1.3 Classification of environmental impact reduction efforts

The following section describes the tools for the environmental performance improvements related to an organisation's processes, products and management in general.

Process oriented tool

- Cleaner Production (CP)
- Environmental Accounting (EAc)

Product oriented tool

- Life Cycle Assessment (LCA)
- Life Cycle Screening (LCS)
- Life Cycle Costing (LCC)
- Material, Energy and Toxic-analysis(MET)
- Material Input per Service Unit (MIPS)
- Design for the Environment (DfE)

Environmental conscious management tools

Companies adopting CP, LCA, DfE etc., normally improve their overall environmental performance because of better housekeeping and better products. To achieve continuous improvement, their management systems should build on principles of environmental consciousness. Formal Environmental Management Systems[2] (EMS), Environmental Auditing[3] (EA), or Environmental Performance Evaluation[4] (EPE) in accordance to given standards, help companies in this work

- Environmental Auditing (EA)
- Environmental Performance Evaluation(EPE)
- Environmental Management Systems (EMS)

Cleaner Production (CP)

Cleaner production is a strategy to prevent emissions at the source and to initiate a continuous preventive improvement of environmental performance of organizations. In terms of Cleaner production the focus of management should be on prevention rather than on cure in avoiding environmental problems.

It is considered a new and creative approach towards products and production processes. Cleaner production **focuses on reduction of use of natural resources**, thus minimizing the waste generated from the process. It also stresses how to prevent these wastes at the source by the use of cleaner technologies.

Cleaner production can reduce operating costs, improve profitability and worker safety, and reduce the environmental impact of the business. Companies are frequently surprised at the cost reductions achievable through the adoption of cleaner production techniques. Frequently, minimal or no capital expenditure is required to achieve worthwhile gains, with fast payback periods. Waste handling and charges, raw material usage and insurance premiums can often be cut, along with potential risks.

It is obvious that cleaner production techniques are good business for industry because it will:

- Reduce waste disposal cost
- Reduce raw material cost.
- Reduce Health Safety Environment (HSE) damage cost.
- Improve public relations/image.
- Improve companies performance.
- Improve the local and international market competitiveness.
- Help comply with environmental protection regulations.

On a broader scale, cleaner production can help alleviate the serious and increasing problems of air and water pollution, ozone depletion, global warming, landscape degradation, solid and liquid wastes, resource depletion, acidification of the natural and built environment, visual pollution, and reduced bio-diversity.
Examples include: energy efficiency, selective catalytic reduction, non-toxic materials, water purification, solar energy, wind energy, and new paradigms in energy conservation.

Environmental Accounting

Environmental accounting refers to the identification, measurement and communication of the data on environmentally responsible performance of a business firms to facilitate economic decision making. It identifies the resources used by a business and measures and communicates costs of its impact on the environment.
A very important function of environmental accounting is to bring environmental costs to the managers; therefore motivating them to identify way to reduce and avoid economic costs related to the environment and at the same time reduced the company's environment impact.

It is the process of accountings for any costs and benefits that arises out of the resulting change in environment due to the change to a firm's product and processes of production. The costs include costs to clean up or remediate contaminated sites, environmental fines, penalties and taxes, purchase of pollution prevention technologies and waste management costs.

Objective

To help in negotiation of the concepts of environment and to deerming the enterprise's relationship with the society as whole
To segregate and collaborate all environmental related flows and stocks of resources
To minimize environmental impacts through improved products and process design
To estimate the total expenditure on protection and enhancement of environment
To assess changes in environment in terms of costs and benefits
To ensure effective and efficient management of natural resources

Benefits of opting

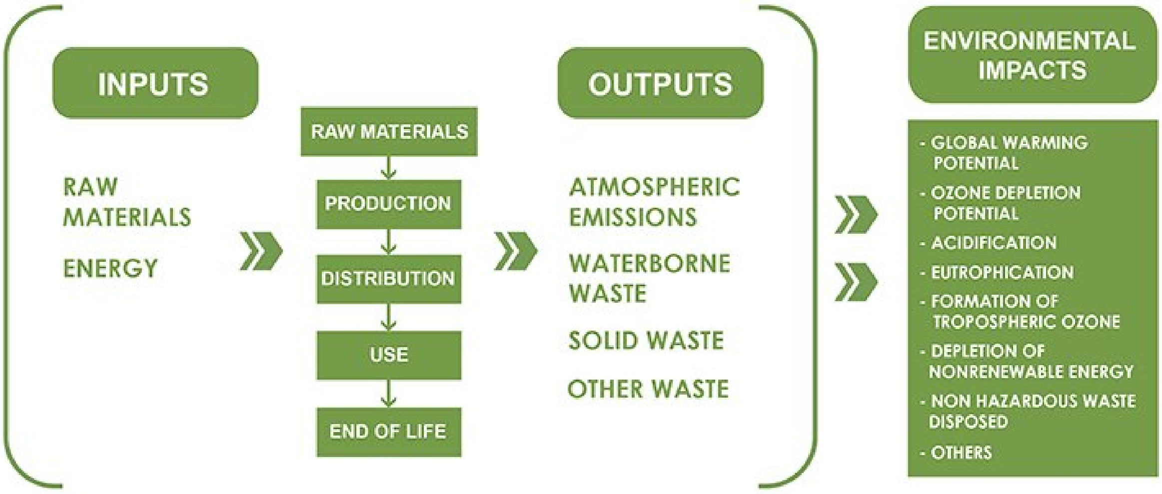
It enhances the image of the product and the company which may have an impact on the sales and ultimately profitability
It improves the safety of the workers which in trun will help increasing productivity
It provides competitive advantage as the customs may prefer environmental friendly products and services

It helps to build up trust and confidence in the society
Environmental cost can be offset by generating revenues through sale of waster or by products
Better knowledge of environmental cost can facilitate more accurate costing and pricing of products

There are three form of environmental accounting. These are; Environmental Financial Accounting (EFA), Environmental Cost Accounting (ECA)and Environmental Nation Accounting (ENA)

Life Cycle Assessment (LCA)

Life cycle assessment (or life cycle analysis) is a methodology used to estimate the environmental impact of a product, process or a system throughout its whole life cycle. The products´ life cycle is divided into different phases of which the earliest one is the extraction of raw materials, following the manufacturing, transportation, final use and disposal. Life cycle analysis generates results for different life stages, including various environmental impacts then adding them all and offering a final result per unit of a product.



Main goals of the life cycle assessment
Quantification – to know the value of the **total environmental load per product unit**, in order to be able **to compare products and take informed decisions.**
Improvement - the careful analysis allows to **evaluate the environmental performance** at each stage of life and allows **determining which actions would be the most beneficial in order to achieve an improvement.**
Informative purpose – providing **objective information** to decision makers in industry, governments, local authorities, consumers etc., allows to influence the change and **promotes the policy-making based on scientific data.**
Encourage environmental competition – making the **data about environmental impacts** available to everybody (Environmental Declaration Product).
LCA makes it **easy to compare the products** and since **sustainability is becoming an important factor for many consumers,** in order stay competitive **companies have to**

embrace a new environmentally friendly approach and **aim at reducing the negative impacts**

The phases of a Life Cycle Assessment are defined in the ISO standards 14040 and 14044.
A Life Cycle Assessment Consists Of 4 Steps:

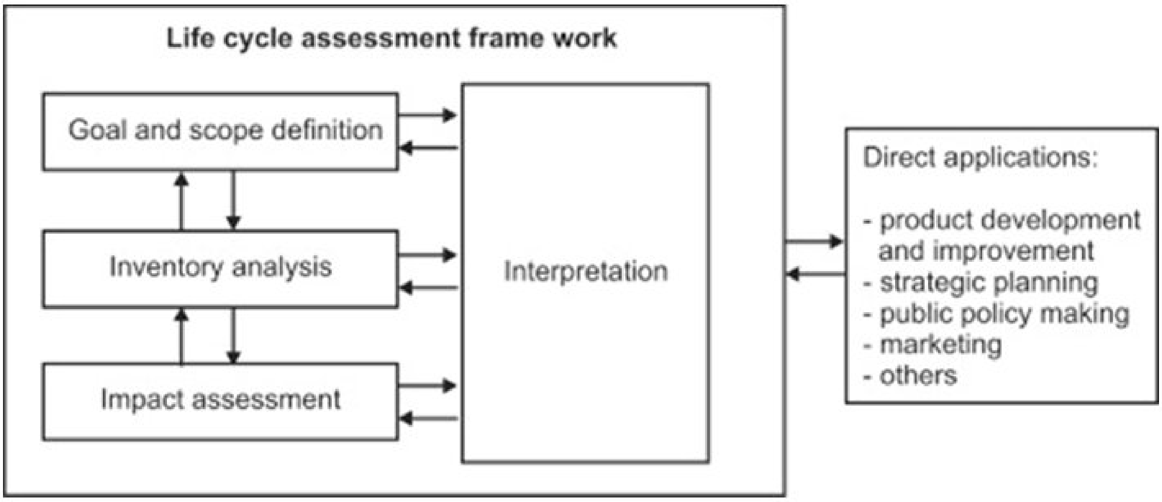
1. Definition of Goal and Scope
2. Inventory Analysis
3. Impact Assessment
4. Interpretation

Stage 1.
Definition of a scope and objective
– in this phase it is being **determined how big part of a products´ life cycle will be taken into consideration in the assessment, and what is the goal of the analysis,** for example the chosen scope can be from cradle to gate (just the manufacturing phase) or from cradle to grave (full life cycle, including manufacturing, transportation, installation, final use and disposal).

Stage 2. Inventory
– this step includes a collection of the data concerning the materials and energy flow within the considered system.
This includes all the environmentally important inputs and outputs, which are:
Inputs: includes use of the resources such as raw materials, water, air, land, energy
Outputs: gas emissions, waterborne waste, soil pollutants, solid waste and by-products

Step 3. Environmental impact assessment
– using the collected data an evaluation of negative impacts and the quantity of harmful substances is being summed up. The importance of every impact category and life cycle phase is being assessed in order to identify the most and least contributing elements. In general, this process involves the association of inventory data with specific environmental impacts and distribution of the impacts between the life stages.

Step 4. Interpretation of the results
– in this stage an analysis and critical review of the data is being performed with the aim to outline the conclusions. The obtained results can be also compared and confronted with other similar studies and from the comparison a possibility of improvement can be detected. For instance, we can compare two identical building, with the same transmittance (therefore same energy consumption) but with different kind of material applied as an insulation. Determining which of them has lower environmental impact indicators would point out the preferred material.



Life Cycle Screening (LCS)

When the intention is to identify key issues for further investigations, e.g. identify parts of a life cycle that needs further research, an LCS should be carried out. An LCS is a simplification of an LCA, but it can never claim to substitute a full LCA.

Life Cycle Costing (LCC)

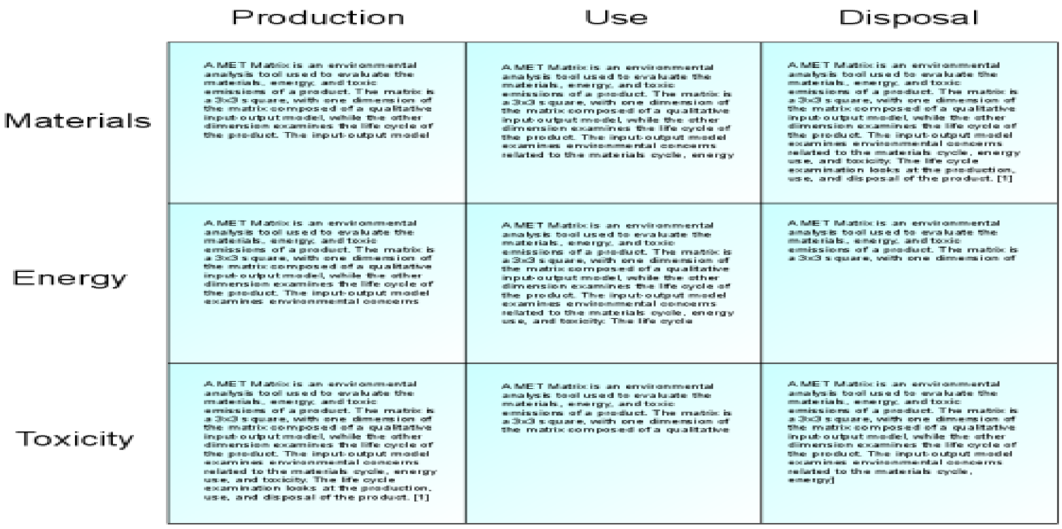
Estimating the total costs associated with the production, use, and disposal of a product or service is introduced.

The economic issues are the driving forces in the industry, and the results from an LCA-study are very often linked to LCC information. Traditionally cost effectiveness implies "most performance for least cost". LCC does normally not focus on environmental issues. However, a cost examination tool that takes environmental issues into account is the Value Added Analysis (VAA), Liedtke (1994). This is related to the MIPS concept and by VAA the sale opportunities of different products and their constituents can be estimated from both an ecological and an economic point of view.

Material, Energy and Toxic-analysis (MET)

A MET (Materials, Energy, and Toxicity) Matrix is an analysis tool used to evaluate various environmental impacts of a product over its life cycle.

The tool takes the form of a 3x3 matrix with descriptive text in each of its cells. One dimension of the matrix is composed of a qualitative input-output model that examines environmental concerns related to the product's materials use, energy use, and toxicity. The other dimension looks at the life cycle of the product through its production, use, and disposal phase. The text in each cell corresponds to the intersection of two particular aspects. For example, this means that by looking at certain cells, one can examine aspects such as energy use during the production phase, or levels of toxicity that may be a concern during the disposal phase



Material Input per Service Unit (MIPS)

Material input per unit of service (MIPS) is an economic concept, originally developed at the Wuppertal Institute, Germany in the 1990s. The MIPS concept can be used to measure eco-efficiency of a product or service and applied in all scales from a single product to complex systems.

The calculation takes into account materials required to produce a product or service. The total material input (MI) is divided by the number of service units (S). For example, in case of a passenger car, the number of service units is the total number of passenger kilometres during the whole life span of the vehicle. The lower the material input per kilometre, the more eco-efficient is the vehicle. The whole life-cycle of a product or service is measured when MIPS values are calculated.[1] This allows comparisons of resource consumption of different solutions to produce the same service. When a single product is examined, the MIPS calculations reveal the magnitude of resource use along the life-cycle and help to focus efforts on the most significant phases to reduce environmental burden of the product

Design for the Environment (DFE)

It is a design approach to reduce the overall human health and environmental impact of a product, process or service, where impacts are considered across its life cycle. Different software tools have been developed to assist designers in finding optimized products or processes/services. DfE is also the original name of a United States Environmental Protection Agency (EPA) program, created in 1992, that works to prevent pollution, and the risk pollution presents to humans and the environment

Four main concepts that fall under the DfE umbrella

- Design for environmental processing and manufacturing: Raw material extraction (mining, drilling, etc.), processing (processing reusable materials, metal melting, etc.) and manufacturing are done using materials and processes which are not dangerous to the environment or the employees working on said processes. This includes the minimization of waste and hazardous by-products, air pollution, energy expenditure and other factors.

- Design for environmental packaging: Materials used in packaging are environmentally responsible, which can be achieved through the reuse of shipping products, elimination of unnecessary paper and packaging products, efficient use of materials and space, use of recycled and/or recyclable materials.
- Design for disposal or reuse: The end-of-life of a product is very important, because some products emit dangerous chemicals into the air, ground and water after they are disposed of in a landfill. Planning for the reuse or refurbishing of a product will change the types of materials that would be used, how they could later be disassembled and reused, and the environmental impacts such materials have.
- Design for energy efficiency: The design of products to reduce overall energy consumption throughout the product's life

Environmental Auditing (EA)

Whether the results of environmental work tally with the targets. It studies whether the methods or means used to achieve the goals or ends are effective. EA involves studying documents and reports, interviewing key people in the organization, etc. to assess the level of deviations between targets and results. An environmental audit is being used as a tool and as an aid to test the effectiveness of environmental efforts at local level.

It is carried out for a number of reasons including the following:

- To verify compliance
- To review implementation of policies
- To identify liabilities
- To review management systems
- To identify needs, strengths, and weaknesses
- To assess environmental performance
- To promote environmental awareness

The objectives of an environmental audit are to evaluate the efficiency and efficacy of resource utilization (i.e., people, machines, and materials), to identify the areas of risk, environmental liabilities, weakness in management systems and problems in complying with regulatory requirements and to ensure the control on waste/pollutant generation

Environmental Performance Evaluation (EPE)

EPE is the process that organisations can use to measure, analyse and assess their environmental performance against a set of criteria. EPE helps to understand what their environmental aspects are, and determines what their significant environmental aspects may be. This lets the organisation form a baseline from which objectives and targets for improvements can be derived. Therefore EPE is central to improvements of environmental performance and to compare an organisation’s performance against another similar organisation (benchmarking). An organisation that is committed to improving its environmental performance needs to be able to measure its performance level.

By means of Environmental Performance Indicators (EPIs) a company will be able to do so.

An EPI must reflect changes over a period of time, be reliable and reproducible, and be calibrated in the same terms as the policy goals or targets they are linked to

Environmental Management Systems (EMS)

An Environmental Management System (EMS) is a framework that helps an organization achieve its environmental goals through consistent review, evaluation, and improvement of its environmental performance

Potential Benefits
Improved environmental performance
Enhanced compliance
Pollution prevention
Resource conservation
New customers/markets
Increased efficiency/reduced costs
Enhanced employee morale
Enhanced image with public, regulators, lenders, investors
Employee awareness of environmental issues and responsibilities

Another environmental management instrument is the Resource Management (RM), a management system to combine eco- and cost-efficiency, Liedtke (1994). This includes material flow management, product management and eco-design. By such resource management the material flows can be reduced and in many cases the de-materialisation factor is expected to be 5 to 10, Schmidt-Bleek (1995). This system is built upon the same principles as the MIPS concept.

Eco Labelling (EL)

Eco labelling is a voluntary method of environmental performance certification and labelling that is practised around the world. An Eco label identifies products or services proven to be environmentally preferable within a specific category. Eco-labels are used to provide information about the environmental impact of a product. Eco-labels must take life cycle considerations into account