

CLEANER PRODUCTION

C1.1 What is cleaner production?

Cleaner Production is the continuous application of an integrated, preventive environmental strategy towards processes, products and services in order to reduce damage & risks for humans and the environment (United Nations Environment Programme UNEP).

With Cleaner Production industries reduce pollution in their production processes by means of preventive measures. It's a structural business strategy that increases the efficiency and the gross returns (profit).

C1.2 Five Basic Principles of Cleaner Production

Cleaner Production requires that resources be managed efficiently. This consists both of careful use of resources, the closing of material streams, and resource substitution. It is possible to outline five general principles of Cleaner Production:

Input-Substitution

Use of less hazardous raw-, auxiliary- or operating materials.

Use of operating materials with a longer lifetime.

Good Housekeeping

Increase the Material and Energy efficiency of actions in the process. Try to fetch the "low hanging fruits" first, e.g. reduce losses due to leakage. It is important to train employees

Internal Recycling

Close Material and Energy Loops for water, solvents, etc. Cascading of Material and Energy streams.

Technological Optimisation/Change

Implementation of new technologies.

Improved process control.

Redesign of processes.

Change in or substitution of hazardous processes.

Optimisation of the Product

Increasing the lifetime.

Easier repair.

Easier de-manufacturing, recycling or deposition.

Use of non-hazardous materials.

C1.3 Related concepts to Cleaner Production are: eco-efficiency; waste minimization; pollution prevention; green productivity; dematerialization.

For production processes, Cleaner Production aims to

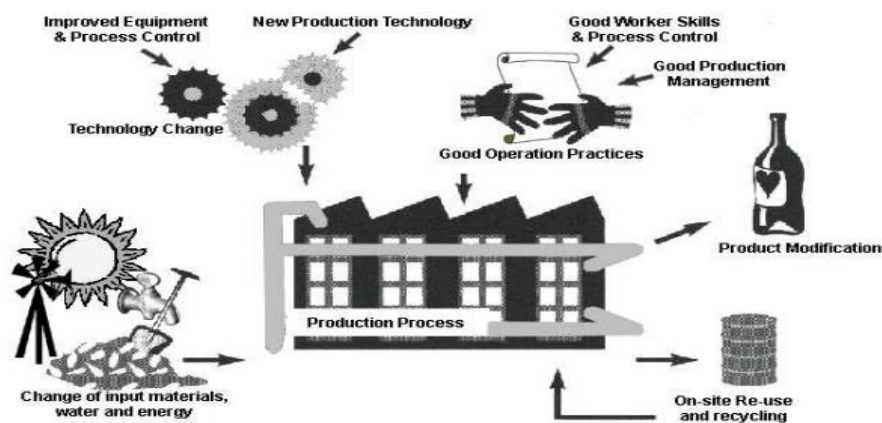
- Reduce at source the quantity and toxicity of all emissions and wastes generated and released;
- Eliminate as far as possible the use of toxic and dangerous materials;
- Reduce the consumption of raw materials and energy used in the production of one unit of product (efficiency improvement).

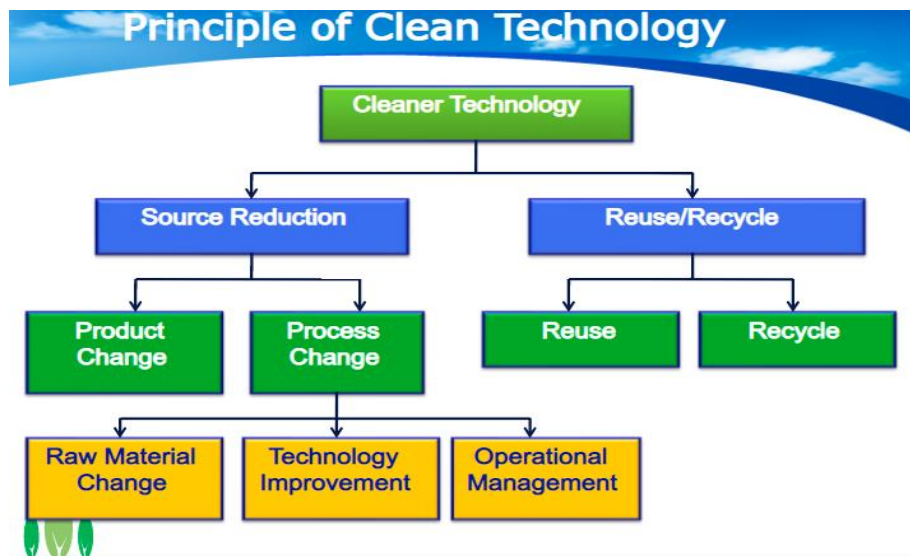
For products, Cleaner Production aims to reduce the environmental, health and safety impacts of products

- Over their entire life cycle;
- From raw materials extraction, through manufacturing and use, to the ultimate disposal of the product.

C1.4 Cleaner Production measures can be taken in 5 categories:

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





1. Change of input materials

The first category is changing the input materials by:

Replacing toxic or harmful materials with less toxic materials;

- Using renewable materials;
- Using adjunct materials which have a longer service life-time in production;
- Material purification.

2. Technology change

The second category is technology change, which can be divided in:

- Replacement of the technology: new (chemical) process technology and new equipment technology in order to minimise waste and emission generation during production.
- Equipment modification: modify the existing production equipment and utilities in order to run the processes at higher efficiency and to lower waste and emission generation rates. Improved equipment lay-out and increased automation.
- Better process control: modify operational procedures (pH, T, Flow, Pressure, Dosing etc.); equipment instructions and/or process record keeping in order to run the processes more efficiently and at lower waste and emission generation rates

3. Good operation practises

The third category is taking appropriate managerial and operational actions to prevent leaks and spills and to enforce existing operational instructions. This category usually has strong effects without investment.

It's known that over 50% of waste can be avoided by simple management measures and minor process changes! And in addition: over 65% of the barriers to Cleaner Production involve human motivation and attitudes! Good operational practices start with an efficient production planning and a well-planned maintenance programme for all equipment and facilities.

Energy management is an important focus area of good operations. Especially preventing a high peak in energy consumption can save money in terms of tariffs and in terms of high peak load equipment.

And of course prevention of unnecessary power consumption through switching off equipment (light/heaters) when not in use will add significant savings. Finally management should develop proper working instructions and procedures with and for the operational workers and provide a proper training programme with interesting incentives.

The operational workers themselves have to bring into practice the procedures and instructions at the work floor on a day-to-day basis. Especially those on efficient process control; they have to react adequately on any signal given by the process control system. Proper maintenance and cleaning of the process and manufacturing equipment should be a day-to-day routine, resulting in a clean and tidy workplace.

4. Product modification

The fourth category is the modification of the product characteristics in order to minimise the environmental impacts of the product during or after its use (disposal) and/or to minimise the environmental impacts of its production.

This implies:

- Eco-Design;
- Product Life Extension;
- Environmental friendly packaging.

5. On site re-use and recycling

The last category is reuse of the wasted materials in the same process or for another useful application within the company. In this category also transforming waste into a useful by-product can be considered, for example to be sold as input for companies in another business sector.

The category can be divided in:

- On site recovery and re-use of raw materials in the process; waste water and cooling water; waste heat;
- Transforming waste into an useful by-product;
- Waste segregation and storage.

C1.5 THE PROFITS OF CLEANER PRODUCTION

Cleaner Production can create mutual company and governmental benefits to save the environment and improve the living conditions and at the other side to increase the financial performance: people, planet profit.

Cleaner Production measures leads to:

- Reduced costs on resources: Cleaner Production options can reduce the material-, energy-and water consumption per product, and increase savings made on the costs of these natural resources.
- Reduced costs for treatment of waste and emissions: the costs for processing waste streams (including solid waste, wastewater, and air emissions) will increase in the next future. Minimizing waste streams and a pro-active compliance with laws and regulations can save money.
- Improved production: Most often, with environmental measures, the efficiency of production processes will increase as well, resulting in higher levels of production output, or improvement of the product quality.

Cleaner Production usually:

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

- Relies on active worker participation in idea generation and implementation;
- Reduces consumer risks;
- Reduces the risk of environmental accidents;
- Is supported by employees, local communities, customers and the public. Cleaner Production often:
 - Avoids regulatory compliance costs;
 - Leads to insurance savings;
 - Provides enhanced access to capital from financial institutions and lenders;
 - Is fast and easy to implement;
 - Requires little capital investment.

C1.6 BENEFITS

Financial and economic benefits

- Integrated economic benefits due to reduction of waste and emissions and the related fees and treatment costs, reduced material and energy consumption, increased product output and improved product quality.
- The economic benefits can be made clear by implementing low/no-cost options. This will enhance the trust and confidence in implementing feasible medium/high cost options.

Production benefits

- Increased process and better production reliability due to technological improvements to minimise waste/emissions and energy consumption.
- Increased product output and improved product quality also due to technological improvements.
- Possibly increased health and safety situation as spin-off of Cleaner Production measures, i.e. by reducing the use of toxic and hazardous components.

Environmental Benefits

- It is the international and national-level trend to regulate environmental protection of the industrial sites.

The following environmental benefits therefore should be considered on both levels:

- Decreased water pollution (COD, BOD, TS, SS, N, P): e.g. bio-diversity, but also access to drinkable water and irrigation water,

- Decreased air pollution (NOX, SO₂): e.g. global warming and climate change, but also health conditions (smog) in the major conglomerations,
- Decreased generation of solid and chemical waste, improved living conditions of neighbouring communities and animal species.
- Cleaner Production is a systematic method to recognise and solve environmental and financial problems and aims to achieve ongoing improvement of the company's sustainability and the continuous improvement of its technical and managerial processes.

Corporate image improvements

- A recent trend in the industry world-wide has been to promote environment-friendly corporate image, as to improve general image of the company and to gain competitive advantage,
- Also, the company's management can choose to take its social responsibility towards the neighbouring communities to improve their living environment,
- The businesses have responsibility to contribute to solving international social issues, e.g. fair trade, abolishment of child labour, deforestation, climate change, etc.
- Improved communications and relationships with authorities will make the enterprises less liable to fines, rigid attitudes, closure and obligatory abatement technology purchase,
- It has, obviously, a positive impact on improving the qualification and skills of employees

Technology Improvement

Implementation of new technologies and equipment, and adoption of sustainable, environmental technologies introduces technical innovation in an enterprise.

- The latest worldwide technologies ("state-of-the-art") can be achieved through the Cleaner Production Assessment, using benchmarking and assistance of (inter) national experts

Management improvements

- Management focus on employee's welfare tends to lead to increased employee participation and commitment.
- Responsible care of the management includes:
 - Demonstrate interest in improving working conditions, safety and health,
 - Assure the working place is clean and appropriate,
 - Maintain clean cloak, shower and bath rooms,
 - Supply proper tools and protection devices, such as eye, ear and respiratory protection and appropriate clothing (boots, helmets and coveralls),
 - Stimulate personal and employee's family interest in environmental and health issues.

Summarised Cleaner Production options makes companies more profitable, more environmentally friendly and more efficient.

Cleaner Production can be seen as a four-in-one tool:

- A management tool;
- An economic tool;
- An environmental tool;
- A quality improvement tool.

C1.7 THE BARRIERS FOR CLEANER PRODUCTION

The barriers, which can frustrate the Cleaner Production process, are:

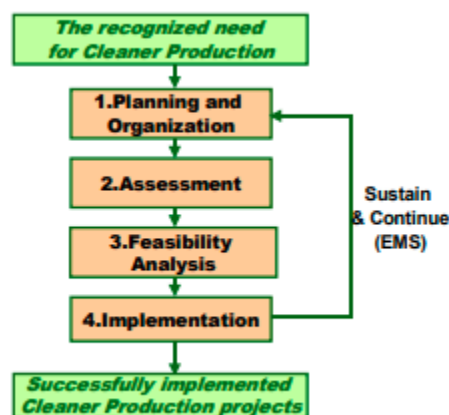
- 1. The business philosophy or environmental attitude of CEOs:** that environment will only costs money; that there is a lack of finance, manpower and time; that special experts (and knowledge) are needed to organise and implement Cleaner Production options in the company and; that only technical innovation reduces waste and emissions.
- 2. Initial constraints due to internal organisation and communication:** gaining management support (see above); setting up a project group; limited awareness on waste and emissions; limited authority for Cleaner Production; indifference on the working floor etc.
- 3. Limited adequate information, data and expertise on the waste and emissions and the related costs within a company:** bookkeeping is financial figures oriented (credit/debit), not material flow oriented; financial figures are not related to environmental costs; material and financial data are purchase and sales oriented, not waste and emission oriented.
- 4. Focus on end-of-pipe solutions:** by governmental laws and regulations; by licensing and control authorities; within the compliance framework of ISO14000; by technology suppliers.
- 5. Inadequate cost/benefit accounting of Cleaner Production options against end-of-pipe costs:** no calculation of material saving benefits; no full calculation of product value losses in waste streams; no full calculation of waste and emission treatment and management costs, apart from levies and fines; no calculation of externalized costs (burden on society) etc.

- 6. Missing or unreliable process control:** lack of information on pH, T, Flow, Pressure, Dosing etc.; no record keeping and monitoring systems; no equipment instructions.
- 7.** Lack of information and expertise and low environmental awareness in middle management; lack of communication in firms; labour force obstacles; competing business priorities, in particular, the pressure for a short term profits.
- 8.** No management system to formalise improvements and changes made in the production process and no internal policy framework or legal basis for continuation.
- 9.** Difficulty in accessing external finance; no availability of investment capital; a negative attitude of financial institutes, funds and banks and other financial obstacles.
- 10.** Difficulty in accessing cleaner technologies. To avoid or to overcome barriers and to guarantee a successful implementation, Cleaner Production calls for an organised approach.

C1.8. CLEANER PRODUCTION APPROACH

Cleaner Production should be organized by a systematic approach, informing the necessary stakeholders within the company and bringing together those persons who can develop, evaluate and implement Cleaner Production opportunities.

The step-by-step approach, consisting of four phases, is based on the model used by UNEP.



Planning and organisation

After the recognized need for a change towards Cleaner Production, this phase prepares the organisation for the execution of the Cleaner Production assessment and the managerial changes.

The steps to be taken are:

- Obtaining (further) management commitment;
- Organising a project team;
- Identifying possible barriers and solutions by a (time limited) pre-assessment;
- Setting strategic objectives;
- Pre-assessing the focus areas for an (in-depth) assessment.

Assessment

The pre-assessment in the first phase will set the focus for the assessment. During the assessment the causes of waste in the selected unit(s) will be researched in detail. As Cleaner Production focuses on the manufacturing processes that inefficiently use raw materials and generate waste, the central element of this approach should be to assess the manufacturing processes and to find the real big opportunities. In manufacturing processes often only 20% of the operations causes more than 80% of the waste.

The challenge is to find this 20% by:

- Identifying sources (where): an inventory should be made of the input, throughput and output of material and energy flows, together with the associated costs. This results in a process flow diagram (see figure);
- Analysing causes (why): an investigation of the factors that create the volume and composition of the waste and emissions;
- Generation of options (how): to create a vision on how to eliminate or control the identified causes. This results in options and measures for the five categories of Cleaner Production: change of input materials; technology change; good operation practices; product modification; on site re-use and recycling.

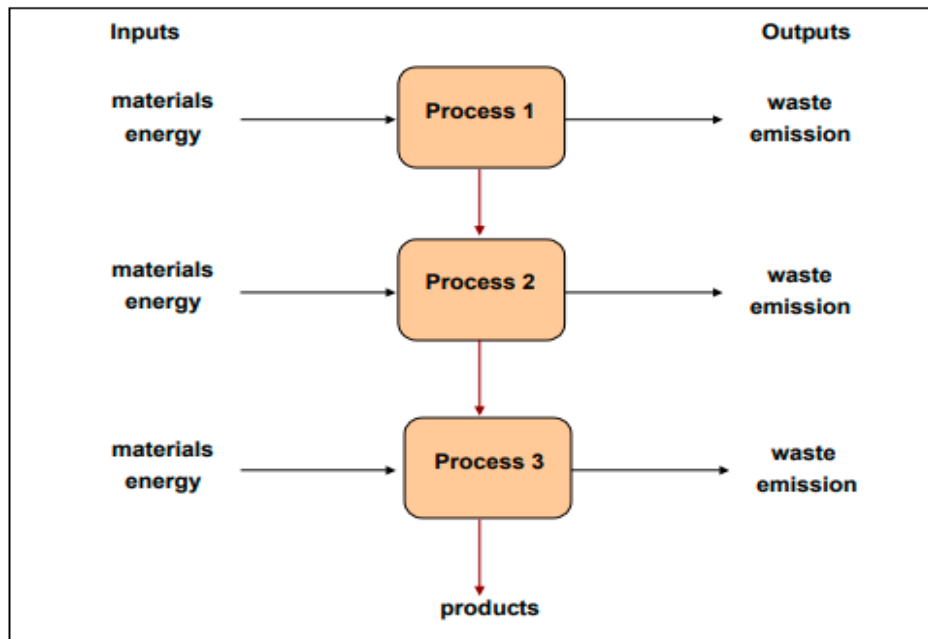


Figure: process flow diagram

Feasibility analysis

When the real opportunities are assessed and options are identified, the next phase is to study the technical, economic and environmental feasibility of the mid and high cost options.

The steps to be taken are:

- Screen options technical, economic, environmental;
- Prioritise and select best options.

Implementation

Finally, the feasible options and managerial changes are implemented and integrated into the daily processes.

The steps to be taken are:

- Option implementation;
- Monitoring and evaluation;
- Sustain and continue (EMS).