Green Production Guideline.

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Presentation/Objective of the guideline

The aim of this guide is to introduce companies into the green production, also called clean manufacturing or sustainable production, which is a concept totally connected with eco-innovation and circular economy.

The guide offers a wide vision of the term to industries and several ways and measures to improve the environmental performance, from the management perspective and also more specific ones by environmental vectors.

There are also considered improvement of activities related to the value chain management, such us distribution or industrial simbiosis or remanufacturing.

When appropiate, the user of the guide is redirected to other specific guides.

*US Department of Commerce (2011), Sustainable Manufacturing Initiative website, *http://trade.gov/competitiveness/sustainablemanufacturing/index.asp*, accessed 27 April 2011.

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1. Introduction

1.1. Green production and Eco-innovation

Eco-innovation is defined as any innovation - new technology, product, process or service - capable of contributing to the protection of the environment or to a more efficient use of resources, through the analysis of their life cycle, as well as the application of new business management methods that avoid or minimize environmental damage.

Green Production is a preventive business management strategy applied to products, processes and work organization, whose objective is to minimize emissions and/or discharges at the source, reducing risks to human and environmental health, and simultaneously increasing competitiveness.

Both Eco-innovation or Green Production can therefore be applied from two points of view:

1. The management of the company from the documentary and planning point of view, which is divided into two aspects:

- the design/redesign of new products and services (eco-design), and
- improving business management procedures

2. The optimization of production processes, from much more technological perspective (clean technologies), although it includes good operating practices that can be considered as the implementation of environmental management procedures.

Both aspects are related to the company's efforts in research, development and innovation (R&D&i), both at a management and technological level, and can contribute to positioning the company as a leader while reducing its environmental impacts, not only of its processes, but of its whole value chain.

1.2. Relationship between the guides

Green production guideline refers mainly to manufacturing processes (industrial sector), and it is mainly focused on waste generated from the raw materials used as consequence of a low efficiency at the processes or management.

It considers different tools to be implemented at each facility, from the management perspective to the most technical one, including alternative technologies such as additive manufacturing, and it also covers industrial symbiosis: collaboration and recycling or energy valorisation options between companies.

So, this material is complemented with the **Additive Manufacturing guideline** (potential clean technology) and the **Industrial Symbiosis guideline** (value chain collaboration).

*US Department of Commerce (2011), Sustainable Manufacturing Initiative website, *http://trade.gov/competitiveness/sustainablemanufacturing/index.asp*, accessed 27 April 2011.

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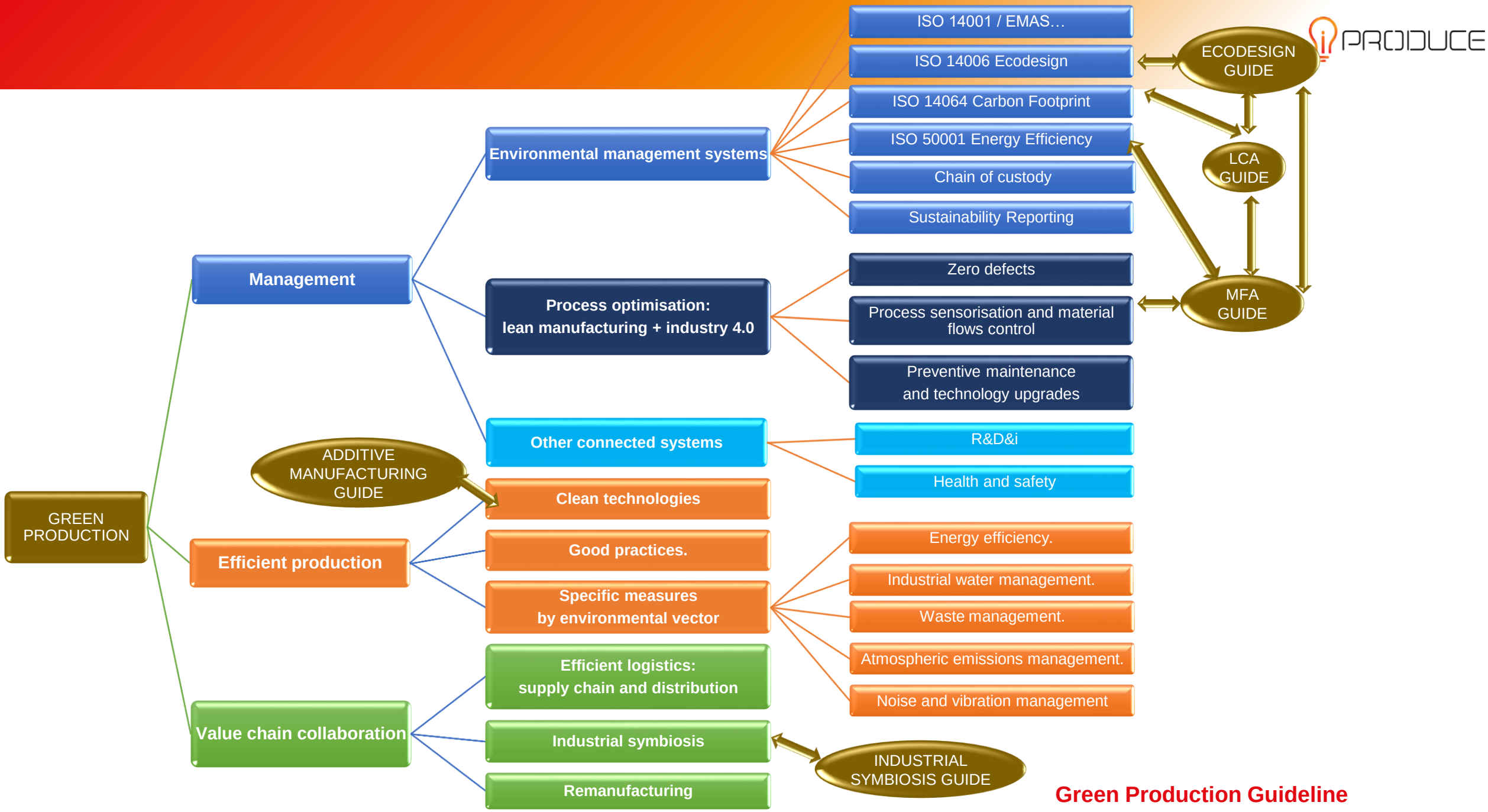
At the management area, there can be found the following interconnected guidelines.

Ecodesign guideline introduces a methodology focus on design to reduce the environmental impact of products/services, considering their whole life cycle from raw material extraction to their end-of-life treatment.

Since it includes the manufacturing step (the connection with Green Production guideline is bidirectional). Beside the concept, benefits and eco-design strategies (with examples), the guide describes several qualitative environmental assessment tools and how to manage the eco-design process.

Quantitative Environmental Analysis Tools are represented by the **Material Analysis Flow** and **Life Cycle Assessment** guidelines. These tools are needed to quantify the environmental aspects and impacts of waste generation and take conscious decisions to implement the other proposed waste reduction tools and control the improvement achieved. So, they complement the **Ecodesign Guideline** and the **Green Production** (Process diagnosis and optimisation).


GREEN PRODUCTION
Management
Efficient production
Value chain collaboration
Environmental management systems
Process optimisation: lean manufacturing + industry 4.0
Other connected systems
Clean technologies
Good practices.
Specific measures by environmental vector
Efficient logistics: supply chain and distribution
Industrial symbiosis
Remanufacturing
ISO 14001 / EMAS…
ISO 14006 Ecodesign
ISO 14064 Carbon Footprint
ISO 50001 Energy Efficiency
Chain of custody
Sustainability Reporting
Zero defects
Process sensorisation and material flows control
Preventive maintenance and technology upgrades
R&D&i
Health and safety
Energy efficiency.
Industrial water management.
Waste management.
Atmospheric emissions management.
Noise and vibration management
ADDITIVE MANUFACTURING GUIDE
ECODESIGN GUIDE
LCA GUIDE
MFA GUIDE
INDUSTRIAL SYMBIOSIS GUIDE
PRODUCE
Green Production Guideline

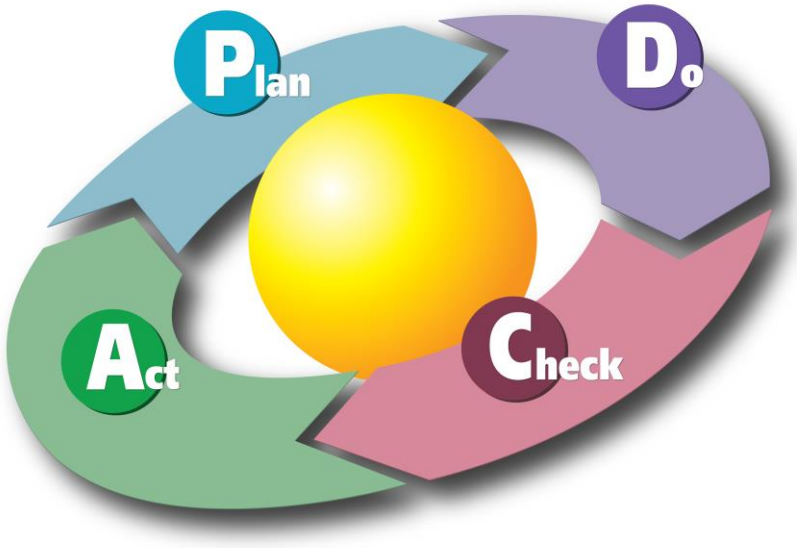
2. HOW TO MANAGE GREEN PRODUCTION?

2.1. Environmental management systems (ISO 14001, EMAS, etc.)

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. The permanent review and evaluation will identify opportunities for improving the environmental performance of the organization.

The EMS itself does not dictate a level of environmental performance that must be achieved; each organization's EMS is tailored to its own individual objectives and targets.

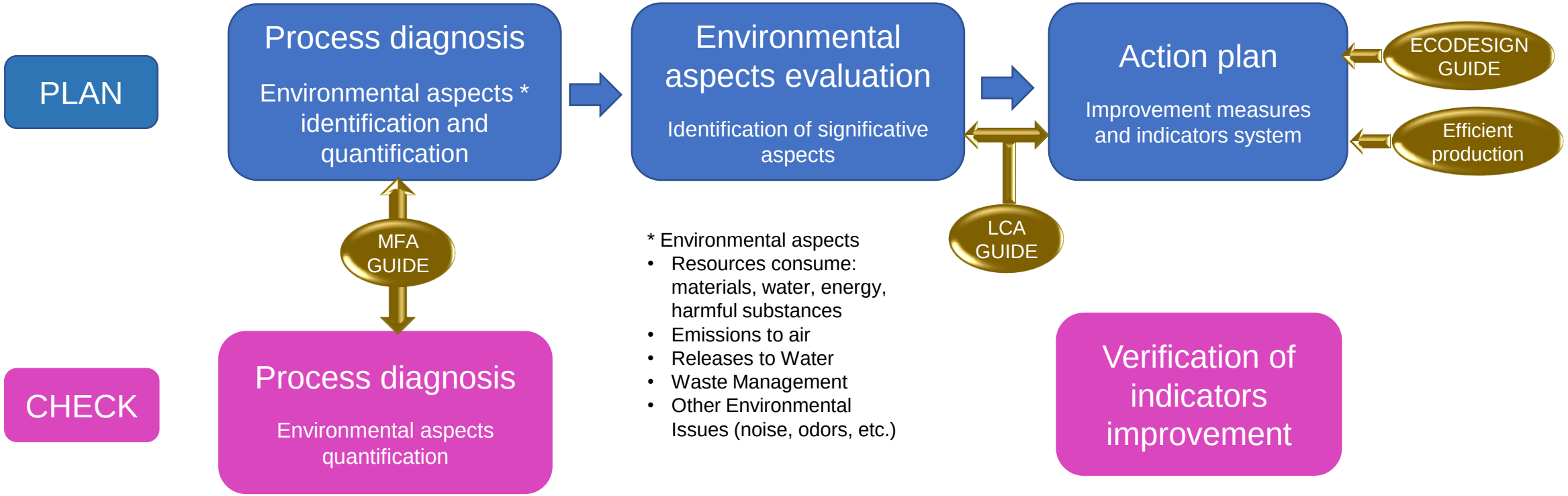
EPA, Gob



The EMS starts with the commitment of top management to environmental improvement and establishes the organization's environmental policy.

The implementation of the EMS corresponds with one common characteristic in most of management systems (environment, quality, H&S, energy): the approach from **the continual improvement cycle**.

When considering this continuous improvement cycle, there are two reflexive steps connecting this guide with others, specially those related to environmental assessment.



2.2. Ecodesign management system (ISO 14006) *(more info at the ecodesign guide)*

This standard gives guidelines for assisting organizations in establishing, documenting, implementing, maintaining and continually improving their management of ecodesign as part of an environmental management system (EMS). It is applicable to product-related environmental aspects and activities that an organization can control and those it can influence.

2.3. Carbon footprint at organization level (ISO 14064-1*)

The carbon footprint represents the total volume of greenhouse gases (GHG) resulting from everyday economic and human activity. Knowing the carbon footprint of an activity, which is measured in tons of CO2eq emissions, is important when it comes to taking measures and launching initiatives to reduce it to the lowest possible level.

ISO 14064-1 includes requirements for the design, development, management, reporting and verification of an organization's GHG inventory.

* ISO 14064-1:2018 Greenhouse gases — Part 1:Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals

2.4. Energy efficiency system (ISO 50001)

ISO 50001 is based on the management system model of continual improvement. This makes it easier for organizations to integrate energy management into other environmental management.

The standard aims to help organizations continually reduce their energy use, and therefore their energy costs and their greenhouse gas emissions (the carbon footprint).

2.5. Chain of custody (FSC,PEFC)

A chain of custody certification confirms that the timber used in production is sourced from responsibly managed forests and is traceable in all production and trade processes – from the forest manager to the producer of the final product.

Two of the most well-known systems developed to manage chain of custody are FSC (Forest Stewardship Council) and PEFC (Programme for the Endorsement of Forest Certification).

2.6. Sustainability Reporting

EU law requires all large companies and all listed companies (except listed micro-enterprises) to disclose information on their risks and opportunities arising from social and environmental issues, and on the impacts of their activities on people and the environment. This helps investors, civil society organizations, consumers and other stakeholders to evaluate the sustainability performance of companies, as part of the European Green Deal.

But is also a voluntary tool to the rest of companies to connect with their interested parties and improve the image and relationships with them.One of the most reputed voluntary programm os sustainability reporting is the **Global Repoting Iniciative** (**GRI**, www.globalreporting.org).

There are 3 main parts in the structure of GRI reporting:

1. Profile and focus of the management: context of the company to understand its performance, among others through its strategy, its profile and its corporate governance structure and practices, including the vision and sustainability strategy.

2. Not all are relevant (material) to all the companies and the philosophy of GRI is based on a materiality to adapt the report to communicate about main topics to interested parts.

3. Sustainability performance: besides 3 global standards to setting the bases of the reporting, there are specific ones to each considered topic: series 200 comprises economic aspects, series 300 environmental ones and series 400 the social ones.

GRI 201: Economic Performance
GRI 202: Market Presence
GRI 203: Indirect Economic Impacts
GRI 204: Procurement Practices
GRI 205: Anti-corruption
GRI 206: Anti-competitive Behavior
GRI 207: Tax

GRI 301: Materials
GRI 302: Energy
GRI 303: Water and Effluents 2018
GRI 304: Biodiversity
GRI 305: Emissions
GRI 306: Effluents and Waste
GRI 306: Waste 2020
GRI 308: Supplier Environmental Assessment

GRI 401: Employment
GRI 402: Labor/Management Relations
GRI 403: Occupational Health and Safety
GRI 404: Training and Education
GRI 405: Diversity and Equal Opportunity
GRI 406: Non-discrimination
GRI 407: Freedom of Association and Collective Bargaining
GRI 408: Child Labor
GRI 409: Forced or Compulsory Labor
GRI 410: Security Practices
GRI 411: Rights of Indigenous Peoples
GRI 413: Local Communities
GRI 414: Supplier Social Assessment
GRI 415: Public Policy
GRI 416: Customer Health and Safety
GRI 417: Marketing and Labeling
GRI 418: Customer Privacy

There is also a non-certifiable ISO 26000 standard, which provides guidance on the principles underlying social responsibility, the recognition of social responsibility and the involvement with interested parties, the fundamental matters and the issues that constitute social responsibility, as well as on ways to integrate socially responsible behavior into the organization. The following figure presents the 7 areas of action of social responsibility included in the standard.

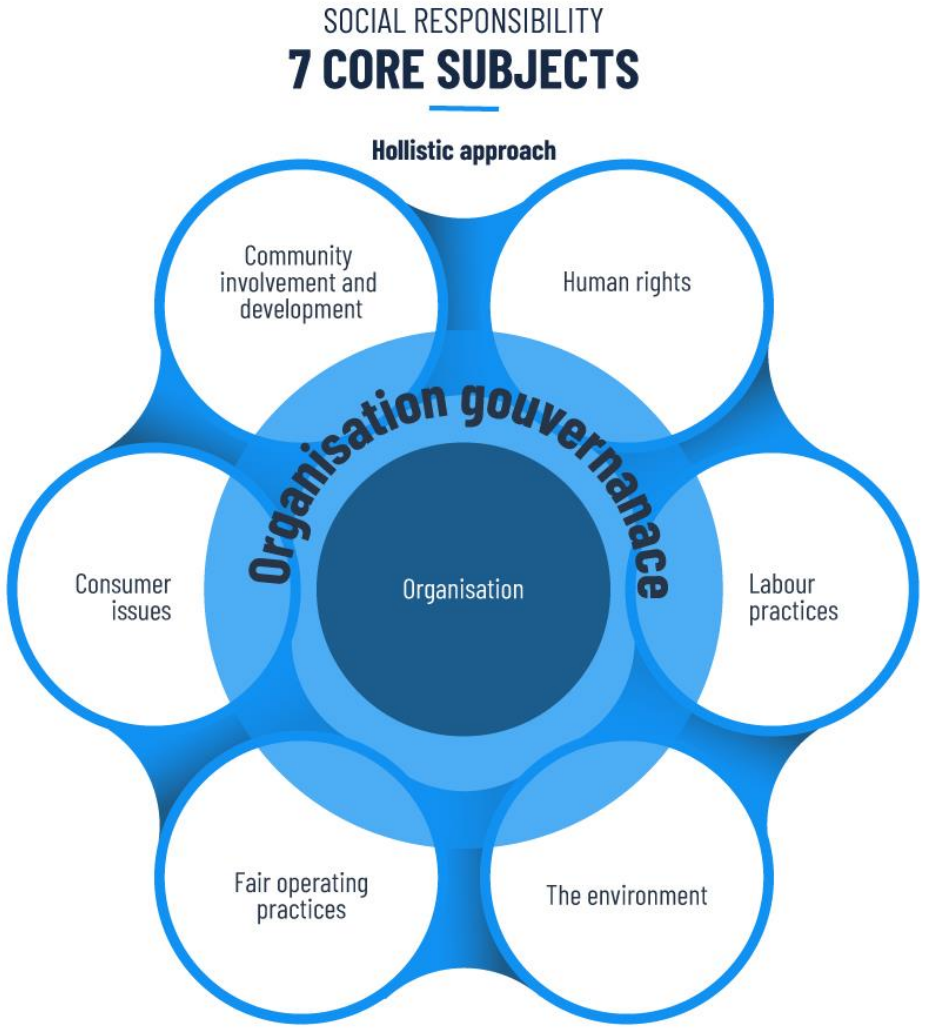


Figure. The 7 fundamental areas of social responsibility according to ISO 26000:2011.
Source: www.boreal-is.com/

2.7. Health and safety and environmental risks management

Environmental risks and risks in the workplace are related to each other, as they complement and enrich each other. The elimination of inefficiencies and hazards caused by unfavorable conditions in the workplace is essential to perform the work in a safe and acceptable manner.

The presence in the working environment of chemical, physical, chemical or biological agents can negatively affect the health of workers. The highest risk are generated usually by the use of harmful substances which can cause environmental impacts depending on the development of the management of the productive activity.

Specially in case of accidents, these negative effects are more dangerous (both for humand or the environment) if the preventive and contention measures have not been implemented.

Once the existence of a risk situation has been determined, it is necessary to eliminate it or, if this is not possible, reduce it to levels that are considered acceptable.

2.2.1 Process optimisation: Lean Manufacturing + Industry 4.0

Zero defects

The theory of zero defects consists of manufacturing products with zero defects, i.e., that all manufactured products comply with all the quality requirements demanded and designed, thus avoiding waste.

This theory has been applied by numerous famous manufacturing companies (Toyota, Martin, Motorola, pharmaceutical companies), since by avoiding defects in the manufacturing chain, waste and errors are also avoided, thus reducing production costs.

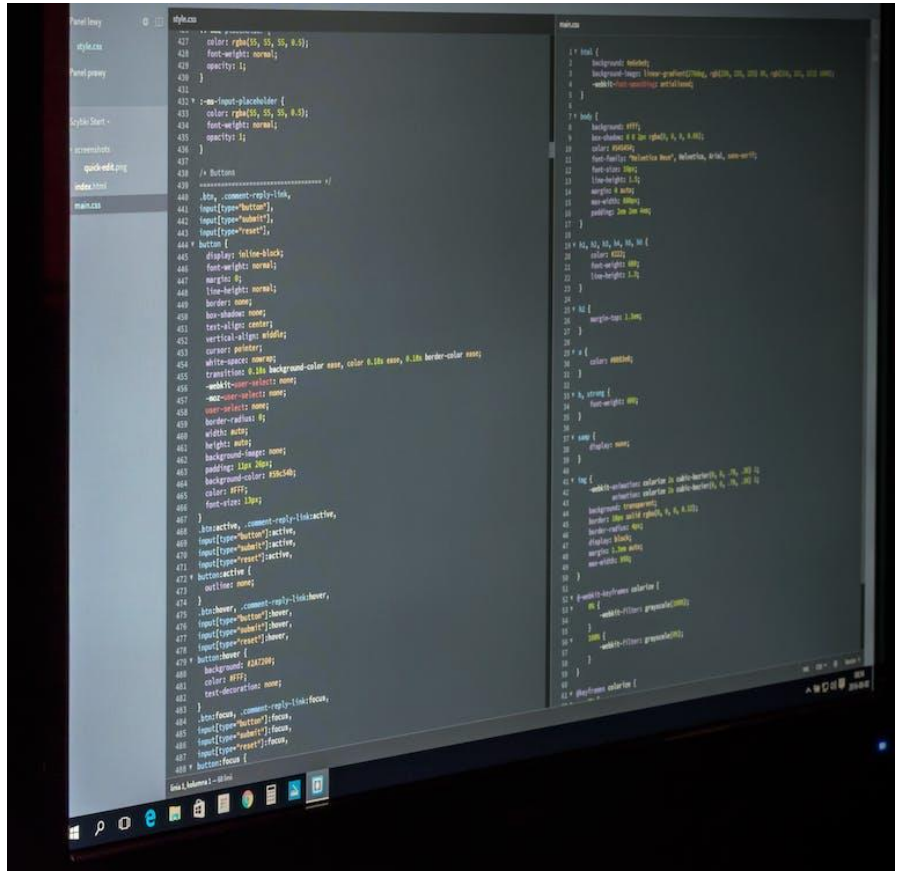
The "zero defect" strategy is a quality improvement that aims processes to be done right the first time, and to avoid that they must be repeated because the manufactured product does not meet the established requirements.

Process sensorisation, and material flow control.

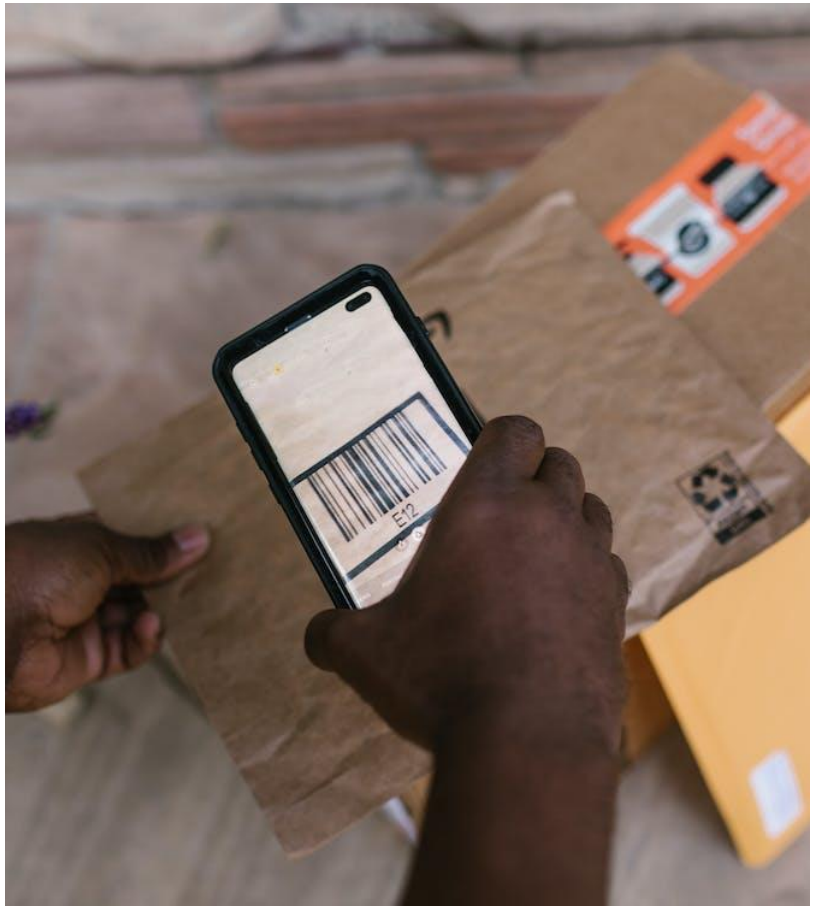
Process sensor systems allow the acquisition of parameters of the production process, optimising its efficiency and improving the management of the company from the perspective of quality and the environment.

Sensorisation is part of the strategies of Industry 4.0, which allows us to know in real time relevant data that can help us in decision-making or promote the automation of processes.

Sensorisation is also a key tool for increasing the efficiency and profitability of maintenance tasks and it also allows to put in practice supply good practices and material control inside the process



Traceability.



Connected with the application of industry 4.0, the concept of traceability refers to the **monitoring of the entire production**, from the procurement of raw materials for its manufacture to its arrival at the end consumer.

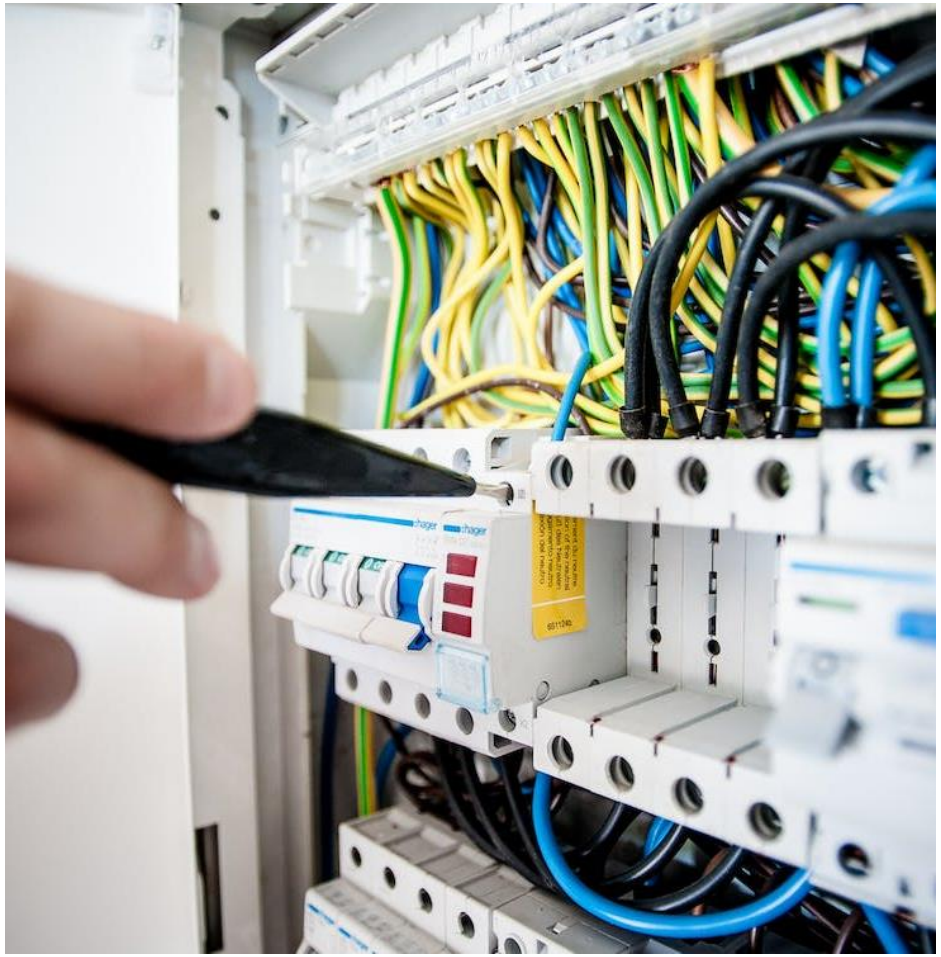
Having a good product traceability system helps to comply with quality assurance, hygiene standards and safety in compliance with current regulations. It also allows to put in practice supply good practices and material control inside the process and provides the consumer with reliable environmental information on the materials that make up the product (recycled content or absence of hazardous substances, certifications, etc.) or even waste managers.

Equipment: Preventive maintenance/technological upgrading

Preventive maintenance reduces the risk of damage or loss of equipment and contributes to increasing their lifetime, reducing unwanted downtime and ultimately reducing long-term maintenance costs.

From an **environmental perspective**, preventive maintenance makes it possible to avoid the generation of defective products that need to be reprocessed or discarded, oil spills, leaks or excessive consumption, and in general, technological updating improves production efficiency.

Technological updating (as an alternative to using the equipment until it stops working) sometimes involves a significant investment, but it allows to improve productivity, or allows new operations that lead to an improvement or innovation in the product, as well as reducing energy consumption.



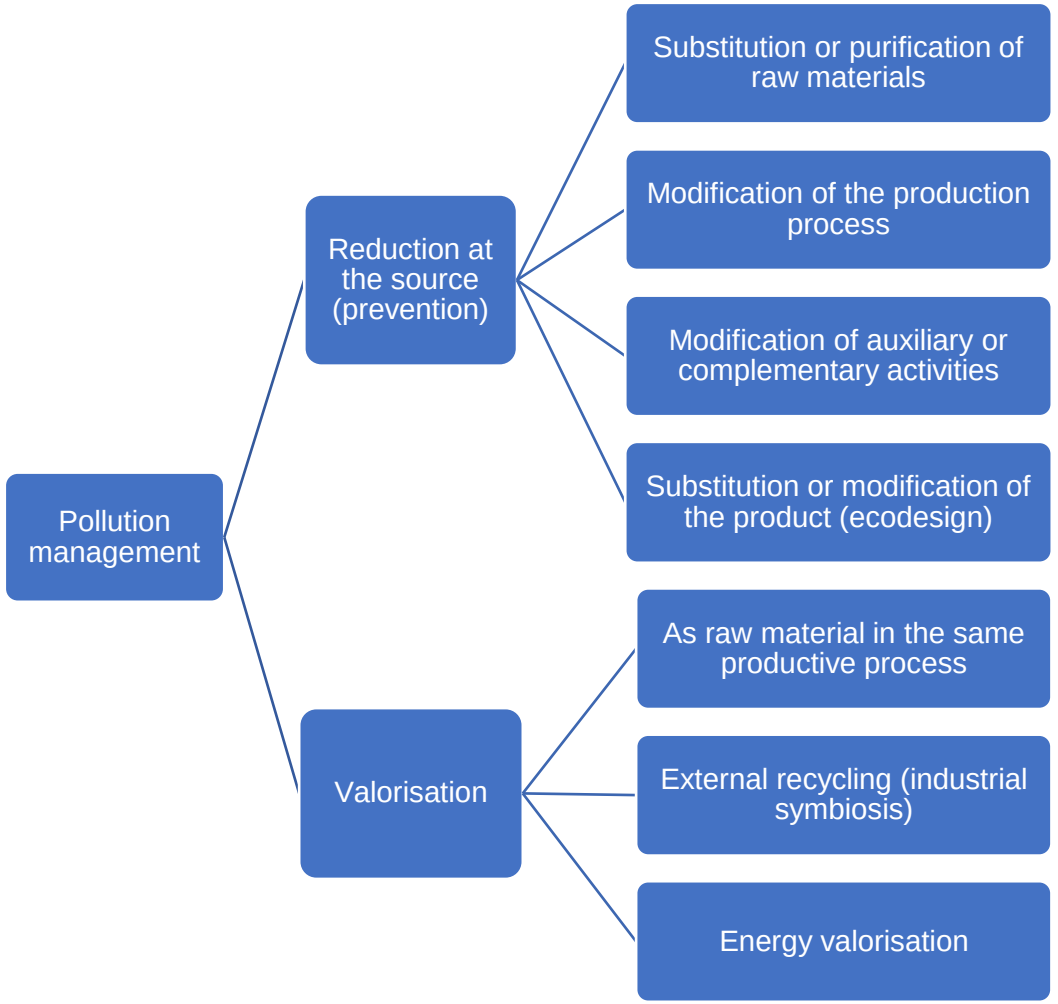
3. GREEN PRODUCTION MEASURES (by environmental vector)

3.1 GREEN PRODUCTION MEASURES

Green production is based in the concept of **pollution prevention and control**, that can be achieved through measures that act at the source and avoid or reduce the generation generation of waste, discharge or emission, and those for control or the end of the pipeline, which act by treating pollution generated by reducing its impact.

Those measures, can be classified as follows:

- the minimization and efficient consumption of materials, water and energy consumption;
- minimizing the use of toxic raw materials;
- the minimization of the volume and toxicity of all emissions generated by the production process (waste, discharges or atmospheric emissions);
- the recycling of the maximum waste/wastewater in the plant and if not, select the appropriate authorized managers, prioritizing recovery over final disposal;



Green Production has different **steps to be implemented**:

1. Review of processes and unit operations that make up the activity
2. Identification of inputs and outputs (flow of materials and energy) in processes and operations
3. Identification of other resources that are required in the processes and operations

Once the previous steps have been completed through the PROCESS DIAGNOSIS, the baseline of the activity is available. Then, three types of **improvement measures** can be proposed:

a) Operational measures that allow the reduction of demanded resources and generated emissions.
b) Change in materials used or control of by-products generated
c) Technological restructuring (use of clean technologies or best available techniques).

The PROCESS DIAGNOSIS identifies and quantifies inputs and outputs and which of these actions the company has already implemented, based on the processes it carries out. With the ECODESIGN CHECkLIST (see *Ecodesign Guideline*), the company can identify the potential measures to be implemented and estimate the potential benefits.

3.3 CLEAN TECHNOLOGIES

In general, **clean technologies are those more efficient**, referred to:

- better utilization of the raw material they are processing or applying (or with lower impact such as lower toxicity), and
- lower consumption of energy or other consumables necessary for their operation.

In the case of the use of raw materials, we find **examples** such as:

- cutting optimization software, which makes it possible to maximize the quantity of parts with a given geometry obtained from a standard board in order to generate the minimum amount of trimming possible;
- HVLP guns for furniture finishing, that generate less overspray (bouncing of the paint particles on the part) to achieve the same result as traditional guns.

There are some oficial documents called BREF ellaborated by the European Comission on Best Available Techniques (BAT) used to control industrial pollution. Each BREF contains a specific chapter on BAT conclusions, which comprise a short description of the BAT identified, their applicability and associated emission or consumption levels. (https://eippcb.jrc.ec.europa.eu/reference).

3.3 ORGANIZATIONAL PREVENTION MEASURES: GOOD PRACTICES

Good practices are actions that reduce the negative environmental impact of production, through a change in the organization of processes, operating methods, etc. and especially in the behavior and attitudes of workers.

Good practices are measures that **do not require a change of equipment, and therefore, economic investments are null or low**, but their results are favorable from the environmental point of view. In some cases, they also allow a significant improvement in the control and management of certain company processes.

They are usually well accepted because they are useful both for their simplicity and low cost and for the fast and surprising results that are obtained.

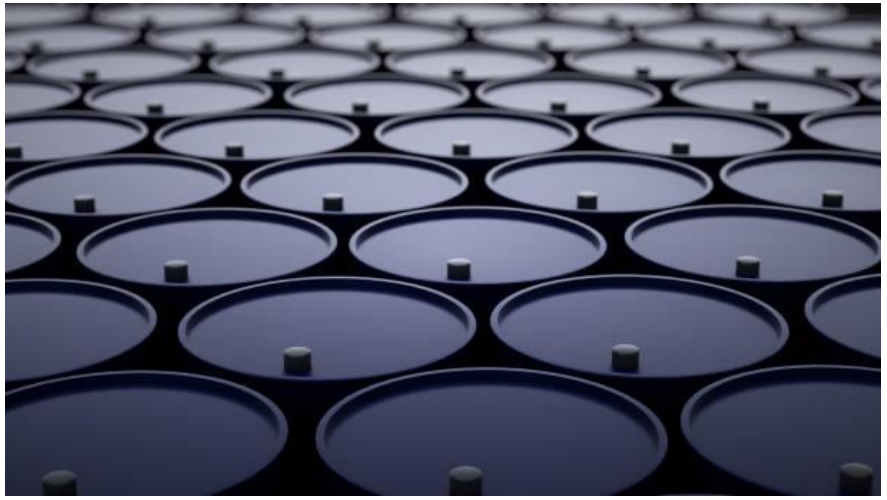
Good practices examples:

- **Inventory control plus modification of the purchasing policy for chemical or perishable raw materials according to production** to facilitate the management of warehouse stocks, and control of expiration dates avoids unnecessary expenses and the generation of hazardous waste due to the expiration of the material prior to its use.

  Besides, to keep the good storage conditions (order and identification, cleaning, protection from light, humidity, heat, etc., and safety measures such as separation of incompatible materials, respect the stacking heights of the containers, avoids accidents and potential wastes.

- **Adjust the quantities of product prepared** (whit very short lifetime, hours or less) **to the expected consumption**, such as The preparation of resins that use a catalyst.

- **Control of the quality of auxiliary raw materials that gradually lose properties through their use**, such as coolants, hydraulic oil, etc. By controlling the parameters that determine its end of useful life instead of doing it systematically from time to time, its duration can be optimized, reducing hazardous waste and its consumption.



- **Development and compliance with work procedures and process control.**

  This is one of the common requierements of management systems, specially the quality one. The existence of written work procedures that contain instructions for the different processes serve both to accurately describe the tasks to be carried out and to improve production processes and reduce waste generation:
  - Manufacturing processes
  - Maintenance operations
  - Cleaning of equipment and facilities
  - Storage and manipulation of materials (specially loading and unloading)
  - Collecting leaks and spills (including advises and contention measures or infraestructures needed)

3.4 ENERGY EFFICIENCY

Energy efficiency can be defined as the reduction of energy consumption while maintaining the same energy services, protecting the environment, ensuring supply and promoting sustainable behavior in its use.

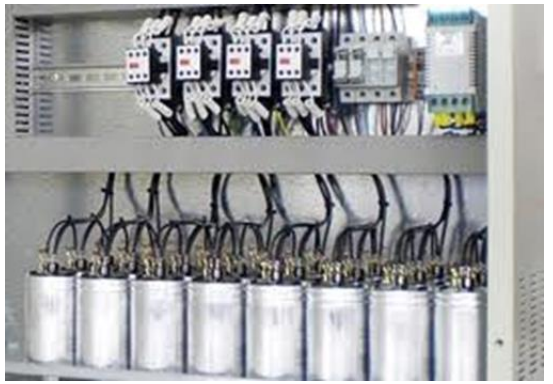
When considering energy there are two aspects to be considered: **consume** (amount of energy) and **source** (removable or secondary sources when possible, or fuels generating less emissions or that have a higher calorific value).

The energy situation of the companies in the sector depends a lot on their size, characteristics etc., so it is highly recommended to perform an **energy audit** in each installation. Although energy improvements can always be found in all companies, many of them do not turn out to be viable in terms of payback time, profit margin or technological limitations.

There are **technological aspects** that influence the energy efficiency (the design of the production, technologies to be used, plant design, sequence of operations, over/under sizing of equipment, etc.) but also human factors from the existing culture on energy efficiency.

In a generic way, the key energy efficiency improvement points can be classified into improvement measures in electrical energy, the lighting system and in thermal energy. Examples of measures are:

- Electric power:
  - Optimization of contracted power.
  - Optimization of reactive energy: capacitor bank.
  - Installation of frequency inverters in pumps, motors, compressors, suction systems.
    - Thermal energy:
      - Install burners with power modulators
      - Use of high-performance industrial boilers
      - Residual heat recuperators for its use
      - Improve the thermal insulation of pipes and heat generation equipment.



Capacitor bank.
Source: Kaysersberg Plastics

LED bulb.

- Improvements in the lighting system:
  - Replacing incandescent bulbs with LED bulbs or better energy efficient systems.
  - Regulation, control and use of natural light.
  - Maintenance of the lighting system (cleaning, replacement of lamps)

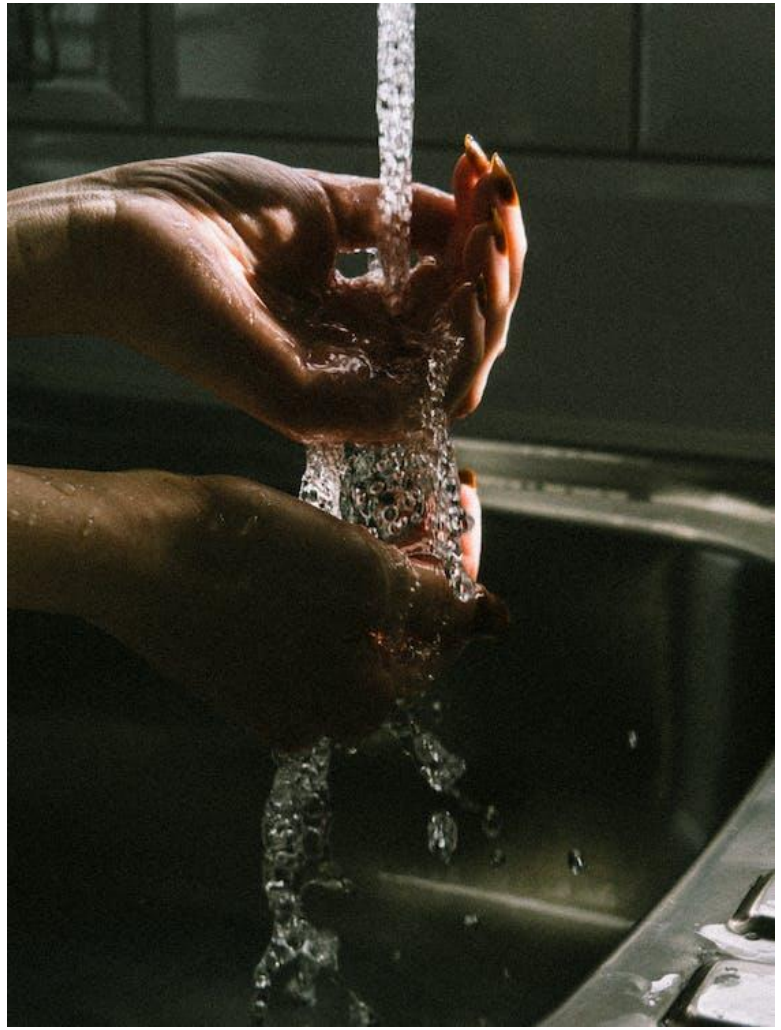
3.5 Water management

Water in industry can be used for:

- Cooling and heating water
- Processes, in most cases as a solvent
- Steam generation
- As a raw material

Good practices related to minimizing the impact of water use are:

- Control water consumption and the use of water for cleaning, avoiding the indiscriminate use of water.
- Use of equipment that regulates the flow of water
- Maintenance of plumbing installations to detect losses and leaks
- Reuse of water between processes, as well as use of water recycling equipment.



Industrial wastewater is a combination of wastewater from the production process and domestic wastewater produced in the industry from bathrooms, showers, etc. Depending on the contaminants that they contain and their related concentration, wastewaters can be directly discharged to the sewage or the environment (with the related administrative authorization) or they should be treated at the company.

Basically, **water treatment can include**:

- Primary treatments: they can be physical or chemical or a combination of both. Physical systems separate generally immiscible phases by filtration, decantation or flotation. They are used to separate large solids, easily decantable solids, fats and oils. Chemical systems are used to precipitate metals and other substances that are in solution. Physical-chemical systems can be used as a complete wastewater treatment, or to prepare the water for further treatment, usually a biological process.
- Secondary treatments: biological systems use microorganisms to break down organic substances present in wastewater. The treatment is quite common due to its simplicity and low cost of operation.

- Tertiary systems: there are a certain techniques that make it possible to meet various objectives prior to the final discharge of effluent (eliminate persistent organic pollutants, separate specific pollutants), even facilitating its recycling.

Among these techniques we can mention:

- adsorption on various supports.
- ion exchange
- membrane techniques
- thermal and electrical techniques
- various oxidizing techniques are widely used to remove color from effluents.

Membrane
https://www.kic-krones.com/es/nuestros-productos/membrana-ultrafiltracion-higienizable.php

3.6 WASTE MANAGEMENT

Industrial activities consume raw materials that have an impact on the environment and waste is produced as a consequence of their use. In a company we can find several **types of waste**:

- Domestic waste (similar to those generated at homes)
- Hazardous waste
- Other type of waste (with specific legislation)

The company must assume the management of the waste produced in its manufacturing process. For this, workers must know the characteristics of the waste produced in their section, supervising the collection, handling, storage and removal of the same. The must be transferred to an authorized waste manager inside the legal period of storage (2 years for non hazard ones and 6 month for hazard ones).

It is advisable to create a temporary waste storage area next to the production area to avoid unnecessary travel. These areas must be in perfect order and checking that no waste other than specific waste is deposited. Once full, these containers will be transferred to the final storage area.

Containers for waste must be resistant to respond to the necessary manipulations and will be kept in good condition, without defects or leaks. The packaging material must not be attacked by the content. The packaging will be carried out in such a way as to avoid the generation of heat, the formation of toxic substances or any effect that makes management difficult.

The waste must be **properly labelled**, the labels that identify the hazardous waste will have a minimum size of 10 x 10 cm and must be written clearly, legibly and indelibly.

They include:

- Normal name of the product
- Identification code (LER)
- Name, address and telephone
- Storage start date
- Pictogram that identifies risks according to the legislation

Hazard pictograms

Warehouses must have security measures to prevent leaks or accidental spills.
Storage areas must be correctly identified.

It is a good practice, and a legal requirement to control and periodically check the evolution of waste generation, to prevent their generation at source, on when it is not posible to avoid it, reduce them and select the waste manager that can offer prioritary options according to waste hierarchy: material valorisation, energy valorisation and finally safe elimination.

Zero Waste

Zero Waste, according to the Zero Waste International Alliance, is the conversion of all resources by means of responsable production, consumption, reuse and recovery of products, packaging and materials without burning, and with no discharges to land, wáter, or air that threaten the environment or human health.

Hierarchy of Waste

The waste hierarchy describes the options that are most relevant from a sustainability perspective:

1. Prevent waste
2. Reduce waste
3. Reuse waste
4. Recycle waste

Good manufacturing practices oriented towards waste prevention.

Zero Waste manufacturing Check-list

What is the material input in your processes, what is the output and what is the loss?

- Can the new components or materials used as input, be replaced by recycled components or materials?
    - Or can they be replaced by materials from regenerative sources?
    - Can you internally recycle and reuse some materials?
- Are there hazardous materials that can be replaced by less hazardous materials?
- How is the hazardous waste treated?
    - Do you produce waste?
    - Can you find a recycling company, so that waste is not being filled in the land and produces toxic leachate?

Good manufacturing practices oriented towards waste prevention.

Zero Waste manufacturing Check-list

- Can you use generated waste as raw material, or is there maybe another business nearby that can reuse your waste?
    - Do you find a company that produces waste, that you can reuse?
- Is there an option to change your production process towards less waste production?
    - Is there the possibility to use additive manufacturing instead of injection moulding processes?
    - Is there the possibility to use dry machining or MQL instead of wet machining?
    - Is there a way to filter the dust produced, e.g. by cleaning castings, and thus reduce the pollutants released?
- Do heat or energy losses occur during production?
    - At which steps are these particularly high?
    - Can equipment with lower energy consumption be used at these steps?
    - Can some of the waste heat be recovered and used in the production process.

3.7 Atmospheric emissions

Air quality depends directly on the polluting emissions (substances or energy) that are emitted into the atmosphere and can pose a serious risk and cause damage or inconvenience to people and the environment. The emissions that can appear in a company are:

- Specific: those with a localized outlet to the atmosphere: a chimney, a tower, etc.
- Diffuse: These are non-localized emissions that can come from gas emissions, handling of substances, vapors, etc. that propagate inside the facilities.

Companies generating atmospheric emissions should have the related administrative authorisation and control them periodically (contaminantsand concentrations) to keep them below specific limits, and register these controls.

Some times, there is needed to treat the effluent priot to its discharge to the atmosphere:

- Gas washing systems or scrubbers
- Adsorption systems
- Thermal oxidation systems
- Filter systems

In addition to the adoption of the systems indicated above, good practices can be adopted to minimize atmospheric emissions, such as:

- Use fuels and combustion equipment ensuring complete oxidation (CO_2 + water), generating less particles, CO, NOx, and other contaminants.
- Use of solvents with low volatility or substitute the solvent base raw materials by bater based alternatives.
- Avoid leaks of steam, compressed air.
- Proper closure of all containers, etc.

3.7 Noise and vibrations

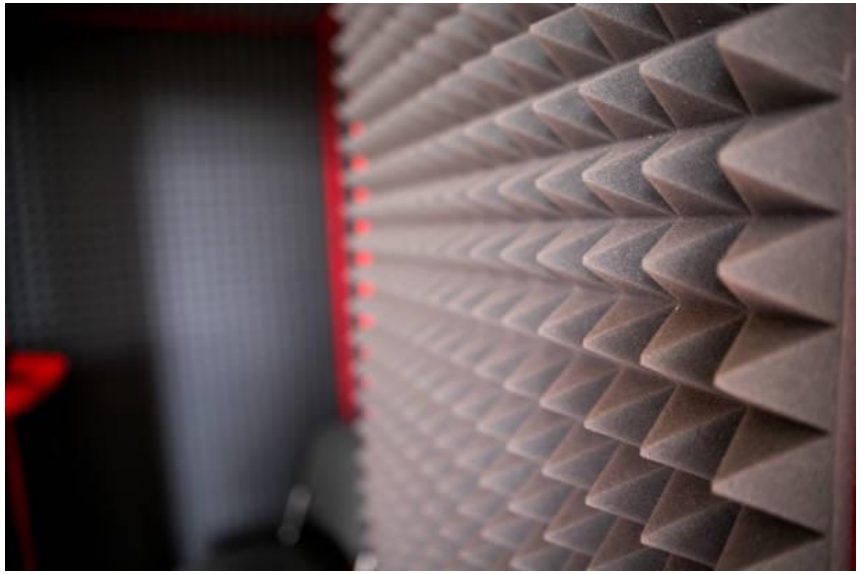
The **applicable measures** for the management of noise and vibrations must eliminate or reduce the risk to the minimum possible. Technical measures reduce noise and vibration levels at sources of emission and/or on the means of transmission or propagation thereof.

The **actions applied** at the emitting source are usually the most effective, among them we can highlight:

- Select equipment with low noise level or adapt it
- Reduce impact-related noise by using surfaces that can absorb impact energy
- Use noise control devices (compressed air silencers, pressure regulation at air outlets, etc.)
- Isolate the source by means of enclosures
- Install soundproof booths
- Regularly grease and lubricate the machines to avoid friction
- Replace worn parts
- Align gears and bearings
- Slow down the rotation speed of fans and machines

In relation to the control of noise transmission, the actions are referred to the path of the wave absorbed, refracted or radiated to the circulating medium.

- Use absorbent materials in the covering of the premises
- Use sound barriers
- Smooth, hard surfaces that reflect sound should be avoided
- To reduce vibrations, it is necessary:
- Install anti-vibration elements in the whole of the machine
- Seal machines and casings with elastic elements
- Introduce anti-vibration mounts for fixing machines and equipment
- Use of materials that dampen shocks or vibrations



In any case, the combination of techniques used to control noise depends on the reduction required, the frequencies of interest, and the nature of the equipment available.

4. VALUE CHAIN COLLABORATION

4.1 Industrial symbiosis

The generation of waste flows is an inevitable consequence of industrial activity.

The use of **secondary raw materials** reduces the extraction of new raw materials, avoiding pressure on natural resources, and in most cases, they implies considerable energy savings.

Industrial symbiosis is the process by which wastes or by-products of an industry or industrial process become the raw materials for another. **By-product platforms** allow to connect the offer and demand of by-products from companies.

Other option of industrial symbiosis is to establish an agreement between different companies to **share common services** of supply, distribution, etc., or treat the waste flows through **common waste management services** or purification facilities. In this case, in addition to the economic factor, the pooling of efforts makes it possible to optimise the treatment and possible reuse of these flows.

4.2 Efficient logistics

Efficient logistics are those that **ensure that products reach their destination while consuming the cleanest and least amount of fuel** and therefore reducing pollution derived from combustion emissions, using fewer working hours, etc.

Companies use to have a partial control on logistics, specially regarding the supply chain, but in any case, to introduce the environmental criteria when selecting the providers o distribution agency can reduce the related environmental impact.

Supply chain

Reliable suppliers contribute to the stability of the value chain (generating a positive effect on the stability of employment and solvency of those involved) and has direct benefits for the efficient production of the company (deliveries, quality of raw materials, reduction of stocks…).

Besides **if the providers are local**, the environmental impact of the transport (al least the km) is reduced and contributes to the economical empowerment of the region.

Reducing packaging of raw materials is also a good practice.

Product distribution

Efficient transport procedures accompanied by good planning and management practices, are key to achieve to optimize **distribution routes** and to optimize **vehicle loading**. This second aim can be improved from the product (sending the product unassembled or in a nestable design)and its packaging design. Transport by specialized agencies makes it possible to avoid empty return transports.

The selection of the **type of vehicle** also affects the environmental impact of transport, increasing by ton of good and km transported following this sequence: ship, train, truck and plane. The combustion efficiency or the fuel used are affecting the final impact.

When the company has not its own vehicles, planification plus the selection of the distribution agency with environmental criteria can reduce significantly the impact of this process.

4.3 Remanufacturing

Remanufacturing is one of the circular economy strategies.

It is a rigorous and comprehensive industrial process by which a product or component is returned to its original condition using a combination of used, repaired or new parts, and its function and quality is assured. Remanufacturing may involve the repair or replacement of worn or obsolete parts. Typical products that are remanufactured include: electrical and electronic equipment, printers, furniture, engines, etc.

Remanufacturing is more than repairing the product, as it offers the same warranties as an original product but has lower costs than if it were new.

Remanufacturing reduces the use of raw materials and consumption of resources and at the same time avoids the generation of waste.

When it is carried out on defective products that have not been offered for sale or have been returned by the customer, it is usually an occasional activity of the company.

When the product is recovered without a defined need, at its end of life, to avoid it becoming waste, it is a main activity of the company with important reverse logistics implications that must be carefully planned and where the traceability of the products and components can have a certain importance.

PRODUCE

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