## WHAT IS ISO 14001:2015 – ENVIRONMENTAL MANAGEMENT SYSTEMS?

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.

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." The framework in the ISO 14001 standard can be used within a plan-do-check-act (PDCA) approach to continuous improvement.

## WHO SHOULD USE THE ISO 14001:2015 REVISION?

ISO 14001:2015 should be used by any organization that wishes to set up, improve, or maintain an environmental management system to conform with its established environmental policy and requirements. The requirements of the standard can be incorporated into any environmental management system, the extent to which is determined by several factors including the organization's industry, environmental policy, products and service offerings, and location.

ISO 14001:2015 is relevant to all organizations, regardless of size, location, sector, or industry.

What topics does ISO 14001:2015 cover?

At the highest level, ISO 14001:2015 covers the following topics with regard to environmental management systems:

Context of the organization

Leadership

Planning

Support

Operation

Performance evaluation

Improvement

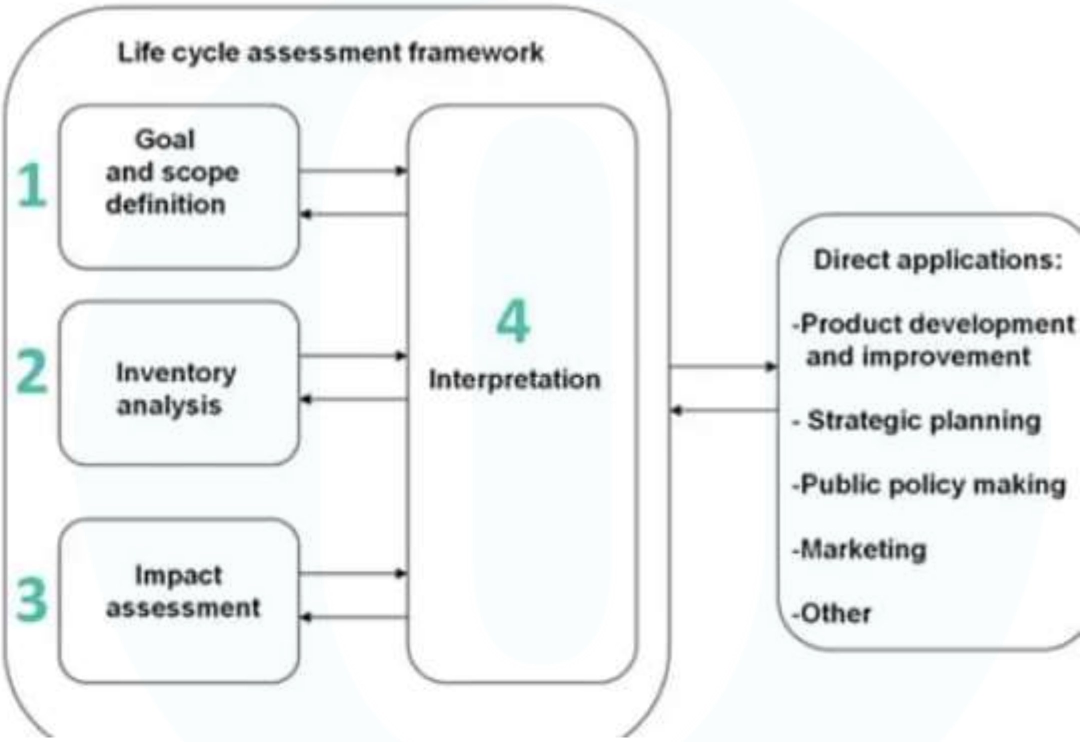
**WHAT ARE THE BENEFITS OF ISO 14001:2015?**

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

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

# Life Cycle Assessment (LCA)

A life cycle assessment (LCA), also known as life cycle analysis, typically assesses the full life cycle impact of a product, activity or service and against often 20 environmental impact categories, such as carbon, water depletion, eutrophication, toxicity, and more.According to the ISO standards there are four main stages of an LCA. These are shown in the diagram below:




The four stages are described further below:

1. **Goal and scope definition:** Before starting an LCA it's important to define a clear goal and scope of study. This will be used to select a robust calculation method.
2. **Inventory analysis:** Once the goal, scope and method have been determined the important stage of inventory analysis can begin. We will work with you to collect primary data from your supply chain, or will work to collect the most robust data in the literature. we need to understand the consumption of all materials and energy and creation of waste associated with your product (system). We can then use this data to build a sophisticated LCA model.

3. **Life cycle impact assessment:** With the data collected and a model built we can start to produce LCA results. We can analyse 20 different LCA impact categories, including energy, carbon, water, toxicity, eutrophication, acidification, metal depletion and more.
4. **Interpretation (conclusions and recommendations):** This is the key output of the life cycle assessment. The results will be analysed in detail to determine the impact hotspots and the key environmental impact categories. These can then be used to make recommendations for improvement.

LCA can be done for for materials, products, buildings, services and supply chains. Typically LCA studies fall into one of the types below:

Streamlined LCA: A streamlined LCA relies heavily on secondary data and professional life cycle assessment software to produce rapid results. This streamlined approach can produce results quickly and is therefore useful for initial hot-spotting and testing conclusions before embarking upon a detailed study. Streamlined LCA is useful to determine if a full LCA is needed.

Detailed LCA: A detailed life cycle assessment is required for the maximum robustness, or if the study is comparative and to be released in the public domain.

LCA training: For further information on LCA training we have online and workshop based courses.

LCA peer review: To achieve maximum credibility a peer review is recommended. LCA is a detailed field. If an LCA is comparative and to be released in the public domain the ISO standards on LCA require that independent peer review is completed.

An LCA covers many different environmental impacts. However, it also includes carbon footprint or embodied carbon results. The results for carbon are still typically the indicator of most interest. They are also useful to support claims of carbon neutrality or net zero carbon.

**Advantages of LCA:**

- LCA allows analysis of all steps within the life cycle of a product.
- LCAs offer valuable quantitative comparisons.
- LCAs can serve as an effective marketing tool when used appropriately.

- LCAs are currently becoming a hot button issue in industry and regulatory organizations alike.

**Disadvantages of LCA :**

- Completing a full life cycle analysis on complicated products is much easier said than done (the larger your scope, the more complicated the LCA).
- Requires complete data which sometimes are very daunting.
- LCAs depending on the specific product or process, can be very time intensive.
- Lack of Global Standards.

# Circular economy

A circular economy (often referred to simply as "circularity") is an economic system aimed at eliminating waste and the continual use of resources. Circular systems employ reuse, sharing, repair, refurbishment, remanufacturing and recycling to create a closed-loop system, minimising the use of resource inputs and the creation of waste, pollution and carbon emissions. The circular economy aims to keep products, equipment and infrastructure in use for longer, thus improving the productivity of these resources. All "waste" should become "food" for another process: either a by-product or recovered resource for another industrial process or as regenerative resources for nature (e.g., compost). This regenerative approach is in contrast to the traditional linear economy, which has a "take, make, dispose" model of production

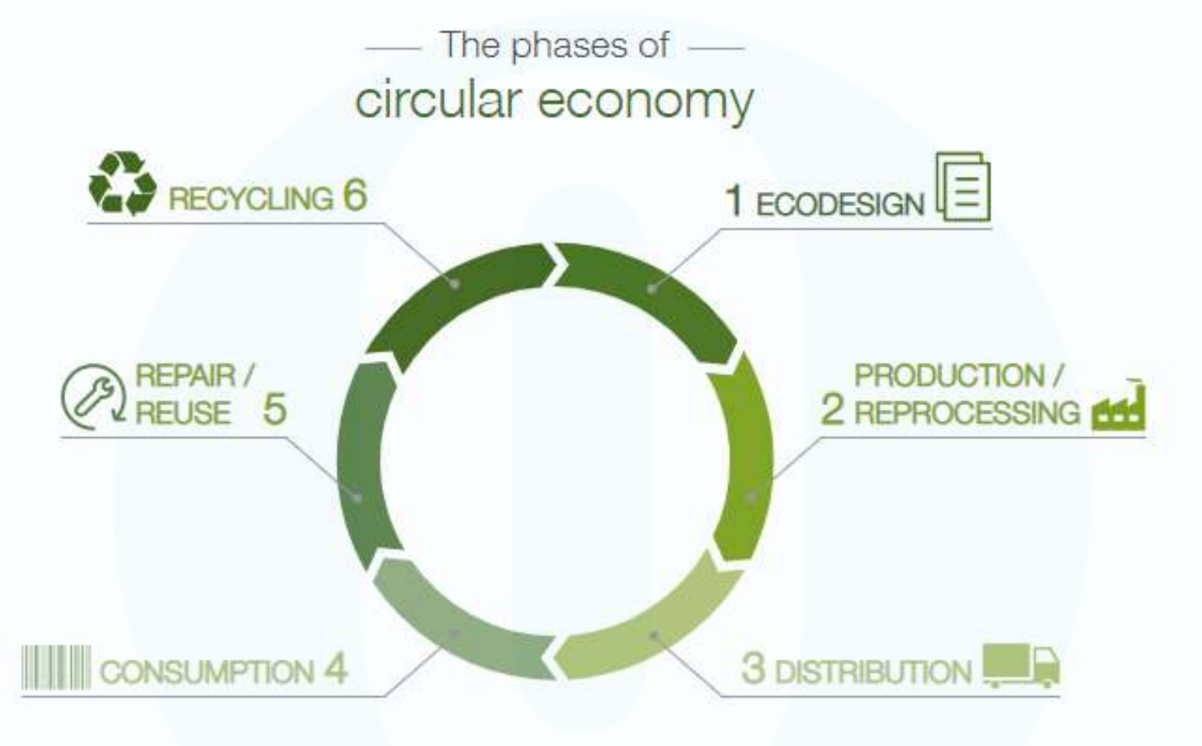
WHAT IS THE CIRCULAR ECONOMY

The circular economy takes production processes into consideration and outlines how to reuse, repair, and recycle items, thus increasing sustainable manufacturing and consumption. This way, in addition to reducing waste, saves energy and helps avoid irreversible damage caused in terms of climate and biodiversity, as well as in terms of air, soil, and water pollution, owing to the use of resources at a rate that exceeds the Earth's capacity to renew them.

In order to mitigate the possible environmental consequences, it is necessary to minimise the generation of waste and encourage the use of products, materials, and resources that will remain in the economy for as long as possible. These are the foundations of the so-called circular economy which seeks a new model of production and consumption of goods and services associated with sustainability.

Society as a whole can and must help the circular economy become a widespread reality. For example, the UN has established the Sustainable Development Goals to ensure sustainable consumption and production patterns (Goal 12). These 17 goals are ambitious and universal, set forth as a call to action, so the main environmental, social and economic challenges the planet is facing can be addressed.

## PHASES OR STAGES OF THE CIRCULAR ECONOMY




## What Is Biomimicry?

Biomimicry (literally: imitation of the living ) aims to take inspiration from natural selection solutions adopted by nature and translate the principles to human engineering. The biomimicry approach aims to favor "choices" tested by nature which had millions of years to understand what works best and what doesn't. Designs following biometrics will ultimately allow human productions to be more efficient, resilient and sustainable.

### Biomimicry Institute Definition Of Biomimicry

According to the Biomimicry Institute, biomimicry can be defined as "an approach to innovation that seeks sustainable solutions to human challenges by emulating nature's time-tested patterns and strategies. The goal is to create products, processes, and policies—new ways of living—that are well-adapted to life on earth over the long haul."

**A Few Ideas On The Principles Of Biomimicry**

The central idea is that nature has already fixed many problems society is facing. Animals, plants, and microorganisms are experienced engineers. They know what works, what's appropriate, and most importantly, what lasts on Earth. The main belief of the biomimicry approach is that after 3,8 billion years of research and development, what did not work is now a fossil and what is around us is the secret to survival.

Biomimicry is a technological-oriented approach focused on putting nature's lessons into practice. According to Janine Benyus, biomimicry sees nature as:

A model. It studies nature's models and imitates them or uses them as inspiration for designs or processes with the goal of solving human problems

A measure. It uses ecological standards to judge the rightness of human innovations

A mentor. It is a new way of observing, assessing and valuing nature

Biomimicry: Fields Of Application And Perspectives

Biomimicry concerns many sectors of human activity. From medicine to research, industry, economy, architecture and urban planning, agriculture and management… This list is not exhaustive because biomimicry is, above all, a question of how we approach these areas of expertise. Therefore, it may apply more or less directly to all sectors.

The concept of biomimicry is based on a key idea: nature always operates on the principles of economy and efficiency while generating no waste. Remember Lavoir saying "nothing is lost, nothing is created, everything is transformed"? That's the idea. No matter the field of application, the biomimetic philosophy is part of a global strategy of responsible and sustainable development that aims to balance the way the planet's resources are used.

**Examples Of Biomimicry**

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

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

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

Architecture is inspired by termite mounds to design passive cooling structures.

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

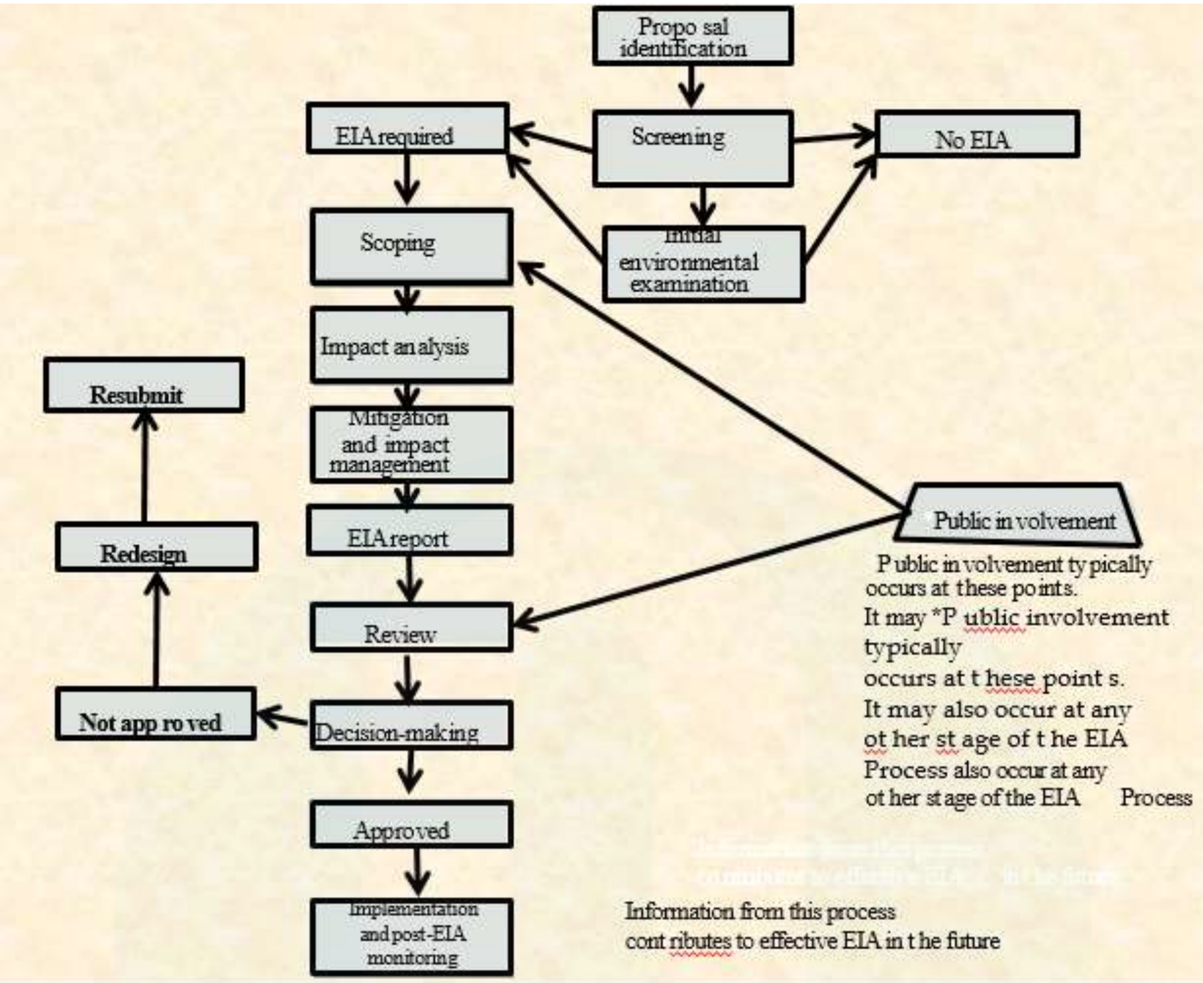
The study of shark skin is at the origin of particularly effective swimming suits, as well as a varnish for planes fuselage

## Environmental Impact Assessment

Environmental Impact Assessment (EIA) is a process of evaluating the likely environmental impacts of a proposed project or development, taking into account inter-related socio-economic, cultural and human-health impacts, both beneficial and adverse.

**AN EIA INCLUDES THESE ATTRIBUTES**

- Meteorology
- Ambient Air Quality
- Ambient Noise Quality
- Surface and Ground water Quality
- Geo-Hydrological Information
- Soil Quality & Geological Features
- Land use pattern
- Ecology -Biological Information
- Socio-Economic Information




**SCREENING:** Screening is the first stage of the EIA process which results in a key EIA decision, namely to either conduct the assessment (based on the likely significant impacts) or not conduct it (in the anticipated absence of such impacts). Screening needs to follow specific procedures often described in the legislation so all the projects follow the same process.

Key contributions of screening to a good EIA:

Facilitates informed decision making by providing clear, well-structured, factual analysis of the effects and consequences of proposed actions.

Influences both project selection and policy design by screening out environmentally and/or socially unsound proposals, as well as modifying feasible action.

WHY THE SCREENING IS CONDUCTED

An essential aspect of conducting an EIA is to determine the level of impact of the proposed project, development or initiative. When we look at major development projects—especially those involving natural resources, such as mining, hydroelectric dams, or oil extraction—we can say for certain that they will require an environmental and social impact assessment. On the other hand, while the development of a tourism project may seem low-risk at first, a second look could reveal that the project requires large amounts of drinking water, energy, the removal of endangered flora or fauna, and will result in extensive sewage production. It may also lead to increased road and air traffic to deliver supplies, visitors and workers. Finally, the impacts of project could change over time. Thus, during the screening step as well as the whole EIA process, impacts are considered over the lifetime of the project, from the construction phase through to operations and after closing.

Most proposals can be screened very quickly because they will have few impacts and will be screened out of the EIA process. Only a limited number of proposals, usually large-scale projects, require a full EIA because they will likely have major irreversible impacts on environmental resources or on people's health, livelihoods or cultural heritage. However, many projects with medium impacts will require an Environmental Management Plan (EMP) which is a component of a full EIA. EMPs are further described in Step 4: Impact Management.

**SCOPING:** Scoping is a critical step in the preparation of an EIA, as it identifies the issues that are likely to be of most importance during the EIA and eliminates those that are of little concern. Scoping is a systematic exercise that establishes the boundaries of your EIA and sets the basis of the analyses you will conduct at each stage. A quality scoping study reduces the risk of including inappropriate components or excluding components that should be addressed. It involves:

Identifying all relevant issues and factors, including cumulative effects, social impacts, and health risks.

Facilitating meaningful public engagement and review.

Determining the appropriate time and space boundaries of the EIA.

Identifying the important issues to be considered in the EIA, such as setting the baseline and identifying alternatives.

WHY THE SCOPING IS CONDUCTED

Scoping is critical as it sets up the boundaries of the EIA, including the project area; it establishes what the EIA will include and how to put the EIA together in accordance with the terms of reference (TOR). An EIA is an intensive process in terms of costs, cross-sectoral expertise and assessments that must be completed, and the types and extent of the consultations that must be conducted. Scoping helps to select what is needed and what is not relevant, and thus it serves as a work plan for the entire EIA process. The information gathered during the scoping phase is used in the next steps of the EIA.

HOW THE SCOPING IS CONDUCTED

A project scoping activity can be carried out in nine main steps. These are:

Set up the team of experts that will conduct the EIA.

Describe the project area and the area of project influence.

Outline project alternatives for preparation, implementation and closure.

Conduct public meetings and stakeholder consultations; integrate comments and collected feedback into project planning and the alternatives.

Outline a set of environmental, biological and socioeconomic resources and issues that will be addressed in the assessment.

Define a set of criteria to assess the planned project/development.

Identify the project impacts, during its all stages, list the significant and non-significant impacts and explain why.

Identify a set of data for baseline descriptions and potential additional data collection needs.

Start inserting this information in the appropriate section of the TOR.

## IMPACT ASSESSMENT AND MITIGATION

This step is the core part of an EIA.

Impact assessment refers to the detailed evaluation of the environmental and social impacts of the planned project and identified alternatives, compared to the baseline conditions. This includes qualitative descriptions such as measuring high, medium and low impacts, and quantitative descriptions, such as indicating the cubic metres of water withdrawn, sewage produced, and pollutants released. This is done for the planned project as well as the identified alternatives, allowing for comparisons. Once the detailed assessment is complete, mitigation measures to reduce or avoid impacts are identified.

Mitigation refers to minimizing or avoiding the described impacts.Overall, mitigation measures are a response to the findings of impact assessment; they need to cover all the areas identified. The key focus of mitigation actions should be on:

Preventive measures that avoid the occurrence of impacts and thus avoid harm or even produce positive outcomes.

Measures that focus on limiting the severity and the duration of the impacts.

Compensation mechanisms for those impacts that are unavoidable and cannot be reduced further.

Key impacts and potential mitigation actions often relate to land. Almost all development proposals involve disturbance of the land surface. This is usually extensive for major linear projects (roads, pipelines), dams and reservoirs, and large-scale mining, agriculture, forestry and housing schemes. Environmental impacts of particular concern can include drainage of wetlands, conversion of natural areas, or expansion into areas that are vulnerable to natural hazards.

## PURPOSE OF IMPACT ASSESSMENT AND MITIGATION

The purpose of conducting an EIA is to clearly identify and understand (assess), and then prevent or minimize (mitigate) the adverse impacts of the planned project on the environment and people. Because the impacts of the project can change over time, the impacts need to be assessed and measured over the lifetime of the project – from its construction through to operations and after closing.

Impact assessment is indispensable in order to provide systematic and detailed descriptions of the probable impacts in comparison to the identified project alternatives. Mitigation measures are a critical part of the EIA process, as these actions aim to prevent adverse impacts from the planned project on the environment and people, ensuring that unavoidable impacts are maintained within acceptable levels.

The key contributions of impact assessment and mitigation to a good EIA include:

It provides a clear and itemized list of relevant impacts on the environment and people, including cumulative effects, social impacts, and health risks.

Based on the results of the impact assessment, a detailed list of mitigation actions is identified.

### IMPACT MANAGEMENT

Essentially, impact management is the creation of a series of plans and protocols aiming to manage and monitor the identified mitigation measures and risks that may occur over the project lifetime, such as technology failures and natural disasters. Some of the plans are compulsory, such as an environmental management plan (EMP), which is required as part of an EIA report in most countries. Other plans are context-specific and/or depend on guidance from national legislation. For example, if the project takes place in close proximity to a community, a resettlement plan may be needed; if there are no communities close by, a resettlement plan would not be necessary. Impact Management begins during the project's planning phase and continues on after project implementation.

WHY CONDUCT OF IMPACT MANAGEMENT

The analyses of the impacts and the creation of mitigation measures (carried out in the previous step) will likely identify a number of changes in the project design, implementation and closure. Additional action plans to manage risks and carry out monitoring will also be required. The need for these plans depends on the type of project, the identified impacts, and the risks associated with the project, taking into consideration the natural and social context where the project activities will take place.

**THE EIA REPORT:** The EIA Report is a compilation of several important project components, including the project description, the assessment of its environmental and social impacts, mitigation measures, and related management and monitoring plans. During this step, all the information gathered during the previous steps is compiled into a comprehensive report that analyzes and synthesizes the data, structuring it as stipulated in the terms of reference (TOR).

A quality EIA Report has the following characteristics:

It is well-structured and uses non-technical language supported by data and well-executed analyses.

It provides information that is helpful and relevant to decision making.

It results in the satisfactory prediction of the adverse effects of the proposed actions and their mitigation using conventional and customized techniques.

There are many challenges in putting together a comprehensive EIA. These include incomplete identification of the critical impacts, insufficiently described alternatives and mitigation measures, and the use of outdated assessment models. The table below describes several examples of typical EIA reports and the types of shortcomings they could present.

## INDUSTRIAL ECOLOGY

Definition

Industrial ecology conceptualises industry as a man-made ecosystem that operates in a similar way to natural ecosystems, where the waste or by product of one process is used as an input into another process. Industrial ecology interacts with natural ecosystems and attempts to move from a linear to cyclical or closed loop system. Like natural ecosystems, industrial ecology is in a continual state of flux.

B. Main Features

Industrial processes, from material extraction through to product disposal, have an adverse impact upon the environment. Industrial ecology aims to reduce environmental stress caused by industry whilst encouraging innovation, resource efficiency and sustained growth. Industrial ecology acknowledges that industry will continue operate and expand however, it supports industry that is environmentally conscious and has less burden upon the planet. It views industrial sites as part of a wider ecology rather than an external, solitary entity.

Within the industrial ecology concept, industry interacts with nature and utilises the wastes and by products of other industries as inputs into its own processes. Industrial ecology ranges from purely industrial ecosystems to purely natural ecosystems with a range of hybrid industrial/natural ecosystems in between. Covering both industrial management and technology, industrial ecology encompasses other sustainability concepts and tools such as material flows analysis; environmentally sound technologies; design for disassembly; and dematerialisation.

The principles of industrial ecology as defined by Tibbs (1992) are:

Create industrial ecosystems - close the loop; view waste as a resource; create partnerships with other industries to trade by-products which are used as inputs to other processes.

Balance industrial inputs and outputs to natural levels - manage the environmental-industrial interface; increase knowledge of ecosystem behaviour, recovery time and capacity; increase knowledge of how and when industry can interact with natural ecosystems and the limitations.

Dematerialisation of industrial output - use less virgin materials and energy by becoming more resource efficient; reuse materials or substituting more environmentally friendly materials; do more with less.

Improve the efficiency of industrial processes - redesign products, processes, equipment; reuse materials to conserve resources.

Energy use - incorporate energy supply within the industrial ecology; use alternative sources of energy that have less or no impact upon the environment.

Align policies with the industrial ecology concept - incorporate environment and economics into organisational, national and international policies; internalize the externalities; use economic instruments to encourage a move towards industrial ecology; use a more appropriate discount rate; use a more comprehensive index to measure a nation's wealth rather than GNP.

The benefits of industrial ecology include: cost savings (materials purchasing, licensing fees, waste disposal fees, etc); improved environmental protection; income generation through selling waste or by products; enhanced corporate image; improved relations with other industries and organisations and market advantages. Limitations to industrial ecology include: no market for materials; lack of support from government and industry; reluctance of industry to invest in appropriate technology; perceived legal implications and reluctance to move to another supplier.

The formation of virtual or physical eco-parks arises from clusters of industry that agree to supply or sell waste to each other, thereby moving towards the industrial ecology concept. Most eco-parks are virtual due to the high cost associated with relocating facilities. However some physical eco-parks are being designed whereby certain industries are located on the same site.

C. Case Studies and Examples

1. Industry Partnerships

Since the 1970's several industries in Denmark have supplied or sold by products and wastes to other industries. Asnaes, the largest coal-fired power plant in Denmark, sold processed steam to Statoil (an oil refinery) and Novo Nordisk (a pharmaceutical plant). Some of Asnaes' surplus heat was supplied to the town's heating scheme, reducing the number of domestic oil burning systems in use. Surplus heat was also used to heat the water of Asnaes' commercial fish farm. Local farmers used sludge from the fish farm as fertilizer. By treating some of its waste, Novo Nordisk sold high nutrient liquid sludge to farmers. Statoil supplied cooling and purified waste water to Asnaes which reduced Asnaes' freshwater extraction. In addition, Statoil removed sulphur from its surplus gas and sold all of its cleaned surplus gas to Asnaes and Gyproc (a plasterboard factory). The removed sulfur was sold to Kemira (a sulfuric acid producer). By desulfurising its smoke, Asnaes sold the resulting calcium sulfate to Gyproc as an alternative to mined gypsum which was being imported.

These partnerships were formed voluntarily and negotiated independently. Initially for purely economic reasons, some of the later deals were made for environmental reasons.

## INDUSTRIAL SYMBIOSIS

Industrial symbiosis is a form of brokering to bring companies together in innovative collaborations, finding ways to use the waste from one as raw materials for another.

The word “symbiosis” is usually associated with relationships in nature, where two or more species exchange materials, energy, or information in a mutually beneficial manner.

Local or wider co-operation in industrial symbiosis can reduce the need for virgin raw material and waste disposal, thereby closing the material loop – a fundamental feature of the circular economy and a driver for green growth and eco-innovative solutions. It can also reduce emissions and energy use and create new revenue streams.

Currently, Europe has some EU support networks for industrial symbiosis and European Innovation Partnerships such as National Programmes (e.g. NISP (UK)), regional initiatives (e.g. Cleantech Östergötland (Sweden)) and Local initiatives (e.g. Kalundborg in Denmark).

However, in order to make industrial symbiosis a wide-spread commercial reality, more needs to be done to manage the flow of waste material from different sectors and industries, and there is still much to understand about: environmental and societal impacts harmonization of technologies, processes, policies civil society engagement to a circular economy at EU level waste resources information waste treatment technologies business models and coordination between value chain actors.

## ADVANTAGES OF INDUSTRIAL SYBIOSIS

- Reduce raw material and waste disposal costs
- Generate new revenue from residues and by-products
- Divert waste from landfill and reduce carbon emissions
- Open up new business opportunities
- Strengthen environmental profiles