Best Environmental Management Practice in the manufacture of Fabricated Metal Products sector

The European Commission's Joint Research Centre (JRC) is developing a sectoral reference document on best environmental management practice for the manufacture of Fabricated Metal Products[1]. This will be a guidance document on techniques, measures and actions, which allow organisations in the manufacture of Fabricated Metal Products sector to minimise their impact on the environment in all the aspects under their direct control (direct environmental aspects) or on which they have a considerable influence (indirect environmental aspects). This activity is part of the JRC's work on the identification of best environmental management practices and the development of Sectoral Reference Documents under the EU Eco-Management and Audit Scheme (EMAS). This brief introduction outlines the proposed scope and priorities of the project and provides a list of proposed Best Environmental Management practices (BEMPs) for the sector.

The work will cover the most relevant manufacturing and supporting activities and processes of the manufacture of Fabricated Metal Products sector, such as forming processes, removing processes, additive and welding processes and finishing processes. The primary manufacturing of iron, steel and non-ferrous metals is not included in the scope of the document. For all activities and processes within the scope, BEMPs will be identified both of a technical and/or technological nature, such as improving the energy efficiency of a certain process, and of a more organisational or management type, such as chemical leasing or engaging in environmental improvement with suppliers. BEMPs will be identified not only within the physical site boundaries of organisations belonging to the manufacture of Fabricated Metal Products sector, but also looking at minimising environmental impacts across the entire value chain. Besides BEMPs that improve the environmental performance of the manufacture of Fabricated Metal Products sector, BEMPs contributing to an improvement of the environmental performance of other related sectors are also considered (Figure 1). In particular, BEMPs on concurrent engineering and product design define precisely how the environmental impacts within the value chain of Fabricated Metal Products manufacturing companies can be minimised.

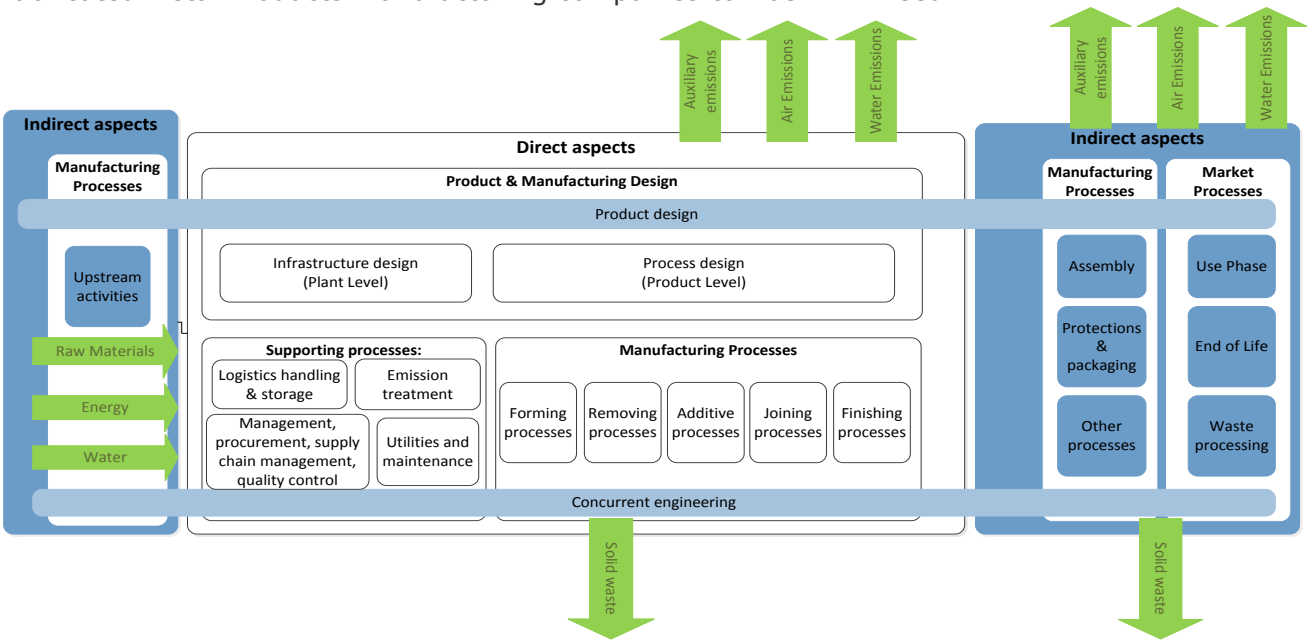

Figure 1. Scematic overview of the direct and indirect aspects and environmental pressures of the manufacture of Fabricated Metal Products sector

[1] For more information, see http://susproc.jrc.ec.europa.eu/activities/emas/fab_metal_prod.html

JRC contracted VITO, in cooperation with Sirris and Agoria, to support the identification of the main environmental issues for the sector, and put forward proposals of BEMPs and environmental performance indicators. These proposals are summarised below and will be the basis for discussion with stakeholders.

Structure of the work and proposed BEMPs

The proposed BEMPs for supporting processes are divided into *management, procurement* and *supply chain management:*

- **Extend the lean principles with measure for energy and material consumption** describes an overall approach for reducing the amount of energy and material used in Fabricated Metal Products manufacturing companies;
- By taking effective **Measures for stock reduction – while keeping customer demand flexibility**, the lead time will be lower. This results not only in smaller stock and less work in progress but also in less non-conforming products and a lower environmental impact.
- **Cross-sectorial and value chain collaboration (by communication and integration)** lead to a reduction of the environmental impact over the value chain;
- By means of **Chemical leasing & Chemical management services** Fabricated Metal Product manufacturers can reduce the amount of waste generated, and emission of chemicals used in the various manufacturing processes;

and *BEMPs for optimisation of utilities*:

- The BEMP on **Energy management** describes an overall approach for reducing and optimising the energy use within Fabricated Metal Products manufacturing companies. The five following BEMPs specify how this can be achieved for the different utilities and process lines;
- **Efficient ventilation** deals with the minimisation of the ventilation needs, as well as with the optimisation of the ventilation system design and use;
- **Optimal lighting** adapted to the specific needs of the production line, storage rooms, utilty rooms, offices etc. results in a better light quality, better working conditions and a lower electricity consumption;
- **Energy and water savings of cooling circuits** deals with the systematic approach of reducing the cooling needs, using and optimising the cooling design;
- **Efficient use of compressed air systems** by minimising pressurised air needs and optimising the system's design and use, results in a lower overall energy use;
- The implementation of smart tools (switches, software, PLC stearing, etc.) on machines results in a **Reduction of standby energy of metal working machines;**

BEMPs on manufacturing process are divided into four process groups. The following *BEMPs are applicable for all manufacturing processes*:

- **Application of solid low-friction coatings on tools and components** and **Application of wear and corrosion-resistant coatings of tools and equipment** are two BEMPs where the surface of tools and equipment is changed. The first BEMP results in a longer lifetime of the tools and a reduction of lubricoolant use in the production process. The second one focuses on the protection of the underlying materials from corrosive elements, resulting in longer lifetime of tools and produced goods;

- There are two main trends in eco-efficient cooling for machining operations: cryogenic cooling and Minimum Quantity Lubrication (MQL). The BEMP **Selection of coolant as environmental and performance criterion** results in a significant reduction of lubricant use.

BEMPs for forming processes:

- **Incremental Sheet metal Forming (ISF) as alternative for mold making** leads to lower material use. The technique starts from metal sheets, which are formed by punching;
- **Additive manufacturing of complex equipment - flow optimization for optimal heat transfer and temperature control** gives a solution for shaping complex metal pieces by using a limited amount of raw materials;
- **Multi-directional forging: a resource efficient metal forming alternative** for complex geometric pieces in large series leads to lower material and energy use;

BEMPs for removing processes:

- Manufacturing processes that combine two or more established processes are described in **Hybrid machining as a method to reduce energy consumption**;
- **Machining of near-net-shape feedstock** uses products which initial form is very close to the final product's geometry. This results in a reduction of the number of finishing operations;

BEMPs for finishing processes:

- **Reduce the energy for paint booth HVAC with predictive control** is done by monitoring the actual temperature and humidity of the incoming air in the paint booth on the one hand and conditioning this air to the optimal window for curing on the other hand. This results in a lower energy use by the HVAC unit;
- **Selection and optimization of thermal processes for curing wet-chemical coatings on metal products** leads to lower energy use for curing. It comprises a combination of choosing the optimal paintings and coatings and the optimal drying technique (room curing, high temperature curing, IR or UV curring).

The two proposed BEMPs on concurrent engineering and product design provide guidance on how the environmental impacts within the value chain of companies, which belong to the manufacture of fabricated metal products, can be minimised:

- By dismantling products, which contain high value materials and pieces, the latter can be reassembled into new products. The **Remanufacturing of high value components** does not only have a positive impact in the Fabricated Metal Product manufacturing company itself, but also up- and downstream in the value chain;
- **Co-design and open innovation with downstream partners to reduce environmental impact during product life cycle** leads to new products and product designs. During the design phase, all aspects of the production, use and reuse are taken into account.