Prevention of Contamination in the **Metal Machining Sector**

CD

Castellano

English

Français

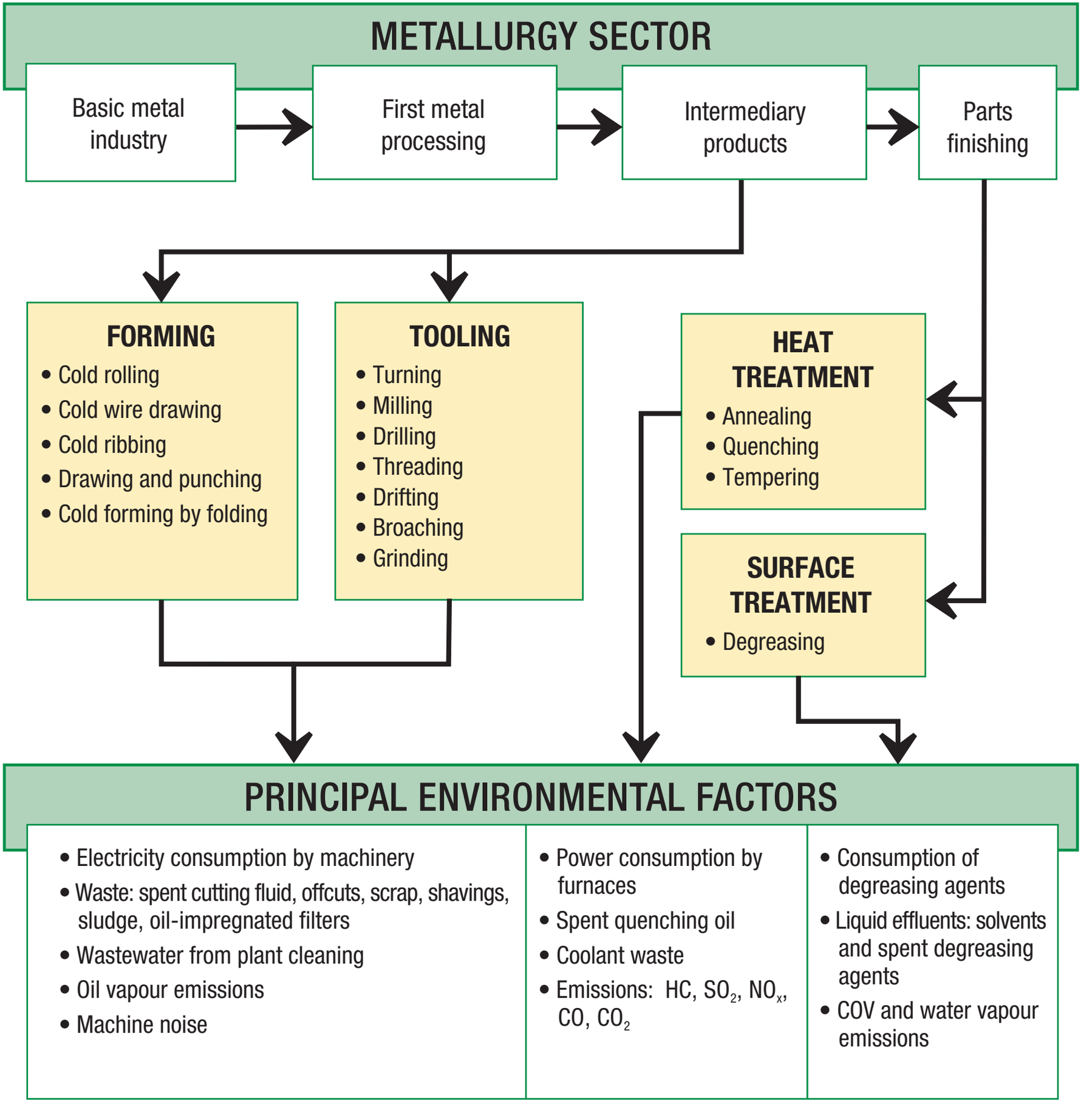
This leaflet is published by the Mediterranean Action Plan's Regional Activity Centre for Cleaner Production (RAC/CP) to present some of the opportunities for integrated pollution prevention (OPP) in the metal machining sector. Its aim is to promote the adoption by companies working in this sector of practices, techniques and technologies designed to reduce the environmental impacts of their activity.

There are two principal techniques used in the **metal machining sector**:

- **Plastic deformation**, where the shape of the workpiece is altered without stock removal.
- **Machine tooling**, where the workpiece is shaped via stock removal.

The environmental impact of metal machining largely derives from the use of cutting fluids in contact between tool and workpiece. These fluids are used for cooling, lubricating and removing shavings generated during tooling. Cutting fluid which has lost its efficacy is generally disposed of as liquid and solid waste.

There are plenty of opportunities in the metal machining sector for reducing the environmental impact of processes, especially where reducing and preventing contamination are concerned.


METALLURGY SECTOR
Basic metal industry
First metal processing
Intermediary products
Parts finishing
FORMING
• Cold rolling
• Cold wire drawing
• Cold ribbing
• Drawing and punching
• Cold forming by folding
TOOLING
• Turning
• Milling
• Drilling
• Threading
• Drifting
• Broaching
• Grinding
HEAT TREATMENT
• Annealing
• Quenching
• Tempering
SURFACE TREATMENT
• Degreasing
PRINCIPAL ENVIRONMENTAL FACTORS
• Electricity consumption by machinery
• Waste: spent cutting fluid, offcuts, scrap, shavings, sludge, oil-impregnated filters
• Wastewater from plant cleaning
• Oil vapour emissions
• Machine noise
• Power consumption by furnaces
• Spent quenching oil
• Coolant waste
• Emissions: HC, SO_2, NO_x, CO, CO_2
• Consumption of degreasing agents
• Liquid effluents: solvents and spent degreasing agents
• COV and water vapour emissions

OPPORTUNITIES FOR INTEGRATED POLLUTION PREVENTION

Redesign of parts.
Employee training.
Creation of a control plan for metal forming and cutting fluids.
Adoption of less hazardous cutting fluids and degreasing agents.
Dry machining.
Adoption of Minimum Quantity Lubrication (MQL) technology.
Machine fairings.
Reduction of annealing furnace NO_x emissions via the introduction of low-NO_x burners.
Recycling of waste gases for use in preheating combustion air in annealing furnaces.
Reinjection of cutting fluid recovered from workpieces and shavings.
Purification and recycling of fluids used in cutting and forming metals.
Purification and recycling of alkaline degreaser solutions.
Adoption of reusable filtration media.
Installation of auxiliary equipment for recovering cutting fluid from workpieces and shavings.
Installation of auxiliary equipment for filtering vapours and other atmospheric emissions.

BENEFITS

REDUCED CONSUMPTION			REDUCED EMISSION		
					
RAW MATERIALS	ENERGY	WATER	LIQUID EFFLUENTS	SOLID WASTE	ATMOSPHERIC EMISSIONS
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CONSTRAINTS AND CONDITIONS

Investment in R&D.
Investment in employee training.
Creation of procedures, definition of responsibilities, personnel training, investment in measurement apparatus and application of corrective measure.
Machinery has to be compatible with the alternative fluid / agent .
Detailed studies have to establish whether the technique is suited to the process. Introduction of alternative methods for ensuring heat stability and the elimination of shavings.
The spraying / injection system used must be compatible with the new process, and suitable flow regulators / air inlets must be installed.
Investment in the fairing most suited to the machine characteristics.
Replacement of furnace burners with the adoption of certain control parameters (temperature, fuel type etc.) to optimize the reduction of NOx emissions.
Installation of regenerative or recovery burner systems.
Installation of a pump and piping system to recirculate the fluid.
Installation of fluid refining equipment: oil separators (e.g. skimmers), solid separators (e.g. hydrocyclones) or oil and solid separators.
Installation of suitable equipment for purifying degreasing solutions (e.g. mechanical devices, magnetic separators, ultrafiltration of surfactant and oil absorption).
Existing equipment has to be modified to become compatible with the new filtration system.
Requires purchase of necessary equipment (e.g. vibrators, centrifugal separators, compacters).
Investment in equipment and installation of systems where open or semi-enclosed machinery is used.

SOME EXAMPLES OF THE INTRODUCTION OF OPP

A company which manufactures parts and components for the automobile industry installed the following equipment in its efforts to reduce its consumption of cutting fluids and the associated production of waste and waste water:

	BENEFITS
Evaporator for recycling spent cutting fluids, wash water and waste water produced by cleaning.	- 81% reduction in water consumption - 95% reduction in waste liquid production

Investment: €82,078.9 **Annual savings:** €135,071.6 **Payback period:** 7 months

Press for recycling cutting oil from filters discarded after refining operations.	- 50% reduction in oil consumption - Reduction of approximately 90% in waste processing costs

Investment: €11,500 **Annual savings:** €45,922 **Payback period:** 3 months

Installation of sumps and centrifuges for recycling cutting oil from workpieces.	- 37% reduction in oil consumption - 90% reduction in workpiece washing costs

Investment: €5,500 **Annual savings:** €4,560 **Payback period:** 1.2 years

A company producing machine-tooled parts for the automobile, eolian, electrical and tools sectors introduced a system designed to improve environmental conditions and avoid splash loss of cutting oil.

	BENEFITS
Installation of high-performance rigid machine fairing.	- Elimination of splash loss, which accounted for some 70% of annual replenishment costs

Investment: €13,524 **Annual savings:** €5,630 **Payback period:** 2.4 years

Mediterranean Action Plan

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Ministry of the Environment and Housing