MCN-201:
SUSTAINABLE ENGINEERING

Module 3

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Module 3

Environmental management standards: ISO 14001:2015 frame work and benefits

Scope and goal of Life Cycle Analysis(LCA),

Circular economy,

Bio-mimicking,

Environment Impact Assessment (EIA),

Industrial ecology and industrial symbiosis.

1. Environmental management standards: ISO 14001:2015 frame work and benefits

- ★ The international standard ISO 14001 provides the standards for an efficient environmental management system (EMS).
- ★ Rather than establishing environmental performance requirements, it gives a framework for an organization to follow.
- ★ An environmental management system is defined by the International Organization for Standardization (ISO) as "a component of a management system used to manage environmental elements, meet compliance duties, and address risks and opportunities."
- ★ The ISO 14001 framework can be used in connection with a plan-do-check-act (PDCA) strategy to continuous improvement.

ISO 14001:2015

★ Any organization that wishes to build, upgrade, or maintain an environmental management system in accordance with its specified environmental policy and standards should adopt ISO 14001:2015.

★ ISO 14001:2015 addresses the following environmental management system topics:

- Context of the organization
- Leadership
- Planning
- Support
- Operation
- Performance evaluation
- Improvement

ISO 14001 Environmental Management Systems (EMS) Framework

10 major areas of impact of the 2015 revision:

1. Expansion in EMS coverage and scope
2. Required interactions with external parties
3. New requirements for leadership engagement
4. Expanded legal compliance requirements
5. Need for risk-based planning and controls
6. New documentation requirements
7. Expanded operational control requirements
8. Changes in competence and awareness requirements
9. Impacts on the internal audit program
10. Increased certification costs

THE BENEFITS OF ISO 14001:2015

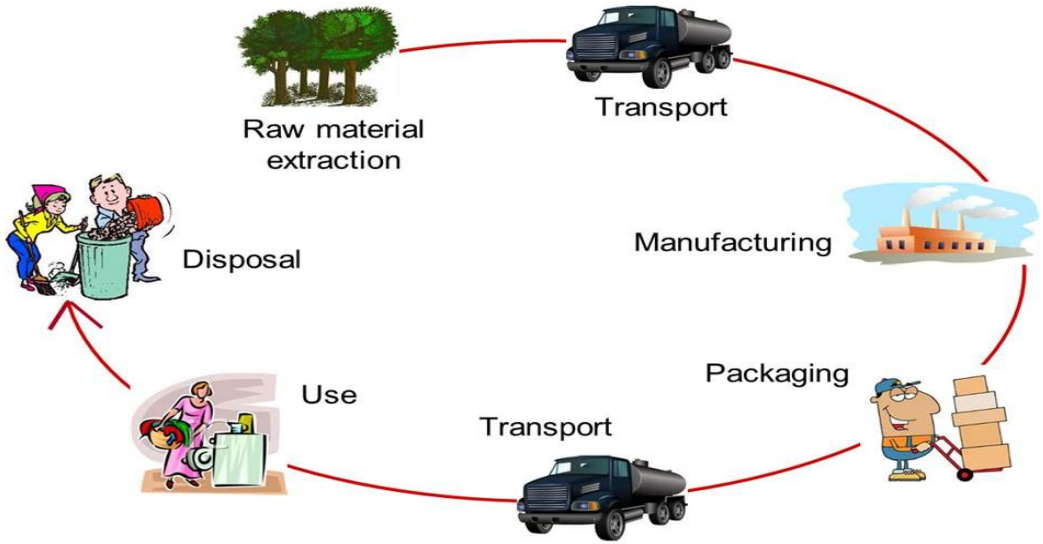
The use of ISO 14001:2015 has numerous advantages for organizations using environmental management systems.

1. Improve resource efficiency
2. Reduce waste
3. Drive down costs
4. Provide assurance that environmental impact is being measured
5. Gain competitive advantage in supply chain design
6. Increase new business opportunities
7. Meet legal obligations
8. Increase stakeholder and customer trust
9. Improve overall environmental impact
10. Manage environmental obligations with consistency

2. Scope and goal of Life Cycle Analysis(LCA)

★ Life cycle assessment (LCA) is a tool that helps decision makers and companies make decisions by looking at the effects of a product's life and processes from the time it is made until it is thrown away.

★ This includes the extraction of resources, production, manufacture, transportation, use, and disposal.



Life cycle assessment consists of four phases:

1. Goal and scope definition
2. Life cycle inventory
3. Life cycle impact assessment
4. Interpretation

Goal and Scope Definition

★ 1st phase includes the goal and scope of the study and defines the system under study, in terms of its functional unit, system boundaries, hypotheses and data requirement.

Life Cycle Inventory

- ★ 2nd phase is a life cycle inventory (LCI) which involves data collection and modeling of the product system.
- ★ In this phase, information about environmental inputs (raw materials, chemicals, energy, etc.) and outputs (air emissions, water emissions and waste) from all parts of the product system is gathered.

Life Cycle Impact Assessment

- ★ Life cycle impact assessment (LCIA) evaluates the potential environmental impacts (such as global warming, ozone depletion, smog, acidification, eutrophication, ecotoxicity, etc.) associated with identified inputs and releases.

★ There are mandatory and optional elements in the LCIA phase. Mandatory elements include

i) the selection of relevant environmental impact categories (selection)

ii) the assignment of LCI results to the selected impact categories (classification)

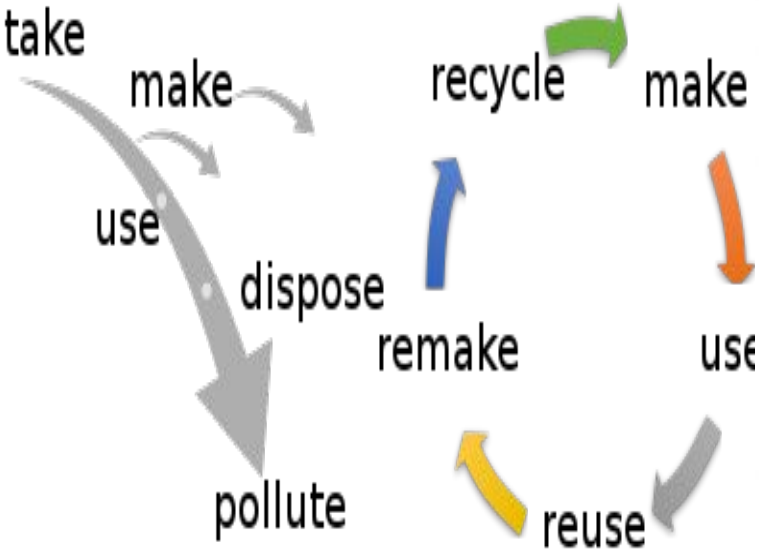
iii) the calculation of environmental impact scores (characterization)

Interpretation

★ Interpretation leads to the conclusion whether the goal and scope was met.
★ Interpretation of results helps to make an informed decision about the environmental impacts of products and processes.
★ Conclusions, limitations and recommendations are given in this phase.

3. Circular economy

- ★ A circular economy (CE) comprises sharing, leasing, reusing, repairing, refurbishing, and recycling materials and products as long as possible.
- ★ CE emphasizes design-based implementation of the model's three main principles to address climate change, biodiversity loss, waste, and pollution.
- ★ The circular economy requires eliminating waste and pollution, rotating products and materials, and regenerating nature. CE differs from linear economy.
- ★ CE is popular because it reduces emissions and raw material consumption, opens new markets, and improves consumption sustainability and resource efficiency.



Benefits?

★ Waste prevention, ecodesign, and re-use might save the companies money and lower greenhouse gas emissions.

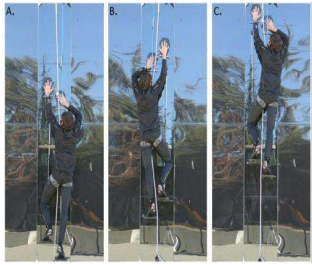
★ circular economy might reduce environmental impact, improve raw material security, promote competitiveness, innovation, economic growth, and job creation.

4. Bio-mimicking

- ★ Biomimicry, which literally means "imitation of life," aims to take inspiration from natural selection solutions adopted by nature and translate the principles to human engineering
- ★ The goal of the biomimicry approach is to favor "choices" that nature has already tried and tested over millions of years.
- ★ Biometrics-based designs will allow humans to make things that are more efficient, durable, and long-lasting.

Examples of Biomimicry

1. Climbing pads capable of supporting human weight are a mimic of the biomechanics of gecko feet.



2. The aerodynamics of the famous Japanese Bullet train was inspired by the shape of a bird's beak.

3. The first flying machine heavier than the air from
the Wright brothers, in 1903, was inspired by flying pigeons.

Examples of Biomimicry

4. Architecture is inspired by termite mounds to design passive cooling Structures.

5. Velcro is born from the observation of the hooks implemented by some plants for the propagation of their seeds via animal's coat.

6. The study of shark skin is at the origin of particularly effective swimming suits.

5. Environment Impact Assessment (EIA)

- ★ The EIA is a tool that helps in identifying the environmental, economic & social impacts of a project before decision-making.
- ★ It aims to forecast ecological impacts at an initial stage during project planning & design, identify methods to minimize negative impacts,and outline projects to meet the local environment.

Objectives of Environment Impact Assessment (EIA)

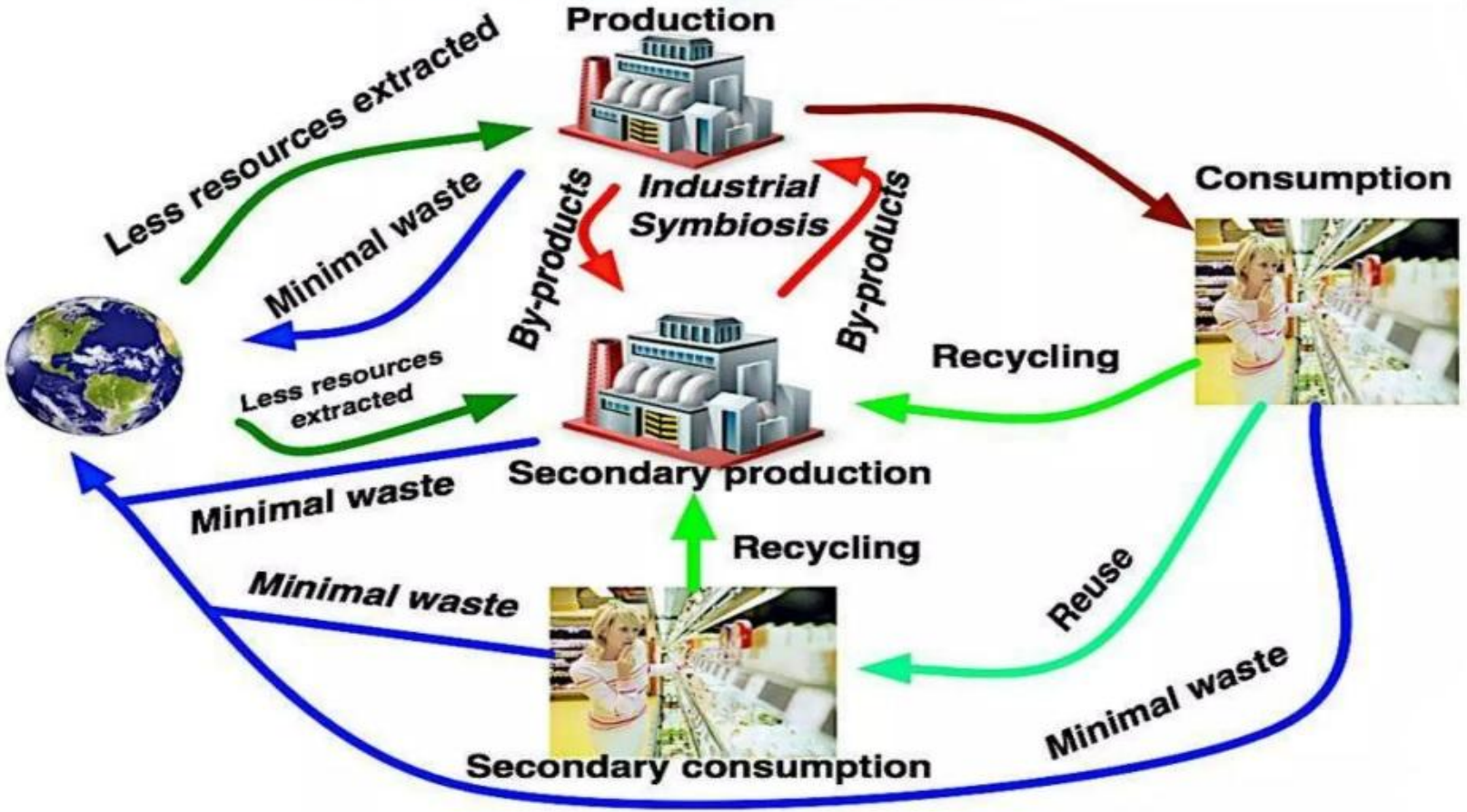
Importances of Environment Impact Assessment

- ★ EIA links the environment and development so that development is safe for the environment and lasts for a long time.
- ★ EIA is a low-cost way to get rid of or lessen the bad effects of development projects.
- ★ EIA allows decision-makers to examine the environmental impact of development activities long before the project is implemented.
- ★ EIA encourages the use of mitigation methods in the development plan.
- ★ EIA makes sure that the plan for development is good for the environment and doesn't go beyond what the ecosystem can handle.

6.Industrial ecology and industrial symbiosis.

- ★ The study of the flows of materials and energy in industrial and consumer activities, the effects of these flows on the environment, and the influences of economic, political, and social factors on the flow, use and transformation of resources.
- ★ The primary goal of industrial ecology is to promote sustainable development at the local, regional, national, and global levels.
- ★ IE is a dynamic system-based framework that enables management of human activity on a sustainable basis by:
  - Minimizing energy and materials usage
  - Ensuring acceptable quality of life for people
  - Minimizing the ecological impact of human activity to levels natural system can sustain
  - Maintaining the economic viability of systems industry

Industrial Ecology processes

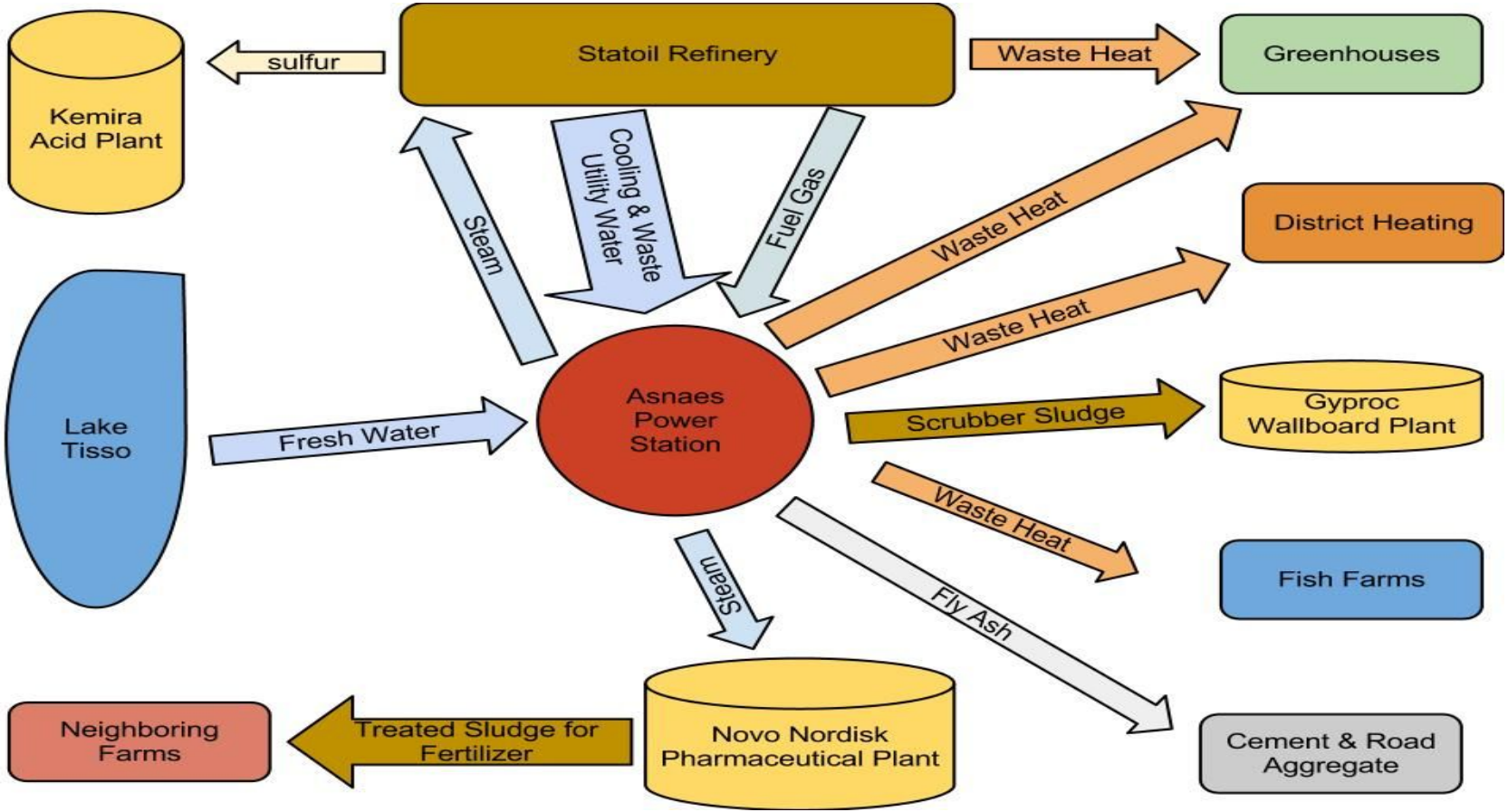


Industrial Symbiosis

- ★ Industrial symbiosis is the process by which wastes or by-products of an industry or industrial process become the raw materials for another.
- ★ Application of this concept allows materials to be used in a more sustainable way and contributes to the creation of a circular economy.
- ★ It was first coined in 1989 to describe the collaboration of businesses in Kalundborg involves the physical exchange of materials, energy, water, and by- products among several organizations

Eco-industrial Park

- A community of manufacturing and service businesses seeking enhanced environmental and resource issues including energy, water, materials, information, and natural habitat.



Kalundborg Eco-Industrial Park Symbiosis Map