ATME College of Engineering

SUB: "ENVIRONMENTAL PROTECTION & MANAGEMENT"

SUB CODE:21CV753

MODULE 1

- **Environmental Management Standards**: Unique Characteristics of Environmental Problems – Systems approach to Corporate environmental management - Classification of Environmental Impact Reduction Efforts - Business Charter for Sustainable Production and Consumption – Tools, Business strategy drivers and Barriers - Evolution of Environmental Stewardship. Environmental Management Principles - National policies on environment, abatement of pollution and conservation of resources - Charter on Corporate responsibility for Environmental protection.

ENVIRONMENTAL MANAGEMENT SYSTEM

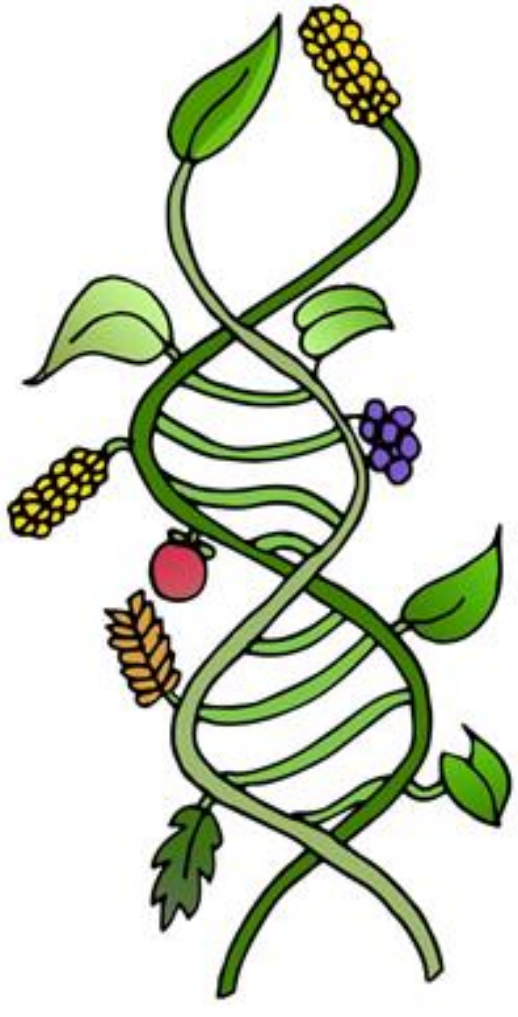
- The International Organization for Standardization (ISO) defines an environmental management system as “part of the management system used to manage environmental aspects, fulfill compliance obligations, and address risks and opportunities.”

UNIQUE CHARACTERISTICS OF ENVIRONMENTAL PROBLEMS

- **Global environmental problems involve one or more of the following:**

1. Deforestation
2. Desertification
3. Rapid Population Growth
4. Food Production and Equitable Distribution
5. Global Warming
6. Depletion of the Atmospheric Ozone
7. Acid Precipitation and Air Pollution
8. Ocean Pollution

1. Genetic Modification Of Crops



Genetically Modified Crops are plants whose DNA has been modified to introduce useful traits such as high yield, pest resistance, nutrition profile and flavour

UNIQUE CHARACTERISTICS OF ENVIRONMENTAL PROBLEMS

- GM foods are derived from plants whose genes are artificially modified, usually by inserting genetic material from another organism, in order to give it a new property, such as increased yield, tolerance to a herbicide, resistance to disease or drought, or to improve its nutritional value.
- There is also some speculation that genetically-modified plants may leak chemical compounds into soil through their roots, possibly affecting communities of microorganisms.

❖ Environmental concerns:

- They can reduce species diversity. For example, Insect-resistant plants might harm insects that are not their intended target and thus result in destruction of that particular species.
- GM technology could also allow the transfer of genes from one crop to another, creating “super weeds”, which will be immune to common control methods.
- Viral genes added to crops to confer resistance might be transferred to other viral pathogens, which can lead to new and more virulent virus strains.

2. Waste Production

- Solid Wastage Management (SWM) Rules, which replaced by the Municipal Solid Waste (Management and Handling) Rules, and 2000 of which had been in place for 16 years.
- India generates 62 million tonnes of waste each year. About 43 million tonnes (70%) are collected, of which about 12 million tonnes are treated, and 31 million tonnes are dumped in landfill sites.
- With changing consumption patterns and rapid economic growth, it is estimated that urban municipal solid waste generation will increase to 165 million tonnes in 2030.

- The average person produces 4.3 pounds of waste per day. Much of this waste ends up in landfills, which generate enormous amounts of methane.
- Not only does this create explosion hazards, but methane also ranks as one of the worst of the greenhouse gases because of its high global warming potential.

- **Methane:**

➢ It is the primary contributor to the formation of ground level ozone, a hazardous air pollutant and greenhouse gas.

➢ Exposure to methane causes 1 million premature deaths every year.

➢ Methane gas is a powerful gas. Over a 20 year period it is 80 times more potent at warming than Carbon dioxide.

3. Population Growth

- Many of the issues listed here result from the massive population growth that Earth has experienced in the last century.
- The planet’s population grows by 1.13% per year, which works out to 80 million people.
- This results in a number of issues, such as a lack of fresh water, habitat loss for wild animals, overuse of natural resources and even species extinction.
- The latter is particularly damaging, as the planet is now losing 30,000 species per year.

4. Water Pollution

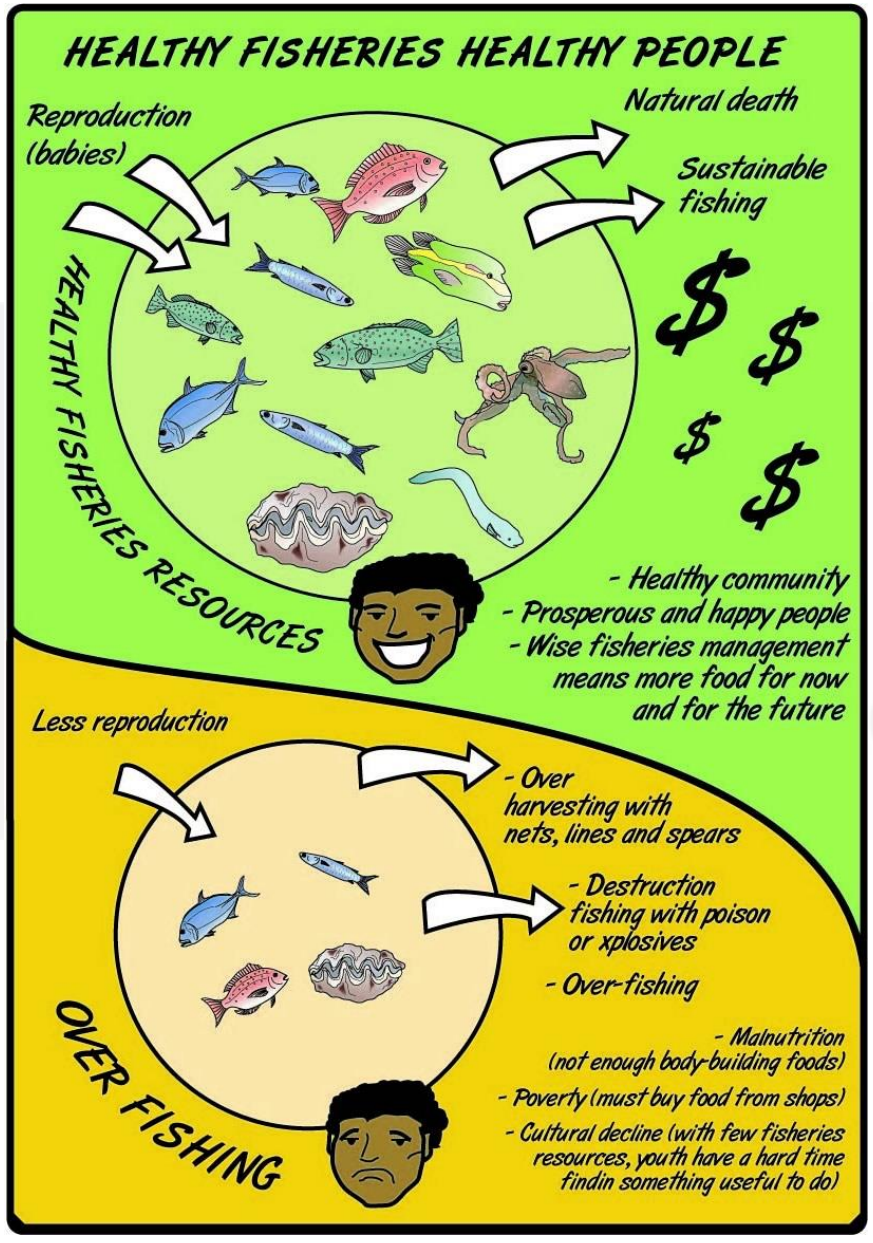
- Fresh water is crucial to life on Earth, yet more sources are being polluted through human activities each year.
- On a global scale, 2 million tons of sewage, agricultural and industrial waste enters the world’s water every day.
- Water pollution can have harmful effects outside of contamination of the water we drink. It also disrupts marine life, sometimes altering reproductive cycles and increasing mortality rates.

- **Water Pollution in India:**

➢ Around 80% of India's water is severely polluted because people dump raw sewage, silt and garbage into the country's rivers and lakes.

➢ Each year more than 1.5 million India children die from diarrhea.

5. Overfishing



- It is estimated that 63% of global fish stocks are now considered overfished. This has led to many fishing fleets heading to new waters, which will only serve to deplete fish stocks further.
- Overfishing leads to a misbalance of ocean life, severely affecting natural ecosystems in the process.
- Furthermore, it also has negative effects on coastal communities that rely on fishing to support their economies.

6. Deforestation

- The demands of an increasing population has resulted in increasing levels of deforestation.
- Current estimates state that the planet is losing 80,000 acres of tropical forests per day.
- This results in loss of habitat for many species, placing many at risk and leading to large-scale extinction.
- Furthermore, deforestation is estimated to produce 15% of the world's greenhouse gas emissions.

7. Urban Sprawl

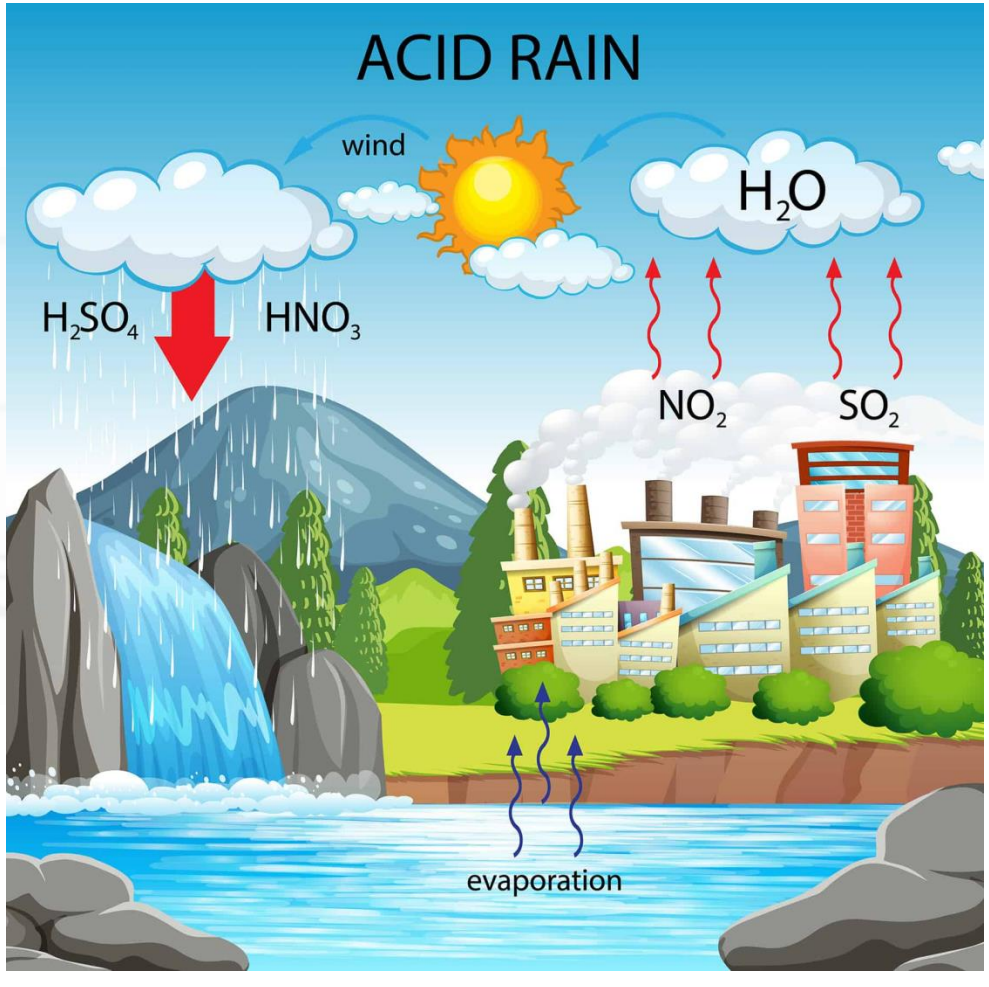
- The continued expansion of urban areas into traditionally rural regions is not without its problems.
- Urban sprawl has been linked to environmental issues like air and water pollution increases, in addition to the creation of heat-islands.
- Satellite images produced by NASA have also shown how urban sprawl contributes to forest fragmentation, which often leads to larger deforestation

Urban areas in India by Category

Type of Urban Area	2011 Census	2001 Census
Towns	7,935	5,161
a. Statutory towns	4,041	3,799
b. Census towns	3,894	1,362

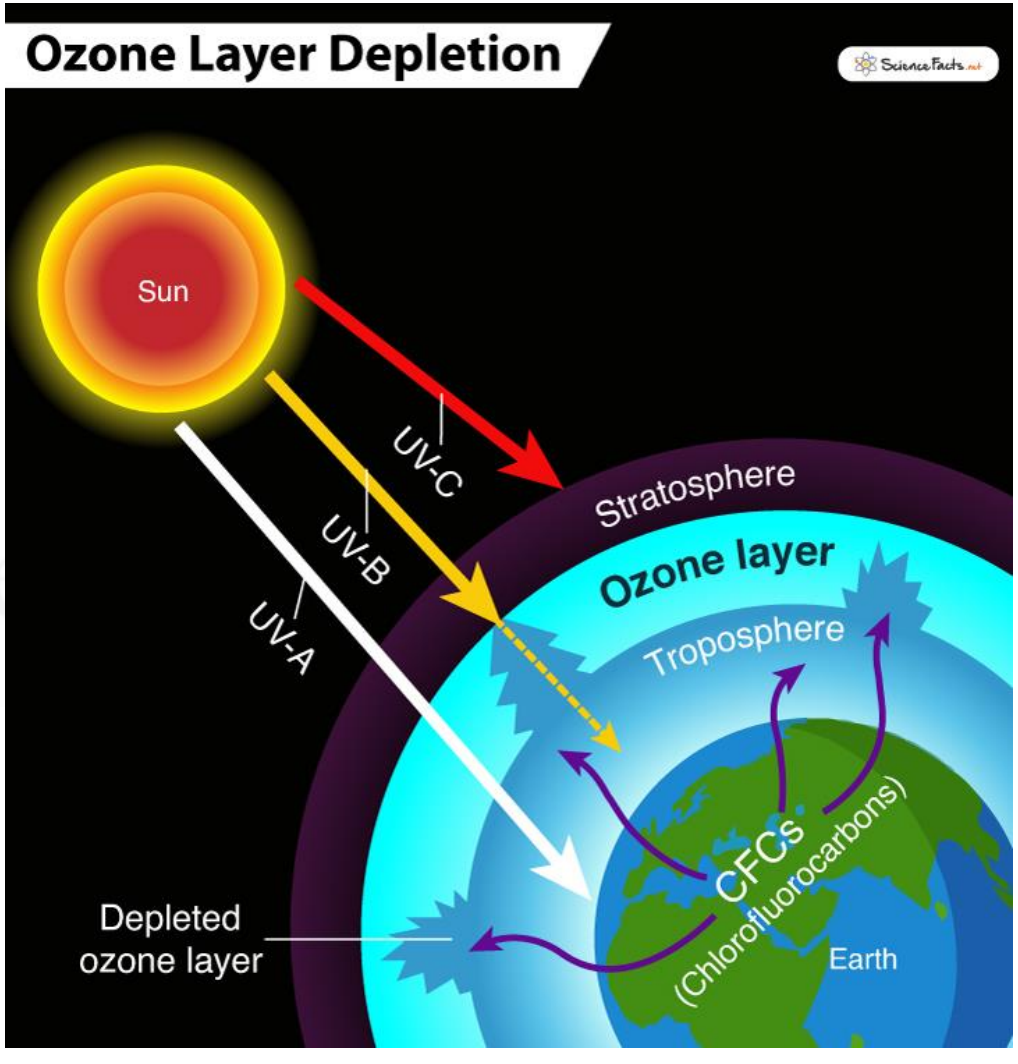
According to the 2011 Population Census data, urban India grew by 90 million people in the previous decade. During this period, 2774 new towns were born with over 90% of the new towns belonging to the category of census towns.

8. Acid Rain



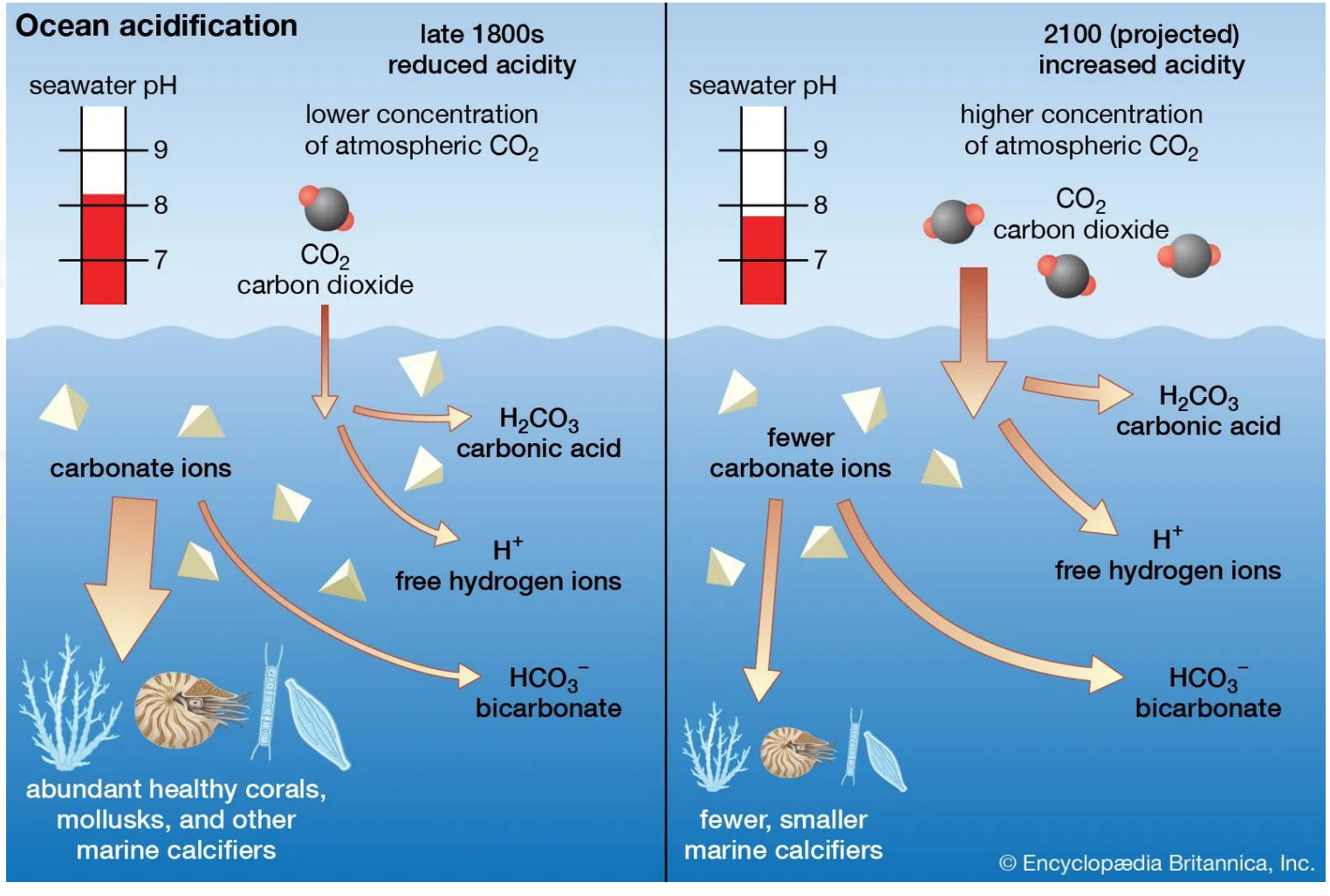
- Acid rain comes as a result of air pollution, mostly through chemicals released into the environment when fuel is burned. Its effects are most clearly seen in aquatic ecosystems, where increasing acidity in the water can lead to animal deaths.
- It also causes various issues for trees. Though it doesn’t kill trees directly, acid rain does weaken them by damaging leaves, poisoning the trees and limiting their available nutrients.

9. Ozone Layer Depletion



- Ozone depletion is caused by the release of chemicals, primarily chlorine and bromide, into the atmosphere.
- A single atom of either has the potential to destroy thousands of ozone molecules before leaving the stratosphere.
- Ozone depletion results in more UVB radiation reaching the Earth’s surface.
- UVB has been linked to skin cancer and eye disease, plus it affects plant life and has been linked to a reduction of **plankton** in marine environments.

10. Ocean Acidification



- Ocean acidification is the term used to describe the continued lowering of the pH levels of the Earth's oceans as a result of carbon dioxide emissions.
- It is estimated that ocean acidity will increase by 150% by 2100 if efforts aren't made to halt it.
- This increase in acidification can have dire effect on **calcifying** species, such as shellfish. This causes issues throughout the food chain and may lead to reductions in aquatic life that would otherwise not be affected by acidification.

11. Air Pollution

- Air pollution is becoming an increasingly dangerous problem, particularly in heavily-populated cities.
- The World Health Organization (WHO) has found that 80% of people living in urban areas are exposed to air quality levels deemed unfit by the organization.
- It is also directly linked to other environmental issues, such as acid rain and eutrophication.
- Animals and humans are also at risk of developing a number of health problems due to air pollution.

12. Lowered Biodiversity

- Continued human activities and expansion has led to lowered biodiversity. A lack of biodiversity means that future generations will have to deal with increasing vulnerability of plants to pests and fewer sources of fresh water.
- Some studies have found that lowered biodiversity has as pronounced an impact as climate change and pollution on ecosystems, particularly in areas with higher amounts of species extinction.

13. The Nitrogen Cycle

- With most of the focus being placed on the carbon cycle, the effects of human use of nitrogen often slips under the radar.
- It is estimated that agriculture may be responsible for half of the nitrogen fixation on earth, primarily through the use and production of man-made fertilizers.
- Excess levels of nitrogen in water can cause issues in marine ecosystems, primarily through overstimulation of plant and algae growth.
- This can result in blocked intakes and less light getting to deeper waters, damaging the rest of the marine population.

14. Natural Resource Use

- Recent studies have shown that humanity uses so many natural resources that we would need almost 1.5 Earths to cover our needs.
- This is only set to increase as industrialization continues in nations like China and India.
- Increased resource use is linked to a number of other environmental issues, such as air pollution and population growth.
- Over time, the depletion of these resources will lead to an energy crisis, plus the chemicals emitted by many natural resources are strong contributors to climate change.

15. Transportation

- An ever-growing population needs transportation, much of which is fueled by the natural resources that emit greenhouse gases, such as petroleum.
- In 2014, transportation accounted for 26% of all greenhouse gas emissions.
- Transportation also contributes to a range of other environmental issues, such as the destruction of natural habitats and increase in air pollution.

16. Polar Ice Caps

- The issue of the melting of polar ice caps is a contentious one. While NASA studies have shown that the amount of ice in Antarctica is actually increasing, these rises only amount to a third of what is being lost in the Arctic.
- There is strong evidence to suggest that sea levels are rising, with the Arctic ice caps melting being a major contributor.
- Over time, this could lead to extensive flooding, contamination of drinking water and major changes in ecosystems.

17. Climate Change

- The majority of the issues previously listed contribute or are linked to climate change.
- Statistics created by NASA state that global temperatures have risen by 1.7 degrees Fahrenheit since 1880, which is directly linked to a reduction in Arctic ice of 13.3% per decade.
- The effects of climate change are widespread, as it will cause issues with deforestation, water supplies, oceans and ecosystems.
- Each of these have widespread implications of their own, marking climate change as the major environmental issue the planet faces today.

SYSTEMS APPROACH TO CORPORATE ENVIRONMENTAL MANAGEMENT

- A system approach is identifying, understanding, and managing integrated and interdependent processes and their risks that contribute to the organization's environmental management system effectiveness.
- Reviewing the inputs and outputs of each process as only a section of the company as a whole contributes to understanding the effects on other processes within the organization. This approach helps managers avoid analyzing problems in isolation.
- The most common system model used for environmental management is the ISO 14001. There have been other models, such as the European Eco-Management and Audit Scheme (EMAS) and the Responsible Care model, developed by the American Chemical Council (ACC).

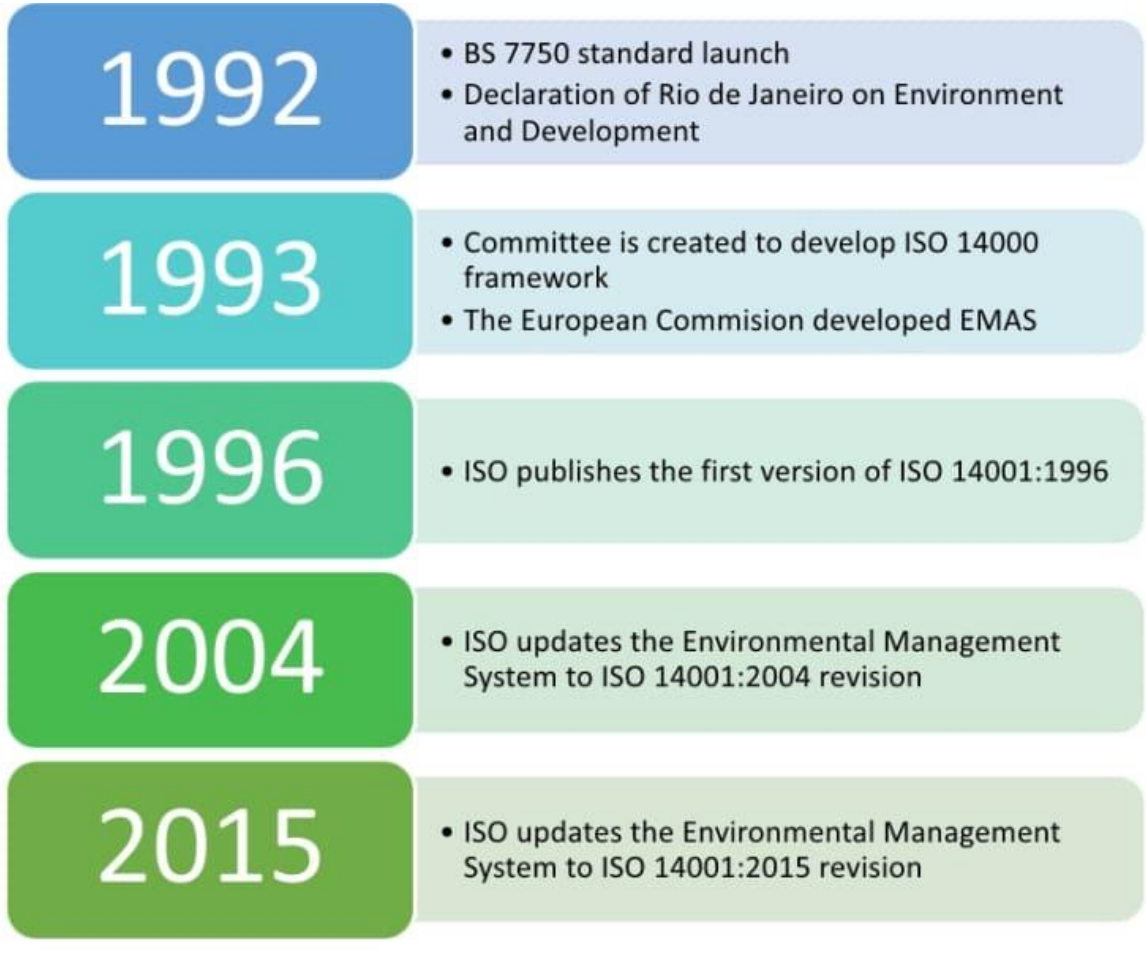
- Many organizations, when implementing their environmental management system (EMS) to ISO 14001 requirements, have used the PDCA methodology, based on Deming's “Plan-Do-Check-Act,” implemented in post-WWII Japan.

Need for Environmental Management System

- There is a growing interest among the companies in improving their environmental performance.
- It must build a comprehensive environmental management system within the organization in as much as a lack of a comprehensive and effective management system may often lead to failure.
- Inadequate management systems may cause environmental damage and may cost firms and organizations heavily in terms of clean-up costs and damaged reputations.

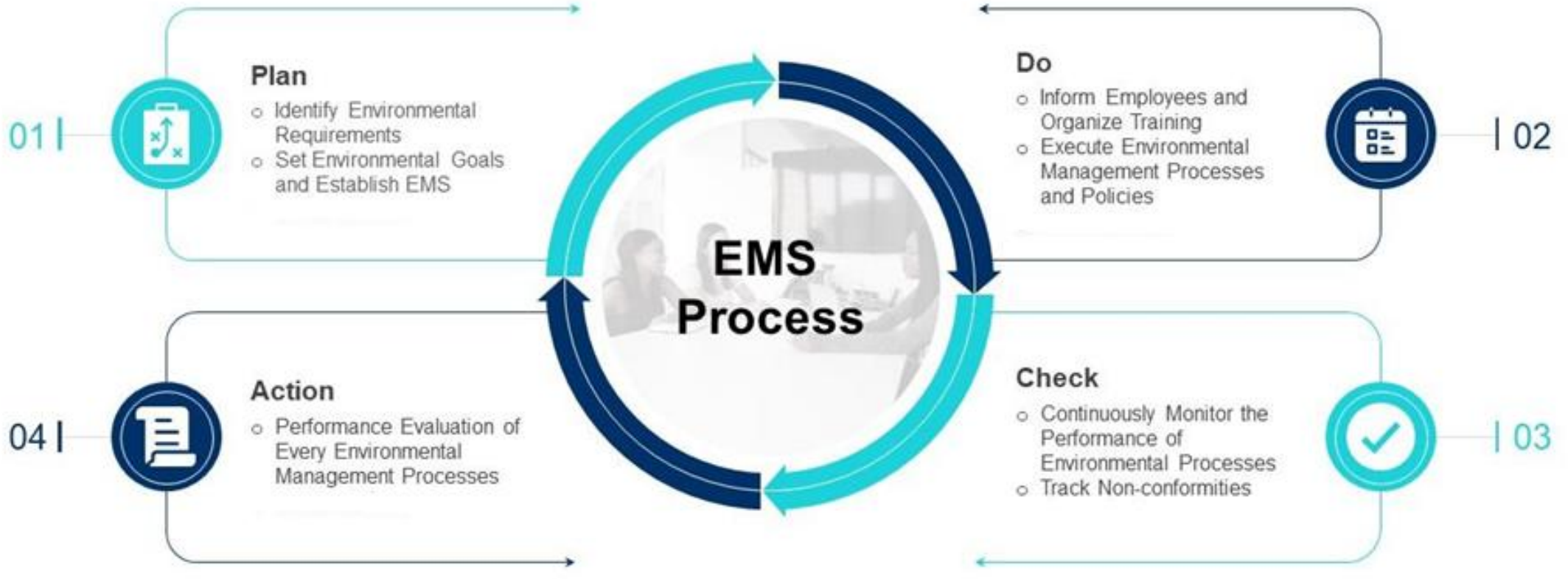
ISO 14001

- ISO 14001:2015 specifies the requirements for an environmental management system that an organization can use to enhance its environmental performance.
- ISO 14001:2015 is intended for use by an organization seeking to manage its environmental responsibilities in a systematic manner that contributes to the environmental pillar of sustainability.



History of ISO 14001

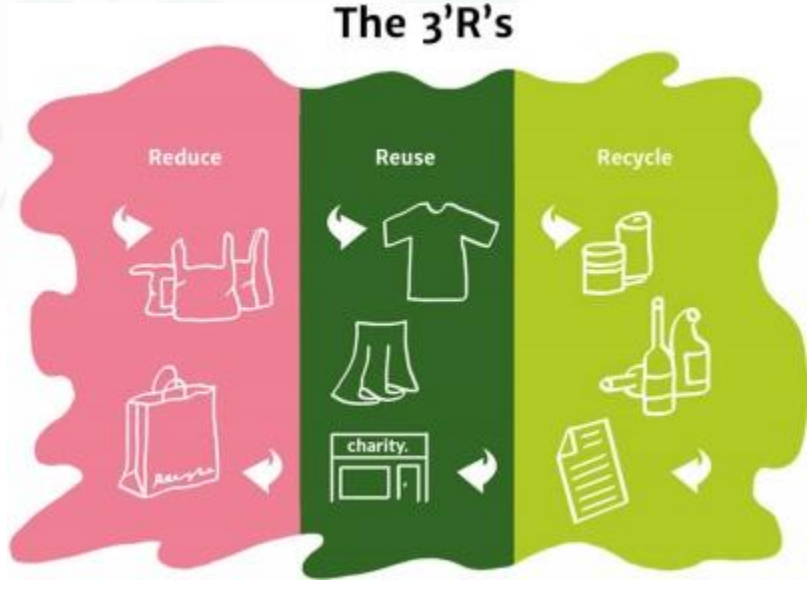
ISO 14001



THREE I'S

Environmental impact reduction efforts

- Use Energy more efficiently
- Install renewables
- Conserve water
- Reduce, Reuse & Recycle
- Travel less
- Consider near sourcing
- Ship goods more efficiently



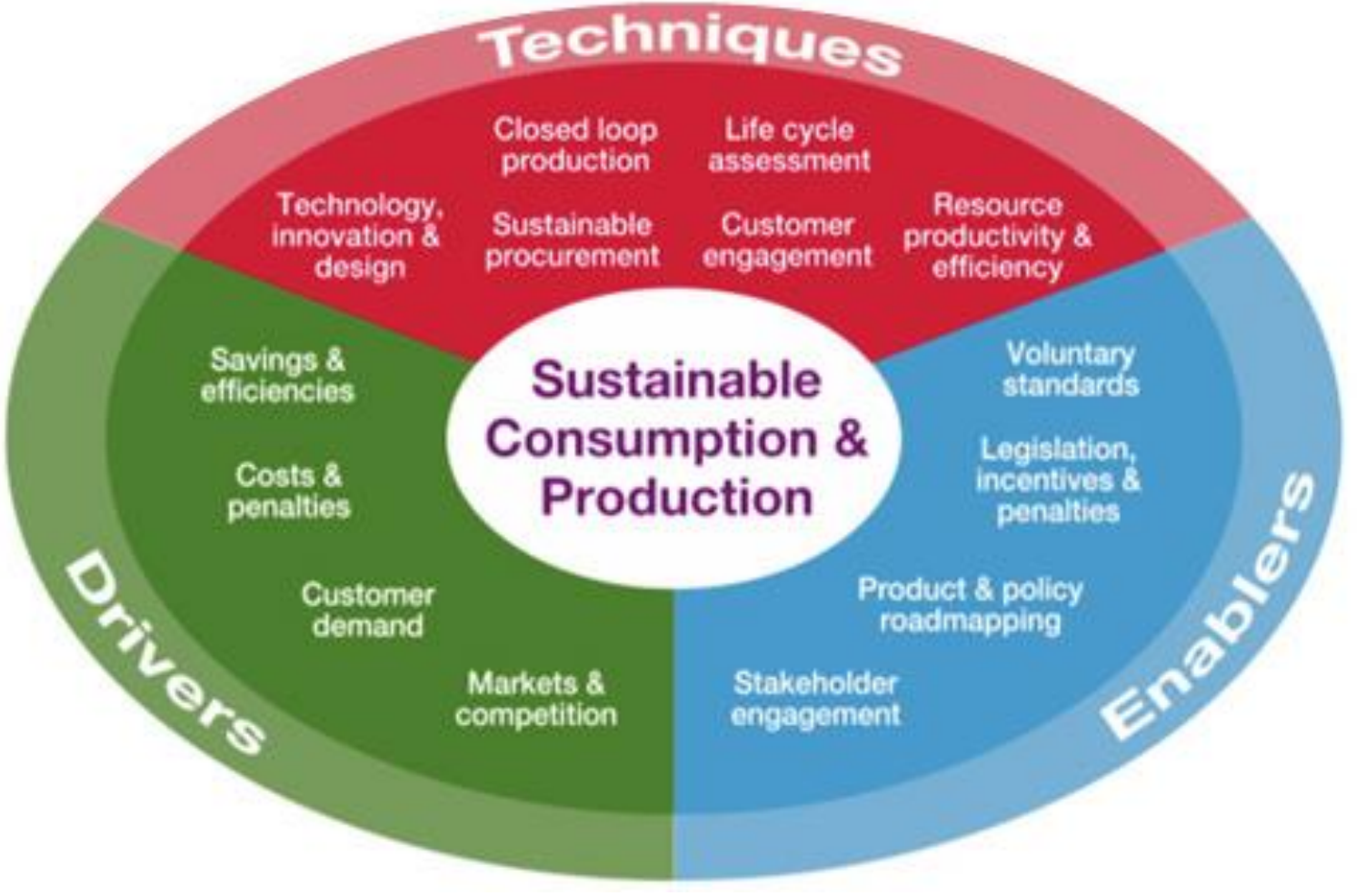
Environmental Stewardship

- Stewardship means taking responsibility for our choices
- Relevance to environmental protection (World Business Council for Sustainable Development to the National Academy of Public Administration to the National Religious Partnership for the Environment)
- Recognize the value of environmental stewardship in achieving sustainable results
- EPA is increasingly incorporating stewardship strategies into its programs and activities.

- Focused on six natural resource systems and desired outcomes for each on

- Air: Sustain clean and healthy air
- Ecosystems: Protect and restore ecosystems functions, goods, and services
- Energy: Generate clean energy and use it efficiently
- Land: Support ecologically sensitive land management and development
- Materials: Use materials carefully and shift to environmentally preferable materials
- Water: Sustain water resources to ensure quality and availability for desired uses

Business charter for sustainable production and consumption



- In response to the World Commission on Environment and Development report, ICC developed a 'Business Charter for Sustainable Development' which sets out 16 principles for environmental management.

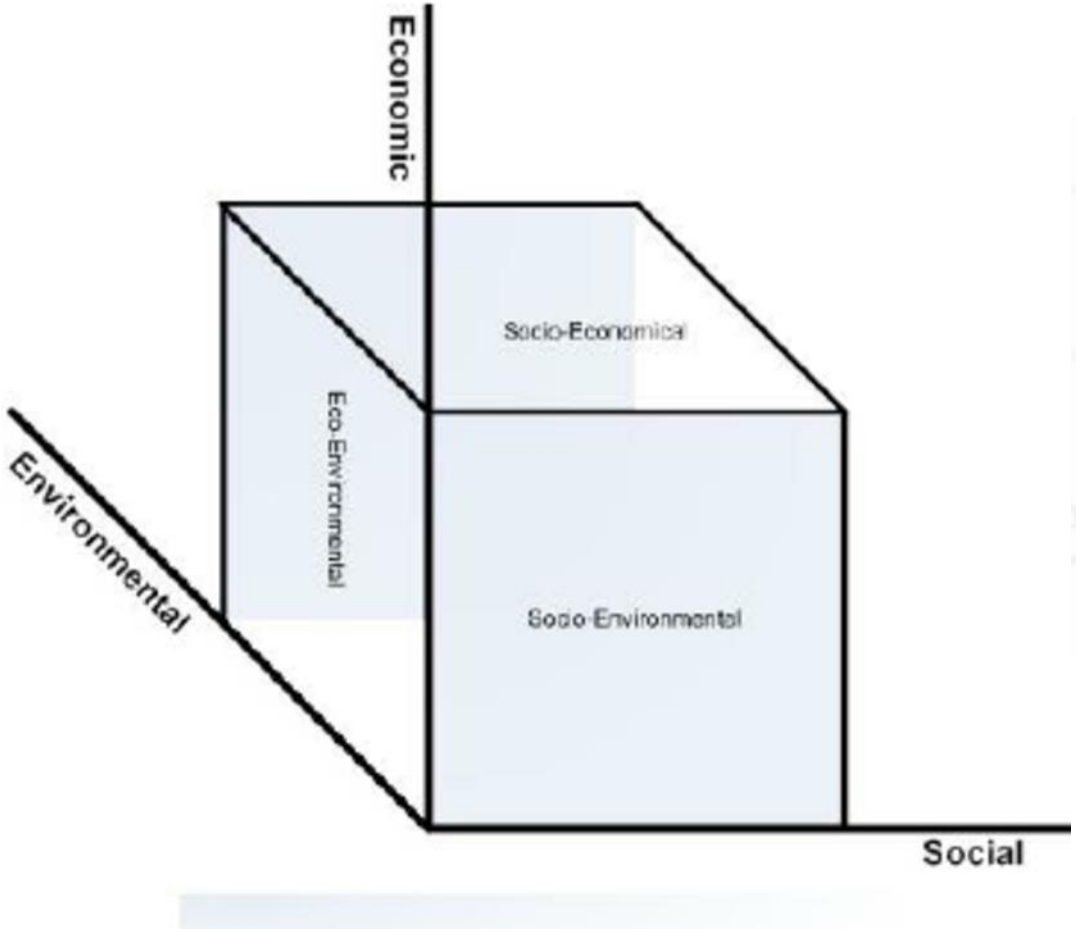
The Charter covers environmentally relevant aspects of health, safety and product stewardship.

- Its objective is 'that the widest range of enterprises commit themselves to improving their environmental performance in accordance with the principles, to having in place management practices to effect such improvement, to measuring their progress, and to reporting this progress as appropriate, internally and externally'

Tools for Sustainable Business Management

- Specific tools for translation of general requirements of sustainable development into manageable demands are necessary.
- The sustainability balanced scorecard is the central tool for the development and implementation of sustainable business strategies.

Sustainable cube



- This tool contains the three perspectives of sustainable development - the economical, the ecological and the social one - and proposes a metric system for each of them.
- The position within the cube allows one to define strategies for further sustainable management. The cube can be used for the whole organization, for parts of an organization or for individual products or services.
- The economic perspective can be measured with common economic concepts like economic value added, option pricing theory, shareholder value, contribution accounting, target costing or product profit loss accounting.

Drivers of sustainability

- The business case for sustainability has been at the forefront of much of the literature.
- Some of the most commonly mentioned drivers/benefits of sustainability include: competitive advantage, reduced costs, increased sales, improved image and reputation, and increased employee motivation
- The top three drivers to sustainability for large organizations were:

(1) Compliance with legal and regulatory requirements

(2) Managing risk to the reputation of your brand and

(3) Achieving competitive advantage and long-term profitability

BARRIERS

- Sustainable development has been widely promoted as a holistic concept which aims or targets to integrate social, economic and cultural policies to ensure high-quality growth.
- However, there are barriers combating the implementation of sustainable development.

- Economic and financial barriers
- Innovation Barriers
- Social barriers
- Political barriers
- Poor monitoring and evaluation systems
- Institutional barriers
- Trade barriers

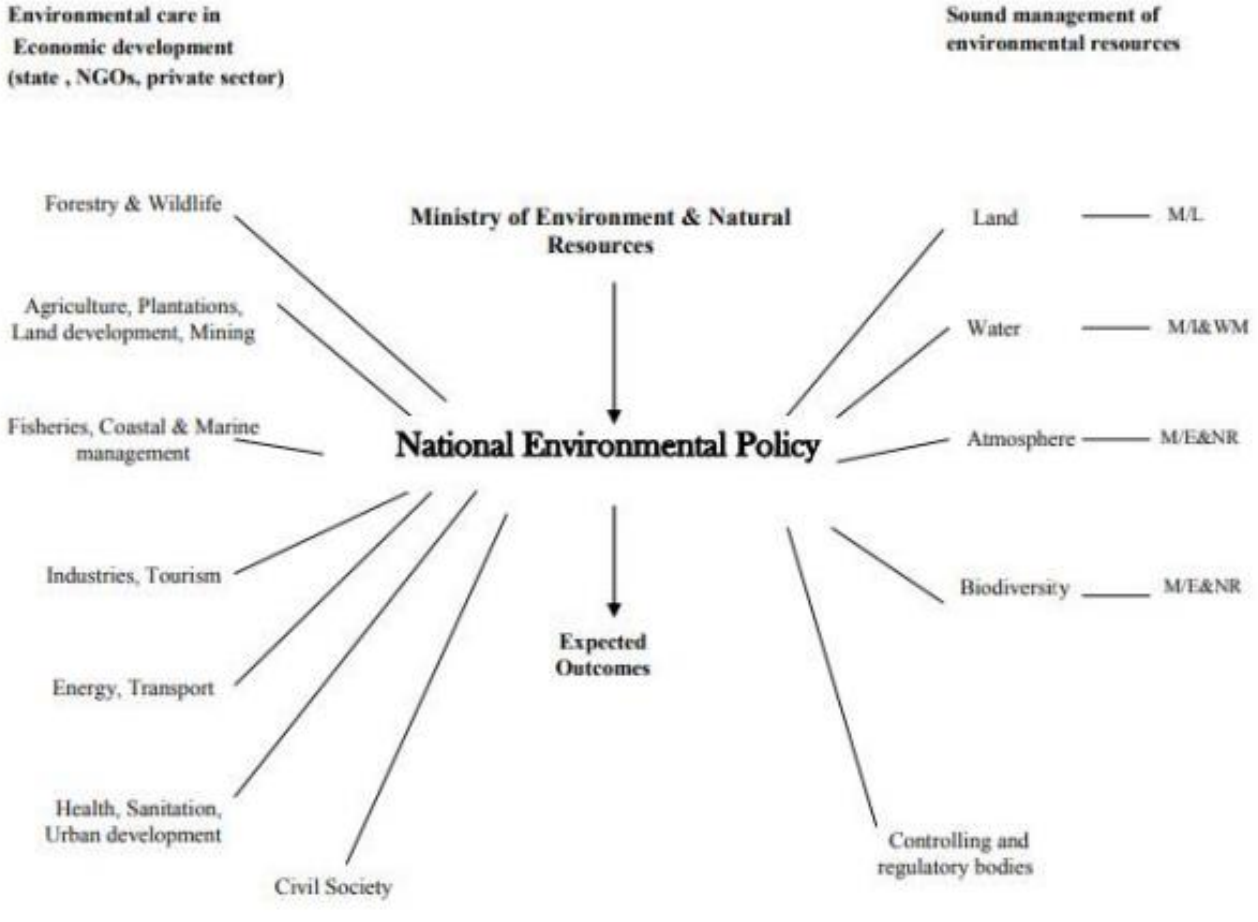
Environmental Management Principles

- 7 Key Principles Of Environmental Management

1. Polluter Pays Principle (PPP)
2. User Pays Principle (UPP)
3. Precautionary Principle (PP)
4. Principle of Responsibility
5. Principle Of Effectiveness and Efficiency
6. Principle of Proportionality
7. Principle Of Participation

National Environment Policy (NEP)

- The objectives of the policy include:
- Conservation of critical environmental resources
- Intra-generational equity
- Livelihood security for the poor
- Inter-generational equity
- Integration of environmental concerns in economic and social development
- Efficiency in environmental resource use
- Environmental governance
- Enhancement of resources for environmental conservation


Environmental care in
Economic development
(state , NGOs, private sector)
Sound management of
environmental resources
Forestry & Wildlife
Agriculture, Plantations,
Land development, Mining
Fisheries, Coastal & Marine
management
Industries, Tourism
Energy, Transport
Health, Sanitation,
Urban development
Civil Society
Ministry of Environment & Natural
Resources
National Environmental Policy
Expected
Outcomes
Land
M/L
Water
M/I&WM
Atmosphere
M/E&NR
Biodiversity
M/E&NR
Controlling and
regulatory bodies

Pollution Abatement

- Pollution abatement refers to any measure taken to reduce, control or eliminate pollution from a given environment.
- Abatement measures can be technological, like catalytic converters on vehicles to reduce air pollution, or they may be regulatory, like laws limiting the amount of solid waste a sewage management facility can release into a waterway.
- Abatement measures may also be behavioral, like turning down a home thermostat a degree or two in winter to reduce electricity consumption and greenhouse gas emissions

Energy Conservation

- Another basic but important pollution abatement strategy includes what many call reducing your carbon footprint.
- More people using fewer resources and less energy reduces pollution impacts on a larger scale.
- Examples of conservation include: using cleaner-burning fuels and renewable sources of energy like solar or wind power, using public transportation or carpooling, recycling and reusing paper, plastics and metals.
- Insulating your home to make it more energy-efficient, installing energy-efficient appliances, and buying locally produced goods to reduce the need for shipping of products over long distances.

CORPORATE RESPONSIBILITY FOR ENVIRONMENTAL PROTECTION (CREP)

- Ministry of Environment & Forest (MoEF) launched the Charter on "Corporate Responsibility for Environmental Protection (CREP)" in March 2003.
- the purpose to go beyond the compliance of regulatory norms for prevention & control of pollution through various measures including waste minimization, in-plant process control & adoption of clean technologies.
- The Charter set targets concerning conservation of water, energy, recovery of chemicals, reduction in pollution, elimination of toxic pollutants, process & management of residues that are required to be disposed off in an environmentally sound manner.
- The Charter enlists the action points for pollution control for various categories of highly polluting industries. The Task Forces were constituted for monitoring the progress of implementation of CREP recommendations/ action points.

Action Points under CREP for Tannery Sector

- Chrome Recovery
- Waste Minimization Measures
- Reduction of Water Consumption in Tannery Units
- Compliance of standards All CETPs and ETPs
- Management of Total Dissolved Solids (TDS) For TDS management
- Solid Waste Management
- Salts from Solar Evaporation
- Use of Boron bearing compounds
- Ground water quality monitoring

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MODULE 2

- **Environmental Management Objectives**: Environmental quality objectives – Rationale of Environmental standards: Concentration and Mass standards, Effluent and stream standards, Emission and ambient standards, Minimum national standards, environmental performance evaluation: Indicators, benchmarking. Pollution control v/s Pollution Prevention - Opportunities and Barriers – Cleaner production and Clean technology, closing the loops, zero discharge technologies.

ENVIRONMENTAL QUALITY OBJECTIVES

- REDUCED CLIMATE IMPACT: In accordance with the UN Framework Convention on Climate Change, concentrations of greenhouse gases in the atmosphere must be stabilized at a level that will prevent dangerous anthropogenic interference with the climate system.
- CLEAN AIR: The air must be clean enough not to represent a risk to human health or to animals, plants or cultural assets.
- NATURAL ACIDIFICATION: ONLY The acidifying effects of deposition and land use must not exceed the limits that can be tolerated by soil and water.

- A NON TOXIC ENVIRONMENT: The occurrence of man-made or extracted compounds in the environment must not represent a threat to human health or biological diversity.
- A PROTECTIVE OZONE LAYER: The ozone layer must be replenished so as to provide long-term protection against harmful UV radiation.
- A SAFE RADIATION ENVIRONMENT: Human health and biological diversity must be protected against the harmful effects of radiation.
- ZERO EUTROPHICATION: Nutrient levels in soil and water must not be such that they adversely affect human health, the conditions for biological diversity or the possibility of varied use of land and water.

- Flourishing Lakes And Streams
- Good Quality Groundwater
- A Balanced Marine Environment, Flourishing Coastal Areas
- Thriving Wetlands
- Sustainable Forests
- A Magnificent Mountain Landscape
- A Magnificent Mountain Landscape
- A Rich Diversity Of Plant And Animal Life

Rationale of Environmental standards

- The purpose of environmental quality standards is to protect quality of life and health by controlling the quantity and quality (mainly in terms of toxicity) of anthropogenic pollutants, emanating mainly from industrial activities, released to the environment.
- It includes,

➢ Concentration and mass standards

➢ Effluent and stream standards

➢ Emission and ambient standards

Mass and concentration

- Mass concentration (mass per unit volume e.g. ppb or μg L −1) is the traditional metric to report the environmental concentration (exposure) and toxicity thresholds (dose) of conventional contaminants.
- Mass concentration is also the metric used when investigating the release and fate and transport of conventional contaminants in the environment. It is likely the best suitable metric to represent sedimentation of manufactured NMs after aggregation.
- In addition, there are well-validated methods for NM mass concentration determination, making the production of accurate data easier. Therefore, mass concentration is the current practical choice for a rapid overall assessment of environmental processes related to the larger NM fractions (e.g. sedimentation).

Effluent Standards

- They are generally established for the effluent from industry and municipality waste water treatment plant to be discharge into stream, land, sewer, ocean etc.
- Effluent standard system is carried out to control the following stream standard system.
- No detail stream analysis is required to determine exact amount of waste treatment, effluent standard can serve as a guide to establish the stream classification or during organization of any pollution abutment program.
- Unless the effluent standards are upgraded, this system does not provide any effective protection for an over loaded stream.
- Main disadvantage of this type of standards is that there is no control over total volume of polluting substances added to stream each day

Stream Standards

- The system is based on establishing classification or standard quality for a stream & regulating any discharge to the extent, necessary to maintain the established stream classification or quality.
- The primary objective of stream standards is to protect and preserve each stream for its best usage on a equitable basis for both upstream & downstream uses.
- The stream standard system is the prevention of excessive pollution regardless of type of industry or other factors such as location of industry or municipality.
- Pollution abutment should be considered in the decisions concerning location of a plant just as carefully as the laboures, transportation, market & other conditions.
- It also allows the public to establish goals for maintaining quality of water for present as well for future needs.

Emission standards

- Emission standards are requirements that set specific limits to the amount of pollutants that can be released into the environment.
- Many emissions standards focus on regulating pollutants released by automobiles (motor cars) and other powered vehicles but they can also regulate emissions from industry , power plants, small equipment such as lawn mowers and diesel generators.
- An emission performance standard is a limit that sets thresholds above which a different type of emission control technology might be needed.

- **Emission Norms**:-

➢ It was in 1991 that first time emission norms were introduced in India for petrol cars, diesel cars followed in 1992.

➢ Emission norms means some rules (which has specified quantity) decided by the govt for control of air pollution.

➢ Implementation of mandatory catalytic converters in 1995 for the 4 Metro cities, thus reducing pollution further.

➢ From 2000,India introduced strict Emission standards modeled on the European ones. This means the birth of Bharat Norms, with the first set of norms known as Bharat stage II, followed by BS III, and BS IV (BS I was the earlier, Indian standard)

- **Ambient Air Quality Standards (AAQS)** are setup for protecting public health from adverse effects of air pollution and eliminating or reducing to a minimum, those contaminants that are known to be or likely to be hazardous to human health.

Several approaches have been considered for setting air quality standards.

i) Using another community's air as the standard,

ii) Using as standard the quality of air that existed at an earlier time for which it was believed that adverse effects were either nonexistent or tolerable by the community,

iii) Using as standard the quality of air that exists in the community on certain days of good ventilation and

iv) Considering health protection - control cost relationship. National Ambient Air Quality Standards A National Ambient Air Quality Standard (NAAQS) is a uniform, national standard establishing the maximum permissible concentration of an air pollutant in the ambient air - the "portion of the atmosphere, external to buildings, to which the general public has access.

" The USEPA has setup two types of standards, viz. "Primary Standards" to protect health with a margin of safety and for "Secondary Standards" to protect welfare.

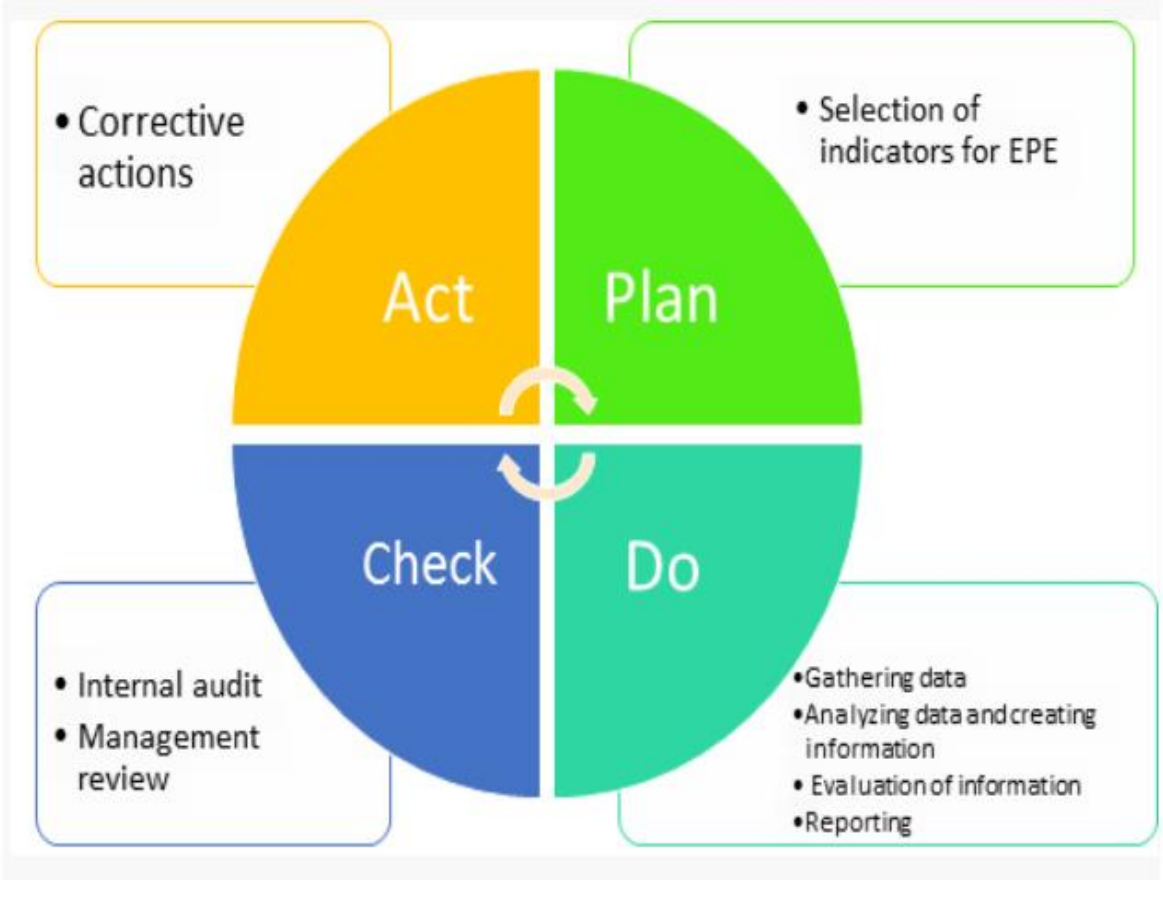
- Primary Standards of NAAQS define the acceptable concentration of an air pollutant in the ambient air - necessarily to protect health with adequate margin of safety.
- Secondary Standards Secondary NAAQS define the concentration of an air pollutant in the ambient air necessary to protect the "public welfare.

Minimum National Environmental Standards for industrial wastewater (NESs)

- National Environmental Standards provide the opportunity for central government to promote the adoption of consistent standards at the regional and district levels.
- National environmental standards are regulations which prescribe technical standards, methods or requirement for land use and subdivision, use of the coastal marine area and beds of lakes and rivers, water take and use, discharges, or noise.
- Wastewater discharge standards are set (at least) at a national level for centralized treatment systems for salient receiving environments

- The key feature of a water body from a discharge perspective is its assimilative capacity i.e., maximum amount of pollution that can be diluted or degraded without affecting preliminary defined designated best uses.
- Effluent discharge standards can be concentration-based or load-based. Concentration-based standards are the most common and specify a permissible mass of pollutant per liter.
- A limitation of concentration-based standards can be that it does not promote wastewater treatment, since dilution can be used to meet the discharge standard.

Environmental performance evaluation



Environmental performance indicators (EPI)

- The standard identifies two categories of EPI — operational performance indicators (OPIs) and management performance indicators (MPIs).
- A third category — environmental condition indicators (ECI) — measures how an organization's activities, products and services interact with the natural environment at a local, regional, national or global level.
- ISO 14031 provides guidance on the selection of indicators, the measurement and monitoring processes and the subsequent use of the validated data.

- MPIs relate the management system and address:

➢ Policy issues and development, eg effectiveness of environmental commitments

➢ Resource allocation and purchasing

➢ Human resource issues, eg staff training

➢ Planning and practices, eg which objectives are being pursued and achieved

➢ Conformance with regulations and audit programmes.

- OPIs relate to performance of operations, including:

❑ Inputs, eg energy, materials, utilities and contractor services

❑ Through-puts, eg design, installation, operation and maintenance of buildings, materials used, process equipment and other facilities

❑ Outputs, eg process emissions, trade effluent, emissions to air, solid and liquid wastes, noise, vibration, light, dust, litter, odour and radiation.

Environmental condition indicators (ECI)

- ECIs are principally about the state of the natural environment that may be affected by an organization's activities, products and services.
- This will include local air and water quality and the condition of land or whether the soil is contaminated.
- Overall responsibility for the state of the environmental rests with those governmental and regulatory agencies responsible for protecting and improving it, hence the need for regulatory controls and statutory monitoring regimes.

ECIs might include:

• air quality, eg polluting or non-polluting odours that can cause nuisance to local residential areas

• water condition, eg activities that release water causing turbidity in local streams. Equally, are local water resources suitable for operational use? Is there enough water resource for future business needs?

• land, eg are activities likely to degrade soil condition? Equally, are there opportunities for enhancing local biodiversity by planting trees, for example?

Module – 3

Environmental Management System

EMAS (Eco-Management and Audit Scheme)

It is one of the Voluntary instruments of environmental protection, i.e., it positively motivates organizations to responsible approach and to improving its environmental performance beyond the legal requirements

Established by the European Union in order to detect and monitor the impacts of the activities of organizations on the environment and to publish information in the form of individual environmental statements

EMAS is a proactive approach of the company to monitoring, control and gradual reduction of the impact of the activities of the organization on the environment.

It is designed for organizations functioning in the private sector (joint stock companies, limited liability companies, etc.) as well as for organizations of state and public administration (ministries, municipalities, etc.) or its parts (producing unit, remote workplaces).

EMAS system is one of two ways which an organization can use to implement the EMS

The second tool used to implement the environmental management system is ISO

Both ways are similar to each other in many parts - environmental policy, continuous improvement, objectives and target values, programs, the implementation of the system and its operation, monitoring, and management review

EMAS, however, extends the ISO 14001 system, especially in terms of transparency when organizations with an established system according to EMAS are obliged to publish environmental statements and hold open discussions with the public and other interested parties

ISO 14000

- ISO 14000 is a family of standards related to environmental management that exists to help organizations
- Minimize operations: negatively affect the environment
- Comply with applicable laws, regulations, and other environmentally oriented requirements
- Continually improve in the above.

- ISO 14000 is similar to ISO 9000 quality management
- The requirements of ISO 14000 are an integral part of the European Union‘s Eco- Management and Audit Scheme (EMAS)

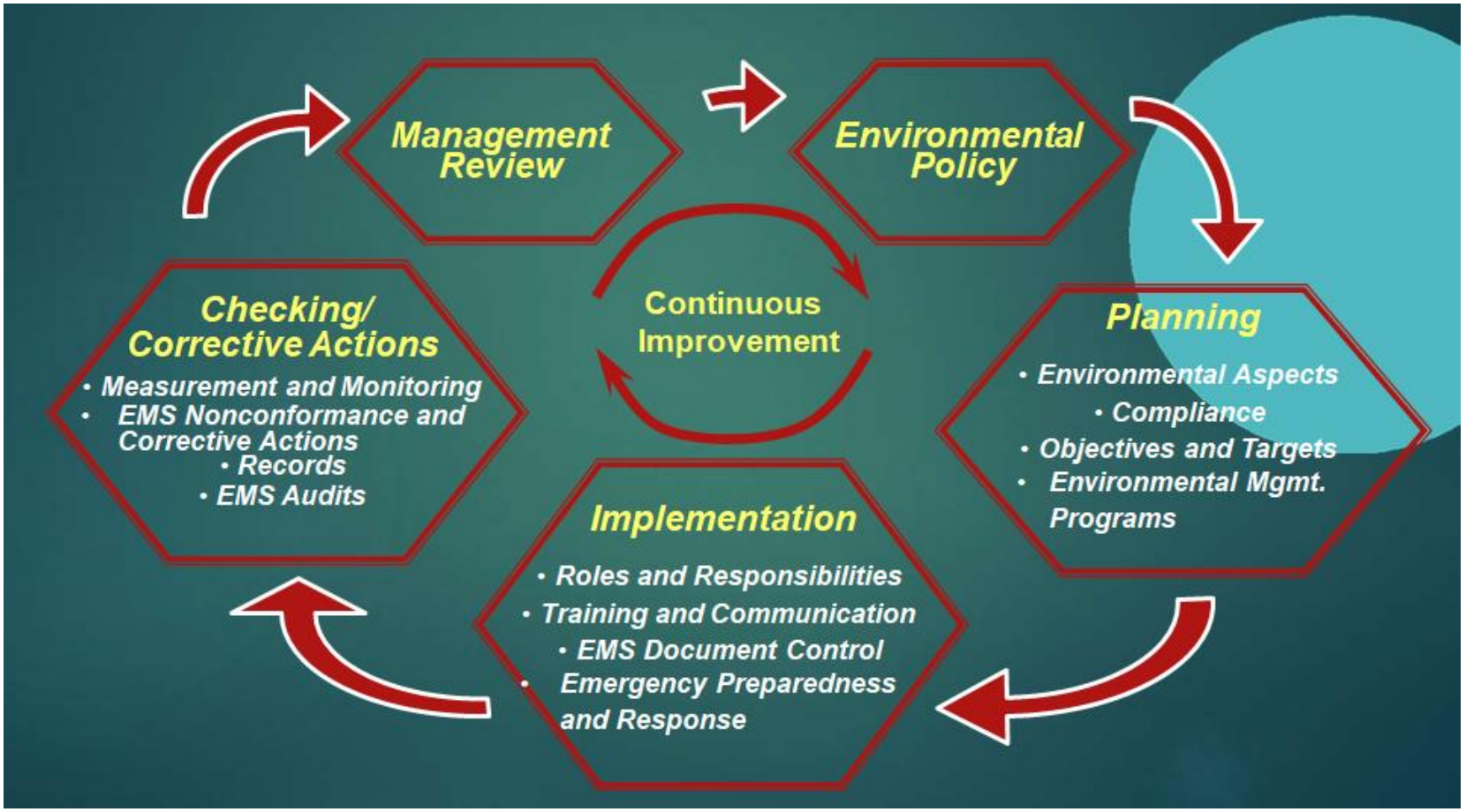
ISO 14001

ISO 14001 is the international standard that specifies requirements for an effective environmental management system (EMS).

It provides a framework that an organization can follow, rather than establishing environmental performance requirements.

Part of the ISO 14000 family of standards on environmental management, ISO 14001 is a voluntary standard that organizations can certify to. Integrating it with other management systems standards, most commonly ISO 9001, can further assist in accomplishing organizational goals.

Components of ISO 140001



Benefits of ISO 14001:2015..?

Using ISO 14001:2015 has many benefits for organizations with environmental management systems. Organizations and companies find that using the standard helps them;

- Improve resource efficiency
- Reduce waste
- Drive down costs
- Provide assurance that environmental impact is being measured
- Gain competitive advantage in supply chain design

- Increase new business opportunities
- Meet legal obligations
- Increase stakeholder and customer trust
- Improve overall environmental impact
- Manage environmental obligations with consistency

Barriers in Implementing ISO-14001;

- Lack of government/legislative pressure
- Lack of customer support
- High costs for implementation of EMS
- Lack of environmentally friendly technologies and materials
- Complex documentation process
- Lack of support from staff

- The ISO 14001 EMS standards underline the **minimum requirements for a certification**, which can be a barrier for other routes of potential performance improvements for sustainable industrial development.
- companies broadly experience two different barriers in the environmental management process. Those are **industrial barriers** such as; technical information, capital costs, configuration of current operations, competitive pressures and industry regulation.
- **organizational barriers** such as, employee attitude, poor communication, past practice and inadequate top management leadership

"**Costs** (training, auditor fees, audits) required in addition to implementation and certification of EMS and its maintenance.

Lack of support and resources available for SMEs; unclear guidelines for EMS implementation for organizations with mobile workforce, such as the construction sector;

Lack of set guidelines for setting of objectives and targets and extent of involvement of employees, suppliers and other stakeholders.

Lack of guidelines on how to accomplish 'continuous improvement element of the standard;

Continual improvement & Pollution prevention as per ISO-14001;

The core requirement of a continual improvement process (CIP) is different from the one known from quality management systems. CIP in ISO 14001 has three dimensions:

Expansion: More and more business areas get covered by the implemented EMS.

Enrichment: More and more activities, products, processes, emissions, resources, etc. get managed by the implemented EMS.

Upgrading: An improvement of the structural and organizational framework of the EMS, as well as an accumulation of know-how in dealing with business-environmental issues.

Overall, the CIP concept expects the organization to gradually move away from merely operational environmental measures towards a strategic approach on how to deal with environmental challenges.

Pollution prevention as per ISO-14001

The organization has to identify the obligatory requirement that is applicable to the organizational activities /processes /products/ services.

1. **Materials and feedstock substitution** is a method of source elimination.

Polluting materials in a production process or embedded in a product are replaced with less polluting or nonpolluting substances

Opportunities for materials and feedstock substitution include:

- Painting applications
- Parts cleaning
- Metal finishing
- Printing operations
- Building and grounds maintenance

2. **Operating efficiencies and training**

These examples gives an idea on how normal parts of good operation can provide effective ways to prevent pollution.

Examples include

•Changing production schedules to minimize equipment and feedstock change overs

•Improving maintenance schedules

•Segregating by-products at the source

•Training staff to improve material handling and recognize opportunities.

3. <u>Product design and reformulation</u> includes methods for preventing pollution associated with the entire life cycle.

Addressing environmental concerns at an early stage can avoid environmental impacts throughout the product life cycle in a cost-effective manner.

Results of redesigning or reformulating a product include

- Reducing toxicity of a product
- Reducing waste material
- Extending the life of a product
- Extending the life of the materials used
- Reducing energy and material intensity needed to produce, use and dispose of the product

4. **Equipment modifications and process changes** involve new technologies or approaches to existing operating systems processes and practices to improve production efficiencies and reduce pollution and waste.

5. **The Value of Waste**

Waste can also be viewed as a loss of valuable process materials that could have economic and environmental benefits if reused or recycled.

Environmental Policy

What is an environmental policy?

An environmental policy is a statement about an organization's environmental position and values

The ISO 14001 standard states that an environmental policy is the organization's overall environmental performance intentions and direction formally expressed by top management

Benefits of developing an environmental policy

- An organization can publicly advertise that it has considered its environmental performance and has adopted best practice or is working towards improving its environmental performance
- It can advertise the environmental status and environmental objectives of the organization to all stakeholders
- Current and potential clients can read the statement and are able to determine whether they would like to continue or start business with the organization
- It also can provide clear direction to all stakeholders about the organization's environmental values

Initial Environmental Review

- First step in creating an EMS is to perform an Initial Environmental Review.
- Tells where organization is and creates a road map for organization
- There are four main areas
  - ❖ Review previous environmental issues
  - ❖ Consider any regulations which have operational impact
  - ❖ Identify and evaluate possible environmental issues in organization.
  - ❖ Outline current operations and how it is managed; also consider indirect impacts
- The Initial Environmental Review does not considered an audit.
- The Environmental Review is an **initial assessment** to help to create an EMS.
- The Environmental Audit **assesses the performance** of the organizations' EMS.

Environmental Aspects and Impacts Analysis

Environmental Aspect: Element of an organization's activities, products, or services that can interact with the environment.

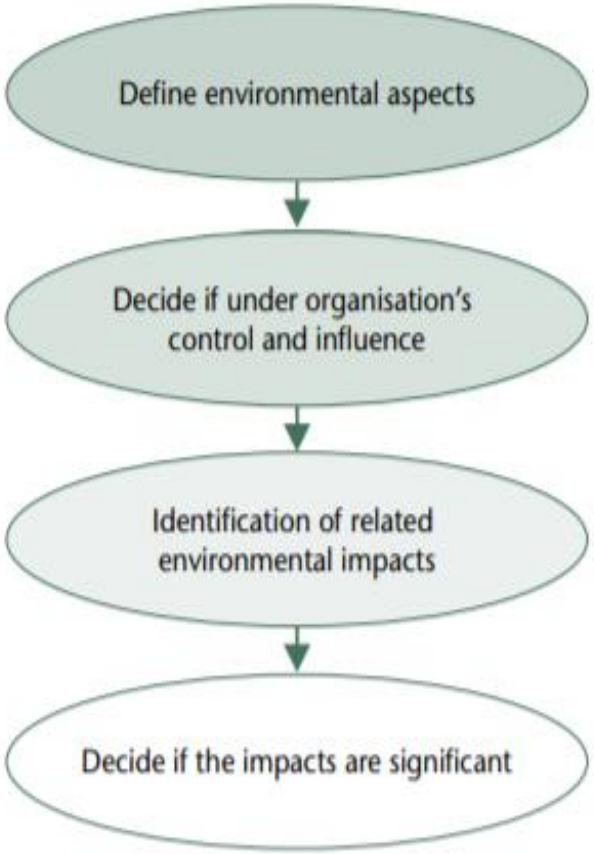
Environmental Impact: Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization's activities, products or services

Tool 1 : Measuring the Importance of Environmental Problems → Direct and Indirect Aspects

Tool 2: Sample Procedure: Instruction for Environmental Aspects Identification Form → Input/ Output Analysis (Ecomaps)

Key Points

- ✓ When identifying aspects and impacts, one should look beyond activities covered by laws and regulations
- ✓ Both services and products need to be looked at
- ✓ The identification of environmental aspects and impacts can be seen as one of the most critical steps in the EMS implementation process



Environmental Policy

Environmental Policy

Module – 4

Environmental Audit

Introduction

Environmental auditing is essentially an environmental management tool for measuring the effects of certain activities on the environment against set criteria or standards.

Depending on the types of standards and the focus of the audit, there are different types of environmental audit.

Organisations of all kinds now recognise the importance of environmental matters and accept that their environmental performance will be scrutinised by a wide range of interested parties

Environmental management system audits as per ISO 19011

ISO 19011 is defined as the standard that sets forth guidelines for auditing management systems.

The standard contains guidance on managing an audit program, the principles of auditing, and the evaluation of individuals responsible for managing the audit programs.

An audit program consists of the arrangements made to complete all of the individual audits needed to achieve a specific purpose.

ISO 19011:2018 provides valuable information on how to improve an audit program systematically, just as other departments in an organization are expected to improve.

One aspect of such improvement is continuously ensuring the audit program objectives are in line with the management system policies and objectives.

Organizations, in pushing for auditing improvements, should consider the needs of customers and other interested parties.


Defining program objectives
ISO 19011 guidelines
Reviewing results and process
Completing audits needed

ISO 19011 offers guidance on every step of auditing a management system or audit program, including:

Defining program objectives

- Ensuring you understand the specific objectives you hope to achieve
- Making audit arrangements
- Assigning roles and responsibilities
- Defining number, scope, location, and duration of audits
- Determining criteria and specific checklists
- Establishing review procedures

Completing the audits needed

- Planning and reviewing internal documents
- Collecting and verifying audit evidence
- Generating findings and preparing reports
- Communicating findings

Reviewing the results and process

- Assessing results and trends
- Conforming with audit program procedures
- Evolving needs and expectations of interested parties
- Analyzing audit program records
- Examining effectiveness of the measures to address risks
- Ensuring confidentiality and information security

Roles of Auditors

As an environmental auditor, they will be responsible for the regular auditing of all environmental policies and procedures. This involves working with an audit team and with staff to get a good picture of how environmental compliance is being handled. Auditors will be responsible for:

- Selecting and managing the audit team
- Reviewing the operations of the business being audited and determining how environmental issues are being handled
- Gathering data on the business operations through on-site inspections, document reviews, staff interviews, and other methods
- Check business records for governmental permits and requirements, safety standards, maintenance, and inventory control measures

- Review emergency preparedness and response procedures
- Review management systems, environmental monitoring programs and waste management efforts
- Review employee training procedures and programs and the work environment for compliance with government and corporate standards
- Write and compile final audit reports including results of the audit and recommendations for changes and improvement
- Present the audit findings to the business managers and directors
- Assist in the development of an environmental management plan
- Follow up at a future time to ensure improvements and recommendations have been successfully implemented.

Qualifications of auditors

The auditors should have a relevant degree or diploma and completed a minimum of four years of work experience in a technical, professional or managerial position involving the exercise of judgment and decision-making skills.

In addition to the four years of work experience they need to demonstrate a satisfactory level of work experience gained within an environmental context relevant to their level of education. The four years of work experience in a technical, professional or managerial position may have been concurrent with the work experience within an environmental context.

Skills and Knowledge

Auditors shall through education, training and/or work experience and auditing experience be able to demonstrate a satisfactory level of competence in all of the following areas:

- Environmental science and technology
- Technical and environmental aspects of facility operations
- Relevant requirements of environmental laws, regulations and related documents
- Environmental management systems and standards against which audits may be performed
- Audit procedures, processes and techniques
- Communication skills – written and oral

Environmental performance indicators and their evaluation

Environmental performance indicators (EPI)

The standard identifies two categories of EPI — operational performance indicators (OPIs) and management performance indicators (MPIs). A third category — environmental condition indicators (ECI) — measures how an organization's activities, products and services interact with the natural environment at a local, regional, national or global level. ISO 14031 provides guidance on the selection of indicators, the measurement and monitoring processes and the subsequent use of the validated data.

Typical EPIs in the first two categories may include:

MPIs relate the management system and address:

- Policy issues and development, eg effectiveness of environmental commitments
- Resource allocation and purchasing
- Human resource issues, eg staff training
- Planning and practices, eg which objectives are being pursued and achieved
- Conformance with regulations and audit programs

OPIs relate to performance of operations, including:

- Inputs, eg energy, materials, utilities and contractor services
- Through-puts, eg design, installation, operation and maintenance of buildings, materials used, process equipment and other facilities
- Outputs, eg process emissions, trade effluent, emissions to air, solid and liquid wastes, noise, vibration, light, dust, litter, odour and radiation.

Examples of performance indicator data might include:

- Raw materials consumed (including hazardous substances and materials)
- Quantities of emissions and discharges that can have a significant impact
- Environmental protection measures
- Number of polluting incidents or breaches of compliances which attracted fines, damages or increased costs of regulatory inspections
- Performance indicators such as waste generated per unit of production or energy consumption.

EPE is used to assess environmental performance and keep track of how well the EMS is functioning, including whether agreed aims and objectives are being met. ISO 14031 is essentially a monitoring tool, helping an organization:

- Identify environmental aspects and related impacts and determine which are significant
- Set criteria for its environmental performance and track progress towards objectives and targets
- Benchmark performance more easily
- Assess the effectiveness and potential of environmental management initiatives and projects

- Identify inter-relationships of different management functions and environmental performance
- Communicate more effectively through the use of tangible data
- Produce information for stakeholders that relates directly to their concerns and requirements
- Focus on root causes and risk analysis and identifying areas for action
- Regularly provide information to support any review process.

Non conformance

Non-conformances are defined as a failure to conform, or non-fulfillment of specified requirements. Basically, whenever an organization does not satisfy the requirements of either the standard, relevant third-party requirements or their own procedures then that would be considered a non-conformance. That really depends on the severity of the non-conformance – when it comes to the certification audit, they are generally separated into two categories, minor (sometimes referred to as a part non- conformance) and major.

Identification of a major non-conformance will often result from;

- Absence of procedures
- Failure to meet requirements of the standard i.e. no management reviews conducted or no internal audits performed
- Actions not aligning with procedures i.e. the procedure specifies equipment to be calibrated every 3 months, but records show this is happening just once per year
- Not addressing a minor conformance identified as part of the audit in the time-frame provided
- Having multiple minor non-conformances that relate to the same process
- Major spill or discharge to air, water and waste

Minor non-conformances are defined as any non-conformance that is not major, or non-conformance is unlikely to result in the failure of the EMS.

For example isolated incident i.e. Daily records are required for equipment use, but it is noted that one record was not inputted

As per ISO 19011:2018 the audit finding are evaluated as conformities and Non conformities based on audit findings and the guidelines for auditing management systems states in section A.18.3 of ISO 19011-2018, where the following items are recommended for a written nonconformity –

- Description of or reference to audit criteria
- Audit evidence
- Declaration of nonconformity and related audit findings if applicable

Corrective and preventive actions

Nonconformity is non-fulfilment of a requirement. A requirement may be stated in relation to the management system or in terms of environmental performance. Situation may occur where part of the system may not function as intended or environmental performance requirements are not met.

Corrective Action - Action taken to correct a known non-compliance/non-conformance.

Preventive Action - Action taken to bring awareness and to prevent a potential non-conformance.

System for corrective and preventive action is described in two stages. This procedure addresses all types of nonconformities including, but not limited to

a) Results of audits.

b) Inputs obtained from measurement & monitoring.

c) Regulatory non-compliances and incidents and accidents

d) Non-conformances with internal objectives and targets

e) Insufficient documentation to evaluate conformance with EMS

f) Non-conformances with respect to existing policies and procedures.

Corrective action

Below mentioned table details the type of nonconformity, source for its identification, and the mitigation action recommended. Criterion for taking corrective action is described in the subsequent paragraphs.

Sl. No.	Type of nonconformity (NC)	Source for the identification and reporting of NC	Mitigation action
1	Documentation inadequacy to achieve policy and objectives, and to fulfill standards requirements	Audit – adequacy audit	Review and revision of identified document
2	Responsibilities not defined for a system activity	Document review – part of audit	Review and revision of identified document
3	Pertinent operational document not available at the point of use	Audit	Ensure its availability
4	Non-compliance with EMS Legal requirement which was not identified	External Communication	Update legal register; establish compliance
5	Legal and other requirements not complied with	Evaluation of compliance	Establish compliance for the reported finding
6	Operational control not effective to achieve planned results	Management review inputs (related to process performance)	Review and ensure established operational controls are adequate; personnel are competent.
7	Objectives and targets not achieved	Management review inputs; Audit	As decided in the MRM

Sl. No.	Type of nonconformity (NC)	Source for the identification and reporting of NC	Mitigation action
8	Emergency response not effective	Emergency response report	Revise Emergency response procedures; train personnel
9	Internal audits are not effective	External audit	Review by top management and implement the actions proposed
10	Incident occurred is related to an unidentified aspect.	Internal communication	Implement operational controls; update aspect-impact.

Preventive action

Elements for which a preventive action can be implemented are similar to those described under corrective action. One or more of the following means can be utilized to identify opportunity for preventive action:

a) Trend analysis of element (of EMS system) wise nonconformities;

b) Trends in "no loss incidents"

c) Periodic inspection / "walk-through"

d) Suggestion from employees

e) Audit recommendations

Root-cause analysis shall be carried out for the identified / reported potential nonconformity.

Preventive actions proposed for an identified / reported potential nonconformity shall be reviewed in the management review meetings or by the EMR for techno-commercial viability.

The respective functional heads shall implement those that are approved. Records of the results of action taken shall be maintained.

Compliance audits

As the name implies, these audits are intended to review the site's/company's legal compliance status in an operational context. Compliance audits generally begin with determining the applicable compliance requirements against which the operations will be assessed. This tends to include federal regulations, state regulations, permits and local ordinances/codes. In some cases, it may also include requirements within legal settlements.

Environmental Compliance Audit can be simplified into three steps:

Pre-Audit

The auditor will determine which environmental laws, policies, and procedures are applicable to the operations of the business, as well as determine the scope and objectives of the audit. The auditor must establish the criteria against which the audit will be conducted. Common criteria are company policies and procedures on environmental issues, applicable legislation and regulations, and best environmental management practices.

Environmental Compliance Audit can be simplified into three steps:

On-site Audit

The auditor will conduct an assessment to determine whether the business is complying with the applicable environmental regulations, policies, and procedures.

The auditor must develop an understanding of the controls that are in place, including formal procedures and practices, record-keeping and monitoring, inspection programs, and physical controls for containing pollution and spills. Through testing, observation, or inquiry, the auditor will attempt to verify whether the controls work as intended. All information gathered is recorded and evaluated. Potential problems noticed on-site are discussed with the management team or contractors.

Environmental Compliance Audit can be simplified into three steps:

Post-Audit

Following the on-site work, the next step is to prepare a report. The auditor will compile an Environmental Compliance Audit report which designates the status of the business as full compliance, partial compliance, or non-compliance. The report indicates the laws and policies the company follows and where the company is non-compliant. In the event of non-compliance, the report will provide advisory action to improve overall environmental legal compliance. The company has the option to request recommendations in the form of an action plan or not.

Benefits of Environmental Compliance Audits

An Environmental Compliance Audit can benefit companies in several ways:

- Ensures safeguarding of the environment
- Verifies compliance with local and national laws
- Indicates critical current or future problems and environmental impacts
- Assesses training programs, providing data for future environmental training
- Enables companies to build good environmental performance and highlight shortcomings
- Identifies areas for saving, such as waste minimization
- Demonstrates the company's environmental protection commitment to employees, the public, other stakeholders, and the authorities

Waste audits and Waste minimization planning

A waste audit is a physical analysis of waste composition to provide a detailed understanding of problems, identify potential opportunities, and give you a detailed analysis of your waste composition

Waste Audit Process:

The Audit

The data collected from the audit will identify the type of waste produced by the organization and how the organization manages this waste.

Validating the Data;

Once the organization receives the data from a waste audit, the organization must validate the data.

Implementation;

Organizations may choose to implement aspects of the waste audit with the help of different environmental agencies such as the Environmental Protection Agency or various state and local agencies.

Monitoring and Reviewing

In many cases, the initial excitement of performing and implementing these audits does not last long.

Identify Wastes;

The objective of this step is to estimate types of wastes and places where they are generated.

Estimate Waste Quantities

It is now necessary to estimate how much of each of the three classifications of waste materials identified above that your operation generates during a specific period.

Identify Recycled Content

This step requires to examine purchasing specifications to identify the recycled content of purchased products, packaging and raw materials.

Complete Waste Audit Report;

Maintain a record of the information reviewed, assumptions made, waste samples examined (including the sample dates) and the material weights and/or volumes calculated.

Waste minimization planning;

Reducing environmental impact: Effective waste management enables you to minimize your company's adverse effects on the environment.

Staying compliant with regulations: A robust waste management program keeps your company in compliance with local and federal laws.

Lowering disposal costs: Many businesses wonder whether professional waste management will be too expensive.

Waste minimization planning;

Reducing your logistical burden: Proper waste management services reduce the logistical strain on your organization and its resources.

Ensuring worker health and safety: You want your company to maintain a safe, comfortable working environment for employees.

Consider Your Waste Hierarchy

As you plan your waste management practices, consider implementing a hierarchy that prioritizes sustainable processes like reusing and recycling over landfill disposal:

Reduce: Start by examining where your facility can reduce its waste generation.

Reuse: Consider what types of waste your facility can repurpose.

Recycle: Consider what waste you can divert from your disposal stream and break down for recycling.

Recover: Waste products you can recover for resale often include scraps of metal and leftover construction materials. With a waste-to-energy program, you may also recover energy from combusting waste.

Dispose: Generally, everything that remains after you've exhausted the options above must go to a landfill.

Environmental statement (form V);

Definition:-

Environmental statement is process of self-Inspection for Improvement in Processes and Reduction in Waste over the last year.

Environmental Statement Form V Contents

In the Environmental Statement every industry should to provide Information on Production, Consumption of raw, Water, Pollutants discharged in environment, Solid and Hazardous waste with their Treatment Processes.

Important things to be reported to Pollution control board are:

If that company is reusing its by-products or waste material which results in Reduction in consumption of Air, Water or energy.

Production cost

Additional Investment proposals for environmental Protection i.e. up-gradation, Improvement in Process or New Equipment's to reduce Environmental Pollution.

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Environmental Statement Form V Filling Process

There are total Nine Section in Environmental Statement Form V. It consists

Part A: Basic Information About Company Like Name, Address, Industry Category, Production Capacity and Date of Last Environmental Audit Submitted.

Part B: This Part is for Comparison of Water and Raw Material consumption for this financial year to previous year.

Part C: This Part is to measure Pollutants Discharged to Environment through medium Air and Water. How much in excess, an industry is releasing the pollutants into the environment.

Part D: This part to Measure Hazardous Waste from processes and from Pollution control Facilities

Environmental Statement Form V Filling Process

Part D: This part to Measure Hazardous Waste from processes and from Pollution control Facilities

Part E: This Part is to measure Solid waste generated by industry. Also details like Quantity recycled, Sold and Disposed

Part F: Any new practices adopted to reduce Hazardous waste.

Part G: Impacts of pollution control measures on natural resources and with Cost of Production.

Part H: Additional Investment / Process / measures to minimization or prevention of pollution.

Part I: In this part other information / initiatives to improve quality of Environment needs to be given.

Dispose: Generally, everything that remains after you've exhausted the options above must go to a landfill. With effective waste management practices, you can often minimize the amount of waste that falls into this category and develop strategies for responsible disposal.

Module – 5

Applications

Waste Audits and Pollution Prevention Control

Pre Audit activities;

Selection of the audit team members.

- Composed of two to eight people, with a team leader, this team must represent all the needed specialities (policy, environmental management, toxicology, operational aspects, etc.) to carry out the audit in good conditions.

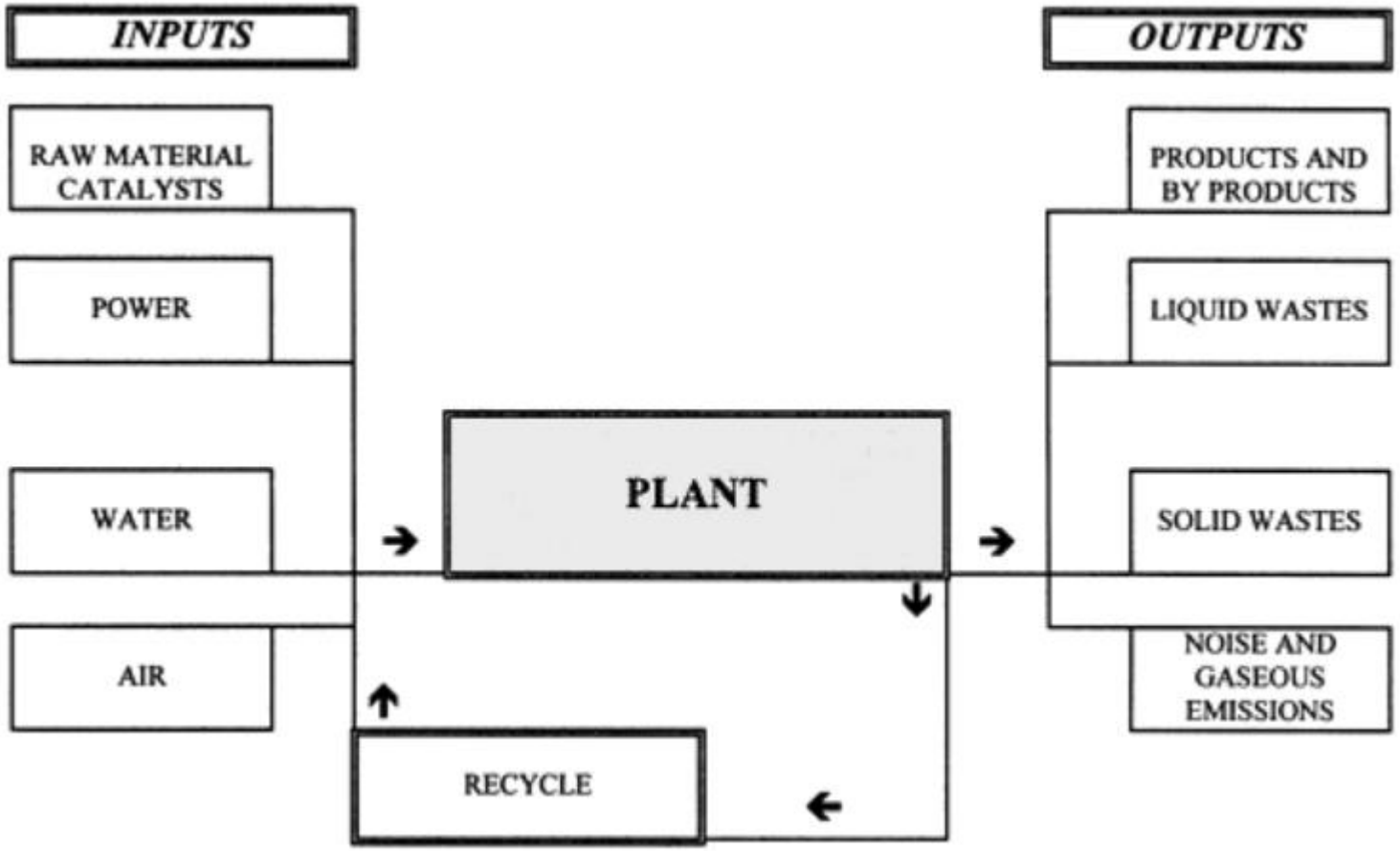
Scoping of the proposed audit.

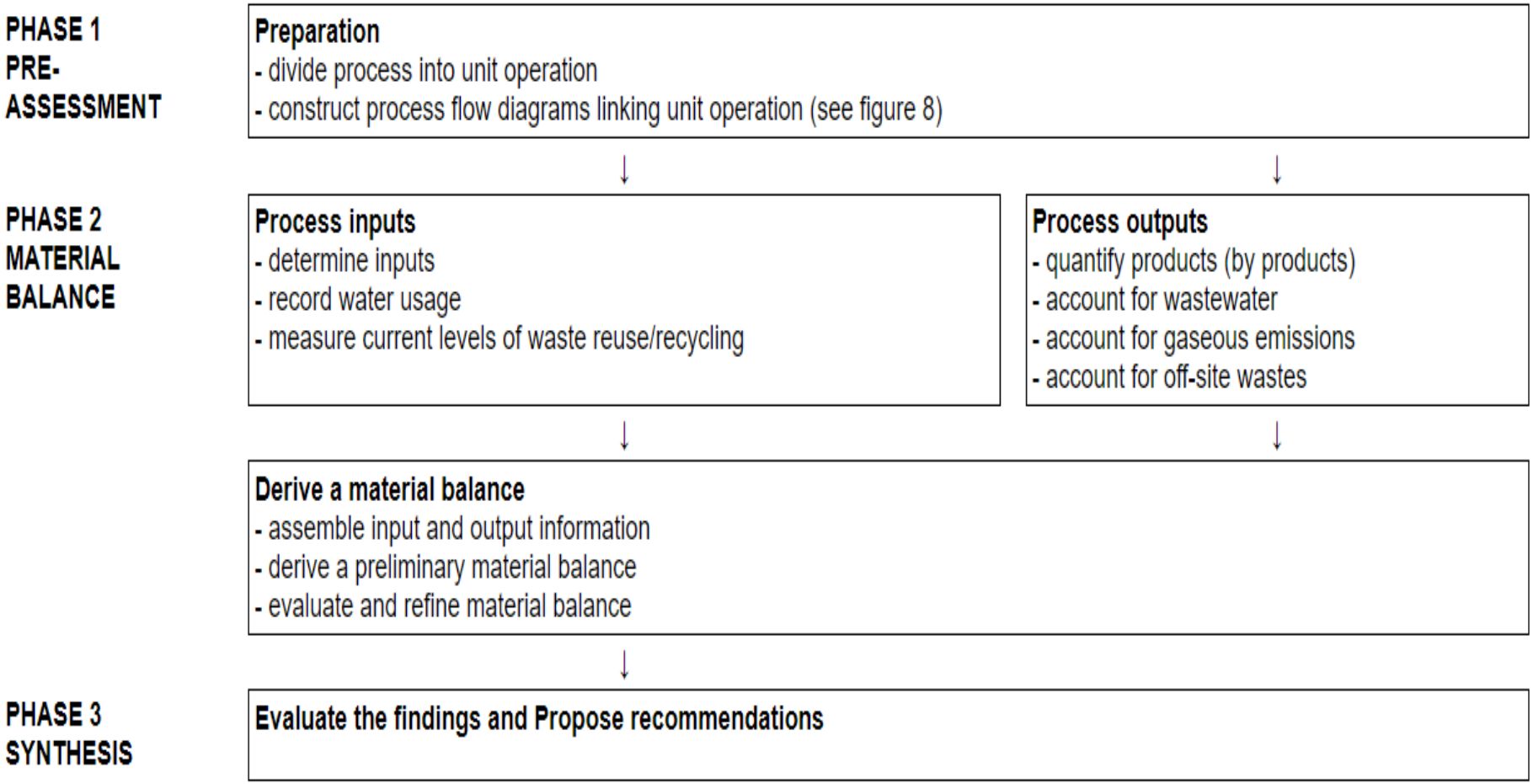
It is clear that the scope of the audit has to be defined before it begins. The audit can be focused on industrial activities. More rarely it includes raw material production and exploitation. Other goals can be proposed to the audit (hazards, occupational health, spill prevention, toxic control, waste management, etc.).

Collection of background information.

In particular, previous audits and copies of all registers where data are recorded and possible administration of a questionnaire to prepare the visit at the site.

Various inputs and outputs to be studied in the plant during an EA




PHASE 1
PRE-
ASSESSMENT
Preparation
- divide process into unit operation
- construct process flow diagrams linking unit operation (see figure 8)
PHASE 2
MATERIAL
BALANCE
Process inputs
- determine inputs
- record water usage
- measure current levels of waste reuse/recycling
Process outputs
- quantify products (by products)
- account for wastewater
- account for gaseous emissions
- account for off-site wastes
Derive a material balance
- assemble input and output information
- derive a preliminary material balance
- evaluate and refine material balance
PHASE 3
SYNTHESIS
Evaluate the findings and Propose recommendations

Textile Industry

Textile effluent

- The liquor discharged after the completion of unit operations in industry is known as Effluent
- The effluent consists of remaining unused or modified chemicals, dyes, auxiliaries and finishing agents & traces of raw material used & Energy consumed,
- It is essential to treat effluent to reduce toxic pollutants either by separation method & / or by cracking molecule in to normal element or Both.

Pollutant and their Nature

Process	Effluent Composition	Pollutant nature
Sizing	Starch, waxes, CMC, PVA, etc	High in BOD,COD
Desizing	Starch, CMC, PVA, Fats, Waxes, etc	High in BOD,COD,SS,TDS
Bleaching	Sodium Hypochlorite, NaOH, H2O2, acid, Surfactants, Sodium Phosphate, Short Cotton Fibre, Etc	Highly alkalinity, High SS
Mercerization	Sodium Hydroxide, Cotton Wax	High pH, Low BOD, High DS
Dyeing	Dyestuff, Reducing Agent, Acetic Acid, Detergents, Wetting Agent, Salt, Etc	Strongly Colored, High BOD, DS, Low SS, heavy metal
Printing	Paste, Urea, Starches, Gums, Oils, Binders, Thickners, Cross- Linkers, Reducing Agent, Alkali,etc.	Strongly Colored, High BOD,DS,SS, Slightly Alkaline.
Finishing	Emulsifiers, Silicones, Various finishing agents	Harmful - non biodegradable substances

Textile Effluent & Discharge Norms

Parameters for **Dyehouse**	Untreated waste water	Treated waste water
pH	4.0 to 10.5	6 to 9
Colour	Dark, offensive	No Colour, not offensive
Foam	Persistent	No foam or dissipates
Heavy metals	10 to 15 ppm	0.01 to 1.5 ppm
Suspended solids	200 to 300 ppm	30 To 45 ppm
Total Dissolved Solids	3500 to 6000 ppm	2100 ppm
Chemical Oxygen Demand	900 to 1500 ppm	250 ppm
Biochemical Oxygen Demand	300 to 500 ppm	30 ppm

Analysis of Pollutants: Textile Effluents

A. Relatively Harmless Inorganic Contaminants

- Alkalis
- Mineral acids
- Neutral salts
- Oxidizing agents

B. Moderate to high BOD but readily Biodegradable

- Starch sizes
- Vegetable oils, fats and waxes
- Biodegradable surfactants
- Organic acids
- Reducing agents

C. Dyes and Polymers Difficult to Biodegrade

- Dyes and fluorescent brighteners
- Most fibres and polymeric impurities
- Polyacrylate sizes
- Synthetic –polymer finishes (crease –resistant, flame-retardent)
- Silicones

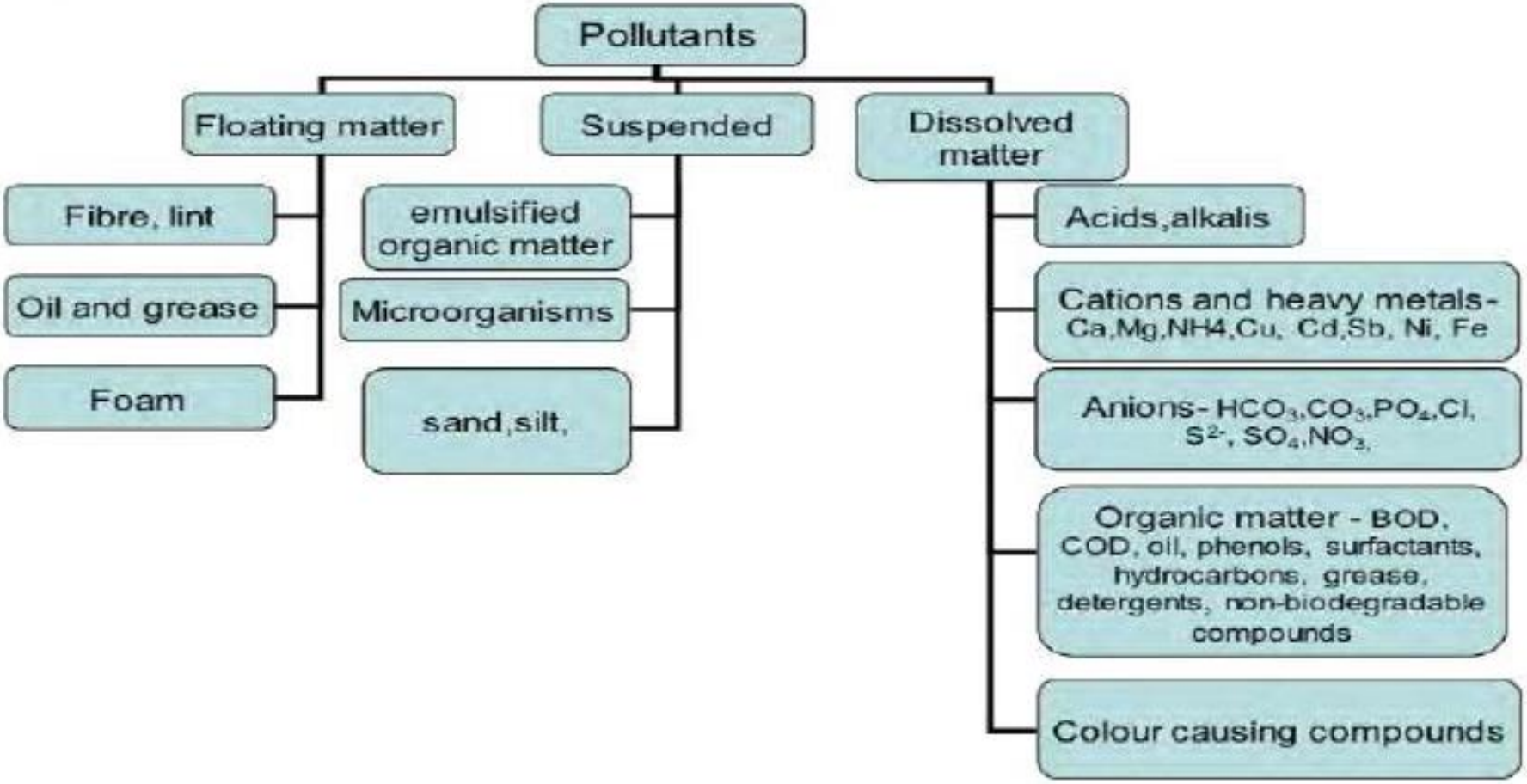
D. Moderate BOD and Difficult to biodegrade

- Wool grease
- Poly(vinyl alcohol) sizes
- Starch ethers and esters
- Mineral oil (spin finishes)
- Surfactants resistant to biodegradation

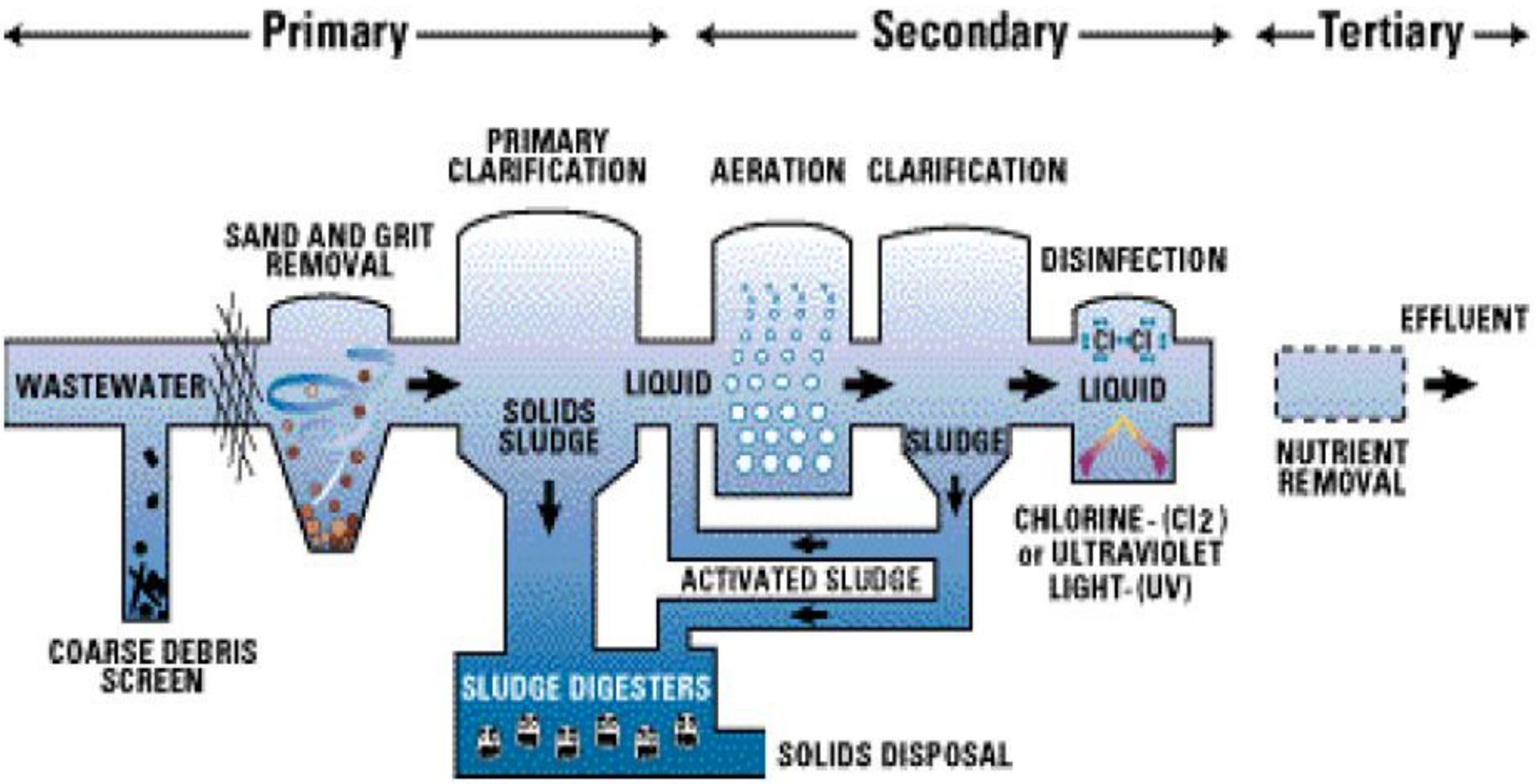
E. Negligible BOD but Unsuitable for Conventional Treatment

- Formaldehyde and N-methylol reactants
- Chlorinated solvents and carriers
- Cationic retarders and softeners
- Biocides
- Sequestering agents
- Heavy metal Salts

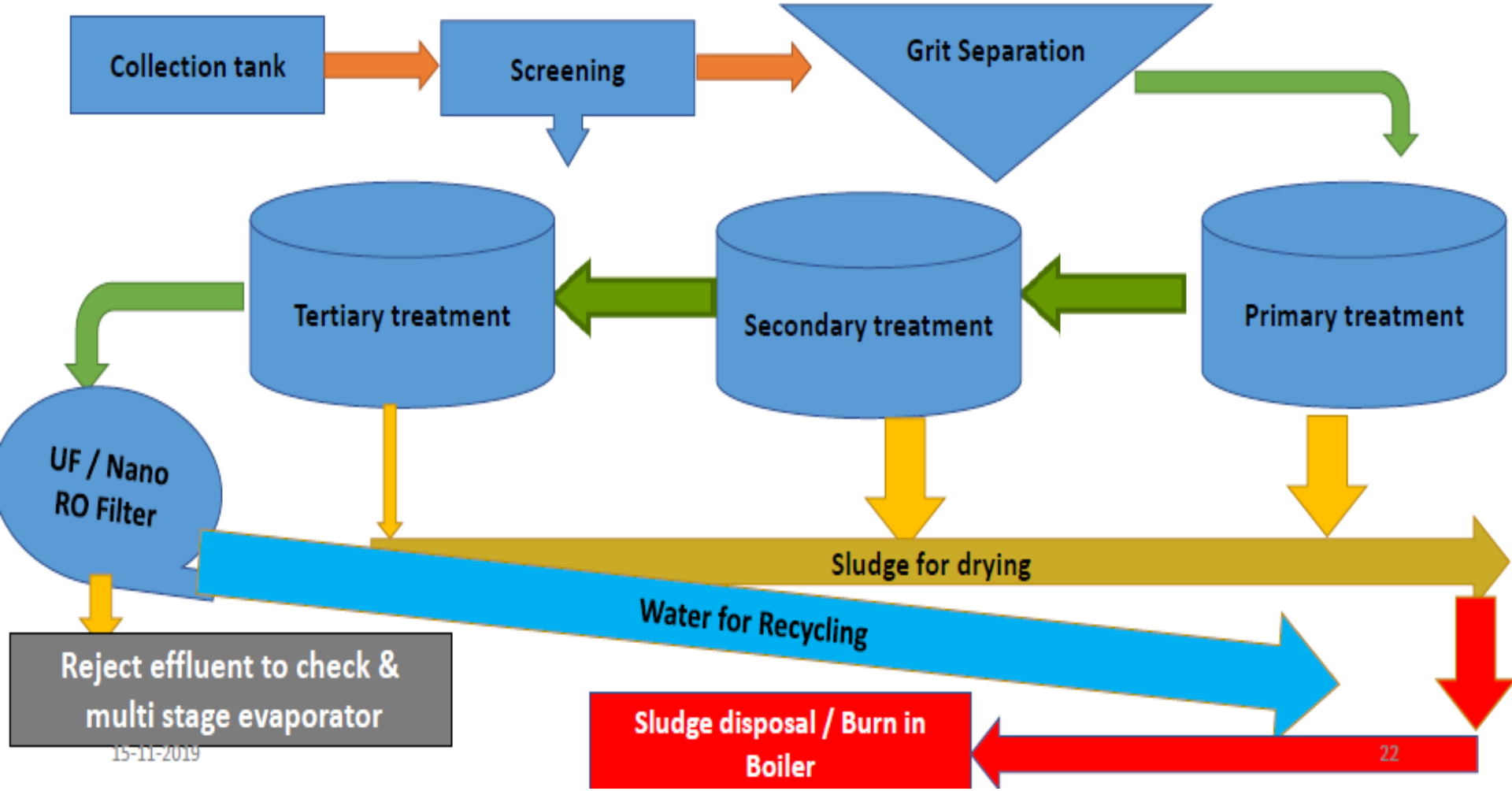
Classification of Pollutants



ETP (Effluent Treatment Plant)



Process flow of standard ETP & Recycling



Various Treatments in ETP

Primary

Involves sedimentation of solid waste within the water.

Secondary

Makes use of oxidation to further purify wastewater

Tertiary

This is basically a polishing stage.

Water Recycling

Recycling of water means, reuse of water. It can be done in various manners.

- Recycle of good quality of water back to process without treatment - Cooling water, ETP effluent used in chemical dosing / culture making system instead of fresh water being used.
- Internal reuse of water - Discharge water of one process can be a starting water for another process by little modifications – Peroxide bleach water to be reused in scouring or Desizing, drain of selected Polyester dye-bath to use for cotton soaping. Mercerize wash liquor to be recycled in Bleaching process.
- Recycle of effluent after full treatment – To recycle effluent after partial or full treatment & reuse in selective / all processes – ETP – – Bag filter – Cartridge filter, - Membrane Filters

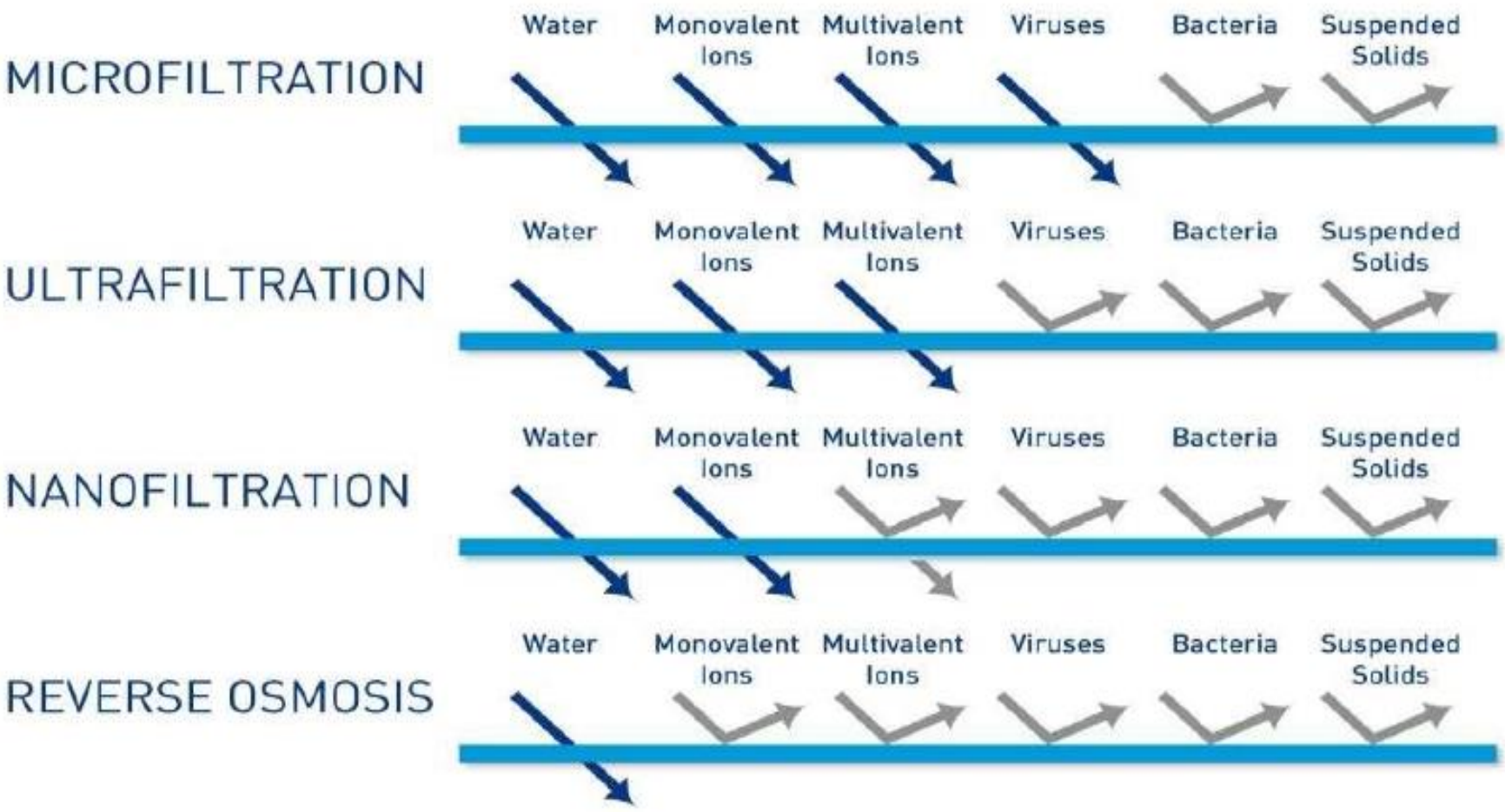
Membrane Filtration

- A membrane is a selective barrier. it allows some things to pass through but stops others. Such things may be molecules, ions, or other small particles
- Synthetic membranes are men made for selective usage as per requirements. (Mostly Polyamides / Ceramic / Carbon)

Types of Membrane processes

- Microfiltration (MF)
- Ultrafiltration (UF)
- Nanofiltration (NF)
- Reverse Osmosis (RO)

TYPE OF MEMBRANES AND CHARACTERISTICS



ISO 19011:2018 provides valuable information on how to improve an audit program systematically, just as other departments in an organization are expected to improve.

Paper & Pulp Industry

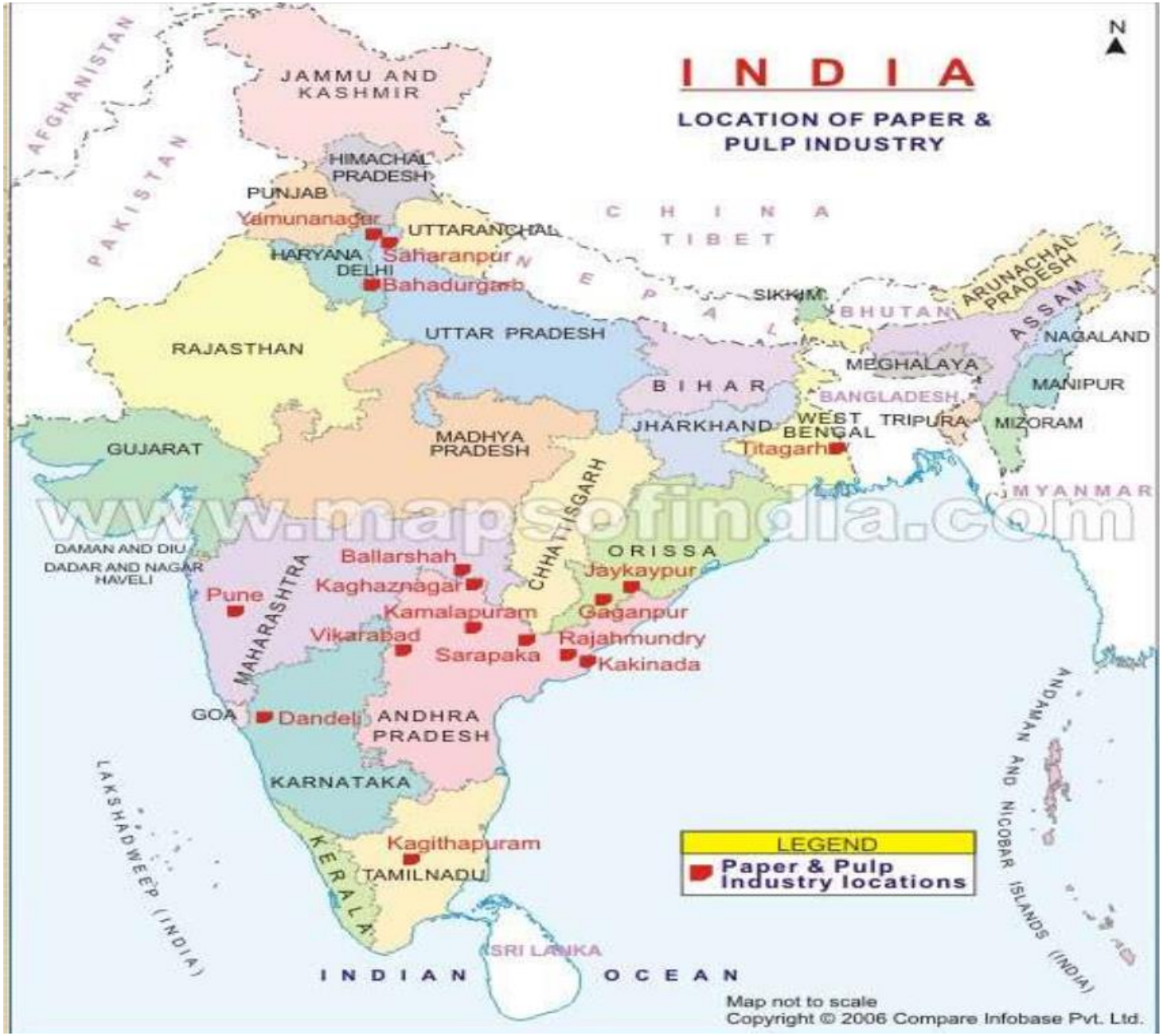
Paper industry in India is the 15th largest paper industry in the world. It provides employment to nearly 1.5 million people and contributes Rs 25 billion to the government's kitty. The government regards the paper industry as one of the 35 high priority industries of the country. The annual global paper and paperboard production was approximately 382.0 million tones in 2006. It is expected to increase to 402.0 million tones by 2010 and 490.0 million tones by 2020 In India pulp and paper Industry is the sixth largest consumer in the industrial sector

Main consumer of natural resources:

1 -Wood (as raw material)

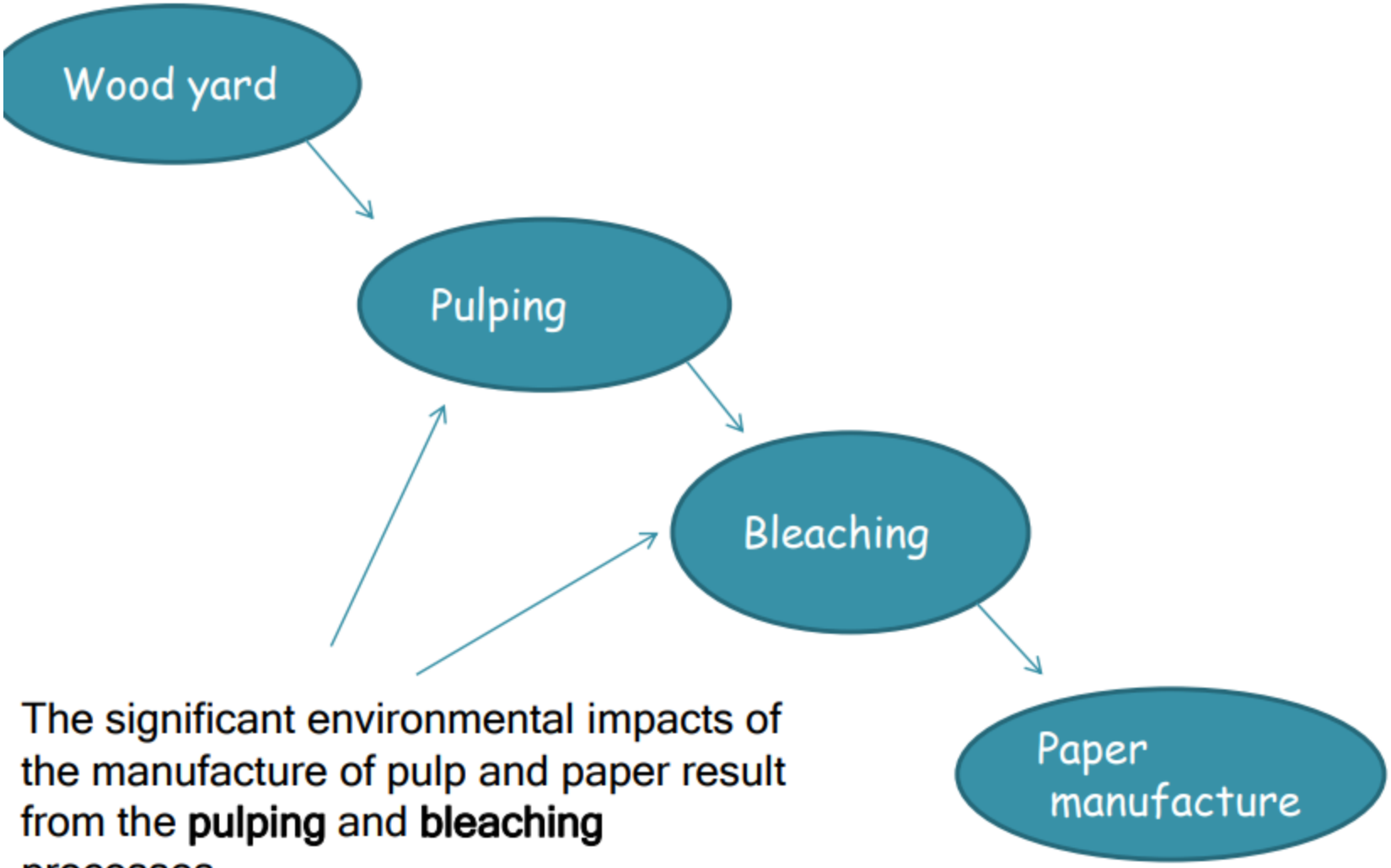
2 -Fossil-fuel, electricity (as energy)

3 -Water



OVERVIEW OF THE PULP AND PAPER PROCESS

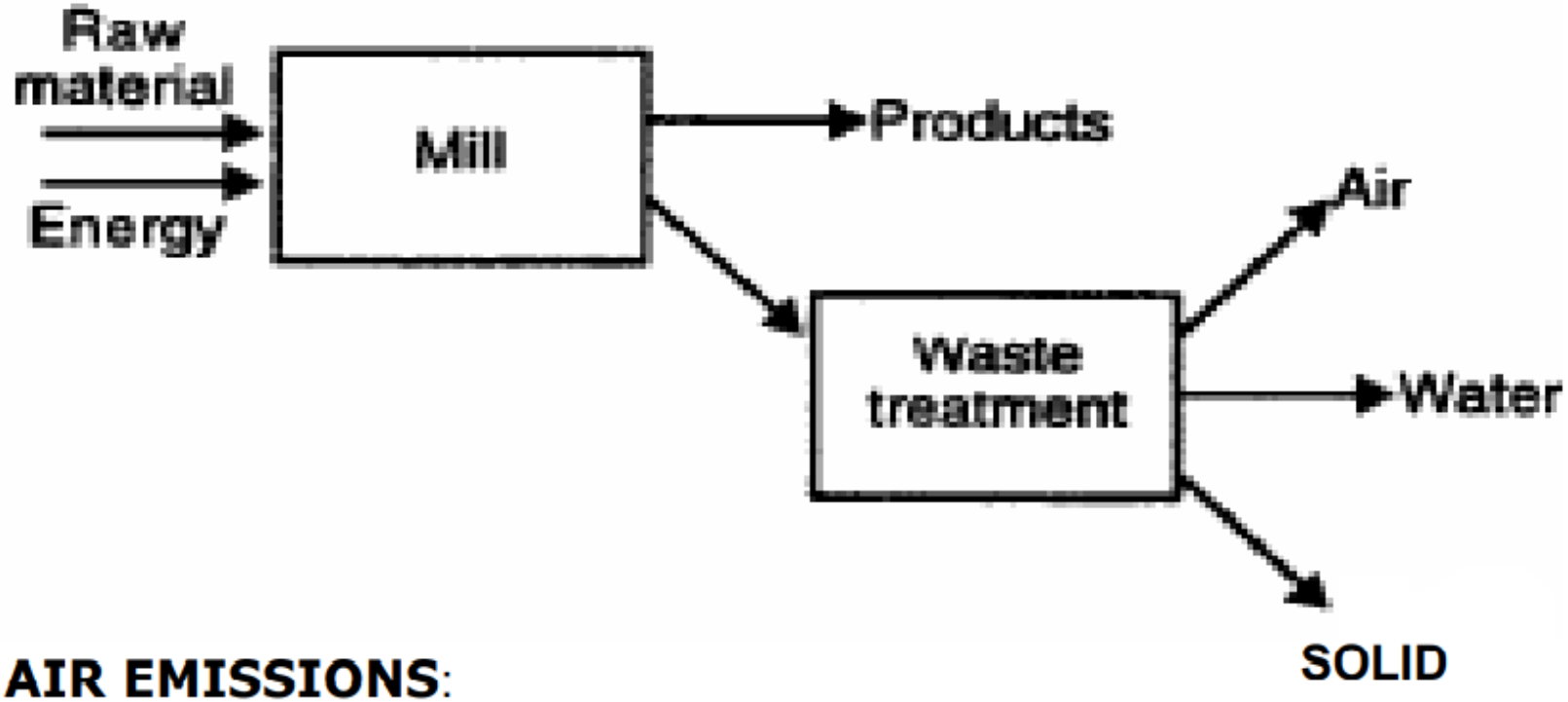
- The main steps in pulp and paper manufacturing are



The significant environmental impacts of the manufacture of pulp and paper result from the **pulping** and **bleaching** processes

PROCESS	PURPOSE	MAJOR TECHNOLOGIES
PULPING	Convert wood chips of wastepaper into fibers suitable for papermaking	Chemical (Kraft, sulfite)- digesters, mechanical – refiners, semi chemical – digesters & refiners
CHEMICAL RECOVERY (KRAFT PULPING)	Recovery of inorganic chemicals from spend pulping liquor and combustion of organic residuals to produce energy	Evaporation concentration recovery boiler, causticizing, calcining.
BLEACHING	Brighten of whiten pulps by using chemicals to selectively remove lignin.	Chlorine dioxide, oxygen, hypochlorite, peroxide, ozone, of chlorination- upflow of downflowtowers, vacuum washers, pumps, mixers.
PAPER MANUFACTURE	Prepare stock from pulp, sheet, dewater, dry, caleder	Heat box, sheet forming table.

WASTE CHARACTERISTICS



AIR EMISSIONS:

TRS (Total reduced sulphur): 0.3-3 kg/ton of ADP (air dried pulp)
particulate matter: 75–150 kg/t;
sulfur oxides: 0.5–30 kg/t;
nitrogen oxides: 1–3 kg/t
volatile organic compounds (VOCs): 15 kg/t from black liquor oxidation.
Coal burning can emit fly ash at the rate of 100 kg/t of ADP

- **LIQUID WASTE:**
- BOD: 10–40 kg/t of ADP
- total suspended solids: 10–50 kg/t of ADP;
- chemical oxygen demand (COD): 20–200 kg/t of ADP
- chlorinated organic compounds: 0–4 kg/t of ADP.
- Waste water: 20- 250 m3 /t

- **SOLID WASTES:**
- Wastewater treatment sludge: 50–150 kg/t of ADP
- Fly Ash 100 kg/t of ADP

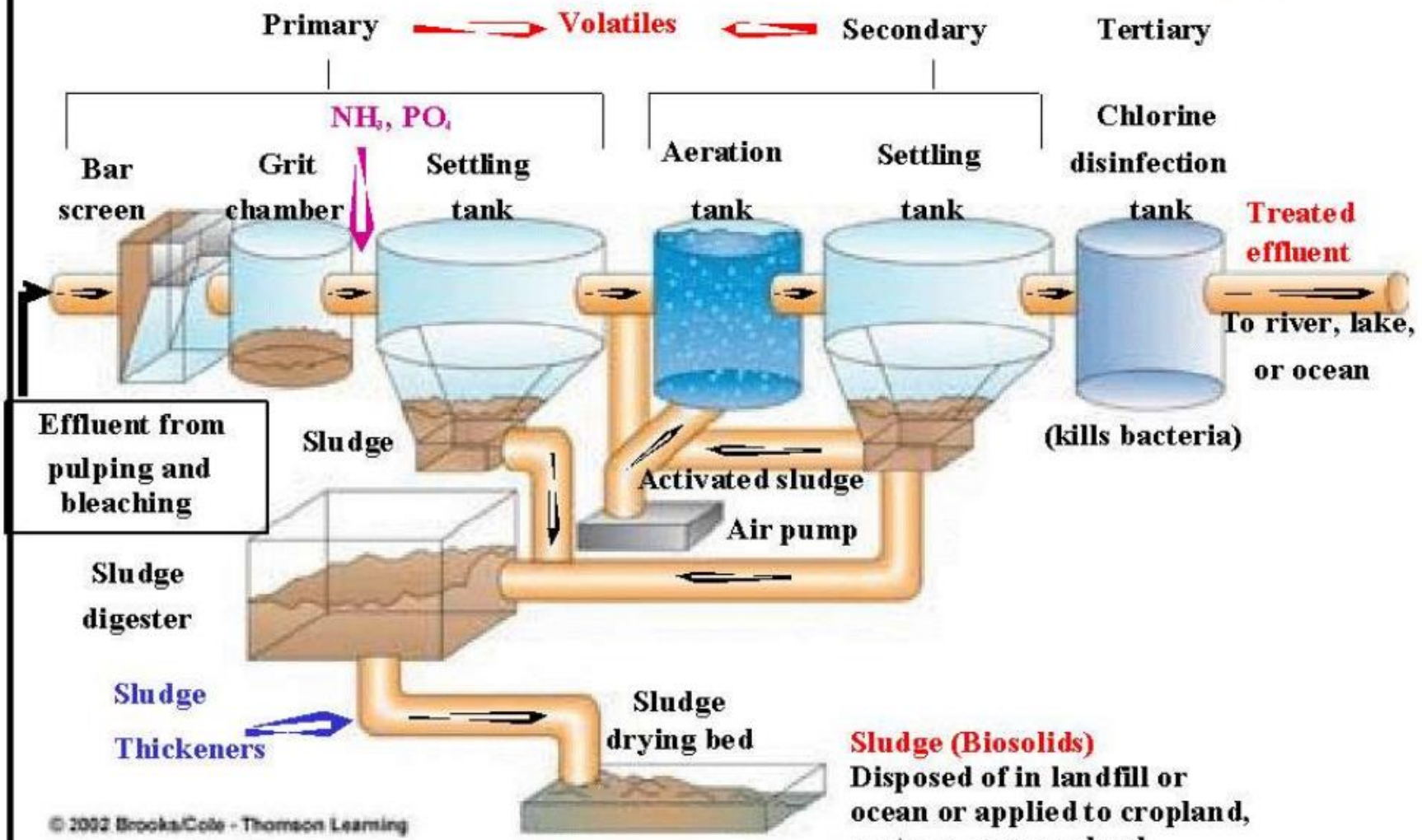
WASTEWATER CHARACTERISTICS

- The volume & characteristic of waste depends on the type of manufacturing process adopted & extent of reuse of water.
- Waste produced from digestion of cellulosic material is known as "BLACK LIQUOR". This contain lignin & a large amount of unutilized chemicals.
- Waste liquor produced from paper mill is known as "White water", that contain fine fiber, alum, talc etc.
- Integrated pulp & paper mill employing Kraft process for pulping produce waste water225-320 m3/ton of paper produced.
- Chemical composition of waste will depend on size of plant, manufacturing process & material used.
- Generally the pulp & paper mill waste is characterized by very strong color, high BOD, high suspended solid, high COD/BOD ratio.

WASTE CHARACTERISTICS FROM VARIOUS PROCESSES

Wastewater from	Paper manufacturing	Sulphite liquor	Cellulose manufacturing
Total dry matter (mg/l)	600- 2000	abt 100,000	3000 -5000
Suspended matter (mg/l)	250 - 1000	1000-2000	2000-3500
BOD_5 (mg/l)	100 - 250	20,000-30,000	500-1500
COD (mg/l	600-1000	abt 150,000	2000-4500
pH	6 - 8	2 - 3	7 - 9

Solutions: Effluent Treatment (Activated Sludge)



Sludge (Biosolids)
Disposed of in landfill or ocean or applied to cropland, pasture, or rangeland