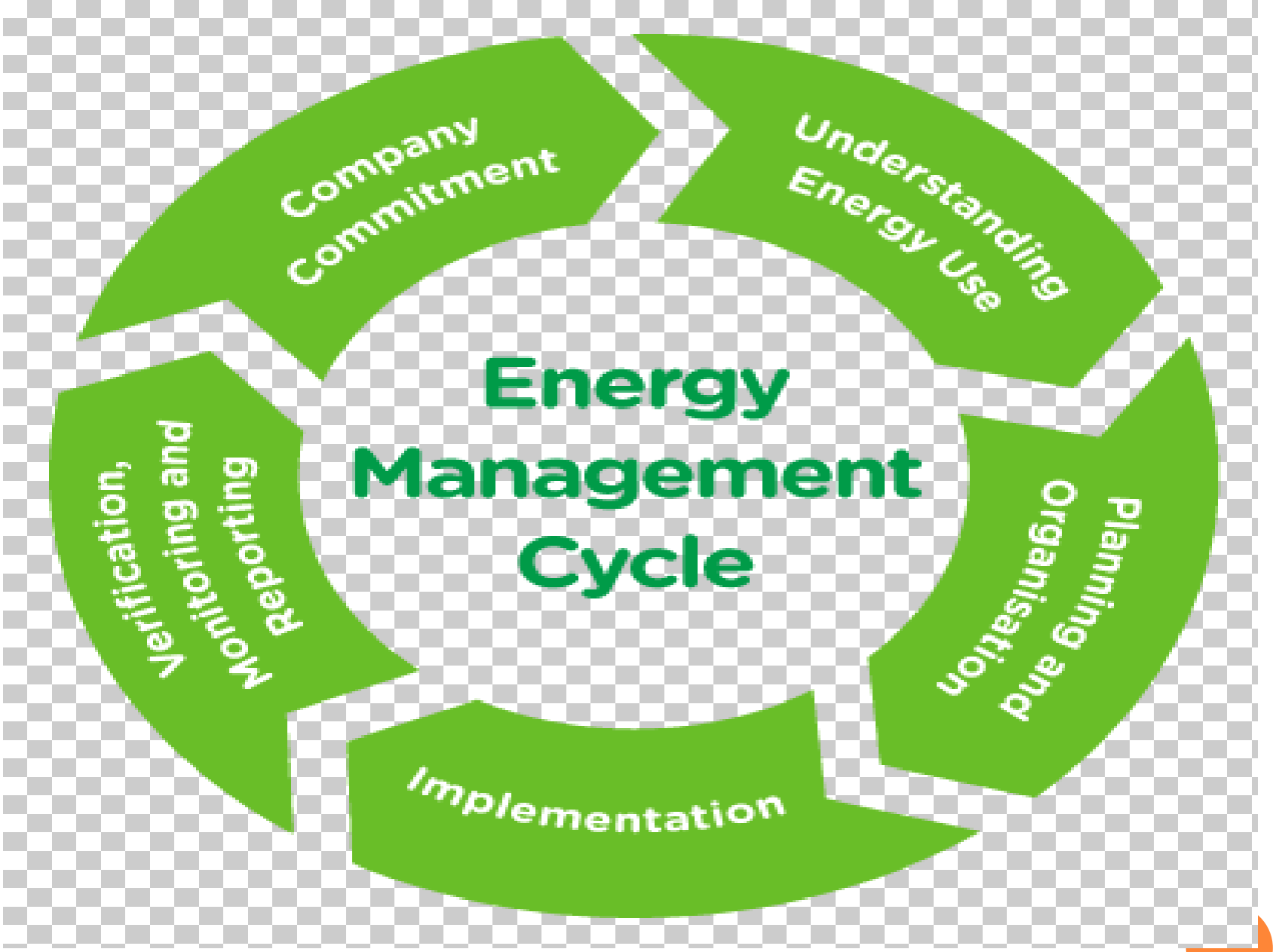
Energy Management

- Energy Management encompasses a wide range of activities and expertise in the optimal use of energy. This includes the areas of:
- development of management strategies programmes and plans,
- implementation of techniques, technology and tools
- measurement, verification and control.


Company Commitment
Understanding Energy Use
Planning and Organisation
Implementation
Verification, Monitoring and Reporting
Energy Management Cycle

Objectives of Energy Management

- Eliminating unnecessary energy use
- Improving the efficiency of needed energy use
- Buying energy at lower net prices
- Adjusting operations to allow purchasing energy at lower prices

What is Energy Audit

- In the Indian Energy Conservation Act of 2001 (BEE 2008), an energy audit is defined as:

"The verification, monitoring and analysis of the use of energy and submission of technical report containing recommendations for improving energy efficiency with cost-benefit analysis and an action plan to reduce energy consumption."

Energy Audit-Description

- The energy audit is one of the first tasks to be performed in accomplishing an effective energy management program.
- It is designed to improve the energy efficiency and reduce the energy operating costs of a facility.
- The energy audit is sometimes called an energy surveyor an energy analysis, so that it is not confused with a financial audit.
- The term “audit” should be avoided if it clearly produces a negative image in the mind of a particular business, organization, or individual.
- The audit process starts by collecting information about a facility’s operation and about its past record of utility bills.
- This data is then analyzed to get a picture of how the facility uses – and possibly wastes – energy, as well as to help the auditor learn what areas to examine to reduce energy costs.

CONTD….

- Specific changes – called Energy Conservation Measures (ECM's) – are identified and evaluated to determine their benefits and their cost effectiveness.
- These ECM's are assessed in terms of their costs and benefits, and an economic comparison is made to rank the various ECM's.
- Finally, an Energy Action Plan is created where certain ECM's are selected for implementation, and the actual process of saving energy and money begins.

OBJECTIVES OF ENERGY AUDIT

- an energy audit is usually conducted to understand how energy is used within the plant and to find opportunities for improvement and energy saving.
- Sometimes, energy audits are conducted to evaluate the effectiveness of an energy efficiency project or program

Types of Enegry Audit

Preliminary audit (Walk-through audit)

- In a preliminary energy audit, readily-available data are mostly used for a simple analysis of energy use and performance of the plant.
- This type of audit does not require a lot of measurement and data collection. These audits take a relatively short time and the results are more general, providing common opportunities for energy efficiency.
- The economic analysis is typically limited to calculation of the simple payback period, or the time required paying back the initial capital investment through realized energy savings

B) Detailed audit (Diagnostic audit)

- For detailed (or diagnostic) energy audits, more detailed data and information are required. Measurements and a data inventory are usually conducted and different energy systems (pump, fan, compressed air, steam, process heating, etc.) are assessed in detail. Hence, the time required for this type of audit is longer than that of preliminary audits.
- The results of these audits are more comprehensive and useful since they give a more accurate picture of the energy performance of the plant and more specific recommendation for improvements.
- The economic analysis conducted for the efficiency measures recommended typically go beyond the simple payback period and usually include the calculation of an internal rate of return (IRR), net present value (NPV), and often also life cycle cost (LCC).

Targeted Energy Audit

- Targeted energy audits are mostly based upon the outcome of the preliminary audit results. They provide data and detailed analysis on specified target projects.
- As an example, an organization may target its lighting system or boiler system or compressed air system with a view to bring about energy savings.
- Targeted audits therefore involve detailed surveys of the target subjects/areas with analysis of the energy flows and costs associated with those targets.

Ten Steps For Audit

The Ten Steps for Detailed 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

	Phase II –Audit Phase	
Step 3	• 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.

Step No	PLAN OF ACTION	PURPOSE / RESULTS
Step10	Phase III –Post Audit phase • Implementation and Follow-up	Assist and Implement ENCON recommendations measures and Monitor the performance • Action plan. Schedule for implementation • Follow-up and periodic review

Good Collaboration with energy manager is important

Energy Audit Instruments

Energy Audit

Energy Audit Instruments

1. *Electrical parameters*
2. *Combustion analyzer*
3. *Fuel efficiency monitor*
4. *Fyrites- gas analyzer*
5. *Temperature measurements*
6. *Pressure measurements*
7. *Velocity measurements*
8. *Speed measurements*
9. *Leak detectors*
10. *Measurement of light*
11. *Measurement of water flow*
12. *Humidity measurement*

FLUE GAS ANALYSERS

Combustion analyzer:
This instrument has in-built chemical cells which measure various gases such as CO_2, CO, NO_x, SO_x etc.

Fuel Efficiency Monitor:
This measures Oxygen and temperature of the flue gas. Calorific values of common fuels are fed into the microprocessor which calculates the combustion efficiency.

Fyrite:

A hand bellow pump draws the flue gas sample into the solution inside the fyrite. A chemical reaction changes the liquid volume revealing the amount of gas. Percentage Oxygen or CO_2 can be read from the scale.

TEMPERATURE MEASURMENTS

Contact thermometer:

There are thermocouples which measure for example flue gas, hot air, hot water temperatures by insertion of probe into the stream.

For surface temperature a lead type probe is used with the same instrument.

Infrared Pyrometer:

This is a non-contact type measurement which when directed at a heat source directly gives the temperature read out. Can be useful for measuring hot jobs in furnaces, surface temperatures etc.

FLOW MEASURMENTS – AIR ,WATER

	**Pitot Tube and manometer:** Air velocity in ducts can be measured using a pitot tube and inclined manometer for further calculation of flows.
	**Ultrasonic flow meter:** This a non contact flow measuring device using Doppler effect principle. There is a transmitter and receiver which are positioned on opposite sides of the pipe. The meter directly gives the flow. Water and other fluid flows can be easily measured with this meter.

Energy management for cleaner production

- *Cleaner Production means the reduction of pollution by means of pollution preventive measures applied to products and production processes.*

Cleaner Production generates options for improvement in five categories:

- *Change of input materials;*
- *Technology change; Good operation practises; Product modification and on site re-use and recycling.*
- *Cleaner Production options can reduce the material-, energy- and water consumption per product, and*
- *increase savings made on the costs of these natural resources. The costs for processing waste streams*
- *(including solid waste, wastewater, air emissions) will increase in the next future. Minimizing waste*
- *streams and a pro-active compliance with laws and regulations can save money. And last but not least,*
- *most often with environmental measures, the efficiency of production processes will increase as well,resulting in higher levels of production output, or improvement of the product quality.*
- *Cleaner Production can be approached in four phases: planning and organisation; assessment; feasibility analysis; implementation and sustaining.*

Cleaner Production measures can be taken in 5 categories:

- Change of input materials;
- Technology change;
- Good operation practices;
- Product modification;
- On site re-use and recycling.

Cleaner Production usually:

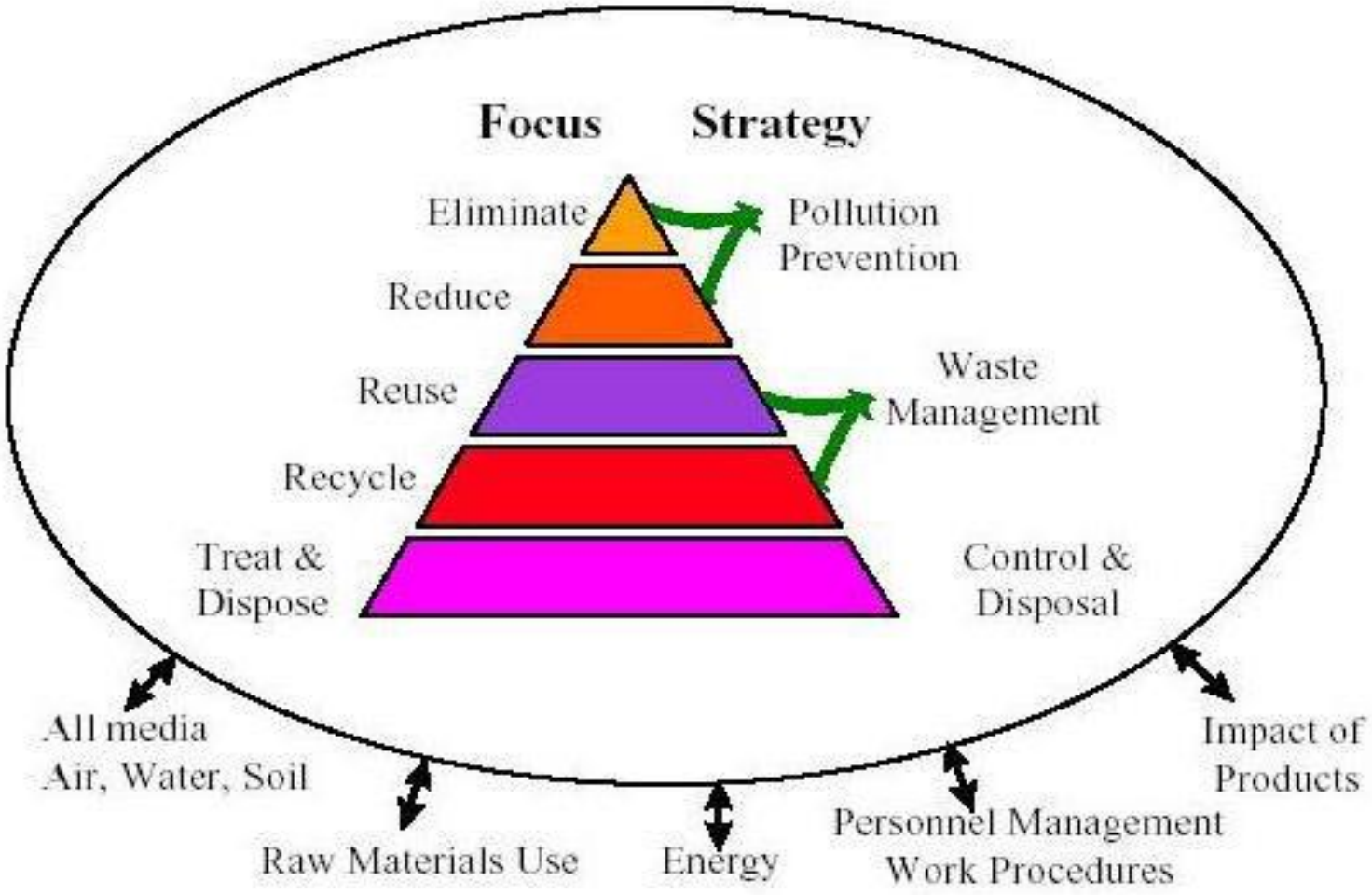
- Reduces long-term liabilities which companies can face many years after pollution has beengenerated or disposed at a given site;
- Increases profitability;
- Lowers production costs;
- Enhances productivity;
- Provides a rapid return on any capital or operating investments required;
- Increases product yield;
- Leads to the more efficient use of energy and raw materials;
- Results in improved product quality;

- Increases staff motivation;
- Relies on active worker participation in idea generation and implementation;
- Reduces consumer risks;
- Reduces the risk of environmental accidents;
- Is supported by employees, local communities, customers and the public.

Cleaner Production often:

- Avoids regulatory compliance costs;
- Leads to insurance savings;
- Provides enhanced access to capital from financial institutions and lenders;
- Is fast and easy to implement;
- Requires little capital investment.

Approach for cleaner production



Practices for cleaner production

1. *Good housekeeping*

- take appropriate *managerial and operational* actions to prevent:
- - leaks
- - spills
- - to enforce existing operational instructions

2. *Input substitution*

- substitute input materials
- - by less toxic
- - or by renewable materials
- - or by adjunct materials which have a longer service life-time in production

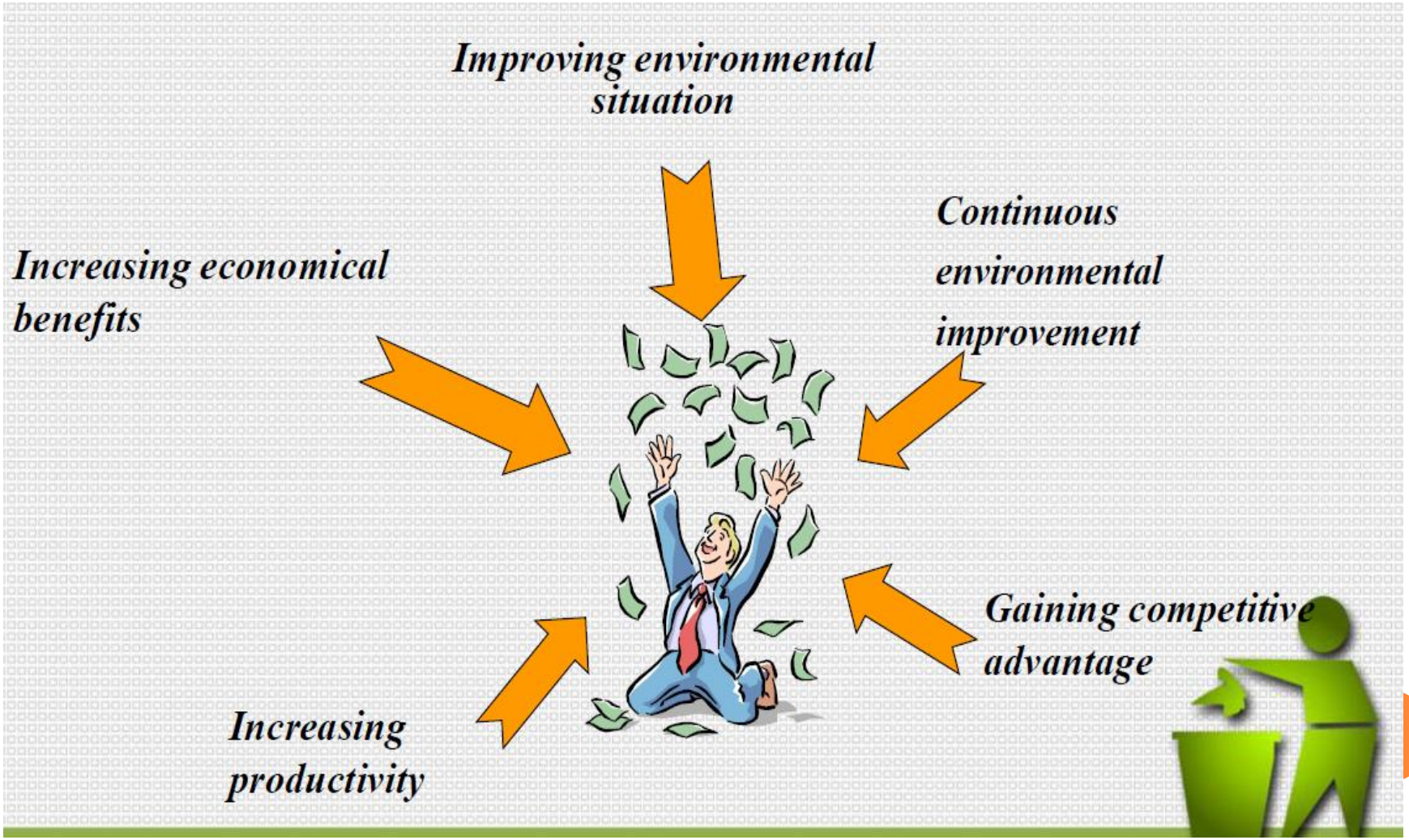
3. *Better process control*

- modify:
- - operational procedures
- - equipment instructions and process record keeping in order to run the processes more efficiently and at lower waste and emission generation rates

4. *Equipment modification*

- modify the existing production equipment and utilities in order:
- - run the processes at higher efficiency
- - lower waste and emission generation rates

Benefits of cleaner production



APPLICATION OF RENEWABLE ENERGY, APPROPRIATE TECHNOLOGIES.

- Wind energy A wind turbine produces power by converting the force of the wind (kinetic energy) acting on the rotor blades (rotational energy) into torque (turning force or mechanical energy). This rotational energy is used either within a generator to produce electricity or, perhaps less commonly, it is used directly for driving equipment such as milling machines or water pumps (often via conversion to linear motion for piston pumps). Water pumping applications are more common in developing countries

- wind energy systems are classified in three categories:

grid-connected electricity generating, stand-alone electricity generating (often subdivided into battery-based or autonomous diesel, the later having automatic start-up when the wind speed falls, although diesel generators may also be used within stand-alone battery systems) and mechanical systems.

- Solar energy Solar energy technologies can be loosely divided into two categories: solar thermal systems and solar electric or photovoltaic (PV) system

Applications

Technology type (PV/solar thermal)	System	Application
PV (solar electric)	Grid connected	Supplementing mains supply
PV (solar electric)	Stand-alone	Small home systems for lighting, radio, TV, etc. Small commercial/community systems, including health care, schools, etc. Telecommunications Navigation aids Water pumping Commercial systems Remote settlements Mini-grid systems
Solar thermal	Connected to existing water and/or space heating system	Supplementing supply of hot water and/or space heating provided by the electricity grid or gas network
Solar thermal	Stand-alone	Water heating, i.e. for rural clinics Drying (often grain or other agricultural products) Cooking Distillation Cooling

- Bioenergy

Bioenergy is a general term that covers energy derived from a wide variety of material of plant or animal origin. Strictly, this includes fossil fuels but, generally, the term is used to mean renewable energy sources such as wood and wood residues, agricultural crops and residues, animal fats, and animal and human wastes, all of which can yield useful fuels either directly or after some form of conversion. There are technologies for bioenergy using liquid and gaseous fuel, as well as traditional applications of direct combustion.

The conversion process can be physical (for example, drying, size, reduction or densification), thermal (as in carbonization) or chemical (as in biogas production). The end result of the conversion process may be a solid, liquid or gaseous fuel and this flexibility of choice in the physical form of the fuel is one of the advantages of bioenergy over other renewable energy sources. The basis for all these applications is organic matter, in most cases plants and trees. There is a trend towards purposefully planted biomass energy crops, although biomass can also be collected as a by-product and residue from agricultural, forestry, industry and household waste. Bioenergy can be used for a great variety of energy needs, from heating and transport fuel to power generation.

Application

Fuel state	Application
Biogas	Supplementing mains supply (grid-connected)
Biogas	Cooking and lighting (household-scale digesters), motive power for small industry and electric needs (with gas engine)
Liquid biofuel	Transport fuel and mechanical power, particularly for agriculture; heating and electricity generation; some rural cooking fuel
Solid biomass	Cooking and lighting (direct combustion), motive power for small industry and electric needs (with electric motor)

- Hydro

Hydropower is the extraction of energy from falling water (from a higher to a lower altitude) when it is made to pass through an energy conversion device, such as a water turbine or a water wheel. A water turbine converts the energy of water into mechanical energy, which in turn is often converted into electrical energy by means of a generator. Alternatively, hydropower can also be extracted from river currents when a suitable device is placed directly in a river. The devices employed in this case are generally known as river or water current turbines1 or a “zero head” turbine. This module will review only the former type of hydropower, as the latter has a limited potential and application.

- Geothermal

Geothermal is energy available as heat emitted from within the earth, usually in the form of hot water or steam. Geothermal heat has two sources: the original heat produced from the formation of the earth by gravitational collapse and the heat produced by the radioactive decay of various isotopes. It is very site dependent as the resource needs to be near surface and can be used for heating and power generation purposes. High temperature resources (150° C+) can be used for electricity generation, while low temperature resources (50-150° C) can be used for various direct uses such as district heating and industrial processing. Since the earth's crust is continuously emitting heat towards its surface at a rate of 40 million megawatts, geothermal is in principle an inexhaustible energy source, with the centre of the earth having cooled down by only about 2 per cent over the earth's lifetime of about 4 billion years.

Renewable energy technology	Energy service/application	Area of application
Wind turbines – grid-connected	Residential and industrial electricity, supplementing mains supply	Mostly urban
Wind Turbines – stand-alone	Power for lighting (homes, schools, streets), refrigeration (vaccine) and other low-to medium electric power needs (telecommunications, etc.) Occasionally mechanical power for agriculture.	Urban and rural
Wind pumps	Pumping water (for agriculture and drinking)	Mostly rural
PV (solar electric) – grid-connected	Residential and industrial electricity, supplementing mains supply	Mostly urban
PV (solar electric) – stand-alone	Power for lighting (homes, schools, streets), refrigeration (vaccine) and other low- to medium-voltage electric needs (telecommunications, etc.)	Urban and rural
Solar PV pumps	Pumping water (for agriculture and drinking)	Mostly rural
Solar thermal power plant – grid-connected	Residential and industrial electricity, supplementing mains supply	Mostly urban
Solar thermal – water heaters	Heating water	Urban and rural
Solar thermal – cookers	Cooking (for homes, commercial stoves, and ovens)	Mostly rural
Solar thermal – dryers	Drying crops	Mostly rural
Solar thermal – cooling	Air-conditioning (centralized system for buildings, etc.) Cooling for industrial processes	Mostly urban
Solid biomass	Cooking and lighting (direct combustion), motive power for small industry and electric needs (with electric motor)	Mostly rural
Liquid biofuel	Transport fuel and mechanical power, particularly for agriculture; heating and electricity generation; some rural cooking fuel	Urban and rural
Large hydro – grid-connected	Residential and industrial electricity, supplementing mains supply	Mostly urban
Small hydro	Lighting and other low-to-medium voltage electric needs (telecommunications, hand tools, etc.), process motive power for small industry (with electric motor)	Mostly rural
Geothermal	Grid electricity and large-scale heating.	Urban and rural
Village-scale	Mini-grids usually hybrid systems, solar and/or wind energy with diesel engines. Small-scale residential and commercial.	Mostly rural, some peri-urban


Thank
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